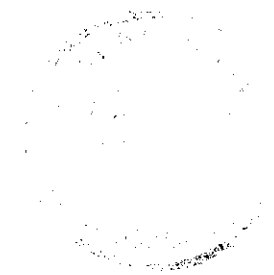


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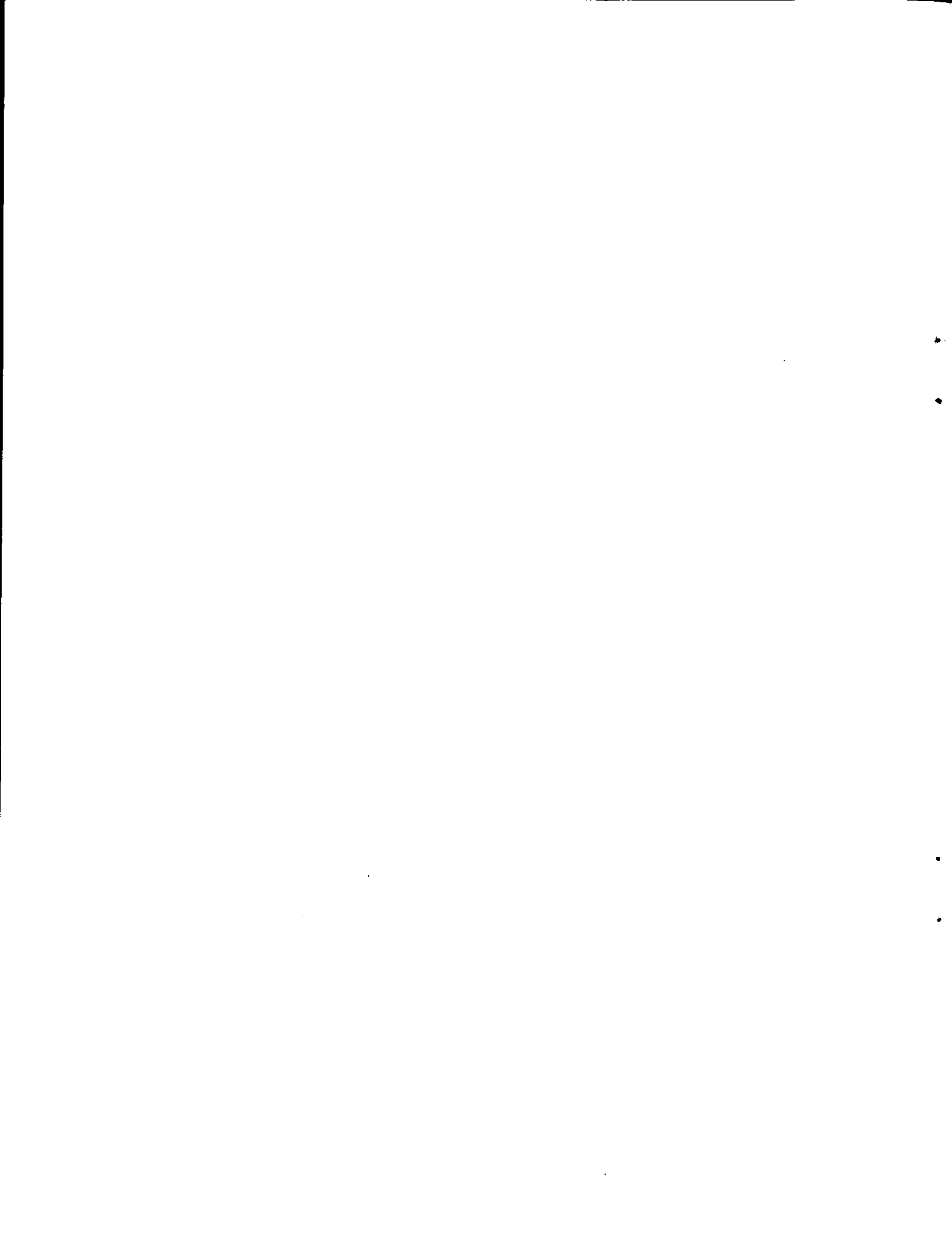
For participants only
20-23 May 1980

CEPAL
ECONOMIC COMMISSION FOR LATIN AMERICA



* TRAINING SEMINAR ON
MANAGEMENT INFORMATION SERVICES*

*This seminar was conducted by Dr. Milton Silver.



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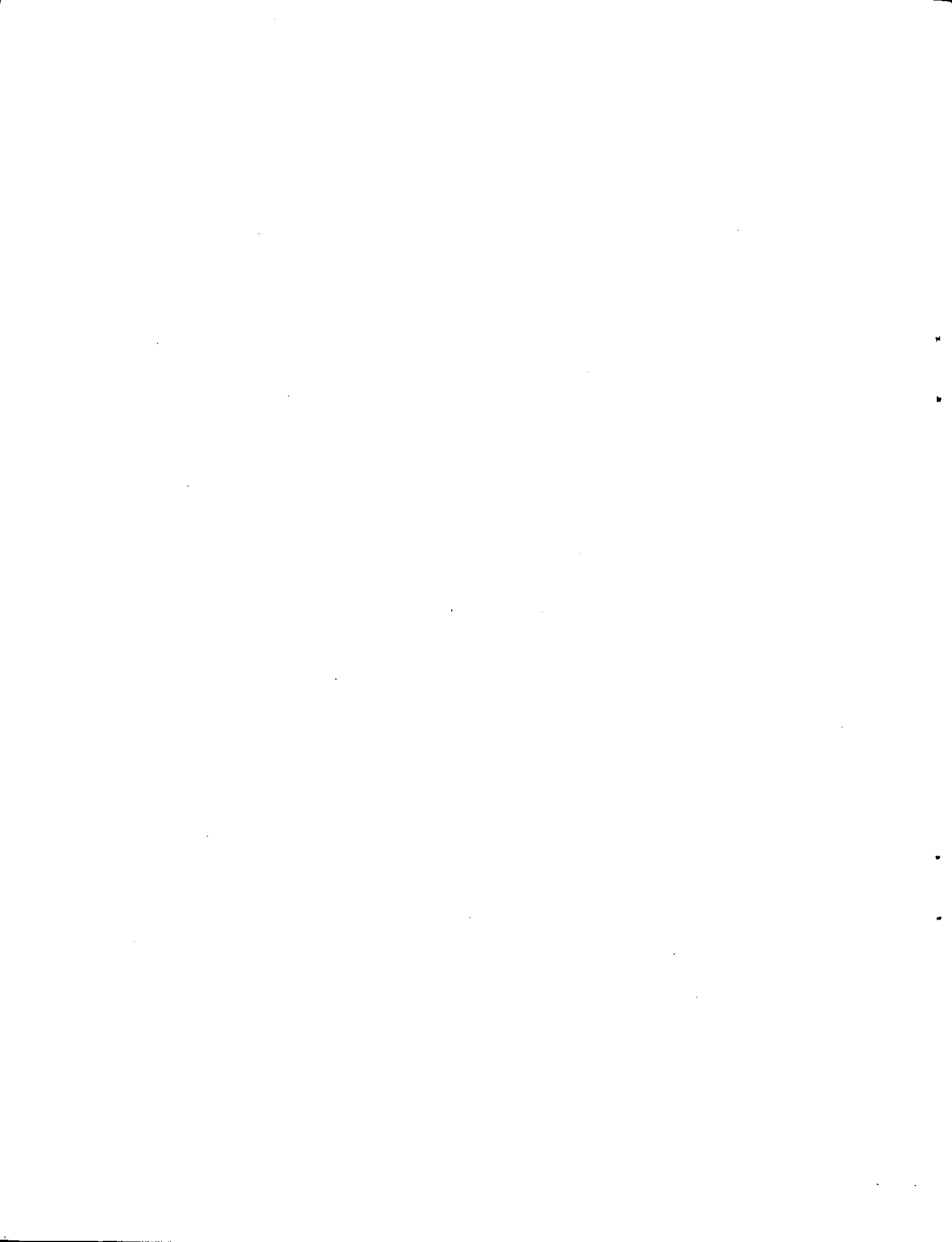
TRAINING PROGRAM

IN

DESIGN AND USE OF A MANAGEMENT INFORMATION SYSTEM

Presented by

MILSAN ASSOCIATES



MILSAN ASSOCIATES

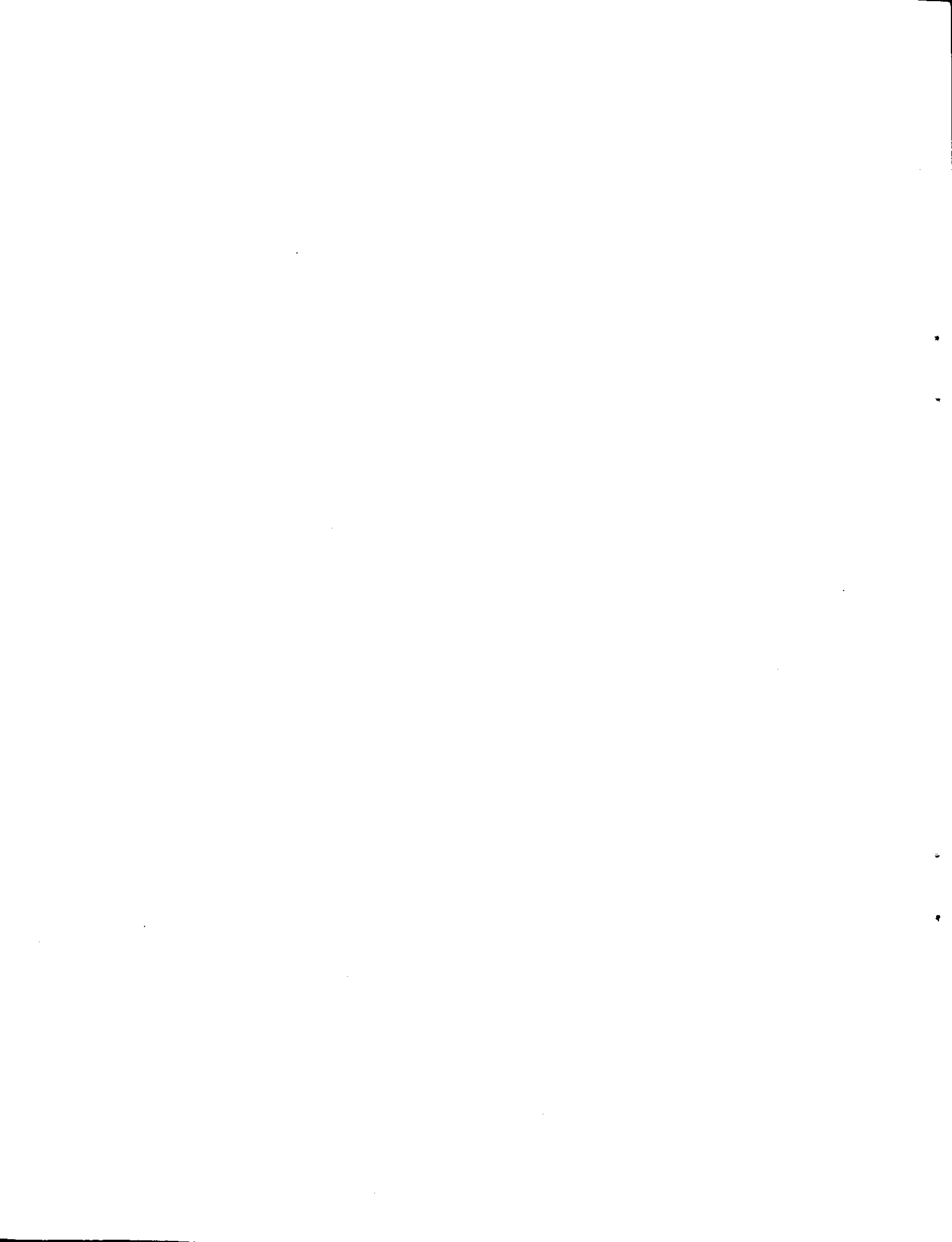
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TRAINING COURSE: DESIGN OF A MANAGEMENT INFORMATION SYSTEM

TABLE OF CONTENTS

i	TITLE PAGE
ii	TABLE OF CONTENTS
I	COURSE OUTLINE AND SCHEDULE
II	COURSE LECTURE NOTES (PER SESSION)
III	COURSE REFERENCE MATERIALS
	a) Selected (Reprints) Articles
	b) Bibliography
	c) Demonstration Problems and Case Studies
IV	MILSAN COMPETENCE AND EXPERIENCE
	a) Statement of Accomplishment
	b) Biographies of Staff Members



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SEMINAR/WORKSHOP: DESIGN AND USE OF A MANAGEMENT INFORMATION SYSTEM

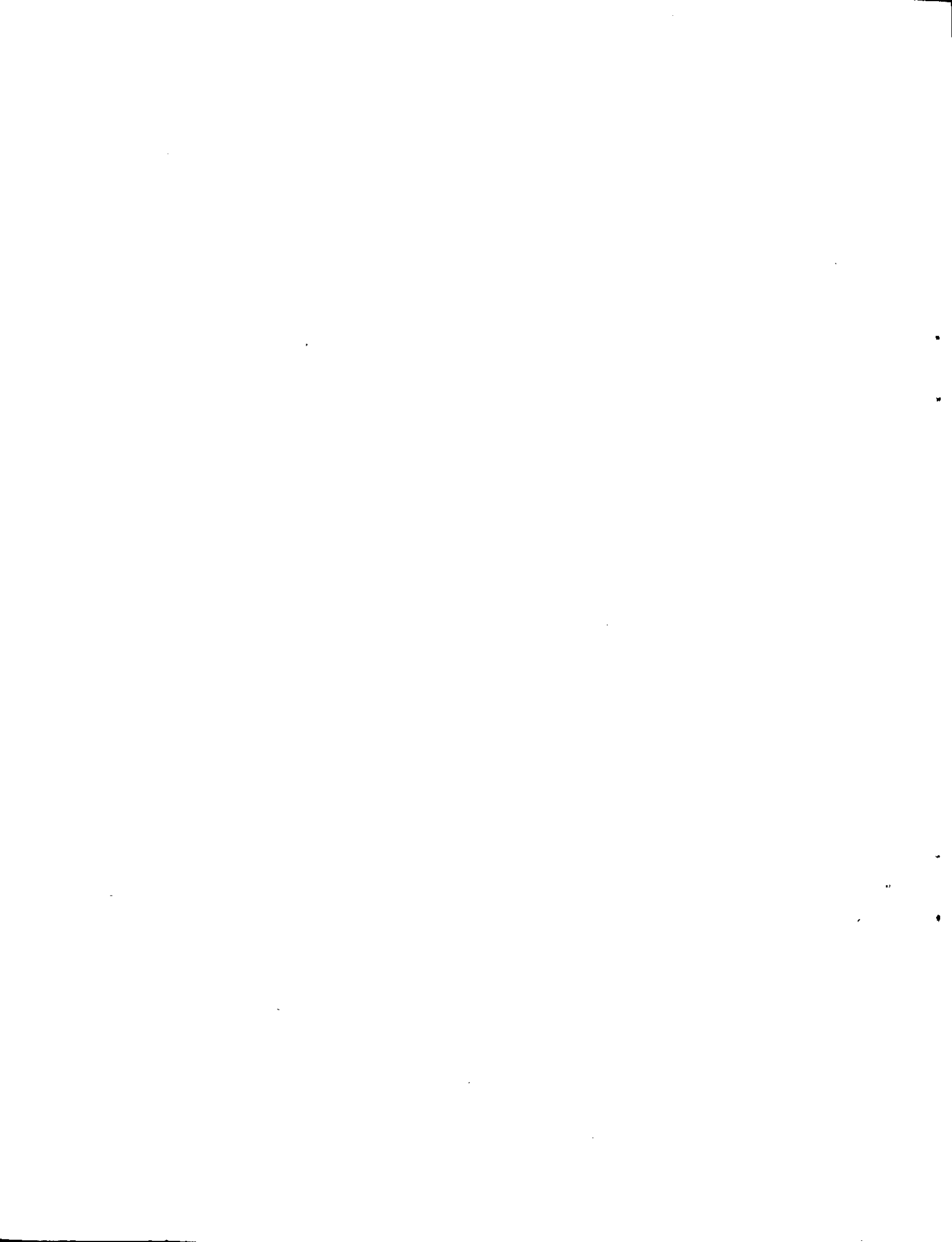
I. COURSE OUTLINE AND SCHEDULE

DAY 1

- Session 1 - Design of an MIS - A Management Approach
- Session 1A - Workshop: Demonstration Case Problem
The Interface Organization Structure and MIS
- Session 2 - MIS Systems Analysis and Design
- Session 2A - Workshop: Demonstration Case Problem
Development of an MIS - Applications
Strategy for Managers/Users

DAY 2

- Session 3 - A Management View of MIS Technology
 - Part I - Configuration of Computer-based MIS
 - Part II - Introduction to Computer Software
 - Part III - Human Factors in System Design
- Session 3A - Workshop: Demonstration Case Problem
Computerization of an Information (MIS) Project
Human Factors in Design and Implementation
- Session 4 - Evaluation of MIS Effectiveness
- Session 4A - Management Summary and Overview
Panel Discussion: Application of Principles and
Practices to "real" UN problems



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I. COURSE OUTLINE AND SCHEDULE (CONTINUED)

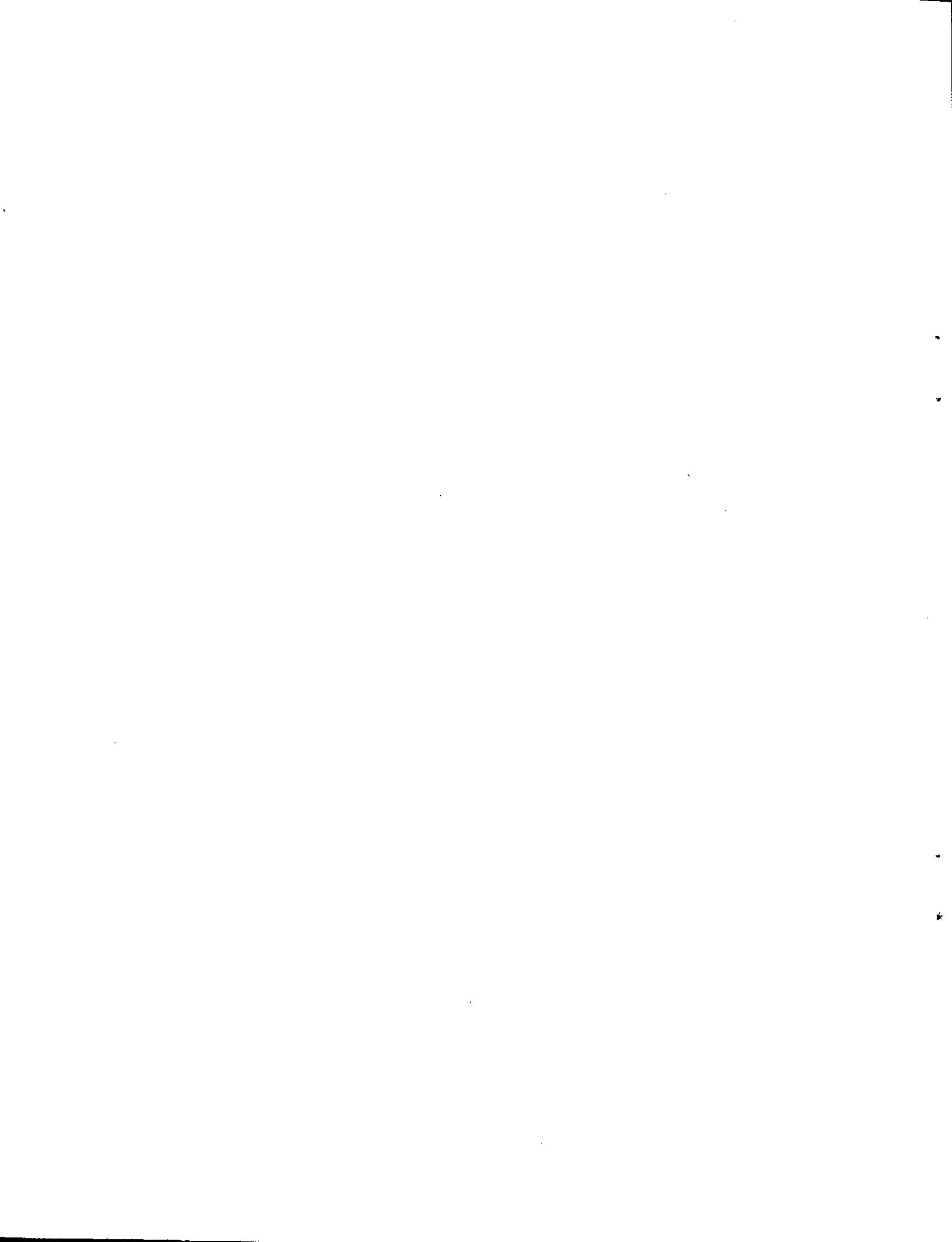
DAY 3

Session 5 - Simulation Workshop: Design and Implementation of an MIS

Session 5A - Workshop: Case - Team Preparation

Session 6 - Workshop: Case - Team Presentation

Session 6A - A Management Overview



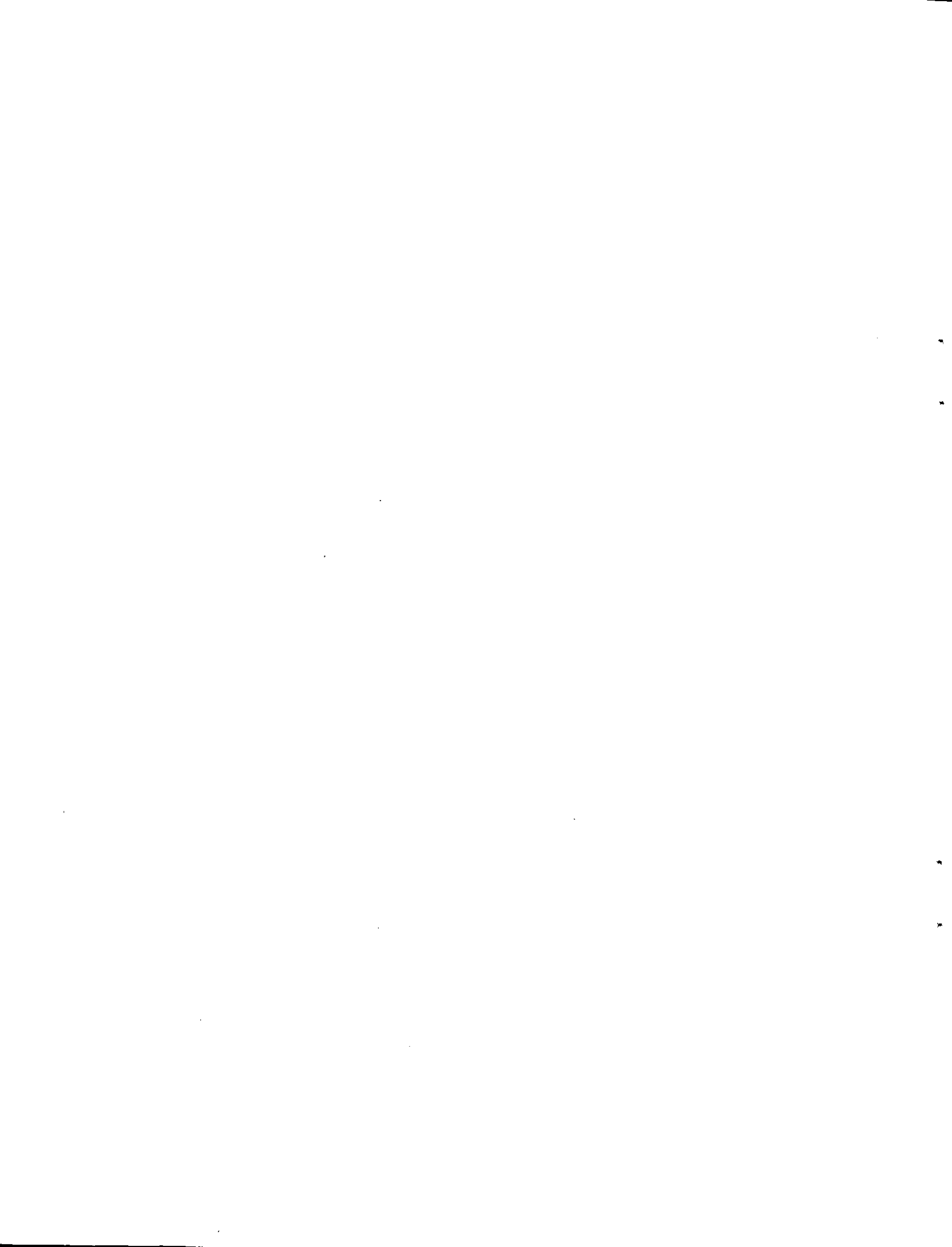
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II. COURSE LECTURE NOTES (PER SESSION)



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SEMINAR/WORKSHOP IN THE DESIGN AND USE OF A MANAGEMENT INFORMATION SYSTEM

Background

The world of the United Nations (UN) "career manager," i.e. Director, Professionals, Administrators, etc., reflects an increasing utilization of computer-based systems. The computer has become a part of the general operating routine in such areas as personnel, finance, and accounting. Further, it is now possible to design and implement improved information networks for management planning and control. Indeed, the harnessing of the power of the computer to serve the decision-making (and other) needs of managers is a principal concern in the field of MIS. Future expectations in this area are great -- the potential benefits to be derived from computer-system assisted management performance are apparently plentiful. But realization of these benefits will require the development of MIS-oriented skills within the (UN) organization.

Management personnel need timely, objective and factual information for effective decision making. An essential aid to managers at all levels is the modern management information system. These systems must be built upon sound principles and must use modern data collection, data processing and analytical methods. This implies as well, economy, accuracy, and timeliness in data collection and data processing. In addition, the users must know how to maximize the effectiveness of the systems by applying appropriate data analysis techniques. This body of knowledge can be

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learned from a skilled and experienced practitioner in the field of Management Information Systems.

The career "manager" and associated staff personnel must be prepared to be active participants in the design and implementation of the new/modified system. He must be a partner with the computer specialists to insure that the MIS efficiently provides support for his activities and thereby justifies the investment made to create the system.

Objectives

For UN "managers," and for all potential users of such systems, this program offers an appreciation of the full scope of resource requirements (men, material, machines and methods). Such an understanding will enable them to utilize the systems most effectively, know their roles and responsibilities, and contribute to the continued improvement of Management Information Systems.

The program also offers an understanding of the basic elements and specific methodology required in designing an effective Management Information System, so that as future designers of such systems they would use the most essential steps and methodology.

The course analyzes the concept of systems as it relates to UN programs and operations. The role of management as an input to operating systems is examined. Information is identified as an output of operating systems and an input to management.

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Attention is focused on the management role in the design and implementation of MIS; emphasis is placed on computer-based systems. Economic analysis of systems inputs and outputs is stressed. So too, design of processing requirements.

New developments in concepts, techniques and applications of computerized information systems for management are discussed.

Case studies -- i.e. UN applications, are employed to give participants the opportunity to design and/or evaluate proposed and existing information systems.

Content

The content of the program addresses the objectives (and background) outlined above. The specific subject areas presented are listed below:

- . Scope and Objectives of a Management Information System
- . The systems concept as it relates to United Nations operations and the management of the activities involved.
- . Identifying the information needs of management -- i.e. Directors, Professionals, and Administrators.
- . Management role in design and implementation of computerized MIS including systems' inputs, process, output.
- . Required staff and material resources: involvement of management and responsibilities of team members.

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- . The systems design cycle -- A management view. Logical steps in planning, analysis, design and implementation of an MIS.
- . Technology of MIS -- hardware, software, brainware -- e.g. programming, languages, processes, display, etc.
- . Documentation of the system
- . Evaluation of MIS system effectiveness.
- . New concepts in technology and application -- e.g. real time systems.

Appreciation to major implementation problems of management and/or functions, i.e. activities, programs, etc., of the UN.

