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ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM (EPICS) AND CONVENTIONAL PERSONNEL SYSTEM (CPS): PRELIMINARY COMPARISON OF TRAINING AND ANCILLARY COSTS

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NAVY PERSONNEL RESEARCH
AND
DEVELOPMENT CENTER
San Diego, California 92152

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ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM (EPICS) AND CONVENTIONAL PERSONNEL SYSTEM (CPS): PRELIMINARY COMPARISON OF TRAINING AND ANCILLARY COSTS

A. M. Megrditchian

Reviewed by
R. E. Blanchard

Released by
James F. Kelly, Jr.
Commanding Officer

Navy Personnel Research and Development Center
San Diego, California 92152

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The objective of this effort was to estimate and compare the formal training and ancillary support costs required to qualify fire control technicians to operate and maintain the NATO Seasparrow Surface Missile System using EPICS and conventional personnel system (CPS) paths. Results showed that, in the case of a new weapon system, requiring the training and support of technicians, EPICS costs would be about 19 percent less than CPS costs for a 200-man cohort and about 25 percent less for a 500-man cohort. In the

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case of an existing weapon system, where CPS curriculum and materials are available, EPICS costs would be about 7 percent more than CPS costs for a 200-man cohort and about 13 percent less for a 500-man cohort. For initial skills training only, EPICS costs would be about 32 percent less than CPS costs for both cohorts.

FOREWORD

This effort was conducted under advanced development task area Z0828-PN (Enlisted Personnel Individualized Career System (EPICS)) and was sponsored by the Deputy Chief of Naval Operations (OP-01). The objective of the effort was to estimate and compare the formal training and ancillary support costs required to qualify fire control technicians to operate the NATO Seasparrow Surface Missile System using EPICS and conventional personnel system (CPS) paths.

The costs, which include those relating to curriculum, applicable instructional modules, job performance aids, and staff support, are expressed in terms of the net present value (NPV) and the equivalent uniform annual cost (EUAC). These preliminary results are intended for use by Navy personnel planners.

JAMES F. KELLY, JR.
Commanding Officer

JAMES W. TWEEDDALE
Technical Director

SUMMARY

Problem and Background

Maintaining desired levels of readiness under such constraints as declining prime enlistable population (nonprior-service, male, high school graduates) and increased personnel training costs becomes an elusive goal without benefit of a systems-oriented personnel concept. A system is required that can prepare personnel for early operational and technical contribution, minimize and defer the initial training investment, and utilize the available enlistable resource pool to the fullest. The enlisted personnel individualized career system (EPICS) program provides an alternative that strives for these advantages. It defers formal school assignment to follow sea duty, provides early on-the-job experience complemented by job performance aids (JPAs), and includes self-paced instructional and preparatory materials enabling the seaman to understand and adjust to the shipboard environment as well as prepare for an optimally-phased, formal, shore-based schools program.

The operational feasibility of EPICS is currently being tested and evaluated in 34 Atlantic and Pacific Fleet ships. The NATO Seasparrow Surface Missile System (NSSMS), which is operated and maintained by personnel in the fire control technician (surface missile) (FTM) rating, is the test system. As part of that evaluation, a cost analysis is being conducted to quantify and compare major cost components of EPICS and the conventional personnel system (CPS).

Objective

The objective of this effort was to estimate and compare formal training and attendant ancillary support costs necessary to achieve FTM Navy enlisted classification (NEC) qualification using EPICS and CPS. Ancillary support includes costs related to curriculum, applicable instructional modules, JPAs, and staff support when applicable.

Approach

The EPICS test and evaluation project has provided the career path and most component costs for technical preparation for both personnel systems. The training path and support structure for each personnel system was determined. Two cohort population levels were hypothesized for training for each path: One of 200 FTMs, to be consistent with initial estimates of the EPICS test and evaluation population, and one of 500 FTMs, to represent long-term NSSMS requirements. Individual training and ancillary support costs for each population were estimated, discounted, and expressed in terms of base year dollars. Finally, the cost components for each system were aggregated and expressed in terms of net present value (NPV) and equivalent uniform annual cost (EUAC).

Results

In a case of a new weapon system, requiring the training and support of FTMs, EPICS costs would be approximately 19 and 25 percent less than CPS costs for FTM cohorts of 200 and 500 respectively. In the case of an existing weapon system, where CPS curriculum and maintenance requirements cards are already available, EPICS costs would be about 7 percent more than CPS costs for the 200-man cohort and 13 percent less for the 500-man cohort. For initial skills training only, EPICS costs would be about 32 percent less than CPS costs for both cohorts.

Conclusions

The findings of this analysis are preliminary and do not constitute a complete basis for comparison. However, they do suggest that:

1. EPICS can be expected to reduce initial skills training investment cost leading to FTM NEC qualification by approximately one-third over the current training approach.

