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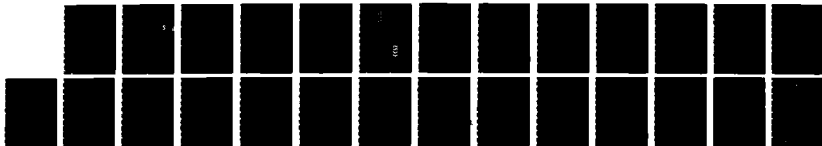
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BENEFIT ANALYSIS VOLUME 2 (U) ARMY TRADOC ANALYSIS  
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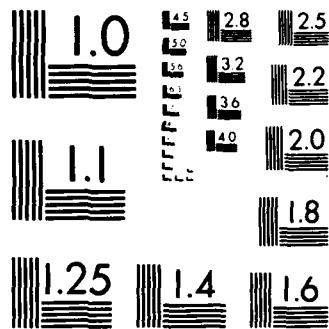
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TRADOC Analysis Command-Fort Leavenworth (TRAC-FLVN),  
Force Analysis Directorate  
Fort Leavenworth, Kansas 66027-5220

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ARMY TACTICAL COMMAND AND CONTROL SYSTEM (ATCCS)  
BENEFIT ANALYSIS

VOLUME II: MAIN REPORT WITH APPENDIX I - FIGURES

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Approved for public release  
Distribution Unlimited

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APPENDIX I

FIGURES

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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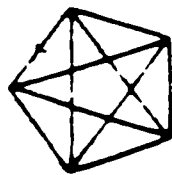
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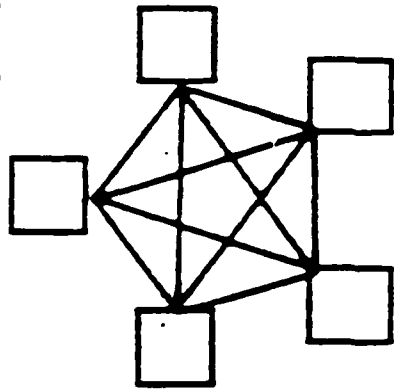
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**COMMAND**

