

ANALYSIS 3: DIFFERENCES

SIMULATION REALISM

ANALYSIS 4: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

These items concern relative number of problems and benefits
and involve comparisons between mid-experiment, wrap-up, follow up expected, and
follow up obtained .

Data are presented on 13 items repeated in 4 forms:

1. Post Familiarization Survey, Form D, page 3, "Mid-experiment administration"
called "D1 1PROB vs BENE" herein.
2. Post Familiarization Survey, Form D, page 3, "Post-experiment (wrap-up) administration"
called "D2 2PROB vs BENE" herein.
3. Follow Up Survey, Form H, page 4, "Follow-up administration (concept potential)"
called "HE EPROB vs BENE" herein.
4. Follow Up Survey, Form H, page 4, "Follow-up administration (as tested)"
called "HO OPROB vs BENE" herein.

The items were rated on the following scale: Using this ETABS feature creates
(when compared to present NAS)

7. Many More Benefits
6. More Benefits
5. Slightly More Benefits
- (midscale) 4. Problems = Benefits
3. Slightly More Problems
2. More Problems
1. Many More Problems

Positive and negative t scores indicate significant deviation from "Problems = Benefits" in the directions of "Many More Benefits" and "Many More Problems," respectively.

ANALYSIS 4: DIFFERENCES
PROBLEMS VERSUS BENEFITS

FORM 12 1-2 PROB/BENE STR -2.757
 12 10 ELEC RCORD VS ILIITY -2.326
 12 15 AUTO POSTING KEYBRD -2.993
 12 20 TOUCH VS KEYBRD 1.992
 12 25 TOUCH VS PENCIL 1.926
 12 30 MANUAL POSTING STRPS 1.766
 12 35 READ FIGHTING STRPS 1.656
 12 40 HIGHL UPDATES TECH 1.469
 12 45 AUTO UPDATES 1.429
 12 50 MANUAL UPDATES 1.251
 12 55 HANDOFFS W/ETABS 1.551
 13 00 HANDOFFS W/ETABS/STAT 0.385
 13 05 2ND TO OUFLOW/STAT 46.615385
 13 10 SUM=632 MEAN=46.615385
 13 15 RESULTS ARE ABOVE 5 BELOW
 13 20 RESULTS ARE DIFFERENT (P<=.05)
 13 25 FROM MIDS SCALE.

FORM 1E 1-E PROB/BENE 15
 1E 13 ETABS SPEED YBRD -5.161
 1E 12 TOUCH VS KEYBRD -4.548
 1E 11 MANUAL POSTING 3.144
 1E 10 TOUCH VS PENCIL -3.054
 1E 09 AUTO POSTING STRPS -2.544
 1E 08 HANDOFFS W/ETABS -2.126
 1E 07 HIGHL UPDATES TECH 1.469
 1E 06 2ND TO OUFLOW/STAT 1.401
 1E 05 ELEC RCORD VS STR 1.1
 1E 04 SUM=593 MEAN=59.290769
 1E 03 RESULTS ARE ABOVE 8 BELOW
 1E 02 RESULTS ARE DIFFERENT (P<=.05)
 1E 01 FROM MIDS SCALE.

FORM 10 1-0 PROB/BENE STR +2.902
 10 14 2ND TO OUFLOW/STR 1.799
 10 13 HANDOFFS W/ETABS 1.445
 10 12 TOUCH VS PENCIL 1.153
 10 11 MANUAL POSTING TECH 1.088
 10 10 HIGHL UPDATES 0.876
 10 09 HANDOFFS W/ETABS 0.611
 10 08 AUTO UPDATES STRPS 0.59
 10 07 MANUAL UPDATES 0.14
 10 06 HANDOFFS W/ETABS/STAT 558462
 10 05 2ND TO OUFLOW/STAT 62.558462
 10 04 SUM=613 MEAN=62.558462
 10 03 RESULTS ARE ABOVE 11 BELOW
 10 02 RESULTS ARE DIFFERENT (P<=.05)
 10 01 FROM MIDS SCALE.

FORM 2E 2-E PROB/BENE STR +3.287
 2E 13 ETABS RCORD VS STR +3.287
 2E 12 TOUCH VS KEYBRD +2.993
 2E 11 TOUCH VS PENCIL +2.993
 2E 10 ELEC RCORD VS STR 1.469
 2E 09 MANUAL POSTING STRPS 1.429
 2E 08 HANDOFFS W/ETABS 1.251
 2E 07 HANDOFFS W/ETABS/STAT 1.551
 2E 06 2ND TO OUFLOW/STAT 1.401
 2E 05 ELEC RCORD VS STR 1.1
 2E 04 SUM=623 MEAN=47.925077
 2E 03 RESULTS ARE ABOVE 4 BELOW
 2E 02 RESULTS ARE DIFFERENT (P<=.05)
 2E 01 FROM MIDS SCALE.

FORM 20 2-0 PROB/BENE STR +3.287
 20 10 ELEC RCORD VS STR +3.287
 20 09 AUTO POSTING STRPS +2.993
 20 08 2ND TO OUFLOW/STAT +2.993
 20 07 TOUCH VS KEYBRD +2.993
 20 06 TOUCH VS PENCIL +2.993
 20 05 HANDOFFS W/ETABS +2.993
 20 04 HANDOFFS W/ETABS +2.993
 20 03 HANDOFFS W/ETABS +2.993
 20 02 HANDOFFS W/ETABS +2.993
 20 01 HANDOFFS W/ETABS +2.993
 20 00 SUM=451 MEAN=34.692308
 20 00 RESULTS ARE ABOVE 9 BELOW
 20 00 RESULTS ARE DIFFERENT (P<=.05)
 20 00 FROM MIDS SCALE.

FORM 20 2-0 PROB/BENE STR +3.287
 20 13 ETABS RCORD VS STR +3.287
 20 12 TOUCH VS KEYBRD +2.993
 20 11 TOUCH VS PENCIL +2.993
 20 10 ELEC RCORD VS STRPS +4.011
 20 09 2ND TO OUFLOW/STAT +3.997
 20 08 HANDOFFS W/ETABS +3.997
 20 07 HANDOFFS W/ETABS +3.997
 20 06 HANDOFFS W/ETABS +3.997
 20 05 HANDOFFS W/ETABS +3.997
 20 04 HANDOFFS W/ETABS +3.997
 20 03 HANDOFFS W/ETABS +3.997
 20 02 HANDOFFS W/ETABS +3.997
 20 01 HANDOFFS W/ETABS +3.997
 20 00 SUM=169 MEAN=13
 20 00 RESULTS ARE ABOVE 13 BELOW
 20 00 RESULTS ARE DIFFERENT (P<=.05)
 20 00 FROM MIDS SCALE.

KRUSKAL-WALLIS ANOV, H=37.87574
 CHI SQ, 5 DF.

ANALYSIS 5: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

These items concern human factors (I/O) and console aspects and involve comparisons between first and second evaluation and follow up for the R- and D-sides.

Data are presented on 12 items repeated in 4 forms:

1. Post Training Survey, Form C, page 1, "First evaluation" called "C1 1 Human Factors" herein.
2. Wrap-Up Survey, Form F, page 1, "Second evaluation" called "F1 2 Human Factors" herein.
3. Follow Up Survey, Form H, page 1, "R-side" called "HR R Human Factors" herein.
4. Follow Up Survey, Form H, page 1, "D-side" called "HD D Human Factors" herein.

The items were rated on the following scale: Rate the various human factors aspects by checking the appropriate category.

7. Very Good
6. Good
5. Moderately Good
- (midscale) 4. Moderate
3. Moderately Poor
2. Poor
1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in the directions of "Very Good" and "Very Poor," respectively.

HR RHUMAN FACTORS
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 14121111161
 13211111171
 22111111181
 41111111191
 11211111201
 11211111211
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 11211111371
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 11211111451
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HR RHUMAN FACTORS
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ANALYSIS 5: DIFFERENCES

HUMAN FACTORS ASPECTS

ANALYSIS 6: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

These items concern interactive display (ID) aspects
and involve comparisons between first and second evaluation and follow up for the
R- and D-sides.

Data are presented on 12 items repeated in 4 forms:

1. Post Training Survey, Form C, page 2, "First evaluation"
called "C2 IID" herein.
2. Wrap-Up Survey, Form F, page 2, "Second evaluation"
called "F2 2ID" herein.
3. Follow Up Survey, Form H, page 2, "R-side"
called "HR RID" herein.
4. Follow Up Survey, Form H, page 2, "D-side"
called "HD DID" herein.

The items were rated on the following scale: Rate the various CRT display
aspects by checking the appropriate category.

7. Very Good
6. Good
5. Moderately Good
- (midscale) 4. Moderate
3. Moderately Poor
2. Poor
1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in
the directions of "Very Good" and "Very Poor," respectively.

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KRUSKAL-WALLIS ANDU, H=2.8477891
 CHI SQ: 3 DF.

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ANALYSIS 6: DIFFERENCES
INTERACTIVE DISPLAY ASPECTS


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FORM 12 1 12 HIGHER VIZ -3.855
100450700 112 HIGHER COLOR 2.488
112 HIGHER SHARPNESS 1.244
12 HIGHER STABILITY 1.140
100450700 112 HIGHER DRIFT 1.800
112 HIGHER RANGE 0.488
12 HIGHER MEAN=30.58000
112 RESULTS ARE DIFFERENT (P<=.05)
FROM 10 MIDS.
RANDOM MIDS.

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FORM 12 1 12 HIGHER VIZ -3.855
100450700 112 HIGHER COLOR 2.488
112 HIGHER SHARPNESS 1.244
12 HIGHER STABILITY 1.140
100450700 112 HIGHER DRIFT 1.800
112 HIGHER RANGE 0.488
12 HIGHER MEAN=30.58000
112 RESULTS ARE DIFFERENT (P<=.05)
FROM 10 MIDS.
RANDOM MIDS.

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FORM 20 2 20 HIGHER VIZ 2.755
100450700 212 HIGHER COLOR 1.624
212 HIGHER SHARPNESS 1.140
20 HIGHER STABILITY 1.140
20 HIGHER DRIFT 1.140
20 HIGHER RANGE 0.65
20 HIGHER MEAN=31.20000
212 RESULTS ARE DIFFERENT (P<=.05)
FROM 12 MIDS.
RANDOM MIDS.

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FORM 10 1 10 HIGHER VIZ 2.94
100450700 112 HIGHER COLOR 1.027
112 HIGHER SHARPNESS 0.930
10 HIGHER STABILITY 0.488
10 HIGHER DRIFT 0.488
10 HIGHER RANGE 0.488
10 HIGHER MEAN=30.58000
112 RESULTS ARE DIFFERENT (P<=.05)
FROM 10 MIDS.
RANDOM MIDS.

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FORM 10 1 10 HIGHER VIZ 2.75
100450700 112 HIGHER COLOR 1.624
112 HIGHER SHARPNESS 1.140
10 HIGHER STABILITY 1.140
10 HIGHER DRIFT 1.140
10 HIGHER RANGE 0.65
10 HIGHER MEAN=31.20000
112 RESULTS ARE DIFFERENT (P<=.05)
FROM 12 MIDS.
RANDOM MIDS.

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FORM 10 1 10 HIGHER VIZ 2.94
100450700 112 HIGHER COLOR 1.027
112 HIGHER SHARPNESS 0.930
10 HIGHER STABILITY 0.488
10 HIGHER DRIFT 0.488
10 HIGHER RANGE 0.488
10 HIGHER MEAN=30.58000
112 RESULTS ARE DIFFERENT (P<=.05)
FROM 10 MIDS.
RANDOM MIDS.

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KRUSKAL-WALLIS ANOV, H=15.666189
CHI SQ.

ANALYSIS 7: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

These items concern near tabular display (TD1) aspects
and involve comparisons between first and second evaluations; and follow up for the
R- and D-sides.

Data are presented on 12 items repeated in 4 forms:

1. Post Training Survey, Form C, page 2, "First evaluation"
called "C2 1Near Tab Display" herein.
2. Wrap-Up Survey, Form F, page 2, "Second evaluation"
called "F2 2Near Tab Display" herein.
3. Follow Up Survey, Form H, page 2, "R-side"
called "HR RNear Tab Display" herein.
4. Follow Up Survey, Form H, page 2, "D-side"
called "HD DNear Tab Display" herein.

The items were rated on the following scale: Rate the various CRT display
aspects by checking the appropriate category.

7. Very Good
6. Good
5. Moderately Good
- (midscale) 4. Moderate
3. Moderately Poor
2. Poor
1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in
the directions of "Very Good" and "Very Poor," respectively.

ANALYSIS 7: DIFFERENCES
NEAR TABULAR DISPLAY ASPECTS

ALL 72 OFRNCS FROM FRNCS FORMS ARE
 12 ITEMS IN 6 OFRNCS FROM
 RANKED BY THEIR SCORES FROM
 HIGH TO LOW (TOP TO BOT).

100	25	UNIFORM SHARPNESS	-4	77
40	4	VIEWING ANGLE	-5	65
60	11	NO REFLECTING	+3	55
70	11	NO REFLECTING	-5	55
80	11	NO REFLECTING	-5	55
90	12	NO REFLECTING	-5	40
110	11	NO REFLECTING	-5	35
120	11	NO REFLECTING	-5	35
130	11	NO REFLECTING	-5	35
140	11	NO REFLECTING	-5	35
150	11	NO REFLECTING	-5	35
160	11	NO REFLECTING	-5	35
170	11	NO REFLECTING	-5	35
180	11	NO REFLECTING	-5	35
190	11	NO REFLECTING	-5	35
200	11	NO REFLECTING	-5	35
210	11	NO REFLECTING	-5	35
220	11	NO REFLECTING	-5	35
230	11	NO REFLECTING	-5	35
240	11	NO REFLECTING	-5	35
250	11	NO REFLECTING	-5	35
260	11	NO REFLECTING	-5	35
270	11	NO REFLECTING	-5	35
280	11	NO REFLECTING	-5	35
290	11	NO REFLECTING	-5	35
300	11	NO REFLECTING	-5	35

600	27	UNIFORM SHARPNESS	00
41	10	HIGHLIGHT	17
42	10	HIGHLIGHT	00
43	10	HIGHLIGHT	00
44	10	HIGHLIGHT	00
45	10	HIGHLIGHT	00
46	10	HIGHLIGHT	00
47	10	HIGHLIGHT	00
48	10	HIGHLIGHT	00
49	10	HIGHLIGHT	00
50	10	HIGHLIGHT	00
51	10	HIGHLIGHT	00
52	10	HIGHLIGHT	00
53	10	HIGHLIGHT	00
54	10	HIGHLIGHT	00
55	10	HIGHLIGHT	00
56	10	HIGHLIGHT	00
57	10	HIGHLIGHT	00
58	10	HIGHLIGHT	00
59	10	HIGHLIGHT	00
60	10	HIGHLIGHT	00
61	10	HIGHLIGHT	00
62	10	HIGHLIGHT	00
63	10	HIGHLIGHT	00
64	10	HIGHLIGHT	00
65	10	HIGHLIGHT	00
66	10	HIGHLIGHT	00
67	10	HIGHLIGHT	00
68	10	HIGHLIGHT	00
69	10	HIGHLIGHT	00
70	10	HIGHLIGHT	00
71	10	HIGHLIGHT	00
72	10	HIGHLIGHT	00
73	10	HIGHLIGHT	00
74	10	HIGHLIGHT	00
75	10	HIGHLIGHT	00
76	10	HIGHLIGHT	00
77	10	HIGHLIGHT	00
78	10	HIGHLIGHT	00
79	10	HIGHLIGHT	00
80	10	HIGHLIGHT	00

ANALYSIS 8: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

These items concern far tabular display (ID2) aspects
and involve comparisons between first and second evaluations; and follow up for the
R- and D-sides.

Data are presented on 12 items repeated in 4 forms:

1. Post Training Survey, Form C, page 2, "First evaluation"
called "C2 1Far Tab Display" herein.
2. Wrap-Up Survey, Form F, page 2, "Second evaluation"
called "F2 2Far Tab Display" herein.
3. Follow Up Survey, Form H, page 2, "R-side"
called "HR RFar Tab Display" herein.
4. Follow Up Survey, Form H, page 2, "D-side"
called "HD DFar Tab Display" herein.

The items were rated on the following scale: Rate the various CRT display
aspects by checking the appropriate category.

7. Very Good
6. Good
5. Moderately Good
- (midscale) 4. Moderate
3. Moderately Poor
2. Poor
1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in
the directions of "Very Good" and "Very Poor," respectively.

ANALYSIS 8: DIFFERENCES
FAR TABULAR DISPLAY ASPECTS

ANALYSES 9 AND 10: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

Analysis 9 treats 3 displays for Form C.
Analysis 10 treats 3 displays for Form F.

These items concern CRT display aspects

and involve within-form comparisons between the three displays: ID, TD1, and TD2.

Side-by-side presentation of the results for the two analyses permits easy comparison of the results for the two forms representing the first evaluation and the second evaluation.

Data are presented on 12 items repeated for 3 displays and 2 analyses.

ANALYSIS 9:

1. Post Training Survey, Form C, page 2, "First evaluation of interactive display" called "CI Interactive Display" herein.
2. Post Training Survey, Form C, page 2, "First evaluation of near tabular display" called "CN Near Tab Display" herein.
3. Post Training Survey, Form C, page 2, "First evaluation of far tabular display" called "CF Far Tab Display" herein.