College of Business and Administration

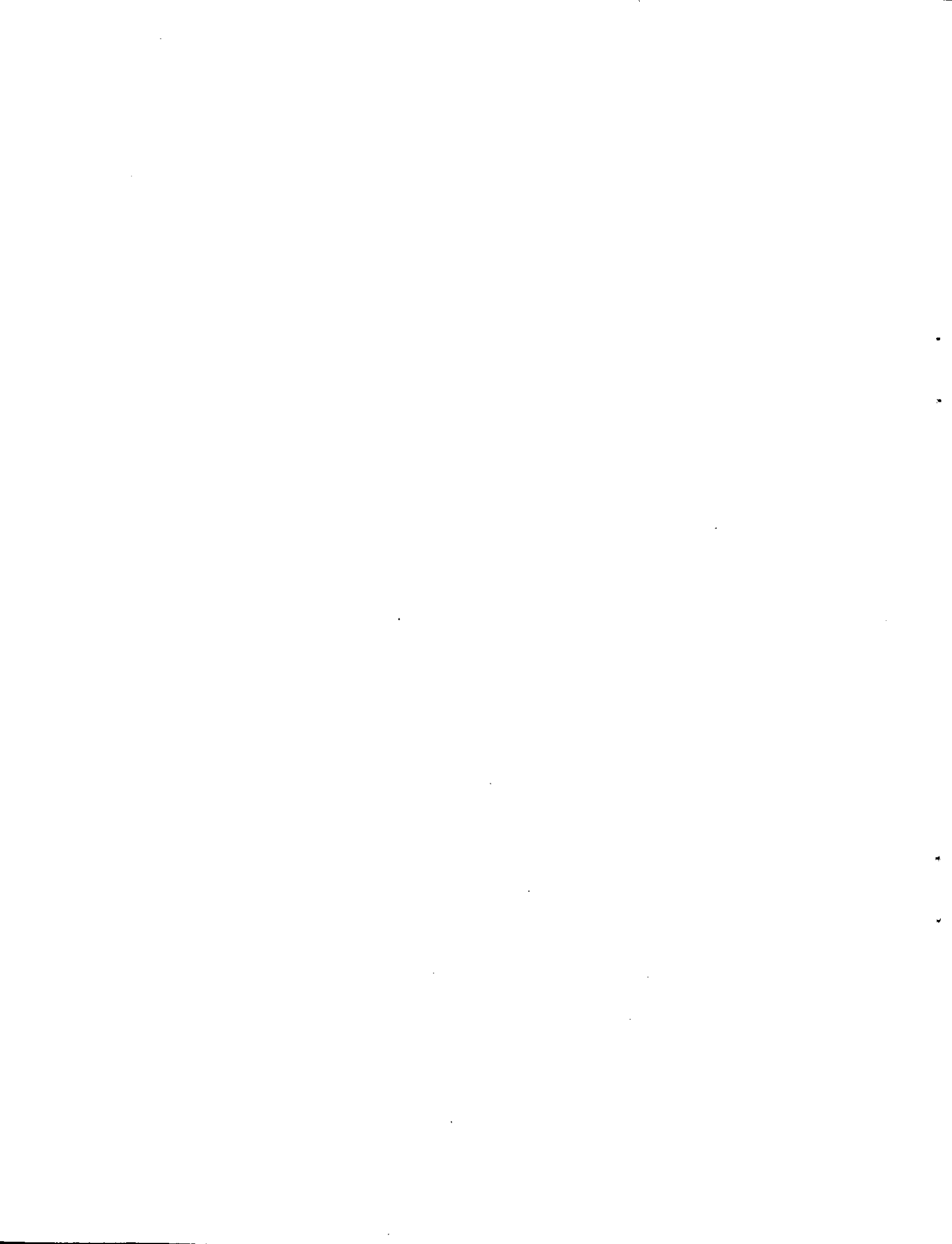


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UNITED NATIONS

PERSONNEL MANAGEMENT INFORMATION SYSTEM

PROPOSED DATA BASE



APPENDIX A

LAYOUT OF THE PERSONNEL MASTER FILE

Part 1:

<u>Field Name</u>	<u>Field Length</u>
1. Index number	6
2. Post Number	12
3. Post type	1
4. Name	30
5. Region	1
6. Nationality	3
7. Sex	1
8. Visa	1
9. Marital Status	1
10. Married to S/A	1
11. Birth date	6
12. Date of last medical exam	6
13. Medical classification	2
14. EOD date - UN family	6
15. EOD date - United Nations	6
16. Date joined present duty station ^{2/}	6
17. Contract expiration or review date	6
18. Appointment Status (Geo., lang. etc.)	1
19. Payroll Status (On headquarter payroll or not)	1
20. Allotment account code	12
21. Office code -	6
22. Location code	3
23. Functional title (code) ^{3/}	4
24. Assignment alw. exp. date	6
25. Repatriation grant	1
26. Leave Status ^{4/}	1
27. Home Leave indicator ^{5/}	1
28. Present occupation	5
29. Seniority date	6
30. Official Languages indicator	5
31. Separation date/Secondment date	6
32. Separation reason/Secondment indicator	1
33. Periodic report date	6
34. Pension active number	5
35. Pension code (status)	1
36. Date of Entry into Pension Fund	6
37. Home address	36
38. Social Security Number	9
39. Uncertified sick leave during this calendar year in half days	3
40. Uncertified sick leave since last periodic report in half days	3
41. Certified sick leave since last periodic report in half days	3
42. Accumulated annual leave in half days	3
43. Total number of non-normals	2
Total	229

Part 2:

<u>Field Name</u>	<u>Field Length</u>
1. Effective date of last update	6
2. Contract type	3
3. Category	2
4. Level	1
5. Step	2
6. Non-resident allowance code	1
7. Language allowance code	1
8. Post adjustment code	2
9. Spouse allowance code (name)	1
10. Children's allowance code (name(s))	2
11. Secondary dependant's allowance code (name)	1
12. Assignment allowance code	1
13. Medical insurance code	1
14. Dental insurance code	1
15. Life insurance code	1
16. SPA indicator	1
Total	27

Part 3:

Information here is same as that in part 2, except that it will be as of 31 December of 2 calendar years ago, i.e., if one looks at the file any time between 1 January 1974 and 31 December 1974, the information here will be as of 31 December 1972. On January 1, 1975, this part will be updated incorporating all changes submitted between 1 January 1973 and 31 December 1973 and hence, any time between 1 January and 31 December 1975, this part will show staff member's payroll status as of 31 December 1973. Total length of part three will be 27 characters.

Part 4:

Part 4 will contain a series of non-normals of 20 characters each. These non-normals will be added to staff member's record as more and more of the information which will be carried in the form of non-normals becomes available. A staff member's record may have anywhere from zero to a maximum of 40 non-normals. Details of various types are given in Appendix C.

FOOTNOTES:

1. A type '12' non-normal shown on page 3 of appendix C must appear on S/M's record
2. This is the last allotment account change date.
3. 3 digits for functional title code plus 1 digit for prefix.
4. A leave non-normal of type 18 must appear on S/M's record.
5. A home leave country and city non normal of type 10 must appear on S/M's record

Field Name	Original Source Doc.	Source for Per. Inf. Sys.	Interested Users	Output Reports
Index Number	P5,P11,P35 etc.	PAY,PDU	ALL	EAW,ART,ARS,RTR,EO, AEO DUMP
Post Number, Post Type	P5,MFA	PAY,PDU	AO,PO,EO,BO,OTC	EBO,DUMP
Name	P5	PAY,PDU	ALL	ALL
Region	.	.	PO	RTR
Nationality	P5	PAY,PDU	PO,OTC	RTR,EO,DUMP
Sex	P5	PAY,PDU	PO,EO	RTR,DUMP
Visa	P5	PAY,PDU	PO	RTR,DUMP
Marital Status	P5	PAY,PDU	AO,PO,EO	RTR,DUMP
Married to Staff Member	P5	PAY,PDU	AO,PO	RTR,DUMP
Birth Date	P5	PAY,PDU	PO,EO	RTR,AEO,DUMP,MED
Date of Last Medical Exam.	P11	PDU	Clinic, Pension Fund	MED
Medical Classification	P11	PDU	Clinic, Pension Fund	MED
EOD - UN Family	P5	PDU	PO	RTR,DUMP
EOD - UN	P5	PDU	PO	RTR,DUMP
Date Joined Present Duty Station	P5	PAY,PDU	PO,OTC	RTR,DUMP
Contract Exp. or Review Date	P5	PAY,PDU	AO,PO,EO,OTC	RTR,AEO,DUMP
Appointment Status	P5	PDU	PO	RTR,DUMP
Payroll Status	.	.	.	RTR
Allotment Account Code	P5,MFA	PAY,PDU	EO,OTC	RTR,DUMP
Office Code	P5	PAY,PDU	PO,EO,BO	RTR,EO,AEO,DUMP
Location Code	P5	PAY,PDU	PO	RTR,DUMP
Functional Title Code	P5	PAY,PDU	PO,EO	RTR,EO,DUMP
Assignment Alw. Exp. Date	P5	PDU	AO,EO	AEO,RTR,DUMP
Repatriation Grant	P5	PAY,PDU	PO	RTR,DUMP
Leave Status	P5	PDU	AO,PO,EO	RTR,DUMP
Home Leave Indicator	P5	PDU	AO,PO,EO	RTR,DUMP
Present Occupation	F44	PDU	PO	RTR,DUMP
Seniority date	.	.	PO,EO	RTR,DUMP
Official Languages Indicator	P5	PDU	PO	RTR,DUMP
Separation date/Secondment date	P5,P35	PDU	PO	DUMP
Separation reason/Secondment indicator	P5,P35	PDU	PO	DUMP
Periodic report date	F71	PDU	PO,EO	AEO
Pension Active Number	PF Transmittal	PAY	-	-
Pension Code	PF Transmittal	PAY	-	-
Date of Entry into Pension Fund	P5/PF Transmittal	PAY	-	-
Home Address	.	PDU	TAX	DUMP
Sick Leave	F71	PDU	PO,EO	AEO,RTR
Annual Leave	F71	PDU	PO,EO	

Field Name	Original Source Doc.	Source for Per. Inf. Sys.	Interested Users	Output Reports
Contract Type	P5	PAY,PDU	AO,EO,PO	RTR,ARO,EBO,DUMP
Category	P5	PAY,PDU	AO,EO	RTR,EBO,DUMP
Level	P5	PAY,PDU	AO,EO	RTR,EBO,DUMP
Step	P5	PAY,PDU	AO,EO	RTR,DUMP
Non-res. alw. code	P5	PAY,PDU	AO,EO,PO	RTR,DUMP
Language alw. code	P5	PAY,PDU	AO,EO,PO	RTR,DUMP
Post Adjustment Code	P5	PAY,PDU	AO,EO	RTR,DUMP
Spouse allowance code	P5	PAY,PIU	AO,PO	RTR,DUMP
Children's allowance code	P5	PAY,PDU	AO,PO	RTR,ARO,DUMP
Assignment allowance code	P5	PAY,PDU	AO,PO	RTR,ARO,DUMP
Medical insurance code	F164,OTC60	PAY	PO	RTR
Dental insurance code	F164	PAY	PO	RTR
Life insurance code	Ins. Unit Trans.	PAY	PO	RTR
SPA indicator	P5	PAY,PDU	AO,EO,PO	RTR,EBO,DUMP

NOTE: Non-normals shown in appendix C will be either created by the computer program using above mentioned information or will be coded and submitted for processing by the Personnel Data Unit.

LEGEND:

PAY - Actions created for processing by Payroll Programs.
 PDU - Actions coded by Personnel Data Unit.
 AO - Administrative Officer.
 PO - Personnel Officer.
 EO - Executive Officer.
 BO - Budget Officer.
 OTC - Office of Technical Co-operation.
 TAX - Statement of Taxable earnings Programs.
 EAW - Errors and Warnings Report.
 ART - Actions Report by Type of Action.
 ARS - Action Report by Staff Member.
 RTR - Retrieval Program Report.
 EBO - Executive Officer/ Budget Officer's Report
 ARO - Administrative Officer / Executive Officer Report.
 DUMP - Complete Dump Program Report.
 MFD - Medical Classification Report for new entrants in the pension fund.

RUN/OPER. NO. _____ TITLE _____ FREQ. _____ PAGE 2
 APPLICATION Personnel Update and Retrieval System ANALYST P. Ranadive DATE _____
 PROBLEM AREA _____ PROGRAMMER _____ REVISED _____

Code	Seq. No.	Processing Date	Effective Date	Contract Code	Category	
						Action Non-normal 1: Code = '01' Created with change in contract and/or category

Code	Seq. No.	Processing Date	Effective Date	Level	Step	NRA	LA	
								Action Non-normal 2: Code = '02' Created with change in level, step, NRA, LA

Code	Seq. No.	Processing Date	Effective Date	Post Adj.	Spouse	Children	Sec. Dep.	
								Action Non-normal 3: Code = '03' Created with change in post adj., spouse, children, secondary dependent

Code	Seq. No.	Processing Date	Effective Date	ASSIGN. ALW.	MEDICAL	DENTAL	LIFE	
								Action Non-normal 4: Code = '04' Created with change in assign. alw., medical, dental, life insurance

Code	Seq. No.	Effective Date	Category	Level	Step	NRA	LA	Post Adj.	ASSIGN. ALW.	
										Current SPA Non-normal: Code = '05' Latest SPA information will be stored here.

FILE NAME _____
 LENGTH FIXED VARIABLE _____ WORDS _____ MIX _____
 LOGGING/RECORDING/SEARCHING/INDEXING _____

RUN / OPER. NO. _____ TITLE _____ FREQ. _____ PAGE 2
 APPLICATION _____ ANALYST _____ DATE _____
 PROBLEM AREA _____ PROGRAMMER _____ REVISED _____

Code	Seq. No.	Year Code	Sick Leave						/ / / / / /	
			w/ full pay							
			1st mo.	2nd mo.	3rd mo.	4th mo.	5th mo.	6th mo.		

Sick leave Non-normal: Code = '06'
 2-digit year code and 1-digit semester code will identify the six mos. for which information is carried. Sick leave will be given in half days.

Code	Seq. No.	Date of Birth	Sp. Indic. S. Grant Son/Daughter	Name	
------	----------	---------------	--	------	--

Child Non-normal: Code = '07'
 1 Non-normal per child. Special indicator will suppress warning messages for children between 18-21.

Code	Seq. No.	Educat. Dtl. 1				Educat. Dtl. 2				/ / / / / /	
		Field of Study	Country of Study	Level of Degree	Years	Field of Study	Country of Study	Level of Degree	Years		

Educational background Non-normal: Code = '08'
 Staff member may have several non-normals of this type.

Code	Seq. No.	Date Reached	First Grade	Date Reached	Subsequent Grades	
------	----------	--------------	-------------	--------------	-------------------	--

Grades non-normal: Code = '09'
 Staff member may have several non-normals of this type.

Code	Seq. No.	Country of Home Leave	City Name	Year and Month of H.L.	
------	----------	-----------------------	-----------	------------------------	--

Home Leave Non-normal: Code = '10'

RUN/OPER. NO. _____ TITLE _____ FREQ. _____
 APPLICATION _____ LYST _____ DATE _____
 PROBLEM AREA _____ PROGRAMMER _____ REVISED _____

Code	Seq. No.	Country Code	City Name		Place of Recruitment Non-Normal: Code '11'
------	----------	--------------	-----------	--	--

Code	Seq. No.	Index Number	Name	Spouse Staff Member Non-Normal: Code = '12' If the spouse staff member indicator on fixed portion of record is on, then this non-normal must appear on S/M's record for cross-reference purposes.
------	----------	--------------	------	--

Code	Seq. No.	Ed.Gr. Info.	Ed.Gr. Info.		Education Grant Non-Normal: Code = '13'. Education Grant information on 2 children will be stored in one non-normal. 'CH.NN.XRED' column here must have the same number here as the 'Ed. Grant' column in child non-normal, type '07'.
------	----------	--------------	--------------	--	--

Code	Seq. No.	Occupation	DATE STARTED	DATE ENDED	SECTOR OF RESP. ACTIVITY	Previous employment non-normal: Code '14'.
------	----------	------------	--------------	------------	--------------------------	--

Code	Seq. No.	Language	Proficiency	Language	Proficiency	Language	Proficiency	Non-Official Language Non-Normal: Code = '15'
------	----------	----------	-------------	----------	-------------	----------	-------------	---

FILE NAME _____
 LENGTH FIXED VARIABLE _____ WORDS _____ MAX. _____ MIN. _____
 RECORDS _____

RUN / OPER. NO. _____ TITLE _____ FREQ. _____ PAGE 1 of 3
 APPLICATION _____ ANALYST _____ DATE _____
 PROBLEM AREA _____ PROGRAMMER _____ REVISED _____

Code	Seq. No.	Date of Assignment	Assignment Code	Date of Assignment	Assignment Code	
						Assignments Non-Normal: Code='16'.

Code	Seq. No.	Date of Contract	Contract Code	Date of Contract	Contract Code	
						Contracts Non-Normal: Code='17'.

Code	Seq. No.	From Date	To Date	Type of Leave	Comment	
						Leave Non-Normal: Code='18'.

Code	Seq. No.	Birth Date	Name	
				Spouse Non-Normal: Code='19'.

Code	Seq. No.	Birth Date	Relationship	Name	
					Secondary Dependant NH: Code='20'. Relationship codes: 'F' = Father 'M' = Mother 'B' = Unmarried brother 'S' = Unmarried sister

Code	Seq. no.	EOD Date	SEPARATION Date	Sep. reason		Non-normal for separated-reappointed staff member: code = '21'.
------	----------	----------	-----------------	-------------	--	---

Code	Seq. no.	Year	Sick leave w/half pay							Sick leave with half-pay non-normal: Code = '22'. See explanation given for non-normal '06'.
			1st mo	2nd mo	3rd mo	4th mo	5th mo	6th mo		

Code	Seq. no.	From Date	To Date	SPA Category	SPA level	SPA step	Old SPA non-normal : Code = '23'.
------	----------	-----------	---------	--------------	-----------	----------	-----------------------------------

Code	Seq. no.	Effective Date	Functional Title	Occupation		Functional title non-normal : Code = '24'.
------	----------	----------------	------------------	------------	--	--

Code	Seq. no.	Effective Date	Comments		Comments Non-normal: Code = '25'.
------	----------	----------------	----------	--	-----------------------------------

RUN/OPER. NO. _____ TITLE _____ PAGE _____
 APPLICATION PERSONNEL UPDATE AND RETRIEVAL SYSTEM ANALYST _____ DATE _____
 PROBLEM AREA _____ PROGRAMMER _____ REVISED _____

Address non-normal : Code = '26'. Information will vary with the sequence number as follows:

Code	Seq. No.	Address or Telephone number Information	Sequence no.	Columns	Description
			01	1 - 18	First line of address
			02	1 - 18	Second line of address
			03	1 - 9	State name or abbreviation
				10 - 15	Zip code
				16 - 18	Country code
			04	1 - 18	Telephone number with area code

RUN/OPER. NO. _____ TITLE ACTION FILE (ACCESS ACTIONS) WALDEN FREQUENCY _____ PAGE 1 OF 1
 APPLICATION PERSONAL MESSAGE AND TELEPHONE SYSTEM ANALYST P. RONDOLIVE DATE 07/11/72
 PROGRAMMER _____ REVISION _____

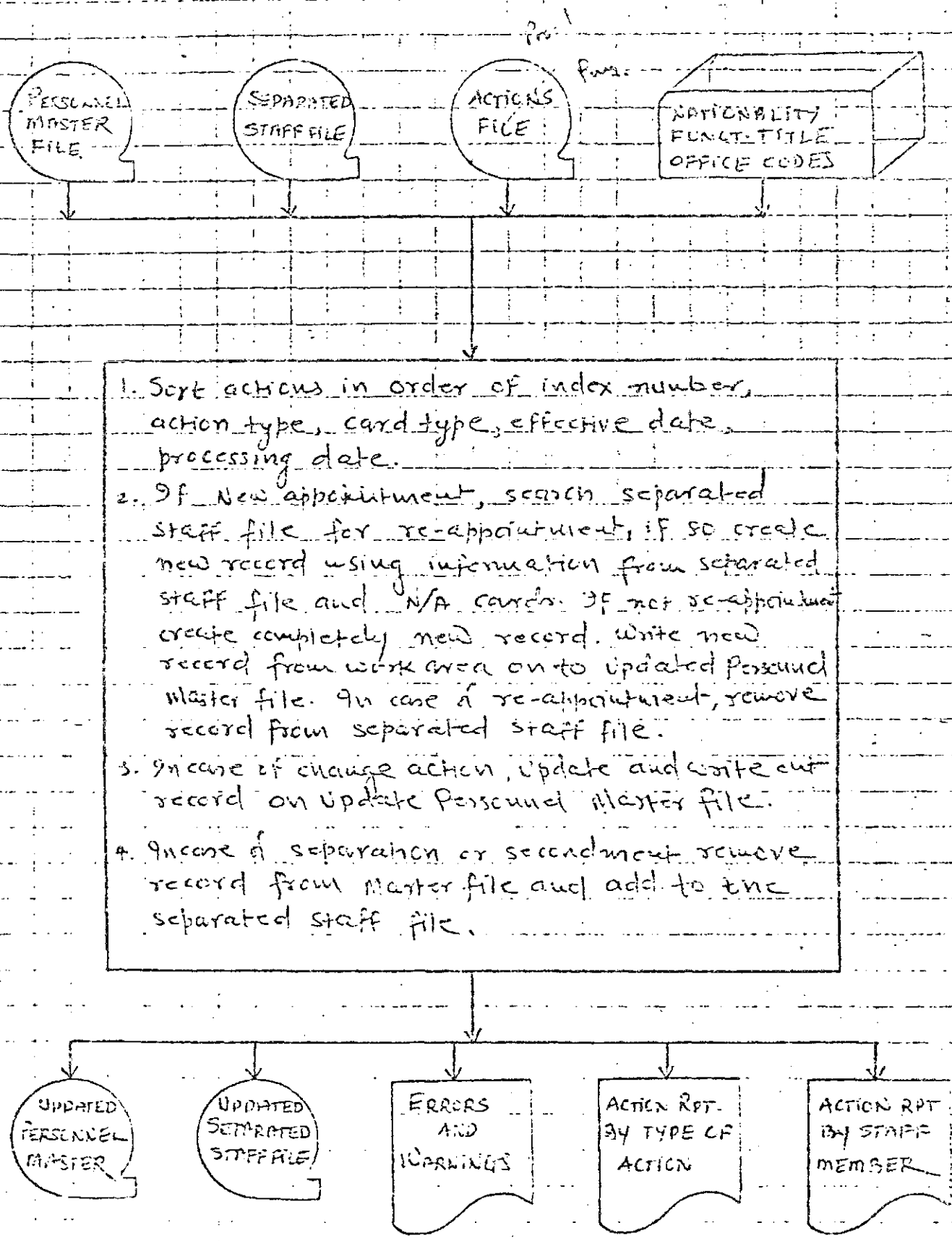
INDEX NUMBER	NAME	22 CHARACTER ACTION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		

This is a variable length file. As many non-normals as are needed to keep staff member record up to date will be carried. At the present

time it is proposed that we provide room for maximum of 40 non-normals. This number may be increased in the future.

This file is not to be confused with input actions file for personnel update program.

Block Diagram of Personnel Update Program



1. Sort actions in order of index number, action type, card type, effective date, processing date.

2. If New appointment, search separated staff file for re-appointment, if so create new record using information from separated staff file and N/A cards. If not re-appointment create completely new record. Write new record from work area on to updated Personnel Master file. In case of re-appointment, remove record from separated staff file.

3. In case of change action, update and write out record on update Personnel Master file.

4. In case of separation or secondment remove record from Master file and add to the separated staff file.

APPENDIX F

Errors and Warnings Report Format

INPUT ACTION

ERROR MESSAGE

01C 2987654300273 PR203

ERROR IN EFFECTIVE DATE

02A 2567835111272PERGS405NNOOYO2N

NO CARD TYPE 1 FOR NEW APPOINTMENT

03C 2666777110972 03

ERROR IN INDEX NO. NO MATCH ON MASTER

04Z 1222333JOHN DOE
*

ERROR IN ACTION TYPE

APPENDIX G

ACTION REPORT BY TYPE OF ACTION

APPOINTMENTS:	INDEX NO.	NAME	EOD DATE	CONTRACT	POSITION	EXP/DATE	OFFICE
	234567	JOHN DOE	010173	S.T.-LOC.	GS101	230273	11345
	345678	JACK PARKS	131272	F.T.	PR501	121274	12345
PROMOTIONS:	112233	JAMES WAGNER	FROM: PR304	TO: PR401		ON 010273	
	223344	FRANK YATES	FROM: GS509	TO: PR205		ON 010273	
TRANSFERS:	112233	JAMES WAGNER	FROM: ESA/CHBP	TO: ESA/OTC		ON 010273	
	334455	REGINA ZYTKA	FROM: GS/BMS	TO: ESA/STAT		ON 151272	

SUMMARY

APPOINTMENTS	PROMOTIONS	TRANSFERS	CHANGE OF FUNCT.	TOTAL ACTIONS
2	2	2	0	6

APPENDIX 5

ACTION REPORT BY STAFF MEMBER

INDEX NO.	NAME	ACTION	COMMENT
234567	JOHN DOE	APPOINTMENT	S.T.--LOC. AT GS101 ON 010173 IN OFFICE 11345
345678	JACK PARKS	APPOINTMENT	F.T. AT PR501 ON 131272 IN OFFICE 12345
112233	SALENS WAGNER	PROMOTION TRANSFER	FROM PR304 TO PR401 ON 010273 FROM ESA/CHBP TO ESA/OTC ON 010273
223344	FRANK YATES	PROMOTION	FROM GS509 TO PR205 ON 010273
334455	REGINA ZYTKA	TRANSFER	FROM GS/BMS TO ESA/STAT ON 151272

SELECTION, SORTING AND PRINTING FIELDS FOR GENERALIZED PERSONNEL REPORTS

FIELD NAME	SELECT	SORT	PRINT	COMMENT
Index number	.	.	X	Printing is automatic unless suppressed
Post number and type	.	.	X	
Name	.	X	X	Sorting is automatic. Print may be suppressed
Region	X	X	X	
Nationality Code	X	X	X	Nationality name may be printed
Sex	X	X	X	
Wisa	X	X	X	
Marital Status	X	X	X	
Married to S/M	X	X	X	Corresponding type '12' may be printed
Birth date	X	X	X	
Date of last medical exam.	X	X	X	
Medical Classification	.	.	X	
EDC date - UN family	.	.	X	
EDC date - UN	X	X	X	
Date joined present Dty.st.	X	X	X	
Contract exp. or review	X	X	X	
Appointment status	X	X	X	
Payroll status	X	.	X	
Allotment acc. code	X	X	X	Selection based on lines 2 and 3 of field
Office Code	X	X	X	Selection on any combination of fields
Location code	X	X	X	
Functional title code	X	X	X	Functional title may be printed
Assign. Alw. exp date	X	X	X	
Repatriation grant	X	X	X	
Leave status	X	X	X	Corr. type '13' may be printed
Home leave indicator	.	.	X	
Present occupation	X	X	X	
Seniority date	X	X	X	
Official languages	X	X	X	
Separation date	X	X	X	
Separation reason	X	X	X	
Contract type	X	X	X	
Category	X	X	X	
Level	X	X	X	
Step	X	X	X	
HRA code	X	X	X	
Lang. alw. code	X	X	X	
Post-adj. code	X	X	X	
Spouse alw. code	X	X	X	
Children's alw code	X	X	X	
Sev. dep. alw. code	X	X	X	
Assignment alw. code	X	X	X	
Medical Ins. code	X	X	X	
Dental Ins. code	X	X	X	
Life Ins. code	X	X	X	
SPA indicator	X	X	X	

FIELD NAME	SELECT	SORT	PRINT	COMMENT
SPA Non-normal	.	.	.	Selection may be made on category level, step, NRA code, LA-code, post. adj. code and assignment all code at SPA level.
Homeleave non-normal	x	x	x	Selection and sort may be based on country of home leave. City name and month and year of home leave may be printed in addition to country of home leave.
Place of recruitment nn	x	x	x	Some sort, select and print rules as home leave non-normal.
Non-offl. languages	x	x	x	
Leave non-normal	.	.	x	From date, to date type of leave and comment will be printed.

APPENDIX J

PROPOSED LAYOUT OF COMPLETE DUMP PROGRAM REPORT

INDEX NO. 123456 NAME: DOE, JOHN K. SEX: MALE MAR/STA.: MARRIED NATL.: USA BIRTH DT: 1.1.3

FAMILY COMP:

NAME	BIRTH DT.	RELATION	COMMENT
JEAN	2.2.38	WIFE	S/M DOES NOT RECEIVE SPOUSE ALLOWANCE
CURT	4.5.62	SON	S/M RECEIVES DEPENDENCY ALLOWANCE
MARIE	6.7.65	DAUGHTER	S/M RECEIVES DEPENDENCY ALLOWANCE
MAX	8.6.09	FATHER	S/M RECEIVES SECONDARY DEP. ALLOWANCE

EDUCATION :

FIELD OF STUDY	COUNTRY OF STUDY	LEVEL OF DEGREE	COMMENT
ECONOMICS	USA	B.S.	
BUSINESS ADM.	USA	#	1 YEAR GRADUATE DIPLOMA

LANGUAGES :

OFFICIAL: NAME	PROFICIENCY	UNOFFICIAL: NAME	PROFICIENCY
ENGLISH	.	SWAHILI	3
FRENCH	2	HINDI	1

PREV. EXP. :

FROM DATE	OCCUPATION	FIELD OF ACTIVITY
11/55	SALESMAN	RETAIL BUSINESS
12/57	PERS. OFF.	INDUSTRY

UN EMPLOYMENT: DATE JOINED UN FAMILY: 1/3/62 DATE JOINED UN: 1/3/62

DATE	CONTRACT	GRADE	ASSIGNMENT	SPA
01/03/62	FIX	PR-2	PERSONNEL OFF.	
01/09/62	PBY			
01/03/64	PER			
01/05/64		PR-3	ADMIN. OFF	SPA GRANTED
01/05/65		PR-3		SPA DISCONTINUED
01/07/70		PR-4	DTY. CH. SEC.	

PRESENT STATUS: OFFICE: SG/PL/PL ADMIN GRADE: PR-4 STEP: 4 POST NO.: 076-P4-003R
 FUNCT. TITLE: DTY. CH. SEC. APPT. STATUS: GEOGRAPHICAL

NOTE: ANY ADDITIONAL INFORMATION REQUIRED MAY BE PRINTED ON THIS REPORT PROVIDED IT IS ON THE MASTER FILE.

JOB DESCRIPTION (CONTINUED)	
LINE 3	LINE 4

APPENDIX TO	DATE ISSUED	HEADLINE		DURATION	PROGRAM	RECRUITMENT
		S	T			
5			DATE			

JOB REMARKS CODE	INCREMENT ONE PROGRAM	SUBSTITUTIVE EVOLUTION		AVAILABILITY		GOVERNMENT	
		DATE REQUESTED	DATE RECEIVED	DATE REQUESTED	DATE RECEIVED	DATE REQUESTED	DATE RECEIVED

OFFICER	ENTER ON DUTY		REMARKS
	RECRUITMENT DATE	ENTERED ON DUTY	

RUN/OP. NO. _____ TITLE _____ FREQ. _____ PAGE _____
 APPLICATION CANDIDATES POSIER, ILE ALYST PRANDIVE DATE _____
 PROGRAMMER _____ REVISOR _____

NAME	DATE OF BIRTH	DATE OF LAST CORRESPONDANCE	DATE WHEN AVAILABLE	DATE BY WHICH INTERESTED

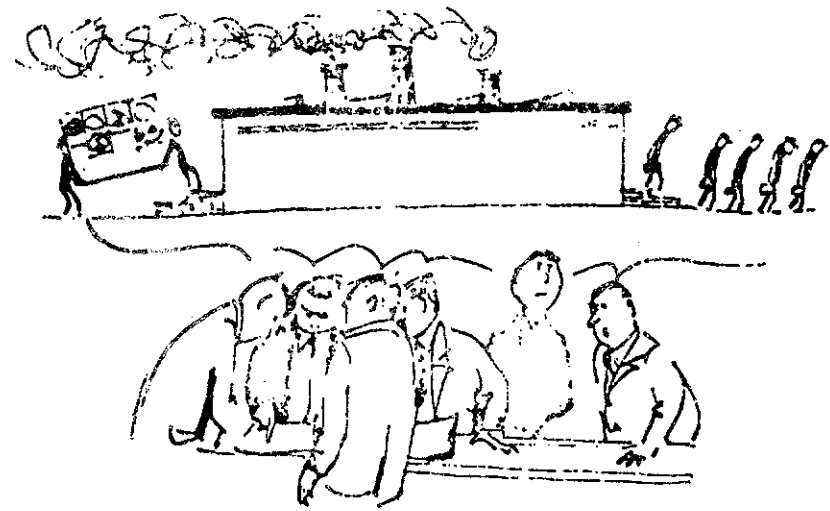
EDUCATION					OFF. LANG. NON-OFFICIAL LANGUAGES				
DETAIL 1	DETAIL 2	DETAIL 3	DETAIL 4	DETAIL 5	ENGLISH	SPANISH	RUSSIAN	FRENCH	GERMAN

PRESENT OCCUPATION		EMPLOY. PRIOR TO PRESENT JOB		2 JOBS AGO		3 JOBS AGO	
DATE STARTED	FIELD OF ACTIVITY	DATE STARTED	FIELD OF ACTIVITY	DATE STARTED	FIELD OF ACTIVITY	DATE STARTED	FIELD OF ACTIVITY

4 JOBS AGO		MAILING ADDRESS	
DATE STARTED	FIELD OF ACTIVITY	ADDRESS LINE 1	ADDRESS LINE 2

JOB DESCRIPTION	
LINE 1	LINE 2

FILE NAME _____ LENGTH (FIXED OR VARIABLE) _____ WORDS _____ MAX. 590 CHARACTERS
 POSITION _____ RECORD NO. _____



Congressional hearings have highlighted the great fear of automation's opponents—unemployment!