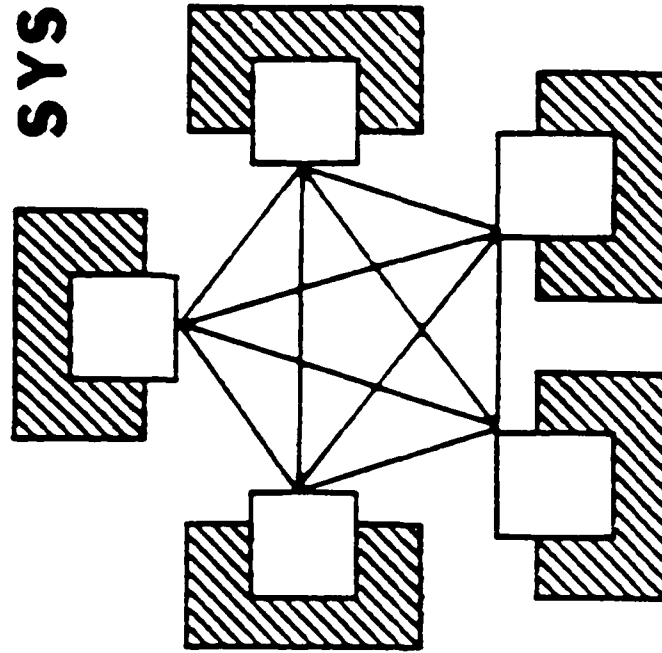


**CONTROL**



**AND**

**SUBORDINATE  
SYSTEMS**



**CCS2**

Figure 2-1. CCS2 architecture

# CCS<sup>2</sup> ARCHITECTURE

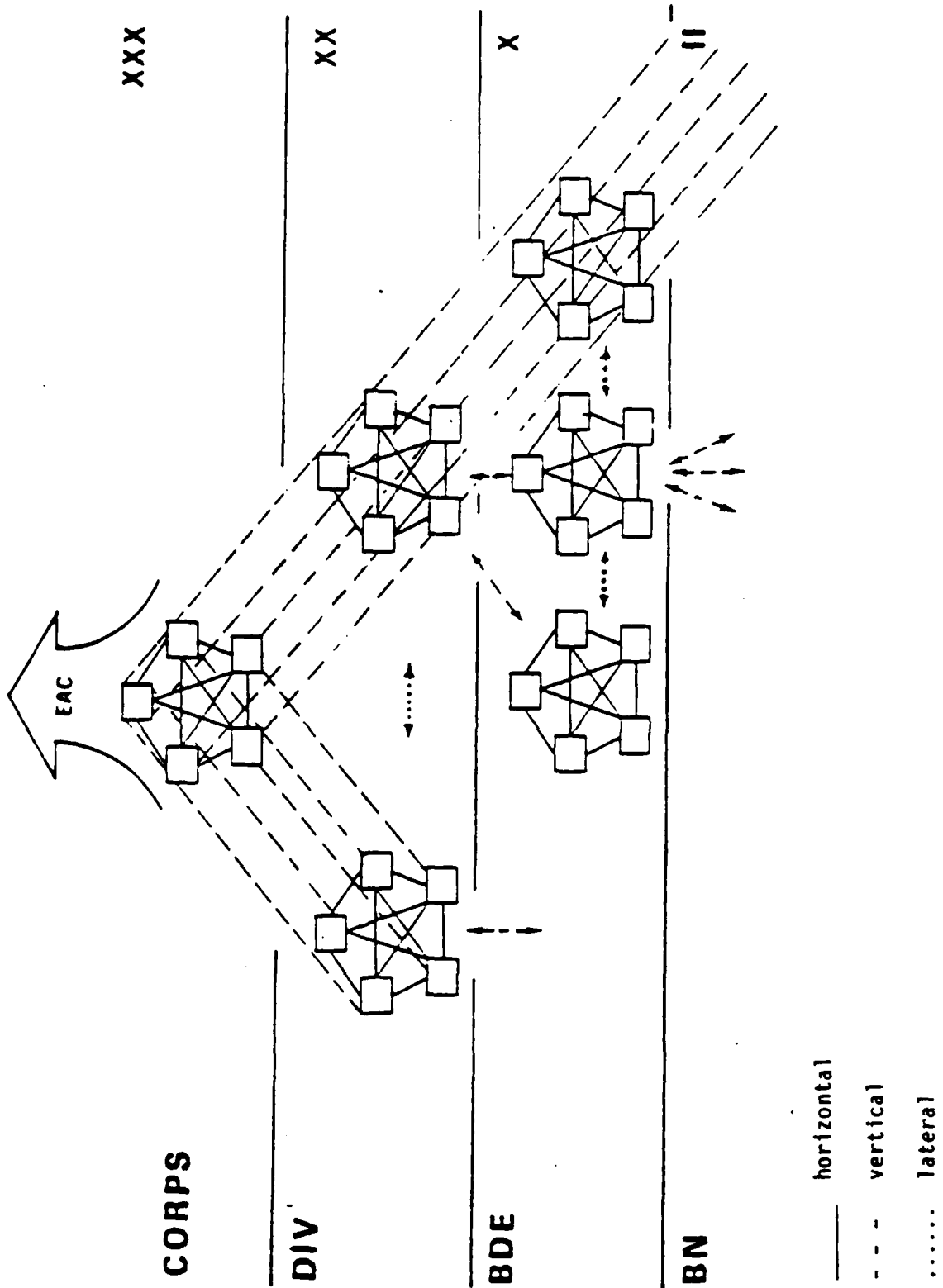


Figure 2-2. Information flows



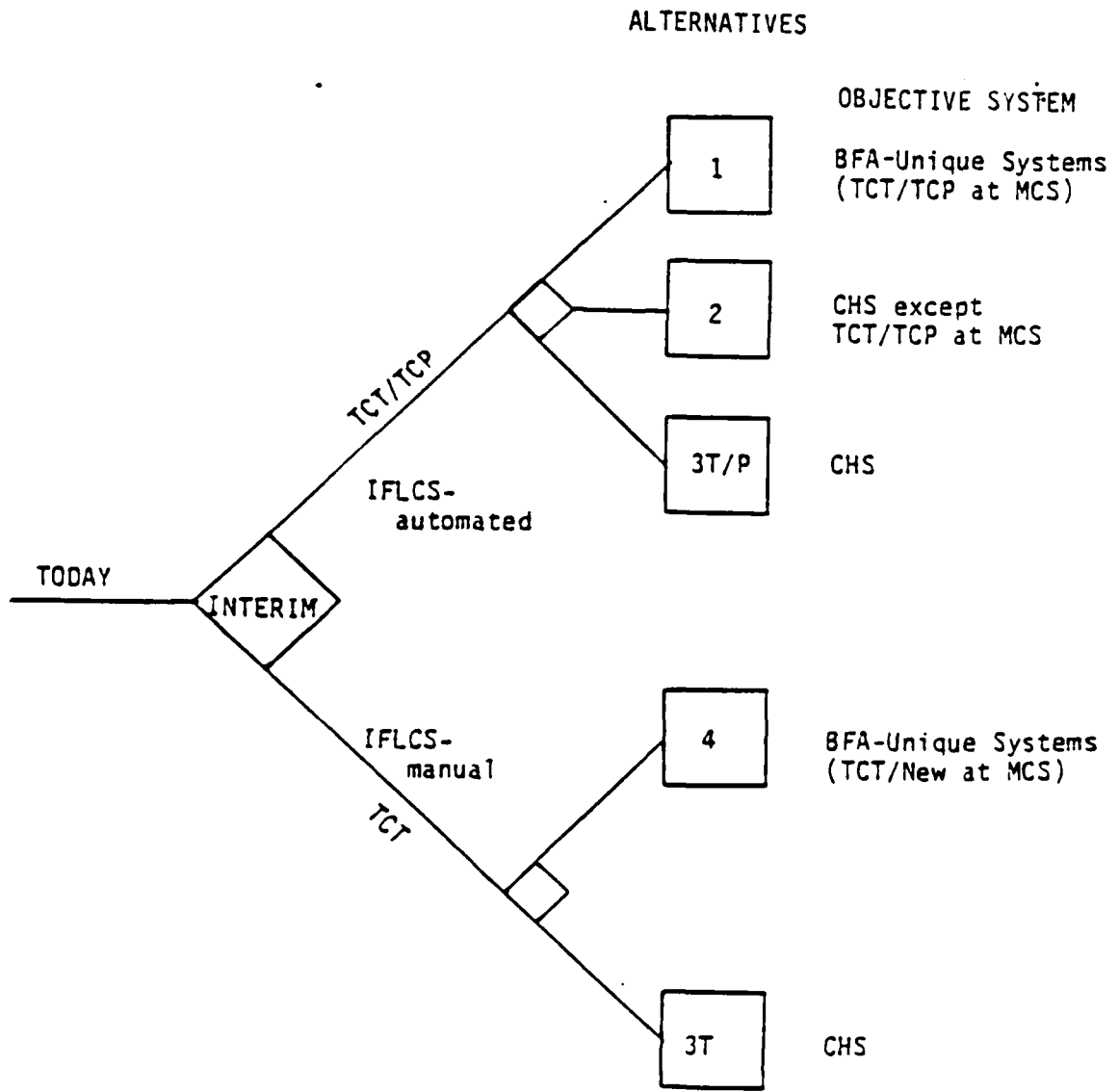
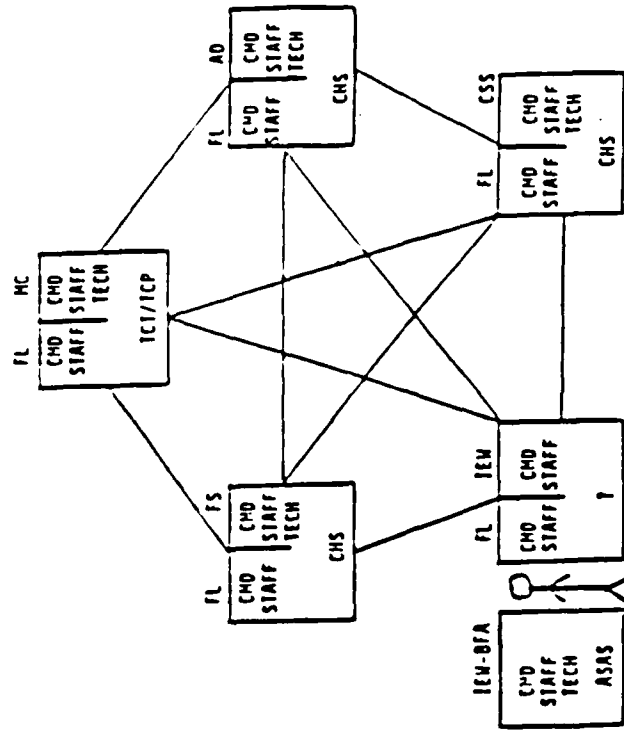


