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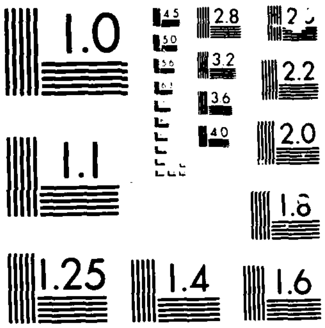
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AD-A169 565

Final Report

on

Soldier Data Tag Study Effort

(Contract Number DATB60-84-C-0146)

Appendices

Submitted to
U.S. Army Soldier Support Center
Fort Benjamin Harrison, Indiana 46216

Battelle
Columbus Division

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FINAL REPORT

Submitted Under
Contract Number DATB60-84-C-0146

on

SOLDIER DATA TAG
STUDY EFFORT

APPENDICES

to

U.S. Army Soldier Support Center
ATZI/DDS (Mr. Occhialini)
Fort Benjamin Harrison, IN 46216

June 10, 1985

The views, opinions, and findings contained in this document are those of the authors and should not be construed as official Department of the Army position, policy, or decision unless so designated by other official documents.

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APPENDIX A

COST/BENEFIT INFORMATION

The "Cost Data Sheets" and "Data/Computation Sheets" found in this Appendix are in the format required by Army Pamphlets 11-2, 11-3, 11-4, and 11-5. Each cost data sheet has a cell number in the upper right hand corner which corresponds to a row in Figure 5.1. Each row of Figure 5.1 has at least one cost data sheet.

Divider sheets with cell numbers equal to the rows of Figure 5.1 are in front of their associated cost data sheets. Data/computation sheets follow behind the cost data sheet. Each data/computation sheet corresponds to on or more columns of Figure 5.1.

In order to use this Appendix, the reader should look at Figure 5.1 and select the row and column of the entry of interest. The reader should then turn to the divider sheet with the cell number equal to the row of interest. Behind the divider will be the equation used to compute the entry. The data used in the equation will be on a data/computation sheet directly behind the cost data sheet. The cell number at the top of the page corresponds to the row and the column of Figure 5.1.

<u>Cell Number 1.1</u>

Hardware

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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MICRO-CHIP
PERSONNEL
DATA RECORD
INTERFACE

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The scope of the current study effort is directed at an analysis of the Soldier Data Tag System Concept during both wartime and peacetime scenarios. The current study is directed primarily at Army personnel systems, medical systems, and financial systems. However, it is likely that the SDT system will have wider applications. For example, in an earlier study conducted for DoD in the logistics area, Battelle identified many feasible, cost-effective applications for portable

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BLOCK 20. (continue)

data carriers. These included inventory tags, maintenace and repair records, and manifest lists.
Data acquisiton and analysis for the project was limited to that available on the SDT system concept demonstrations ane emerging DoD automation systems. No detailed system design or laboratory experiments were performed.
The benefits from the SDT would be expected to lie in the areas of: improved readiness in peacetime, redundancy and backup of data for the on-line automation systems, overall improvement to the speed and accuracy of routine data entries, ability to provide a transfer data record (TDR) which replaces the error-prone paper system, and improved information processing on the battlefield.
As a result of the study, the major peacetime benefits identified for the system are primarily enhancements to the automated Army systems coming on-line. These enhancements include:
automated retrieval of data files without keyboard data entry;
accessibility of data when the primary ADP system is unavailable;
transportation of machine readable data to new locations in rugged format; and
ability to handle the unanticipated file exchange problems that exist when a transferred soldier is diverted to a new station at the last minute.

Cell No.: 1.1

Date: 3/7/85

Cost Data Sheet

Item: Hardware

Cost Data Expression:

$H_{R\&D}$ = Estimate based upon SDT Program Office projected Budget

= $1.9 million

Included: Future Costs

Excluded: Sunk Costs

Variables:

Cell Number 1.2

Software

Cell No.: 1.2

Date: 3/7/85

Cost Data Sheet

Item: Software

Cost Data Expression:

$$Sft = M_h \times I_n + M_s \times A_n$$

Included: Interface and application software for major Army systems

Excluded: Minor systems/analyses

Variables: M_h = Number of major hardware systems requiring interface software

I_n = Cost to interface with a hardware system

M_s = Number of applications to cover basic M/P/F applications

A_n = Cost per application software

Assumptions

- Similar read/write methods for all size chips
- High percentage of Army personnel in software development
- SDT1 would primarily serve as read only
- Assumes software for application analyses already exists--that is, personnel analyses are considered contained in the personnel software systems being developed.

Cell No. 1.2, M/P/F

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
M_h	5	Estimate from Battelle expert
M_s	100	Estimate from Battelle expert
I_n (SDT1) (SDT2/3)	\$20K \$25K	Estimate from Battelle expert
A_n (SDT1) (SDT2/3)	\$2K \$10K	Estimate from Battelle expert

Computation:

$$Sft(SDT1)^* = 5 \times 20 + 100 \times 2K$$
$$= \$300,000$$

$$Sft(SDT2/3)^* = 5 \times 25 + 100 \times 10K$$
$$= \$1,125,000$$

* Cost distributed evenly across M/P/F

Cell Number 2.1

Cost of Initial Tags

Cell No.: 2.1

Date: 2/6/85

Cost Data Sheet

Item: Cost of Initial Tags

Cost Data Expression:

$$C_t = \sum_{i=1}^{10} N_{t,i} \cdot C_{t,i}$$

Included: Cost of initial tags (1,737,519 total)

Excluded: Initial spares and recurring spares

Variables: i = Year 1-10

$N_{t,i}$ = Number of initial tags procured in year i

$C_{t,i}$ = Cost per tag in year i

Note: $\sum_{i=1}^{10} N_{t,i}$ = **1,737,519 (total number of Active, Reserve, and Guard Army Personnel, Defense '84)**

Cell No. 2.1, SDT1 Common

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$C_{t,i}$		
$i = 1\text{-}10$	\$3	Based on vendor estimates
$\sum_{i=1}^{10} N_{t,i}$	1,737,519	Defense '84 total of Army Active, Reserve, and Guard personnel

Computation: $C_t = \$3 \times 1{,}737{,}519 = \$5{,}212{,}557$

Data/Computation Sheet (Continued)

FY	Planned[(1)] Buy	Initial[(3)] Buy ($N_{t,i}$)	Initial[(4)] Spares ($N_{in,i}$)	O&S[(2)] Spares ($N_{os,i}$)
'89	970,195	740,607	229,588	--
'90	970,195	565,349	175,258	229,588
'91	970,195	431,564	133,785	404,846
'92	538,631			538,631
'93	538,631			538,631
'94	538,631			538,631
'95	538,631			538,631
'96	538,631			538,631
'97	538,631			538,631
'98	538,631			538,631

(1) Planned production schedule from SDT Program Office. Assumes all initial procurements are complete after three years.

(2) $$\text{O\&S Spares}_{\text{Year } i} = 0.31^{(5)} \times \sum_{j=\text{Year } 1}^{i-1} \text{Initial Buy}_j$$

(3) $$\text{Initial Buy}_{\text{Year } i} = (\text{Planned Buy}_{\text{Year } i} - \text{O\&S Spares}_{\text{Year } i})/1.31$$

(4) $$\begin{aligned}\text{Initial Spares} &= \text{Planned Buy}_i - \text{O\&S Spares}_i - \text{Initial Buy}_i \\ &= 0.31 \times \text{Initial Buy}_i\end{aligned}$$

(5) 0.31 is percentage of SDTs turning over per year. Equals a 5 percent loss (based upon current dog tag losses), 18 percent turnover (based on Army Force Planning Cost Handbook) assuming retention of tag upon discharge, and 10 percent failure rate of the 77 percent not lost or turned over (+8%), for a total of 31 percent replacement/year. Note: 18 percent turnover is assumed to allow discharged or retired personnel to carry their medical records. It is unknown whether the tags will stay with original owners or recycled at this time. Worse case (in terms of cost) was assumed; 18 percent are lost due to turnover per year and would have to be replaced.

Cell No. 2.1, SDT2 Common

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$C_{t,i}$ $i = 1\text{-}10$	\$30	SDT Program Office
$\sum_{i=1}^{10} N_{t,i}$	1,737,519	See Cell No. 2.1, SDT1 Common, Page 2

Computation: $C_t = \$30 \times 1{,}737{,}519 = \$52{,}125{,}570$

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$C_{t,i}$		
i = 1	$30[1]	SDT Program Office
i = 2	$200	Based upon vendor estimates
i = 3	$200	
i = 4	$150	Based upon vendor estimates
i = 5	$150	
i = 6	$150	
i = 7	$100	Assumed based upon current trends
i = 8	$100	
i = 9	$100	
i = 10	$100	
$N_{t,i}$		
i = 1	740,607[1]	
i = 2	565,349	
i = 3	1,172,171	
i = 4	0	
i = 5	0	See Cell No. 2.1, SDT1, Common, Page 2
i = 6	0	
i = 7	0	
i = 8	0	
i = 9	0	
i = 10	0	

Computation:

$$C_t = \$30 \times 740{,}607 + \$200 \times 1{,}737{,}520 = \$369{,}722{,}210$$

(1) Assumes SDT3 production starts in FY90. SDT2 produced for year '89 and then replaced with SDT3. Production schedule for SDT3 initial buy will replace the initial SDT2 buy in year 3.