ANALYSIS 10:

1. Wrap-Up Survey, Form F, page 2, "Second evaluation of interactive display" called "FI Interactive Display" herein.
2. Wrap-Up Survey, Form F, page 2, "Second evaluation of near tabular display" called "FN Near Tab Display" herein.
3. Wrap-Up Survey, Form F, page 2, "Second evaluation of far tabular display" called "CF Far Tab Display" herein.

ANALYSES 9 AND 10: RESULTS FOR TABULAR, MULTI-ITEM RATINGS (CONTINUED)

The items were rated on the following scale: Rate the various CRT display
aspects by checking the appropriate category.

7. Very Good
6. Good
5. Moderately Good
- (midscale) 4. Moderate
3. Moderately Poor
2. Poor
1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in the directions of "Very Good" and "Very Poor," respectively.

FORM 1) INTERACTIVE DISPLAY
 F1,001) 5664455564
 F1,002) 6622455476
 F1,003) 6644554476
 F1,004) 66219945476
 F1,005) 6621646655476
 F1,006) 72412244554
 F1,007) 6444234554
 F1,008) 592244
 F1,009) 592244
 F1,010) 592244
 F1,011) 592244
 F1,012) 592244

FORM 1) INTERACTIVE DISPLAY
 F1,001) I4555554
 F1,002) I4555554
 F1,003) I4555554
 F1,004) I4555554
 F1,005) I4555554
 F1,006) I4555554
 F1,007) I4555554
 F1,008) I4555554
 F1,009) I4555554
 F1,010) I4555554
 F1,011) I4555554
 F1,012) I4555554

FORM 2) NEAR TAB DISPLAY
 F2,001) FN664455554
 F2,002) 566445554
 F2,003) 664455554
 F2,004) 664455554
 F2,005) 455554445554
 F2,006) 455554445554
 F2,007) 455554445554
 F2,008) 455554445554
 F2,009) 455554445554
 F2,010) 455554445554
 F2,011) 455554445554
 F2,012) 455554445554

FORM 2) NEAR TAB DISPLAY
 F2,001) FN664455554
 F2,002) 566445554
 F2,003) 664455554
 F2,004) 664455554
 F2,005) 455554445554
 F2,006) 455554445554
 F2,007) 455554445554
 F2,008) 455554445554
 F2,009) 455554445554
 F2,010) 455554445554
 F2,011) 455554445554
 F2,012) 455554445554

FORM 3) DISPLAY
 F3,001) F45554445554
 F3,002) 45554445554
 F3,003) 664455544554
 F3,004) 664455544554
 F3,005) 45554445554
 F3,006) 45554445554
 F3,007) 45554445554
 F3,008) 45554445554
 F3,009) 45554445554
 F3,010) 45554445554
 F3,011) 45554445554
 F3,012) 45554445554

FORM 3) DISPLAY
 F3,001) F45554445554
 F3,002) 45554445554
 F3,003) 664455544554
 F3,004) 664455544554
 F3,005) 45554445554
 F3,006) 45554445554
 F3,007) 45554445554
 F3,008) 45554445554
 F3,009) 45554445554
 F3,010) 45554445554
 F3,011) 45554445554
 F3,012) 45554445554

FORM CI INTERACTIVE DISPLAY
 I:10 NO REFLECTNS CRT +3.888
 II:18 NO FINGERPRINTS +2.207
 III:18 NO ADJMT RANGE -1.276
 IV:18 NO PHOSPHOR ANGLE 1.151
 V:18 NO VIEWING SHARPNESS 1.140
 VI:18 NO HIGH LIGHT I/O 1.11
 VII:18 NO GEOMETRY 1.97
 VIII:18 NO BIL EFFECTVMS 0.75
 IX:18 NO VRAE STABLIITY 0.6
 X:18 NO IMAGE STABLIITY 0.6
 RANKS:5 SUME=21 ABOVE
 RESULT 8 ARE DIFFERENT, (P<=.05)
 FROM MIDS SCALE.

FORM CN NEAR DISPLAY
 I:4 NO GEOM STARPNESS 1.115
 II:2 NO REFLECTNS CRT +3.275
 III:12 NO VRAE STABLIITY +2.205
 IV:12 NO HIGH LIGHT I/O +2.204
 V:12 NO PHOSPHOR ANGLE 1.104
 VI:12 NO BIL EFFECTVMS 1.044
 VII:12 NO VRAE STABLIITY 1.045
 VIII:12 NO IMAGE STABLIITY 1.045
 IX:12 NO GEOM STARPNESS 1.045
 X:12 NO VIEWING SHARPNESS 1.045
 RANKS:5 SUME=21 ABOVE
 RESULT 8 ARE DIFFERENT, (P<=.05)
 FROM MIDS SCALE.

FORM CF FAR DISPLAY
 I:4 NO GEOM STARPNESS +3.888
 II:2 NO REFLECTNS CRT +2.207
 III:12 NO VRAE STABLIITY +2.207
 IV:12 NO HIGH LIGHT I/O 1.170
 V:12 NO PHOSPHOR ANGLE 1.147
 VI:12 NO BIL EFFECTVMS 1.144
 VII:12 NO VRAE STABLIITY 1.044
 VIII:12 NO IMAGE STABLIITY 1.044
 IX:12 NO GEOM STARPNESS 1.044
 X:12 NO VIEWING SHARPNESS 1.044
 RANKS:5 SUME=21 ABOVE
 RESULT 8 ARE DIFFERENT, (P<=.05)
 FROM MIDS SCALE.

KRUSKAL-WALLIS ANOV, H=0.4069069
 CHI SQ: 2 DF.

FORM FI INTERACTIVE DISPLAY
 I:10 NO REFLECTNS CRT +4.888
 II:18 NO FINGERPRINTS +2.207
 III:18 NO ADJMT RANGE -1.276
 IV:18 NO PHOSPHOR ANGLE 1.151
 V:18 NO VIEWING SHARPNESS 1.140
 VI:18 NO HIGH LIGHT I/O 1.11
 VII:18 NO GEOMETRY 1.97
 VIII:18 NO BIL EFFECTVMS 0.75
 IX:18 NO VRAE STABLIITY 0.6
 X:18 NO IMAGE STABLIITY 0.6
 RANKS:5 SUME=21 ABOVE
 RESULT 8 ARE DIFFERENT, (P<=.05)
 FROM MIDS SCALE.

FORM FN NEAR DISPLAY
 I:4 NO GEOM STARPNESS 5.888
 II:2 NO REFLECTNS CRT +4.888
 III:12 NO VRAE STABLIITY +3.888
 IV:12 NO HIGH LIGHT I/O +3.888
 V:12 NO PHOSPHOR ANGLE 3.888
 VI:12 NO BIL EFFECTVMS 3.888
 VII:12 NO VRAE STABLIITY 3.888
 VIII:12 NO IMAGE STABLIITY 3.888
 IX:12 NO GEOM STARPNESS 3.888
 X:12 NO VIEWING SHARPNESS 3.888
 RANKS:5 SUME=21 ABOVE
 RESULT 8 ARE DIFFERENT, (P<=.05)
 FROM MIDS SCALE.

FORM FF FAR DISPLAY
 I:4 NO GEOM STARPNESS 7.888
 II:2 NO REFLECTNS CRT +4.888
 III:12 NO VRAE STABLIITY +3.888
 IV:12 NO HIGH LIGHT I/O +3.888
 V:12 NO PHOSPHOR ANGLE 3.888
 VI:12 NO BIL EFFECTVMS 3.888
 VII:12 NO VRAE STABLIITY 3.888
 VIII:12 NO IMAGE STABLIITY 3.888
 IX:12 NO GEOM STARPNESS 3.888
 X:12 NO VIEWING SHARPNESS 3.888
 RANKS:5 SUME=21 ABOVE
 RESULT 8 ARE DIFFERENT, (P<=.05)
 FROM MIDS SCALE.

KRUSKAL-WALLIS ANOV, H=0.2888888
 CHI SQ: 2 DF.

ANALYSES 9 AND 10: DIFFERENCES INTERACTIVE, NEAR TABULAR, AND
FAR TABULAR DISPLAY ASPECTS
FORMS C AND F

ANALYSES 11 AND 12: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

Analysis 11 treats 3 displays for Form H, R-side.
Analysis 12 treats 3 displays for Form H, D-side.

These items concern CRT display aspects

and involve within-form comparisons between the three displays: ID, TD1, and TD2.

Side-by-side presentation of the results for the two analyses permits easy comparison of the results for the two forms representing R-side and D-side perspectives.

Data are presented on 13 items repeated for 3 displays and 2 analyses.

ANALYSIS 11:

1. Follow Up Survey, Form H, page 2, " R-side view of interactive display " called "RI Interact CRT, R-Side" herein.
2. Follow Up Survey, Form H, page 2, " R-side view of near tabular display " called "RN Near Tab CRT, R-Side" herein.
3. Follow Up Survey, Form H, page 2, " R-side view of far tabular display " called "RF Far Tab CRT, R-Side" herein.

ANALYSIS 12:

1. Follow Up Survey, Form H, page 2, " D-side view of interactive display " called "DI Interact CRT, D-Side" herein.
2. Follow Up Survey, Form H, page 2, " D-side view of near tabular display " called "DN Near Tab CRT, D-Side" herein.
3. Follow Up Survey, Form H, page 2, " D-Side view of far tabular display " called "DF Far Tab CRT, D-Side" herein.

ANALYSES 11 AND 12: RESULTS FOR TABULAR, MULTI-ITEM RATINGS (CONTINUED)

The items were rated on the following scale: Rate the various CRT display
aspects by checking the appropriate category.

- 7. Very Good
- 6. Good
- 5. Moderately Good
- (midscale) 4. Moderate
- 3. Moderately Poor
- 2. Poor
- 1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in the directions of "Very Good" and "Very Poor," respectively.


```

FORM I 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
R SIDE +2.75 +2.44 +2.44 +2.29 +2.07 +1.16 +1.00 +0.60
INTERACT CRT, OR D SIDE
PHOSPHOR COLOR VIZ
HIGH LIGHTING VIZ
IMAGE STRABILITY
INCE STRAIN
NO FENCE EY DISTRAIT
NO SECE EY DISTRAIT
NO GEOM EY DISTRAIT
NO ADJ M ANGLE
NO OR M ANGLE
UNIFOR M SHARPNES
CHARACT ERY SHARPNES
LEVA BILIT Y SHARPNES
LOVABLE I T Y SHARPNES
EFFECT UN S SHARPNES
NO REFLECT UN S SHARPNES
SUME=274 ABOVE, (P<=.05)
RESULTS NOT DIFFERENT
RANDOM MIDSCALE.

```

```

FORM R 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
R SIDE +2.75 +2.44 +2.44 +2.29 +2.07 +1.16 +1.00 +0.60
INTERACT CRT, OR R SIDE
PHOSPHOR COLOR VIZ
HIGH LIGHTING VIZ
IMAGE STRABILITY
INCE STRAIN
NO FENCE EY DISTRAIT
NO SECE EY DISTRAIT
NO GEOM EY DISTRAIT
NO ADJ M ANGLE
NO OR M ANGLE
UNIFOR M SHARPNES
CHARACT ERY SHARPNES
LEVA BILIT Y SHARPNES
LOVABLE I T Y SHARPNES
EFFECT UN S SHARPNES
NO REFLECT UN S SHARPNES
SUME=240 ABOVE, (P<=.05)
RESULTS NOT DIFFERENT
RANDOM MIDSCALE.

```

```

FORM D 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
D SIDE +4.71 +4.11 +4.11 +3.88 +3.68 +3.02 +2.76 +1.40
TAB ANGLE CRT, D SIDE

```

```

FORM N 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
N SIDE +3.45 +3.45 +3.45 +3.45 +3.45 +3.45 +3.45 +3.45
TAB ANGLE CRT, RY SIDE

```

```

FORM D 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
D SIDE +3.71 +3.11 +3.11 +2.88 +2.68 +2.02 +1.76 +1.40
TAB ANGLE CRT, D SIDE

```

```

FORM R 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
R SIDE +3.71 +3.11 +3.11 +2.88 +2.68 +2.02 +1.76 +1.40
TAB ANGLE CRT, RY SIDE

```

KRUSKAL-WALLIS ANOVA, H=13.733077
CHI 2 DF

KRUSKAL-WALLIS ANOVA, H=5.9993491
CHI 2 DF

ANALYSES 11 AND 12: DIFFERENCES
INTERACTIVE, NEAR TABULAR, AND FAR TABULAR DISPLAY ASPECTS
FORM H-, R-, AND D-SIDES

ANALYSIS 13: RESULTS FOR TABULAR, MULTI-ITEM RATINGS

These items concern ATC improvement potential for flight data handling concepts and involve within form comparisons between R-side and D-side viewpoints.

Data are presented on 43 items repeated for 2 points of view:

1. Follow Up Survey, Form H, page 6,7, "R-side view of concept potential" called "HR R Idea Potential" herein.
2. Follow Up Survey, Form H, page 6,7 "D-side view of concept potential" called "HD D Idea Potential" herein.

The items were rated on the following scale: Potential for ATC is

7. Very Good
6. Good
5. Moderately Good
- (midscale) 4. Moderate
3. Moderately Poor
2. Poor
1. Very Poor

Positive and negative t scores indicate significant deviation from "Moderate" in the directions of "Very Good" and "Very Poor," respectively.

ANALYSIS 13: DIFFERENCES
POTENTIAL OF CONCEPTS FOR ATC IMPROVEMENT

APPENDIX J

NARRATIVE ANSWERS TO FORM A
PRELIMINARY SURVEY

The following Form A questions required narrative answers:

Question 4.4 "Please list below any problems which you feel may exist for flight data handling in your present NAS facility."

Question 4.5 "Have you any suggestions as to how the above problems might be resolved?"

Question 5.23 Comments on Question 5: Expectations of the effect of ETABS on general ATC aspects

Form A was administered one time (10/4/82) on the first day after controller arrival, prior to training. Below are the responses to the three narrative questions.

CONTROLLER NO. 1

4.4 Present NAS Problems "Numerous fix postings, sometimes as high as five per aircraft, takes a lot of unnecessary time in my opinion; but, all controllers do not agree with my opinion. I feel that RDP reduces or eliminates the need for more than one strip per aircraft."

4.5 Recommended Fixes "RDP, as mentioned above, does resolve the problem, so controller education would be the next step."

CONTROLLER NO. 2

4.4 Present NAS Problems "FSP's are the major bottleneck in the NAS System - output is too slow; occasional slow response times."

4.5 Recommended Fixes "High Speed FSP's - centrally located in the aisle to serve all the sectors, manned by two assistant controllers: one stuffing and delivering strips, and one for relief."

CONTROLLER NO. 3

4.4 Present NAS Problems "Thru-put time is very slow. The overuse of PAR'S, PDR'S, and PDAR'S

4.5 Recommended Fixes Reduce thru-put time. Eliminate altitude shelves. More vector departures instead of spelled-out routes."

CONTROLLER NO. 4

4.4 Present NAS Problems "Breakdown of FSP's. Too many unneeded strips. Many inputs can only be made from the "D" computer input device. Slowness of the FSP "

4.5 Recommended Fixes. "Replace FSP. Modify the program to allow inputs for the "R" computer input device. Use a faster device."

CONTROLLER NO. 5

4.4 Present NAS Problems "Inadvertent throwing away of strips. Nonlogging of information; i.e., heading, revised altitudes, revised routes "

CONTROLLER NO. 6

4.4 Present NAS Problems "Breakdown of flight strip printer. Too many strips printed on same aircraft. A lot of input can only be done from "D" side

4.5 Recommended Fixes. "Replace the FSP. Modify the system so that input can be put in from the radar position as well as the "D" side."

CONTROLLER NO. 7

4.4 Present NAS Problems "The A men are not fast enough to assist the D or R man to enter information, therefore putting more work on the D and R man "

4.5 Recommended Fixes "More thorough training and requirements for assistants to assist."

CONTROLLER NO. 8

4.4 Present NAS Problems "(1) Too many strips generated. (2) Too much information on strips."

4.5 Recommended Fixes. "(1) One strip per sector. (2) Streamline information on strips."

CONTROLLER NO. 9

4.4 Present NAS Problems

1. "Poor condition of flight strip printers.
2. Poor to fair readability of flight data.
3. Not enough "land lines" for coordination.
4. Too restrictive in computer input."

4.5 Recommended Fixes.

1. "Electronic display. (for 1 above)
2. Electronic display (for 2 above)
3. If ETABS can reduce need for manual coord. GREAT!"

5.23 Other Comments "Hopefully. ETABS will be less restrictive in input format so that GI information will greatly increase and miskeying of input information will greatly decrease and maybe speed of inputting messages to the computer will increase. 'Queuing' inputs for flight plan or amendment data would reduce errors, and frustration and increase speed."

CONTROLLER NO. 10

4.4 Present NAS Problems "None noted."

4.5 Recommended Fixes "N/A"

APPENDIX K
NARRATIVE ANSWERS TO FORM B
DAILY TRAINING SURVEY (10-7-83)

The narrative answers to the last day (10-7-83) of training are provide below

1.0 After today's training session, can you think of any aids or procedures that could be utilized to help you learn ETABS?