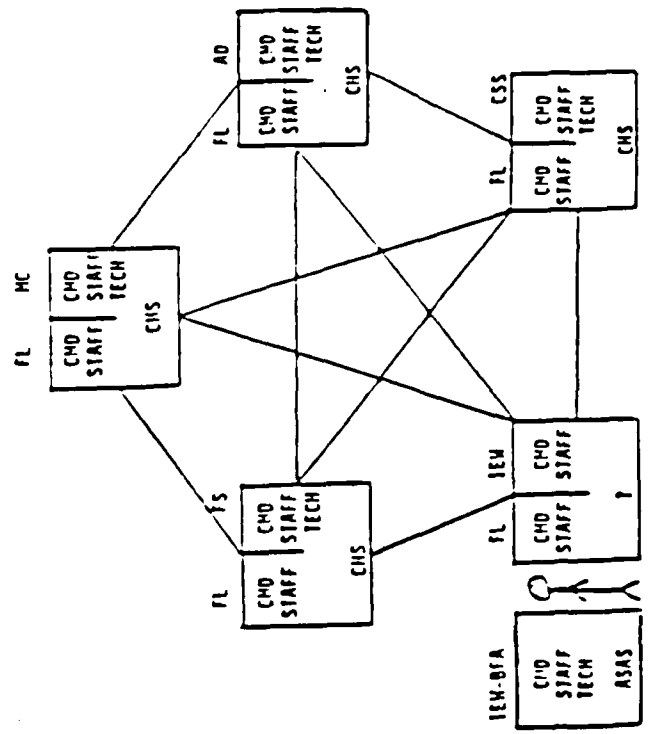
Figure 5-1. ATCCS automation alternatives