Cell Number 2.2

Equipment Investment Cost

Cell No.: 2.2

Date: 2/6/85

Cost Data Sheet

Item: Equipment Investment Cost

Cost Data Expression:

$$C_E = \sum_{i=1}^{n} C_{e,i} \times N_{e,i}$$

Included: Cost of initial equipment - Hand-helds and reader/writers

Excluded: Cost of initial spares and recurring costs

Variables: i = Number of equipment type (1 = Tag Receptacle, 2 = Hand-Held Unit)

n = Total number of equipment types = 2 (Program Office/Battelle Experts)

$C_{e,i}$ = Cost per unit for equipment type i

$N_{e,i}$ = Number of units of equipment type i

Cell No. 2.2, M

Page No. 1

Data/Computation Sheet

Data:

Variable		Values(s)	Source(s)
$C_{e,1}$		\$200	SDT Program Office
$C_{e,2}$		\$1,500	
$N_{e,1}$	(SDT1)	600	Assumed ½ x SDT 2 or 3
	(SDT2 or 3)	1,190(1)	
$N_{e,2}$	(SDT1)	2,679	Assumed ½ x SDT 2 or 3
	(SDT2 or 3)	5,358(2)	

Computation: C_E for SDT1 = \$200 x 600 + \$1,500 x 2,679

= \$4,138,500

C_E for SDT2 or SDT3 = \$200 x 1190 + \$1,500 x 5,358

= \$8,275,000

(1) A buy of 15,000 tag receptacles was identified by the SDT Program Office from previous Program Office estimates--89.6% are personnel, 7.9% are medical, and 2.5% are finance.

(2) 6,000 identified; previous breakout from Program Office was 89.3% medical, 10.7% finance.

Cell No. 2.2, P

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$C_{e,1}$	\$200	SDT Program Office
$C_{e,2}$	\$1500	
$N_{e,1}$ (SDT1)	6,720	Assumed ½ x SDT2 or 3
(SDT2 or 3)	13,440	See 2.2, M
$N_{e,2}$ (SDT1)	--	
(SDT2 or 3)	--	

Computation:

C_E for SDT1 = \$200 x 6720
= \$1,344,000

C_E for SDT 2 or 3 = \$200 x 13,440
= \$2,688,000

Cell No. 2.2, F

Page No. 1

Data/Computation Sheet

Data:

Variable		Values(s)	Source(s)
$C_{e,1}$		\$200	SDT Program Office
$C_{e,2}$		\$1500	
$N_{e,1}$	(SDT1)	190	Assumed ½ x SDT2 or 3
	(SDT2 or 3)	375	SDT Production Plan
$N_{e,2}$	(SDT1)	321	Assumed ½ x SDT2 or 3
	(SDT2 or 3)	642	See Cell No. 2.2, M

Computation:

C_E for SDT1 = \$200 x 190 + \$1,500 x 321

= \$519,500

C_E for SDT 2 or 3 = \$200 x 375 + \$1,500 x 642

= \$1,038,000

Cell Number 2.3

Investment Training Cost

Cell No.: 2.3

Date: ______________

Cost Data Sheet

Item: Investment Training

Cost Data Expression:

$$C_i = \emptyset$$

Included:

Excluded:

Variables:

Note: Investment training cost is included under site activation, Cell No. 2.5

Cell Number 2.4

Cost of Technical Data (T.O.s)

Cell No.: 2.4

Date: 2/6/85

Cost Data Sheet

Item: Cost of Technical Data (T.O.s)

Cost Data Expression:

$$TD = N_p \times C_p$$

Included:

Excluded:

Variables: C_p = Cost per page

N_p = Number of pages

Cell No. 2.4, Common

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
N_p		
SDT1	25	
SDT2	80	SDT Program Office estimates
SDT3	1000	
C_p	$600	Based upon '79 M1 Cost Baseline of $440/page. Assuming cost/page for SDT < cost/page for M1, reduced cost to $400/page ('79 dollars) and inflating 9%/year equals about $600/page.

Computation:

C_p for SDT1 = $600 x 25
= $15,000

C_p for SDT2 = $600 x 80
= $48,000

C_p for SDT3 = $600 x 1000
= $600,000

Cell Number 2.5

Site Activation Cost

Cell No.: 2.5

Date: 3/4/85

Cost Data Sheet

Item: Site Activation Cost

Cost Data Expression:

$$SA = \Big[\underbrace{N_s \times CH}_{\text{Miscellaneous Aid/Checks}} + \underbrace{N_{e,1} \times S_t}_{\text{Equipment Setup}} + \underbrace{N_T \times I_t}_{\text{Initiate Tags}} + \underbrace{N_p \times N_s \times T_t}_{\text{Trainees}} + \underbrace{N_t \times T_{tr} \times N_{tr}}_{\text{Trainers}} \Big]$$

$$\times M_{yr} + \underbrace{Trav \times (N_p \times N_s + N_t \times N_{tr})}_{\text{Travel Expenses}}$$

Included: Equipment setup, initialization of tags, cost of training trainees, trainer costs, miscellaneous aid

Excluded:

Variables:

- CH = *Miscellaneous aid/site checks (man-years) per site*
- I_t = Time to initialize tag with info (man-years)
- M_{yr} = Cost per man-year
- $N_{e,1}$ = Number of tag receptacles
- N_p = Number of persons to be trained for application per site
- N_s = Number of sites
- N_T = Total number of tags
- N_t = Number of trainers per application
- N_{tr} = Number of training sessions (to be held at regional sites)
- S_t = Equipment setup time (in man-years) per equipment
- T_t = Training time for application per person (man-years)
- T_{tr} = Trainer time for application (man-years) per trainer per training session
- $Trav$ = Travel expense per person

Cell No. 2.5, M

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
CH	$\frac{7 \text{ Man-Hours}}{3 \text{ Applications}}/2000$ = mn-yrs	Tag experts, 1/85.
I_t		
SDT1	1.0 hrs/2000 = mn-yrs	Tag and M, P, F experts.
SDT2 or 3	1.5 hrs/2000 = mn-yrs	Interviews 1/85 and 2/85.
M_{yr}	$19,035	Army Force Planning Cost Handbook
$N_{e,1}$ (M only)		
SDT1	600	(See Cell No. 2.2, M)
SDT2,3	1,190	SDT Program Office Production Plan
N_p	2	Tag and M, P, F experts. Interviews 1/85 and 2/85.
N_s	443	Defense '84
N_T	1,737,519	Defense '84
N_t	5 (total)/3 (Applications)	Tag and M, P, F experts. Interview 2/85.
N_{tr}	24	Tag and M, P, F experts. Interview 2/85.
S_t	5 min/120,000 = mn-yrs	Tag experts. Interview 1/85.
T_t	16 hrs/2000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
T_{tr}	32 hrs/2000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
Trav	$100	Assumes all Army.

Computation:

$$\text{SA for SDT1} = \{443 \times \frac{7/3}{2000} + 600 \times \frac{5}{120{,}000} + 1{,}737{,}519 \times \frac{1}{2000} + 2 \times 443 \times \frac{16}{2000}$$

$$+ \frac{5}{3} \times \frac{32}{2000} \times 24\} \times \$19{,}035 + \$100 \times (2 \times 444 + 5 \times 24)$$

$$= \$16{,}794{,}853$$

$$\text{SA for SDT2 or 3} = \text{SA for SDT1} + [0.5/2000 \times 1{,}737{,}519 \text{ (additional Init Time)}$$

$$+ \frac{5}{120{,}000} \times (1190 - 600)] \times \$19{,}035 \text{ (Difference in tag receptacles}$$

$$= \$25{,}063{,}739$$

Cell No. 2.5, P

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
CH	$\frac{7 \text{ Man-Hours}}{3 \text{ Applications}}/2000$ = mn-yrs	Tag experts, 1/85.
I_t	2 min/120,000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
M_{yr}	\$19,035	Army Force Planning Cost Handbook
$N_{e,1}$ (P only)		
SDT1	6,720	(See Cell No. 2.2, P)
SDT2,3	13,440	SDT Program Office Production Plan
N_p	2	Tag and M, P, F experts. Interviews 1/85 and 2/85.
N_s	443	Defense '84
N_T	1,737,519	Defense '84
N_t	5 (total)/3 (Applications)	Tag and M, P, F experts. Interview 2/85.
N_{tr}	24	Tag and M, P, F experts. Interview 2/85.
S_t	5 min/120,000 = mn-yrs	Tag experts. Interview 1/85.
T_t	16 hrs/2000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
T_{tr}	32 hrs/2000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
Trav	\$100	Assumes all Army.