CONTROLLER 1

- "No "

CONTROLLER 4

- "Visual of AIDS. "

CONTROLLER 7

- "Have a separate list for the R & D run with a script for that run thru. Example (1) Move data block (2) Change altitude etc. "

CONTROLLER 8

- "I didn't get an opportunity to work a position with pilot simulators. I think this is a very good technique. I think a simpler area instead of NYC sectors would be better. You need to devote time on the sector working ETABS rather than trying to recall or search for data on a new area. "

CONTROLLER 10

- "Utilize visual aids in the classroom. "

2.0 Below is the complete list of ETABS messages and data fields needed to input them. Please check any that give you special problems. A comment section is provided beside and after the list. Please explain all checks.

CONTROLLER 1

- "When an interim altitude is removed the "#" symbol appears on the data block indicating an interim altitude is still attached to flight plan. "

CONTROLLER 4

- "After doing a 6-7-10 amendment, the FDE was dropped from the TD & ID. "

- "The need for two inputs to remove the "T" is a waste of time.

- Did not get a chance to use this (conflict alert). The system failed "

CONTROLLER 7

- "If flight ID not in AIDS list, this became very difficult. "

CONTROLLER 8

- "Removing interim altitude is sometimes confusing. "

CONTROLLER 9

- "Several methods were attempted (unsuccessfully) on some aircraft for interim altitude deletion. Some were not difficult. In several instances, an entry on PVD did not update ETABS FDE. "

CONTROLLER 9

- "Had several instances where difficulty was experienced in H/O's.
- Could not drop some FDB's. Even where no difficulty was experienced, the process seems illogical (format). Requires, in addition, too many entries.
- Need OOO in menu (for altitude limits message). "

CONTROLLER 10

- "Did not attempt (coordination)
- Pilot time message not attempted.
- Did not attempt (progress report message).
- Did not attempt (hold message)
- Lengthy process to force data block to own sector "

2.12 Comments:

CONTROLLER 3

- "It appears to be impossible to remove interim alt. using your interactive display. Also see Run 2 controller 3 observer sheet. The entire display area for altitudes in your FDE are not straight-forward enough. You have to go searching for the info. and then check the FDB if you have one.
- There were many instances where we were being handed off aircraft but could not accept them, had to resort to keyboard. No FDE no H/O "

CONTROLLER 4

- "The system has far too many failures for use in ATC at this time. "

CONTROLLER 5

- "Today I observed and floated. I still believe that the interactive display is not necessary on the "R" position.
- From what I saw the people were becoming more familiar with the equipment and starting to experiment a little. However, compared with today's system some of the ETABS messages take too long to execute. "

CONTROLLER 6

- "Working the radar position and talking to airplanes. It was hard looking over the tabular display FDE to find a strip on an aircraft. Just as you find strip on aircraft to see aircraft's destinations, the tabular display shifts as automatic strip posting or D-side made a manual strip posting. Found it was easy to ring up AID on ID to find route of flights rather than looking at tabular display "

CONTROLLER 7

- "The ID KY/BRD characters are too small to read.
- When working the R-side it takes too much time to make entries with the ETABS.
- It is much faster to use the "slewball" and the enter key and is more accurate "

CONTROLLER 8

- "Requesting an FDE on an aircraft that you have no information was too time consuming. First you "FR" msge., then Req. FDE, then move the FDE to a fix postings from the information posting fix. Three separate functions - too many "

- When working D position, there is little time left to search for traffic conflicts or to observe PVD due to complexity of functions of ETABS. This will improve with practice. More accurate assessment at a later date."

CONTROLLER 9

- "The ETABS ID is attention intensive-requires too many operations to be efficient, and touch display is too inaccurate to be effective
- To be max effective the ID device should not distract from radar scope OR controllers board
- A light pen seems (still) best way to operate.
- The FDE's displayed are getting much easier to identify, read, and use
- Need more tailoring in various levels so destination is never lost from display."

CONTROLLER 10

- "The format used to receive the desired results is complex and lengthy compared to our system today. Perhaps it would be possible to examine and research the possibility of combining our present utilization of the QAK and ANK system with the tabular display. If the touch entry is desired, this could be achieved by having the QAK and ANK presented on the ID which would use our message entry sequences as use in today's system."

3 0 Please evaluate the ease or difficulty you experienced today in learning or using the following aspects of the ETABS Simulation. Check one box for each aspect. Use NA if not covered in today's training

3 13 COMMENTS:

CONTROLLER 3

- "Very definite problem with slow response times with regards to message input. Four messages were input with no response except message being processed. I then started getting error message's with no way of correcting them "

CONTROLLER 4

- "Don't always understand the characters and placement of characters.
- The altitude box becomes confusing after an interim altitude has been used."

CONTROLLER 6

- "System went down several times today "

CONTROLLER 8

- "Touch entry technique can be very frustrating "

CONTROLLER 9

- "The simulation had pilot problems. ETABS "bombed" several times, ect
- ID message entry sequence was too lengthy
- TD non-FDE info formats - too lengthy
- ID touch entry technique - inaccurate.
- ETABS control of PVD functions - too lengthy."

S 1 Please estimate your present skill level in using ETABS. (Check One)

S 2 Comments (if any):

CONTROLLER 8

- "The touch technique is too cumbersome. Much time is wasted either reentering or attempting to locate exact character position for entry. Each character seems to have a touch position different from other characters on the interactive (Some you hit low, others high, etc.) No continuity. Tabular display concept is excellent. Consider possibly TD w/track ball or other method. Touch technique may still work but with greater refinement."

APPENDIX L

NARRATIVE ANSWERS TO FORM C
POST TRAINING QUESTIONNAIRE

Form C (Post Training questionnaire) was given at the end of the last training day. These same questions were later repeated in the Wrap Up questionnaire for comparison (Form F, question 1.14). Most questions in it were multiple rating scales. However, one question (1.14) asked for comments on the ratings for human factors aspects of ETABS. Four controllers replied. Their comments are given below.

1.14 Comments:

CONTROLLER 1

"Touch screen data entry seems to be a good system; however, this model is too sensitive and too easy to enter or insert wrong data. Also, the interactive device at the R-position takes up a lot of space on the console shelf and is not really an asset to R-controller."

CONTROLLER 4

"The repositioning, of the AID's in the ID causes you to misshit the AID's "

CONTROLLER 5

"The interactive device is too time consuming to do all the different messages. Perhaps incorporating a touch device within the tabular display would be better."

CONTROLLER 9

1. With the addition of field delimiters (lines), the FDE's would be much better.
2. Generally, every function requires too many steps. Some logic in steps seems backwards. Very inefficient.
3. As far as the overall quality and quantity of operations, as compared to the old system, ETABS is superior. It is just inefficient yet. It is flexible (generally)."

APPENDIX M

NARRATIVE ANSWERS TO FORM D
POST FAMILIARIZATION

The three questions which required or allowed narrative comments for form D are listed below:

Question 1.10 "Comments" on simulation realism aspects.

Question 1.11 "What would you change to improve the realism of the simulation?"

Question 2 "Comments" on problems vs benefits of ETABS features.

Form D was administered twice; once after the first three runs (10/14/82) and once after the last three runs (10/20/82). The narrative comments or answers are listed per subject per date below.

CONTROLLER NO. 1

Question 1.11 Realism recommendations

10/14 - "During the runs we've had, the traffic was very light, not at all like traffic that's handled at most centers. It is difficult to give a valid evaluation without being exposed to peak traffic as well as light traffic. I never saw what I consider peak traffic during the evaluation."

10/20 - "Eliminate interactive display at R-position. It much more of a hindrance to R-controller than present system."

Question 2.1 ETABS problems/benefits

- 10/20 - Automatic posting - "As seen, it can be compared to 'A-man' posting present strips (a no-no)."
- Manual posting - "More benefits than auto posting but equal to present system"
 - Automatic updates - "Same as automatic posting"
 - Reliability of ETABS - "The concept of ETABS should, with proper adaptation and hardware, enhance the flight data handling of the ATC system."

CONTROLLER NO. 2

Question 1.11 Realism recommendations

10/14 - "Have the system be much more reliable. It's hard to evaluate the simulation with so many interruptions - probably (needs) more traffic and a guideline to standardize sector requirements."

10/20 - "There should be considerably more traffic."

Question 2.1 ETABS problems/benefits

- 10/14 - Speed of data handling - the concept = more benefits
as tested = more problems
- Reliability of data handling - the concept = more benefits
as tested = more problems
- 10/20 - Second tabular display - "Prefer one tabular display with two or more columns" - Automatic and manual posting and updating - "All have more benefits - not necessary one over the other though. It would depend on the sector traffic requirements."

CONTROLLER NO. 3

Question 1.10 Realism aspects

10/20 - "Too few airplanes for sector 18."

Question 1.11 Realism recommendations

- 10/14 - "Different traffic sample More planes "
- 10/20 - "There should be considerably more traffic "

Question 2.1 ETABS problems/benefits

- 10/14 - Touch entry - "Not as positive input as keyboard entry."
- Second tabular display - "Stretching the limits of your eyesight."
 - Automatic posting - "Information is posted without your knowledge."
 - ETABS speed - "Many communications problems."
 - ETABS reliability - "Information appears to be dropped with communication transfers."
- 10/20 - Touch entry - "I do not consider ETABS touch entry "
- Touch updating - "I do not consider ETABS touch entry "
 - Second tabular - "Too far from radar controller."
 - Automatic posting - "Not aware of what was placed in your bay."
 - Automatic updates - "Same as automatic posting."
 - ETABS speed - "Too many comm. problems."
 - ETABS reliability - "Very questionable at this time. Has a long way to go."

CONTROLLER NO. 4

Question 1.10 Realism aspects

- 10/20 - "The physical layout could be improved by placing the TD's on a swivel and eliminating the ID from the R position."

Question 2.1 ETABS problems/benefits

- 10/14 - Touch entry - "Must be precise with your touch, and takes more actions to enter messages "
- Second tabular display - "Not enough space for present-day sectors "
 - Automatic posting - "Does not give you the opportunity to look at each new posted strip."
 - Manual posting - "Requires two actions to display an FDE."
 - Automatic updating - "May miss information."
 - Manual updating - "Requires two actions to display an update."
 - Handoffs - "Requires three actions."
 - Highlighting techniques - "Not sure yet."
 - ETABS speed - "The system is not stable enough to tell."
 - ETABS reliability - "System not stable."
- 10/20 - Touch entry - "Too much attention required to touch the precise items."
- Touch updating - "With modifications benefits would be a plus."
 - Automatic posting - "Does not allow scanning of new postings."
 - Manual posting - "Should eliminate the acknowledge requirement "
 - Automatic updates - "May be missed completely "
 - Manual updates - "Should add an audible alarm."
 - Handoffs - "Should give you the option to accept with one touch "
 - ETABS speed - "Provided the system does not fail "
 - ETABS reliability - "The concept, not the present system."

CONTROLLER NO. 5

Question 1.10 Realism aspects

- 10/14 - "The actual readbacks are unreal. The aircraft climb and descend unrealistically. Some request for route changes should be included."

Question 1.11 Realism recommendations

- 10/20 - "Increase the amount of traffic. Also eliminate the New York adaptation and adapt Aero Center "

Question 2.1 ETABS problems/benefits

- 10/14 - Touch entry - "Too unreliable "
- ETABS speed - (Checked more problems) "This is for the interactive device."
- 10/20 - Manual posting - "Able to keep a better traffic picture."

CONTROLLER NO. 6

Question 2.1 ETABS problems/benefits

- 10/20 - Second tabular display - "If you can read it from the R position."

CONTROLLER NO. 7

Question 1.11 Realism recommendation

- 10/14 - "Increase the traffic about 100% "
- 10/20 - "Increase traffic and communications between R and D man."

Question 2.1 ETABS problems/benefits

- 10/20 - Electronic strip - "Format on FDE must be changed to a lesser amount of information."
- Touch entry - More benefits "Except for a keyboard menu."
 - Second tabular display - "Too far away to be usable by R man."
 - Automatic posting - "Unless there is a way to identify the FDE, this should not be used."
 - Automatic updates - Same as automatic posting.
 - Handoffs - "Needs to cut down to one entry like the slewball."
 - ETABS speed - "Takes too many entries which takes time."

CONTROLLER NO. 8

Question 1.10 Realism aspect

- 10/14 - "Problems with the computer made the simulation unrealistic."
10/20 - "The problems with the computer reduced the realism."

Question 1.11 Realism recommendations

- 10/14 - "Improve computer capability, introduce route changes, etc. (requested by pilots)."
10/20 - "The simulation needs more aircraft, route and altitude requests by the pilot. It also needs coordination between controllers to provide more realism in the area of normal sector activity."

Question 2.1 ETABS problems/benefits

- 10/14 - Touch entry - "Requires too much attention."
- Second tabular display - "Needs to be able to hold more FDE's."
- Automatic posting - "Entries in TD made and controller has no knowledge."
- Automatic updates - "Entries and revisions made and controller has no knowledge."
- ETABS speed - "Too slow (response time)."
- ETABS reliability - "Cannot really make an honest evaluation."
10/20 - Touch entry - "Concept only, not this equipment."
- Second tabular display - "visibility is poor."
- Manual posting - "No indication (light, etc.) when post or updates appear."
- Manual updates - "Same as manual posting."
- Handoffs - "More steps needed to make RHD's."
- ETABS reliability - "Cannot judge due to unreliability of computer."

CONTROLLER NO. 9

Question 1.10 Realism aspects

- 10/20 - "A direct comparison (ETABS vs NAS) on a one-to-one comparison would be greatly beneficial."

Question 1.11 Realism recommendation

10/14 - "Find some loud printers and DSS people to shout "

10/20 - Probably not much, further realism might be detracting and not beneficial in the slightest."

Question 2.1 ETABS problems/benefits

10/14 - Reading ETABS strips - "With delineation lines and the right adaptation it would be many more benefits instead of slightly more problems "

- Highlighting techniques - "With proper adaptation etc., it would be" (many more benefits instead of slightly more benefits).

- ETABS speed - "Assuming proper response time" (many more benefits).

- ETABS reliability - "As tested" (many more problems instead of envisioned more benefits).

10/20 - Reading ETABS strips - "With a few modifications, electronics could be beneficial "

- Touch entry - "Finger placement and movement is too critical and difficult to replace KBD Touch data entry is predicted to only enhance keyboard entries (supplement) never supplant; mainly through menu usage, never individual inputs "

- Touch updating - "With a streamlined and automatic mark-adapted system it would be beneficial. "

- Second tabular display - "TD2 is necessary for information strips, proposals, departures, etc. "(NOT OPTIONAL)"

- Automatic posting - "Assuming, of course, they are timely and accurate. not as demonstrated. "

- Manual posting - "Faster than printed but not fast enough. "

- Automatic updates - "Great for one man operations "

- Manual updates - "Faster than printed, but not fast enough for one man. "

- Handoffs - "Projected minimal benefits without major progress and modification. "

- Computerized recordkeeping - "It would be done and be done more accurately 90% of the time. "

- Highlighting Techniques - "Printed strips cannot flash, DBLBRT, ULINE, etc. "

- ETABS speed - "With the correct electronic processing, many more benefits. "

- ETABS reliability - "As demonstrated. . ." (many more problems.)

CONTROLLER NO. 10

Question 1.11 Realism recommendations

10/14 - "Make sure all the jacks work - be able to coordinate with other sectors using 300 system - make the training sector an "Aero Center sector - have the sectors depicted on PVD. "

10/20 - "More traffic - utilize an Aero Center sector - depict the sector boundary on PVD. "

APPENDIX N

NARRATIVE ANSWERS TO THE
POST RUN QUESTIONNAIRE, FORM E

The Post Run Questionnaire, form E, was administered on six separate days (October 12, 14, 15, 18, 19, and 20). The first 5 days had two runs each, and the last day had one run. Form E was administered once per run to each of the 6 controllers who were participating at the time.

Form E consists of nine questions, each of which were commented upon by the controller subjects. Below is a summary of the questions by number as they appear in form E.

- 1.2 Comment on your present knowledge of ETABS.
- 1.4 Comment on your present skill in using ETABS.
- 2.18 Comment on any highly rated workload aspects present in the run
- 3.1 Comment on response delays
- 4.1 List any problems with ETABS not mentioned elsewhere.
- 5.1 List any problems with the ATC simulation.
- 6.1 Rate the overall workload.
- 7.2 Comment on traffic density of run.
- 8.2 Comment on task demand of run.
- 9.2 Comment on ETABS contribution to ATC performance.

The following is a compilation of comments per question which chronologically documents the narrative answers to the form E questions. The questions themselves are boxed.

1.1 Please estimate your present level of knowledge of ETABS.
(Check one)

- very high
- high
- moderately high
- moderate
- moderately low
- low
- very low

1.2 COMMENTS (if any)

10-12-82 RUN 1

CONTROLLER 1 - "Exposure time has been slight due to program outages."

CONTROLLER 2 - "This would be higher if there was more traffic in sector 18. Actually, we should rotate thru all of the sectors."

1 3 Please estimate your present skill level in using ETABS. (Check one)

_____ very high
_____ high
_____ moderately high
_____ moderate
_____ moderate low
_____ low
_____ very low

1 4 COMMENTS (if any):

10-12-82 RUN 2

CONTROLLER 5 - "It is hard to improve with the system being unreliable."

10-14-82 RUN 2

CONTROLLER 6 - "No input due to ETABS being down. Worked NAS to support other sectors."

10-19-82 RUN 1

CONTROLLER 5 - "Today was the first time the system worked without failing. It worked well."