A system may be logically perfect—but it still must be administered by all-too-human beings. Here are some ways to minimize the human problems in systems design and change—

HUMAN FACTORS IN SYSTEMS DESIGN

*by James B. Bower and J. Bruce Seferl
University of Wisconsin*

THE GROWING mechanization of data processing operations, particularly the automation brought about by the application of electronic computers, has intensified the human relations problems in-

The research underlying this study has been financed in part by a grant from the General Electric Company to the University of Wisconsin. However, the conclusions, opinions, and other statements are those of the authors and are not necessarily those of General Electric Company or of any other group or individual.

herent in the design of business systems. As a result, business managers and systems analysts are devoting increased attention to the impact of the financial information system on the people within their organizations—and to that of the people on the financial information system.

Many trade unions, with some public support, have attacked automation as a leading cause of unemployment. There have even been proposals that automation and data processing revisions be

banned altogether.¹ The relation of automation to unemployment remains unclear. Congressional hearings have provided a sounding board for automation's opponents and proponents but no satisfactory answer.

Management opinion is divided as to the actual effect on employee wage levels, job security, advancement, and morale of the many changes that are taking place in both factory and office as a result of changes in procedures, work simplification, elimination of man-

ual data handling, and the advent of high-speed communication. These changes are not confined to companies installing computers but are magnified and highlighted there.

Since systems changes involve people, they do not always have the same effects. Sometimes they are or seem to be beneficial to one or a group of the people involved; sometimes, harmful. Some studies of the effects of wholesale revampings of data processing methods have indicated that the employees were on the whole happy with their new jobs, that they generally benefited through higher wages, and that no hardship of any significant duration was visited upon anyone.⁸ Other studies have reported employee disillusionment with the new jobs, the elimination of many promotion opportunities formerly available, complaints of being "chained to the machine," empire building by a new elite of EDP specialists, stagnation of middle management, and other adverse effects.⁹

In any case it is clear that there is need for extensive planning of every major procedural or data processing change. Provision should be made in advance to combat any possible harmful effects of systems change on the employees concerned and to take account in the systems design of the effect of human factors upon the operation of an economical and efficient system.

Human factors

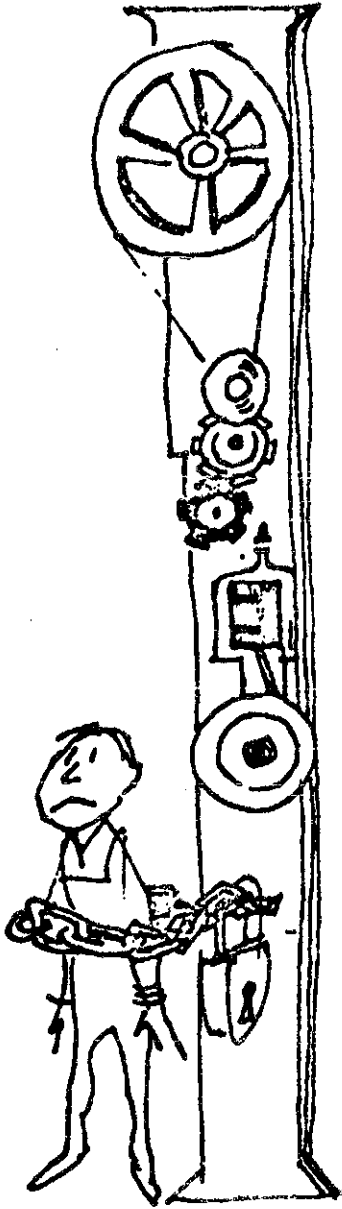
The human factors principle of systems design, namely, that the design of a system should be consistent with applicable human factors since people are responsible for the effectiveness of the system, has been proved by experience to be a vital guide to the systems analyst in his work. The term human factors includes all those personality traits that consciously or unconsciously shape the actions and reactions of the people who must use the system as finally

designed as well as those same traits reflected in the systems analyst himself as they may affect his ability to achieve an objectively efficient and successful design.

Only the more significant human traits can be explored here and those only as they affect systems design. Some factors, such as resistance to the new and strange, desire for job security, tendency to be influenced by the opinions of others, and preference for familiar work habits are basic in all employees at all levels but may apply with particular force or in particular ways with certain types of employees. Other factors become a problem only with certain groups.

For convenience in examining the effect of human factors on systems design, two levels of management are distinguished in this article. Top management consists of those executives who participate in companywide policy formulation, including the chief executive and those who report directly to him. The term middle management is used to encompass not only the usual group of middle and junior executives, such as division managers, department heads, and their staff functional advisers, but also operating supervisors and foremen since the human factors that affect this group as a whole are similar. Nonsupervisory employees are treated separately since their reactions to systems changes are usually different from those of people on the managerial levels. For purposes of this article the systems analyst is assumed to be either a member of a company's internal systems and procedures staff or an outside specialist in this field, who might represent an accounting or management consulting firm.

Some of the more important human factors that should be considered by the systems analyst in applying the human factors principle are illustrated in the exhibit on page 47. Unforeseen problems, including problems caused by human factors, often arise during



Some studies have cited workers' fears of being chained to the machine.



Some corporate patterns are as intricate as the rituals of a South Seas tribe.

the actual implementation of a new or revised financial information system, requiring adaptations. By taking as many human factors as possible into account during the planning of the system, however, the analyst improves his chances of producing an efficient, well accepted system with few subsequent revisions.

In the discussion that follows the components of the human factors principle are applied in detail to each of the three levels of personnel previously identified.

Top management

It is axiomatic that the wholehearted support of top management is required for systems acceptance and success. Middle management and nonsupervisory employees are quick to take their cue from the attitudes that flow downward. In the past, top management often viewed work procedures and systems study as a specialized function worthy of its attention only when a crisis arose. With the advent of computers, which are often so costly as to require justification to boards of directors or stockholders and which have been so heavily publicized as to become status symbols, top management has become much more involved in the problems of data processing.

This is fortunate, for continued top management attention is vital to the eventual success of any system. At several points during the systems project top management must review interim findings and approve or disapprove recommendations for further action. Careful consideration and prompt decisions are essential.

Mere interest and support from top management is not the whole answer, however. The analyst must take account of many human factors at this level in determining management's information needs, in alerting top executives to the full implications of any large-scale revision in the data processing system, and in making sure that executives are aware of and capable of obtaining the full range of benefits available.

Company patterns — Most established companies have certain patterns of activity that affect their approach to innovations. One sys-

tems analyst has likened these patterns to the rituals of a South Seas tribe, complete with dances to drive out evil spirits.⁶

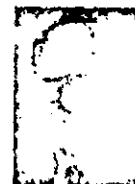
In some organizations duties and responsibilities are well defined; many small, closely knit companies prefer a freer, looser structure.⁷ Some managers are direct and forceful in ordering changes; others prefer devious and indirect methods. Some top managements are simply not prepared to make any substantial changes in the organization or in methods of operation. In such situations the systems analyst must decide whether to adapt the system to accommodate the attitude or to try to change the attitude.

The pattern of change in a company may have been molded by special factors that operated in the past. A top executive may feel that he holds his present position because of some procedure or method he introduced many years ago;



JAMES B. BOWER, Ph.D., CPA, is professor of commerce, accounting, at the University of Wisconsin in Madison. He has contributed numerous articles to professional magazines and is the author of several books. He is a member

of the American Accounting Association, the National Association of Accountants, and the American Institute of CPAs and serves on the Wisconsin State Board of Accountancy.



J. BRUCE SEBERT is an instructor in commerce at the University of Wisconsin. In the past he served as Director, National Audit Division of the Internal Revenue Service in Washington, D.C., and as Chief, Audit Division of the IRS

in St. Paul, Minnesota. Mr. Sebert is a member of the Institute of Internal Auditors, the Federal Government Accountants Association, the NAA, and the AAA.



The analyst should always handle "sacred cows" with extreme care.

he is not likely to welcome any change.* Special care should be taken to see that the new system, instead of endangering this executive's sense of value to the company, can be identified with his contribution as an outgrowth of it. Another top manager may have a pet project to which he gives special attention and which is part of his personal pattern of self-esteem. The analyst must always be alert to avoid colliding with such "sacred cows."

Individual personalities are important, too. One executive may be a so-called detail man who likes to have a hand in designing procedures himself. Another may be an idea man interested only in the broader aspects of the system or a results man interested only in end objectives. In each case the analyst must adapt his approach accordingly.

If the company has a history of orderly and considered attention to continued improvement rather than one of patchwork solutions to immediate crises, the analyst can conclude that the top management is likely to be systems-oriented and ready to support him in designing and installing a new system.

Management climate — Companies that show sincere concern for the employee as a human being build up an employee trust in top management that is of great value in gaining acceptance of change. If management has been willing in the past to use employees' ideas,

imagination, and suggestions and to pay attention to workers' feelings in visible ways, the systems analyst's task will be eased considerably.

He should, therefore, appraise the management climate of the organization as early as possible so that he can take it into account in systems planning. If he finds a climate of teamwork and understanding among departments, delegation of authority by management, and stimulation of the challenge of problem solving, he can devote his primary attention to technical problems. If he finds a climate of top management isolation, rigid departmental barriers, little or no downward communication, and a reluctance to keep employees informed of company plans and policies, he may need to educate top management about the importance of attention to people in assuring the success of any proposed new system.

An aspect of management climate that has particular significance for the systems analyst is the extent to which authority has been delegated to lower levels. If all decisions have traditionally been made from above, the analyst is likely to find managers and employees alike hesitant to make suggestions and express opinions; their ideas have dried up from lack of encouragement.⁵ In such a situation top management needs to give visible evidence of its support of the system project. It should, for

example, select capable representatives from the departments that will be affected by the systems study to help the analyst with it, and it should give them the time and authority needed to do a proper job.

A detailed study of fundamental systems changes made over a five-year period in a large electric utility⁶ provides a striking example of the way in which differences in prior participation in planning and problem solving can affect departments' contribution to and acceptance of change. In the accounting department much effort had been spent over the years in developing participation in management by intermediate and first-line supervisors. The result was a high degree of employee satisfaction, trust, and good will, which proved very valuable during the transition from one system to another. In the sales department, for a variety of reasons, the employees had never participated in management to this degree. Furthermore, this pattern continued during the systems changeover. Communication of information about the change was much less complete at all levels than in the accounting department. No attempt was made to present the new system to the sales employees in relation to their special interests and objectives. As a result, the sales employees never understood the system as well as the accounting employees, had less confidence in it, and presented more

difficult problems during the transition.

As recent experience with large-scale computer installations has demonstrated, employee acceptance of change depends heavily on top management's willingness to make assurances about job security, salary retention, opportunity for training, and rules to be followed in reassignment.¹⁰ As the plans for a major systems change unfold, top management will have to chart its course of action in the field of human relations.

What attitude should it adopt toward displaced labor? Is it willing to assure to all affected employees the opportunity for continued employment regardless of the changes in data processing methods and departmental and individual functions? Is it willing to bear the expense of retraining employees? Will it show concern for the employees' self-respect and personal improvement during periods of change and at other times?¹¹

Although these decisions are not the systems analyst's to make, he cannot — and should not — avoid some involvement in them. He has a responsibility to take account in his planning of any provision for

utilization of present employees, their training and retraining, and their job mobility. He should, therefore, press for early top management decisions on these points.

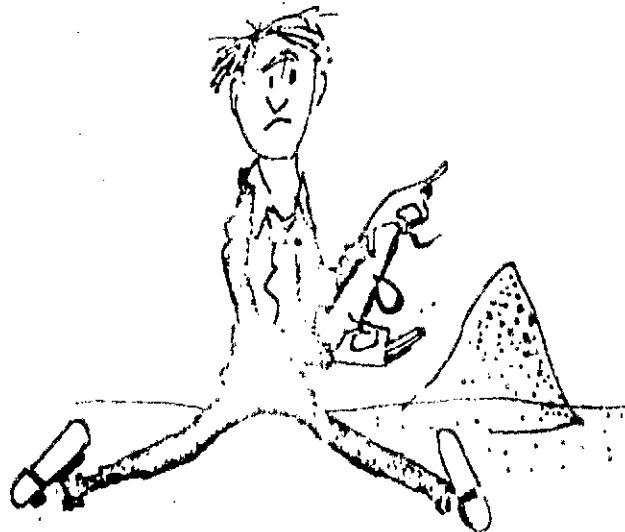
In fact, the analyst's ability to obtain prompt policy decisions from top management on all questions that arise throughout the study will be an important factor in the success of his work. Procrastination in making difficult decisions is a basic human trait. The systems analyst must press firmly for such decisions while using every means available to demonstrate the logical basis of his proposals. In one manufacturing company the systems and procedures staff personnel were forced to spend 60 per cent of their time on attempts to obtain final decisions. In the words of one staff member, attempting to get a decision was "like trying to tie a rope around a pile of sand."¹²

Decisions will be particularly difficult to get if a basic change in organizational structure is required or if the proposed change will create an embarrassing personnel problem. If the organizational pattern of the company has tended to develop around person-

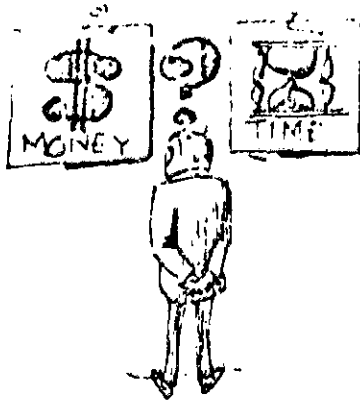
alities rather than being based upon logical division of functions, the difficulties of change will be magnified. If top management is adamant in refusing to make an indicated organizational or personnel change, the systems analyst may have to build around the existing structure or person, recognizing that a good system that has the support of management is to be preferred to the best system if the latter will not be supported or used.¹³

Desire for improvement — If the systems analyst finds that top management has a genuine desire to solve any systems problem discovered to exist, it is likely that he will also find the desire and courage to make the changes necessary to implement the solution.

Top management's willingness to assign good people to work with the analyst and to give them the necessary time and responsibility is one test of its real interest and concern. Too often the tendency has been to make such assignments on the basis of availability rather than suitability. If management shows such a tendency, the analyst needs to point out the importance of having outstanding people on



Sometimes getting a firm, final decision is like trying "to tie a rope around a pile of sand."



Top management should receive a realistic appraisal of the training time and costs of each system.

the planning group and the benefits to be expected.

The use of a project team made up of representatives of the various departments affected, operating with or under the analyst, may be a new problem solving procedure in the company. It has, however, many advantages. Not only does it usually produce a sounder systems design but it also greatly facilitates acceptance of the system, both by the members of the team and by others. The representatives of the personnel and industrial relations departments can help in determining the human relations climate of the organization and in helping to plan the final proposals regarding employee utilization. The representatives of the operating depart-

ments can be useful in alerting the analyst to any special human factors problems that may arise in their areas.

The strength of top management's desire for improvement will be further tested as it is informed of the training time and costs of installation that will probably be involved in any large-scale systems revision. A realistic appraisal of such factors during the planning phase of the systems project will give management an opportunity to determine its step-by-step involvement.

If cost cutting has been the principal factor in top management's motive for change, it may be desirable for the analyst to reorient management toward the goal of labor saving in the broadest sense, that is, the use of saved labor to make possible improved and faster information for decision making. A system that provides better tools for management is more valuable over the long run than one that simply reduces costs. This shift in emphasis toward a broader goal also will help to ease the fears of operating personnel about labor displacement.²⁴

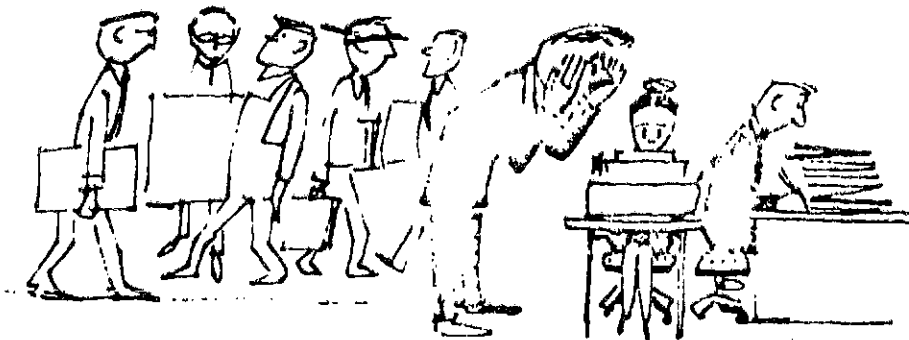
The systems analyst bears much of the responsibility for educating top management about systems in general and about his system in particular. He should do what he can to help management understand what the system can provide and how it can be of value in

planning and decision making. At the same time he should be laying the groundwork for further systems advances. The managers of tomorrow must have a broad knowledge of the interdependence of all parts of the business and the potential for improving decision making offered by the increased variety of information made possible by a modern data system. The systems analyst can play a vital role in top management's data processing education.

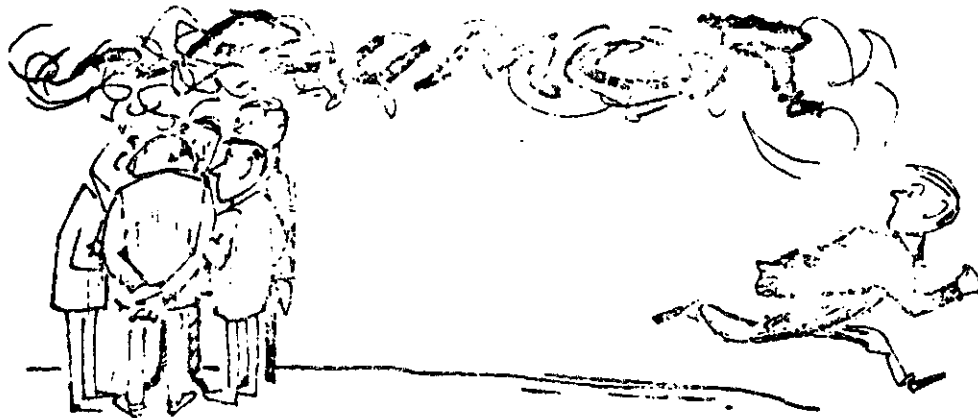
Middle management

An understanding of the human factors at work in the middle management group of managers and supervisors is especially important to the systems analyst. The personnel at this level hold the key to success or failure of a new system. Top management relies on them for the organization's everyday efficiency and smooth operation; the nonsupervisory employees take their direction and set their course from them. The systems analyst has traditionally found it necessary to work closely with middle management. In systems analysis he must depend heavily on the information they furnish; in systems implementation and follow-up he needs their acceptance and cooperation.

Problems -- Middle management presents a number of special problems for the systems analyst. Typ-



A typical problem is the middle manager so immersed in his own department that he can't see the significance of what's going on in the rest of the company.



In any organization it is difficult to get ahead of the rumor network. Thus management should always be frank and detailed about the scope of the study.

ically, managers below the top management group and supervisors have a narrow perspective on company operations. They are so immersed in their own jobs and their own departments that they cannot see the significance of what is going on elsewhere in the company. The systems analyst will have to devote considerable educational effort to the task of building up in the middle managers a feeling for the total job that is being attempted.

Typically, too, middle managers concentrate their attention on the technical rather than on the administrative and human relations aspects of their work. Thus, the analyst will need to keep emphasizing to them the importance of teaching the new system to the employees under them and the need for selling the system to the workers.

Another human factor that is important at the middle management level is the increased resistance to change that accompanies increased age. This resistance is likely to be especially intense in large and stable organizations. Age increases resistance to change partly because of growing reluctance to alter familiar and comfortable established work patterns and partly from the ever-present fear of inability to compete with younger people in

the organization. This resistance is partly unconscious. There is an instinctive tendency to organize experience in a manner that will be minimally threatening and to believe what one wants to believe.¹⁷

Furthermore, middle managers are consciously fearful of automation. Any substantial reduction in the number of employees is likely to reduce the number of supervisors needed as well. Forecasts that the computer, by taking over routine decision making, will wipe out middle management have been highly publicized. Certainly the inflexibility of programs necessary to ensure uniform input, processing and output in a large-scale computer system changes the scope of middle management decision making. This may, as some claim, leave the manager free for higher activities, but some middle managers are understandably skeptical.

As with any other employee group, middle management's past experience with systems change is a powerful determinant of its current attitude. A manager whose last experience with a staff specialist was unfortunate may be convinced that all staff men are arrogant, impractical, and opinionated and that it is a waste of time to deal with them. Perhaps he once suggested an improvement that was not acknowledged or that was

adopted without credit. If so, he is probably still nurturing his hurt feelings. The systems analyst will have to dig out such attitudes and convince the supervisor that suggestions will be welcomed and used.¹⁸

Past experience also, although unfortunately less frequently, can be a help. If earlier systems analysts have dealt with middle managers successfully—and particularly if top management has made a practice of encouraging middle management participation in problem solving and decision making—the systems analyst will find his path easier.

One advantageous characteristic of middle managers is that they are usually accustomed to working toward long-range goals, such as promotion, retirement, and education of their children. Thus, they do not need evidence that a change will bring them immediate benefits to the extent that lower-level employees do.

Preliminary study—Even before the study has actually begun, the systems analyst will need to be at work allaying the fears of middle management and employees alike. In any organization it is difficult to get ahead of the rumor network. As early as possible top management should make a definitive announcement of the scope of the

The systems analyst can build the middle manager's confidence by treating him as an intelligent equal, competent to understand the system and its problems.

study. If this announcement can also contain assurances of job security and other measures for employment stabilization, so much the better. In case top management does not recognize the importance of informing employees early, the systems analyst should consider it his responsibility to point out the need for such announcements and recommend their timing and content. Reasons for the change should be stated, with emphasis upon the broader goals and the benefits to be derived by everyone. If possible, better use of labor rather than cost reduction should be stressed. Some companies planning computer installations have given employees as much as three years' notice of impending changes in order to accustom them to the idea.

Subsequent interim reports are also desirable. These should be as specific and factual as possible and should continue to stress positive benefits. Middle management in particular needs to be kept continuously informed so that it can answer questions from employees and interpret to them the aims and policies of top management.

Analysis phase — The analysis phase of the study, when the systems analyst is gathering information on current procedures and work flows by interviewing middle managers and employees, gives the analyst one of his best opportunities to obtain supervisory cooperation and reduce supervisory fears.

The middle manager's fear of loss of self-esteem and status can be countered by stressing the increased importance of each manager or supervisor through his part in supplying better information for decision making. The increased need for the manager as a trainer of personnel can be emphasized as an offset to any diminution of his personal responsibility for decision making.

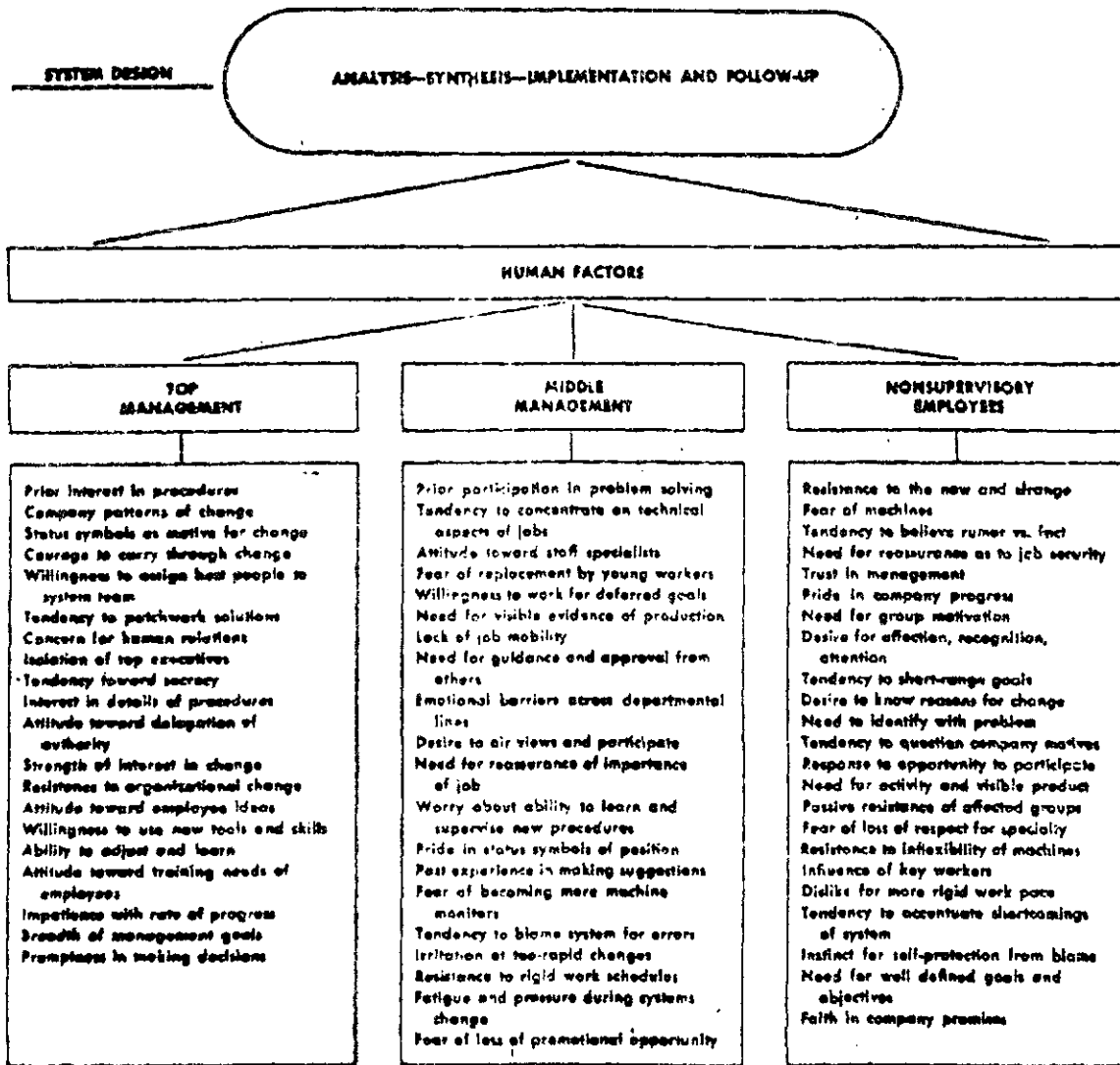
Middle managers will be anxious about possible decreases in employment and the effect on them. The systems analyst can reiterate any assurances previously given by top management as to job security,

displacement policies, and retraining and can explain probable new positions and their duties. More generally, he can point out that studies of current employment trends indicate that the number of professional and technical workers will increase more than 40 per cent over the next decade and that the number in clerical and sales occupations will increase by 30 per cent.¹⁷ He must be careful, however, not to promise upgrading to any specific manager.

Managers and supervisors may be worried about their ability to learn new techniques and keep ahead of their subordinates. Many will doubt their ability to supervise under the new methods. The systems analyst can cite the experience of other companies installing automated data processing systems to show that many persons over 45 have been trained to fill technical positions in the computer field, often more rapidly than younger persons could be trained. These companies have found that older employees' greater sense of responsibility, their reliability, their care for details, and their mature judgment have made such a policy advantageous.¹⁸

More generally, the systems analyst can build up the middle manager's confidence by treating him as an intelligent equal, competent to understand the system and its problems. The analyst should avoid all signs of condescension or any implication that there is the slightest question about the supervisor's ability to handle any situation that may arise.

In addition to allaying middle management's fears, the analyst should attempt to build positive support for the new system. If the supervisor is given an opportunity to air his views on the present system and take part in the planning for improvement, he will become interested in the ultimate success of the new procedures. The analyst should recognize the supervisor's experience and remember to be a good listener. Whenever appropriate, he should visibly record sug-



FOCUSING ON HUMAN FACTORS

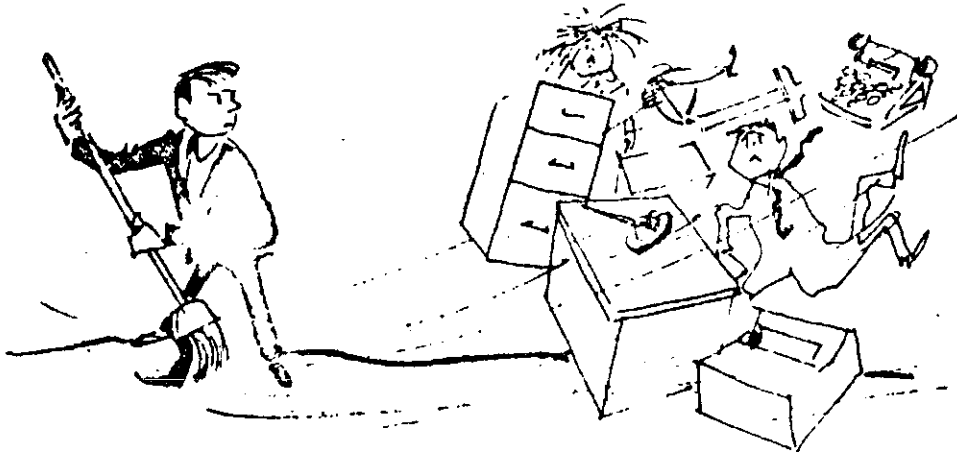
gestions so that credit can be given for them if they are adopted.¹² And he should stress middle and top management's common interest in building the best possible system. Often it may be wise to interview the supervisor away from the office atmosphere to keep work pressures from interfering with his objective consideration of new ideas and to ensure that he will be free to discuss controversial aspects of the present and proposed systems.