Computation:

$$\text{SA for SDT1} = \{443 \times \frac{7/3}{2000} + 6720 \times \frac{5}{120,000} + 1,737,519 \times \frac{2}{120,000}$$

$$+ 2 \times 443 \times \frac{16}{2000} + \frac{5}{3} \times \frac{32}{2000} \times 24\} \times \$19,035 + 100$$

$$\times (2 \times 443 + 5 \times 24)$$

$$= \$814,098$$

$$\text{SA for SDT2, SDT3} = \text{SA for SDT1} + \frac{5}{120,000} \times \$19,035$$

$$\times (13,440 - 6720) \text{ (the difference in tag receptacles)}$$

$$= \$819,428$$

Cell No. 2.5, F

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
CH	$\frac{7 \text{ Man-Hours}}{3 \text{ Applications}}/2000$ = mn-yrs	Tag experts, 1/85.
I_t	1 min/120,000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
M_{yr}	$19,035	Army Force Planning Cost Handbook
$N_{e,1}$ (F only)		
SDT1	190	(See Cell No. 2.2, F)
SDT2,3	375	SDT Program Office Production Plan
N_p	2	Tag and M, P, F experts. Interviews 1/85 and 2/85.
N_s	443	Defense '84
N_T	1,737,519	Defense '84
N_t	5 (total)/3 (Applications)	Tag and M, P, F experts. Interview 2/85.
N_{tr}	24	Tag and M, P, F experts. Interview 2/85.
S_t	5 min/120,000 = mn-yrs	Tag experts. Interview 1/85.
T_t	16 hrs/2000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.
T_{tr}	32 hrs/2000 = mn-yrs	Tag and M, P, F experts. Interviews 1/85 and 2/85.

Computation:

$$\text{SA for SDT1} = \{443 \times \frac{7/3}{2000} + 190 \times \frac{5}{120{,}000} + 1{,}737{,}519 \times \frac{1}{120{,}000}$$

$$+ 2 \times 443 \times \frac{16}{2000} + \frac{5}{3} \times \frac{32}{2000} \times 24\} \times \$19{,}035$$

$$+ 100 \times (2 \times 443 + 5 \times 24)$$

$$= \$533{,}035$$

$$\text{SA for SDT2, SDT3} = \text{SA for SDT1} + \frac{5}{120{,}000} \times \$19{,}035$$

$$\times (375 - 190) \text{ (the difference in tag receptacles)}$$

$$= \$533{,}451$$

Cell Number 2.6.1

Cost of Tag Initial Spares

Cell No.: 2.6.1

Date: 3/5/85

Cost Data Sheet

Item: Cost of Tag Initial Spares

Cost Data Expression:

$$IS = \sum_{i=1}^{10} N_{in,i} \times C_{t,i}$$

Included: Initial Spares

Excluded: Initial Buy, Recurring Spares

Variables: $N_{in,i}$ = Number of initial tags procured in year i

$C_{t,i}$ = Cost of tag in year i

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$\sum N_{in,i}$	538,631	See Cell No. 2.1 (Cost of Initial Spares Page 2, SDT1 Common
$C_{t,i}$		
i = 1,10	\$3	Based on vendor estimates

Computation: $IS = \$3 \times \sum_{i=1}^{10} N_{in,i} = \$3 \times 538{,}631 = \$1{,}615{,}893$

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$\sum N_{in,i}$	538,631	See Cell No. 2.1 (Cost of Initial Spares), Page 2, SDT1 Common
$C_{t,i}$ $i = 1\text{-}10$	\$30	SDT Program Office

Computation: $IS = \$30 \times 538{,}631 = \$16{,}158{,}930$

Cell No. 2.6.1, SDT3 Common

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$N_{in,i}$		
i = 1	229,588	See Cell No. 2.1 (Cost of Initial Spares, Page 2, SDT1 Common)
i = 2	175,258	
i = 3	133,785	
i = 4-10	0	
$C_{t,i}$		
i = 1	$30[1]	
i = 2	$200	
i = 3	$200	

Computation: IS = $30 x 229,588 + $200(175,258 + 133,785) = $68,696,240

(1) See Cell No. 2.1, SDT3 Common, Page 1

Cell Number 2.6.2

Cost of Equipment Initial Spares

Cell No.: 2.6.2

Date: 3/5/85

Cost Data Sheet

Item: Initial Spares, Equipment

Cost Data Expression:

$$IE = F \times C_E$$

Included: Initial Equipment Spares (tag receptacles and hand-held readers)

Excluded: Initial Buy, Recurring Spares, Tag Costs

Variables: F = Portion of equipment replaced per year

C_E = Equipment Investment Cost (Cell No. 2.2)

Note: One year initial spares is assumed since lead time is generally one year. This may or may not be true for SDT equipment.

Cell No. 2.6.2, M

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
F	0.10	Assuming total replacement in 10 years
C_E (Medical only)		Computed--See Cell No. 2.2
SDT1	\$4,138,500	
SDT2,3	\$8,275,000	

Computation: IE_{SDT1} = 0.10 x \$4,138,500 = \$413,850

$IE_{SDT2/3}$ = 0.10 x \$8,275,000 = \$827,500

Cell No. 2.6.2, P

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
F	0.10	Assuming total replacement in 10 years
C_E (Personnel)		
SDT1	\$1,343,000	Computed--See Cell No. 2.2
SDT2,3	\$2,688,000	

Computation:

$$IE_{SDT1} = 0.10 \times \$1,344,000 = \$134,400$$

$$IE_{SDT2/3} = 0.10 \times \$2,688,000 = \$268,800$$

Cell No. 2.6.2, F

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
F	0.10	Assuming total replacement in 10 years
C_E (Facilities only)		
SDT1	\$ 519,500	Computed--See Cell No. 2.2
SDT2,3	\$1,038,000	

Computation: $IE_{SDT1} = 0.10 \times \$519,500 = \$51,950$

$$IE_{SDT2/3} = 0.10 \times \$1,038,000 = \$103,800$$

Cell Number 3.1

Facilities

Cell No.: 3.1

Date: 3/5/85

Cost Data Sheet

Item: Facilities

Cost Data Expression:

No addition or reduction of facilities identified

Included:

Excluded:

Variables:

Cell Number 3.2.1

Personnel (Transactions)

Cell No.: 3.2.1, M

Date: 3/5/85

Cost Data Sheet

Item: Personnel (Transactions)

Cost Data Expression:

$$PT = \frac{T \times S}{60 \times Y} \times C \times N \times F_t$$

Included:

Excluded:

Variables:

T	=	Transactions - active Army, Reserve, and Guard
S	=	Time savings (or addition) in minutes per transaction per person
Y	=	Hours per person-year
C	=	Cost/person/year
N	=	Number of persons in transaction
F_t	=	Equivalent years of full benefits

Cell No. 3.2.1, M

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
T	8,811,615	U.S. Army, Health Services Command
S	-14	Battelle Medical Expert(1)
Y	2,000	50 40-hour weeks assumption
C	$19,035	Army Force Planning Cost Handbook
N	2	Assumption
F_t	9.2	SDT Production Schedule

Computation:

$$PT = \frac{8{,}811{,}615 \times -14}{60 \times 2000} \times 19{,}035 \times 9.2$$

$$= -\$360{,}058{,}449$$

(1) Based upon time motion studies of Army medical facilities and expert opinion. Current time to get information to get file, and then to retrieve file averages 15 minutes. Battelle expert believes 14 minutes could be saved if SDT were used to retrieve the file.

DATA/COMPUTATION SHEET (Continued)

F_t:

FY	No. Tags in Field	Portion of Total to be in Field
89	740,607	0.4262
90	1,305,956	0.7516
91	1,737,519	1.00
92-98	1,737,519	1.00 (7 years)
	Total:	9.2

$9.2 = F_t \Longrightarrow$ Portion of 10 years that are benefits at full value

Cell No.: 3.2.1, P or F

Date: 3/5/85

Cost Data Sheet

Item: Personnel (Transactions)

Cost Data Expression:

$$PT = \frac{M_{yr}}{2000} \times F_t \left\{ A \sum_{j=1}^{n} (P_{t,j} \times R_j) + RG \sum_{j=1}^{n} \left(P_{t,j} \times \frac{R_j}{2}^{*}\right) \right\}$$

$$= \frac{M_{yr}}{2000} \times F_t \times \sum_{j=1}^{n} (P_{t,j} \times R_j) \times \left(A + \frac{RG}{2}\right)$$

Included:

Excluded:

Variables:

A = Number of Active Army Personnel

RG = Number of Army Reserve and Guard Personnel

j = Index of different trasaction types

n = Total number of transaction types

$P_{t,j}$ = Difference in personnel time per transaction type; between having SDT and not having SDT (mn hrs)

R_j = Rate (per soldier per year) of transaction type j

M_{yr} = Cost per manyear

F_t = Time Factor = equivalent number of years being costed.