2.18 In the above question on aspects contributing to workload, if you rated the contribution to workload of any aspect "MODERATELY HIGH" or higher, please briefly state why below.

10-12-82 RUN 1

CONTROLLER 1 - "The FDE's on the TD are set up different from today's flight progress strip. So, having to scan the info to find particular info creates more workload. Also unfamiliarity with ETABS in general, along with having to make more entries than when using RDP keyboard /Ok, creates more workload. More time should reduce this workload as well as learning geography. ETABS does require more attention away from PVD than today's system, having to be precise as to placing your finger correctly to make the correct entry."

- CONTROLLER 2 - "Format seems to disrupt the natural flow of the thought process for entering a flight plan (As we know it now) Also, it seems too difficult to correct an error while entering the flight plan. With the FDE's moving about and the controller not physically making the entries, it is harder to keep the "picture" - FDE format re-arrangement might correct this (Strip marking workload is rated moderately high), mainly the location of the symbols and notes in the FDE - that is if they relate to altitude and are located near the route."
- CONTROLLER 4 - "The tabular display is slightly recessed. It seems to take an extra effort or movement to see the FDE. It is also difficult to pick out a specific flight plan when the TD is full. (Entering new flight plans.) requires too much attention and too many actions to enter a flight plan Unless the (strip marking) entry is made within two minutes after the H/C, you lose the FDE."
- CONTROLLER 5 - "Took too much concentration to complete the actions." (Most ETABS functions)
- CONTROLLER 7 - "I am not completely familiar with the sector configuration yet, and the menu formats/sequences I have not quite learned yet."
- CONTROLLER 8 - "Touch entry device requires too much attention "

10-12-82 RUN 2

- CONTROLLER 3 - "Too many altitudes being displayed in the altitude area and not being kept current.
- Unreliable system
 - Location of data is not easily discernible.
 - Data moves on you while your selecting an AID to access. I do not consider this a touch system because of the action of the lights.
 - Whenever you call up information on a flight, the prominent information is the menus and not the flight your working. The response area is buried in the upper left corner and very difficult to see.
 - The characters on the ID are very small and sometimes unreadable "
- CONTROLLER 8 - "Touch technique requires too much attention to insure that you touch the right spot. Keyboard is much faster."
- CONTROLLER 9 - "Entering of messages is lengthy and redundant (using the present formats). The ID requires so much attention that it is nearly impossible to be aware of what the radar person is doing or to be attentive to the separation responsibility of the manual person. Eyestrain is tremendous when trying to watch the TD or ID when the strip postings are continually updating and changing positions. Due to the attention that the ID requires, it is difficult to visual where the traffic is "

10-14-82 RUN 1

- CONTROLLER 2 - "FP format still hard to use - it is difficult to get out of an error situation (i.e., back to your menus) "
- CONTROLLER 3 - "(Simulation) not realistic enough for comprehensive evaluation.
- The touch system is too restricting."
- CONTROLLER 5 - "Not familiar with procedures for area. Reading the strips is a little hard only because not sure where to locate FDE for fix posting."
- CONTROLLER 6 - "The ETABS has been up and down so much at this sector. You get a format to go one day and the next day the same format will not work. I spent most of this problem talking to the Director. He wanted to know what I thought about ETABS and I told him. Some of the message would work at the other sectors."
- CONTROLLER 8 - "Too many actions required to perform one function. ID requires too much attention. ID FDE's hard to read."
- CONTROLLER 9 - "ETABS requires 4 or 5 times as many entries as the old method. It is innately slow and inflexible. It is relatively uncomplicated to learn but terribly complicated to use. The run just completed would be no challenge for any but the very newest ATC specialist. However, ETABS makes it unbearable. It is a shame that someone took a fine (concept) system and made it practically unusable."

10-15-82 RUN 1

- CONTROLLER 1 - "The interactive display at the R-position is attention sensitive (requires too much attention to make entries) and requires R-controller to look away from PVD. It also is slower than present RDP operation because of having numerous entries from aid list, menus, etc. The touch sensitive area for entering information sometimes requires the controller to make entry 2, 3 or 4 times to enter the desired information, where present system normally requires depressing entry button no more than once."
- CONTROLLERS 10/2 - "Message entries are lengthy. The TD is hard to read - It is difficult to seek out information immediately off of the TD. The ID requires visual attentiveness at all times. The ID diverts attention from the TD and from working together with the radar man. The ID is error-prone due to the accuracy that must be exhibited when selecting menu's, characters, etc., on the ID. This system is much more complex and inefficient compared to our present NAS system. The concept of ETABS is excellent but must be redesigned with considerable more thought given to the operational application of this system."

10-15-82 RUN 1

- CONTROLLER 4 - "Used only the present NAS system due to failure of equipment "
- CONTROLLER 7 - "From the R position, the ID takes away from the radar scope because you have to search thru the AID list to find the A/C call sign. All of this while it is blinking and changing positions. "
- CONTROLLER 9 - "Hard to maintain mental picture from D due to attention draw of ETABS
- Entries (are) too time consuming "

10-15-82 RUN 2

- CONTROLLER 3 - "Requesting FDE on a flight your working without one (increase workload)
- I am still having trouble hitting touch points.
- Operating in the manual post, manual update mode you have control of the board, but it is a little confusing. Whenever we have proposals and they get off, we get, I believe, an update message, a delete message, and a post message. I believe we only need one message that he's off and running.
- System does not appear to have been tested to see what it is capable of prior to our arrival, based on some of the answer I received in the lab. "
- CONTROLLER 4 - "Distance from control position and distinguishing each FDE - (contributed moderately high workload.)
- The ID seemed to be out of sync. It required hitting above each entry; too much precision is required for each entry.
- Too many steps (to enter new flight plan).
- Today the response was too slow or not at all. "
- CONTROLLER 7 - "Slow response times and takes too much time away from the radar. "

10-18-82 RUN 1

- CONTROLLER 3 - "It is faster to use manual keyboard than menu and electronic keyboard "
- CONTROLLER 4 - "Same problems - Too much precision required (for ID entries).
- Requires too many entries to enter new flight plan. "
- CONTROLLER 6 - "Due to problems at the O2 sector, the O2 sector was moved to another sector. In order to see the traffic at the new sector, sector O2 had to be quick-looked. The ID at the new sector was not performing correctly so the ANK at the radar position had to be utilized frequently. This situation caused the new sector to have double data blocks on many of the aircraft. When we requested a route readout utilizing ETABS, we had to look across the aisle to the O2 sector in order to see the route displayed.

- The TD is difficult to see from the "R" position and because of the format used to display information on the TD it is quite difficult to locate specific information readily.
- The ID was not calibrated correctly. It was necessary to hit high on the action desired, which in some instances caused errors. Many times action was taken on the ID and there would be no response or OO would appear in the response area or we would receive an accept, but the desired result to our action was not displayed many times.
- The present ETAB system requires too much attention to be devoted to the ID. The message formats are lengthy and unnecessary. This system is much more time consuming than the system used in the field today and in its present form is more error-prone (due to character size, calibration etc.).

CONTROLLER 9 - "Too many steps to complete one function."

10-18-82 RUN 2

CONTROLLER 4 - "The movement of data is hard to keep up with in the automatic mode on the TD. When the "D" position is acknowledging posting for the FDE, the AID's in the ID are hard to keep up with.

- The information on the TD would be easier to read if the display was turned toward the "R" position just slightly. Maybe placed on a swivel."

CONTROLLER 5 - "Not used to aircraft movement in sector.

- Interactive display is too attention requiring."

CONTROLLER 8 - "When ETABS is in manual sort mode, too much time is spent posting and updating; very little time for looking for traffic in the FDE's. Difficulty in maintaining mental picture of traffic due to lack of time.

- Touch technique still difficult, needs refinement; larger letters and reduce attention required to operate it."

10-19-82 RUN 1

CONTROLLER 6 - "Today was the best that Coyle sector has worked since we have been here "

CONTROLLER 8 - "Formats too time consuming. Also, even with more experience, entry device requires too much attention. Formats and menus need to be simplified. Too much information exhibited "

10-19-82 RUN 1

CONTROLLERS 9/10 - "3 problems:

- (1) Too busy watching for posting and updates to pay close attention.
- (2) Unable to relocate headings (postings) manually to facilitate manual separation
- (3) Format of individual FDE's makes direction and route of flight difficult to determine."

- Lengthy formats and too redundant
- (Touch entry is) error prone and finger placement too critical.
- (ETABS man has) too many steps and the sequence is different for each function.
- (Modifying flight strips is) not flexible enough, too difficult to modify and too slow."

10-19-82 RUN 2

CONTROLLERS 9/10 - "Comments are the same as noted on RUN #1 10/19/82."

10-20-82 RUN 1

CONTROLLER 4 - "It is very difficult and seems impossible at times to request an FDE for your ID on an ACFT that is in your control using the ID "

CONTROLLERS 7/10 - "Same comments as recorded on RUN 1 dated 7/19/82, #9 controller.

- Again, quite difficult to give a fair evaluation of ETABS when the system was down (function tied off) for the majority of the run. During majority of run utilized the OAK, ANK, and NAS system.
- The concept of ETABS is excellent, but this particular system is inflexible, inefficient, and is too error-prone for the field today "

CONTROLLER 8 - "Interactive requires too much attention, leaves little time for traffic picture to be maintained "

3.1 For this run, how would you rate typical system response delays?
(Check one.)

- acceptable, very short
- acceptable, short.
- acceptable, moderately short.
- marginal, moderate.
- unacceptable, moderately long.
- unacceptable, long.
- unacceptable, very long.

10-12-82 RUN 1

CONTROLLER 1 - "Some responses take longer than desired, but I believe these responses would be less than 25%."

CONTROLLER 4 - "We experienced too many lockouts of the ETABS. The ID response lags behind the update of the data block."

10-19-82 RUN 1

CONTROLLERS 7/10 - "Much better today."

4.1 Please list below any other problems (Not mentioned elsewhere) which you may have had with anything involving ETABS.

10-12-82 RUN 1

CONTROLLER 1 - "TD-2 is very hard to see from R position. It should be turned somehow towards R controller. Fix postings should be able to be transferred from one TD to the other."

CONTROLLER 4 - "The FDE drops from the TD before the FDB leaves my sector airspace. This then requires numerous entries to suppress the FDB. This could be corrected if the AID remained in the ID list until the FDB was suppressed."

CONTROLLER 5 - "The interactive device did not work for most of the run"

CONTROLLER 7 - "The continuous flops created a problem by erasing our ID and TD's."

CONTROLLER 8 - "Too many computer problems."

10-12-82 RUN 2

CONTROLLER 3 - "Conflict alert, Run 2, VV2E030, N1868M. These two a/c were in conflict. I suppressed the conflict with group suppress new group. It stopped blinking and I got group/sector 01 with no AID's on the PVD. It also did not delete the C in the VA field on one other group."

CONTROLLER 5 - "The system is presently unreliable and it is hard to make an objective judgement."

CONTROLLER 8 - "Computer problems needed to be corrected"

10-14-82 RUN 1

CONTROLLER 3 - "We are still having a problem requesting an FDE for a particular flight we do not have. It seems to be a hit or miss situation. It worked once, but I could not do it a second time. The SR message works fine."

CONTROLLER 9 - "ETABS makes entries so time consuming and complicated (tedious) that it makes observing radar (etc.) almost impossible."

10-14-82 RUN 2

CONTROLLER 1 - "I had problems right towards the end of the problem removing FDE's from TD. No response in response, but interactive display indicated message was being processed. FDE's never were removed from TD"

CONTROLLER 4 - "The TD display has two listed fix's. It requires two separate actions to mark a field on the same ACFT, such as checking the altitude. It should be checked on both FDE's. Had an interface problem. We were able to accept handoffs and change altitudes in the FDB on the PVD, but the ID did not receive an accept message, and the FDE's were not updated."

10-15-82 RUN 1

CONTROLLER 1 - "Whenever an update or note is added to a particular FDE, that information should be placed on all FDE's pertaining to that flight; e.g., "R" for radar contract or a " " for level altitude. You shouldn't have to make a separate entry for each fix posting (sometimes three or four FPA's)."

CONTROLLERS 10/2 "Presently, it is necessary to place an "R" for radar contact by each AID under each bay posting that the flight appears. This function should be automatically performed by the computer after the controller has entered the "R" on the 1st strip."

CONTROLLER 5 - "This run had the "D" position located across the aisle from the "R" position so it was very inconvenient."

CONTROLLER 7 - "It took several touches before the ETABS would respond when entering information."

10-15-82 RUN 2

CONTROLLER 3 - "While entering a flight plan I received an internal set error. What does that mean? On a number of occasions I got accepts for messages without any resultant outputs. The reason, I was told, that I did not get info was data base errors in CEG. If the machine is not going to perform the task please inform me."

CONTROLLER 4 - "If you have FDE's for two fix lists, any mark should be placed on both entries. If the altitude has been marked with a check, the check should be removed when a new altitude is assigned. When an interim altitude is removed from the FDB, it should be removed from the FDE."

CONTROLLER 5 - "Getting handoffs on the PVD, but the aircraft ID was not in the interactive display. Also sometimes the aircraft ID is there but it is not indicating in hand-off status, so you're not able to accept the handoff."

10-18-82 RUN 1

CONTROLLER 1 - "Unable to remove interim altitude for FDE. Using interim altitude delete on the interactive display removes the interim altitude on FDB, but not on FDE."

CONTROLLER 3 - "In attempting to suppress a group for group suppress I got into a field 7 error format response."

10-18-82 RUN 2

CONTROLLER 2 - "I thought you could move all FDE's from one posting area to another sector - if so I could not do it."

CONTROLLER 4 - "This was the most successful run as far as system break-down. Sector 2 workload is made heavier by the physical location and the problems this creates. The precision required to hit the right information on the ID requires too much focus of attention away from the PVD (traffic) "

10-19-82 RUN 1

CONTROLLER 2 - "The preferential route (DBLB RTE) remains brite after issuing - it should be on/off so after issuance you could set it off/normal brite. "

CONTROLLER 3 - "When field 10 is highlighted in DBL brightness, how do you show the route has been issued? We now check it. "

CONTROLLER 5 - "Parallax with interactive display. "

CONTROLLERS 9/10 "There is no adaptation made for a "6-7-10" amendment (Fix-time-route of flight). This is a very important function that deserves special consideration!"

10-20-82 RUN 1

CONTROLLER 1 - "This run wasn't reliable after first 7-8 minutes. "

CONTROLLER 4 - "When we had a start over, all previously entered control symbols from the mark menu were lost from the FDE. "

5.1 Please list below any problems which you may have had with the ATC simulation.

10-12-82 RUN 1

CONTROLLER 2 - "Sector 18 SIM has not been very good, too much failure time and erroneous tracks (FDB (appeared on radar) but the aircraft was still proposed. "

10-12-82 RUN 2

CONTROLLER 9 - "Sector configuration should be depicted on the PVD. "

10-14-82 RUN 1

CONTROLLER 8 - "Too many computer problems"

10-15-82 RUN 1

CONTROLLERS 10/2 "Sector's outline should be depicted on the PVD. "

CONTROLLER 4 - "Noise level due to the hook up we used with the D man with ETABS on one side of the room overriding the R man on the other side. "

CONTROLLER 9 - "Not notified of using sim tape. Aircraft could not turn or change altitudes. "

10-18-82 RUN 2

CONTROLLER 8 - "Need different runs with gradual increase in traffic load Same aircraft and traffic problems becomes boring "

10-19-82 RUN 1

CONTROLLER 2 - "Cannot take handoff without FDE. "

CONTROLLER 5 - "Other sectors not being familiar with their airspace and controlling aircraft in someone else's airspace. "

CONTROLLER 8 - "This run was a little better than previous ones. Run at this point should have more aircraft. "

6.1 Please rate your workload in the run just completed. Use the scale of one to ten below. Circle the number most closely matching your overall workload.

1	2	3	4	5	6	7	8	9	10
LOWEST								HIGHEST	

10-14-82 RUN 1

CONTROLLER 9 - (Circle 8) "Mostly due to cumbersome input of information "

10-15-82 RUN 1

CONTROLLERS 10/2 "Difficult to rate workload as the ETABS system was constantly going up and down. Rated the workload today a 6 due to the fact that I would have to scramble and catch up on my postings when ETABS would come back up and considering the fact that traffic actually handled was very light. "

10-20-82 RUN 1

CONTROLLERS 7/10 "Workload was rated low due to the fact that ETABS was tied off for the majority of the run, and so the GAK, ANK, and NAS system was utilized. "

7.1 In the run just completed, how would you rate the amount of traffic handled in comparison to average traffic at your own facility position. Nonactive controller mark N/A. (Check one.)

- much greater than average
- greater than average
- slightly greater than average
- the same
- slightly less than average
- less than average
- much less than average

7.2 COMMENTS (if any): _____

10-14-82 RUN 1

CONTROLLER 9 - "Even being in "new" airspace, the problem itself is a snap "

10-15-82 RUN 2

CONTROLLER 3 - "Most of my time was consumed by trying to get FDE's on flights we did not have any on."

B.1 Please complete the following statement. "On the run just completed I felt that I was _____ the ATC task demand." (Check one)

- _____ way ahead of
- _____ ahead of
- _____ slightly ahead of
- _____ just keeping up with
- _____ slightly behind
- _____ behind
- _____ way behind

B.2 COMMENTS (if any): _____

10-12-82 RUN 1

CONTROLLER 4 - "Ahead of, except at times we lost our interface, between ETABS and CCC "

CONTROLLER 5 - "It was hard to correlate the action necessary to take with the ATC action."