CHS

BFA Unique

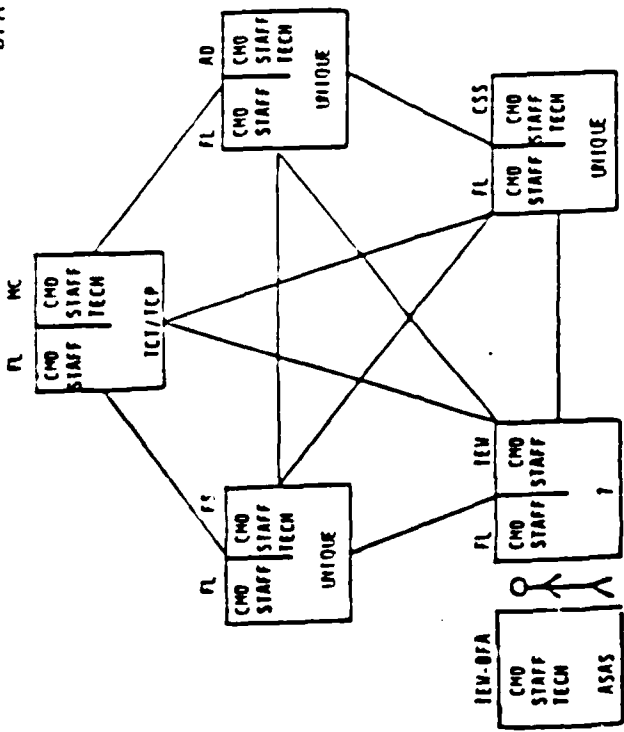


Alternative 2

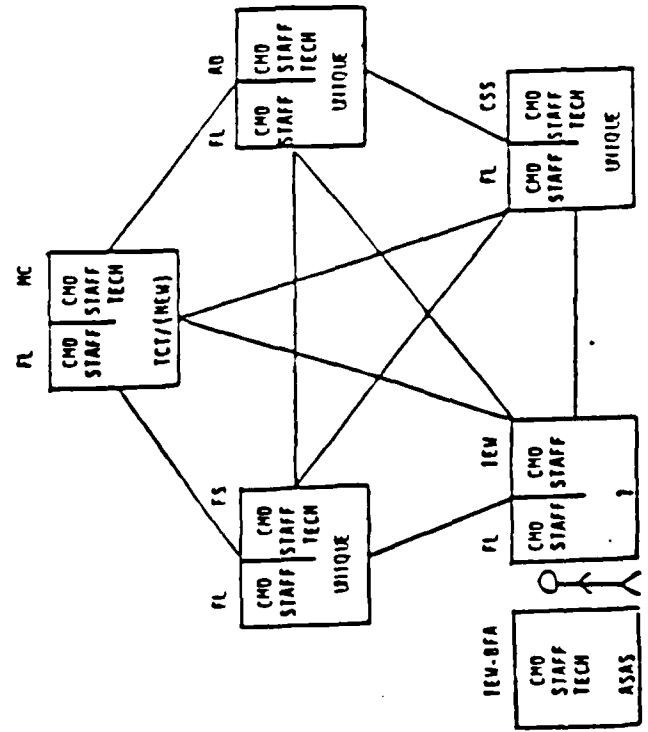


Alternatives 3I/P and 3I

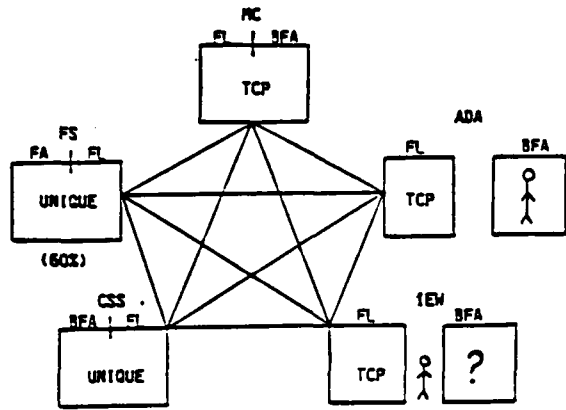
Alternative 1



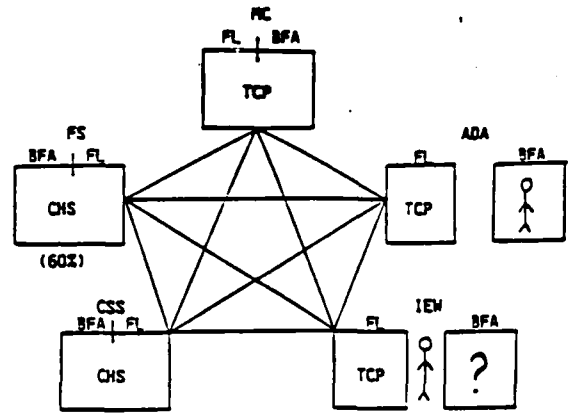
Alternative 4



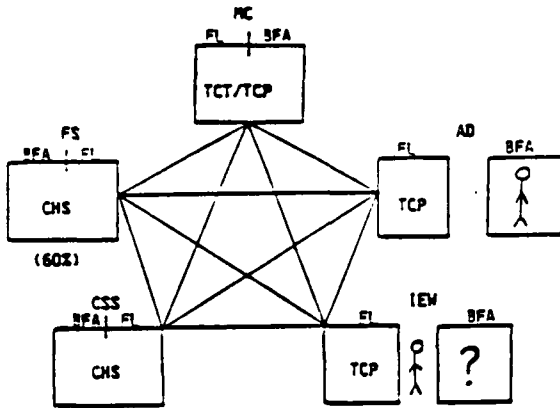
ALTERNATIVE 1



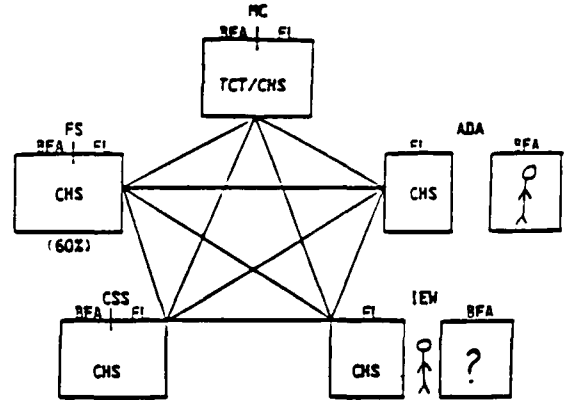
ALTERNATIVE 2



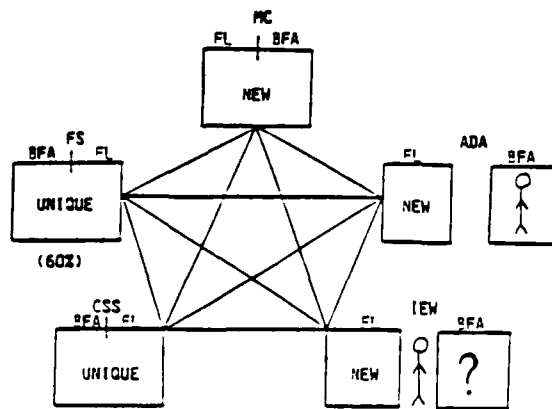
ALTERNATIVE 3T/P



ALTERNATIVE 3T



ALTERNATIVE 4





-  : MANUAL INTERFACE
-  : MANUAL SYSTEMS

Figure 5-3. Reserve component configurations

| LOCATION       | MC              |                 | FS              |                | CSS             |                 | IEW             |                 | ADA             |               |
|----------------|-----------------|-----------------|-----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|---------------|
|                | FL              | BFA             | FL              | BFA            | FL              | BFA             | FL              | BFA             | FL              | BFA           |
| SW             | 100%            | 100%            | 100%            | 60%            | 100%            | 100%            | 100%            | 100%            | 100%            | 0%            |
| <del>ALT</del> | <del>100%</del> | <del>100%</del> | <del>100%</del> | <del>60%</del> | <del>100%</del> | <del>100%</del> | <del>100%</del> | <del>100%</del> | <del>100%</del> | <del>0%</del> |
| ALT 1          | TCP             |                 | UNIQUE          |                | UNIQUE          |                 | TCP             | ?               | TCP             | ?             |
| ALT 2          | TCP             |                 | CHS             |                | CHS             |                 | TCP             | ?               | TCP             | ?             |
| ALT 3T/P       | TCT/TCP         |                 | CHS             |                | CHS             |                 | TCP             | ?               | TCP             | ?             |
| ALT 3T         | TCT/CHS         |                 | CHS             |                | CHS             |                 | CHS             | ?               | CHS             | ?             |
| ALT 4          | NEW             |                 | UNIQUE          |                | UNIQUE          |                 | NEW             | ?               | NEW             | ?             |