2000 = Number of mn-hrs/mn-yr

*Assuming Reserve and Guard rates = 50% of Active transaction rates

Data/Computation Sheet

Data:

Variable		Values(s)		Source(s)
n		7		Tag, M, P, F Experts, 1/85, 2/85
F_t		9.2		See Cell 3.2.1, M, Page 2
$P_{t,j}$		SDT_1	SDT_{2or3}	
(Inproc)	j=1	- .2875	- 2.875	P Experts 1-2/85
(Outproc)	j=2	- .2875	- 2.875	P Experts 1-2/85
(Update file)	j=3	-0.47	- 0.47	P Experts 1-2/85
(Tag Update)	j=4		+ 0.03	P Experts 1-2/85
(Record Initiate)	j=5		- 0.17	P Experts 1-2/85
(Reconstruct)	j=6		-16.92	P Experts 1-2/85
(Errors)	j=7	-0.08	- 0.08	PRIDE Information System
R_j	j=1	0.4	0.4	P Experts 1-2/85
	j=2	0.4	0.4	P Experts 1-2/85
	j=3	0.2	11.2*	P Experts 1-2/85
	j=4		3.5	P Experts 1-2/85
	j=5		0.18	P Experts 1-2/85
	j=6		0.05	P Experts 1-2/85
	j=7	0.254	0.254	PRIDE Information System
A		785,806		Defense '84
RG		951,713		Defense '84
Myr		\$19,035(1)		Army Force Planning Cost Handbook

Computation:

$$PT(SDT1) = \frac{19{,}035}{2000} \times 9.2 \times \left(785{,}806 + \frac{951{,}713}{2}\right) \times (-0.2875 \times 0.8$$

$$- 0.47 \times 0.2 - 0.08 \times 0.254)$$

$$= -\$4{,}134{,}551 \times 9.2 = -\$38{,}037{,}867 \quad \text{(200 mn-yrs/yr saving)}$$

$$PT(SDT2,3) = \frac{19{,}035}{2000} \times 9.2 \times \left(785{,}806 + \frac{951{,}713}{2}\right) \times (-2.875 \times 0.8$$

$$- 0.47 \times 11.2 + 0.03 \times 3.5 - 0.17 \times 0.18 - 16.92 \times 0.05$$

$$- 0.08 \times 0.254)$$

$$= -\$100{,}336{,}824.9 \times 9.2 = -\$923{,}098{,}789 \quad \text{(5000 mn-yrs/yr saved)}$$

(1) Assuming E-6 as average personnel level

***0.2 = Error savings equal to file update**

Cell No. 3.2.1, F

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
n		
F_t		
$P_{t,j}$		
j=1		
j=2		
j=3		
j=4		
j=5		
j=6		
j=7		Qualitative info received
R_j j=1		See results in report
j=2		under Cost/Benefit Analysis
j=3		
j=4		
j=5		
j=6		
j=7		
A	785,806	Defense '84
RG	951,713	Defense '84
Myr	$19,035 (1)	Army Force Planning Cost Handbook

Computation:

PT =

(1) Assuming E-6 as average personnel level

Cell Number 3.2.2

Personnel (Manifests)

Cell No.: 3.2.2

Date: 3/5/85

Cost Data Sheet

Item: Personnel (Manifests)

Cost Data Expression:

$$Man = F_t \times 12 \times B \times Myr \times \frac{Hr}{2000} X J_p$$

Included:

Excluded:

Variables:

Variables:	B	=	Number of battalion equivalents costed
	Hr	=	Hours additional or saved to perform manifest
	jm	=	Number of jump types
	J_p	=	Number of jumps/month/battalion
	2000	=	Man-hours/year
	Myr	=	Cost epr man-year (E-6 assumed)
	12	=	Months per year
	F_t	=	Time factor (see 3.2.1, Medical, Page 2)

Cell No. 3.2.2, P

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
B	32.3(1)	SDT Program Office
jm	2(2)	SDT Program Office
J_p	1/month	75th Infantry Division figures from SDT Program Office
Hr	-48 hrs	Ft. Benning test results memo--14 Feb 85
M_{yr}	$19,035	Army Force Planning Cost Handbook
F_t	9.2	See 3.2.1, Medical, Page 2

Comp[illegible]

man [illegible] $\frac{-48}{[illegible]}$ x 9.2

= $[illegible]

(1) Approximately 21,000 jumps/month divided by an average of 650 persons

(2) Battalion size, and small

Note: Using the SDT for identification, all three concepts assumed equally applicable.

Cell Number 3.3

Training

Cell No.: 3.3

Date: 3/7/85

Cost Data Sheet

Item: Training

Cost Data Expression:

$$TR = PT \times \frac{T_t}{2000}$$

Included:

Excluded:

Variables:

PT = Personnel (transactions), (Cell number 3.2.1)(Personnel cost or savings due to transactions savings)

T_t = Training time/person/yr

2000 = Man-hours per year

(Assumes training time/yr is the same with or without SDT. Time is saved for those not trained)

Cell No. 3.3, M,P,F

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
T_t	40 hrs	Assumed
$P_{T,M}$	-$360,058,449	
$P_{T,P,\ SDT1}$	-$38,037,867	Computed (Cell No. 3.2.1)
$P_{,\ SDT2/3}$	-$923,098,789	
$P_{T,F}$		No Quantitative Data

Computation:

$$P_{T,M} = \frac{40}{2000} \times -\$360,058,449 = -\$7,201,169$$

$$P_{T,P,SDT1} = \frac{40}{2000} \times -\$38,037,867 = -\$760,757$$

$$P_{T,P,SDT2/3} = \frac{40}{2000} \times -\$923,098,789 = -\$18,461,976$$

Cell Number 3.4

Spares/Supplies (Tags)

Cell No.: 3.4, C

Date: 3/6/85

Cost Data Sheet

Item: Spares/Supplies (tag)

Cost Data Expression:

$$SS = \sum_{i=1}^{10} N_{o\&s,i} \times C_{t,i}$$

Included: O&S Tag Spares

Excluded: Initial Tags, Initial Spares, and All Equipment/Software Costs

Variables:

$N_{o\&s,I}$ = Number of o&s Spare tags procured in year i

$C_{t,i}$ = Cost of tag in year i

Cell No. 3.4, SDT1 C

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$\sum N_{o\&s,i}$	4,404,851	See Cell number 2.1, P2, SDT1 Common
$C_{t,i}$ i=1-10	\$3	Based on Vendor estimates

Computation:

SS = \$3 x 4,404,851 = \$13,214,553

Cell No. 3.4, SDT2 C

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
$\sum N_{o\&s,i}$	4,404,851	Cell No. 2.1, Page 2, SDT1 Common
$C_{t,i}$ i = 1-10	\$30	SDT Program Office

Computation:

$$SS = \$30 \times 4,404,851 = \$132,145,530$$

Data/Computation Sheet

Data:

Variable	Value(s)	Source(s)
$N_{o\&s,i}$		
i=1	--	
i=2	229,588	
i=3	404,846	
i=4	538,631	
i=5	538,631	Cell No. 2.1
i=6	538,631	
i=7	538,631	
i=8	538,631	
i=9	538,631	
i=10	538,631	
$C_{t,i}$		
i=1	30	SDT Program Office
i=2	200	
i=3	200	Based on Vendor Estimates
i=4	150	
i=5	150	
i=6	150	Assumed based upon current trends
i=7	100	
i=8	100	
i=9	100	
i=10	100	

Computation:

$$SS = \$200 \times (229{,}588 + 404{,}846) + \$150\,(538{,}631 \times 3) + \$100 \times (538{,}631 \times 4)$$

$$= \$584{,}723{,}150$$

Cell Number 3.5

Security

Cell No.: 3.5,M

Date: ______________

Cost Data Sheet

Item: Security

Cost Data Expression:

$$S_{IR} = \frac{M_a \times P_I \times P_A \times P_{SDT}}{D + 1} \times F_t$$

Included:

Excluded:

Variables:

M_a = Annual DoD Medical Services in dollars

P_I = Proportion ineligible recipient

P_A = Proportion of annual medical services which are Army

P_{SDT} = Proportion of savings contributed by SDT

D = Number of dependents per sponsor

F_t = Equivalent years of full benefits of SDT

Cell No. 3.5, M

Page No. ______

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
M_a	-$4,000,000,000	*
P_I	.15	Battelle Expert
P_A	.33	Computed based upon ratio of Personnel to DoD personnel - Defense '84
P_{SDT}	.1	Assumed
D	2.3	EDS Deers doc.
F_t	9.2	SDT production schedule

* **"Predicted Benefits of Automated Information Systems on Medical Treatment Facilities, Summary of Findings"**

Computation:

$$\frac{-\$4{,}000{,}000{,}000 \times .15 \times .33 \times .1}{2.3 + 1} \times 9.2 = -\$55{,}200{,}000$$

Cell No.: 3.5, P, F

Date: 3/16/85

Cost Data Sheet

Item: Security

Cost Data Expression:

No additional security costs or savings identified for personnel or finance applications.

Need to be defined.