The systems analyst's approach has been likened to that of a doctor whose objective is essentially preservative. He should adopt the view that the organization is basically sound and healthy and that he is not there to tinker for the sake of tinkering. In this way he will impress the supervisor with his concern for people and their problems and his willingness to conserve ideas that have survival value.

Implementation — Other prob-

lems arise during implementation of the system. When possible, the analyst should anticipate these problems and do what he can in the planning stage to minimize or offset them.

One source of job dissatisfaction for workers and supervisors alike after the installation of automated systems is the lack of visible evidence of the product of their labor. Workers have a basic need to see that their jobs are significant. A series of entries, a list prepared, a



Some analysts give the impression of automatically opposing any methods in use before their arrival.

report are all visible evidence of accomplishment. Closely related is the feeling that to be producing one must be doing. In many new systems supervisors and workers see no end product of their work, nor is the work itself highly visible. This trend is likely to continue.

The only solution for the systems analyst is to begin educating middle management to other job satisfactions as early in the systems project as possible. This will not be easy since these other satisfactions tend to be more abstract than the old. The analyst also should remind supervisors that they will have to plan to give more attention to worker morale and develop new methods of praise and reward. Most middle managers will need training in human relations, and the analyst should make certain that such training is provided.

The relatively greater inflexibility of highly integrated data processing systems will create problems for middle management. Because of the interdependence of parts of the system, the supervisor will be blamed for delays further down the line. He will be subject to greater pressure for adherence to higher work standards, and he will find that improved feedback will pinpoint responsibility more surely than before.²⁰ If he is caught off guard by these changes, he may

become resentful and resistant—and transmit this feeling to his subordinates. The systems analyst can forestall these reactions by holding briefing sessions with both supervisors and employees and by meeting regularly with individual supervisors during and after the system implementation to check on their reactions and on the morale of their employees.

Unreasonable deadlines can provoke resentment in both supervisors and employees. The analyst should work with top management to keep deadlines realistic. If it becomes evident that the deadlines set cannot be met through no fault of the supervisors or employees, he should relieve their anxiety by assuring them that no blame attaches to them.

During the entire systems design period middle management's work load will be increased. Learning new procedures, training employees, being interviewed, attending meetings, and supervising two parallel work processing systems during testing periods can combine to create tremendous pressure on middle management, pressures that are not conducive to a kindly feeling toward any new system. By careful preplanning the analyst should attempt to minimize these pressures so far as is possible.

It is just as important for the

systems analyst to enlist the understanding and support of the rank-and-file employees as of the managers. A group of nonsupervisory workers can sabotage a system they do not accept just as effectively as a supervisor can. In fact, their sabotage may be even more difficult to combat since it may be more subtly applied through group action.

Although the basic human factors that affect the nonsupervisory employee are the same as those that operate at the top and middle management levels, his different position in the organization and normal lack of contact with top management plans and policies lends added weight to some of them. For example, because nonsupervisory workers, particularly younger ones, tend to have shorter-range goals than management, it is difficult to sell them change based upon some abstract general benefit. They demand an immediate personal advantage.

The nonsupervisory employee is generally more group-oriented and less of an individualist than the manager. He is more susceptible to rumors and to the influence of his fellow-workers' opinions. Other human factors that are particularly important at the nonsupervisory level include the desire to produce a visible product as evidence of

work accomplished; a need for recognition, affection, and attention; the importance of status in the eyes of co-workers, friends, and family; a need for activity in work as contrasted with the relative inactivity of merely monitoring a machine; the need to lean on others for support and encouragement; and the social need for working in groups. Automation is making the worker more isolated at his work place at the same time that there seems to be a growing number of other-directed persons in our culture who look to others for guidelines and approval.

The basic instinct of resistance to the new, strange, and unknown is intensified in employees by the common human fear of machinery as a displacer of labor. Recurrent periods of unemployment help to keep this fear alive. Automation seems to have replaced the loom and steam engine of the early Industrial Revolution as the public and trade union symbol of danger from impersonal forces outside the worker's control.

The systems analyst cannot completely prevent the operation of these basic human factors. It will take a long time to substitute new values and new job satisfactions. If, however, he is aware of these forces at work, he may be able to offset them or at least minimize their effects by proper training and by introducing contrary forces.

Even the employee who would admit the desirability of proposed systems changes if he were capable of being objective is likely to develop a core of passive resistance under the influence of his fears and his fellow-workers. The systems analyst must exert continuous positive pressure to overcome this tendency."

The importance of keeping the employees informed has already been stressed. The inevitability of rumors negates the theory that information which might upset the employees should be withheld. They will be upset anyway, and they need reassurance as to their job security, opportunities under

the new system, and steps to be followed during the changeover. In addition to the usual meetings, bulletins, and newsletters, the union may sometimes be used as an effective channel of communication.

Many of the employees the analyst interviews will question the real motives of the company in making the changes. The analyst can break down this skepticism by relating the company's general systems problems to each individual's own work experience, thus demonstrating the need for improvement. Often it is wise to devote extra effort to convincing the opinion leaders within employee groups so that they in turn can become salesmen to their fellow-employees. Such employees should be given opportunities to air their views, and the analyst should return to them for further suggestions as the project develops. The analyst must be careful to sell the ideas on their own merit rather than by mere personality; there should, of course, be no misrepresentation.

To counteract employee fear of loss of status, the analyst can emphasize the new job values, which will place a premium on responsibility. He can encourage employees to apply for new positions as they open up. By showing genuine interest in the individuals he is interviewing, the analyst can do much to boost employee morale and build confidence.

As with middle managers, non-supervisory employees should be prepared for the greater rigidity of mechanical equipment and the importance of interdepartmental teamwork in keeping the work flowing. The analyst should emphasize the importance of adherence to work standards, both to keep the employee on his toes and to keep him from blaming breakdowns on "the system" rather than on human errors. Any tendency to blame the system for errors can create serious operating problems by undermining confidence in the system and thus encouraging the human tendency to create addi-

Even the employee who would admit the desirability of system change if he were capable of being objective is likely to resist it under the influence of his fears and his fellow-workers.

REPRINTED FROM MANAGEMENT SERVICES, NOVEMBER-DECEMBER, 1965, VOLUME 2, NUMBER 2. COPYRIGHTED, 1965, BY THE AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS, INC.

tional records as protection against possible blame for error. The plan for systems implementation should include provision for continuous checking by the analyst to uncover possible sources of breakdown and eliminate trouble spots promptly.

Another systems design technique that is helpful in preventing breakdowns is to build some flexibility for limited self-adjustment into the system. Allowing affected departments to adjust for unforeseen contingencies without having to wait for a formal systems change prevents irritants from growing and gives both employees and supervisors a sense of identification with the system.

The analyst himself

As a human being, the systems analyst is, of course, subject to some of the same human factors that operate in managers and employees—and to some of his own. When given an opportunity to comment, employees have variously accused systems men of demonstrating a narrow perspec-

tive, of having a tendency toward isolation, of talking in language incomprehensible to the ordinary person, of cutting across lines of authority, of empire building, and of stirring up jurisdictional disputes. Some analysts have given the impression of automatically opposing any methods in use before they arrived on the scene, setting themselves almost by instinct against the old to favor the new.

The advent of electronic data processing and the necessity of combining on management and operating teams persons of technical training and scientific background with those having only operating experience have compounded the problems of human relations in the systems field. Often the specialized personnel are accused by the others of setting themselves apart from the regular organization, of adopting a tough attitude, and of seeming to feel that human frailties are a nuisance best avoided by adding equipment.

The natural suspicion that an expert arouses when he comes into a department to begin an analysis

of work flows and procedures makes it all the more important for him to establish cooperative relationships as quickly as possible. Among the more desirable qualities in a systems analyst are humility, a realization that his mission is one of service, not an end in itself, and a genuine interest in people. He should be a good listener, willing to accept suggestions, analyze them objectively, and give due credit for any ideas adopted. Giving credit for an idea to the person whose acceptance of it is sought can have a strong influence on the employee's interpretation of a situation.¹²

The systems analyst's awareness of the problems that human factors can cause for him in his work makes it all the more important for him to analyze his own methods critically to see whether any of the difficulties he may be encountering in obtaining cooperation and acceptance from employees may stem from his own failure to practice good human relations. Like Caesar's wife, he should be above approach.

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¹¹ "Human Side of Enterprise," *Factory*, Vol. 118, August, 1960, p. 84.

¹² Richard F. Neuschel, *Management by System*, McGraw-Hill Book Company, Inc., New York, 1960.

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¹⁷ Louis F. Buckley, "1960 Manpower Trends and Automation's Impact," *Commercial and Financial Chronicle*, August 18, 1960, p. 660.

¹⁸ *Adjustments to the Introduction of Office Automation*, U.S. Dept. of Labor Bulletin No. 1276, Washington, D.C., 1960.

¹⁹ John M. Emery, "Systems and Procedures Development," *Journal of Machine Accounting*, December, 1959, p. 12.

²⁰ G. H. Cowperthwaite, "The Challenge of Mechanization," *Systems and Procedures*, May, 1960, p. 20.

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²² Robert E. Schlosser, "Psychology for the Systems Analyst," *Management Services*, November-December, 1964, p. 34.

How effective managers use information systems

Steven L. Alter

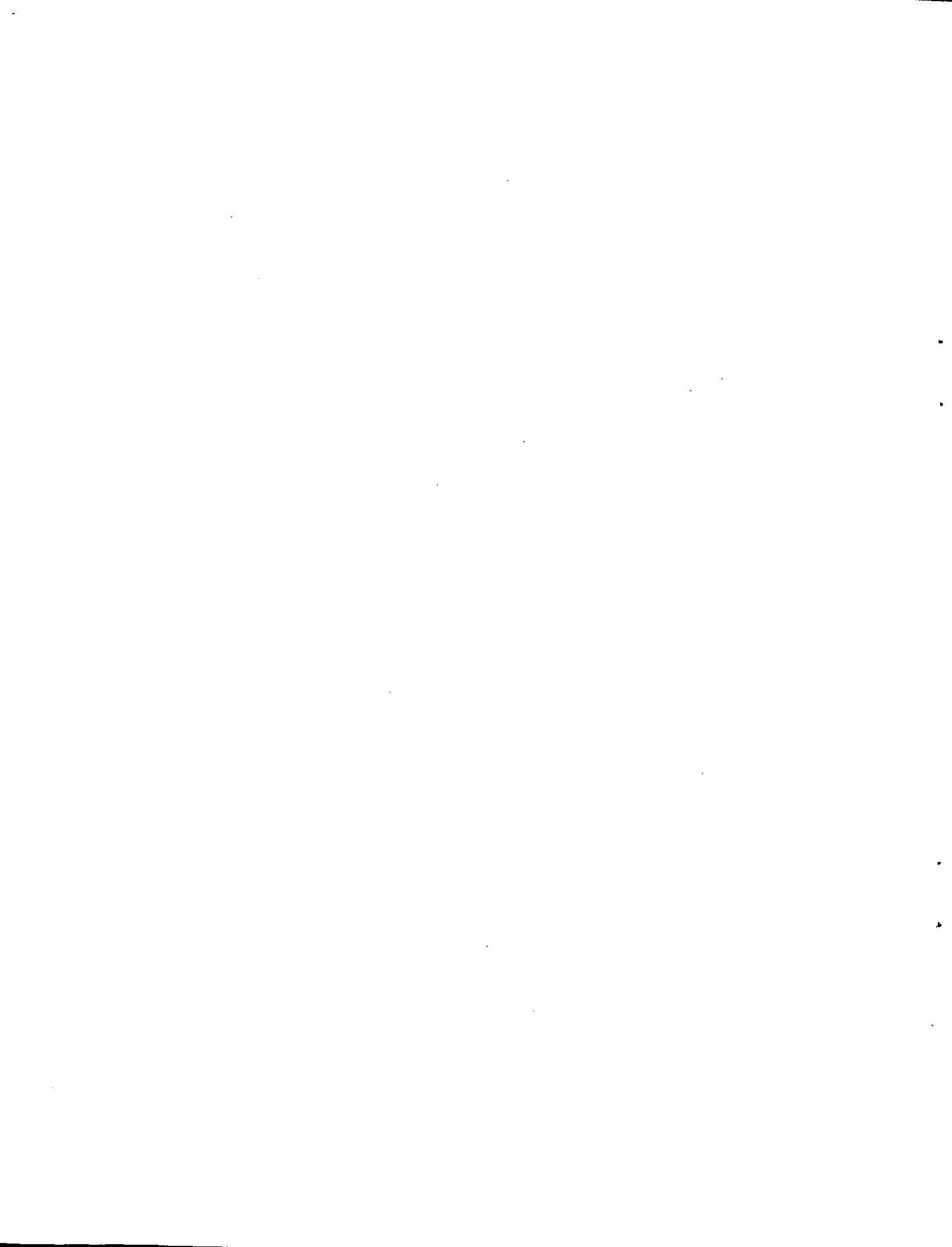
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How effective managers use information systems

From the manager's viewpoint, computer-based decision support systems must be more than technological marvels

Steven L. Alter

Advances in computer-based information technology in recent years have led to a wide variety of systems that managers are now using to make and implement decisions. By and large, these systems have been developed from scratch for specific purposes and differ significantly from standard electronic data processing systems. Too often, unfortunately, managers have little say in the development of these decision support systems; at the same time, non-managers who do develop them have a limited view of how they can be used. In spite of these drawbacks, the author found that a number of the 56 systems he studied are successful. And the difference between success and failure is the extent to which managers can use the system to increase their effectiveness within their organizations. Thus, the author suggests that this is the criterion designers and managers should jointly ascribe to in exploiting the capabilities of today's technologies.

Mr. Alter is assistant professor of quantitative business analysis at the Business School of the University of Southern California. His research and consulting concern long-range planning methods and the development and use of computer systems in organizations.

What can managers realistically expect from computers other than a pile of reports a foot deep dumped on their desks every other week?

Everyone knows, for instance, that computers are great at listing receivables. But what about all the promises and all the speculations over the past few decades about the role of the computer in management? While there have been advances in basic information retrieval, processing, and display technologies, my recent study of 56 computerized decision support systems confirms the common wisdom that very few management functions have actually been automated to date and all indications are that most cannot be.

Instead, my findings show what other researchers have reported: applications are being developed and used to *support* the manager responsible for making and implementing decisions, rather than to *replace* him. In other words, people in a growing number of organizations are using what are often called decision support systems to improve their managerial effectiveness.¹

Unfortunately my research also bore out the fact that while more and more practical applications are being developed for the use of decision makers, three sizable stumbling blocks still stand in the way of others who might benefit from them.

First, managers and computer users in many organizations are familiar with only a few of the types of systems now in use. As a result, different types of innovative systems have often been conceived and

1. Steven Alter, "A Study of Computer Aided Decision Making in Organizations," Ph.D. thesis, Sloan School of Management, MIT, 1975.

nurtured by internal or external "entrepreneurs," not by the system users or their superiors.

Second, and closely related to my first finding, these entrepreneurs tend to concentrate on technical characteristics. Too often, this myopia means that they fail to anticipate the ways in which such systems can be used to increase the effectiveness of individuals in organizations.

Finally, highly innovative systems—the very ones management should find most useful—run a high risk of never being implemented, especially when the impetus for change comes from a source other than the potential user.

Quite simply, my purpose in this article is to discuss, without getting into the technology involved, the high potential of a variety of decision support systems, the challenges and risks they pose to managers and implementers, and a wide range of strategies to meet these challenges and risks.

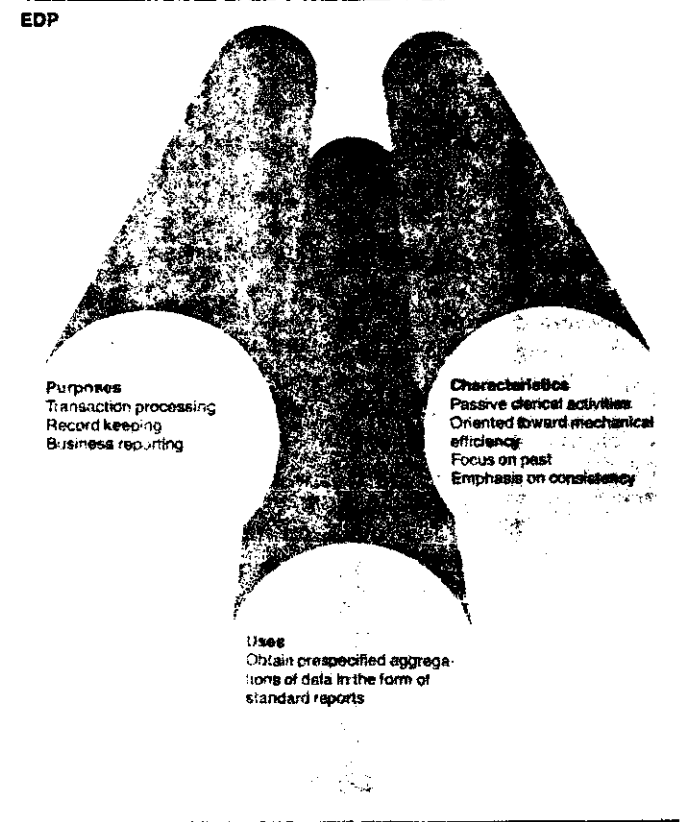
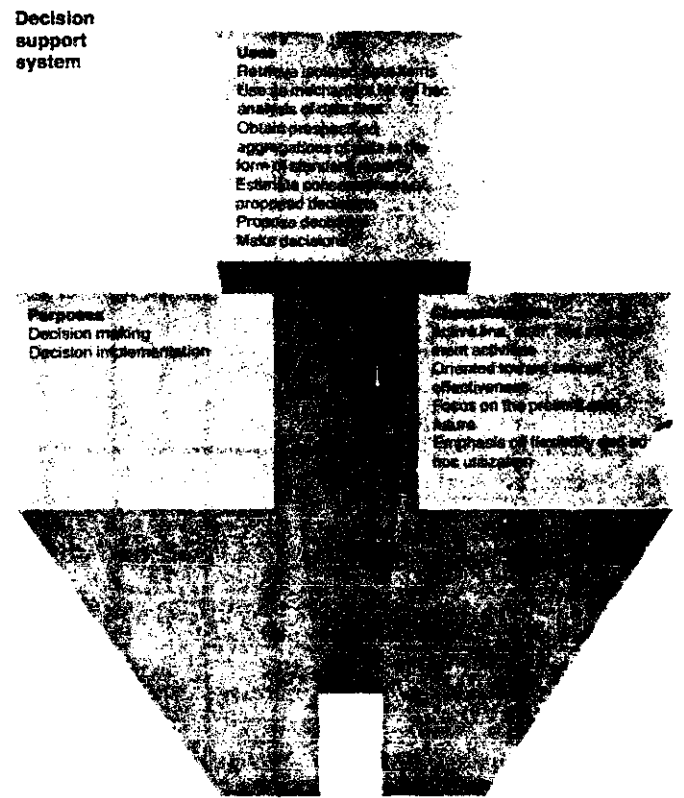
Types of decision support systems

While there are many ways to categorize computer systems, a practical one is to compare them in terms of what the user does with them:

- Retrieves isolated data items.
- Uses as a mechanism for ad hoc analysis of data files.
- Obtains prespecified aggregations of data in the form of standard reports.
- Estimates the consequences of proposed decisions.
- Proposes decisions.
- Makes decisions.

As Exhibit 1 indicates, EDP reporting systems usually perform only the third function in this list of operations, which I have organized along a dimension from "data-orientation" to "model-orientation." Hence, unlike the EDP user who receives standard

Exhibit 1
Comparison of uses, purposes, and characteristics of EDP systems vs. Decision Support Systems



reports on a periodic basis, the decision support system user typically initiates each instance of system usage, either directly or through a staff intermediary.

Although decision-oriented reporting systems often grow out of standard EDP systems, I will concentrate on seven distinct types, briefly describing one example of each type.

Incidentally, it is interesting to note that external consultants developed the systems cited in my second, fifth, and seventh examples, while those of the first, third, and sixth were the creations of people acting as internal entrepreneurs through staff roles; only the fourth system was developed on direct assignment by the user. This same pattern of initiation of innovative systems by people other than the users was present in many of the 56 systems.

1

Retrieval only—a shop floor information system

In order to help production foremen improve the percentage yield on a newly developed 50-stage process for manufacturing micro-circuits, the management of one company has installed an on-line, shop floor information system. Operators submit daily piecework reports, which include yield, release date, identification of the person who does the work, and so on. The foremen then juggle this information to obtain productivity data by operation, operator, machine, and lot.

Thus they are able to use the system in a number of ways. They can monitor work flow, pinpoint yield problems, and settle day-to-day questions such as who worked on which lot when, and which operators are ahead of or behind schedule, or below standards. The foremen have 13 standard commands by which they can retrieve the data stored in the system and display them on a cathode ray tube terminal. The commands permit them to tailor reports to their needs.

2

Retrieval and analysis—a portfolio analysis system

Before advising clients or making authorized trading decisions, the portfolio managers at a bank I studied use an on-line system to analyze individual portfolios. The managers can bypass time-consuming manual methods and obtain up-to-date and clearly organized portfolio information in either graphic or tabular form.

Depending on the situation, a manager can inspect both individual portfolios and groups of portfolios from different viewpoints—for example, rank them in different ways, obtain breakdowns by industry or risk level, and so on. With this kind of flexibility, the bank's portfolio managers make more effective use of a vast amount of information, most of which had existed prior to the system, but had been accessible only through tedious manual analysis.

3

Multiple data bases plus analysis—sales information systems

Greater flexibility was also the reason that two consumer products companies and one manufacturing company I looked at developed sales information systems which are quite similar. Standard EDP functions were too inflexible to produce ad hoc sales analysis reports in a timely and cost-effective manner for those in the companies' marketing and planning areas. In each case, information extracted from the EDP systems is now maintained separately in order to have it handy and, in two instances, to be able to analyze it in conjunction with externally purchased proprietary data bases and models.

Basically, each system is a vehicle by which a staff man or group tries to help decision makers. Their modus operandi is incremental: identify a problem; bring the current system and existing expertise to bear on it; develop a solution in the form of an analysis or additional system module; and incorporate the results into an expanded version of the system.

4

Evaluating decisions using an accounting model—a source-and-application-of-funds budget

To expedite operational decision making and financial planning over a two-year horizon, an insurance company is using an on-line, source-and-application-of-funds budget system. Inputs are projections of future business levels in various lines of insurance and investment areas, plus assumptions concerning important numbers such as future money-market rates. The output is a projected overall cash flow by month.

An investment committee uses the model to allocate funds across investment areas and to minimize the amount of cash left idle in banks. The committee compares projected cash flows based on different allocation decisions; the decisions that it actually

adopts are those that produce adequate projected cash flows and that are acceptable to the various groups in the company.

Actually, the system is an accounting definition of the company. There is no question about the accuracy of the relationships in the model, so the only way projected results can be in error is if estimates of business activity levels or money market rates are incorrect.

5

Evaluating decisions using a simulation model—a marketing decision system

In order to provide a more rational basis for repetitive marketing decisions, a consumer products company uses a model that relates levels of advertising, promotions, and pricing to levels of sales for a particular brand. The model was developed in a team setting by reconciling an analysis of historical brand information with an individual's subjective feelings concerning the effects on sales of various levels and types of advertising and other marketing actions.

The model was validated by tracking its accuracy in predicting sales based on the competitive actions that were taken. Unlike the accounting model I just mentioned, this is a simulation model in which some of the most important relationships are estimates at best. For instance, there simply is no rule by which it is possible to predict sales with certainty based on advertising levels. In fact, this was the heart of the issue in developing the model.

Even though it has turned out to be useful for prediction, much of the value of the model lies in the company's improved understanding of the market environment.

6

Proposing decisions—optimization of raw materials usage

Another consumer products company, faced with short-run supply problems for many of its raw materials, has developed an optimization model to solve the mathematical puzzle of choosing and balancing among various product recipes.

The inputs to the model include a series of different recipes for many products, short-run supply levels for raw materials, and production requirements for finished products. The output is the choice of recipes that maximizes production using existing supplies.

When the short-run supply situation shifts, the model can be revised and a new set of recipes chosen.

The system has had a major impact on the way managers view allocation policy. Initially, they considered allocating scarce raw materials to products by setting priorities among products. The model showed that it was more advantageous to start with production requirements and then allocate scarce resources by optimizing the mix of product recipes.

7

Making decisions—an insurance renewal rate system

As an outgrowth of an overhaul of its group insurance information system, an insurance company has developed a system to eliminate part of the clerical burden associated with renewal underwriting and to help assure that rate calculations are consistent and accurate.

Instead of calculating renewal rates by hand, underwriters fill out coded input sheets for the system, which calculates a renewal rate based on a series of standard statistical and actuarial assumptions. Since these assumptions might or might not apply to a particular policy, the underwriters review documentation accompanying the policies and decide whether the standard calculations are applicable. If they are not, the coding sheet is modified in an appropriate manner and resubmitted.

In effect, the system makes the decision in completely standard situations, while the underwriter decides whether the situation is standard and, if not, what adjustments are required. As a result, the underwriters can concentrate on the substance of their jobs rather than the related clerical chores.

Spectrum of possibilities

These seven systems represent a wide range of approaches in supporting decisions. The first one helps production foremen by simply providing rapid access to historical information such as who worked on what lot, and when the work was done. But the foremen must decide what should be done once they have the information. At the other extreme, the system supporting the underwriters virtually makes the decision in some cases. Between the two extremes, analysis systems and model-oriented systems help people organize information and also facilitate and formalize the evaluation of proposed decisions.

Although managers in most large companies have used budgeting or planning systems similar to the source-and-application-of-funds model I mentioned, the spectrum of possibilities for other kinds of decision support systems is surprisingly wide. Obviously, some of these systems are of no particular use in many settings. Still, their variety suggests that most companies should have a number of genuine opportunities for applying the concept of computer-based support for decision making.

Motives of managers

What do decision support systems do that actually helps their users? What is their real impact? In my survey, answers to these questions proved elusive in many cases since the users valued the systems for reasons that were completely different from initial ideas of what the systems were to accomplish. In fact, a wide range of purposes exists for these systems. While many decision support systems share the goals of standard EDP systems, they go further and address other managerial concerns such as improving interpersonal communication, facilitating problem solving, fostering individual learning, and increasing organizational control.

Such systems can affect interpersonal communication in two ways: by providing individuals with tools for persuasion and by providing organizations with a vocabulary and a discipline which facilitates negotiations across subunit boundaries.

Tools of persuasion

Standard texts on systems analysis totally overlook the personal use of decision support systems as tools of persuasion. But consider the following "offensive" (persuading someone else to do something) uses to which various companies have put these systems:

□ The manager of a chemical plant was attempting to meet output goals (quantities by product) that were being set by a marketing group. Unfortunately, the group was setting goals without much consideration of raw material shortages under which the plant was operating. The plant had been using a model to calculate production mixes.

At one point, it occurred to the plant manager that he could use this model to investigate whether marketing was setting goals that resulted in poor plant utilization and made him appear inefficient. As he ran the model under a series of different production mix goals, it became clear that this was the case, and he used the results to persuade marketing to change his plant's production mix.

□ A data retrieval and manipulation system first received wide exposure in a transportation company when a number of the company's top executives used it to develop a good quantitative rationale for a proposed merger. With the system, it was possible to explore and manipulate a large data base of information on the industry.

Although the merger was not approved, management thought that the system helped it put up a good fight.

□ The management of a shipping company found that a system it used in consolidating and fine-tuning strategic investment plans also helped it negotiate with banks. The banks and other sources of financing seemed to be uniformly impressed by the careful computer-based analysis on which management based its financing requests. The resulting edge in credibility was small, but, in management's opinion, noticeable.

Now that we have seen illustrations of the offensive tools of persuasion, let us turn to examples of the "defensive" (persuading someone that the user has done a good job) uses of these systems:

□ When asked whether he ever made direct use of a case tracking system, the head of an adjudication group in a government regulatory agency said that he remembered only one instance. This was when he spent a lunch hour generating a report to make his group's recent performance appear as favorable as possible in spite of some unfortunate delays and problems that made the standard report look bad.

□ The new president of a large conglomerate used a one-year budgeting model to learn about the budgeting choices that existed, as well as to help him discount what people in various areas claimed concerning their own budgetary needs.

□ The class scheduler of a training school for a company's service personnel had found his job frustrating because it was always difficult to justify the budget on explicit grounds.

With a model that generated optimal training schedules, the scheduler could protect himself very easily by saying: "Using these assumptions concerning attrition, acceptable peak-time shortfalls, and other considerations, this is the best budget. If you (the budget cutter) would like me to change these assumptions, I would be glad to generate a new budget. What level of shortfall do you suggest?" Thus the system not only helped the scheduler make decisions, but also helped him defend them.

□ Many people suspected that a new product venture in a consumer company might not be worthwhile, but no one knew exactly why. When a risk analysis was carried out with a model, the reason became clear: the venture had a very substantial downside risk. In addition to sealing the decision, the analysis provided an understandable response to the people who had proposed the venture.

A cynic might contend that the people in these situations were taking advantage of or abusing the systems. A more practical conclusion is that these systems simply serve to improve managers' effectiveness in their organizations by helping them communicate with other people. My point is that much of the benefit of many of the decision support systems in my sample was of this sort.

Aids to communication

Decision support systems also help managers negotiate across organizational units by standardizing the mechanics of the process and by providing a common conceptual basis for decision making.

During my survey, managers frequently commented that consistent definitions and formats are important aids to communication, especially between people in different organizational units such as divisions or departments. In a number of instances, the development of these definitions and formats was a lengthy and sometimes arduous task that was accomplished gradually over the course of several years, but which was also considered one of the main contributions of the systems.