2. EPICS provides a significant opportunity for cost reduction in technical preparation even when ancillary support costs, including curriculum development, instructional modules, JPAs, and staff support, are combined with training costs.

Future Plans

The findings of this study constitute only part of the effort for a comparative evaluation of EPICS and CPS. The cash flow data developed herein remain to be associated with various systems effectiveness measures. The effectiveness for selected variables, those reflecting system appeal, resource attributes, individual preparation, contribution, job effectiveness, progression, attrition, and intentions, will be captured and evaluated from several perspectives. These variables have been selected because they are minimally intrusive, least confounded, and highly descriptive of the overall system performance.

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INTRODUCTION

Problem

The operational feasibility of the enlisted personnel individualized career system (EPICS), a total systems concept based on deferred formal training, job performance aids (JPAs) and individualized shipboard training modules, is presently being tested and evaluated in 34 Atlantic and Pacific Fleet ships (Clelland & Megrditchian, 1981). The NATO Seasparrow Surface Missile System (NSSMS), which is operated by personnel in the fire control technician surface missile (FTM) rating, is the test system. As part of this evaluation, a cost analysis is necessary to quantify and compare the major cost components of training FTMs using EPICS and the conventional personnel system (CPS).

Objective

The objective of this effort was to estimate and compare formal training and ancillary support costs necessary to achieve FTM Navy enlisted classification (NEC) qualification using EPICS and CPS.

Background

The Navy's current approach to technical training leading to NEC qualification can be characterized as heavily front-end loaded, since the primary pipeline to technical training leads directly from recruit training. As a consequence, significant expenditures are made during periods of high uncertainty with respect to return-on-investment. The EPICS path defers formal school training investment while providing work-related support in the form of early ship/weapon system experience, JPAs, and individualized training modules. Formal training experience is also provided but no earlier than 1 year after enlistment. In this way, the prospective trainee's adaptability to shipboard life can be tested and the uncertainty associated with return-on-training investment reduced.

COST ANALYSIS

Conditions and Assumptions

This analysis addresses the components costs of EPICS and CPS necessary to prepare and support a NSSMS NEC-qualified technician (Megrditchian, 1978). Cost components include (1) formal training, (2) instructional modules, (3) JPAs, and (4) administrative support materials and staff support. Cost estimation is made in terms of net present value (NPV) and equivalent uniform annual cost (EUAC). NPV is the present worth of a stream of future benefits or costs determined by discounting the future values, using an appropriate rate; EUAC is the amount that, if paid annually for the specified time, would total the NPV (DoN, 1975).

Since the EPICS test and evaluation (T&E) has not been completed, some significant data have not yet emerged. However, a number of assumptions, definitions, and realities have been stated with respect to data, comparison criteria, and modeling relationships to allow meaningful comparisons. It is expected that most assumptions that subrogate data will become superfluous once the data emerges. It is tacitly assumed that those data that are known now are known with certainty. Assumptions that relate to uncertainty, risks, and sensitivity will be discussed and applied where possible in the cost-effectiveness report that will be published following completion of the T&E. On the other hand, assumptions that relate to economic life, inflation, performance parity, etc. will not

necessarily be altered with more data and must be carefully evaluated in terms of sensitivity to change. Assumptions of major cost components are discussed under the pertinent subject headings.

Before discussing specific cost components, consideration must be given to (1) the basis for comparison and (2) economic life estimates. These topics are discussed below.

Establishing Basis for Comparison

This step is necessary to identify that point in the personnel system life at which the comparative evaluation is to begin. In considering the several possible options in selecting a basis for comparison, two become apparent. One assumes a common starting point for both EPICS and CPS; and the other, that the CPS is in place and already supporting the manpower requirements of a weapon system (e.g., NSSMS). Each is characterized as follows:

1. In the first option, it is assumed that both personnel systems have to be developed before they can support the manpower needs of a new weapon system. To reach the FTM NEC achievement goal, both personnel systems require investment in all major components. The EPICS preparation path investments include development of formal school course/curriculum, JPAs, instructional models, and administrative material/staff support. The CPS path investments include development of formal training/curriculum and maintenance requirement cards (MRCs).

2. In the second option, EPICS is again beginning anew while CPS is already in place to provide FTM NEC manning. The EPICS path investments are as before. The CPS path investments, however, are reduced since curriculum and MRC development have already been accomplished and already paid for. Only formal school training costs are to be considered.

Both options are of interest and to be pursued since each offers a uniqueness of perspective. For example, the first permits easier generalization of the results to other potential hardware systems; and the second, comparison with the status quo.