: MANUAL SYSTEM

: MANUAL INTERFACE

Figure 5-4. Reserve Component capabilities

| 1<br>ALTERNATIVE | 2<br>PARTIAL<br>AUTO MCS ONLY<br>(TCT) | 3<br>IFLCS<br>(TCT & TCP) | 4<br>FLCS   |            |
|------------------|--|---------------------------|-------------|------------|
|                  |  |                           | a           | b          |
|                  |  |                           | FIRST CORPS | LAST CORPS |
| ALT 1            | 87                                     | 88                        | 93          | 97         |
| ALT 2            | 87                                     | 88                        | 92          | 96         |
| ALT 3T/P         | 87                                     | 88                        | 92          | 96         |
| ALT 3T           | 87                                     | NA                        | 92          | 96         |
| ALT 4            | 87                                     | NA                        | 93          | 97         |

Figure 5-5. Fielding schedule

| ALT  | MEASUREMENT OF CHARACTERISTICS, CAPABILITY, PERFORMANCE, AND EFFECTIVENESS | FIELDING TIMES |            |           | RESERVE COMPONENT CAPABILITIES | BFA CONCERNS                           |
|------|--|----------------|------------|-----------|--------------------------------|--|
|      |  | AUTO MCS       | AUTO IFLCS | AUTO FLCS |                                |  |
| 1    | POOR   | 87             | 88         | 93        | TCP/UNIQUE                     | NONSTANDARDIZATION                     |
| 2    | FAIR   | 87             | 88         | 92        | TCP/CHS                        | NONSTANDARDIZATION<br>PROCESSING SPEED |
| 3T/P | GOOD   | 87             | 88         | 92        | TCP/TCT/CHS                    | PROCESSING SPEED                       |
| 3T   | GOOD   | 87             | ---        | 92        | TCT/CHS                        | PROCESSING SPEED                       |
| 4    | POOR   | 87             | ---        | 93        | TCT/NEW/UNIQUE                 | NONSTANDARDIZATION                     |

Figure 5-6. Summary of alternatives attributes

| ALT  | MEASUREMENT OF CHARACTERISTICS, CAPABILITY, PERFORMANCE, AND EFFECTIVENESS | FIELDING TIMES  |                |           | RESERVE COMPONENT CAPABILITIES | BFA CONCERNS |
|------|--|---|----------------|-----------|--------------------------------|--------------|
|      |  | AUTO MCS  | AUTO IFLCS     | AUTO FLCS |                                |              |
| 1    | POOR   | N<br>O<br>N<br>D<br>I<br>S<br>C<br>R<br>I<br>M<br>I<br>N<br>A<br>T<br>I<br>N<br>G | GOOD           | FAIR      | POOR                           | FAIR         |
| 2    | FAIR   |   | GOOD           | GOOD      | FAIR                           | POOR         |
| 3T/P | GOOD   |   | GOOD           | GOOD      | FAIR                           | FAIR         |
| 3T   | GOOD   |   | POOR<br>(NONE) | GOOD      | FAIR/GOOD                      | FAIR         |
| 4    | POOR   |   | POOR<br>(NONE) | FAIR      | POOR                           | FAIR         |