Included:

Excluded:

Variables:

Cell Number 3.6

Master File

Cell No.: 3.6

Date: 3/6/85

Cost Data Sheet

Item: Master file

Cost Data Expression:

Personnel Δ's costed under "personnel (transactions)", software updates are costed under "software".

No other charges noted.

Included:

Excluded:

Variables:

Cell Number 3.7

Equipment

Cell No.: 3.7

Date: 3/6/85

Cost Data Sheet

Item: Equipment

Cost Data Expression:

$$EQ = F_t \times fl \times C_E$$

Included:

Excluded:

Variables:

F_t = Time factor - in equivalent years

Fl = Failure rate of equipment

C_E = Equipment investment coat, Cell number 2.2

Cell No. 3.7, M

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
F_t	9.2	Computed, see Cell number 3.2.1, Medical, P2
Fl	10%/yr	Assuming 100% turnover in 10 yrs
$C_{E,SDT1}$	$4,138,500	Computed, see Cell number 2.2
$SDT2,3$	$8,275,000	

Computation:

EQ for SDT1 = 9.2 x 0.1 x $4,138,500

= $3,807,420

EQ for SDT2 or 3 = 9.2 x 0.1 x $8,275,000

= $7,613,000

Cell No. 3.7, P

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
F_t	9.2	Computed, see Cell number 3.2.1, Medical, P2
Fl	10%/yr	Assuming 100% turnover in 10 yrs
$C_{E,SDT1}$	$1,344,000	Computed, see Cell number 2.2
$\quad_{SDT2,3}$	$2,688,000	

Computation:

EQ for SDT1 = 9.2 x $1,344,000 x 0.1

= $1,236,480

EQ for SDT2 or 3 = 9.2 x 0.1 x $2,688,000

= $2,472,960

Cell No. 3.7, F

Page No. 1

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
F_t	9.2	Computed, see Cell number 3.2.1, Medical, P2
Fl	10%/yr	Assuming 100% turnover in 10 yrs
$C_{E,SDT1}$	$ 519,500	Computed, see Cell number 2.2
$SDT2,3$	$1,038,000	

Computation:

EQ for SDT1 = 9.2 x 0.1 x $519,500

= $477,940

EQ for SDT2 or 3 = 9.2 x 0.1 x $1,038,000

= $954,960

Cell Number 3.8

Software

Cell No.: 3.8

Date: 3/16/85

Cost Data Sheet

Item: Software

Cost Data Expression:

$$S_{op} = S_f \times S_{ft} \times F_t$$

Included:

Excluded:

Variables:

S_f = Factor of yearly software update costs

S_{ft} = Investment cost of software (Cell number 1.2) per application

F_t = Time factor

Cell No. 3.8, M, P or F

Page No. ____________

Data/Computation Sheet

Data:

Variable	Values(s)	Source(s)
S_f	0.20	Battelle Software Expert
$S_{ft,SDT1}$	\$100,000/Application	See Cell 1.2
SDT2,3	\$375,000/Application	See Cell 1.2
F_t	9.2	Computed--see Cell No. 2.2

Computation:

$$S_{ft,SDT1,M,P,\text{ or } F} = 0.20 \times \$100{,}000 \times 9.2 = \$20{,}000 \times 9.2$$
$$= \$184{,}000$$

$$S_{ft} \text{ for SDT2/3, M,P, or F} = 0.2 \times \$375{,}000 \times 9.2 = \$75{,}000 \times 9.2$$
$$= \$690{,}000$$

Cell Number 4.0

Column Totals

Cell No.: 4.0

Date: 3/7/85

Cost Data Sheet

Item: Column Totals

Cost Data Expression:

$\sum$ Cells 1.0 - 3.8

See Figure 5.1

Included:

Excluded:

Variables:

Cell Number 5.0

Concept Totals

Cell No.: 5.0

Date: 3/7/85

Cost Data Sheet

Item: Concept Totals

Cost Data Expression:

$$T = \sum M,P,F, \text{ Common Column Totals}$$

See Figure 5.1

Included:

Excluded:

Variables:

APPENDIX B

SECURITY DATA

APPENDIX B

TREATMENT OF SECURITY IN BANK SYSTEMS OPERATIONS

Overview

The objective of the research presented in this appendix is to briefly describe the treatment of security as it relates to banking system operations. A brief historical overview of security in a paper based banking system is discussed with particular emphasis on the importants of the signature in dat-to-day account activity. With this background, we then explore security issues that confront banking operations as the system moves from paper to electronic transaction processing. Attention is devoted to electronic fund transfer network, transmission and terminal elements of banking operations with prime focus on data security and personal identification. During the course of the discussion we highlight the design issues that we believe are of prime importance to SDT program designers. The final section also summarizes the relevant design issues for an SDT program.

Security Issues As Banks Move From Paper to Electronics

Security takes on many forms in bank operations. Historically, banking institutions designed their offices to highlight the size and strength of their vault. Physical security of funds was an important marketing factor assuring customers that their deposits were safe. Closely associated with physical security of the vault was the design of banking facilities to resemble Greek temples, thus giving the customer the impression that the vault in which funds were deposited were housed in a solid unimpregnable building. Unfortunately though, violation of physical security was never the major problem causing banks to experience financial problems or insolvency. The true threat to bank security has been, and remains, access control to demand and time deposit accounts.

In the simple financial world of yesteryear, banking establishments used a form of double entry bookkeeping where deposits and withdrawals were recorded on ledger cards. When a customer opened a bank account the operating rules and policies of the bank were found printed on a card that over time became known as the signature card. To verify a transaction the teller would match a withdrawal slip with the signature card. As long as the financial institution was housed in a single building, withdrawal transactions were simple, but far from speedy.

The branching system presented banks with a new and difficult problem. How could withdrawals be verified when the account holder is at one branch location while the signature care is filed at another location? At first, customers were required to withdraw funds from their "home" branch. When this policy proved to be inconvenient and unpopular, banks adopted policies limited the amount of a withdrawal and augmented by a description of a signature over the phone. Fortunately, the appearance of microfiche technology during the great branching revolution of the 1950-1975 period prevented such questionable verification techniques from becoming established banking policy.

During this same time period, the usage of demand deposit accounts (checking) was also rising rapidly. Like savings account withdrawals these checking accounts also required banks to verify signatures before each transaction was considered to be legitimate. This cumbersome process served as a bottleneck which mitigated the efficiencies of high volume check processing equipment.

In summary, the paper based banking world controlled access to savings and checking accounts through the verification of signatures. That is, the security of funds was made possible through a manual sight comparison of the signature contained on two documents. This general process was consistent with century old customs supported by contract law and social acceptance of the signature.

Security Issues for Banks in an Electronic Environment

The technology revolution of the 1970s and 1980s has presented the banking industry with an extraordinary set of new opportunities but also sobering realities. Opportunities are manifested in the increased efficiencies in transaction processing. However, obstacles exist in the form of shaping a predominantly paper based system ruled by signature verification into an electronic verification process controlled by digital codes, not analog signatures.

This dilemma has yet to be resolved in the banking industry. Signatures still form the legal foundation of all transactions or agreements conducted in the U.S. banking system. Despite this, signature surrogates have been introduced and approved within some financial institution conventions. Signature surrogates refer specifically to the use of computer generated personal identification numbers (PINs) and customer selected personal identification codes (PICs).

While the legal status of the PIN is very unclear and remains the subject of great debate in regulatory agencies and legal circles, it nonetheless is the mechanism used as the sole means for identifying the customer at most of the nation's 60,000 ATMs. Despite the ubiquitous nature of the PIN though, it remains unclear whether such transactions can pass the legal test under the present body of law. In 1979, a group called the "3-4-8" committee studied this problem and issued a number of draft recommendations that have been discussed but have not yet been acted upon.

As the banking industry embraces more technology in the form of remote ATMs, point-of-sale terminals, video banking, and international wire transfers, the issues of account access in the form of personal identification and data security will become more acute, and will require an interpretation of what legally constitutes a "digital signature". **This subject must be given a high priority by SDT program designers because banks and the new competitors known as the "nonbank banks" are moving rapidly into high technology electronic network delivery systems.**

Developments Affecting Security in Bank Operations

The developments described in this section affect banking operations in general, but potentially impact the payment systems most severely. Of particular concern is vulnerability caused by deliberate threat due to fraudulent intentions. It should be remembered that security in the context of electronic payment systems can be categorized into two different classifications. That which is related to operational reliability, and that which pertains to deliberate threat.

Breaches of security in operational reliability are unintentional in nature. As for example, when the accuracy and integrity of data is jeopardized due to equipment and transmission line failures, or system availability is compromised by poor design or the actions of an operator or user. In these cases breaches of security originate from unintentional causes.

In contrast, the operational vulnerability aspect of security is the degree to which a system can protect against criminal intent, whether that be to access information illegally (e.g., fraud, access to confidential files), or to penetrate installations by means of sabotage or arson.