Economic Life Estimates

Considerations of economic life, which is defined as the time period during which the specific alternatives or alternative components provide a benefit or incur a cost, are basic to all cash flow evaluations. Existing analysis guidelines require that economic lives for alternatives be set, when possible, for the same benefit yield period using the same base year. The duration of economic life is influenced and limited by specific factors, including the following:

1. Mission life. The time period over which a need for the asset(s) is anticipated.

2. Physical life. The time period over which the asset(s) may be expected to last physically.

3. Technological life. The time period before obsolence would dictate replacement of the existing asset(s).

To evaluate cash flow, each cost component must have an associated economic life that provides definition of a discounting period. The problem complexity is increased by

the several alternative components of EPICS and CPS (e.g., school curriculum, training modules, JPPs/MRCs, and administrative support and support materials), all of which must be considered in terms of economic life and the resulting cost stream. Table 1 presents the economic life estimates for EPICS and CPS. NSSMS, the weapons system, was included to establish an upper limit to the cost stream of the rest of the components.

Table 1

EPICS and CPS Economic Life Estimates (yrs.)

Component	Mission Life		Physical Life		Technological Life	
	EPICS	CPS	EPICS	CPS	EPICS	CPS
NSSMS	20	20	10	10	10	10
JPAs/MRCs	20	20	5	5	10	10
Courseware	10	10	5	5	10	10
Instructional modules	10	--	5	--	10	--
Administrative support	1	--	--	--	--	--
Administrative support materials	20	--	10	--	10	--

Note. The estimates included in this table were developed through discussion with experienced Navy instructional technologists and NSSMS data systems developers.

Based on the above, the following assumptions were made with respect to economic life:

1. EPICS and CPS have an identical perpetual economic life.

2. School curricula, training modules, JPAs, and administrative support materials are amortized over a life of 10 years. These items have a physical life of 5 years requiring, in effect, one replacement during the 10 years of economic life accomplished through maintenance.

3. Maintenance cost percentages for curriculum, modules, JPAs, and support materials are 1 percent for the first 3 years, 5 percent for the following 3 years, and 1 percent for the final 4 years (numbers based on limited past experience).

4. Training horizon is taken as 4 years for training 200 FTMs and 10 years for training 500 FTMs.

5. Administrative support cost is computed for the initial year of implementation.

Throughout this report, the NPV is computed using a 10 percent discount rate[1] (OMB, 1972). Table 2 presents the average yearly (i.e., mid-year) single and cumulative NPV factors computed for the 10 percent rate (Swope & Green, 1978). Below each cost component is given the applicable discount horizon. Inflationary factors beyond that implied by the 10 percent discount rate are not considered, since discount rate adjusts for normal inflation (DoN, 1975).

Table 2

Application of Discount Factors

	Application/Value Range						Discount Factor	
Year	Training	Curriculum	Modules	JPAs/MRCs	Admin. Support	Support Materials	Single Amount	Cumul. Amount
1	X	X	X	X	X	X	.954	.954
2	-	-	-	-	-	-	.867	1.821
3	-	X	X	X	-	X	.788	2.609
4	X	-	-	-	-	-	.717	3.326
5	-	-	-	-	-	-	.652	3.977
6	-	X	X	X	-	X	.592	4.570
7	-	-	-	-	-	-	.538	5.108
8	-	-	-	-	-	-	.489	5.597
9	-	-	-	-	-	-	.445	6.042
10	X	X	X	X	-	X	.405	6.447

Cost Components

This section discusses each cost component in detail.

Formal Training

Formal training costs include those items currently identified by the Navy course costing system (CCS) in the categories of labor, supplies, contracts, etc. for cost items such as travel, pay, facilities, housing, overhead, and support. Training costs will be estimated for preparing 200- and 500-person groups of NSSMS FTMs via both the EPICS and CPS training paths.

To permit this estimation, a common level of total job preparedness approached through both the EPIC and CPS paths must be established. It must be remembered that the EPICS training goal during the early years of enlistment is achievement of job readiness and not academic maturity. Although academic equivalence will be attained

[1]A zero differential inflation rate is assumed (i.e., all items inflating equally).

following the EPICS path, it will come later when much of the choices about job specialty and career orientation have been decided. In terms of job preparedness parity, EPICS and CPS can be considered equivalent at NEC qualification. The following actual situations and assumptions have been stated to better define conditions of parity and the resultant cost scenarios.

1. Formal training costs for EPICS and CPS will be assumed equal per week per student graduate (Doughty, Stern, & Thompson, 1976). This is based on two reasons: (a) school loss data are incomplete since, at this point, all of the EPICS cohort has not entered equipment technician training (ETT) and system technician training (STT), and (b) EPICS school training uses the same facilities as CPS schools.

2. At present, the curriculum for the NSSMS "C" school includes 23 weeks for training in fire control systems (FCSs) and 10 weeks for training in guided missile launching systems (GMLSs). However, the NSSMS "C" school curriculum requirements have been modified; in the near future, a combined FCS/GMLS curriculum, which will encompass 26 weeks of training, will be implemented. This change permits a fair comparison of NSSMS "C" school and EPICS STT, which includes training in FCSs and GMLSs.