Figure 5-7. Generalized summary of alternatives' attributes

# ATCCS CBA STUDY METHODOLOGY

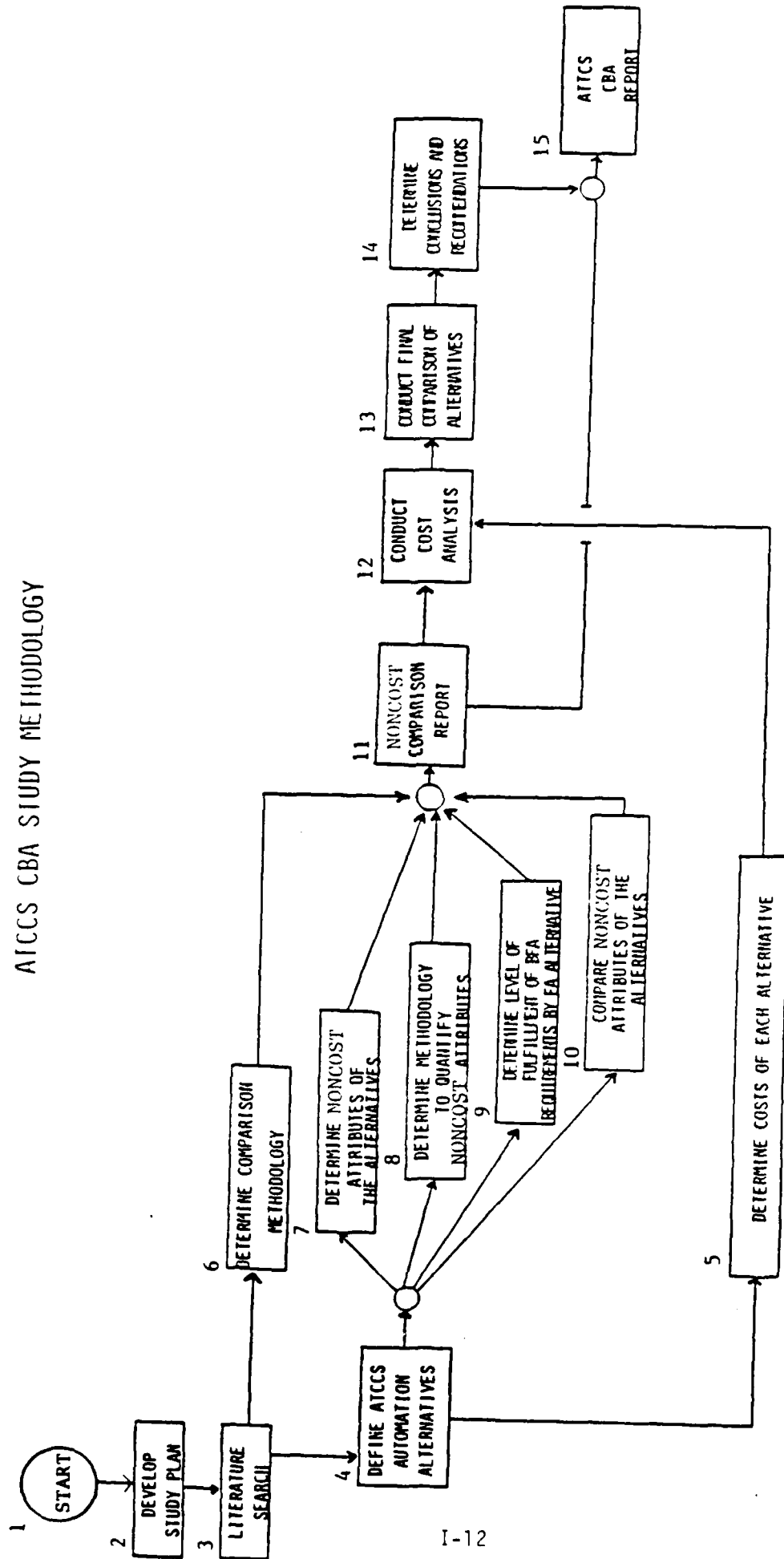


Figure F-1. The ATCCS CBA study methodology

CONTRIBUTION SCORE MATRIX

MEASURES OF SYSTEM CCPE

| ALTERNATIVES | ABILITY TO EXCHANGING OPERATIORS | ABILITY TO EXCHANGING EQUIPMENT | EASE OF HW SETUP | EASE OF TRAIN | EASE OF PERS MGMT | EASE OF MAINT MGMT | EASE OF SW MGMT |
|--------------|----------------------------------|---------------------------------|------------------|---------------|-------------------|--------------------|-----------------|
| ALT 1        |                                  |                                 |                  |               |                   |                    |                 |
| ALT 2        |                                  |                                 |                  |               |                   |                    |                 |
| ALT 3T/P     |                                  |                                 |                  |               |                   |                    |                 |
| ALT 3T       |                                  |                                 |                  |               |                   |                    |                 |
| ALT 4        |                                  |                                 |                  |               |                   |                    |                 |

Rating Scale

| <u>Values</u> | <u>Description</u>  |
|---------------|---|
| 0             | - This alternative provides <u>no contribution</u> to this criteria                   |
| 1             | - This alternative provides a <u>very weak weak contribution</u> to this criteria     |
| 2             | - This alternative provides a <u>weak contribution</u> to this criteria               |
| 3             | - This alternative provides a <u>moderately weak contribution</u> to this criteria    |
| 4             | - This alternative provides a <u>moderately strong contribution</u> to this criteria  |
| 5             | - This alternative provides a <u>strong contribution</u> to this criteria             |
| 6             | - This alternative provides a <u>very strong contribution</u> to this criteria        |
| 7             | - This alternative provide an <u>extreme (absolute) contribution</u> to this criteria |

Figure G-1. Matrix for scoring of alternatives against CCPE



|          | EXCH<br>OPS | EXCH<br>EQUIP | HW<br>SETUP | TRNG | PERS.<br>MGMT | MAINT<br>MGMT | SW<br>MGMT |
|----------|-------------|---------------|-------------|------|---------------|---------------|------------|
| ALT 1    | 2.15        | 1.44          | 3.08        | 2.35 | 1.85          | 1.33          | 1.65       |
| ALT 2    | 4.06        | 3.65          | 3.67        | 4.00 | 3.73          | 4.15          | 3.92       |
| ALT 3T/P | 5.71        | 5.42          | 4.48        | 5.46 | 5.04          | 5.52          | 5.58       |
| ALT 3/T  | 5.71        | 5.38          | 4.54        | 4.92 | 4.90          | 5.67          | 5.58       |
| ALT 4    | 2.25        | 1.23          | 2.92        | 2.35 | 1.81          | 1.64          | 1.71       |

Figure G-2. Average individual CCPE scores

|                  | EXCH OPS | EXCH EQUIP | HW SETUP | TRNG  | PERS. MGMT | MAINT MGMT | SW MGMT |
|------------------|----------|------------|----------|-------|------------|------------|---------|
| EXCHANGE OPS     |          | (3.6)      | (5.5)    | (2.6) | (2.9)      | 2.2        | 3.6     |
| EXCHANGE EQUIP   |          |            | 3.8      | 4.9   | 5.1        | 6.0        | 5.7     |
| HARDWARE SETUP   |          |            |          | 4.0   | 3.2        | 5.7        | 6.4     |
| TRAINING EASE    |          |            |          |       | 3.4        | 3.7        | 4.0     |
| PERSONNEL MGMT   |          |            |          |       |            | 3.1        | 5.3     |
| MAINTENANCE MGMT |          |            |          |       |            |            | 4.8     |
| SOFTWARE MGMT    |          |            |          |       |            |            |         |