For example, one of the purposes of some of the model-oriented systems in my sample was to estimate beforehand the overall result of decisions various people were considering separately, by filtering these decisions through a single model. In these cases, the system became an implicit arbiter between differing goals of various departments. Instead of arguing from their own divergent viewpoints, marketing, production, and financial people could use the model to demonstrate the effect of one group's proposals on an other group's actions and on the total outcome. As a result, issues were clarified and the negotiation process expedited.

The production foremen I mentioned earlier noted the same kind of facilitation. It helped them in work-scheduling discussions and problem investigations by providing immediate access to "objective information about "who did what, when, and how well on any production lot in the shop."

Value to user

Although the implementers of a number of the successful systems I studied found it necessary to go through the motions of presenting a cost/benefit rationale which attributed a dollar value to personal effectiveness, they didn't believe these numbers any more than anyone else did. Management usually decided to proceed on the basis that the proposed system seemed to make sense and would likely have a beneficial impact on the way people interacted and/or made decisions.

Monetary savings are obviously a very important and worthwhile rationale for developing computer systems, but it should be clear at this point that the EDP-style assumption that systems should always be justified in these terms does not suffice in the area of decision support systems.

Equally obvious, there is a definite danger in developing a system simply because someone thinks it makes sense, especially if that someone is not the direct user of the system. In fact, the systems I cited as my first, second, and fifth examples began this way and encountered resistance until they were repositioned as something that users would want in order to become more effective.

Again, the general problem here is a common tendency for technical people to concentrate on the "technical beauty" of a system or idea and to assume that nontechnical people will somehow see

the light and will be able to figure out how to use the system in solving business problems. This sort of overoptimism was present in the history of almost every unsuccessful system in the sample.

The message is clear: try to take advantage of the creativity of technical experts, but be sure that it is channeled toward real problems. The challenge, of course, is how to accomplish both of these goals. There are a number of ways, which I shall now discuss.

Patterns of development

Despite the common wisdom that the needs of users must be considered in developing systems and that users should participate actively in implementing them, the users did not initiate 31 of the 56 systems I studied and did not participate actively in the development of 38 of the 56.

The results, illustrated in *Exhibit II*, are not surprising. Intended users neither initiated nor played an active role in implementing 11 of the 15 systems that suffered significant implementation problems. Conversely, there were relatively few such problems in 27 of the 31 systems in which the users had a hand in initiating and/or played an active role in implementing.

But it would be wrong to infer from these findings that systems should be avoided totally, if intended users neither initiate them nor play an active role in their implementation. For one thing, 14 of the 25 systems I studied in which this was the pattern were ultimately successful. More important, many of the genuinely innovative systems in my sample, including 5 of the 7 that I described earlier, exhibited this pattern.

Exhibit II
Systems resisted by users

	Few or none of the intended users involved in implementing system	All or most of the intended users helped implement system
Intended users did not initiate	11 of 25 systems	0 of 6 systems
Intended users helped initiate	2 of 13 systems	2 of 12 systems

On the other hand, many of the systems initiated by users do little more than mechanize existing practices. While such mechanization can be very beneficial, and while I'm certainly not suggesting that major innovations must come from outside sources, the real challenge is to be able to use insights regardless of their source.

One way to do this is to devise an implementation strategy to encourage user involvement and participation throughout the development of the systems regardless of who originated the concept. Examples of successful strategies follow.

Impose gracefully: Marketing and production managers in a decentralized company did not relish the extra work (format changes and data submission requirements) needed for a yearly budgeting system, which top management was installing. Initially, they were especially unenthusiastic because they thought the system would not really help them.

So at every stage the designers made a point of developing subsystems to provide these middle managers with sales and materials usage information that had never been available. This quid pro quo worked well; instead of seeing the system as a total imposition, the manager saw it as an opportunity for them to take part in something which would be beneficial to them.

Run a dog and pony show: Central planning personnel in two companies designed systems for budgeting and financial analysis. In one company, the system never caught on despite lengthy training demonstrations for divisional staff and other potential users. These individuals seemed enthusiastic about the system's possibilities, but never really used it unless corporate planning people did all the work for them.

In contrast, the training program for the system in the other company fostered immediate and active involvement. In order to attend the workshops, people were required to bring their own financial analysis problems. They learned to use the system by working on these problems. When the workshops ended, many users were enthusiastic: not only did they know how to use the system, but they had also proved to themselves that it could help them.

Use a prototype: Two ever-present dangers in developing a system are creating a large, expensive one that solves the wrong problem or creating one that some people in the organization cannot live with.

Either can happen, not only when the system is designed without consulting the user and affected parties, but also when there is no one having enough experience with the particular kind of system under consideration to clearly visualize its strengths and weaknesses before it is built.

Implementers of a number of systems in my sample avoided these traps by building small prototypes, which gave the users something specific to react to. As a result, the large-scale version could be developed with a realistic notion of both what was needed and what would fly in the organization. A similar approach, also successful, was simply to build systems in small pieces that could be used, changed, or discarded easily.

Hook the user with the responsibility: Each new module or application developed as an outgrowth of one of the three sales information systems I mentioned earlier goes through three stages. The first stage consists of general, uncommitted discussions of any current problem areas with which user groups are concerned. Following research by the management science staff, the second stage is a brief formal problem statement written in conjunction with the user group. In addition to describing the problem, this statement goes over the methodology and resources that will be required to respond to it. The third stage is a formal request for authorization of out-of-pocket expenses.

Sell the system: In one of the companies I studied, a marketing analysis group used a direct selling procedure to convince people of the merits of a sales forecasting system. The pitch was very simple: they compared manual monthly forecasts for one year with the system's forecasts. The system's forecasts proved to be more accurate in ten months out of twelve, with less error overall than the manual ones. The system was adopted.

In another company, management had a real-time system installed for monitoring the largely automatic production of an inexpensive consumer item in order to minimize material loss due to creeping maladjustments in machine settings. During the initial installation, the implementation team discovered suspected, but previously unsubstantiated, cheating by piecework employees; more pieces were leaving many machines than were entering them. Discreet hints were dropped that the monitor had to be checked because it was registering "impossible" results. The employees were sold on the new system: they knew very well that it worked.

Fundamental changes

Despite extensive experience with EDP, many organizations have used no more than one or two of the seven types of decision support systems I have illustrated here.

One reason for this is that justifying such systems can be difficult: quantifying the impact of replacing ten clerks with one computer is one thing, while quantifying the impact of improved individual effectiveness of line personnel is quite a different thing. Another reason is that implementation can be tricky: many of the ideas come from people other than the users.

Nevertheless, developing a decision support system makes sense when it becomes clear that a fundamental change may be needed in the way decisions are reached and implemented. Often, the process of defining the system is every bit as valuable as the system produced.

My final point is that the concept of decision support systems itself can help managers in understanding the role of computers in their organizations. As the name implies, data processing systems systematize and expedite the mechanics of carrying on business activities by processing masses of data automatically. On the other hand, the decision-oriented extensions of these systems help people make and communicate decisions concerning administrative and/or competitive tactics and strategy.

The decision support systems I have discussed go one step further. Instead of starting as extensions of existing data processing systems, many decision support systems are built from scratch for the sole purpose of improving or expediting a decision making process. The underlying philosophy is that the use of computers to help people make and communicate decisions is every bit as legitimate and worthwhile as the use of computers to process masses of data.

There is evidence that this viewpoint has caught on to a certain degree and is becoming more widely accepted. The implication is not that all organizations should get on the bandwagon, but rather that managers should be aware of the opportunities and challenges in this area and should attempt to assess whether their organizations should move in this direction.

Managing the four stages of EDP growth

Cyrus F. Gibson and Richard L. Nolan

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Managing the four stages of EDP growth

Running a new business is a different task from running a middle-aged one or an old one; the same is true of the EDP department

In all that has been said about the computer in business, there are few clues as to how the EDP department ought to grow or what management ought to be doing about the department at each stage of its growth. Here is a convenient categorization for placing the life crises of the EDP department in perspective, for developing the management techniques necessary or useful at various points, and for managing the human issues involved. These human issues, as a matter of fact, complicate the problems of growth at least as much as the hardware and software questions, which have been so well massaged in the literature; the authors show how these issues change shape as a company moves through the four stages of development. This article will be particularly helpful to the new

business that is about to buy its first computer. For the company in the throes of later-stage development, it offers a framework useful for identifying issues and evaluating and controlling the growth of EDP.

Mr. Gibson is assistant professor of business administration at the Harvard Business School, where he teaches in the organizational behavior area. He has done research and consulted extensively on problems of computer-resource management within organizations. Mr. Nolan is associate professor of business administration at the Harvard Business School and the author or coauthor of several recent HBR articles on information management. The work on which the following article is based was funded in part by the Division of Research of the school.

From the viewpoint of the executive vice president, "The EDP manager always waffles around when he has to explain his budget." From the viewpoint of the EDP manager, "The executive vice president never seems to understand why this department needs a lot of money."

The reason for this kind of impasse is clear enough: EDP, as corporations use it today, is so complex that controlling it, or even understanding it, is almost too difficult for words. However, through our work with a number of companies, we have reached certain conclusions about how EDP departments grow and how they should fit into the company's organization. These conclu-

sions offer a framework for communication for both the EDP manager and the senior managers to whom he reports.

There are four distinct stages in the growth of all EDP facilities, each with its distinctive applications, its rewards and its traumata, and its managerial problems. By breaking the evolution of the EDP department into four easy stages, it is possible to sort out the affairs of the department, if not into four neat, sequential packages, at least into four relatively small, sequential cans of worms.

The basis for this framework of stages is the recent discovery that the EDP budget for a num-

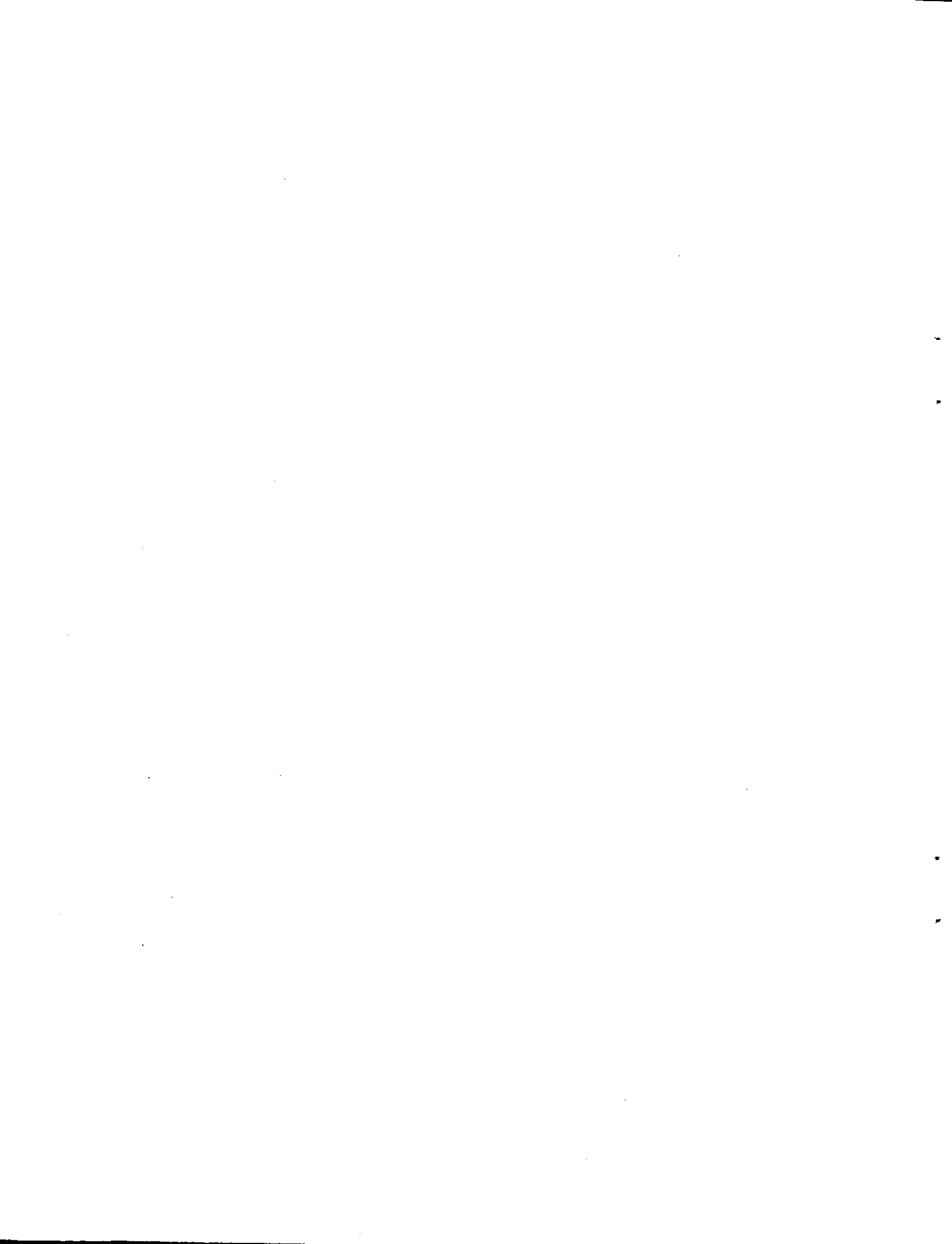


Exhibit 1. Growth of applications

Stage 1 Cost-reduction accounting applications	Stage 2 Proliferation of applications in all functional areas	Stage 3 Moratorium on new applications; emphasis on control	Stage 4 Data-base applications
Payroll	Cash flow	Purchasing control	Simulation models
Accounts receivable	General ledger	Scheduling	Financial planning models
Accounts payable	Budgeting		On-line personnel system
Billing	Capital budgeting		On-line customer service system
	Forecasting		On-line source directory (e.g., cost collection, order entry)
	Personnel inventory		
	Order processing		
	Sales		
	Inventory control		

ber of companies, when plotted over time from initial investment to mature operation, forms an S-shaped curve.¹ This is the curve that appears in the exhibits accompanying this article. The turnings of this curve correspond to the main events—often crises—in the life of the EDP function that signal important shifts in the way the computer resource is used and managed. There are three such turnings, and, consequently, four stages.

In the companies we know, there are remarkable similarities in the problems which arise and the management techniques applied to solve them at a given stage, despite variations among industries and companies, and despite ways in which EDP installations are used. Moreover, associated with each stage is a distinctive, informal organizational process. Each of these seems to play an important role in giving rise to the issues which need to be resolved if the stage is to be passed without a crisis and if the growth of the resource is to be managed to yield maximum benefit to the company.

Our purpose here is to describe the four stages in turn, listing the key characteristics of each

and explaining the underlying organizational forces at work in each.

In the space of an article we can touch only on the main problems of EDP management at the different stages. Hence the view we present is bound to be somewhat simplified. Caution is advisable in another respect, too: history has not yet come to an end, and we are sure that the S-curve we describe and the stages it seems to follow do not represent the whole story. At the end of the S-curve of contemporary experience there will doubtless be more S-curves, as new EDP technologies emerge, and as companies become more ambitious in their use of EDP techniques and more sophisticated in systems analysis. However, we hope that the dynamics of later cost escalations will be clearer after the reader has finished with our description—clearer, and perhaps even predictable and controllable.

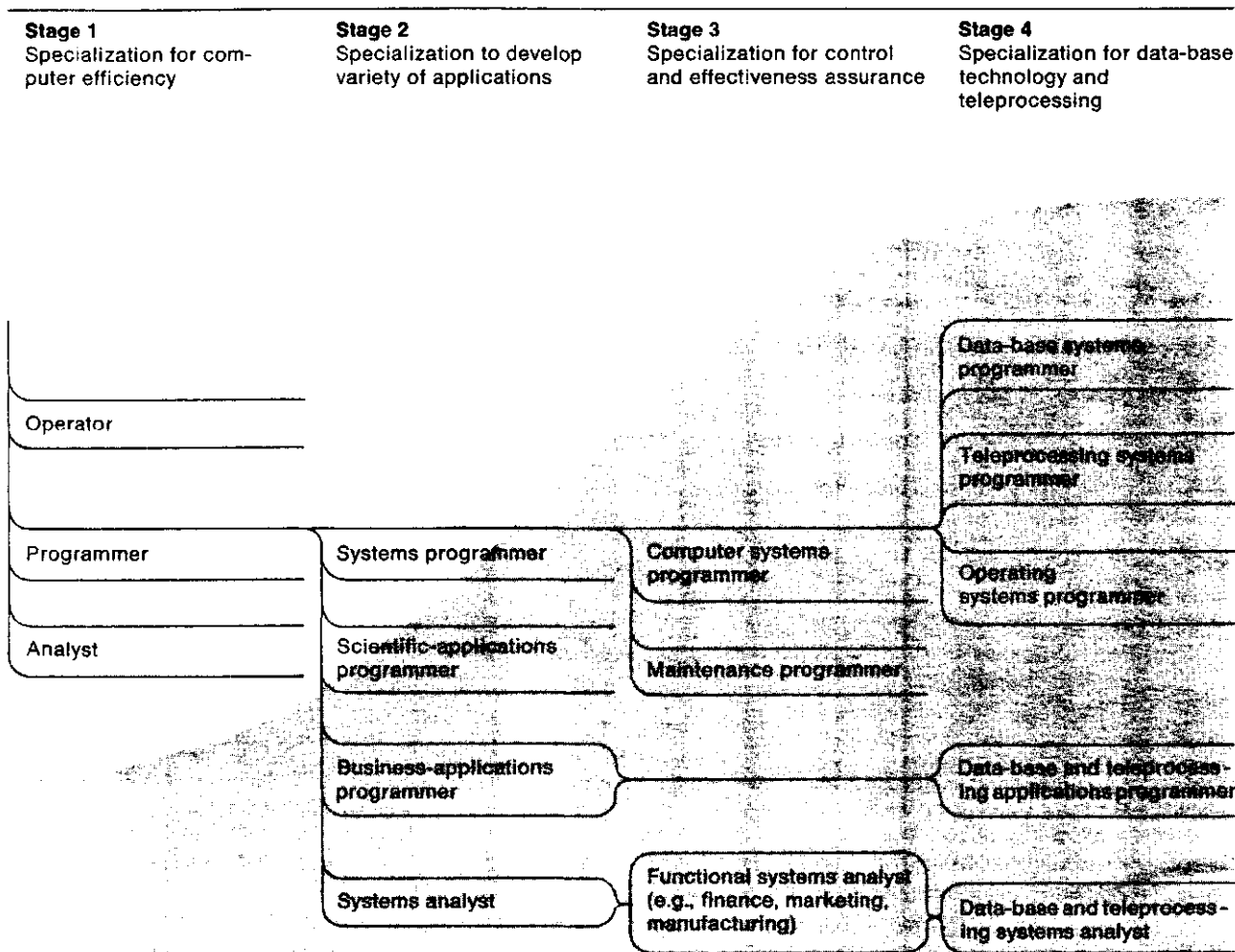
Four stages of growth

Three types of growth must be dealt with as an EDP department matures:

○ A growth in computer applications—see Exhibit 1.

¹ Richard L. Nolan, "Managing the Computer Resource: A Stage Hypothesis," *Communications of the ACM*, July 1973, p. 349.

Exhibit II. Growth of personnel specialization



○ A growth in the specialization of EDP personnel—see *Exhibit II*.

○ A growth in formal management techniques and organization—see *Exhibit III*.

The S-curve that overlies these three kinds of growth breaks conveniently into four segments, which represent the four stages of EDP growth: initiation, expansion, formalization, and maturity. Most notable are the proliferation of applications in Stage 2 (as reflected in *Exhibit I*) that causes the budget to increase exponentially, and the proliferation of controls in Stage 3 designed to curb this increase (as reflected in *Exhibit III*).

This sequence of stages is a useful framework for placing a company's current problems vis-à-vis EDP in perspective and helping its management understand the problems it will face as it moves forward. It is especially helpful for discussing ways to smooth out the chaotic conditions of change that have caused so many de-

railments in Stages 2 and 3. Even in our work with small companies, we have found the framework helpful—in obviating crises before they arise and in suggesting the kinds of planning that will induce smooth growth.

Thus one virtue of this framework is that it lays out for the company as a whole the nature of its task at each stage—whether it is a new company planning to buy its first computer, or a company in the throes of developing advanced applications, or a company with a steady, mature EDP facility.

Stage 1: Initiation

When the first computer is implanted in the organization, the move is normally justified in terms of cost savings. Rarely, at this point, does senior management assess the long-term impact of the computer on personnel, or on the organiza-

Exhibit III. Management techniques customarily applied in each of the four stages

	Stage 1 Lax management	Stage 2 Sales-oriented management	Stage 3 Control-oriented management	Stage 4 Resource-oriented planning and control
Organization	EDP is organized under the department of first-applications justification; it is generally a small department.	The EDP manager is moved up in the organization; systems analysts and programmers are assigned to work in the various functional areas.	EDP moves out of the functional area of first applications; a steering committee is set up; control is exerted through centralization; maintenance programming and systems programming become dominant activities.	EDP is set up as a separate functional area, the EDP manager taking on a higher-level position; some systems analysts and sometimes programmers are decentralized to other departments.
Control	Controls notably lacking; priorities assigned by FIFO; no chargeout.	Lax controls, intended to engender applications development; few standards; informal project control.	Proliferation of controls to control a runaway budget; formal priority setting; budget justification; Programmer's consistent documentation, standards; Project management initiated; management reporting system introduced; project plan; project performance; customer service; personnel resources; equipment resources; budget performance; Chargeout procedures; post-system audits; Quality control policies for computer system; systems design; programming; operations.	Extensive controls; formal project control; management reporting system; project plan; project performance; customer service; personnel resources; equipment resources; budget performance; Chargeout procedures; post-system audits; Quality control policies for computer system; systems design; programming; operations.
Planning	Loose budget	Loose budget	Strong budgetary planning for hardware facilities and new applications	Formal budget plans for hardware facilities, personnel, and new applications

tion, or on its strategy. Thus management can easily ignore a couple of crucial issues.

The location question

In Stage 1, the priority management issue is to fix departmental responsibility for the computer:

▽ Initially it makes economic sense to locate the computer in the department where it is first applied—very frequently, in accounting—and to hold that department responsible for a smooth introduction and a sound control of costs and

benefits. The costs and benefits can be clearly stated and rigidly controlled under this approach—and they usually are.

△ However, the department where the computer will first be used—accounting, say—may not be the best location for the EDP facility later on. The later and more complex applications, such as inventory control and simulation modeling, should ideally be located in an autonomous department of computer services or management information systems which reports through a high-level manager.

But granted this longer perspective, management may decide on a less rigorous application of payback criteria for judging the performance of the initial application. Costs for "future development" may not be scrutinized too closely at this stage, and budgets may expand very early under this arrangement.

Many companies resolve this issue in obvious fashion. Management simply locates the facility within the department of first application for an initial period; then, when its viability has been proved and other applications develop, management creates the autonomous EDP unit.

In practice, however, this seemingly simple resolution conceals a serious trap. The department that controls the resource becomes strongly protective of it, often because a manager or a group within it wants to build up power and influence. When the time comes for computing to assume a broader role, real conflict arises—conflict that can be costly in terms of management turnover and in terms of lingering hostilities that inhibit the provision of computer services and applications across functional areas.

Fear of the computer

Another priority issue is to minimize the disruption that results when high technology is injected into an organization. Job-displacement anxieties appear; some people become concerned over doing old jobs in new ways; and others fear a loss of personal identity with their work. These fears may lead to open employee resistance. While reactions of this kind may occur at any of the stages, they can be particularly destructive in Stage 1, where the very survival of the EDP concept is at stake.

In plain fact some of these fears are probably justified. For example, some employees (although usually relatively few) may indeed lose their jobs when the computer is first installed.

On the other hand, the concerns that develop from rumor or false information are usually overblown, and they are readily transformed and generalized into negative sentiments and attitudes toward management, as well as the computer itself. The wise course for management is to spike rumors with the most honest information it has, however the chips may fall. Such

openness will at worst localize fears and resistances that must be dealt with sooner or later anyway.

Unless management is willing to recognize the seriousness of this anxiety, it risks a more generalized reaction in the form of unresponsive and uncreative work behavior, a broader and higher level of uncertainty and anxiety, and even sabotage, as a surprising number of cases have demonstrated.

Management can make no bigger mistake than to falsely reassure all concerned that the computer will not change their work or that it will mean no less work for everyone. Such comfort blankets lead to credibility gaps that are notoriously hard to close.

Thus the key to managing this process of initiation to the computer is to accept the fact that people's perceptions of reality and their views of the situation are what have to be understood and dealt with, rather than some "objective" reality.² These perceptions will be diverse; management cannot assume that all organizational members are equally enthusiastic about introducing efficiency and reducing costs. Where you stand depends on where you sit and on who you are. In communicating its intention to introduce EDP, management should remember this and tailor its communications accordingly.

There will be variations from one situation and company to another in the manner and detail in which management releases information about future location and about the impact of the computer. Depending on circumstance, management directives may best be communicated downward by an outsider, by a department head, or by the new EDP manager. In settings where employees are rarely informed of management planning, it may even be wise to explain to the echelons why they are being given the explanation; again, in settings where the echelons have participated in planning, a formal presentation may be less effective than open group discussion.³

Stage 2: Expansion

The excess computing capacity usually acquired when a company first initiates an EDP facility, combined with the lure of broader and more advanced applications, triggers a period of rapid expansion. The EDP area "takes off" into new projects that, when listed, often seem to have been selected at random. As *Exhibits I-III* show,

2. For a related argument, see James G. March and Herbert A. Simon, *Organizations* (New York, John Wiley, 1958), Chapter 6.

3. For further discussion of this point, see Paul R. Lawrence "How to Deal With Resistance to Change," *HBR* January-February 1969, p. 4.

Stage 2 represents a steady and steep rise in expenditures for hardware, software, and personnel. It is a period of contagious, unplanned growth, characterized by growing responsibilities for the EDP director, loose (usually decentralized) organization of the EDP facility, and few explicit means of setting project priorities or crystallizing plans.

It is a period, further, in which the chaotic effects of rapid development are moderated (if they are moderated at all) only by the quality and judgment of the personnel directly involved in the process. While top management may be sensitive to some of the ill effects of the computer, it tends to be attracted to and carried along with the mystique of EDP as well.

This stage often ends in crisis when top management becomes aware of the explosive growth of the activity, and its budget, and decides to rationalize and coordinate the entire organization's EDP effort. The dynamic force of expansion makes this a fairly difficult thing to do, however.

Dynamics of early success

Once Stage 1 has passed, and the management and personnel of the computer area have justified and assured their permanent place in the organization, a new psychological atmosphere appears as the users from other departments (the customers) grow in number and begin to interact with the technical EDP staff. Although some users stick to economic value in judging the utility of computer applications to their particular problems and functions, other users develop a fascination with the computer and its applications as a symbol of progressive management techniques or as a status symbol for a department or individual. This fascination breeds an enthusiasm not moderated by judgment.

For their part, the technically oriented systems analysts tend to overgeneralize from the successes they have achieved with transaction-oriented computer-based systems (e.g., order processing, payroll, accounts receivable) in Stage 2. They often feel that "now we can do anything"—in other words, that they have mastered problems of communication with users, that their expertise is solid, and that they are ready to select and deal with projects primarily on the basis of their technical and professional interest. In this heady atmosphere, criteria of economic justification and effective project implementation take a back seat.

When the users' exploding demands meet the technicians' euphoric urge to supply, in the absence of management constraint, exponential budget growth results. Overoptimism and overconfidence lead to cost overruns. And once this sharp growth has begun, rationales created in the mood of reinforced enthusiasm are used to justify the installation of additional capacity; this in turn provides the need for larger numbers of personnel and for more rationales for applying the now expanded resource to whatever new projects seem attractive to the crowd. So the spiral begins.

The spiral is fed by the fact that as the resource increases in size and ambition, it must have more specialists.⁴ Indeed, even without this capacity expansion, the continuing pace of technological development in the computer industry creates a constant need for new specialist talent, especially in Stage 2 and beyond. This "technological imperative" is a driving force that has caused the growth of numerous and quite diverse professional groups of computer personnel in the industrial environment. (The reader might find it helpful to review *Exhibit II* at this point.)

Many of these personnel come into the company with a primarily professional orientation, rather than an understanding of or sympathy for the long-term needs of an organization. Like the EDP specialists already employed by the company, these people will be far more interested in tackling technically challenging problems than in worrying about computer payback. If they are allowed to pursue their interests at will, the projects potentially most valuable from the company's viewpoint may never be worked on. Moreover, the chores of program maintenance and data-base development may be neglected, sowing the seeds of costly future problems.⁵

All these factors together lead to the evolution of an informal structure among computer personnel and between computer personnel and users. The lack of clear management guidelines for project priorities, for example, often results in sympathetic wheeling and dealing between EDP systems analysts and the user groups with a preference for those projects which offer the greatest professional challenge. Without specific directives for project developments or new hardware acquisition, too, computer personnel develop expectations of a loose work environment.

4. John Dearden, "MIS Is a Mirage," HBR January-February 1972, p. 90.

5. Richard I. Nolan, "Computer Data Bases: The Future Is Now," HBR September-October 1973, p. 98.

Some of the users, at the other end of the string, are easily enmeshed in impractical, pie-in-the-sky projects.

For short periods such an environment may be highly motivating for some, but, as we need hardly point out again, the other side of the coin is a rapidly growing budget—and a number of vocal and dissatisfied users.

In view of these informal dynamics and structures, what can management do to make this period one of controlled growth? How can control be introduced that will head off the impending crisis and dramatic cutbacks characteristic of such situations but at the same time not choke off experimentation with the resource and not turn off the motivation of specialists?

Here it is useful to compare the lists of management techniques shown for Stages 2 and 3 in *Exhibit III*. For the most part, the problems that arise toward the end of Stage 2 can be greatly alleviated by introducing right at the start of Stage 2 the techniques that companies ordinarily use in Stage 3.⁶ Before carrying out this step, however, attention should be given to two other important strategies: acquiring necessary middle-management skills and improving the company's procedures for hiring computer personnel.

Acquiring managers

The main key to successful management in this stage is acquiring or developing middle managers for EDP who recognize the need for priorities and criteria in project selection and who have strong administrative skills: the ability to prepare plans and stick to budgets, the ability to seek out significant projects from users who may not be demanding attention, and, generally, the ability to manage projects.