3. The training parity horizon is hypothesized as 3 years, at which time both EPIC and CPS students will have received basic and system training required for NEC qualification.

4. CPS students will be NEC-qualified after they have successfully completed BE/E school, FT "A" school (Phases 1 and 2), and NSSMS "C" school (combined). EPICS students will be NEC-qualified after they have successfully completed both ETT and STT.

5. Each year, 50 EPICS students are trained in successive blocks of 4 and 10 years.

6. The course cost discounting rate is used for 4- and 10-year horizons.

7. EPICS student distribution per year will be a uniform mix of ETT and STT students.

It is assumed that EPICS and CPS formal training costs are equal (per week per graduate) except for costs allocated for student travel and per diem. Table 3, which depicts the current and possible school scenarios for CPS and EPICS students, shows that the two systems differ in both siting options and travel status.

As previously noted, travel costs for CPS students are already included in course costing system (CCS) training cost figures. Thus, since school training costs for EPICS and CPS have been assumed to be equal per unit time per graduate, the EPICS cost must be adjusted for anticipated travel differences. This was done by (1) subtracting the percentage of travel costs identified for CPS travel from course costs and (2) adding travel costs for TDY travel and per diem to EPICS course costs. The following assumptions were made to develop appropriate travel and per diem estimates:

1. ETT and STT schools will be single-sited at San Diego and Mare Island during the T&E (Conner, 1980).

2. CPS school costing data indicate that student travel constitutes an average of 3.3 percent of training cost (Warner & Waterman, 1977).

Table 3

CPS and EPICS School Travel Scenarios

Scenario	School	Location	Travel Status[a]
		CPS	
1	Recruit training	Great Lakes	--
	BE/E	Great Lakes	PCS
	FT "A" (Phases 1 & 2)	Great Lakes	PCS
	NSSMS "C"	Dam Neck or Mare Island	PCS
2	Recruit training	San Diego	--
	BE/E	San Diego	PCS
	FT "A" (Phases 1 & 2)	Great Lakes	PCS
	NSSMS "C"	Dam Neck or Mare Island	PCS
3	Recruit training	Orlando	--
	BE/E	Orlando	PCS
	FT "A" (Phases 1 & 2)	Great Lakes	PCS
	NSSMS "C"	Dam Neck or Mare Island	PCS
		EPICS	
1	Recruit training	Great Lakes	--
	ETT	San Diego	TDY
	STT	Mare Island	TDY
2[b]	Recruit training	San Diego	--
	ETT	San Diego	TDY
	STT	Mare Island	TDY
3	Recruit training	Orlando	--
	ETT	San Diego	TDY
	STT	Mare Island	TDY

[a]PCS = Permanent change of station; TDY = Temporary duty.

[b]The EPICS T&E has included recruits from the San Diego recruit training pipeline only.

3. An equal number of ETT and STT trainees travel between the east and west coasts.

4. Travel and per diem costs for ETT and STT are $1,354 and $1,585 respectively, based on the arithmetic average for travel.

As a point of departure for CPS school cost estimation, statistical data for 1979 are used. These data reflect the cost per student for BE/E, FT "A" (Phases 1 and 2), and NSSMS "C" (combined) schools. Tables 4 and 5 present school and associated cost information. Table 6 provides EPICS and CPS cash flow data for training hypothetical groups of 200 and 500 students.

Table 4

CPS Formal School Costs

Item #	Course/ School	Duration (Weeks)	Cost Per Student ($) 1979	Cost Per Student ($) 1981[a]	Cost Per Equivalent[b] Graduate ($) 1981
1	BE/E	10	3,200	3,872	4,178
2	FT "A" (Phase 1)	11	3,500	4,235	4,346
3	FT "A" (Phase 2)	12	3,500	4,235	4,498
4	NSSMS "C" (FSC)	23	13,500	16,335	17,299
5	NSSMS "C" (GMLS)	10	6,000	7,260	7,688
6	NSSMS "C" (comb.)	26	15,364	18,590	19,687
Total (Items 1, 2, 3, and 6 only)					32,709

[a]Reflects cost per student graduate in 1981 dollars, assuming 10 percent inflation per year since 1979. The convention of inflating first and discounting later is used (DoD, 1972).

[b]The cost per student was converted to cost per equivalent graduate (CPEG), using the following relationship:

$$CPEG = \frac{\text{Total Course Cost}}{\text{Equivalent Graduate}}$$

$$EG = \frac{\text{Total Course Student Weeks - Total Course Attritees Weeks}}{\text{Total Course Length (Weeks)}}$$

Table 5

EPICS Formal School Costs

Item #	Course/ School	Duration (Weeks)	Cost/ Week $	CPEG Uncorrected[a] Travel $	CPEG Corrected[b] Travel $
1	ETT	14	395	5,530	6,700
2	STT	18	757	13,626	14,761
Total					21,461

[a]Based on CPS weekly cost per equivalent graduate (CPEG) with imbedded 3.3 percent CPS travel cost.