10-14-82 RUN 1

CONTROLLER 5 - (Check #2) "Not because of ETABS but because of lack of traffic."

CONTROLLER 9 - "ETABS is slow."

10-15-82 RUN 2

CONTROLLER 3 - "FDE problems Also I would get accept messages on SR messages with no strip delivered."

9.1 On the run just completed, how would you rate the contribution of ETABS to the performance of your ATC job? (Check one)

- a great help
- a help
- a slight help
- neutral
- a slight hindrance
- a hindrance
- a great hindrance

9.2 COMMENTS (if any)

10-12-82 RUN 1

CONTROLLER 4 - "In general, it requires more entries to accomplish the same results, and it requires more concentration on the ID"

CONTROLLER 5 - "It takes too long to do some of the actions."

CONTROLLER 7 - "When I get behind using ETABS I just moved the "slew ball" and made one entry. Using the ETABS took five separate actions to drop a data block when the AID was not in the AIDS list."

10-12-82 RUN 2

CONTROLLER 5 - "It takes too much attention to operate the interactive device."

10-14-82 RUN 1

CONTROLLER 3 - "I did not have to post any strips."

CONTROLLER 5 - "ETABS did not make a difference for running traffic; however, it did hinder keeping the data base updated timely."

CONTROLLER 9 - "When do we get to make positive inputs? This system has great potential. How did it get so slow (disregarding intolerable response times)? It has most features conceivable and apparently tremendous potential, yet someone has made it intolerably slow. I would greatly enjoy working heavy traffic (as a test) with this system if it had a reasonable means of inputting and manipulating information. I equate this system to putting a lawn-mower engine in a Rolls Royce."

10-14-82 RUN 2

- CONTROLLER 4 - "The ETABS display of data is a big help, it eliminates the requirement for having strips torn and stuffed."
CONTROLLER 9 - "If only a methods or industrial engineer had worked on the project at Sanders ..."

10-15-82 RUN 2

- CONTROLLER 5 - "No significant advantage to having ETABS."
CONTROLLER 7 - "It is definitely a hindrance to the radar controller because of the time consuming entries."

10-15-82 RUN 2

- CONTROLLER 3 - "Makes it nearly an impossible task to manage a board if you are not given all the tools, namely FDE's "
- "I could not get a straight answer why we have both proposed and active FP. They both do the same task, and one could be eliminated. Also when you're working with this field, you get in the center of the screen new flight plans or stereo plans. It appears to be asking you a question but does not want an answer. The question does not make any sense whatsoever."
No-AID
Proposed FP
Active FP
Stereo FP
CONTROLLER 4 - "Too many equipment failures to give a true evaluation."
CONTROLLER 5 - "Even though I feel I know ETABS better now, I still think the interactive device is too attention oriented, which is bad for the radar man. I like the concept of electronic strips."

10-18-82 RUN 1

- CONTROLLER 1 - "Unfamiliarity (lack of usefull practice) contributes to the above answer, but entering info and slower response times than present system also adds to the problem (hindrence)."
CONTROLLER 3 - "Not enough traffic."

10-10-82 RUN 2

- CONTROLLER 1 - "ETABS still is slower than present RDP from the R position."
CONTROLLER 4 - "The handoff should be shortened so that you have two choices: (a) Keep it the same as is, if you need to read the flight plan, (b) touch H/O underneath the AID for an accept (one step). Strip marking could be shortened by one step, if standard control symbols were displayed in an area of the ID adjacent to the AID's: Touch symbol and touch AID for complete entry."
CONTROLLER 5 - "Because this system you have running is not reliable."

CONTROLLERS 9/10 "The old method is much faster efficient and flexible.
Unless ETABS can perform functions faster it is more
an anchor than help!"

1-20-82 RUN 1

CONTROLLERS 7/10 "I believe that this survey form should have been
thoroughly reviewed with this class. There appears
to exist within this class a misunderstanding or
misinterpretation of what is being asked. I question
the validity of the results of these surveys if this
situation does in fact exist."

APPENDIX D

NARRATIVE ANSWERS TO FORM F
WRAP-UP QUESTIONNAIRE

The Wrap-Up questionnaire was given on the last day of controller evaluation to sum up controller opinion on ETABS. There were 18 questions that elicited comments or narrative answers from the controller subjects. These questions are listed below along with the responses by controller. Questions are boxed.

1.0 Please rate the various human factors aspects
1.14 Comments

CONTROLLER 1

- "I personally like the color green rather than amber, red, or white on the interactive display and tabular display. It's easier on the eyes and more readable
- I do not like the concept using the laser beam to create data areas. It seems to be very sensitive and calibration critical. It is too easy to break the wrong light beam, causing erroneous data to appear in preview area, which in turn takes valuable time from the controller."

CONTROLLER 2

- "Too touch critical. The target area is too small." (ETABS keyboard)

CONTROLLER 3

- "The overall concept of ETABS is fine. The equipment configuration is marginal and open for many errors.
- We need a chair in the center that will make you sit up and pay attention to what is going on. Half of them now you sit down and you're in the prone position if you use the back rest. Please don't make them plastic. I'm swimming now."

CONTROLLER 4

- (ID) "Would improve at eye level."
- (Menus) "Require too many touches."

CONTROLLER 5

- "The tabular display should be touch sensitive so that messages can be formulated on the T D. There shouldn't be two separate devices."

CONTROLLER 6

- (Rated poor but) "If ETABS worked as designed and touch entry was more responsive, some of the aspects could be moved over to the moderately good column."

CONTROLLER 7

- "I tried my best not to use the manual keyboard and to use the I.D. keyboard only "

CONTROLLER 8

- "Interactive requires too much attention. R position interactive needs to be deleted or tailored and simplified to provide only a few of the functions of the D side to allow R man to do handoffs and just a few other functions. Both interactives provide too much information."

CONTROLLER 9

- "There is no lack of marking symbols on the menu. However, the placement of them (on the FDE) and accessibility (overall functionality) and/or efficiency is TERRIBLE.
- There seems to be little planning in coordinating inputs from keyboard and "menu" displays
- (The console configuratin was) functionally ineffective, aesthetically poor, accessibility fair.
- If the keyboard were designed to be used in conjunction with the menu selection capability of the I.D., it would be great.
- (Touch entry was) functionally terrible; potentially great (for menu drive)."

CONTROLLER 10

- "Overall effectiveness of the console configuration would be improved dramatically if the console was redesigned with the ID displayed on the TD. Also the ANK and ID would be more effective if they were integrated completely.
- Character size on ID is too small requires too precise action to activate.
- ID, as tested, lacks the capability of being tilted up or down for better visibility."

3.23 Please use the space below for any comments you may wish to make regarding your answers to the above items

CONTROLLER 1

- "I feel the present model requires more entries and has slower responses than the NAS RDP system. This would decrease considerably the overall efficiency of the ATC system."

CONTROLLER 4

- "It is faster to use a touch type K/BD than a touch entry device, where you must search for entry locations on each menu page."

CONTROLLER 7

- "The way we used ETABS in these demonstrations, the ID took too much attention from the radar man and in real life this could never work."

CONTROLLER 8

- "ETABS formats require a greater number of entries to perform the same function than using the present NAS system. Use of TD (electronic) is excellent. Touch entry device and formats (Menus, etc.) are a problem. There is too much data in many of the menus. Formats need to be simplified."

CONTROLLER 9

- "Even as ineffective and cumbersome as this system has been demonstrated to be, it has several benefits.
 1. Reduce noise level due to elimination of printers.
 2. Projected decrease in manpower due to elimination of "A" position (After initial "shakedown" is complete.)
 3. Projected increase in reliability of system due to elimination of an electro/mechanical printing device
 4. Actual sustained uniformity of character clarity and uniformity due to elimination of impact printer, ribbons, and paper inconsistencies
 5. Projected increase in productivity due to faster handling of data
 6. Projected increase in safety due to more timely updates, more reliable transmission of data, etc., etc."

CONTROLLER 10

- "These comments have been recorded in earlier surveys and observations, but I would add that the ETABS, as tested, required too much attention on the ID. Attention that normally in NAS is focused on strip postings or on the radar scope, was now diverted to the ID for much too long of a period
- Character size on ID is too small, requires too precise of action to activate. Calibration is too critical.
- Not enough FDE capability
- Speed of response system was overall, much too long
- Problems with route hyphenating
- TD not visibly accessible to radar man - not able to rotate TD
- Not able to tilt ID up or down for better visibility.
- Not interfaced completely with NAS
- Process of entering messages is lengthy and redundant when compared to what we have available today with NAS."

5 1 Is there anything about ETABS which you feel might affect ATC safety?

CONTROLLER 1

- "The model evaluated does tend to distract controller because of interactive display being so attention sensitive."

CONTROLLER 2

- "In the past abstract reasoning has been a requirement for an air traffic controller. "Seeing traffic" was the primary requirement for recognizing a potential controller. With ETABS and its related systems (error projection etc.) it will make my job of certifying a developmental more difficult. How can I be relatively certain that the trainee can see traffic and has the temperament to be a controller."

CONTROLLER 3

- "System response times Data base error between 9020 and ETABS. With the interactive display at its present position location it diverts your attention away from your present job station."

CONTROLLER 4

- "The ID on the "R" position requires too much time and attention away from the PVD "

CONTROLLER 5

- "As tested it was entirely too unreliable. The response time normally were too long. The interactive device required too much attention when entering messages, which is not good for the radar man "

CONTROLLER 6

- "The attention that the "R" position controller has to give to the interactive display on entering messages could divert his attention enough so that it might effect ATC safety.

CONTROLLER 7

- "Yes. Unless field controller ideas are listened to, management and controllers who haven't worked live traffic in the last 3 years may develop a system of tomorrow based on yesterday."

CONTROLLER 8

- "Right now the data provided is cumbersome and much more than required to use this system, takes time away from radar surveillance, and creates risk to air safety.

CONTROLLER 9

- "Predictive conflict" can be programmed into ETABS, certainly. (Meaning 15 min. or so prediction on "D" side.) Also, by being able to flash the call sign (for example) of an aircraft at the "R" man he can more easily be alerted. (It's difficult to get some people's attention). Some "D" controllers ignore time changes on aircraft when they get busy. Automatic update could be greatly beneficial. Increase accuracy of markings (assuming automatic mode) and relieving "D" side of even some secretarial type duties would help "

CONTROLLER 10

- "The concept of ETABS should enhance ATC safety by affording the D controller more time to provide assistance to the R controller. This is basically accomplished by reducing the time spent by the D controller in strip posting and marking. The system we just evaluated, accomplishes exactly the opposite. The system is time consuming, inflexible, inefficient and is error-prone. The system

CONTROLLER 10

- "Yes. If ETABS is designed and programmed correctly; that is, with the concept that ETABS will be used by air traffic controllers in the field to perform ATC functions, then the overall efficiency of the ATC system would be improved significantly. Again, this would be accomplished by reducing the time spent by the D controller on clerical duties. This would allow him to devote more of his time to traffic management and to assist the R controller. This would result in a more efficient air traffic control system, where the emphasis is on the safe and expeditious flow of air traffic "

7.1 Is there anything about ETABS which you feel might affect expeditious movement of traffic?

CONTROLLER 1

- "I believe the menu would benefit the ATC system expeditiously if adapted properly. (There is) too much information in the menus though (It) slows the system down because the controller has to scan (redundant) information to select the information desired."

CONTROLLER 2

- "No. Once the training phase and the natural resistance to change has passed, ETABS will contribute. In fact it will be essential to expeditious movement of traffic "

CONTROLLER 4

- "Using the ID for "R" inputs would reduce traffic flow."

CONTROLLER 5

- "As tested, it was entirely too unreliable. the response time normally were too long. The interactive device required too much attention when entering messages, which is not good for the radar man

CONTROLLER 6

- "If ETABS worked as I was told it was designed to, it would greatly reduce the workload on the "D" side controller and would give him more time to help the R controller, which in turn would help the expeditious handling of traffic."

CONTROLLER 7

- "The procedures for using ETABS should be uniform across the country. If every facility is allowed to "Patch," "ammend," or add for their own area then this could cause some delays. The procedures should be minimal and apply to all facilities the same."

CONTROLLER 9

- "Instead of sending a strip to a position and having to wait (while the "A" man posts it, etc.), an FDE can be sent as a piece of traffic is being talked about. Much time saved and probably delays reduced. This would help many times with approach controls, etc. with emergency traffic, etc."

CONTROLLER 10

- "Yes If ETABS is designed and programmed correctly, that is, with the concept that ETABS will be used by air traffic controllers in the field to perform ATC functions, then the overall efficiency of the ATC system would be improved significantly. Again this would be accomplished reducing the time spent by the D controller on clerical duties. This would allow him to devote more of his time to traffic management and to assist the R controller. This would result in a more efficient air traffic control system where the emphasis is on the safe and expeditious flow of air traffic."

8.1 If there are any normal ATC tasks or functions which do not have their counterparts in ETABS, please list them below.

CONTROLLER 1

- "The inability to quick-look another sector. (If this capability is present in the model evaluated, I didn't see it or have the opportunity to use it.)"

CONTROLLER 3

- "After highlighted route is issued, no way of suppressing. Unable to do strip request with any reliability. Unable to request an FDE on a flight if none in ETABS system."

CONTROLLER 4

- "The "QT" or start track message, for starting track on a pop-up or acft requesting VFR advisories."

CONTROLLER 7

- "No provision for "APREQ" strips."

CONTROLLER 8

- "Ability to force a flight plan. RDP has flight plan readout. It is difficult to callup FDE's."

CONTROLLER 9

- "All functions that have so far been indentified are generally slower using ETABS due to either poor design or poor programming. However, most functions have been identified and programmed. (This is a good beginning, but only a beginning."

CONTROLLER 10

- "None noted."

9.1 If there are any ATC procedures (as in the ATP manual) which can be simplified or eliminated by the use of ETABS, please list them below.

CONTROLLER 1

- "NONE"

CONTROLLER 2

- "Strip marking will require a complete overhaul (basically, manual input of strip marking should be deleted, and automatic insertion of indicators as a result of another action (i.e., accepting a handoff) should be adopted."

CONTROLLER 3

- "Strip marking.
- Sign on/off procedures.
- Sector information
- Currency requirement quizzes."

CONTROLLER 5

- "Strip marking could and should be streamlined."

CONTROLLER 7

- "I believe most strip marking locally and in the ATP can be eliminated using ATABS by applying logic and common sense. Ex. We write an "R" on 99% of all our traffic and "NR" on 1% of our traffic. Just eliminate the R and look how much work you save. The absence of "NR" should mean you have the a/c in radar."

CONTROLLER 8

- "A lot of strip writing used now can be either eliminated or done automatically by the computer (For example: R's on strips)."

CONTROLLER 9

- "Most likely strip marking."

CONTROLLER 10

- "Unable at this time to single out any particular ATC procedures to be simplified or eliminated, but I do recommend that a task group be assembled to review the ATP manual with regards to simplifying or eliminating procedures. Utilizing the recording capabilities of RDP and 300 system, it is reasonable to assume that some procedures and some strip marking requirements could be eliminated. This, in itself, could significantly reduce the controllers workload."

10 1 What do you like most about ETABS, and why?

CONTROLLER 1

- "The electronic display of flight data in lieu of paper strips. I believe it is advantageous for the controller because the digital readout is more readable than current strips, reducing chances of errors. I also like the menu concept, because it will expedite flight data, when properly adapted."

CONTROLLER 2

- "In concept - rapid and concise display of data - more accurate recordkeeping."

CONTROLLER 3

- "Electronic display of flight information Don't have to change ribbons or stuff strips "

CONTROLLER 4

- "The displays of th FDE's on the TD. This would eliminate FSP's that are outdated, unreliable, and slow."

CONTROLLER 5

- "I like the concept of electronic strips because it should eliminate the need for paper strips and the need for strip marking."

CONTROLLER 6

- "The concept of eliminating flight strip printers and using electronic display of data is good and also the touch entry. But there has to be a lot of changes made in order to use it in the field."

CONTROLLER 7

- "The touch entry concept is very good and seems to be more efficient than FDP. The electronic displays of strips will create a more positive attitude in the controller. Also, readouts will be the same and not vary in lightness like now where we have to change ribbons on the printers."

CONTROLLER 8

- "The electronic tabular display is an excellent feature. The potential for ETABS to automatically accomplish ATC tasks, or reduce the functions required to do particular operations will provide controllers with more time for radar surveillance and other activities directly related to the separation of air traffic "

CONTROLLER 9

- 1. "Getting rid of noisy printers. 2. Getting rid of strip holders and complications 3. Being able to highlight data fields of FDE's. 4. Special adaptive markings (possibility). 5. Automatic update and posting of information so the latest info is always instantly available. 6. The possibility exists that ETABS could expedite the input of flight plans (with right programming/adaptation). 7. Typing information is much faster than writing or printing. My printing is obviously not the best; basically speed and readability. 8. With menu adapted marking, marking strips will be even faster yet!"