Of the two aspects, operational reliability is the more common breach of security. In other words, data are more often destroyed by negligence or oversight than by dishonesty or malicious acts. However, the growth of electronic payment networks will attract those interested in fraudulent crimes. Therefore, operational vulnerability will become a larger threat and higher growth crime in the future. **This should be of greatest concern to SDT designers, since such deliberate threats are sometimes created by voids and oversights that occur because of rapid technological advances. Security breaches can therefore occur as crimes of opportunity when it is perceived that vulnerabilities exist due to poor system design.**

The Growth of Worldwide Financial Networks

Electronic financial networks are a fast growing international phenomenon. In banking circles today, the objective of money managers is to minimize "information float" and maximize earnings on funds. This has been made possible by the number of networks developed by the international banking community to switch messages, transfer funds, and authorize transactions. The oldest such international message switching networks are SWIFT and BankWire. Other similar networks like FedWire and CHIPS are nationally oriented and serve the financial community in the United States, whereas CHAPS is used in England and SAGITTARE in France. These national funds transfer networks tie directly into the international financial networks.

During the past ten years financial institutions throughout the world have also developed proprietary and shared automated teller machine (ATM) and point-of-sale (POS) networks that reach into the heart of the local financial marketplace. For example, in 1980 the U.S. had about 20,000 ATMs in place, while in 1985 the terminal population rose to 60,000 and forecasts are calling for the number to reach 100,000 by 1990. Countries with advanced financial systems will experience similar growth. Yet to come is the impact of financial transaction activity at the point-of-sale and on home video terminals.

The objective of the banking community is to achieve complete system integration. That is, proprietary and shared ATM and POS networks will need to interface with national (i.e., CHIPS) and international message switching networks (SWIFT) in order to achieve complete end-to-end transaction flow. Such system integration is on the verge of becoming a reality and poses bank operations with significant security problems, particularly at the interface points between different networks. Especially threatening is the fact that such international system integration demands standardization which removes the uniqueness of the proprietary network protection mechanism and, as a result, increases vulnerability to deliberate threat.

Similar to banks, integration into these networks may yield benefits to the Army. **For this reason, designers of SDT systems should take into account the international and national fund clearing and settlement policies when compliance becomes necessary.**

Data Transmission and Communications Lines

It is a well recognized fact in network engineering circles that the communications lines are the weakest and most difficult points to protect on any network. The danger primarily involves an illicit attempt to corrupt messages and to tap lines (eavesdropping) with the intent to misuse the information obtained. Moreover, the number of companies entering the long distance and local network transmission business (i.e., competitors to AT&T such as MCI, SPRINT, SBS) increases the opportunities for system attacks resulting in security degradation.

It is important that SDT designers consider the security implications of using new transmission technologies into their system. For example, packet switching offers increased protection over the use of leased lines moving data over fixed paths. Newer technologies such as microwave and satellite communications may provide more efficient and cost effective data transmission opportunities; however, they are theoretically vulnerable to penetration using a well designed interceptor receiver. The message here is clear. User data protection is vital regardless of the technology or service provider used. Therefore, a bank system compatible encryption technology should be viewed as a fundamental building block in the design of any system that is used for information that is of value. Banks and other financial institutions are only now beginning to employ elaborate encryption techniques to ward off sophisticated and intentional attempts to corrupt messages.

The Growth of Card Activated Financial Terminals

As part of the discussion on network developments, we have already established that the banking industry, driven by the need for greater operating efficiency and funds management, has vigorously pursued the market exploitation of card activated financial terminals. Such financial terminals, mainly ATMs, have thus far been reasonably secure devices. Since most ATMs in the U.S. operate in an on-line environment, account activity can be reasonably controlled by placing withdrawal limits to minimize exposure from unauthorized persons through daily usage maximums. In other words, fraud and unauthorized usage of ATMs has been a controllable business expense for banks. However, the recent growth of the remote ATM terminals and bright prospects for account access from POS, personal computers, and home video terminals will significantly alter the electronic funds network environment of the future. New remote terminals are not only physically separated from the physically secured branch environment, but are also more intelligent and have greater functional capabilities than the previous generation of terminals accessing financial networks.

The greatest concern here to computer system designers is the potential vulnerability to unauthorized access of these networks as a result of the existence of a distributive philosophy. Distributed processing increases the opportunities for unauthorized access and is therefore viewed as an increased threat to on-line computer systems.

Compounding the problem is the use of magnetically encoded plastic cards that are used to access terminals. Throughout the financial community "mag stripe" cards are the universal medium used for access to customer accounts. When used in an electronic payment network the card is used to validate that the person holding the card is the authorized account holder. As mentioned earlier, this identification process is accomplished using a computer generated personal identification number (PIN, also referred to as a PIC, personal identification code) that is randomly assigned to the cardholder. Some financial institutions also use customer selected personal identification numbers and/or codes based on a patented proprietary security algorithm by the Atalla Company. Although the Atalla approach offers a higher level of security than a randomly assigned PIN, both approaches suffer from the same basic problem. There is no assurance that the PIN has not been "stolen" by an unauthorized user.

Another problem is that the magnetic stripe, under present coding conventions and manufacturing processes, has been proven to be vulnerable to counterfeit, alteration, and fraud. Two technologies currently available to improve the security of the existing magnetic stripe are watermark magnetics and optical polymer technology. It is important to note that although watermark technology has been available to the financial community for at least five years, the industry has been reluctant to adopt the concept. Concerns with added costs and imminent prospects for the introduction of more advanced technologies seem to be the key reasons for this reluctance of both of these approaches.

A new development surfacing recently involving secure cards has been led by Mastercard, American Express, and Bank of America. These institutions have undertaken intense investigation of integrated circuit technology to develop a smart plastic financial card, as in the case of the French experiments with the use of chips in plastic cards. The design of cards for the American experiment will be integrated with the existing magnetic stripe configuration to allow for a conversion period. The interest in smart card technology appears to be focused on improving card security, although the marketing potential for applications that take advantage of the memory, logic, and portability of the device is also certainly involved.

The implications of these plastic card developments are clear. Either the financial community adopts a more secure magnetic stripe design using watermark magnetics and/or polymer optical technology, or suffer the consequences of increased fraud vulnerability. The other option is to pursue more advanced technologies such as that offered by a smart card type device that is capable of storing biometric data. The financial community is known to be examining a number of biometric technologies that digitally measure some form of personal characteristic. It is Battelle's view that signature dynamics technology is currently of greatest interest to the financial community since signatures are historically established and universally accepted as personal identification by consumers and the business community. Therefore, many institutions are currently investigating the legal and technical developments in signature dynamics specifically relating to the creation, storage, retrieval, and reproduction of digitized signatures.

Interest in voice activated technology is also very high, and has been treated by some in the industry as a priority technology. Voice activated technology appears to have strong supporters as a reliable and technically sound method for personal identification. Although the development of the technology does not appear to be particularly prohibitive, establishing "voice code signatures" in the body of contract law may be an obstacle that could potentially cause a long delay in implementation.

The Threat Spectrum

For most, information is knowledge. For a few, access to sensitive information is a challenge. For the businessman, information is money, and for the saboteur, manipulating information can be lucrative. Such is the full opportunity spectrum that ranges from legitimate uses of information for purposes of increasing knowledge to the criminal who is bent on gaining access to the transfer of money. The proliferation of networks, the increased movement of data over unprotected communications lines, and the growing acceptance of card activated financial terminals and personal computers have increased the opportunities for illegitimate users to ply their trade.

Faced with this alarming prospect of illegitimate users, and the threats such activity may have on the faith and acceptance by legitimate users of the system, bank managers are beginning to identify and implement suitable countermeasures. Such countermeasures must be evaluated in relation to potential risks and the cost of implementing the deterrent. It is generally accepted that a totally secure computer network is practically unattainable. That is, the determined unauthorized user can always marshall the resources to enter a system. **It is clear, therefore, that the SDT program designers of a bank system must create an opportunity cost barrier that is always incrementally higher than the value of the information that the unauthorized user seeks to obtain.** In brief, the price of security in electronic networks is eternal vigilance.

Banking Industry Countermeasures

The international financial community has adopted and, in many cases, implemented methods of security protection that incorporates technology, operating policies, and auditing procedures. Such methods of providing security and reliability has resulted in acceptable levels of control for certain forms of fraud and unauthorized access. For example, the implementation of such security features for plastic credit cards as fine line printing, ultraviolet symbols, and holograms are one reason why counterfeiting and fraud have been reduced in the bank credit card industry. Also contributing to the decline has been the use of improved electronic authorization of credit card purchasing and improved monitoring of merchants. The sudden reversal in credit card fraud trends using technology shows that system security cannot always be accomplished using only one element of the tools available. Rather, system security is best achieved using technology, accounting audit procedures, management diligence, and choosing knowledgeable people to design and operate the system.

Personal Identification and Verification

A considerable amount of energy is currently being invested into research and development for methods and products to improve personal identification procedures. Keylocks, passwords, coded badges, and PINs are all presently in use to prevent unauthorized access into financial networks. Since the subject of personal identification has already been discussed in a previous section, only those issues affecting SDT design will be covered here.