[b]Based on estimated EPICS TDY travel cost.

Table 6

EPICS and CPS Training Cash Flow Data

Project[a] Year	Student Cohort	Amount $ Recurring	Discount Factor (10% Rate)	Cost $
		EPICS		
1-4	200 (50 per year)	1,073,050	3.326	3,568,964 (NPV)
1-10	500 (50 per year)	1,073,050	6.447	6,917,953 (NPV) 1,073,050 (EUAC)
		CPS		
1-4	200 (50 per year)	1,635,450	3.326	5,439,507 (NPV)
1-10	500 (50 per year)	1,635,450	6.447	10,543,746 (NPV) 1,635,450 (EUAC)

[a]Discounting period in years.

Although the methodology of aggregating formal school costs shown in Tables 4 and 5 is appropriate for the estimation required, the method does obscure the timing impact of the school training investment. A slightly different perspective is to view the cash flow per individual trainee. All CPS training dollars for NEC qualification are invested during the first year of service. In EPICS, training investments of lesser magnitudes are disbursed during the first and second year for training to occur in the second and third year of service. Table 7 reflects EPICS and CPS individual school costs in constant (1981) dollars using the mid-year payoff convention; and Table 8, the EPICS and CPS cash flow (NPV and EUAC) for a single student. The significance of the differing individual training cash flow is demonstrated in Table 7, where formal training investment is related to a postulated attrition time.

Table 7

Individual Training Cost for CPS/EPICS

Attrition Time After Years of Service	Total Training Dollars Invested and Foregone EPICS	CPS
1	0	32,709
2	6,700	32,709
3	21,461	32,709

Table 8

EPICS and CPS Training Cash Flow (Single Student)
(6-Year Obligor)

Project Year	Cost Element	Amount $ One Time	Discount Factor (10% Rate)	Cost $
		EPICS		
1	Training	6,700	.954	6,392
2	Training	14,761	.867	12,798
				19,190 (NPV)
				4,199 (EUAC)
		CPS		
0	Training	32,709	1.0	32,709 (NPV)
				7,157 (EUAC)

If the individual graduate training cost present value is equally distributed over a 6-year horizon (per 6-year obligor) using the EUAC artifact, the EUACs for EPICS and CPS, as shown in Table 8, are $4,199 and $7,157 respectively. Carried to its ultimate conclusion, the total cost computed in Table 8 would be somewhat higher than those in Table 7.

Curriculum Development

To account for curriculum development costs, the teaching methodology for the various schools in EPICS and CPS must be specified and related to the requisite curriculum to be used. EPICS and CPS include different instructional delivery modes and, therefore, different curriculum methodologies. The individualized modular method is used in BE/E and ETT schools; and the conventional lecture method, in FT "A," "C," and STT schools. The following assumptions and definitions relate specifically to curriculum types used in estimating the costs of the two instructional approaches.

1. The EPICS ETT school curriculum is designed to be similar to a combination of that in BE/E and FT "A" (Phase 1) schools.

2. The EPICS STT school curriculum is designed to be similar to a combination of that in FT "A" (Phase 2) and NSSMS "C" (combined) schools.

3. Curriculum development costs for CPS and EPICS are considered equal in terms of cost per module and cost per unit time of instructional material developed.

4. EPICS ETT course development cost is computed to be $20,000 per module, which figure will be used to estimate the curriculum development cost for the 30 module comprising BE/E.

5. EPICS STT cost per week of instructional material developed is computed to be $5,500, which figure will be used to estimate the cost of developing curriculum for FT "A" (Phases 1 and 2) and NSSMS "C" (combined) schools.

Table 9 presents the cost per unit module and unit time of instruction and total curriculum cost for EPICS and CPS schools. The dollar estimates per module and per week of instructional material are based on current EPICS contract experience and closely approximate past unit cost experience. Table 10 presents cash flow details of EPICS and CPS curriculum development, based on a 10 percent discount rate, an economic life of 10 years, and a physical life of 5 years. As shown, the NPV cost for EPICS curriculum development, production, and maintenance is determined to be $890,326, compared to $993,188 for CPS. Maintenance costs are determined as specified earlier--based on 1 percent for the first 3 years, 5 percent for the next 3 years, and 1 percent for the remaining 4 years. Both figures present a one-time development cost and varying discounted recurring maintenance costs amortized over 10 years of economic life. The 1, 5, 1 percent maintenance rates are not critical values for comparative evaluation since they effect both alternatives proportionately. The estimate is based on two maintenance requirements: one based on wear and tear of the product; and the other, on correction requirements due to equipment modification, errors, and feedback changes.