CONTROLLER 10

- "Electronic display of flight information - Utilizing the concept of ETABS, time-consuming manual activities would be reduced by eliminating duplicate controller data entries by automatically updating data. This would reduce the work-load-intensive manual strip management, particularly at the D-side. This would enable the D controller to increase his assistance to the R controller in traffic management and traffic planning "

11.1 What do you like least about ETABS, and why?

CONTROLLER 1

1. "I did not like the laser beam system. I prefer to actually touch the surface of the CRT to activate the interactive function. The laser method appears to be too calibration-sensitive, especially with small data areas."
2. I prefer also that the tabular displays be interactive rather than have a separate interactive display.
3. The redundant information in the menus and the response time."

CONTROLLER 2

- "At present there is too much data present. There should be ongoing input from the field to the programmers. Don't compile the data from a study and then "set in concrete" a system. Progress to a point - and then get a field evaluation of the field's input. Even though it is what they asked for, it will probably need expanding or refinement once it is actually used. With ongoing fine-tuning we should get the best system possible."

CONTROLLER 3

- "ID is too critical to enter message - angle of ID to your line of sight. There are no provisions for changing the tilt for a short person or tall one. If you are sitting between the keyboard and the ID, to access each you have trouble getting info. coming in from the side of the ID. You must sit right in front of it."

CONTROLLER 4

- "The ID touch entry to enter a flight plan requires far too much time. Other entries could be made faster than the system we have been exposed to with changes in programming and available menus, but not fast enough to justify the replacement of our current OAK packs and keyboard entry."

CONTROLLER 5

- "As tested. Unreliability, too attention requiring. Also could not request an FDE on an aircraft."

CONTROLLER 6

- "The reliability of the system as tested."

CONTROLLER 7

- 1. "The constant flickering and readjustment of FDE's and call signs in the AID list.
- 2. The format and levels of information in the FDE's are too many and should be lessened.
- 3. The length of the FDE as compared to present flight strip is twice as long.
- 4. I feel as though no human characteristics were given much thought when designing this setup.
- 5. On the I D. the touch zone is way too small.
- 6. The T D 's should be touch sensitive."

CONTROLLER 8

- 1. "The touch entry device requires too much attention. Needs revamping and tailoring. Too much information on the interactive.
- 2. Operations require too many functions to accomplish."

CONTROLLER 9

- This system is too complicated, attention intensive, inefficient, unstable, etc., etc. Too many steps (inputs) to accomplish one function.
- Slow.
- This concept probably at best will not permit the flexible posting, etc., that is now available with manual. However, with all the additional benefits, it will be small price to pay."

CONTROLLER 10

- "With regards to the concept of ETABS. I believe the most prominent negative will be an increase in eye strain due to the electronic display of flight information.
- Least priority with regards to the system we just evaluated, one negative aspect is the lengthy process of entering a message. This particular system requires, in some cases, many more steps in entering a message than the present NAS. This results in a more time-consuming activity devoted to clerical duties, which significantly reduces the effectiveness of ETABS with regard to assisting the controller in traffic management by reducing the time he spends inputting messages.
- Second least priority - another negative aspect is the attention that must be given to the ID. I believe that too much attention is diverted from the radar scope and scanning of strips to the ID."

12.1 Are there any aspects of ETABS which are of such obvious benefit to present NAS that you would recommend immediate implementation?

CONTROLLER 1

- "Yes, the electronic display of flight data surpasses the use of current paper strips, both operationally and for record-keeping. As stated before the menu operation, properly adapted, could enhance the current ATC system through expediency."

CONTROLLER 2

- "Some form of tabular display - don't wait for sector suite - get something into the field in a couple of years "

CONTROLLER 3

- "Engineering model - No "

CONTROLLER 4

- "The tabular display of flight data information, provided the system is truly fail safe and would insure a way of forwarding data in a degraded mode."

CONTROLLER 5

- "Yes, the ability to eliminate the noisy and somewhat unreliable FSP."

CONTROLLER 6

- "The use of electronic tabular displays "

CONTROLLER 7

- "No"

CONTROLLER 8

- "The electronic tabular display is excellent and very close to being ready for implementation in the field "

CONTROLLER 9

- "Not of this level capability. However, with the right kinds of programming and adaptation changes (and hardware) yes! The sooner the better. Don't wait for sector suite. Even if no "R" functions are available on "ETABS" initially, implement it quickly."

CONTROLLER 10

- "The concept of ETABS is excellent. It is evident that the technology is available today for the implementation of the tabular display. The same technology is available to come up with a suitable system that would make the necessary strip marking on the tabular display possible in an efficient, flexible, and in a relatively error-free manner. This would eliminate or greatly reduce, workload-intensive manual strip management, eliminate the flight strip printers for all practical purposes, and eliminate the need for "A" sides". Many of the problems that we faced with particular ETABS, appears to have arisen from deviating from the basic objective of ETABS (which I understand, is the electronic display of flight progress strips) to expanding the objectives and requirements of ETABS in order to tie it into the sector suite concept "

15.1 How would you complete the following statement?

"As presently configured, I feel that use of ETABS in an operational field environment would lead to _____ NAS effectiveness."

15.2 COMMENTS:

CONTROLLER 1

- "The current model requires very attentive selecting because the fields delineated by the laser beams are too small. The lack of stability of the laser sustm also causes the wrong field to be selected, deterring controller efficiency."

CONTROLLER 3

- "System response time, error referral is badly lacking."
- "Poor communication between 9020 and ETABS."

CONTROLLER 4

- "Without the ID on the "R" position."

CONTROLLER 7

- "The simulation that we used was not very real, plus all the computer problems that occurred could not be tolerated in today's situation. The present adaptation of ETABS in no way should be put into use because it doesn't conform to live situations that we have today."

CONTROLLER 8

- "ETABS concepts are great. Equipment created to meet criteria provided by controllers and providing limited and tailored information and functions would be a great asset."

CONTROLLER 9

- "Electronic display of flight data (configured correctly) would greatly enhance the capability, safety, and effectiveness of the system."

16.1 What would you like to see added to ETABS? Is any needed feature missing?

CONTROLLER 1

- "The tabular displays (1&2) should be at an angle so the radar controller would have a better view of them. Also, there should be the capability of placing any info, whether it be a fix posting Bay, departure bay, etc., on either TD. The present system affords that option."

CONTROLLER 2

- "Controller charting could conceivably be put on tape and added to the items that might be selected on the information TD - one office would maintain and update the tape on normal 56-day chart dates."

CONTROLLER 3

- "Rather than add to ETABS why don't we see if we can get the functions to work that it does have. One feature missing, error correction, very important. Proper field 10 tailoring truncation."

CONTROLLER 4

- "The ability to start a track on an acft. An easy method to request an FDE. An easy method to mark symbols on an FDE. The ability to position a fix sublist in a TD at the controller's discretion."

CONTROLLER 6

- "Incorporating some strip marking functions, such as when one sector hands off aircraft to another sector. When he accepts handoff, an R or some symbol would automatically show on the FDE."

CONTROLLER 7

1. "A touch sensitive TD or slewball/joystick active on the TD.
2. I feel a "joystick" could be used better than a slewball.
3. More area for a "note pad." One sigmet or GI message is totally inadequate, we need at least 6.
4. Larger capacity for FDE's (at least 60)."

CONTROLLER 8

1. "Overhead display with potential for terrain map, weather radar, etc.
2. A rectangular radar display (corners to be used for weather info), restricted area info, or whatever you want to put there.
3. PVD made interactive."

CONTROLLER 9

1. "Interactive TD accessed by (A) light pen, (B) joystick, (C) slew ball, or (D) touch sensitive (not light beam) on both "R" and "D" positions.
2. Field AID and alt. in FDE.
3. Larger AID and alt. in FDE.
4. More FDE capability.
5. Automatic strip marking.
6. Rotatable TDs."

CONTROLLER 10

- "I would like to see ETABS and NAS integrated completely (i.e., when a sector "buys" the handoff of an aircraft, the symbol P appears automatically in the appropriate field in the FDE of the transferring sector tabular display). Also, interactive tabular display (See 18.1)"

17.1 What would you like to see deleted from ETABS? Are there superfluous or undesirable features?

CONTROLLER 1

- The radar controller does not need an interactive display. It is distracting and he can perform the necessary functions just as fast or faster using the current RDP, OAK, and keyboard. If PVD was interactive, this might alter this idea.

CONTROLLER 2

- "Most of the seldom used strip marking symbology - extreme tailoring of the menus."

CONTROLLER 3

- "Delete the D functions from the R position. Have menus tailored for the R man first; then if need be make D functions available to R man on request. The radar man should not be required to look through 20 AID's to find two. Only put current AID's in his list."

CONTROLLER 4

- "Most of these we were told are program adaptable and have been listed on other survey forms"

CONTROLLER 5

- "Some of the menus are too cluttered"

CONTROLLER 6

- "The menus changed to make the entries easier. The response times are too long. Some strip marking could be eliminated."

CONTROLLER 7

1. "The R side ID should not have the same format as the D side. R side should contain only R related functions which would eliminate excessive info. the R man has to filter out
2. The levels and format of FDE's should be reduced; they contain too much information."

CONTROLLER 8

- "The R interactive is not needed."

CONTROLLER 9

1. "Less altitude information (only mode C and assigned alt., plus requested altitude.)
2. Too many steps in inputting data."

CONTROLLER 10

- "Remove the ID from the radar position. Leave the radar position as it is today in NAS. The ID diverts attention from the radar scope."

18.1 What about ETABS would you like to see changed? What would you want done differently?

CONTROLLER 1

- "I would like to see the tabular displays interactive, less info in the menus, larger data areas to reduce the number of erroneous selections, and a system where you touch the surface of the CRT rather than break a light beam "

CONTROLLER 2

- "Possibly one display with tabular display and interactive area."

CONTROLLER 3

- "I would like to see a touch entry device used to access data. Breaking light beams is not my idea of a touch entry device. This would eliminate a lot of hunt and peck errors."

CONTROLLER 4

- "The rectangular PVD with one corner for touch entry and a simple touch system for marking FDE's. This could be done by placing only the AID's of aircraft in the handoff status in this list: with a list of normal marks or symbols, such as a V for altitude or R for radar or C for communications transfer "

CONTROLLER 5

- "A smaller strip display with the minimum info. displayed. Fixed positioning of fix headers. A tabular display that incorporates touch entry on one display."

CONTROLLER 6

- "The menu's changed so that they wouldn't require any more functions than the NAS system does today."

CONTROLLER 7

1. "Have a 22" square TD with three columns of FDE's.
2. Stationary fix postings on the TD's
3. Have the ID located vertically directly below the TD and PVD.
4. Menu format on R side should be structured just for the R side, and both ID menu's structured for that sector stratum only."

CONTROLLER 8

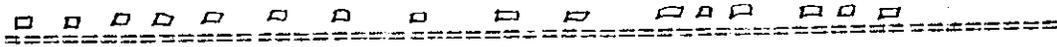
1. "Make the interactive easier to make entries on.
2. Reduce number of steps to make entries.
3. Clean up interactive and menus - too much data.
4. No need for AID list on interactive.
5. Make TD and radar display interactive."

CONTROLLER 9

- "Mount the I D menu device vertically under the TD, out of the way "

CONTROLLER 10

- "Again, the concept of ETABS is excellent, but I would like to see ETABS as evaluated, redesigned and reprogrammed with much more of the controller requirements in mind. I would like the TD to be interactive with a preview/menu area in the lower portion of the tabular display. Would like to see the ANK placed in a horizontal position in front of the TD. Would like to see the FDE presented in a strip format on the TD with the capability of controller to select what fields of the FDE he wants to see. (This can be accomplished by having 11 keys representing your 11 fields placed at the top of the TD, and the controller selects what keys or fields he wants to see. The info is always available.) Would like to see the TD placed on a drawer and swivel so that if 1-man sector, TD can be pull out and turned toward radar position, or if two-man sector be able to tilt TD toward radar man. Leave the radar position as is in today's NAS. Would like to be able to move any information presented on TD to any position on TD. Would like to see ETABS integrated completely with NAS. Would like to be able to have at least two columns of FDE's on TD.
- Character size on ID's too small - requires too precise of action to active.
- Some marks should be adapted for automatic positioning in certain fields: i.e., "R" for radar, "✓" for altitude, etc. Unless manually selected for another field.
- Destination should always appear in route.
- A single word should never be split between two lines on FDE.
- Bay headers should be manually positionable even without FDE's.
- In general, to work more airplanes, fewer entries should be required to enter or amend data.
- Once a strip is "marked" that mark should automatically be displayed on other strips of that particular flight under each bay that it may appear within that particular sector.
- Message entry formats should be simplified and reduced for overall effectiveness."



i. e.

	END			CYN
TW202 B727 455	END 2150	330	RTE	
AL360 B727	END 2000	350	RTE	

Vertical Position

Tabular Display (interactive)

Preview/Manu Area

Horizontal Position

Keyboard	
XXXXXXXXXXXXXXXX	XXX
XXXXXXXXXXXXXXXX	XXX
<u>XXXXXXXXXXXXXXXX</u>	XXX

19.1 Assuming that the above additions, deletions, and changes were made to the ETABS, please complete the following statement.
(Check one)

"Given the above modifications, I feel that use of the ETABS in an operational field environment would lead to _____NAS effectiveness."

a great improvement of
 an improvement of
 a slight improvement of
 no change to
 a slight degradation of
 a degradation of
 a great degradation of

19.2 COMMENTS (IF ANY):

CONTROLLER 1

- "I feel I have been exposed to and used the majority, if not all the functions of ETABS during this evaluation, and I sincerely feel there is considerable room for improvement, especially in the adaptation area "

CONTROLLER 2

- "I evaluated MITRE Corp's concept of ETABS several years ago and have been eagerly awaiting its introduction into the field."

CONTROLLER 3

- "This statement is made because I feel that I have a pretty good background in the NAS MD's and a half decent picture of what's going on in air traffic control."

CONTROLLER 7

- "Knowledge of ETABS is one thing, but knowledge of air traffic control today is another when evaluating ETABS for the use in air traffic control. I believe emphasis should also be placed on one's current knowledge and ability in working air traffic "

CONTROLLER 9

- "This has been an exceptional team. It should be reassembled frequently to help in further development and enhancement of the embodiment of the tabular display concept. The development continuity provided by this team could prove to be an extremely valuable asset to the FAA."

CONTROLLER 10

- "I recommend that this particular evaluation team be reassembled as necessary, in order to evaluate future development in ETABS. This would provide continuity in the evaluation of ETABS. I have respect for this particular group with regard to their dedication and interest in developing an ETABS system that will enhance our air traffic control system."

22.3 On the foldout sheet depicting the FDE formats, please boldly mark over any data field that, in your opinion, needs changes.

22.4 Please comment on each change:

CONTROLLER 2

- "Will give you a format below - that will be easier than making so many marks on the chart
- AID ASN ALT (MODC or INT ALT) FIX ROUTE
A/C data CID, _____ notes _____, REQ ALT TIME remarks (Coordination Indicator if UTM is Generated)"

CONTROLLER 3

- "GSPD already shown on FDB
- Until the ground rules are established, it is very difficult to select the fields you would like to see. Let A T determine the minimum amount of data required, then give the controller the means to either display or not display each field, not the whole line as it is now "

CONTROLLER 4

- "The airspeed is displayed in the full data block.
- The INT, reported, and mode C altitude all show up at the same time and remain on the display. The reported altitude is not used when mode "C" is being received; both could use the same display area. When the interim altitude is removed from the FDB it should be removed from the FDE."

CONTROLLER 5

- "If the one line enroute FDE were modified as shown, then, I would have it ranked as number 1. I personally do not see a need for the posting of previous fixes or groundspeed. As far as the departure FDE goes, I did not get a chance to use the departure FDE. It looks like level 1 should include more room for route and remarks "

CONTROLLER 7

- "Dept - level one should be minimal info. If a/c calls for clearance in nonradar environment then request level 2 just for that strip and you will get full info.
- Enroute - level one should be minimal info. R man does not have time to read more info. when working 25 to 35 a/c at the same time. If traffic is slow, then he can use level 2. and when needed by D man, or on special occasions, you should be able to request level 3 for that one strip only and that would provide you with all the info. needed
- Level 4 should be eliminated altogether because it contains too much unneeded info. and would take time to decipher all the info."

CONTROLLER 10

- "It is not necessary to show what sector has control of the aircraft on the FDE.
- It is very difficult to look at the CID, BCN, TAS, APSD, or the ASN ALT, INT, RPT, MODE C, or REQ ALT and find the specific information you are looking for. readily. There are too many numbers grouped too close together "

APPENDIX F

NARRATIVE ANSWERS TO FORM G OBSERVER'S QUESTIONNAIRE

The narrative answers to Form G were in response to question 1.1:

"This form is completed by the observer during runs. The object is to record observations made by the controller or unreported significant events noticed by the observer."

There were three observers per run - one at each sector. Their responses and observations are listed below.

10-6-82 RUN 1.

CONTROLLER 3.

1. "I had trouble with touch points (radar man) on left side of display using line feed, backline, skip, and backspace.
2. I had a problem with error referral messages at the "D" position. With incorrect data entered, I was unable to correct only that data, and had to enter whole new flight plan.
3. It seems to be a very cumbersome operation to set up an FDE on an aircraft if you do not have one. It takes many steps without any reference to the flight you are working with.
4. The underline feature for showing control in the AID list appears to have problems. Aircraft we have control of are not underlined. Some that are underlined we have no idea where they are.
5. The resultant output actions to certain messages seem to be very slow - (for instance) RD messages.
6. EJ327 had a problem with this flight. AID was in our list. The a/c was in handoff status to us, but we could not take H/O. We got verify eligibility. We /ok'ed, and got track in transfer status."