Personal identification in financial electronic networks has been accomplished using PINs, which are verified either at the terminal or via a central host computer. For reasons previously presented, the financial community has chosen to continue supporting magnetic stripe technology. While the debate over the magnetic stripe issue will continue for some time to come, **the SDT program should not become mired in this controversy since magnetic stripe technology is not appropriate for a "tag" package. Only standards regarding message formats, authentication procedures, and policies impacting settlement and clearing of funds are of immediate relevance. SDT designers should devote their R&D resources to develop a personal identification method that best meets the objectives of the U.S. Army SDT program.** As in the case of the banking industry, attention should be directed to the examination and evaluation of signature dynamics and voice activated identification systems. Signature dynamics offers excellent administrative related features such as that for accessing payroll and medical records, while voice activated systems offer the response times necessary for combat activities.

Message Authentication

The question of message authentication is of major importance in the design of financial networks. Since other portions of this report have been devoted to this subject, only one major issue will be mentioned here. In general, message authentication depends on the derivation of a secure algorithm. At present, financial payment systems use a multiplicity of algorithms or test keys. Attempts have been underway to establish an international standard test key. In addition to the problems normally encountered when attempting to devise standards, it appears that it is impossible to design a key that is foolproof, uncomplicated, and can be operated both manually and electronically. It appears that designers are now leaning toward issuing many keys as opposed to pursuing a one-standard-key approach. The advantage is that higher security can be gained when more keys are in existence even if such proliferation of keys is difficult to control. Financial system designers continue to wrestle with this problem although the solution may be academic if an encryption method is incorporated in the design.

Data Security Using Encryption

The financial community recognizes that data and message encryption are necessary and vital, but have been unable to quell the controversy as to which encryption technique offers the most effective security solution. Bankers have implemented a wide range of proprietary encryption techniques that work reasonably well in closed systems. However, as payment networks are increasingly linked to each other a standard encryption technique is becoming necessary.

The Data Encryption Standard (DES) originally proposed by IBM and adopted as the U.S. Federal Information Processing standard was originally thought to be secure, but has recently come under criticism as being too short and easily broken using modern supercomputer technology. Support seems to now be shifting to the public key crypto system which features two different keys, one of which is public while the other is secret to the sender and/or the receiver.

Another major design issue for the SDT program involves where encryption and decryption should take place in the network. Increased attention is being given to end-to-end encryption where data are encrypted at the source and decrypted at the destination. Although this places considerable responsibilities and costs on the receiver and sender, it does improve security and eliminates the network operator from the security management problem.

Privacy Protection in Payment Systems

There is a worldwide movement, occurring mostly outside the United States, to treat data communications as a national resource. At first it started with concern for privacy and confidentiality of personal and corporate financial information that could be put to unauthorized use. Privacy laws have been most stringent in Western Europe, Canada, and certain countries in Latin America. These national privacy laws require that system designers comply with certain security requirements within those countries.

Unfortunately, the issue of information and data flow moving across international boundaries has been controversial. The "trans-border data flow" issue presents the SDT program with a potential obstacle. For example, Brazil is drafting legislation that will force foreign companies to send their messages to a national data bureau--perhaps a PTT--that will then process that message and route it into or across the territory to the next destination mode. The intent of such trans-border data flow interception is to preserve and nurture the growth and development of local information service providers and equipment manufacturers.

Network Interconnection

In order for networks to interconnect, it is essential that they be mutually compatible. During the 1970s international standards meetings were able to identify seven levels of necessary standard protocols. However, the ISO groups were only able to agree on the X.25 standard which covers three of the seven necessary protocols. Although X.25 appears to be a universally accepted standard, a major problem will continue to be data encryption. Network interconnections require standardization even for data encryption. **From a security aspect, lack of standardization will continue to be a major issue for SDT program designers in that problems exist in accurately identifying one network from another, and ensuring that a request for file access is suitably secure and controlled.** Of all the technological issues connected with payment system security, the proper method for passing encrypted messages from one system to another is perhaps the most controversial.

The Importance of People and Procedures

The wise selection and close supervision of staff may be the most critical factor in operating a secure electronic payment system. Security and enforcement ultimately depend on people despite the continued development of highly sophisticated technological aids.

One of the most important defenses against security breaches is good supervision and diligent management. The knowledgeable supervisor knows his staff well, and has a feel for uncovering problems before they materialize. Auditors are also important in that they back up supervisions with audit controls that are developed before the system becomes operational so that appropriate safeguards can be incorporated in the design. Controls are dynamic and should be subject to constant update and monitoring. System designers of data transmission and payment system networks are technical specialists that have a major responsibility for incorporating comprehensive security measures into their design proposals. **The SDT design team must realize that increased responsibility must be assigned to the end user to preserve and protect the account activator device and all associated codes.** End-to-end security on an electronic network can only be accomplished if all the users are responsible for thwarting unauthorized access.

Relevance to SDT System Design

A wide range of matters have to be considered in order for an electronic payment system to be secure and reliable. Critical factors in the system design of a payment network can be summarized by the following areas of concern.

- The link between the user and the network:
  - Intra-network security
  - End-to-end security (from sender to receiver and return)
  - Inter-network linkage.

It is useful to classify the design problem in such a manner because it forces the designer to look at the much larger picture. This is especially true for the SDT system since the financial component of that system must fold into an existing payment system network. this is because each of the focus areas identified have special design problems that affect physical control of the network, personnel deployment, message and data protection requirements, and legal and regulatory commitments.

The design issues raised in this document apply to all four of the focus areas although the assumptions for the operation and performance of each may be different. For example, users sending messages are responsible to their receiving counterparts that the data message is valid and the transmission is authorized. The network provider responsibility is to provide the communication path to the users and guarantee delivery of an acceptable message. Intra-network responsibilities relate to the delivery of messages to the proper end user, and insuring data integrity and timely transmission. Inter-network responsibility is similar to those of an individual network except that message validity and authentication is achieved at a higher premium.

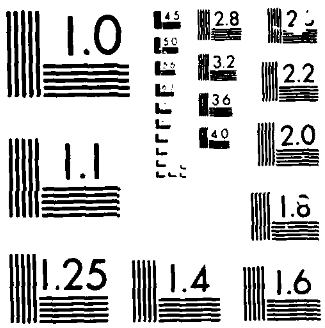
The basic requirements for security and reliability as described in this document are universal and need only to be incorporated in the design of the SDT system before it is placed in operation. The data and message content of the SDT system will contain financial, medical, and training information. Although financial systems may handle transactions of large sums of money that may affect the well-being of a major corporation or country, the SDT system may eventually need to provide a realistic and adequate level of protection that involves national security. The design issues highlighted here should therefore be thoroughly considered in the development of the SDT system.

APPENDIX C

MATERIALS DATA

AD-A169 565 SOLDIER DATA TAG STUDY EFFORT APPENDICES(U) BATTELLE COLUMBUS LABS OH 10 JUN 85 DATB60-84-C-0146 2/2

UNCLASSIFIED F/G 6/5 NL


1.0
2.8
2.2
3.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

APPENDIX C

SDT ENCAPSULATION COST ANALYSIS

A cost analysis is made for the SDT encapsulation step. This analysis considers the effect of various materials costs on the SDT as well as an equipment and direct production cost burden. This cost estimate, however, does not include administrative or general plant overhead and maintenance. It is expected that this burden will be assessed in the overall SDT cost summary. In making this cost analysis a number of assumptions must be made with respect to production rate and volume, equipment requirements, and personnel utilization. Assumptions made during the course of this analysis are specified and the justification reported. Cost drivers considered in this analysis include:

- Materials
- Production Requirements
- Equipment Requirements
- Production Personnel.

Generally, conductive systems are priced in the range of \$6 to \$10/pound in lots around 1000 pounds, Table C-1. The currently used material, System 1, costs from \$6.50 to \$7.00/pound. Since PEEK is a premium priced material, it is expected that this would be more costly, possibly \$25 to \$35/pound. Materials cost projections were made on the basis of \$7.00/pound for low cost materials and \$35/pound to establish the impact of the use of premium grade systems.

In current production, about 27 percent of the injection shot (-7.4 grams) is contained in the runners and sprue. These are nominally ground and blended with virgin material.

TABLE C-1. MATERIAL COST PROJECTION
(Based on 1000 Pounds)

Encapsulation System	Weight/Unit	5.4 grams
Total Units Encapsulated	82,320	
	LCP/PPS	PEEK
Encapsulant System Costs	$7.00/pound	$35.00/pound
Cost/Unit	$0.085	$0.425

Assume recycle of runners, sprues, and overall loss of 2 percent.