Table 9

EPICS and CPS Curriculum Development Costs

School/ Course	Number of Modules/ Weeks of Materials	Cost Per Module/ Week ($)	Total ($)
	EPICS		
ETT	34 modules	20,000	680,000
STT	18 weeks	5,500	99,000
Total			779,000
	CPS		
BE/E	30 modules	20,000	600,000
FT "A" (Phase 1)	11 weeks	5,500	60,500
FT "A" (Phase 2)	12 weeks	5,500	66,000
NSSMS "C"	26 weeks	5,500	143,000
Total			869,500

Table 10

EPICS and CPS Curriculum Cash Flow Data

Project Year	Cost Element	Amount $ One Time	Amount $ Recurring	Discount Factor (10% rate)	Cost $	
			EPICS			
0	Development/ Production	779,000	--	1.0	779,000	
1-3	Maintenance	--	7,790	2.609	20,324	
4-6	Maintenance	--	38,950	1.961	76,381	
7-10	Maintenance	--	7,790	1.877	14,622	
					890,327	(NPV)
					138,099	(EUAC)
			CPS			
0	Development/ Production	869,500	--	1.0	869,500	
1-3	Maintenance	--	8,695	2.609	22,685	
4-6	Maintenance	--	43,475	1.961	85,254	
7-10	Maintenance		8,695	1.877	16,321	
					993,760	(NPV)
					154,143	(EUAC)

Instructional Modules Development

As previously discussed, job readiness parity is obtained in EPICS through formal course work (ETT and STT). Also, EPICS includes self-study course work using self-paced instructional modules in various career stages. These modules, and their development costs, are listed in Table 11. The cash flow data for EPICS instructional modules, using the 1, 5, and 1 maintenance percentages established previously, are presented in Table 12. The one-time development/production investment of $362,330 and the varying discounted recurring maintenance costs are amortized over 10 years of economic life.

JPA/MRC Development and Production

JPAs were developed to help the technician perform maintenance duties on the NSSMS at a level commensurate with ship and system requirements and the individual's background and experience. Thus far, two types of JPAs have been developed for use at the apprentice technician and equipment technician duty levels--the partially proceduralized JPA (PPJPA) and the fully proceduralized JPA (FPJPA). The major differences between the two are the degree of proceduralization, the number of illustrations included, the level of detail included, and the complexity of tasks represented.

Table 11

EPICS Instructional Module Costs

Module	Cost ($)
Ship indoctrination/job indoctrination	150,716
Apprentice technician duty preparation	161,614
System technician duty preparation	50,000
Total	362,330

Table 12

EPICS Instructional Module Cash Flow

Project Year	Cost Element	Amount $ One Time	Amount $ Recurring	Discount Factor (10% rate)	Cost $
0	Development/ Production	362,330	--	1.0	362,330
1-3	Maintenance	--	3,623	2.609	9,452
4-6	Maintenance	--	18,117	1.961	35,527
7-10	Maintenance	--	3,623	1.877	6,800
					414,109 (NPV)
					64,233 (EUAC)

Development effort for both types of JPAs included front-end analysis, task analysis, and job design, all falling in the engineering analysis cost category, which comprised 94 percent of total JPA costs. This value is within documentation cost guidelines for development of normal to complex procedural material (67-97%). Table 13 presents details of JPA and MRC production and shows the relationships between JPAs and MRCs, which will be used subsequently to develop MRC development and production costs. In determining the cost of JPA development and production, actual contractor costs have been used. Table 14 presents the total cash flow data for development, production, and maintenance of FPJPAs and PPJPAs, for a combined JPA NPV of $824,200.

The rationale for estimating the production and development of an equivalent number of MRCs is as follows. First, it was hypothesized that a cost comparison would be much more valid if the contractor developing and producing JPAs were to provide cost data for developing and producing MRCs. Table 15 depicts the data obtained.

Table 13

NSSMS JPA/MRC Comparison Data

Item	MRC	JPA	
		FPJPA	PPJPA
Number available/produced	368	81	114
(Number of MRCs generating JPAs)	N/A	(70)	(49)
Number of pages	1,321	1,387	1,189
(Number of MRC pages generating JPA population)	N/A	(163)	(124)
Average pages per MRC/JPA	3.59	17.1	10.4
(Average MRC pages generating each JPA type)	N/A	(2.33)	(2.53)
JPA/MRC page ratio (average pages per JPA divided by average MRC pages)	N/A	7.3:1	4.1:1