Finding such managers more often than not means going outside the company, especially since most potential middle managers among systems analysts are usually caught up in the computer growth spiral. However, where it is possible, selection from within, particularly from the ranks of systems analysts, can serve the important function of indicating that career paths exist to management ranks. This can show computer technicians and technical experts that there are career rewards for those who balance organizational needs with professional interests.

6. For an approach to introducing these steps in either Stage 2 or Stage 3, see F. Warren McFarlan, "Management Audit of the EDP Department," HBR May-June 1973, p. 131.

Once those at the general-management level have determined that the time has come to institute such "human controls," the EDP manager must be brought to recognize the need for them (if, indeed, he does not recognize that need already) and the fact that he has the countenance and support of top management.

For his part, the EDP manager himself must resist the tempting pressures to see his resource grow faster than is reasonable. He has a delicate and important selling job to do in communicating this to other department managers who want his services. Once he is shored up with competent subordinate managers he will be free to carry out this role.

Finally, in addition to applying administrative controls, management needs to assess continually the climate of the informal forces at work and plan growth with that assessment in mind. The formal organization of middle managers in the EDP department makes such planning, and its implementation, viable.

Acquiring diverse personnel

Senior management must also recognize the increasing specialization of personnel within the computer department:

□ At one extreme are the highly skilled and creative professionals, such as computer systems programmers. Their motivation and interest are oriented to the technology with which they work; they have relatively little interest in organizational rewards. Their satisfaction and best performance may be assured by isolating them organizationally, to some degree.

□ At the other extreme are the analysts who work closely with functional departments of the company. These people may be expert in particular fields relevant to only a few industries or companies, performing tasks that require close interaction with both users and programmers. Their interests and value to the company can coincide when they perceive that career-path opportunities into general management are open to them.

□ There are also the operators with important but relatively low-level skills and training, with some capabilities for organizational advancement, and with relatively little direct interdependence with others.

To organize and control these diverse specialists requires decisions based on one basic trade-off: *balancing professional advancement of special-*

ists against the need for organizational performance.

To cater to specialist professionals, for example, a company might isolate them in a separate department, imposing few organizational checks and gearing quality control to individual judgment or peer review. Such an arrangement might motivate a systems analyst to become the world's best systems analyst.

Emphasis on organizational values, in contrast, suggests that the company locate and control the specialists in such a way as to increase the chances that short-run goals will actually be achieved on schedule. This strategy risks obsolescence or turnover among specialists, but it successfully conveys the important message that some specialists' skills can advance a management career.

However, in the early stages management is well advised to avoid the issue entirely: the highly sophisticated professional should not be hired until his expertise is clearly required. Moreover, at the time of hiring, the specialist's expectations for freedom and professional development should be explicitly discussed in the context of organizational structure and controls (these controls include those administered by the middle level of EDP management), as part of the "psychological contract."⁷

Such discussion can go a long way toward avoiding misunderstanding during the period of rapid growth of computer applications. In effect, making clear the terms of the psychological contract is an example of the management of expectations. In this instance, it is one of the means that can be employed to introduce the organization, controls, and planning procedures that are needed to head off the crisis atmosphere of Stage 3.

Stage 3: Formalization

Let us assume that Stages 1 and 2 have run their bumpy courses without too much direct attention from top management. More likely than not, top management becomes aware of the runaway computer budget suddenly, and it begins a crash effort to find out what is going on. Its typical question at this point is, "How can we be sure that we can afford this EDP floor?"

Top management frequently concludes that the only way to get control of the resource is through drastic measures, even if this means replacing many systems analysts and other valu-

uable technical personnel who will choose to leave rather than work under the stringent controls that are imposed during the stage. Firing the old EDP manager is by no means an unusual step.⁸

From the perspective of computer personnel who have lived through the periods of initial acceptance and growth, but who have not developed a sense of the fit of the computer resource within company functions and objectives, the changes top management introduces at this time may seem radical indeed. Often what was a decentralized function and facility is rather suddenly centralized for better control. Often informal planning suddenly gives way to formal planning, perhaps arbitrarily. This stage frequently includes the first formalization of management reporting systems for computer operation, a new chargeout system, and the establishment of elaborate and cumbersome quality-control measures (again, see *Exhibit III*).

In short, action taken to deal with the crisis often goes beyond what is needed, and the pendulum may swing too far. In response, some computer personnel may leave. What may be worse, most will "hunker down"—withdrawing from innovative applications work, attending to short-term goals, and following the new control systems and plans to the letter. All of this can occur at the expense of full resource utilization in the long run.

In addition, there is a parallel development that dovetails with the budget crisis to reinforce the overcontrol syndrome. Studies of computer usage show that the machines are first applied to projects that reduce general and administrative expenses—typically, replacement of clerical personnel in such tasks as accounting. Next come projects that reduce cost of goods, such as inventory control systems. The crisis atmosphere of Stage 3 roughly coincides with completion of these first two types of applications.

At this juncture the applications that have real potential for increasing revenues and profits and facilitating managerial decision making are still untouched. Financial-planning models and on-line customer service systems are two examples of such applications.

As senior management ponders the problems of Stage 3, it tends to associate the applications of the earlier stages with preexisting manu-

⁷ Herz, Lewinsohn, and Lippitt, *Management and Mental Health* (New York: McGraw-Hill, 1962).

⁸ See, for example, "Flight of the EDP Manager," *IBM Management*, 1967.

al systems and straightforward cost-justification and control. In contrast, it finds projected applications for revenue-producing and decision-making projects hard to envision and define. The natural tendency is to assume that these projects will call for a faster, higher spiral of risk and cost. Thus senior management tends to introduce inappropriately strong controls that are designed, consciously or unconsciously, to put a stop to growth. This clearly may be too strong a reaction for the company's good.

Three sound steps

In general, three control steps that are appropriate and not unduly restrictive are available for most large EDP facilities in Stage 3. First, certain of the more established and less complex operations and hardware can be centralized. Second, the increasing impacts of computer applications can be flagged and defined for the top by introducing overseer and resource-allocation mechanisms at the general-management level. Third, some parts of the systems analysis function can be decentralized and other parts centralized, depending on where the systems work can best be done (we shall say more about this shortly).⁹ Of course, this final step requires that the decentralized systems work be coordinated through a formal integrative mechanism.

But the real problem in Stage 3 is not what steps to take; it is how to take them. Management here is introducing change into a web of informal relationships and expectations. *How* the changes are managed is as important as *what* the changes should be, but more difficult to define.

That is, although there are few formal controls in the first two stages, the *informal* social structures and norms that have grown up by Stage 3 are very much a reality to the personnel involved. While it may appear that systems are replacing no systems, this will not be true:

◇ Lacking guidelines for project selection, systems analysts will have projected their own sets of priorities, either individually, as a group within the company, or as members of their profession.

◇ They will have created criteria and standards, although these will not ordinarily have

been written down or otherwise articulated for higher levels of management.

◇ Without project management guidelines, systems analysts and users will have developed their own rules and procedures for dealing with each other.

On the whole, the stronger these informal controls and structures are (and the weaker the formal controls and structures are, the stronger they will be), the more resistant the personnel will be to change and the more chaotic and traumatic the introduction of formal systems will be.

In managing changes as pervasive as these there is probably nothing worse than doing the job halfway. Doing nothing at all is disaster, of course; but management action that is undertaken on a crash basis—without enough attention to execution and second- and third-order consequences—will sharpen, not resolve, the crisis.

For example, management cannot afford to be either squeamish or precipitous in making personnel changes. Trying to introduce needed formalization of controls with the same personnel and the same organizational structure more often than not encourages conflict and the reinforcement of resistance rather than a resolution of the crisis; by refusing to fire or to enforce layoffs, senior management may simply prolong the crisis, create further dissension, and further demoralize personnel. On the other hand, management must be sure that it retains the experienced personnel who have the potential to function well in the mature stages of the operation—it may not always be obvious who these people are or what their future roles will be.

Thus, although the crisis of Stage 3 calls for action, it first calls for analysis and planning—planning that sets forth clear and explicit objectives for exploitation of the computer resource vis-à-vis the user departments.¹⁰ Such a plan, once it is developed and understood, can turn anarchy back into evolution, while at the same time avoiding the kind of overkill control that results in underutilization and underrealization of the potential of the resource. Here are our suggestions for general plan direction.

1. Reposition the established components of the resource.

Whether or not EDP has been carefully managed in the past, most companies need to centralize some parts and decentralize other parts of the computer resource at about this point.

9. See the section which discusses the McKinsey study on effective users, in F. Warren McFarlan, "Problems in Planning the Information System" HBR March-April 1971, p. 78.

10. For mechanisms for improving the interface between EDP and users, see John Dearden and Richard L. Nolan, "How to Control the Computer Resource," HBR November-December 1973, p. 65.

The issue arises here because the company reaches a turning point in the way it uses the resource. As the EDP function evolves from the early cost-reduction applications of initiation and early growth toward projects aimed at improving operations, revenues, and the quality of unprogrammed and strategic decisions, the influence of the computer will begin to move up and spread out through the organization. The function may truly be called "MIS" instead of "EDP" from this stage forward.

We have already discussed the need for middle managers' involvement in this stage or an earlier stage. The internal structure they represent reinforces the desirability of making the MIS department autonomous and having it report to a senior level of management. At this point, also, it becomes imperative to reexamine and make explicit the rationales for existing applications that have proved beneficial and to routinize them, so that expensive specialist skills can be turned to new applications.

The pressures of new applications ventures, maturing management, specialist personnel, and increasing routine make centralization of the company's core hardware resources just about mandatory at this stage. Too, the centralization eases the tasks of maintenance of data and programs, data-base development, and some of the applications that will be coming up in Stage 4.

The very creation of a central "MIS division," however, creates additional problems.

2. Provide for top-management direction.

While centralization goes a long way toward placing the longer lead times, the greater complexity, and the higher development costs of new applications in perspective, it does not automatically help senior management to control the direction the resource takes.

Effective control derives from understanding, and some device is needed to educate senior management so that it can track and evaluate the department's progress sensibly. The device must also let the resource know what senior management's policies are and what is expected of it operationally and strategically.

This communications device becomes vital in Stage 3 because the resource has grown to a size and a power whereby its applications can affect the strategy and structure of the company as a whole. In a company where a working data base can be used to back up the corporate planning process, for example, corporate planning assumes a somewhat different shape from what it does

in a company that has no such data base available. This is clearly a point at which a person at the vice-presidential level (or even the presidential level) must accept responsibility for directing the evolution of the resource.

An active, high-level steering committee is one such device.¹¹ It provides a means for setting project priorities. It not only brings together those who should be concerned with overall management and planning for the company; it also provides a vehicle for confronting and resolving the political problems that inevitably arise with the computer's more direct impact on managers' roles, organizational structure, and resource allocation in Stage 3.

For, from a behavioral perspective, political issues dominate at this time as never before. Managers throughout the company now see that the applications coming through the pipeline may affect their own roles directly. In the past it was their subordinates who were most affected; and it was largely their own decision to approve or not approve a project; but now a given application may be supported from above and may impinge on their established patterns of work, their decision making, and even their ideas about what it is they do for a living.

Moreover, the prospect of applications that hint at long-term changes in organizational structures and formal departmental roles raises concern within both formal and informal groups of managers—concern about the impacts these changes will have on the strengths of their positions relative to other groups.

Such political issues can only be debated fruitfully before top management, and an expert, informed steering committee provides a convenient forum for this debate.

For his part, as a member of this committee as well as the head of his own department, the MIS manager should expect to assume a stronger role in general management councils. He should not, of course, expect to be exclusively responsible for setting priorities among projects that would benefit different groups, or for implementing significant changes completely under his own initiative.

3. Reorganize the systems analysis function.

Centralization, and tight guidelines and arbitration from a steering committee, however, can create a distance between the resource and its customers throughout the company. As Stage 3

¹¹ F. Warren McFarlan, "Problems in Planning the Information System," *HBR*, March-April 1971, p. 75.

draws to a close, the company will be planning its most important, most ambitious MIS applications to date. This is hardly a point at which to divorce the users from the resource by erecting an impenetrable divisional barrier. Complete centralization of the systems analysis function would constitute such a barrier.

In fact, gearing up for this new era of applications and controlling their impacts requires that the company revise the Stage 3 concept, staffing, and organization of the systems analysis function. The concept should change from systems analysts as developers of *products for users* to systems analysts as developers of *processes affecting users*. The distinction between product and process means, among other things, that the new applications should rarely be considered bounded projects; they will require continual modification as they are integrated into user decision making.

Therefore, systems analysts themselves will necessarily become more and more a constant element in the functioning of the users' areas. As a corollary, they will act as communications conduits between the users, on the one hand, and the computer resource and its programmers, on the other.

Organizationally, this suggests that some systems analysts should be decentralized to user locations while others are retained at the core to build a research and testing facility for the company and its planners. Thus the problem boils down to a trade-off between centralization and decentralization of systems analysts.

These, then, are our best suggestions for minimizing the strains of Stage 3: centralize certain components of the resource, install a steering committee or some equivalent thereof, and spread enough of the systems analysts through the company to ensure that users' needs are met adequately. For the company wise enough to employ these suggestions at the outset of Stage 2, the trauma of Stage 3 may be almost entirely avoidable.

Stage 4: Maturity

When the dust has settled over the changes of Stage 3, the computer resource will have reached maturity in the organization, and it will have the potential to return continuing economic benefits. The applications listed for Stage 4 in *Exhibit I* suggest how very significant the con-

tributions of the resource can be, if only they can be achieved.

The manager's dilemma

At this point the MIS manager has broken into the ranks of senior management, having risen to the level of vice president or equivalent thereof. In some instances he may even enjoy more than proportional support from the president for his view of his own function within the company. He faces this integrative dilemma:

▽ On the one hand, he is under pressure to maintain a steady work environment within his own unit. His line managers and specialists are now familiar with relatively formal structure and procedures; they are presumably satisfied with their career prospects, either within their professions or within the company. Thus they may well constitute a force resisting dramatic change, reorganization, or innovation. Similarly, at this point, senior management and the users probably have a general grasp of the existing technology and existing applications of the resource, and they are reluctant to see major changes.

△ On the other hand, the MIS manager, if he is doing his job well, will be heavily involved in planning for the future. He will be aware that computer technology and modes of application and organization are continuing to change.

Thus, if he chooses to maintain stability, he knowingly runs the risk that his resource will become outdated and inefficient. If he chooses to keep up with technology, he knowingly runs the risk that he will lose the integrative fabric that makes his function applicable to the user groups and the company as a whole.

The MIS manager must strike a balance between protecting an organizational entity and keeping that entity up to date in its technical environment. He has power and credibility, but he sees that these can be threatened either by too little change or by too much change.

There are no hard and fast rules for resolving this trade-off. The key, however, lies in the quality of communications between the MIS manager and top management, and between the MIS department and users.

Communications with the boss

By definition, the mature Stage 4 function is one which is being applied to the key tasks of the

organization. This may well mean that most of the funding for MIS development is devoted to applications touching directly on critical business operations. This is the case of a large petrochemical firm with which we are familiar, where new applications focus on synthetic-fiber production activities.

But whether applications are for line operations or for management decision making, the computer manager in Stage 4 is, perhaps for the first time, in a position to communicate with top management in terms of meaningful, detailed plans.¹²

Because of the nature of his dilemma, he is bound to come under fire from the users—either for allowing parts of his department to obsolesce, in the name of stability, or for introducing change, in the name of progress and the state of the art. His relationship and communications with the top must be sound enough to allow him to weather the inevitable storms—given, of course, that the balance he strikes between stability and change is indeed reasonable in broad outline.

The experience of many suggests that the MIS manager and senior management think in terms of a three-year contract for the position, with explicit recognition that there will be organizational pressures to push out the MIS manager.

With long-term support from the top founded in such a basis, the MIS manager is in a position to legislate policies internally that will exploit the computer as fully as possible.

For his part, the senior line manager to whom a mature EDP department reports can little afford not to know the language of the computer personnel—at least to the extent necessary to evaluate project proposals.

Relations with users

In Stage 4, the MIS manager must also move to strengthen the bridges that have developed between the users and computer personnel. Assuming that it is well managed internally, the computer resource still has a continuing extensive interdependence with departments it serves.

The first difficulty here is that the users are many and the MIS manager only one. He cannot hope for identical relationships with all departments.

Secondly, users naturally tend to co-opt com-

puter personnel into their organizational spheres. If this occurs to any significant extent, user parochialisms will erode the potential for the computer unit to act as an agent for innovation and change.

However, the bridges can be strengthened and the innovative capability of the unit can be increased simultaneously through a policy of “buffering” the different subunits from user influence. Specifically, performance standards and short-term control devices should be formalized for the more routine tasks (such as all machine operations and some programming) and the MIS personnel involved with these should be removed from frequent interaction with the users. A system of project management, too, serves much the same function.

Finally, the systems analysis function at the core should by this time have taken on the character of an influential research unit, controlled primarily through checks on the progress of its projects. These projects will probably not be within the direct purview of the user groups; in a mature department, they are usually focused on long-term applications not likely to be demanded spontaneously by user groups or by the systems analysts decentralized into those groups (e.g., corporate inventory control). The weight of this core group of analysts can be used to counterbalance undue user influence.

For example, when a user needs a new application, the core group might rough it out and approve the final, detailed design; but the final, detailed design itself should be the work of the systems analysts located in the user department. The decentralized analysts will be most familiar with the user's needs and best able to produce a working system for him; for their part, the systems analysts at the core can ensure that the system that is finally designed will mesh efficiently with the company's MIS efforts as a whole, to whatever extent this is possible.

The picture of EDP-user relationships that emerges here is one of considerable complexity and subtlety. Correspondingly, integrating this more specialized and internally differentiated EDP resource into the company as a whole becomes more difficult.¹³ This integration requires that the MIS manager take steps to achieve common understanding of his objectives, not only with senior management but with all other functional managers at the vice-presidential level as well. The steering committee will be important as never before, not only as a committee for determining project priorities, but also as a

12. *Ibid*

13. Paul R. Lawrence and Jay W. Lorsch, *Organization and Environment* (Boston: Division of Research, Harvard Business School, 1967)

sounding board for new techniques, policies, and changes within the MIS department itself.

Beyond Stage 4

Currently some large companies have reached the tail end of the S-shaped EDP budget curve: their departments are mature, in the sense defined by the exhibits. But has EDP evolution really come to an end for these companies? What can they expect in the future?

In retrospect, the curve seems to have been primarily driven by developments in hardware technology in the second- and third-generation computer systems. One thing certain is that computer technology advancements are continuing at an unrelenting pace. More S-shaped curves are inevitable.

Now, however, the advancements seem to be taking place more in software than in hardware, and at present the breakthrough most likely to start off another S-shaped EDP budget curve is

the development of data-base technology. This development is providing a way to make the data collected and retained by the organization a companywide resource; and scores of middle management applications, such as computer modeling, appear to be on the way.

In the blush of enthusiasm for this newest advancement in computer technology, however, it is important to remember the painful lessons of the past. To efficiently exploit the newest technology, it must be managed. It must be reconciled with the capacity of the organization to assimilate new ways of doing business better. It is our belief that the forces underlying the crises and problems of the four stages we have described will also underlie future S-curves, such as one created by the emerging data-base technology. Consequently, management may be able to anticipate the problems and resolve them before they begin. A sign of success would be a dampening of the S-curve, with budgets rising more smoothly as future needs demand continuing investments and increasing budgets.

"Science is nothing but trained and organized common sense, differing from the latter only as a veteran may differ from a raw recruit: and its methods differ from those of common sense only as far as the guardsman's cut and thrust differ from the manner in which a savage wields his club."

Thomas Henry Huxley, 1825-1895
Collected Essays

Management audit of the EDP department

F. Warren McFarlan

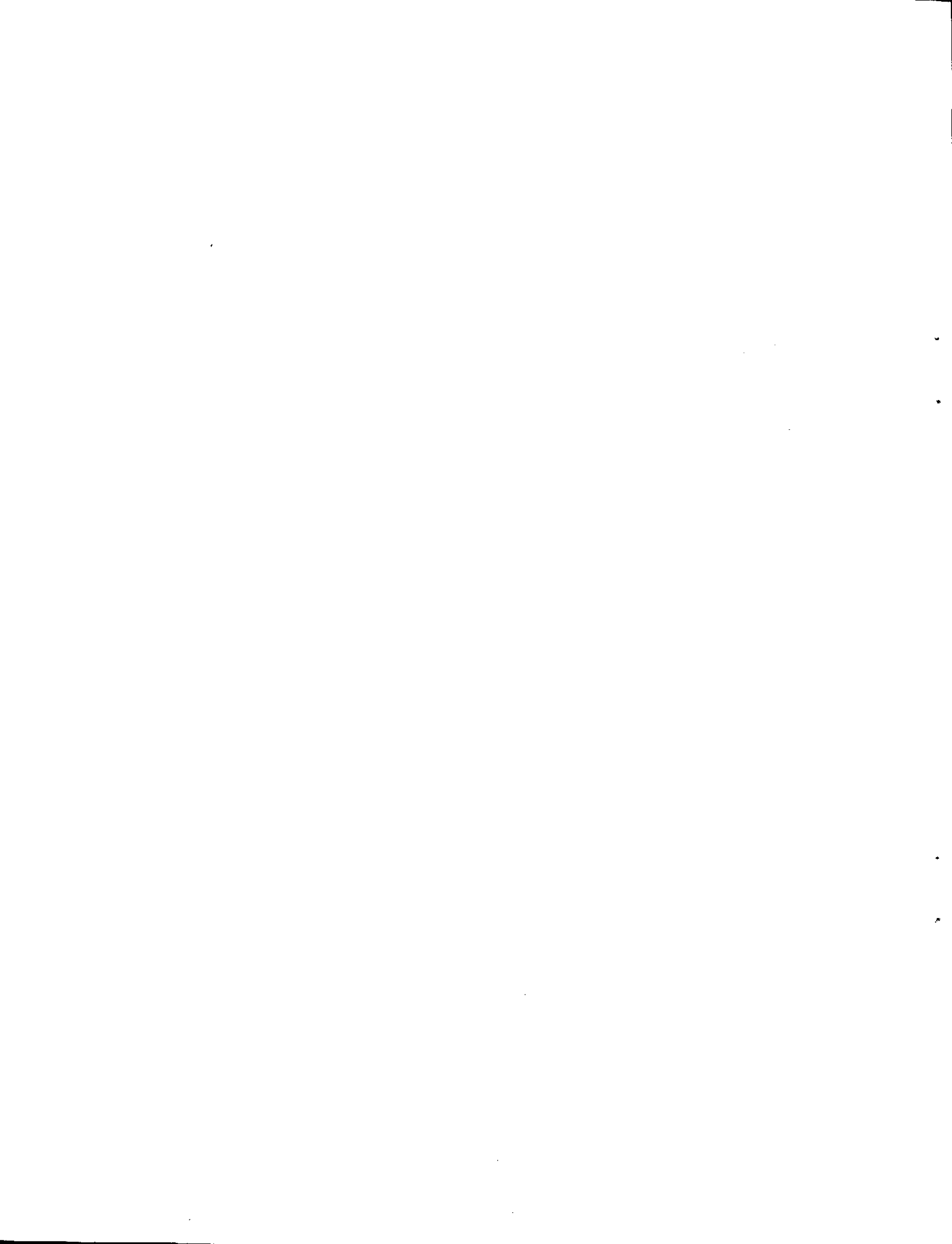
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F. Warren McFarlan

Management audit of the EDP department

*Tracking the thrust of company EDP activity
is a responsibility of top management;
but too often it examines the wrong questions*

Foreword

The top managements of many companies are in the classic position, vis-à-vis EDP activities, of not being able to see the forest for the trees. The latest expensive machine, the latest controversial project, the latest budget dispute, the latest technical wrinkle, and similar quantities have distracted management from its real responsibilities where EDP is concerned: namely, auditing the *management control, resource allocation, operations and technology management, and project control* of the EDP department, and using the resulting information to shape and direct the growth of the activity. This article first sketches the impediments that make a real management audit of

the EDP department difficult and then proceeds to outline the questions management ought to ask in the course of its investigation of each of the four areas of primary concern.

Mr. McFarlan is Associate Professor of Business Administration at the Harvard Business School, where he has taught extensively in the areas of management information systems and information systems administrations. He is leading a faculty effort at HBS to define better approaches to the problems posed by the various aspects of EDP management. This fall he will teach in the school's new International Senior Managers Program in Lausanne, Switzerland.

The recent flood of books and articles on EDP management practice has explicitly recognized the need both for an EDP planning system and for senior-management involvement in key decisions relating to the area. However, the manner in which these needs are fulfilled is also critically important, and this fact has been too often overlooked.

The essence of the problem was captured by a member of the computer steering committee of a large electric-equipment manufacturer when he noted:

"I feel totally frustrated at these meetings. Every time I attend I see a two-hour presentation of some new project with flowcharts, file

structure, and detailed cost/benefit analyses. I am always so overwhelmed by detail that I wind up voting for the project to avoid exposing my ignorance."

The existence of a steering committee, in itself, indicates that the company was at least trying to plan and manage its EDP function at a reasonably high level, but this effort was clearly not meeting with success.

In this particular company, as in so many others, an inadequate interpretation by the top-management group of how to execute its EDP-related responsibilities led to an initial, excessive preoccupation with operating detail, an area

with which a steering committee has neither the time nor the necessary background to cope effectively. Consequently, in the process of its deliberations, this steering committee never even approached the more subtle policy issues, such as the validity of the EDP planning, the adequacy of the EDP management control system, and the practical structure of the resource-allocation process—issues on which its guidance was critically needed and with which it was well qualified to deal. Ultimately, the members' sense of growing frustration led to abandonment of the committee.

What business needs, in my opinion, is a broader definition of senior management's responsibilities in guiding the EDP resources and evaluating its relative effectiveness. To begin with, there are four key topics that top management must examine and raise questions about:

- Management control.
- Resource allocation.
- Operations and technology management.
- Project management.

In the discussion that follows, I have paid special attention to the aspects of these topics about which concepts are particularly poorly formed and where further thought and research are likely to offer significant benefit.

There are also some special considerations relating to the EDP area which top management should keep in mind:

□ The dramatic growth both in dollar value of installed equipment (from \$7.0 billion in 1965 to \$25.5 billion in 1970) and in the number of people employed (there are now over 500,000 systems analysts and programmers) suggests an opportunity for economy through more efficient internal operations. As they audit the EDP activity, managers might keep in the backs of their minds that such rapid growth is often accompanied by the accumulation of fat.

□ In most companies, EDP management practice has developed in isolation from the organization's other management systems and functions. This is true because the whole area has been progressing rapidly, because its technical content and skill requirements have been changing at a great rate, and because the forest of operating problems has prevented companies from integrating the EDP department properly with the other components of the organization.

Hence, beyond simply controlling, motivating, and evaluating the EDP department on a periodic basis, top management should devote

part of its effort to encouraging coordination between the EDP department's management practices and those used in other departments of the company. Management practices are not as well formulated nor as well implemented in this portion of the business as in others, and senior management must take some care to ensure that the characteristically "messy" EDP department is as effectively controlled and planned as the older (and presumably neater) regular departments of the company.

□ The early automation of clerical and physical-control systems has permitted a sequential evolution to more complex, more subtly inter-related EDP applications, and this has caused the number and variety of standard EDP technical skills to explode. The simple world of systems analysts and programmers has been supplanted by one populated with such diverse technical craftsmen as telecommunications specialists, operating systems specialists, and database administrators. In consequence, the levels of technical integration required inside the EDP department have grown sharply.

□ At the same time, the exploding technical performance of new machines has opened new horizons. There are now physical-control applications that previously were not economically feasible, and the dynamics of these applications are more complex than those of the early applications. The stand-alone, batch-processing computer has been replaced by complex multi-programming computers, computer networks, minicomputers, and many other devices. The increase in technological options this new generation of equipment represents is obscuring the boundaries of the territory to be covered.

Indeed, it has become difficult to define exactly where a computer begins and other entities leave off. One large organization, for example, wanted to find out why its research laboratories were using its large computer facility less and less frequently. Investigation revealed that the laboratories had recently acquired several large pieces of industrial testing equipment that contained their own built-in minicomputers. Although this fact had an impact on the company's EDP resource utilization, it was never considered in the decision to acquire the testing equipment, simply because this equipment was to be used "for research purposes."

As it happened, there were other, cheaper ways of getting the same testing capability, by using simpler machines in combination with the company's central EDP facility. These al-

ternatives were concealed from view by the laboratories, because they wanted complete control over all aspects of the testing environment. Such questionable and unnecessary duplication of facilities is far from infrequent.

With these special considerations in mind, let us look at the way management ought to approach its audit of EDP control, resource allocation, operations and technology, and special-project management.

Management control

Top management needs two key structures to control EDP. The first is a financial reporting system that allows it to do the following things:

- Review the department's performance on a periodic basis.
- Compare the department's development against the formal plans for it.
- Check the functioning of the department's project control systems.

The second is a structure that links the responsibility for various departmental decisions to the operations of the users—ordinarily other company departments. Generally, this structure is a procedure to account for EDP expenses, either on a chargeout or an overhead basis.

Periodic financial reports

A financial reporting system should provide timely résumés of expenditures against budget for the different organizational components within the department. In particular, the reporting system should mesh neatly with the project control system so that the aggregate of project expenditures can be clearly related to the department's total expenditures.

One might think that EDP installations, which enable the development and operation of large corporate control systems, would have organized good control systems of their own; but this is frequently not the case. For example, the best financial-reporting effort of the EDP department in one major insurance company is a six-week-old comparison of expenditures and budget which is so constructed that one cannot correlate the reported expenses by project with the aggregate expenditures. This same company has an efficient, imaginatively designed corporate control system, organized around its decentralized

profit centers, that rapidly tracks and evaluates the performance of its agents.

Also, the system must identify financial performance variances. In volatile environments, to be sure, where there are wide fluctuations in transaction volumes, it may be necessary to put parts of the operations budget on a flexible



basis. The important point is that a clear comparison between *expected* expense and actual expense is needed for control.

Finally, for large installations the system should include a software package that diagnoses the ways a given application uses the different components of the EDP configuration. This package permits the financial system to

allocate hardware costs to an application in proportion to the demands that application makes on the whole computer resource. The advent of multiprogramming systems has made the design of this package a complex task—simple devices such as time clocks can no longer give meaningful data on how much of the computer resource is being consumed by a given application.