RATING SCALE \* \*\*

1 - EQUAL IMPORTANCE

3 - FIRST CCPE MODERATELY MORE IMPORTANT

5 - FIRST CCPE STRONGLY MORE IMPORTANT

7 - FIRST CCPE VERY STRONGLY MORE IMPORTANT

9 - FIRST CCPE EXTREMELY MORE IMPORTANT

\* PARENTHESES DENOTE AN INVERSE (USED WHEN SECOND CCPE MOST IMPORTANT)

\*\* ALL VALUES BETWEEN 1 AND 9 MAY BE USED

Figure G-3. CCPE pairwise comparison results

| CCPE                                 | Weight<br>(Relative Importance) |
|--------------------------------------|---------------------------------|
| Ability to Exchange Equipment        | .39                             |
| Simplicity of Hardware Setup         | .25                             |
| Simplicity of Training               | .13                             |
| Simplicity of Personnel Management   | .09                             |
| Ability to Exchange Operators        | .06                             |
| Simplicity of Maintenance Management | .05                             |
| Simplicity of Software Management    | .03                             |

\* CR = .118

\* The consistency ratio (CR) is a comparison of the consistency of the judgements made to total randomness. A CR of less than or equal to .1 is considered acceptable. Obviously CR = .118 is slightly above the acceptable amount. A change in the weights of the CCPE will be addressed under sensitivity.

Figure G-4. CCPE weights

|          | EXCH<br>EQUIP:<br>.39 | IW<br>SET:<br>.25 | TRNG:<br>.13 | PERS.<br>MGT:<br>.09 | EXCH<br>OPS:<br>.06 | MAINT<br>MGT:<br>.05 | SM:<br>.03 | CONTRIBUTION SCORE* | GENERALIZED SCORE |
|----------|-----------------------|-------------------|--------------|----------------------|---------------------|----------------------|------------|---------------------|-------------------|
| ALT 1    | 1.44                  | 3.08              | 2.35         | 1.85                 | 2.15                | 1.33                 | 1.65       | 2.05                | 1                 |
| ALT 2    | 3.65                  | 3.67              | 4.00         | 3.73                 | 4.06                | 4.15                 | 4.92       | 3.80                | 2                 |
| ALT 3T/P | 5.42                  | 4.48              | 5.46         | 5.04                 | 5.71                | 5.52                 | 5.58       | 5.18                | 3                 |
| ALT 3T   | 5.38                  | 4.54              | 4.92         | 4.90                 | 5.71                | 5.67                 | 5.58       | 5.11                | 3                 |
| ALT 4    | 1.23                  | 2.92              | 2.35         | 1.81                 | 2.25                | 1.64                 | 1.71       | 1.95                | 1                 |

GENERALIZED CONTRIBUTION RATING SCALE

- 3 - GOOD
- 2 - FAIR
- 1 - POOR
- 0 - NONE

CR = .118

\*SCORE RANGE: 0 ≤ S ≤ 7

Figure G-5. Interim contribution score determined

| ALT      | IFLCCS<br>(MANUAL INTERFACE TO BFA CS) |                   | FLCCS<br>(CCS2 CAPABILITY) |                   |
|----------|--|-------------------|----------------------------|-------------------|
|          | FIRST YEAR                             | GENERALIZED SCORE | FIRST YEAR                 | GENERALIZED SCORE |
| ALT 1    | 88                                     | 3                 | 93                         | 2                 |
| ALT 2    | 88                                     | 3                 | 92                         | 3                 |
| ALT 3T/P | 88                                     | 3                 | 92                         | 3                 |
| ALT 3T   | NA                                     | 0                 | 92                         | 3                 |
| ALT 4    | NA                                     | 0                 | 93                         | 2                 |

Figure G.6. Fielding schedule

| Alt.         | Distinguishing Characteristics   | Implications   | Score |
|--------------|--|--|-------|
| Alt.<br>1    | FL C2 for MC, AD, IEW handled by TCP<br>FL C2 for FS, CSS handled by unique<br>BFA C2 for MC handled by TCP<br>BFA C2 for FS, CSS handled by unique<br>Fielding starts in 1993       | Extremely complicated SW Mgmt,<br>Logistics, Training, Personnel Mgmt,<br>Maintenance Mgmt, and HW Setup.<br>Low equipment exchange capabilities.            | 1     |
| Alt.<br>2    | FL C2 for MC, AD, IEW handled by TCP<br>FL C2 for FS, CSS handled by CHS<br>BFA C2 for MC handled by TCP<br>BFA C2 for FS, CSS handled by CHS<br>Fielding starts in 1992             | Complicated SW Mgmt, Logistics,<br>Training, Personnel Mgmt,<br>Maintenance Mgmt, and HW Setup.<br>Moderate equipment exchange<br>capabilities.              | 2     |
| Alt.<br>3T/P | FL C2 for AD, IEW handled by TCP/TCP<br>FL C2 & BFA C2 for MC handled by<br>TCP/TCT<br>FL C2 for FS, CSS handled by CHS<br>BFA C2 for FS, CSS handled by CHS<br>Fielding starts 1992 | Complicated SW Mgmt, Logistics,<br>Training, Personnel Mgmt,<br>Maintenance Mgmt, and HW Setup.<br>Moderate equipment exchange<br>capabilities.              | 2     |
| Alt.<br>3T   | FL & BFA C2 for MC handled by TCT/<br>CHS<br>FL & BFA C2 elsewhere handled by<br>CHS<br>Fielding starts in 1992  | Relatively simple SW Mgmt, Logistics,<br>Training, Personnel Mgmt,<br>Maintenance Mgmt, and HW Setup.<br>Relatively good equipment exchange<br>capabilities. | 2.5   |
| Alt.<br>4    | FL C2 for MC, ADA, IEW handled by NEW<br>FL C2 for FS, CSS handled by unique<br>BFA C2 for MC handled by NEW<br>BFA C2 for FS, CSS handled by unique<br>Fielding starts in 1993      | Extremely complicated SW Mgmt,<br>Logistics, Training, Personnel Mgmt,<br>Maintenance Mgmt, and HW Setup.<br>Low equipment exchange capabilities.            | 2     |