Table 14

EPICS Job Performance Aid (JPA) Cash Flow Data

Project Year	Cost Element	Amount $ One Time	Amount $ Recurring	Discount Factor (10% rate)	Cost $	
			PPJPAs			
0	Development/ Production	361,144	--	1.0	361,144	
1-3	Maintenance	--	3,611	2.609	9,421	
4-6	Maintenance	--	18,057	1.961	35,410	
7-10	Maintenance	--	3,611	1.877	6,778	
					412,753	(NPV)
					64,022	(EUAC)
			FPJPAs			
0	Development/ Production	360,000	--	1.0	360,000	
1-3	Maintenance	--	3,600	2.609	9,392	
4-6	Maintenance	--	18,000	1.961	35,298	
7-10	Maintenance	--	3,600	1.877	6,757	
					411,447	(NPV)
					63,820	(EUAC)
					824,200	(NPV)
					127,842	(EUAC)

Table 15

Technical Publication Unit Costs

Step	Time/Unit	Cost/Hour
Engineering analysis	10 hrs/procedure	$45-50
Technical writing Art work Validation/printing	8-10 hrs/page	$25-40
Verification	5 hrs/page	$60 each (3 people)

From the above, an estimate must be made of (1) the number of procedures that are directly equated to the number of MRCs and (2) the average number of pages per procedure. These estimations were made using the following steps:

1. Determine the total number of pages of JPAs developed and produced.

2. Determine the proportion of pages of the two types of JPAs developed and produced.

3. Using the JPA/MRC ratio for each type of JPA, determine the number of equivalent MRC pages developed and produced for each type.

4. From the two, determine the total number of equivalent MRC pages.

5. Divide the total MRC page cost by the average pages per MRC to determine the number of MRCs (procedures).

6. Use the preceding cost data to compute development and production cost estimate for an equivalent number of MRCs.

Using these steps with the data in Tables 13 and 15, the cash flow details of Table 16 were developed.

Administrative Program Material and Staff Support

These two areas are somewhat more difficult to characterize than those previously discussed. Before deciding whether or not to include a cost in this category, consideration must be given to whether or not (1) the cost will be incurred during actual implementation, and (2) the cost-incurring effort may be performed routinely by established organizational personnel or require new and additional resources. Based on these considerations, it was determined that a cost item would be allowed and counted if the effort or resource (1) is expended during general implementation, and (2) cannot be done routinely by existing resources.

Table 16

CPS Maintenance Requirement Card (MRC) Cash Flow Data

Project Year	Cost Element	Amount $ One Time	Amount $ Recurring	Discount Factor (10%)	Cost $
0	Development/ Production	693,000	--	1.0	693,000
1-3	Maintenance	--	6,930	2.609	18,080
4-6	Maintenance	--	34,650	1.961	67,949
7-10	Maintenance	--	6,930	1.877	13,008
					792,037 (NPV)
					122,854 (EUAC)

Administrative Material. EPICS materials developed for T&E support include an orientation guide, a recruiting pamphlet, a sailor's handbook, and an administration guide. The orientation guide was excluded as a cost item because it would not be expended during general implementation; it was primarily designed to promote the EPICS program. The recruiting pamphlet was excluded because, during general implementation, its function would be performed routinely by existing personnel resources (e.g., recruiter) using an operating instruction. There is little evidence to date that the sailor's handbook is being used effectively. Since it would not be included in general implementation, its costs have been excluded.

The administration guide, which was designed to support the administrator by helping him to understand and accomplish his job, does fall within the criteria for allowed costs. Unfortunately, little hard evidence exists to date on the degree to which the document is being used during T&E. Whether or not it is accepted depends on whether it makes a contribution to the general implementation that may follow the T&E. Its cost was included since the effort should be allocated for implementation and could not be done efficiently by routine methods. Certainly the administration guide can be complemented by comprehensive instructions, such as used in the 3M system to provide a useful management tool. The aggregated costing includes an initial development and production cost for 200 guides. Based on the above discussion, contractor and in-house development, and contractor production costs, the cash flow data in Table 17 were developed. The previously used maintenance protocol is applied, resulting in an NPV of $54,859 and an EUAC of $8,509.

Staff Support. The previously established cost selection criterion was applied with respect to staff support cost items, thereby eliminating numerous support tasks, including manpower estimation, billet identification, ship schedule prediction, document/module installation, and data criterion (mail and interview). These tasks were either performed prior to the T&E implementation or can be routinely performed by existing personnel during general implementation.