After management has seen to the installation of such a financial reporting system, it should periodically evaluate its effectiveness by raising these questions:

- ◇ Are the performance data delivered by this system of comparable quality and timeliness as those received from other departments?
- ◇ Has the structure of the financial reporting system been reviewed in the past three or four years with an eye to changing technology standards?
- ◇ Does the system provide its data in a form that permits management to compare the efficiency of the EDP department with that of outside service bureaus and other installations?

Overhead vs. chargeout

Management makes a highly critical decision in choosing between the following alternatives:

- ▽ The EDP department will be a cost center whose charges are passed on to the operating departments as corporate overhead.
- △ The major part of its expense will be charged out to the various departments in proportion to their use of the facility.

Here are the arguments *for* overhead accounting and *against* chargeout accounting:

- Overhead accounting is cheaper than chargeout accounting. Both the design and implementation of cost-allocation systems are expensive, particularly for the computer operations, where special software packages must usually be installed.
- The overhead system leaves the responsibility for EDP department costs where it belongs—in the EDP department. The users of EDP should not be made responsible for EDP department costs. They generally do not have the background to make alternative resource-allocation decisions of EDP expenditures versus other items; these decisions must be made at the corporate level, and hence the quality and efficiency of the EDP department is a top-management responsibility.

(This argument undercuts the rationale for chargeout—namely, holding the users responsible for their own demands—and overhead accounting is then the only fair choice. One may well question the validity of this argument. A similar case, after all, could be made against *all* systems of transfer pricing, of which chargeout is just a special variant.)

□ The overhead system tends to keep the EDP department honest and within bounds, because the EDP department must account for its funds in a straightforward manner. A company that uses the chargeout system runs the risk that EDP department cost will be hidden under other department budgets, and this may encourage ungoverned growth of the EDP function.

□ The overhead system brings EDP expenses directly under the eyes of the corporate controller; and he may feel that he can exercise better control over *all* company department expenditures under overhead accounting. There is some risk that the chargeout system encourages user departments to conceal expenses of their own in the expenditures of the EDP department.

The research division of a large pharmaceutical manufacturer, for example, is a heavy user of the company's central EDP resource. This division has chronic and severe difficulties living within its budget and is in constant conflict with the controller, who monitors the division's expenditures closely. The controller also monitors the EDP department's expenditures closely, which he can do easily because the company uses overhead accounting for EDP expenses. He feels that a change to chargeout would cause him to lose some of his control over the expenses of the research division and the EDP department as well—if these two segments of the company were left to do business with each other, he feels, the levels of their expenditures would grow in a significant and irresponsible way.

(Of course, misdemeanors under chargeout indicate poor management control, not necessarily a weakness inherent in the chargeout concept.)

□ The overhead system tends to insulate the EDP operation from the fluctuations of corporate activity, and this has its advantages. The chargeout system, on the other hand, can lead to dramatic EDP department instability as corporate profits rise and fall. EDP billings are highly visible items on user income statements, and under a chargeout system user requests for reports and services are likely to drop sharply in a time of economic stress. This could have a devastating

impact on the EDP department, whose long lead times for systems development and hardware shifts require some budgetary continuity if it is to make effective progress.

These arguments are primarily relevant where general management is weak, and where it is important to give a fledgling EDP department room to prove itself. Usually, they are outweighed by the reasons for using a chargeout system, particularly in organizations with strongly decentralized management control systems. The chargeout system offers the following advantages:

- It requires more meaningful analyses and commitments on the part of users, who must allocate financial resources among projects that demand EDP and projects that do not.

- It provides a rough map of the ways in which the EDP department is interacting with other segments of the company. Top management can use this map to check its impressions of the extent to which the EDP department is integrated into the company.

- It gives top and divisional management a framework for realistically assessing the relative competitive efficiency and capability of the company department vis-à-vis outside sources.

- Chargeout provides economic data that permit top management to evaluate its option to centralize or to decentralize EDP operations and systems design.

- Chargeout also provides data that are useful in deciding whether to add or delete applications. In practice this use of the data can be dangerous, since significant components of EDP-operations cost are fixed within relatively broad swings in production volumes. Thus, abandoning an application may appear to offer great savings to the user, under a chargeout system, while from the corporate view it will make little or no difference.

If one compares the arguments for overhead accounting and those for chargeout accounting, it is clear that chargeout frequently offers the more significant advantages where management is vigorous or the EDP department is becoming mature. Hence, corporate management should ask these questions:

- ◇ Do we have a chargeout system? If not, has the subject been recently and professionally reviewed?

- ◇ Does our chargeout system integrate effectively with the broader management control

system of the organization? Is it being treated on a serious basis for decision making or is it just another bookkeeping exercise, one we might usefully consider a candidate for elimination?

- ◇ Have the chargeout data been structured to highlight costs of configuration changes and application shifts, or are they so highly aggregated and filled with arbitrary cost allocations that they are valueless for these purposes?

Resource allocation

No topic in EDP administration is more critical or sensitive than the process by which the company allocates financial and manpower resources to the EDP department for its developmental activities and ongoing operations.

Ostensibly, these allocations are approved through a number of different mechanisms:

- The manager or lower level executives in EDP review detailed summaries of a project or a particular operation.

- Senior managements in user departments review project reports for activities that affect them directly. (This happens most often in situations where there is a chargeout system for allocating user costs.)

- A corporate steering committee hears presentations and reviews the project summaries.

In actual practice, however, the vast majority of resource-allocation decisions are no more made in this manner than capital budgeting decisions are made by the committee for capital budgeting in a large corporation.¹ But this fact is often not even recognized; indeed, people act as though it were not true.

In most large organizations, top management, top user management, steering committees, and such groups are so far removed, in sheer organizational distance, from the specifics of any proposed project or operation that they are effectively prohibited from applying analytic criteria to the EDP decisions they must make. Instead, their judgments are heavily influenced by highly subjective criteria relating to the company's financial position ("What can we afford?"), other commitments already made, and the quality of support a project or operation has received as it has moved upward on its way to the decision-making group or individual involved. The evaluation of this last criterion—

1. See Joseph L. Bower, *Managing the Resource Allocation Process* (Boston, Division of Research, Harvard Business School, 1972).

quality of support—is heavily influenced by the track record of the activity's sponsors and their perceived understanding of corporate goals.

The sheer technical merits of the project have little relevance at this point, since neither time nor expertise is ordinarily available at these levels for such considerations. This clearly suggests that the guts of the resource-allocation process cannot be managed just by assigning responsibility for it to decision-making groups at the top of a company.

But it does suggest that these groups must pay attention to the process by which new project ideas are generated at the technical levels of the organization. They should carefully consider this question respecting lower organizational levels:

Does the planning process adequately involve the people who have sufficient understanding and credibility to both develop a new EDP application idea and evaluate its worth?²

Good planning style

The mere existence of a formal planning process is not enough; it is the quality of this process which is the key. This point was dramatically illustrated in a recent study of a research department, in which the investigators made an effort to evaluate the quality of ideas actually submitted to department management against ideas which were formulated but not submitted.³ The results, which were compiled by a panel of knowledgeable judges, are shown in *Exhibit I*—approximately 25% of the best ideas went unsubmitted.

Next, management reviewed both the submitted and unsubmitted projects (without know-

Exhibit I. Quality of projects

	Excellence: good		Fair-poor		Total
Unsubmitted	28	{24%}	19	{10%}	47 {16%}
Submitted	88	{76%}	168	{90%}	256 {84%}
Total	116		187		303

ing the results of the prior analysis) and moved some into the active category and some into inactive categories. A subsequent study showed that of the 29 ideas that were now accorded active project status, 11 were project ideas that previously had gone unsubmitted (see *Exhibit*

Exhibit II. Project status after full-management review

	Active	Decision postponed*	Rejected	Total
Unsubmitted	11	6	30	47
Submitted	18	43	195	256
Total	29	49	225	303

* Idea that was judged to be more relevant to another company division was communicated, but there has been no response.

II). These findings reinforce the importance of designing the planning process to encourage intelligent initiatives at the lower levels, and they strongly suggest that failure on this dimension can lead to significant inefficiencies in terms of new project identification.

As these data would indicate, a company that offers a low reward and high risk for an individual who openly sponsors a new systems development project may well be defeating itself. On the other hand, if sponsorship of a valuable new project for the company promises low risk with high personal career advantages, the company will probably find that it is receiving a richer stream of ideas. The incentive system, in other words, must be congruent with corporate goals.

Further, the company must ensure that the planning and project-approval processes provide feedback and criticism to those who submit ideas; this encourages an evolutionary approach to conception and development, rather than a go/no-go approach.

Yet good planning and proper incentives are only the necessary conditions for effective resource allocation. They are not sufficient in themselves. At the beginning of this article I said that it is the style and manner in which a planning system and a top decision-making unit are used which are really critical. Thus a company needs *informal* as well as formal procedures to meet its need for substantial collaboration and exposure of new ideas during the formulative stages. Frequent presentations of evolving plans to an EDP steering committee, lunches with key members of user management, and joint discussions between user staff and EDP staff are all important elements. At the annual presenta-

2. See my article, "Problems in Planning the Information System," *HBR* March-April 1971, p. 75.

3. Norman R. Baker and James R. Freeland, "Structuring Information Flow to Enhance Innovation," *Management Science*, September 1971, p. 103.

tions of the formal plans, there should be few surprises for anyone.

Finally, attention must be paid to the EDP project portfolio in terms of its riskiness. It is extremely easy to veer either toward a set of low-risk/low-payoff projects in the name of conservatism or, alternatively, toward a series of high-risk projects which, if the worst happens, may so significantly cloud perception of EDP performance that the department will subsequently prevent other potentially attractive projects from being undertaken. A balanced portfolio of proposals must be maintained, including both modest sure winners and high-risk items.

In auditing its resource-allocation procedures, then, top management should keep the following questions in mind:

Are the lower levels adequately involved?

Is the incentive system for project development congruent with corporate goals?

Does the planning process allow for feedback from operations to development?

Is the company developing a viable, balanced portfolio of EDP activities?

Technology & operations

In-company technology and the management of the computer processing environment have changed more rapidly in the past decade than any other aspect of EDP administration. In the hardware-software environment, the simple selection decision for a batch-processing computer made once every two to three years has necessarily been replaced by a complex, highly professional, and continuous decision-making activity. Computer configurations change almost monthly as parts are added and dropped, new software packages are acquired, and new data-input devices installed. Too, companies today deal with more than a single vendor—half a dozen vendors' components may be attached to a company's family of configurations.

The expansion of EDP technology requires that top management review the methods used to track the department's technological growth.

One place to begin is with a complete inventory of hardware and software resources. Many companies are continually surprised at what turns up in the corridors, cabinets, and corners of their facilities. Recently, one company was shocked to find that over 100 minicomputers had been acquired, over a period of two years, without any central coordination or knowledge

of other installations. These acquisitions had in fact led to significant excess capacity and to duplication of software expenses.

Next, there is the task of evaluating the configurations of hardware and software that the company is actually using. Given a certain hardware-software inventory and given a company's specific needs, management should inquire whether the resources are being used to full potential. This requires more than ordinary administrative expertise, in conjunction with up-to-date *technical* expertise.

The technical expertise of the 1960's, unless totally revamped and restructured, is of little value in 1973; hence management should review its sources of technical knowledge. For example, does it have access to really top-notch, disinterested advice on hardware and software, or is it primarily dependent on homegrown, conventional wisdom? Has it evaluated its source of advice against other outside sources? Does it rely primarily on vendors for technical advice or is it self-sustaining? Is there a steady infusion of either new technical expertise or technical training in its EDP department? Is the department familiar with the technical accomplishments and failures of nearby companies facing similar technology challenges?

The following anecdote shows the importance of these points. A large manufacturing company recently undertook a detailed study of alternative methods of selectively reducing the size of its computer configuration while maintaining an acceptable level of service to its customers. One afternoon, as the opening step in this "study" process, the EDP management unhooked part of the capacity of the configuration; since the hardware monitors indicated that this capacity was largely unused, management anticipated it would have little impact on the machine's throughput.

Unfortunately, the computer system reacted violently; it slowed down by 50%, causing several disruptions in the operating schedule. Subsequent analysis indicated both that there were far less risky ways of seeing what would happen if that piece of capacity were disconnected, and that a knowledgeable technical specialist could have predicted the results in detail.

A hard-nosed reevaluation of the company's technical personnel indicated that all the specialists in the department had spent the bulk of their careers in the company, attended few seminars, and had very little major design experience with a vendor

Hence, in auditing the company's technical expertise, management should raise the following questions:

- ◇ Is there a complete, periodic inventory of hardware and software?
- ◇ How efficiently is the inventory being used?
- ◇ Do the department personnel understand the problems and the potential of the latest technology?

Operations management

The operating sections of the EDP department that perform the data-input and computing functions may be considered a factory; they form the locus at which the basic product of the department is produced. Just as with any kind of factory, the existence of a well-procedurized reporting system is absolutely mandatory for monitoring overall performance and identifying the sources of problems. How to set up this reporting system is a subject of some controversy, however, because there are two schools of thought as to what really constitutes the operations factory.

One school of thought seeks to strip operations proper of all programming and other technical skills and to pool these skills with the systems and programming group, or perhaps to split them off as a third wing of the department. Proponents of this method of organization argue that purely technical functions ally themselves more naturally with the systems and programming area, and that putting them together, away from operations, leads to better coordination and better career paths for the individuals involved.

The opposing school of thought has moved toward an "integrated factory" concept, according to which operations includes not only the computer center and data input and output activities, but also program maintenance, operating systems maintenance, and other allied technical-support services. This school believes that since decisions must be made as to what volume and quality of computing resources should be devoted to operations proper, it only makes sense to keep personnel who are competent to analyze and evaluate these resources under the direct supervision of operations.

It seems reasonable to sympathize with the integrated-factory school—at least, to some extent. The group that manages EDP operations must be sufficiently aware of key issues and trade-off possibilities to articulate the full thrust of operations considerations when trade-offs be-

tween design alternatives must be made. The reason is simple; no one else is sufficiently conversant with the facts of operations to articulate them clearly, in first-hand fashion. This requires, however, significant hardware-software expertise in the operations group.

The influence of generations

Equally, advanced operations cannot work unless the operations management has a grasp of each succeeding technological innovation. For example, the installation of a newer and more complex operations system, while it may offer an improved capability in theory, in practice depends on such mundane things as rearrangements of peripheral machines in the computer room, more sophisticated and better-trained operators, and reworked schedules in the data input and output areas. Management of the dull and unattractive tasks entailed by new technology is critical, here, to the success of the technology itself.

The problem of organization design vis-à-vis operations is further complicated by the proliferation of subspecializations—such as telecommunications design, data-base management, and operating-system design—which also have to be integrated into the organizational design. One might think that such sophisticated applications would not bear too heavily on the more routine operations, but this is far from true. Each radical application of this kind generates additional processing requirements and higher workload levels for a department.

The failure of many departments to alter their operating procedures to take account of these new factors has resulted, in many cases, in companies' owning fourth-generation hardware and hiring fourth-generation talent but still managing operations by methods suited to the first and second generations of computing.

One company still maintains a Gantt chart-scheduling mechanism left over from second-generation computing to schedule jobs through its two interconnected, multiprogrammed computers. A three-man group working only on the first shift (the company's computer operations runs three shifts a day) busily posts numbers to a board. But the numbers are obsolete before preparation and are mercifully ignored by both EDP users and other operations personnel.

A company may have a difficult time, then, in defining the proper scope for its operations control system and in seeing that this system

meshes with the internal complexities of its EDP department. The best complement to any system of this kind, of course, and the best guarantee of its proper functioning, is an operations manager who has a management background, a technical background, and a salary level that are commensurate with those of the manager of systems and programming.

The disparity between these positions which could be justified a decade ago is no longer appropriate. Although it is now considered a position of great responsibility, the post of manager of computer operations is all too frequently staffed by an individual with less than impressive credentials. The necessity of dealing with technical options, large numbers of workers, and situations that have a strong impact on the company's ability to function on a day-to-day basis makes this a key managerial position.

In sum, top management should consider these questions respecting control of operations:

◇ Is there a concise, objective performance reporting system that embraces turnaround time, rerun time, hardware-software component utilization, and user complaints in such a way as to permit both senior EDP management and top management, itself, to quantitatively monitor performance?

◇ Are users satisfied with speed and quality of service? If not, why not? If they are, have operational procedures and capacities been studied to ensure that this is not being achieved through highly inefficient procedures which are hidden by the existence of excessive computer manpower and machine resources?

◇ Is the group that manages EDP operations fully involved in the hardware-software evaluation process—and are the members *competent* to be involved?

◇ Have the scheduling and control procedures been modified to become consistent with the technical options made possible by the most recent generation of machines acquired by the department?

◇ Does the manager of computer operations have commensurate salary, management, and technical background with the manager of systems and programming?

◇ Is there a managerial career path with an opportunity for advancement in operations which is commensurate with that in systems and programming?

"Hard" answers, I might note, will not be possible for all these questions. More experience

with and research on the best uses of subspecialization options—for example, data-base management and telecommunications design—are urgently needed. A second area where research is needed is the design and use of hardware and software packages for measuring and monitoring aggregate operations performance in terms of its use of technical and manpower resources. As we acquire more insight on how to link management-control concepts to operations activity, new improvements in operations efficiency will be possible.

Still a third area for spadework is improvement of methods by which a department can more effectively monitor the changing technological environment and translate its shifts into appropriate courses of action for the company.

Project management

An enormous number of controversies and broken promises have been created in project management. In response, a thriving literature of cookbook approaches has developed. Without being unduly harsh and critical of work to date, I have concluded that one can examine this area intelligently only if he begins with the recognition that it is an elusive and complex topic.

First of all, only flexible, contingency-management concepts are likely to be found useful in so fluid a context; standard procedures in one setting often are useless in another. But there

"Plight of the EDP Manager" by Richard L. Nolan, which is the following article beginning on page 143, discusses the problem of EDP management from another perspective.
—The Editors

are basic elements which can be brought to bear in varying combinations on the control and management of a project (see the ruled insert on page 140). As the reader will note, I have classified them into four categories. These categories may be subject to some discussion, but, on balance, they have proved distinctive and useful groupings for me. Categories 1 and 2 are primarily organizational in nature while categories 3 and 4 are composed of specific tools and procedures.

If there is some agreement, however, that these categories present a concise view of the

Elements of project control & management

1. *Formal integration procedures, where the users of the project's output are located outside the EDP department:*

○ Regular meetings between the users and an EDP project advisory committee.

○ The appointment of a full-time manager in the user's department to coordinate and manage the interface with EDP.

○ Assignment of one or more staff members from the user's department to the project design team.

○ Distribution of the minutes of liaison meetings to all management in the user's department.

○ Formal procedures for users to follow in approving the initial design and all subsequent changes.

○ Assignment of a project leader and project personnel who have had significant, positive, personal contact with key members of the user's department.

○ Chargeout of project costs to the user's department.

2. *Formal integration procedures within the EDP design team and between the various units of the EDP department:*

○ Institution of a technical steering committee for the project, composed of key project staff.

○ Selection of a project leader who has significant technical competence (for projects with relatively advanced technology).

○ Use of formal flowcharts and other documents to highlight the interfaces between key systems components, when these are significantly differentiated.

3. *Formal planning tools:*

○ Use of PERT or CPM to lay out the project.

○ Detailed documentation of systems design and specifications prior to project implementation.

○ Use of systems simulation or other hardware-resource planning tools.

○ Use of modular approach to design, with strong limitations on the size of each module. (One large bank recently wrote off as a sunk cost over \$5 million of investment in the development of a trust accounting package. The prime cause of failure appeared to be its decision to install, simultaneously, four massive modules of interwoven coding that constituted a single software package. Although this maneuver might have been appropriate in a sophisticated environment of highly skilled and experienced programmers, the approach failed at the bank because the EDP department lacked the necessary manpower skills. A more modest, evolutionary approach would have offered far greater likelihood of success.)

4. *Formal control tools:*

○ Use of PERT or CPM during project implementation.

○ Formal procedures for collecting and measuring actual expenditures of time and dollars by project submodule.

○ Regular use of formal postaudit procedures. (Post-auditing is often recommended but seldom implemented. No other commitment is easier to state but harder to deliver on.)

elements of project management, there is considerable disagreement about how they should be applied and the impact they can make in different settings. The viewpoints of EDP managers range from the opinion that "project management is an act of faith where there are no tools except the intuitive judgment" to the opinion that "the availability of the new tools and techniques and, above all, experienced managers has reduced most of the risk out of the process."

I do not wish to get involved here in the controversy about the absolute impact of these tools and techniques. Instead, I wish to identify certain critical dimensions that *limit* their effectiveness in any particular setting.

Dimensions of risk

The criterion I have used to identify these dimensions is risk. As the reader will understand

shortly, the farther a project moves out on any of these dimensions, the greater will be the inherent risk of the project's failure, and the less effective will be the contribution of any formal planning and controls. In other words, as a project moves toward high risk on any of these dimensions, two *management* questions—which can be stated, not quantified—must be asked:

◇ How much risk can we tolerate before the project becomes unacceptable, *regardless* of the tools and management techniques available?

◇ When a given project becomes unacceptable, should it be restructured on a more modest scale or should it be dropped completely?

For each project in the department's portfolio, management must answer the preceding questions as risk grows along these dimensions:

□ The degree of absolute technological innovation vis-à-vis the state of the art for the proj-

ect's application. As the project pushes the absolute state of the art—for example, using new data-base software, new telecommunications concepts, and new programming languages—cost estimates, time estimates, and likelihood of simple technical success all become steadily more uncertain and the number of potential, unforeseen difficulties soars.

□ The degree of "company relative" technology. As a project pushes into technology with which the company is unfamiliar, it becomes more risky, even though such technology is being used routinely in other organizations. Project-control mechanisms, supported by outside consultants, can have a bigger impact on this dimension than on the first, but many of the more spectacular failures have occurred here.

□ The degree of organizational differentiation between the EDP department and the departments being served. A department whose primary goals, time-span orientation, interpersonal-relationship patterns, and orientation to change in day-to-day operations are similar to those of the EDP department will be able to implement EDP projects with fewer controls and less difficulty than a department where these factors are at wide variance with those of the EDP department.⁴ Thus EDP/R&D projects may require less control than EDP/marketing projects. Also, R&D will find its projects' output more useful, things being equal, than marketing.

□ The degree of structure inherent in a project. Projects that involve simple automation of existing data-processing or clerical systems or well-understood physical processes are far more tractable to planning and control than projects whose outputs are either information or automation of processes whose characteristics are only poorly understood. A strict project-design discipline, combined with strong integration procedures, is likely to offer great payoffs here.

One such project-design discipline calls for a two-stage design effort. During the first stage project personnel perform a complete systems analysis and design job; the documents are presented to senior management in the user department, and formally signed after the necessary modifications have been made. Only then does the second stage—the implementation stage—begin. It includes a formal procedure for handling any additional design changes that can be justified by the user.

Although it is hard to operate under such a severe system when it is first installed, continued use of this technique has paid strong dividends in diverse settings by forcing stronger analysis and commitment before the main expenditures are authorized.

□ The sheer physical size of the project. As the size of the project grows, the importance of formal project planning and control, external integration, and internal integration grows. For small projects, informal controls are generally adequate; for very large projects, even elaborate controls may be inadequate, and here the extensive use of submodules is often the answer.

These dimensions are unmistakably qualitative; and control procedures for most EDP projects cannot be specified and handled by a simplistic uniform set of procedures. Project control, to be effective, must embrace the thinking and concepts of general management control and organizational behavior. Many of the elements of control in my four categories originated in these fields, and it is that type of broad thinking, as opposed to technical EDP expertise, which needs to be brought to bear on the problem.

In evaluating an EDP administration's efforts on project control, then, management should consider these questions:

◇ Has the problem of project control been systematically addressed? Do we have a meaningful, formal project-control approach and strategy, or do we do it on an ad hoc basis?

◇ Is there a formal procedure for coping with the problem of restructuring a project? Does it take into account changes in technology, reassessments of resource potential, and shifting corporate needs?

◇ Is there a formal process for performing postaudits of projects to examine the effectiveness of the project management efforts and methods for communication?

◇ Are postaudit results used to improve the management of other projects?

◇ Have the key project managers been exposed to modern project-management concepts through seminars, training, and other methods?

◇ Does the company's management-control system reward effective project management?

Concluding note

The technical complexity of the EDP field, its relative newness, the limited, nontechnical

4. See Paul R. Lawrence and Jay W. Lorsch, *Organization in Environment: Managing Differentiation and Integration*. Boston: Division of Research, Harvard Business School, 1967.

training of its managers, and its crisis atmosphere have often prevented the questions I have raised from being asked. Too often, other, tangential questions have been raised instead—for example:

○ What does telecommunication technology mean to me?

○ What do the new developments in external memory imply for the department?

○ What is "data-base software technology" and what are its implications for me and for my environment?

The danger to EDP administration lies in the fact that the expertise needed to answer these

tangential kinds of questions, while also critical to the success of the EDP department, is quite different from the types of *management* acumen that can ensure the questions raised in this article are being handled appropriately.

On the other side of the coin, it is only through answering and acting on the questions I have raised that top management can approach the two main issues with which it must be concerned, vis-à-vis EDP:

○ "Are we spending too much or too little or just enough on EDP?"

○ "Is the money we have allocated to the department being properly spent?"

A gap to bridge

In 1958, *Business Week* analyzed numerous unsuccessful business and government applications of computers. In most cases, the failures were failures in detail—failures of large systems concepts to pay off in detailed accomplishment. That is why in considering the problem of man-machine relations it is necessary to go beyond speculation and aphorisms and to be concerned with detailed accounts of human perception and action. It has been held that the wide gap between the promise and performance of thinking machines is a mere matter of "engineering detail." A measure of the problem of "engineering detail" can be found in the history of mechanical translation, which presents a record of glowing prognostications about what is possible and a record of actual failure in accomplishment. There is a growing realization that even approximate mechanical translation may be impractical just because there are too many engineering details; that is, a computer handling 10^6 or 10^7 bits per second may be no match for the human translator's intuitive recognition of a meaning. Similar considerations seem to limit chess-playing machines to "a-few-move" games of a small selection of pieces.

When the focus of interest turns from relatively controlled problems, such as mechanical translation or chess playing, to systems and strategies, the gap between the promise of complete automation and its accomplishment becomes even wider. There are reasons to expect that this gap will be narrowed; but the narrowing may be a result of more detailed knowledge and better understanding of men and machines, rather than a naïve effort to automate human decision and creativity.

Mortimer Taube,
Computers and Common Sense,
New York, Columbia University
Press, 1961, pp. 81-82.

How to control the computer resource

John Dearden and Richard L. Nolan

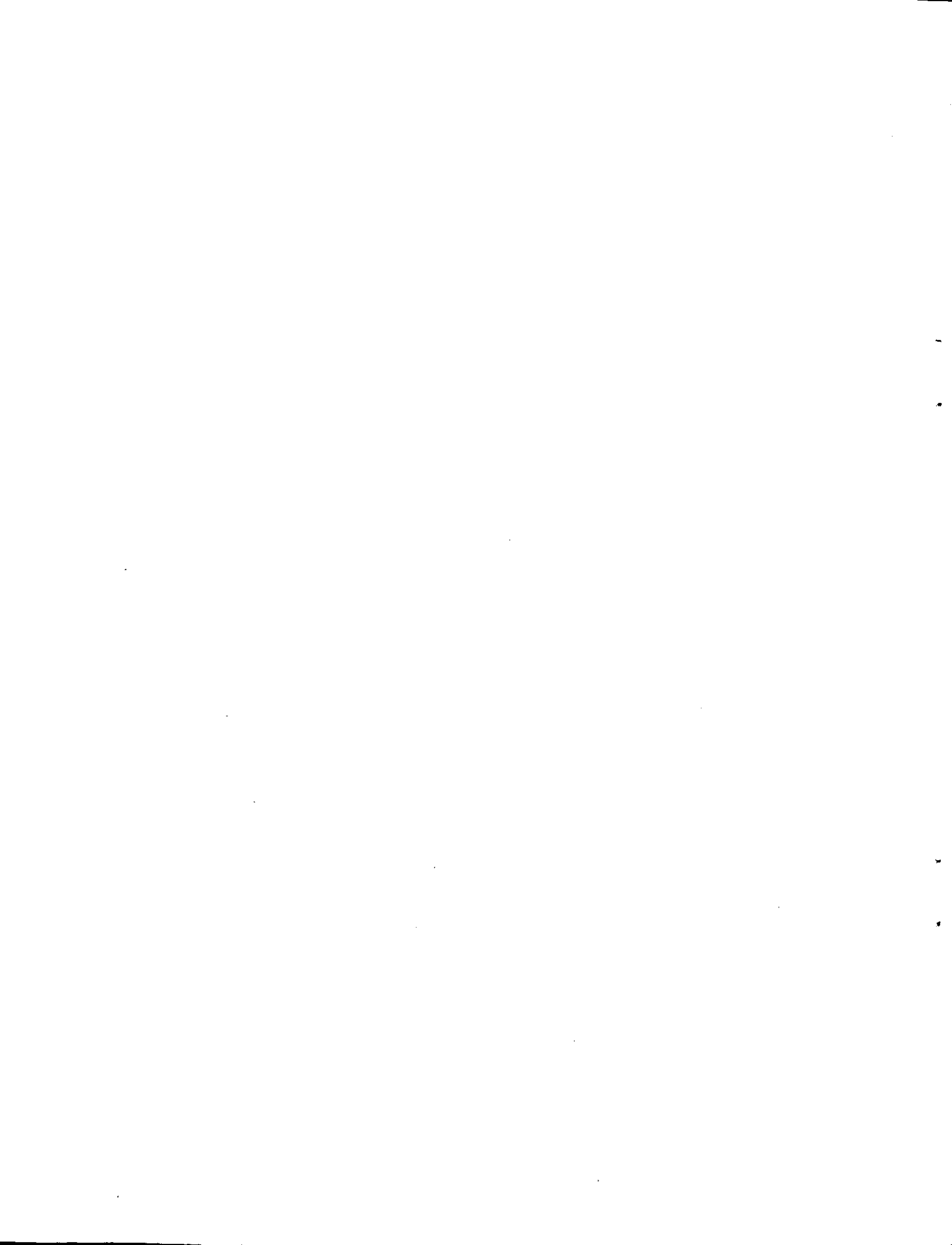
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John Dearden and Richard L. Nolan

How to control the computer resource

*The mechanisms companies can use to control
the EDP department are now well defined;
but how does one make them all work together?*

Chargeout accounting and overhead accounting, plans and audits, corporate funding and development proposals, steering committees and project management—these are some of the devices that must be stirred into the blend of control mechanisms to assure top management that its hold on the computer resource is real, sensitive, and efficacious. By surveying the critical differences between the problem of control in this area and the better-understood problems of control in other areas of company operations, the authors demonstrate that good management of the EDP resource is an unusually tricky affair—a company can easily miscontrol itself right into waste and futility. They also reach some definite conclusions about

which groupings of mechanisms work best at various stages of a company's development as a user of data processing, and provide a framework for a company to use in tailoring a control system for its own particular needs—a system, that is, which ensures that its needs are met both effectively and efficiently.

