



***COST
EFFECTIVENESS
ANALYSIS***

INCOSE – CHESAPEAKE CHAPTER

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FROM BOOK

- “COST EFFECTIVENESS ANALYSIS
- A SYSTEMS ENGINEERING PERSPECTIVE”
- EISNER, H. CRC PRESS 2022; LOOKING FOR A COST-EFFECTIVE SOLUTION (TO THE SYSTEM WE’RE BUILDING); ESTIMATE COSTS AND COMPUTE EFFECTIVENESS OF WELL-DEFINED ALTERNATIVES

MEASURES OF EFFECTIVENESS (MOEs) – COMMUNICATION SYSTEMS (EXAMPLE)

- SPEED OF SERVICE
- GRADE OF SERVICE
- DETECTION PROBABILITY
- FALSE ALARM PROBABILITY
- SIGNAL STRENGTH
- NOISE POWER
- S/N RATIO
- BIT ERROR RATE (BER)
- RANGE

MEASURES OF EFFECTIVENESS (MOEs) - TRANSPORTATION SYSTEMS (EXAMPLE)

- PASSENGER CAPACITY
- FREIGHT CAPACITY
- RANGE/DISTANCE
- STORAGE CAPACITY
- CAPACITY TO DEMAND RATIO
- BRAKING DISTANCE
- TRIP TIME
- AVERAGE VELOCITY/SPEED

ENSEMBLE OF “SYSTEMS”

- THREE REGIONS:
 - - LINEAR: LOW COST; LOW EFFECTIVENESS
 - - KNEE-OF-CURVE; “TIPPING POINT”
 - - HIGH COST; HIGH EFFECTIVENESS
- WHICH REGION WOULD YOU CHOOSE?

EXAMPLE: SCAS A NEOMOMETRY SYSTEM; START WITH FUNCTIONAL DECOMPOSITION- DESIGN ALTERNATIVES

FUNCTIONS & SUBFUNCTIONS	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C
F1 – <u>ATMOSPHERIC SENSING</u>			
F1.1 – WINDSPEED SENSING	COTS PITOT TUBE	PITOT TUBE + TRANSDUCER	PITOT TUBE + RADIO TRANSDUCER
F1.2 – WIND DIRECTION SENSING	SHAFT POSITION	SHAFT POSITION	SHAFT POSITION
F1.3 – PRESSURE SENSING	COTS PITOT TUBE	PITOT TUBE + TRANSDUCER	PITOT TUBE + RADIO TRANSDUCER
F2 – <u>MECHANICAL SERVICE</u>			
F2.1 – INSTRUMENT HOUSING	MACHINED ALUMINUM	ADD MOLDED COMPOSITES	LESS WEIGHT/COMPACT
F2.2 – ORIENTATION/POSITION	WIND VANED BEARING	LESS TAIL BOOM LENGTH	HIGH PRECISION BEARING
F3 – <u>ENVIRONMENTAL SERVICE</u>	ANALOG FEEDBACK TEMP CONTROL	ADD DIGITIZED CONTROL	ADD PROCESS AND HEAT PIPES
F4 – <u>POWER SERVICE</u>			
F4.1 – MAIN POWER SERVICE	COMMERCIAL 220/110	COMMERCIAL 220/110	COMMERCIAL 220/110
F4.2 – POWER REGULATION	CONDITIONERS/RODS	ADD GROUND FAULT INTERRUPTOR	ADD LIGHTNING ARRESTOR
F4.3 – BACKUP POWER	BATTERY INSTRUMENTS	ADD GAS GENERATOR W/SENSOR	Hi-Rel diesel w/switch
F5 – <u>INDOOR/OUTDOOR TRANSMISSION</u>			
F5.1 – POWER TRANSMISSION	STRANDED WIRE HARNESS	STRANDED WIRE HARDNESS	CUSTOM SLIP RINGS
F5.2 – SIGNAL TRANSMISSION	FOIL SHIELDED IRE	COAX W/SLIP RINGS	2 WAY RADIO, NO WIRES
F5.3 – PHYSICAL LINKAGES	SHAFT CONDUIT	ADD SHIELDED TRANSDUCER	MINIMUM SHAFT
F6 – <u>DATA HANDLING</u>			
F6.1 – DATA HANDLING	PNEUMATIC CELL	MAGNETIC POSITION SENSOR	OPTICAL POSITION SENSOR
F6.2 – DATA PROCESSING/STORAGE	MANUAL DATABASE	AUTOMATIC COMPUTER CONTROL	AUTOMATIC COMPUTER CONTROL
F6.3 – REPORTING/DISTRIBUTION	PHYSICAL MANUAL	GUI + MODEM ACCESS	DBMS + PACKET NETWORK

FORMAL (CEA) EVALUATION PROCESS

- ASSESS EFFECTIVENESS USING EVALUATION CRITERIA I.E.:
- - PERFORMANCE
- -HUMAN FACTORS
- - RELIABILITY
- - MAINTAINABILITY
- - RISK
- OBTAIN EFFECTIVENESS “SCORES”
- WEIGHTING X RATING (1 TO 9) SUMMATIONS

EVALUATION OF ALTERNATIVES vs. CRITERIA

	SYSTEM UNDER CONSIDERATION							
	EVALUATION WTS.		LOW COST		KNEE-CURVE		HIGH EFFECT.	
CRITERIA	-----		SCORE WTXRATE		SCORE WTXRATE		SCORE WTXRATE	
PERFORMANCE	30	6	1.8	7	2.1	9	2.7	
HUMAN FACTORS	20	8	1.6	8	1.6	8	1.6	
RELIABILITY	15	7	1.05	8	1.2	9	1.35	
MAINTAINABILITY	20	8	1.6	8	1.6	9	1.8	
RISK	15	7	1.05	9	1.35	9	1.35	
		7.1			7.85		8.8	
COSTS		1.2M			1.4M		1.8M	

COST ESTIMATION

- LIFE CYCLE COST MODEL
- THREE BASIC CATEGORIES (R, D, T & E, PROCUREMENT, OPERATIONS & MAINTENANCE (O & M))
- COSTS OVER TIME (20 YEARS)
- ROLE OF CERs
- SOFTWARE COSTS (COCOMO I AND II)

INCREMENTAL CAPABILITIES AND COST - EXAMPLE

<u>ITEM</u>	<u>COST</u>
• ORIGINAL CD PLAYER	\$27
• CD+ AM/FM RADIO	32
• CD + RADIO + CASSETTE TAPE	36
• CD+RADIO+CASSETTE + 5CD	40
• ADD REMOTE TO ABOVE	42
• ADD ipod interface to above	45

BUSINESS CASE ASSESSMENT

- SUMMARY & RECOMMENDATION
- KEY ASSUMPTIONS
- COSTS
- BENEFITS
- CASH FLOW PROJECTIONS
- RISK
- STRATEGIC OPTIONS
- OPPORTUNITY COSTS
- IMMEDIATE FIRST STEPS