CONTROLLER 6.

1. "The system down and up at 1952Z.
2. There are PVD handoffs that are not on ID (touch display).
3. Mark menu does not show int alt, req alt, pilot time, or vector.
4. The note menu does not work as the engineer says it should."

CONTROLLER 9.

1. "ETABS needs auto skip and backspace.
2. FP entry format critical/doubtful diagnostics.
3. Need "insert" in keyboard functions menu.
4. Too slow to call up keyboard for corrections.
5. Keystrokes touchy (must hit low on "D" side)
6. Vertical slash left of 1 on keyboard needs to be moved
7. Keystroke not consistent from top to bottom of screen.
8. Requires two strokes for handoff/slow
9. All digits in call sign not eligible for entry (R side)
10. Have sense-touch control on TD instead of ID or in addition to ID

11. ID display "jumps" call signs (rearrangement)
12. Why not slew ball or light pen control instead of sense touch?
13. Have the TD interactive by light pen, "Ball" or touch.
14. So far every entry is more complicated and more time consuming than the old way
15. Observation: Maintenance of touch control devices will probably be critical and often
16. Fixes under route and fix menu are different. Using ink pen to touch with requires two or three entries "

10-7-82 RUN 1

CONTROLLER 2

1. "AL183 target is on the PVD, but FR indicates flight is still a proposal on ETABS.
2. Slow response time N2979 alt am 190 to 150 - AL360 170 110.
3. R-controller had difficulty hitting the touch area - not reading the msg response
4. AL360 FDE - unable to remove via FDE off or FP drop.
5. N280RA no handoff from sector 19 The R controller /ok'd the FDB but he couldn't handoff to sector 9 - in essence he did not get control with ETABS
6. FDE route truncation should display destination regardless of operating level (I, II, III, IV).
7. AID response when a handoff is attempted on an aircraft that is already handed off is erroneous - "MSG is now being process" response area displays "00" instead of "not your control".
8. MSG response to a multiple entry is "message is being processed". At this time the controller can clear and enter another multiple message and now the response area might give an error response and the controller may not know which message is in error."

CONTROLLER 5

1. "At 2029:25, TD 1 and TD 2 went blank with a "beep." ETABS maintenance in immediate action Interactive displays went down too.
2. Generally slow responses to R interactive display inputs.
3. CCC went down at 2037:47 - 1 min out into the test. When NAS came back, I could not enter HO or accept HO with ETABS.
4. At 2040:12, TD's went out again. Back in 30 sec.
5. PA002 HO accepted at 2044 in sector, no FDE.
6. CCC down at 2047:38, back 2048:17, down again immediately
7. After reload of ETABS, it takes a long time before I can take/ make a HO using the interactive display. Controllers reverted to track ball and PVD keyboard
8. I had no real controller problems - some coaching by Tech Center ATCS of R controller ID entries - The third member of subject team aided D controller "

CONTROLLER 8

1. "A computer problem occurred at the beginning (only affected Sector 19/41). Interactives were inoperative.
2. R controller had problem dropping data blocks.
3. R controller did not keep up with updates and deletes (easy to overlook).

4. In the TD, the assigned altitude and actual altitude should be displayed like the data block on the PVD.
5. Both R and D controllers had difficulty in changing assigned altitudes in conjunction with interim altitudes.
6. Altimeters should be displayed on R CRD (difficulty in observing altimeters by the R-man on the TD).
7. Strip format (TD) indicates assigned altitude. Same entry on FDE (TD) is the requested altitude. These need to be correlated.
8. D controller spends majority of time using interactive; has very little time to observe FDE's in TD and examine for potential traffic situations.
9. "R man assigns interim altitude of FL280 and makes ETABS entry. This did not show in FDE in TD (Call sign EA529)".

10-7-82 RUN 2.

CONTROLLER 3

1. "No assigned altitude on AL183 in FDE when interim alt was inputted for flight.
2. On a number of messages we had very slow response times.
3. AL360 - Interim altitude of 100 was assigned to this flight. It was removed and showed so on the PVD. The FDE still showed an interim altitude of 100. If NAS inserts interim alt it should also update it.
4. N350NH had a "P" after its call sign in the UA field. We could not figure it out.
5. The truncation of the route field is sadly lacking. Whenever an element is started it should be completed on that line and not hyphenated. Overall truncation has the same NAS problems. Should only show how he's getting to the fix and how he's leaving. I believe you should always show his destination in the route field. In many cases it's not there.
6. Posse 04: We received an update message to delete the FDE, but data block never dropped from PVD. With time and alt parameters set, it should have dropped.
7. At 2054, we lost the interactive display at both positions, R and D."

CONTROLLER 6

1. "AL364 changed route from landing PHL to JFK, system accepted amendment, but AL364 disappeared from TD. I requested a strip. ETABS accepted it but didn't display it on TD.
2. A5253A alt changed to 300. Two strips posted under ENO bay.
3. System went down at 2113Z. Operational 2118Z"

CONTROLLER 9

1. "Requires (4?) entries to drop data block
2. Requires too many processes to request FDE: First do FR, then attempt to find eligible fix; do SR, then manipulate to correct Bay header
3. Operating the ID from the radar position diverts too much attention from scope
4. Operating the ID from D position (manual update) is too slow; does not allow much interaction between "D" and "R"

- 5 It is strange that it is so difficult to accept or give handoffs on a/c not in ETABS
- 6 Often a function performed on PVD is not updated in ETABS
- 7 Either ID can answer the same MWI. If the other position needs the info, it is already lost."

10-8-82 RUN 1

CONTROLLER 1

1. "BLT126 was in handoff status to sector 18, yet FDE showed that sector 18 had track control. Also when the handoff was taken, the response was that the track was in transfer status
2. When restricted area info is requested, the message "illegal entry is displayed ("No data" should be displayed)
3. Deletion of interim altitude by ETABS updates PVD, but not FDE "

CONTROLLER 4

1. "After an acft is handed off, the FDE drops out of the TD and ID before the "R" man is ready to drop the FDB. It then requires a K/BD action to drop the FDB
2. The altitudes on the FDE are confusing. Posse 04 had the following display (240)
(110 110 110)
Meaning 240 asgn , 110 interim, 110 reported, and 110 Mode "C".
3. The interim altitude remains in the FDE after it has been deleted from the FDB. "

CONTROLLER 7

1. "Message entry sequences are lengthy and redundant
2. Response area splits the last word and is confusing. Words should not be split and put on next line.
3. Both controllers are bending down to read the response area on messages received.
4. We attempted to enter a special note on one a/c and could not enter it unless we put that note in the note menu. We should be allowed to enter a note on the FDE directly because the note may not be standard: e.g., if sector 18 requests an a/c at a different altitude, then we could put that note on the FDE and not have a permanent entry in our note menu, which is limited.
5. Fix postings on the TD's and on the ID's cause confusion by jumping around. Fix postings should be stationary "

10-8-82 RUN 2

CONTROLLER 1

1. "Bay headers should be larger so that they will stand out better and not blend in with FDE's.
2. Unable to evaluate for the first 40-45 mins because of system failure (cause unknown)"

CONTROLLER 5

1. "Getting handoffs on aircraft that are not in the AID list requires a QN message to accept handoff.
2. D man unable to get a specific FDE that he feels he needs.
3. Entered revised altitude on AL360 from 170 to 250, which should have forced an FDE to our position, but it never did
4. AL364 entered present position hold, then re-established tracking; however, the FDE indicated thru-out the exercise that the aircraft was in present position hold; EX: (INF).
5. The system went down. When it came back, we had two FDE's on all acft under the "END List" with the exception of TW892. Also we had two FDE's AL414 and VVLK08, appear with no route displayed on either the FDE, on the TD, or in the preview area on the Interactive device."

CONTROLLER 8

1. "Difficulty in location of coordination touch area next to AID.
2. R man had difficulty removing interim altitude
3. Computer was down during initial portion of this run
4. After FDE drops out of TD it is difficult to drop data block on PDV
5. N2332A - only shows *** (flashing) in route. FDE readout shows no route of flight. Ground spd, alt times are flashing. Punching route field in interactive brings up route. Why?"

10-12-83 RUN 1

CONTROLLER 3

1. "Any problem I reported about interim alt you can disregard. Ref. unable to remove interim alt using ID
2. Could I please have an explanation of the meaning of the P character in the VA field. It appears that we are processing flight plans with bum routing, and rejecting them. I know we are talking about a compatibility check but I don't understand how we can have an FDB and FDE."

CONTROLLER 6

1. "Request beacon on aircraft from D position ID. Accepts request puts code on PVD CRD. The requested code should be displayed on ID.
2. The D-side ID was not operational most of the problem."

CONTROLLER 7

1. "Requires five steps to remove data block from scope without an FDE. Should require no more than two
2. Call signs on ID are underlined (supposedly indicating sector control), yet no data block exists in system.
3. AL360 is on bottom of 1st list. When this ID is selected, N5253A is at the top of list #2
4. Altitude format on the FDE in the TD's should show only the assigned altitudes and actual altitudes at the present three altitudes. A temporary altitude in the FDE should cancel out the assigned altitude.

5. FDE on EA112 came up almost all "A"s/also DL117 (same).
6. After requesting a single FDE on one aircraft, a whole posting came up ("D" side doesn't remember which)
7. Very difficult to remove "T" altitudes from "R" side "D" side seems to work okay "

10-12-82 RUN 2

CONTROLLER 1

1. "Attention indicator "C" did not drop out of AID list after conflict alert was suppressed
2. When conflict alert began between VVZE030 and N1868M, no attention indicator appeared on TD.
3. Also, no attention indicator on TD when conflict alert between posse 04 and EA 862 began. "

CONTROLLER 4

1. "We can't figure out any way to start a track on an aircraft using ETABS equipment.
2. It is very difficult to get an FDE into your TD. It is a very simple operation using the SR message to the NAS keyboard. "

CONTROLLER 7

1. "Handoff entered by ETABS, response indicated sequence complete. When he entered it said message processed but then it went back to sequence complete.
2. If "D" man drops the FDE before the data block leaves the sector, it creates a heavy workload for the "R" man to drop the data block after the a/c leaves his sector.
3. On the TD's, the fix posting header should have either LGAN or a separate intensity level or maybe a color different from the FDE's.

10-13-82 RUN 1.

CONTROLLER 2

1. "If there are seven items of information in the AID's list (AID's and fix posting) and there is a second column in th AID's list - when you try to select the last AID in the first column and you touch too low, you will get the first AID in the second column - or some unrelated (not in AID'S list) AID. This occurs using column 2 and 3 if the above conditions exist.
2. Both R and D men do not like auto update or posting. They feel there should be some attention getter to the new FDE or the updated information "

CONTROLLER 5

1. "First message resulted in a communication breakdown.
2. Enter mark menu message, communication breakdown
3. Unable to request an FDE on N2979 for our sector
4. 2012, communication breakdown
5. N5253A mode C alt. showed 383 390, and it had an int. rpt alt. of 200 in the FDE.

6. 2021, communication breakdown
7. Comment: The system so far has not been reliable enough to make an objective judgment "

CONTROLLER 8

1. "N53A - When R man removed int alt., computer assigned AID 17,000
2. D man observed glare off smudges on interactive
3. When touching last AID on interactive (hitting low) the first AID from the second column appears
4. N5253A - handoff taken showing interim of 170 Interim removed with interactive, data block shows reported level at 390?
5. EA369 and N5253A handed off FDE's immediately dropped out of TD
6. DL1124 - hit low on interactive you get AL360 (AL360 is not on our list at all). Seven AIDs on 1st list and one on 2nd column.
7. Too many computer problems.
8. I went to manual sort for DOD All strips all posting then were out of sequence."

10-14-82 RUN 1

CONTROLLER 1

1. "Any corrections to data fields in the preview area are not reflected in the flight plan readout area.
2. Once the K/BD has been selected while entering a flight plan, and for some reason it blanks out, it cannot be recalled. You have to use the ETABS manual K/BD to complete the flight plan. The R position doesn't have an ETABS manual K/BD, which would make it cumbersome should a sector be a one-man sector.
3. 1416EDT - CCC unavailable.
4. 1419EDT - CCC available - 1420EDT - flop 1421 - data base re-load complete.
5. Vertical bar on K/BD menu just to the left of the Figure "1" needs to be removed or repositioned. It causes numerous erroneous selections which results in backspaces or error responses."

CONTROLLER 4

1. "Can't request on FDE using the ETABS format. You can get an FDE by using the SR message on the ID
2. After inserting the FDE using an SR message you can't remove the FDE The response is "no sector postings quality." We were able remove the FDE by using the /OK.
3. After the ETABS and CCC lost interface and recovered, EA369 and N5253A did not come back to the TD or ID list.
4. After a conflict alert the "C" remains in the FDE and the ID list.
5. PA002 came up with FL370A, changed assigned alt. to FL230, and data block changed to "FL230A." No report altitude was entered. The same thing happened with N4565R.
6. VVLKOB has no field 10 or fix time under SIE in ID or ID. It has full information under ENO on both TD and ID "

CONTROLLER 7

1. "The R man is using slewball to catch up.
2. On the ID we need the general format displayed by dots or blank lines on the FDE so we can find the touch areas
3. When we had a reload, the computer did not add back the remarks that we already placed in the FDE's "

10-14-82 RUN 2

CONTROLLER 3

1. "After today's run there appears to be messages that ETABS is capable of but we were not informed of. For the past two days we were trying to get a QB message using ETABS. John V. showed us today
2. When you make an error using the menu format you have to go to K/BD then you can't get back to your menu; must continue with keyboard "

CONTROLLER 8

1. "Slow response times.
2. EJ327 - I attempted delete mark. MSG indicates "No sector positions qualify?"
3. EAB90 - Entered FDE/OFF MSG: "No sector posting qualify.?"

10-15-82 RUN 1

CONTROLLER 3

1. "AL183, ENO fix posting Run 1, aircraft came on freq. with an interim alt of 110. The radar man cleared the aircraft to 140 and deleted the interim altitude using ETABS. This action did not update the FDE. The D man then tried to delete the interim altitude. The response was "No altitude field," FDE still shows 110 interim altitude.
2. As a group at this sector we feel if we mark a strip for a particular flight and we have other postings, these should also be marked; i.e., radar contact check for reported altitude. (controllers 10/1/3)
3. Ten minutes into the problem we are experiencing problems with response times and system communication/breakdown. Up at time 2020
4. Time 2028 This sector now has one active aircraft in sector who is handed off to sector 19. How can we evaluate a concept when we are not performing a function.
5. Time 2031 One aircraft in sector, N1868M.
Time 2034. Two a/c N1868M Posse04.
Time 2057. comm. Breakdown.
6. Need more planes !!!!!
2102 - Comm. Breakdown. 2109 - Comm again.

CONTROLLER 6

1. "DL224 C 330 alt was checked. Level int. alt. of 180 was put in. The mark which was put in to show level at 330 now shows level at 180. When aircraft is assigned a different alt the check mark should disappear and an up or down arrow should appear showing what the aircraft is doing.
2. NW79 in SIE Bay was marked with letter R in note field to show that aircraft was in radar contact. TD should update aircraft in all bays such as ENO and SIE in our sector. Should not have to make entries for each bay header on same aircraft.
3. There was no ETABS in the R position."

CONTROLLER 9

1. "When inputting "QU" function on N2BORA (2004Z) direct MIV, FDE displays direct ENO. Why?
2. FDE's should stay on TD longer; the 2 minute parameter does not allow enough time to drop data block.
3. Today, when inputting slightly low on BN12 (at the bottom of column #1) DL105 is selected (#2 in the second column). Yesterday, the bottom of column #1 selected the top entry of column #2.
4. Mode "C" display on radar is "OFF". Mode C shows 260, but pilots report 330. DL117 and D1105 both descend, neither can take headings. (Disregard; pilots are voice only)
5. Note: One of the greatest problems with the radar ID is finding the correct call sign because of the small letters and "dancing data blocks."

10-15-82 RUN 2

CONTROLLERS 1/10

1. "It is very difficult to give a fair evaluation of ETABS when the system still appears to be going through a shakedown. The system does not remain up with any reliability.
2. Unable to receive a FDE on AL360, AL304, and BLT126 even though ETABS responded to our input messages with "accept". Data-based error between ETABS and the 9020 system appears to exist.
3. When "no aid" menu is selected and then active flight plan action is taken, the statement "new flight plan" or "stereo plan" comes up on the preview portion of the ID. Why? It serves no purpose. It is not looking for a response."

CONTROLLER 4

1. The ID at the PVD is set up for left-hand operation and the controller is right handed.
2. AL364 couldn't get an FDE on the aircraft although the aircraft was in our sector airspace. A1364: The FDE came up with a fix 00136 E2003 after the aircraft had been handed off and was below our altitude.
3. With the arrangement we are using for sector 02, most AID's never come up on the ID, and most FDE's do not come in the TD.
4. 5:10 p.m. did a re-start on ETABS.
5. When an altitude is marked with a check and then amended, the mark remains in place."

CONTROLLER 7

1. "When removing temporary alt from N5253A, it reported the aircraft at 390
2. Cannot receive FDE on AL360 when not in the AID list.
3. During this run we have not had an FDE when we got the handoff
4. In the remarks section, 3 ***'s appear to show it is truncated. On the remarks for EJ327 it showed "O two engines O***". The last word was "OUT" and it should have spelled it out with only one *
5. Cannot remove FDE on AL414 from information list. Reply received is "No sector postings qualify."
6. D man's attention is solely on the ID and TD. It does not appear that he could help the radar man with a "second pair of eyes." This run is on manual posting
7. If we had an alert tone to sound when we had a new strip to post, then maybe we could watch the radar more."