Fleet coordination was determined to be indispensable to the EPICS T&E. This support function has been provided by three highly qualified and experienced military

Table 17

EPICS Administrative Material and Staff Support Cash Flow Data

Project Year	Cost Element	Amount $ One Time	Amount $ Recurring	Discount Factor (10% rate)	Cost $
		Administrative Material			
0	Material Development/ Production	48,000	--	1.0	48,000
1-3	Maintenance	--	480	2.609	1,252
4-6	Maintenance	--	2,400	1.961	4,706
7-10	Maintenance	--	480	1.877	901
					54,859 (NPV)
					8,509 (EUAC)
		Staff Support			
0	Staff Support	82,521	--	1.0	82,521 (NPV)
					12,800 (EUAC)

personnel, who serve primarily as points of contact for fleet units and points of contact to the specific EPICS ships, the individual EPICS cohort, and various Navy commands. These support functions are indispensable for any new program until it is fully implemented, ongoing, and self-sufficient. The analogy between the staff support requirement for EPICS and, for example, the 3M implementation approach used several years ago should not be difficult to establish. The primary purpose of this staff support function is to develop EPICS into a self-sustaining system, with much of the specific effort concentrated on developing procedures and attendant instructions for full implementation. It is estimated that the current 3-man level of effort will suffice if expended for the first year of implementation. The one-time expense will total $82,521, computed using the annual burdened rate for E-8s of $27,507 (see Table 17).

Summary of Cash Flow Data for EPICS and CPS

Table 18, which was compiled from data in Tables 6, 10, 12, 14, 16, and 17, compares the training and ancillary costs incurred in producing 200 and 500 NEC-qualified FTM technicians using the EPIC and CPS paths. Training costs include school and curriculum development and maintenance costs; and ancillary costs such as instructional modules, JPA/MRC production, support staff, and materials. The primary basis for comparison is through using aggregate NPV and EUAC estimates for initiating EPICS and CPS; the secondary basis is through using the aggregate NPV and EUAC for initiating EPICS and continuing CPS. It should be recalled that the overall attrition figures are not included in this study; only attrition during formal school is included.

Table 18

Training and Ancillary Costs of EPICS and CPS

Cost Component[a]	NPV Cohort of 200 EPICS $	NPV Cohort of 200 CPS $	NPV Cohort of 500 EPICS $	NPV Cohort of 500 CPS $	EUAC Cohort of 500 EPICS $	EUAC Cohort of 500 CPS $
School						
Training (6)	3,568,964	5,439,507	6,917,953	10,543,746	1,073,050	1,635,450
Curriculum (10)	890,327	993,760	890,327	993,760	138,099	154,143
Instructional Modules (12)	414,109	N/A	414,109	N/A	64,233	N/A
JPAs/MRCs (14 & 16)	824,200	792,037	824,200	792,037	127,842	122,854
Admin. Support (17)						
Staff	82,521	N/A	82,521	N/A	12,800	N/A
Material	54,859	N/A	54,859	N/A	8,509	N/A
Aggregate	5,834,980	7,225,304	9,183,969	12,329,543	1,424,533	1,912,447
Cost Per Individual	29,175	36,127	18,368	24,659		

[a]Numbers in parentheses refer to tables providing computations.

Table 19 reflects findings in terms of each basis for comparison cited and for initial skills training costs only. As shown, in a case of a new weapon system, requiring the training and support of FTMs, the cost of using EPICS would be approximately 19 and 25 percent less than using CPS for FTM cohorts of 200 and 500 respectively. In the case of an existing weapon system, where CPS curriculum and MRCs are already available, EPICS would cost 7 percent more than using CPS for the 200-man cohort and 13 percent less for the 500-man cohort. For initial skills training only, using EPICS would cost about 32 percent less than using CPS for both cohorts.

Table 19

Cost by Basis for Comparison

Cohort of 200			Cohort of 500		
Cost (In millions of dollars)		Reduction/ Increase Using EPICS	Cost (In millions of dollars)		Reduction/ Increase Using EPICS
Initiating Both Systems					
CPS	7.2	19% less	CPS	12.3	25% less
EPICS	5.8		EPICS	9.2	
Initiating EPICS, Continuing CPS					
EPICS	5.8	7% more	CPS	10.5	13% less
CPS	5.4		EPICS	9.2	
Initial Skills Training Only					
CPS	6.4	31% less	CPS	11.5	32% less
EPICS	4.5		EPICS	7.8	

CONCLUSIONS

The findings of the analysis are preliminary and do not constitute a complete basis for comparison. However, they do suggest that:

1. EPICS can be expected to reduce initial skills training investment cost leading to FTM NEC qualification by approximately one-third over the current training approach.

2. EPICS provides a significant opportunity for cost reduction in technical preparation, even when ancillary support costs, including curriculum development, instructional modules, JPAs, and staff support, are combined with training costs.

FUTURE PLANS

The findings of this study constitute only part of the effort for a comparative evaluation of EPICS and CPS. The cash flow data developed herein remain to be associated with various systems effectiveness measures. The effectiveness for selected variables, those reflecting system appeal, resource attributes, individual preparation, contribution, job effectiveness, progression, attrition, and intentions, will be captured and evaluated from several perspectives. These variables were selected because they are minimally intrusive, least confounded, and highly descriptive of the overall system performance.

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