TABLE C-2. PRODUCTION AND EQUIPMENT REQUIREMENTS
(Based on 1 million units/year)

PRODUCTION REQUIREMENTS	LCP	PEEK
Mold Cycle Time, sec.	~6	~12
Cavities/mold	1	1
Molds	6	6
Operations schedule:		
Shifts/day	1	2
Work week, days	5	5
Production, weeks	50	50

Estimated total production, million	1.2
Production less estimated rejects (-4 percent), million	1.15

EQUIPMENT REQUIREMENTS Equipment		PROJECTED COST
1	Rotary Mold Press	$32,000
12	Standard Mold Bases	3,600
12	Molds Machined	18,000
1	Crating	250
1	Sprue Grinder	2,000
1	Drying Oven	1,200
1	Pellet Blender	1,550
	Total	$58,600

Assumptions based on current practice and equipment capabilities.

TABLE C-3. PROJECTED UTILITIES COST

Utilities, (Est. @ $0.0706/Kwhr)

Equipment		Rating		Kwhr.		Hourly Operating Cost
Rotary Mold Press		10	hp	7.457	continuous	$0.5265
Heaters	(50% operational)	4	Kwh	2.	continuous	0.1412
Oven	(50% operational)	4	Kwy	2.	continuous	0.1412
Grinder	(10% operational)	2	hp	.149	day	0.0007
Blender	(10% operational)	1/3	hp	0.0249	day	0.0001
				Estimated total		$0.8097

Projected Utility Cost Burden:

$0.0014[(a)] $0.0027[(b)]

(a) Liquid crystal polymer hourly encapsulation rate, 6000 units.

(b) PPS and PEEK hourly encapsulation rate, 300 units.

TABLE C-4. PROJECTED LABOR COSTS

Production Personnel	Wage/Hr (including benefits
Press Operator	$10.00
Supervision	$13.00
Estimated total labor cost	$23.00

	LCP	PPS	PEEK
Projected Labor Cost Burden*	$0.0384	$0.0767	$0.0767

* LCP hourly encapsulation rate, 600 units.
PPS hourly encapsulation rate, 300 units.
PEEK hourly encapsulation rate, 300 units.

TABLE C-5. ESTIMATED ENCAPSULATION COSTS, INCLUDING MATERIALS, UTILITIES, AND LABOR

	Cost/Unit		
	LCP	PPS	PEEK
Cost	$7.00/lb	$7.00/lb	$35.00/lb
Materials	$0.085	$0.085	$ 0.425
Utilities	$0.0014	$0.0027	$ 0.0027
Labor	$0.0384	$0.0767	$ 0.0767
Estimated Total	$0.1248	$0.1644	$ 0.5044

PROPERTIES AND PROJECTED COSTS FOR SEVERAL INJECTION MOLDING SYSTEMS

PROPERTIES	POLYMER CLASS 1 Polyphenylene Sulfide	2 Polyphenylene Sulfide	3 Polysulfone	4 Polyether Sulfone	5 PEEK	6 Polyether-imide	7 LCP
Designation	RTP-1399 x 50479	J1300/CF/20	J1500/CF/20	J1100/CF/30	J1105/CF/30	J1106/CF/30	LX 178
Processing							
Melt Temp, F	550-650	550-650	600-780	600-780	660-715	640-800	500
Mold Temp, F	100-400	100-400	200-350	200-350	300	150-350	200
Filler Type/Concentration	Glass/30% Conductive Carbon Black	Chopped Pan/ 20%	Chopped Pan/ 20%	Chopped Pan/ 30%	Chopped Pan/ 30%	Chopped Pan/ 30%	Chopped Pan/ 12%; Conductive Carbon Black
Mechanical							
Tensile Strength, psi x 10^3	11.0	20.0	20.0	30.0	32.0	30.0	23.8
Flexural Modulus, psi x 10^6	1.5	2.2	2.0	2.5	2.5	2.5	2.1
Elongation, %	0.6	2.0	2.4	1.7	1.4	1.4	3.7
Radiation Resistance							
Rods, Gamma Neutron	3×10^8	3×10^8	UK	3×10^7	1.1×10^9	UK	5×10^8
(No property change)	4×10^8	4×10^8	UK	UK	UK	UK	UK
Electrical							
Volume Resistivity, OHM-cm	10^7-5×10^9	10^3	10^4	10^4	10^4	10^4	-
Physical							
Mold Shrinkage, in/in-1/8" section	0.0015	0.08	0.05	0.05	0.05	0.05	0.001-.002
Flammability, UL94	V-0	V-0	V-0	V-0	V-0	V-0	V-0
Moisture Absorption, %, 24 hrs	0.02	0.03	0.2	-	0.06	-	-
Heat Distortion Temp, F,							
@ 264 psi	500	480	370	428	610	410	430
@ 66 psi	>500	520	375	-	615	415	-
Chemical Resistance							
Weak Acids	Excellent	Excellent	Good	Good	Excellent	Good	Excellent
Strong Acids	Good	Good	Good	Good	Excellent	Good	Excellent
Weak Alkalies	Excellent	Excellent	Good	Good	Excellent	Good	Excellent
Strong Alkalies	Excellent	Excellent	Good	Good	Excellent	Poor	Excellent
Organic Solvents	Excellent	Excellent	Fair	Fair	Excellent	Poor	UK
Chlorinated Solvents	Good	Good	Poor	Poor	Excellent	Poor	UK
Cost/Pound/1000 lbs	6.50-7.00	10.25	10.25	12.75	35.00	12.75	7.50-8.50

Source of Materials:
1 RTP Co., Winona, Minnesota
2-6 Wilson-Fiberfil, Evansville, Indiana
7 Celanese Corp., Summit, New Jersey

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APPENDIX E

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Summit, New Jersey 07901

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Cambridge, England

Du Pont
Polymer Products Dept.
Wilmington, Delaware 19898

General Electric Company
Plastics Group
One Plastics Ave.
Pittsfield, Massachusetts 01201

Hooker Chemical and Plastics Corp.
Durez Div.
Walck Road
Tonawanda, New York 14120

ICI Americas, Inc.
Performance Resins Div.
Wilmington, Delaware 19897

Illinois Precision Corp.
303 Delles Road
Wheaton, Illinois 68187

LNP Corp.
412 King Street
Malvern, Pennsylvania 19355

Phillips Chemical Company
Plastics Technical Center
Bartlesville, Oklahoma 74004

RTP Corporation
Winona, Minnesota 55987

Union Carbide
Engineering Polymers
Old Ridgebury Rd.
Danbury, Connecticut 06817

Wilson Fiberfil International
Neshanic Station, New Jersey 08853

Army

SDT/SPO

Chris Occhialini
SGM Taylor
CPT Abplanalp

Personnel Information

Clayton Hornung
MAJ Faegin
SFC Lenington
MAJ Lacher
Jan Nordsic

Finance Information

Alan Foster
LTC Broadhurst
SFC Brown

Medical (Actual contacts)

Army: Ft. Benjamin Harrison

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Center, Combat Development
(317)542-3779

CPT Lawson, Hawley Hospital
Director of Patient Administration
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Mrs. Mallot, Hawley Hospital

Ft. Sam Houston

Mrs. Hutchins, Health Services Command
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Surgeon Generals Office

Maud Hamilton
(202)227-1633

Asst. Secretary of Defense
(Health Affairs)

W. Keith Lively
(703)756-2531

Battelle

Mr. Jim Barrett (Medical Sys. Eval.)
(614)424-4940

Dr. John Simpkins
(614)424-4029

Dr. John Quigley
Professor of International Law
Ohio State University

Other/Multiple Information

MAJ Iving	MaryLynn Cook
MAJ Hypes	LTC Jack Spriggs
LTC Tarbutton	SFC Newman
SFC Lusk	CPT Sippy
MSG Bershers	CPT Weidenbach
John Barry	SFC Hammons

ADP System Compatibility

Name	Association	Location	System
Bill Wehrmachen	Data Key	Minneapolis, MN	SDT
Joe Brittain	Army	Ft. McPherson	CAMIS
MAJ Shaw	Army	Ft. McPherson	DARMS
Charles Askew	Army	Washington, D.C.	EIDS
MAJ Hansen	Army	Ft. B. Harrison	JACS
MAJ Booton	Army	Alexandria, VA	SIDPERS
CPT Shelley	Army	Alexandria, VA	SIDPERS
Pat Phillips	Army	Washington, D.C.	SIDPERS
Mr. Goble (CW2)	Army	Washington, D.C.	SIDPERS
COL Lynch	Army	San Antonio	TAMMIS
LTC Brown	Army	Bethesda, MD	TRIMIS
Margaret French	Navy	Washington, D.C.	MAPMIS
LCDR Schultz	Navy	Washington, D.C.	RAPIDS
John Yogesh	Navy	Washington, D.C.	JUMPS-Navy
CDR Bobulinski	Navy	Cleveland, OH	JUMPS-Navy
CPT Cox	Navy	Cleveland, OH	RPSI
MAJ Carpenter	Air Force	Washington, D.C.	APDS
MAJ James	Air Force	Randolph AFB	TRIMIS
LTC Dougherty	Air Force	Denver, CO	JUMPS-Air Force ARPAS
LTC Davis	Marines	Washington, D.C.	MMS, REPMIS
COL Tillet	Marines	Washington, D.C.	JUMPS-Marines

END
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