10-18-82 RUN 1

CONTROLLER 2

1. "A1183 - int alt. deleted from "R" side - did not delete from FDE. D side could not delete it either.
2. AL364 and DL195 - Same as above. Plus, if the D side made the initial entry it still did not delete the int alt."

CONTROLLER 5

1. "Mark menu only marks the one FDE. It should mark all concerned FDE's.
2. Not being able to request an FDE on any aircraft is bad.
3. After entering a reported altitude you are not able to remove the reported altitude.
4. On the interactive some of the aircraft AID's were double brite and underlined?
5. The rte display on the FDE should not split the fixes or the airways."

CONTROLLER 8

1. "TW740 - 4 altitudes (1 Assigned Mode C, 1 Interim reported C, 1 reported altitude, 1 assigned alt.), these are confusing. R controller entered 130, interim entered at 130, controller reported aircraft at 130.
2. Computer performance much improved."

10-18-82 RUN 2

CONTROLLER 3

1. "In the manual mode the D controller went to mark a flight and a "D" appeared at the same time. Instead of marking the flight he deleted it"

CONTROLLER 6

1. Received FDE on AL364 at 170. Shouldn't have received FDE, since we own 180 and above.
2. DL120 int alt. was put in from the R position. The ID message was accepted and it was put on PVD but not updated on FDE.
3. The same problems exist now as last week.
4. Had to work around the NAS system since we are working at position #40 and have to quick look sector 2."

CONTROLLER 9

1. When touching the bottom of list #1 on th ID, the AID of the second aircraft in list #2 is activated.
2. "R" man observes that the same problems that existed last week still exists.
3. One small problem that has been observed is that controllers from each facility comply with unique techniques, procedures, and operations. All are unique to a high percentage, even. This makes cooperation especially necessary but understanding difficult.
4. Reliability does not seem to be improving on the ETABS system.
5. When in manual post and update mode, "D" man observes that almost all (and entirely too much) time is spent posting and updating, with no time left to mark or reposition FDE's.
6. The interest level should be much higher tomorrow when the traffic level is increased. It is predicted "no sweat" for automatic mode but "bad news" for manual.
7. All three controllers agree that in its present form, ETABS would be totally UNACCEPTABLE in the field environment.
8. From the viewpoint of efficiency and reliability, it has only minimal value as a lab (engineering) model. If a similar system is to be pursued for possible field use, important reliability and efficiency modifications need to be made and then another week (or two) of testing be done by these same controllers.
9. A possible source of beneficial information has been overlooked if we are here "only to evaluate a concept" and "not a specific piece of equipment." Why not evaluate, on a point by point and step by step basis, each design characteristic, function and operation? Considerations should be made of efficiency, necessity, desirability, and possible alternates to each function and operation, one at a time (not all at once or "in general")."

10-19-82 RUN 1

CONTROLLER 1

1. "When a par (route info in double brite) is issued, no way could be found how to change double brightness back to normal brightness.
2. Had problems with requesting an FDE. Received a response indicating the message was accepted, but the FDE never appeared on the tabular display. It seems to be easier to force an FDE to another sector than it is to request one for your own sector."

CONTROLLER 7

1. "N280RA - No route of flight in FDE
2. EA183 - No requested alt in FDE
3. No provision for a 6, 7, 10 amendment
4. R man does not appear to be looking at his FDE's at all. I asked him if he had, and he said once or twice "

10-19-82 RUN 2

CONTROLLER 2

1. "They are still having trouble getting the entries in the first try - usually takes two or three "

CONTROLLER 5

1. "Run appeared to go well !!! (for the first time)"

CONTROLLER 8

1. "Requested WX for 11 locations TD showed first five requested then they disappeared. The second set of five appeared and then they disappeared. Only the last four requested WX readouts remained
2. Update EA24 - entire flight plan was underlined "

10-20-82 RUN 1

CONTROLLER 3

1. "Unable to remove interim alt. on AL183 FDE - NAS deletes it from the FDB
2. Unable to request an FDE for a flight if ETABS doesn't send you one.
3. N280RA unable to update assigned alt in FDE. It took four tries then it finally worked."

CONTROLLER 6

1. "Still can't request an FDE using ETABS.
2. Unable to do a 6-7-10 amendment on DL195 and DL120. Rejected saying that END and ACY fixes do not merge.
3. When ETABS goes down and then recycles, all of the remarks on FDE disappear.
4. AL414 - Assigned alt. of 180 put in and accepted. Changed on PVD, but took about 3 minutes before it changed on FDE "

CONTROLLER 9

1. "In attempting the proverbial "6-7-10" amendment (fix-time-route) by accessing the "active FP" menu, the fixes under "fix" and fixes under "route" (menu generated) are not compatible
2. After further attempts, it is apparent that no convenient format or provision has been made for the "6-7-10" amendment.
***Important:** In most centers, the "6-7-10" amendment is almost as important and basic to ATC as making and taking handoffs!

3. No easy accessible provision has been made for route amendments (present position direct) without typing in the "GU" function in the keyboard mode.
4. Couldn't accept H/O on EA108 Response was "verify eligibility," etc Had to use NAS to take H/O.
5. Response for a couple minutes was "00" for all and every entry made "

10-20-82 RUN 2

CONTROLLER 1

1. "AL183 had no assigned altitude on FDE When D position entered an assigned altitude, the message was accepted but altitude still didn't appear on FDE
2. System went down about 5 minutes after it started and never came back up."

CONTROLLER 4

1. "CCC went down about 5 minutes into run."

APPENDIX Q
NARRATIVE COMMENTS TO FORM H
FOLLOW-UP QUESTIONNAIRE

Although form H consisted mainly of rating scale questions, some comments were made by the controller subjects and are documented below.

CONTROLLER 1

- 1 14 "The interactive display deters rather than enhances the concept of electronically displaying flight data and requires more time and precision to make message entries when compared to present NAS system.
- 8 14 I prefer flashing corrected/posted data instead of audible beep.
- 8 16 Use wire touch on the TD not ID.
- 8 28 Using TD to quick look sector is poor.
- 8 38 Smaller strip with less information is good.
- 8 39 Flash new FDE data on TD."

CONTROLLER 3

- 3 2 "Procedures and requirements must change to reduce workload.
- 4 1 Electronic strips have too many sorts and updates on TD with no control.
- 8 32 Do not want "R" or "NR."

CONTROLLER 4

- 1 14 "Too much accuracy required when making entries on the ID and too many entries required.
- 3 15 Frustration is same because it's still a flight strip looking at us
- 3 18 Capacity to handle simultaneous flights has no relation to ETABS.
- 3 22 Not able to place a "C" (for concept) on all answers "

CONTROLLER 5

- 2 13 "The ID characters are too small."

CONTROLLER 8

- 1 14 "The interactive display on the R position is a distraction from the PVD. The ID should be on PVD.
- 4 1 There is too much data in the FDE's.
- 4 2 Touch entry makes too many errors.
- 4 4 There is a visibility problem with TD2."

CONTROLLER 9

- 1 14 (1) "Poorly designed interaction between keyboard and interactive display.
- (2) Menus worked, however there were too many steps to operate the menus.
- (3) Items marked poor would rather be done without - ID and touch entry.

- 2.3 CRT image was stable but FDE's "jumped".
- 3.13 R-D coordination actually stopped during moderate traffic due to complexity of inputs and increased workload. (This was unfavorable) Conceptualized, ETASS should not affect R-D coordination.
- 4.2 If a combination of menu/keyboard were used, benefits would greatly increase.
- 4.10 Automatic strip marking is great. The manual mode we used was too complicated.
- 8.11 Use interactive TD's.
- 8.18 Don't give R-side quick-look capability of the TD - one FDE only, if at all.
- 8.27 Make charts, etc., available for quick look at TD 2 only.
- 8.28 Give quick-look capability for other sectors - not for TD.
- 8.39 Keep FDE from moving around on the TD, manual mode."

CONTROLLER 10

- 8.13 "The possibility of putting one or two FDE's on the PVD has good potential, but not the entire TD. Especially not in either/or situation of TD or radar. Better situation would be TD presented on PVD in conjunction with radar when the traffic is light.
- 8.22 For a color TD on ID you would have to know that ATCS is color blind to even consider the possibility of using color for control purposes. Potential and benefits depend on the intended use of color. With the exception of the above comments, I think all of the ideas mentioned above have very good potential depending on how they are developed and incorporated into the ATC system."
- 8.23

APPENDIX R
 CATEGORIZED FORM F
 NARRATIVE COMMENTS

Several questions on the Wrap-Up questionnaire Form F, required narrative comments. All of these narrative comments were reviewed as to content and separated into six categories for frequency analysis. The six categories were:

- 1 General Concepts
- 2 Functional Requirements
- 3 Workload and Performance
- 4 ATC Procedures
- 5 Tabular Display
- 6 Interactive Display

The following frequency counts of comments per category show how many controllers made each of the comments. Only those comments with a frequency of 2 or more were listed. The comments listed are paraphrases of the controller responses.

ETABS General Concept

<u>Number of Controllers</u>	<u>Comments</u>
10	The overall concept of ETABS is good
10	The electronic tabular display is preferred over strips.
9	The equipment needs proper adaptation
7	ETABS eliminates bothersome strips, holders, printers, and noise.
3	ETABS enhances recordkeeping
2	Automatic updating is a good feature
2	Touch entry is a good feature.
2	Menus need refining.

Functional Requirements

<u>Number of Controllers</u>	<u>Comments</u>
3	Locate the ID vertically below the TD and PVD.
3	Make the PVD interactive
3	Use larger touch areas for the ID.
3	Give the controller the option of selecting displayed FDE fields on the TD
2	Combine the ID and TD into one display.
2	Make an easier method to request an FDE
2	Make the FDE smaller

Workload and Performance

<u>Number of Controllers</u>	<u>Comments</u>
4	Response is too slow
3	The system is too unreliable
2	The system requires too many entries
2	The overall efficiency of ATC is decreased using ETABS

ATC Procedures

<u>Number of Controllers</u>	<u>Comments</u>
5	Using ETABS would mean changing strip marking procedures.
2	An automatic "R" should appear on strips

Tabular Display

<u>Number of Controllers</u>	<u>Comments</u>
7	Make the TD interactive.
3	Allow the TD to swivel (rotate) for R-side viewing.
2	Use a slewball, joystick, or light pen for TD entries
2	Displayed strips (FDE's) are more readable than paper strips
2	Too much data is present - crowded too close together.
2	Using the TD can be immediately implemented in the field.

Interactive Display

<u>Number of Controllers</u>	<u>Comments</u>
8	The ID is too distracting, attention intensive.
6	The menus have redundant information
5	The ID is too time requiring for the R-side.
4	The ID needs tilt and rotate provision.
3	The R-side ID needs tailoring to delete D-side functions
3	The response time is too slow
2	Make the ID <u>surface</u> interactive, not light beam.
2	Using menus can expedite entries when properly adapted
2	There is little coordination of QAK and ID inputs.

APPENDIX S

QUESTIONNAIRE DESIGN CONSIDERATIONS

1. The first consideration in the design of any questionnaire is to obtain as much information as possible with a minimum number of questions. Overburdening the participants with an excessive number of questions can cause a negative reaction which might invalidate the results.
2. The second major consideration is to query the participants as soon as possible after they have been exposed to the parts of the system on which information is needed. (This was the main reason for the existence and scheduling of the eight different ETABS forms.)
3. The third major consideration is that answering a questionnaire is both a teaching and a learning process. It is important to develop a mental set in the participants by allowing them to preview the forms or by giving the form more than once. This gives them some idea of what to look for in the system. This was the reason that all the specific questions asked in the Wrap-Up questionnaire (form F) were asked in earlier forms. Information was also presented in the questionnaires which was intended to help the participants learn to use the ETABS, e.g., Controllers Messages on pages 2 and 3 of form B.
4. A fourth major consideration is to cover all parts of the system about which information is wanted, and to realize that no matter how thorough a questionnaire is, it is unlikely to cover all of them. For this reason, the ETABS tabular array question sets with columnar categories contained a last row entitled "Other." Each tabular array question set also contained space for comments following the array, and open-ended essay type questions were used in the questionnaires.
5. A fifth major consideration is to ask the questions in an unbiased fashion. Both the content (the question itself) and the format (the way the question is phrased and arranged on the page) must be such that they do not lead the participant to answer one way or the other. A questionnaire can be biased by the items included or not included in it (Poulton, 1982). Since design of a questionnaire to evaluate a system requires knowledge about that system, this knowledge often includes information about the strong or weak points of the system. A questionnaire designer who feels strongly about a system, either pro or con, might tend to inadvertently include more items supporting his view and fewer items negating his view. Thus, inclusion of truly representative set of questions in a questionnaire is essential to a balanced evaluation of a new system.
6. A sixth major consideration is to make the questions easy to answer and analyze. This is the reason for grouping related items within a tabular array and providing (in this case) columns with labeled headings in which the participant can place a check for his answer for each item. Other related techniques are: using consistent scales, using simple category scale headings; using direct, brief, and descriptive question wording, and asking only one question at a time (no compound questions). This makes answering easier and facilitates the analysis and interpretation of the questionnaire. The design of the tabular question sets with the individual questions arrayed as rows down the left side of the page with the seven

rating categories as columns, so that each question can be easily answered by a mark in the appropriate column, is the format found to be optimum by Wright and Bernard, 1978.

7. A seventh major consideration is to be able to measure changes of opinions on key aspects of the system as time goes on. Early in an evaluation there may be an initial negative reaction due just to frustration of learning needed skills. As experience with the system increases, the opinion of the participant is likely to change. If the system is good, the opinion should become more favorable with time. This was the reason for some of the repeated questions in the Post-Run, form E, administrations and the duplication of questions in Post Training, form C, and Wrap-Up, form F.

8. Experience has shown that opinions about a system are more accurately represented by totaled or combined responses to a series of specific questions than by response to a single general question. Thus, the eighth major consideration is the arrangement of the questions within a form. In the case of ETABS, the questions presented first were the more specific or detailed ones. The more general "summing-up" questions were placed at the end of the questionnaire. Doing this allowed the participant to review all of the individual items which might have affected his opinion prior to making overall judgments of suitability, system effectiveness, etc.

9. Consideration number nine is to avoid the use of two-category questions (e.g., those with yes or no, or agree or disagree answers) in studies with fewer than 30 participants. This consideration involves the sensitivity of the statistical tests used to determine the degree of significance of the mean answers. Typically, two-category questions are analyzed using the nonparametric binomial sign test. This test uses the a priori assumption that responses in both categories are equally likely; that is, it is comparable to a flip of a fair coin for each response of a participant. If the number of participants is small, an unreasonably large preponderance of answers in one direction must be obtained for a 0.05 level of probability. For example, if a sign test were used in this ETABS study, 9 out of the 10 participants would have to agree to achieve a 0.05 level of probability. With 30 participants, however, only 21 of them would have to agree to achieve the 0.05 level. In the first case a 90 percent majority is needed, while in the second only a 70 percent majority is needed. Thus, if two category scales and a sign test are used, a minimum of 30 participants should rate the system. The 0.05 probability level means that a split as extreme or greater than that obtained would, if using a fair coin, occur (on the average) only once in 20 times. The alternate hypothesis is that there is significant agreement among the participants; i.e., they are not equally likely to choose one of the two alternatives.

Most of the category scales in this study used seven categories and a t score analysis for the determination of significance. Five categories are more commonly used, for example, the Likert scale (Oppenheim, 1966). There is, however, a tendency for participants to avoid the use of the scale extremes. Thus, if the extremes are eliminated, a five-category scale becomes a three-category scale, and a seven-category scale is reduced to five categories. The use of seven categories provided more options for the participants and more information for the analyst.

10. Questionnaire design consideration number 10 is the use of redundancy. It is helpful to ask the same sort of question in different ways and in different contexts because not all questions will be clear questions. Clear questions are ones which are interpreted similarly by most of the participants; however, a consensus might not be found on all the clear questions. There might be real differences of opinion on the particular question. Thus, the statistical treatment of responses will filter out most unclear as well as some clear questions on which there is no consistent response.

From the statistical analysis performed on the questions in this study, a significant consensus was indicated if the mean rating for 10 subjects differed from the midscale category value by more than 2.26 standard errors of the mean (t-score exceeding 2.26). A finding of nonsignificance can happen two ways: either most of the participants rated the question close to midscale (say FAIR) or the ratings were scattered across the scale from VERY POOR to VERY GOOD. When the ratings are scattered across the scale, it can be due to either the presence of real differences of opinion, differing interpretations of the questions, or differing viewpoints (R-side versus D-side or actual versus concept).

In this study, only the questions with significant ($\alpha = 0.05$) t-scores were discussed in the text. Typically, this reduced the number of items for discussion by about two-thirds. The unclear questions (scattered ratings) dropped out along with those on which the ratings clustered around midscale. Thus, some of the questions were eliminated from discussion; but those items on which the ratings were generally either above or below average emerged as significant. Clusters of significant findings then indicated which parts of the system were seen as good and which parts were seen as poor. Information from the comments and the narrative answers shed light on the reasons for these significant clusters. The 0.05 alpha level was chosen for significance for all questions.