Scale

- 3 - Good
- 2 - Fair
- 1 - Poor
- 0 - Extremely Deficient (Unacceptable)

Figure 0- . Reserve component capabilities

| ALTERNATIVE | BFA CONCERNS   | SCORES |
|-------------|--|--------|
| ALT 1       | NONSTANDARDIZATION OF SYSTEM DESIGN                  | 2      |
| ALT 2       | NONSTANDARDIZATION OF SYSTEM DESIGN PROCESSING SPEED | 1      |
| ALT 3T/P    | PROCESSING SPEED                                     | 2      |
| ALT 3T      | PROCESSING SPEED                                     | 2      |
| ALT 4       | NONSTANDARDIZATION OF SYSTEM DESIGN                  | 2      |

3 - GOOD

2 - FAIR

1 - POOR

0 - EXTREMELY DEFICIENT - UNACCEPTABLE

Figure G-8. Score of alternatives based on BFA concerns

|                             | (A)<br>CPPE | (B)<br>TIMELINESS<br>OF IFLCCS | (C)<br>TIMELINESS<br>FLCCS | (D)<br>R.C.<br>CAPABILITIES | (E)<br>BFA<br>CONCERNS |
|-----------------------------|-------------|--------------------------------|----------------------------|-----------------------------|------------------------|
| CCPE (A)                    |             |                                |                            |                             |                        |
| TIMELINESS OF (B)<br>IFLCCS |             |                                |                            |                             |                        |
| TIMELINESS OF (C)<br>FLCCS  |             |                                |                            |                             |                        |
| R.C. CAPABILITIES (D)       |             |                                |                            |                             |                        |
| BFA CONCERNS (E)            |             |                                |                            |                             |                        |

Figure G-9. Pairwise comparison matrix of decision criteria



|                             | (A)<br>CPPE | (B)<br>TIMELINESS<br>OF IFLCCS | (C)<br>TIMELINESS<br>FLCCS | (D)<br>R.C.<br>CAPABILITIES | (E)<br>BFA<br>CONCERNS |
|-----------------------------|-------------|--------------------------------|----------------------------|-----------------------------|------------------------|
| CCPE (A)                    |             | A                              | A                          | A                           | A                      |
| TIMELINESS OF (B)<br>IFLCCS |             |                                | B                          | B                           | B                      |
| TIMELINESS OF (C)<br>FLCCS  |             |                                |                            | C                           | E                      |
| R.C. CAPABILITIES (D)       |             |                                |                            |                             | D                      |
| BFA CONCERNS (E)            |             |                                |                            |                             |                        |

Figure G-10. Example pairwise comparison of decision criteria

| Respondent        | Decision Criteria Frequencies |    |    |    |   |
|-------------------|-------------------------------|----|----|----|---|
|                   | A                             | B  | C  | D  | E |
| N <sub>1</sub> :  | 4                             | 3  | 2  | 1  | 0 |
| N <sub>2</sub> :  | 3                             | 2  | 4  | 1  | 0 |
| N <sub>3</sub> :  | 4                             | 1  | 3  | 2  | 0 |
| N <sub>4</sub> :  | 3                             | 4  | 2  | 1  | 0 |
| N <sub>5</sub> :  | 4                             | 3  | 2  | 1  | 0 |
| N <sub>6</sub> :  | 4                             | 2  | 1  | 1  | 2 |
| N <sub>7</sub> :  | 4                             | 3  | 0  | 1  | 2 |
| N <sub>8</sub> :  | 4                             | 3  | 2  | 1  | 0 |
| N <sub>9</sub> :  | 4                             | 2  | 3  | 1  | 0 |
| N <sub>10</sub> : | 3                             | 4  | 1  | 2  | 0 |
| Totals            | 37                            | 27 | 20 | 12 | 4 |

| Criteria | Total Frequencies | Relative Frequencies (Weights) |
|----------|-------------------|--------------------------------|
| A        | 37                | 37/100 = .37                   |
| B        | 27                | 27/100 = .27                   |
| C        | 20                | 20/100 = .20                   |
| D        | 12                | 12/100 = .12                   |
| E        | 4                 | 4/100 = .04                    |
| Total    | 100               |                                |

N<sub>i</sub> respondent i

A: Measures of system characteristics, capabilities, performance, and effectiveness

B: Timeliness of the IFLCS

C: Timeliness of the FLCS

D: Automated C2 capabilities of the RC

E: BFA concerns

Figure G-11. Results of pairwise comparison

| DECISION CRITERIA | CHARACTERISTICS, CAPABILITY, PERFORMANCE, AND EFFECTIVENESS SCORE | RESERVE COMP. AUTO FL CAP | TIMELINESS OF IFLCS | TIMELINESS OF FLCS | BFA CONCERNS | FINAL SCORE* | RANK |
|-------------------|---|---------------------------|---------------------|--------------------|--------------|--------------|------|
| ALT wt.           | .37   | .12                       | .27                 | .20                | .04          |              |      |
| ALT 1             | 1   | 1                         | 3                   | 2                  | 2            | 1.78         | 4    |
| ALT 2             | 2   | 2                         | 3                   | 3                  | 1            | 2.43         | 2    |
| ALT 3T/P          | 3   | 2                         | 3                   | 3                  | 2            | 2.84         | 1    |
| ALT 3T            | 3   | 2.5                       | 0                   | 3                  | 2            | 2.09         | 3    |
| ALT 4             | 1   | 2                         | 0                   | 2                  | 2            | 1.09         | 5    |

\* RANGE: 0 ≤ S ≤ 3

Figure 6-12. Scoring of the alternatives

END

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