Mr. Dearden is Professor of Business Administration at the Harvard Business School and is an authority both on management information systems and on control. Mr. Nolan is Associate Professor of Business Administration at the Harvard Business School. He has consulted, taught, and published extensively on EDP applications and on management information systems.

To improve management control over the computer resource, one must answer several fundamental questions:

- How much money should be spent on it?
- How should the money be deployed for maximum effectiveness?
- Is the resource being employed efficiently?

However, management control of any staff activity is concerned with answering these three questions. There are some extra dimensions to the control of the computer that render it a special problem to management. An analysis of these extra dimensions provides some insight into the reasons why so few companies have

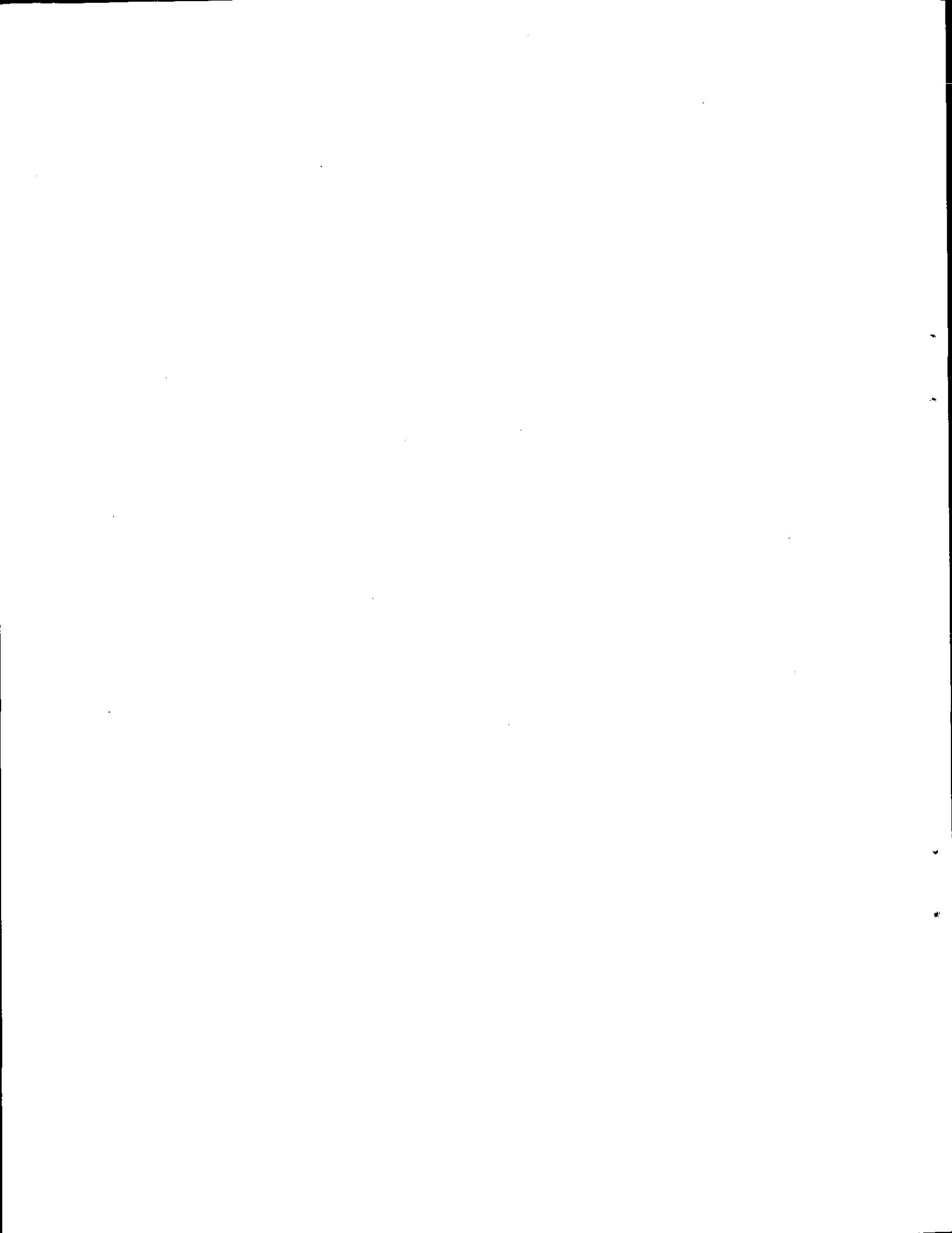
been able to maintain adequate control in this area; also, it provides some ideas for improving current practices.

How it differs

It seems to us that the computer resource differs from other staff activities in three ways.

1. The resource has a simple purpose—economy.

The computer resource exists solely to help staff offices and operating units to execute their responsibilities better through cheaper processing



with top management, so far as its "product" is concerned, is almost exclusively budgetary.

Since the goal of the computer resource is so clear and elementary, it seems as though the control of this activity should be much simpler than for other staff activities. After all, if it provides only economic service, why cannot management simply require all users of this resource to pay its cost? After all, if the benefits are not equal to the costs, then, in theory, management can simply discontinue the service, in whole or in part.

Yet it is clear that the computer resource is not the easiest resource to control—indeed, it may be the most difficult. Why this is so can perhaps best be understood when we examine the other differences between the computer resource and other staff activities.


2. *The resource has a complex set of supply/demand characteristics.*

So far as supply goes, there are several characteristics to consider:

□ The ratio of fixed to variable costs is high. That is, hardware and systems development costs are high, but variable operating costs are low. Consequently, EDP managers tend to maintain a constant, full-capacity workload on a computer system, since the cost of incremental work is so very low—essentially, it is free. Once the full capacity of a computer system is used up, however, figuring out which new demands should replace existing demands is very difficult. Hence this high ratio leads to difficult priority problems.

□ Computer hardware offers economies of scale. For example, an expansion in capacity results in a less-than-proportional increase in costs. The effect for the user is that the acquisition of a larger computer system may actually reduce the cost to process his job. However, if the computer is not used to full capacity, as is often the case at the outset, and total costs are fully allocated to the users, the users may find themselves paying more to process their jobs than before.

□ Incremental capacity must be acquired in large blocks. Although computer capacity can be modestly increased by adding peripheral equipment, it cannot be smoothly augmented to accommodate a linear demand growth. Typically, the acquisition of a larger central processor unit doubles capacity. For example, companies that upgraded their existing IBM 360/50



of data, more efficient organization of information systems, and procurement and deployment of information that is too expensive to obtain otherwise. The resource has no reason for existing except to provide such services, and these services should result in greater profits. In short, the resource has a purely economic purpose.

In this sense it differs from other staff functions. All other such units provide management with advice in their specialty—the legal staff provides legal advice, the accounting staff provides many types of financial advice, and so forth. But the only advice that the computer function provides for management concerns the nature and extent of its activities; its interface

computer systems to the IBM 370/155 obtained a fourfold increase in capacity.

There are also important characteristics to consider on the demand side:

□ Needs for EDP services grow rapidly, in complexity and in sheer size. On the one hand, rapid technological advances have consistently reduced the cost of computing; on the other, rising costs of labor have continued to make the use of computers in labor-intensive tasks increasingly desirable. In addition, more applications are being designed for middle management. Finally, developments in mass storage technology have made the construction of large data bases economically feasible—data bases that are used to support various routine tasks and also the ad hoc studies which are the coming mode of operation for middle management.¹

□ Processing tends to be cyclical. Daily, weekly, monthly, and close-of-business cycles often create peaks and valleys in routine processing. Generally, it is not economically feasible to build an in-house processing capacity that can meet all peak demands; thus arrangements must often be made for handling extreme peak demands through commercial computer utilities.

□ One computer system usually is unable to serve all the diverse demands that a large organization can place on it. For example, organizations involved in producing scientific products and services must balance the configuration design of the computer system toward scientifically oriented computing, which may result in some suboptimal business computing.

□ Processing priorities are highly variable, depending on the application, the users, and the timing. Scheduling the workload in a manner consistent with need often poses hard-to-resolve management problems both in developing automatic priority systems and in handling special case priorities in a consistent manner.

3. *The computer resource is still relatively new.*

Only 15 years ago, this resource did not exist. Now, it is not unusual for a large company to spend as much as \$50 million a year on computers and related activities. Further, constant developments in hardware, software, and systems techniques have lengthened the time required to adequately assimilate the resource into a business's operations. From the viewpoint of

1. See Richard L. Nolan, "Computer Data Bases: The Future Is Now," HBR September-October 1973, p. 98.

top management, this rapid growth has resulted in a couple of uncertainties.

Investment decision uncertainties—How much should a company spend on its computer resource? Theoretically, it should spend up to the point at which the revenue from the marginal application is equal to the cost of this application (including the cost of financial resources). In any type of investment decision, this is a very difficult point to ascertain. Where computers are concerned, it is much more difficult because management lacks experience in making the necessary judgments and calculations.

Staffing uncertainties—The questions that arise in the selection of EDP personnel are harder to resolve than in the more traditional fields (for example, accounting, law, or industrial relations), where long experience in training, evaluating, and selecting key personnel is available.

Given these uncertainties, mistakes are bound to be made. Unfortunately, to compound the difficulties of management control in this new field, mistakes tend to be irreversible. If it is discovered that the manual processing of a certain type of information was cheaper and more flexible than the computer processing, it is often much too late to change back. In other cases, new operating procedures may have been instituted in the expectation that the resource

In the context of this article, a company's computer resource includes computer hardware, software, and all the personnel who are employed by the company as a result of the presence of the computer—programmers, operators, systems analysts, data base managers, EDP executives, and so forth.

would generate new kinds of data. Once this has happened, even if the new data turn out to cost more than expected, it may nevertheless be too expensive to revert back to procedures for operating without them.

To summarize, then:

▽ It seems that management control of the computer resource should be much easier than the control of other staff activities. The goal of the computer resource is a single, straightforward economic one, in contrast to multiple, partially noneconomic goals for other staff activities.

△ This simplicity in goal setting is more than offset by the complexity of the supply/demand

characteristics of the computer resource and the uncertainties in both planning and execution that inhere in this area. No other staff area exhibits the constellation of supply/demand characteristics and other special characteristics that we have just outlined. The complexity of this constellation makes it necessary to provide some central planning for procurement and deployment of the resources, at least for the present. This means that, in most instances, it is not practicable for a company to let the users decide whether to accept or reject computer services. A series of individual decisions will not provide an optimum companywide decision.

Given the problems just described, how can management best exercise control over the computer resources? Although there is no single, simple answer to this question, we believe that there are certain conclusions that can be drawn:

First, systems currently in use differ widely in the degree of centralization that is exercised.

Second, no single system will be successful for all companies.

Third, the successful control system will change for any one company over time. In fact, the typical successful control system will move from complete centralization to, ultimately, nearly complete decentralization.

Fourth, the type of system a company uses will be less important in determining successful control than the way in which it is administered.

To illustrate these conclusions, let us look at three actual systems, each employing a different degree of centralization.

No chargeout

Company A is a medium-sized manufacturer with sales in excess of \$100 million. It manufactures two low-cost, low-margin product lines at two plants. Each plant has a full computer setup that provides billing, accounts receivable, payroll, sales analyses, and perpetual inventories. The EDP manager reports to the vice president for administration. Together, they negotiate the EDP budget annually with top management.

Computer services are provided to the users on a no-charge basis. In this kind of situation, users will tend to exercise little control over the efficient and effective use of the computer services. With such a chargeout system, centralized

control is necessary. It is typically exercised by some kind of steering committee composed of top executives. Company A employs a central committee of this type. This committee consists of five members from sales, production, finance, and EDP. The committee reviews current and proposed computer plans and prepares a comprehensive three-year plan with these goals:

- Identifying potentially profitable EDP systems.

- Determining systems development priorities.

- Projecting manpower requirements for systems and programming.

- Projecting hardware and software requirements.

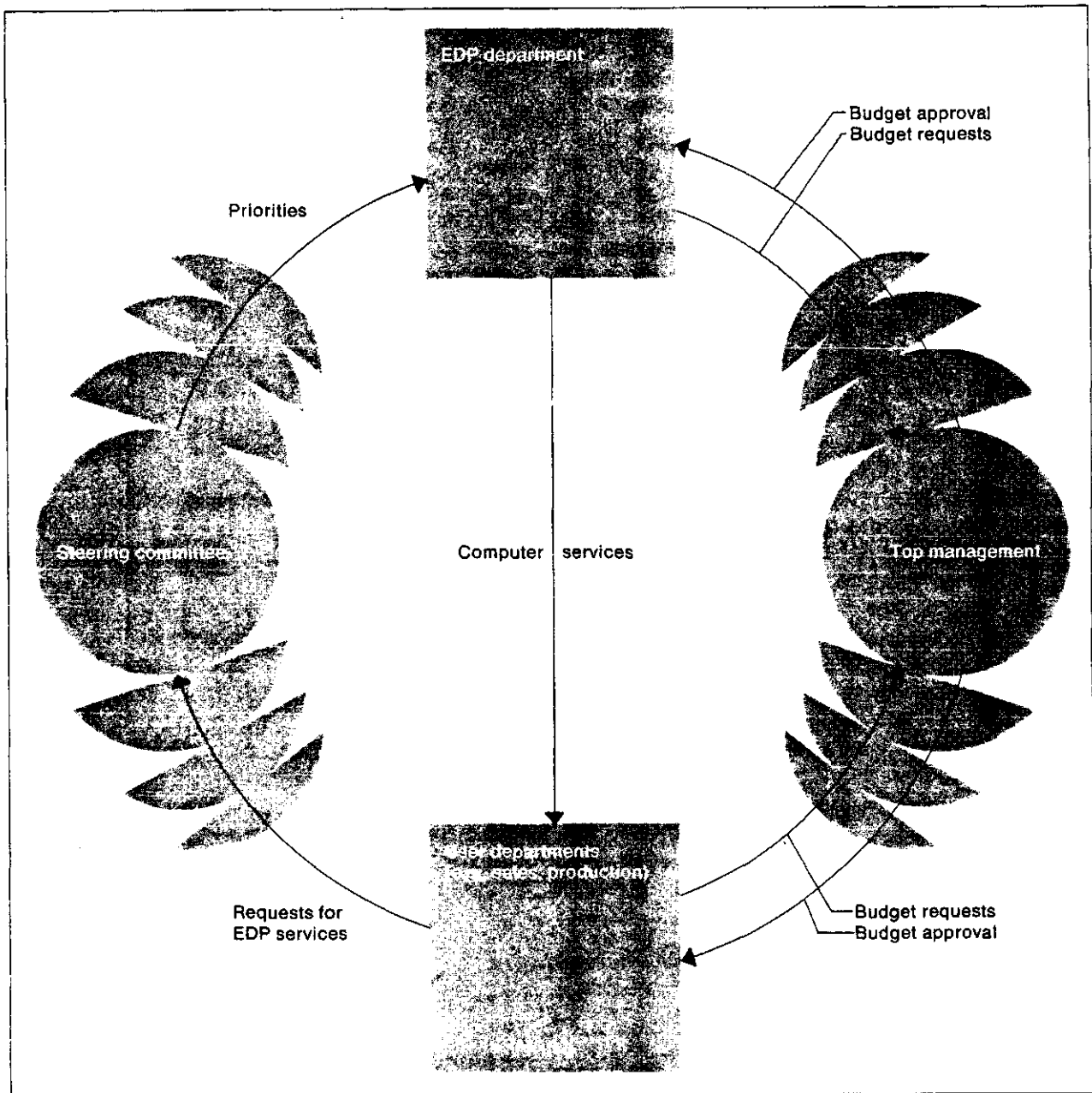
Functional subcommittees review the operations, evaluate existing applications, and recommend additional systems development projects. Exhibit I illustrates these relationships.

In theory, the steering committee is responsible for deciding the major computer system projects to be undertaken and the relative priority of each. In practice, however, computer management often plays a dominant role in advising the committee. Thus the control process is biased by the dependence of top managers on advice from computer management that is, in effect, helping to decide what financial support should be given to its own function.

In Company A this dependence is critically important because of the reluctance of top management to spend the time necessary to ask the right questions and to be sure it receives correct answers. There is no active process in place to promote managerial awareness about realistic opportunities for the computer resource. Consequently, the committee generates little decision-oriented information (such as the proper scope for a system, proper cost ranges, and descriptions of potential benefits) by which to evaluate alternative systems proposals—except insofar as such information is provided by the EDP managers themselves.

Working within this atmosphere of dwindling managerial acuity vis-à-vis the computer resource, the subcommittees constantly incur difficulty in evaluating applications in their respective areas, which amplifies the wide divergencies of perspective among the functional areas of the company respecting the uses, costs, potentials, and limitations of the computer. When a subcommittee proposes modification of an existing

Exhibit I. Control relationships in Company A



system in consequence, the modification is limited in scope and imagination—what is proposed is almost always just an “add-on” (i.e., a new report). The proliferation of these reports has become a problem of major concern to computer management. In fact, the subcommittee’s proposals, in aggregate, amount to an unjustifiable request for additional computer capacity.

Accordingly, the computer plan that has emerged is weak and of questionable use to Company A’s management. It is nothing more than an amalgam of the subcommittee’s pro-

posals, with three or four projects labeled “high priority.”

Missing mechanisms

To compound its ineffectiveness in determining which applications to undertake, Company A has also done a poor job of implementing the system it has approved for use. Subsequent to the decision as to which system to install, the problem of control is largely one of project management.

Project management in Company A is extremely primitive. In almost all cases, the negotiated performance characteristics, schedules, and manpower costs are grossly optimistic. Given the level of computer experience and managerial awareness fostered by Company A's nonchargeout system, this overoptimism is not hard to understand:

▽ Line managers who are considering a computer application tend to minimize their commitment to the project, whether in manpower or in financial terms. Then, if the project does not go as expected, their loss is minimized. Or so the reasoning goes.

△ EDP management, on the other hand, recognizing this behavior on the part of users, employs a foot-in-the-door strategy, reasoning that if it can just get an opportunity to prove that an application can be useful, the line manager's reluctance will be overcome.

Together, these two strategies make cost and schedule overruns inevitable—a condition all too common where no form of chargeout control is used.

To make matters worse, Company A does not employ the post-completion audit. This audit can determine the extent to which original objectives of a project have been satisfied, as well as the extent to which additional objectives have been incorporated into the project during its development. Since it performs no audits of this kind, the company cannot evaluate planning against performance, and the lessons of experience are lost.

Finally, Company A's method for evaluating the efficiency of its computer resource is most unsatisfactory. Every company should watch the efficiency of its development of applications, as well as its EDP operations. Operations efficiency, we might point out, involves systems programming and reconfiguration of the hardware. This is a highly skilled activity, even an art, and thus it tends to elude control by formal management mechanisms. Nevertheless, close management attention should be given to understanding what results the group is striving to achieve and how well it is achieving those results. The group should be held accountable for continued improvements in the overall efficiency of the computer system and innovations in improving the efficiency of computer applications.

On the surface, Company A appears to have a valid control mechanism in its steering com-

mittee. By itself, clearly, this mechanism is not sufficient, nor is it being used effectively. Instead, the *real* control mechanism used here is the EDP budget. Significantly, this budget is line-oriented (for example, it includes annual hardware rental and programmer salaries) rather than project-oriented (for example, order entry, inventory control, accounts receivable). Because of this orientation, management cannot use the budget as a useful tool to measure the general efficiency of its EDP department. The primitive project management system includes only performance characteristics, target completion dates, and manpower for computer projects. It is doubtful whether any control system could succeed where management itself is inherently so weak.

If there is a single fault in Company A's approach to control, it is that users are not directly accountable for the cost of employing computer resources. This weakness of its control process is reflected in the fact that the supervision of the resource depends on negotiations between the resource itself and a management committee that lacks the benefit of firsthand advice—from the users—on what the resource ought to be doing for its customers and whether it is doing the job.

Strongly centralized control such as that employed by Company A may be required when a company first begins to use the computer resource. At this point in time, however, Company A's centralized control has long outlived its usefulness. Company A is guilty of fostering a static system; what it needs is a dynamic system that allows experiential feedback to improve the control system.

Let us look at another company with an opposite perspective.

Complete chargeout

Company B is a large oil company—its sales are over \$4 billion—that uses computer systems extensively. In addition to the conventional applications in accounting and inventory control, many of the company's planning and operating functions employ computerized mathematical models.

The EDP department operates as a cost center. Usage rates are such that *all departmental costs are charged to users* on a "reasonable basis." In exchange, the department must meet a number of policy guidelines:

◇ The department must accommodate all reasonable demands.

◇ Headquarters must approve all major equipment purchases.

◇ Where no confidential company information is involved, users are free to satisfy their computer processing requirements outside the company.

◇ The computer group must develop and maintain certain capabilities necessary to keep abreast of important technology, whether or not a current user requirement exists that will pay for the full costs of application development and production operation.

Exhibit II illustrates the major components of the chargeout-based management control system.

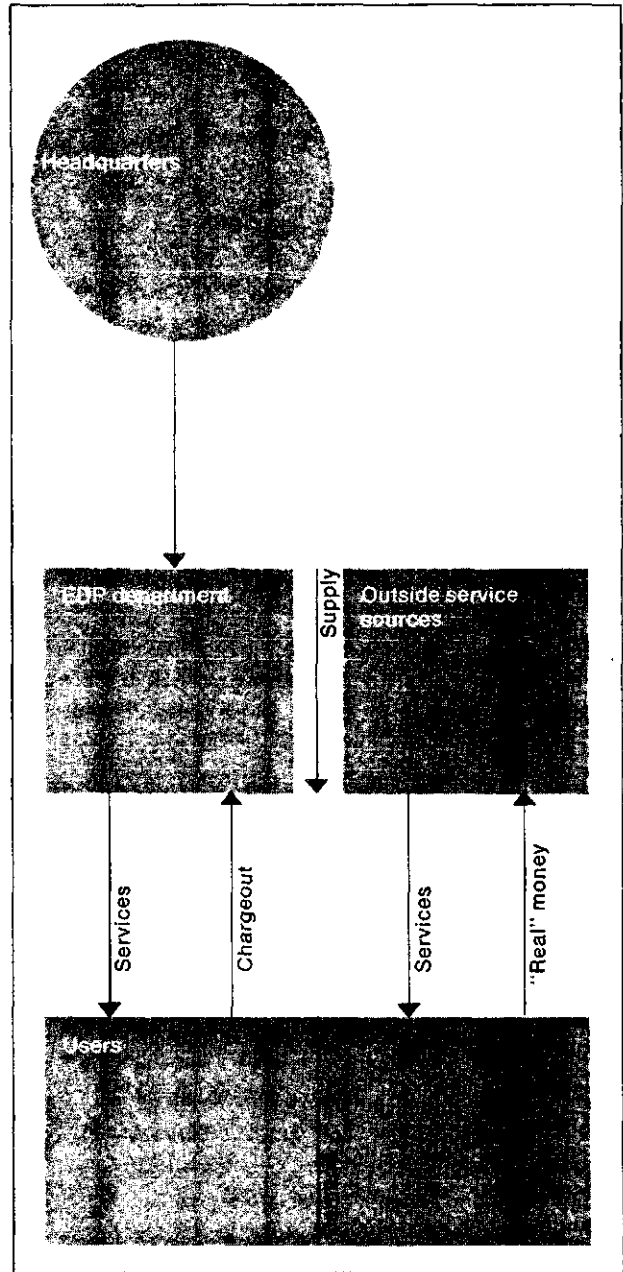
Chargeout rates are calculated monthly—relatively, a very short period in a facility of any size—so that the entire costs of operations for the department are always fully covered. Basically, the chargeout rates are computed from CPU time and the number of operations involved. Consideration is also given to existing market prices—that is, for outside service-center prices—and in some cases adjustments are made. The reader should understand that rates can vary widely from month to month because the price of CPU time and the number of operations depend on the amount of usage.

After a year's experience with the chargeout system, Company B has identified four problems:

1. *Rate fluctuations*—The chargeout rates on the average fluctuate by $\pm 15\%$ from month to month. Users therefore have found it difficult to budget for computer services. More importantly, these fluctuations are creating instability in demand for computer processing. Some users, located in a large metropolitan area, have a wide choice of outside computer services, and it is relatively easy to farm out many jobs. Also, the mathematical programming groups are highly sensitive to price changes, and therefore slight changes in prices immediately affect the amount of computer processing they use. This makes it extremely difficult to ensure that adequate computer power is always available to meet their demands and those of others.

Any short-term pricing strategy that allocates all costs to the user is likely to induce similarly high variances, which tend to confuse the user and stretch his belief in the fairness and validity of the pricing system.

Exhibit II. Control relationships in Company B



2. *Configuration changes*—The present rate structure is designed for the present computer configuration. Every change in the configuration requires a new pricing scheme, reeducation of the users, and readjustment of the strategy for farming out jobs. These changes induce a continuing turmoil.

3. *Capacity/price relationship*—The current chargeout rate depends on the fraction of capacity of the computer system used. As demand increases, the fraction of capacity used increases, causing rates to drop; and lower rates induce

increases in demand until total capacity is used. The opposite is true for a reduction in demand; reduced demand leads to less use and a higher chargeout rate. The higher chargeout rate drives some users away, resulting in lower capacity utilization and a still higher rate. Hence a low use/high rate spiral develops, which is precisely what the company does not want.

4. *Programmer games*—Many of Company B's programs can be run in various combinations on either of the department's two computers. However, the chargeout rate was designed in such a way that the rate for one of the company's computers is roughly half the rate for the other computer. As a result, programmers experiment with running their programs on both computers to find which computing patterns are the cheapest. This practice has complicated scheduling and led to inefficient programming.

Company B's control system has two basic problems, both resulting from its insistence on full cost chargeouts:

□ The first problem results from fluctuating rates which, of course, are inevitable if all costs are to be charged out. This problem could have been eased if the company had used a longer time frame for computing charges—one year, say, rather than one month. The budgeted annual costs for the department could have been used as a base for developing the chargeout formulas. To be sure, this annualized approach implies that a company must stick with its chargeout formulas throughout the year, whatever systems changes may naturally occur, and resolve the problem of a deficit or surplus at the year end. However, this is a common practice in manufacturing departments, for example, where underabsorbed or overabsorbed overhead is reckoned up at the year end as a matter of course.

Even under such a "constant charge" approach, of course, job rates will vary because of internal flexibilities in the resource's capability—whether a job runs on one machine rather than another, and so forth. But the rates will vary far less than under a chargeout system for which the costs are set by the month or by some other very short term.

□ The second problem results from delegating the decisions on the use of the computer resource to the users. Although we agree that a degree of decentralization is desirable for the company, central control of some computer applications could effect a better use of the com-

puter resource. As we indicated earlier in the article, it is rare that a group of decisions made independently by the users will result in optimizing the company's overall use of the computer resource.

Partial chargeout

The two approaches to control just described—overhead accounting and full chargeout—are centralized approaches to control. The third alternative—partial chargeout—is a decentralized approach to some extent. Users are charged an appropriate fee, computed by formula, for their use of the resource on a job-by-job basis. Such a system has the effect of distinguishing the decisions that bear primarily on the effectiveness with which the resource is used from the decisions that bear primarily on the efficiency with which it is used; and it delegates the effectiveness decisions and some of the efficiency decisions to the users.

The effectiveness decisions are decentralized by forcing the user to trade off in-house computing costs against the costs of other activities. The efficiency decisions are partially decentralized by making the user aware of the costs of running his computer applications; thus he is motivated to ensure that his computer applications will run efficiently.

Organizations that provide computer-related consulting services, such as The RAND Corporation, have successfully devised flexible pricing schemes for computing. Jobs are submitted by a diverse group of users, to be processed within a determinate time—usually a 24-hour day. Each job has a desired completion time and requires a specific set of resources of the computer system. During the course of the day, processing queues build up. To control the queues, management applies priority and rationing schemes and sets some restrictive policies—for example, processing only jobs with estimated CPU usage of five minutes or less during prime time.

The critical problem that emerges for EDP management here is effectively accommodating users' demands for more service than the computer can provide at any one point in time. With work backlogs and usage restrictions, there will always be users who require priority. Because a department serves a great diversity of users, its management usually cannot decide priority cases.

There is a solution, however: a flexible pricing

scheme can be used to decentralize the priority decision to the user. One such price structure for an engineering company calls for a 50% premium for jobs running over five minutes' prime time and a 100% premium for those running over ten minutes' prime time. This scheme discourages the overuse of prime time without prohibiting the running of longer jobs that require rapid turnaround. The approach has permitted the removal of all administrative priority restrictions without lengthening turnaround times; average turnaround has been held to less than 30 minutes.

To recapitulate:

□ The nonchargeout system treats computer services as a free good to the user. So long as the services have even marginal benefit, the user will be motivated to acquire as much of the service as possible. Some central body must ensure that the computer resource is used effectively and efficiently; this is often a steering committee or top-management review committee. Depending on its makeup, control may be partially decentralized—for example, where users dominate the steering committee. The important point here, however, is that a pricing mechanism is not ostensibly employed.

□ The full chargeout system uses a strong pricing mechanism to decentralize responsibility for both effectiveness and efficiency to the users. The essential assumption here is that users will make the appropriate trade-offs of computing with other alternatives (an assumption not always justifiable). If the user can acquire better or cheaper computer services outside the company, it is assumed that he will.

□ The underlying assumption of the partial chargeout system is that a flexible pricing mechanism should be used to ration the computer resource. This approach is a realistic attempt to reconcile the need to decentralize some of the effectiveness and efficiency controls with the need to centralize others. Exactly which controls and decisions should be centralized and which decentralized depends heavily on company structure, management, industry, availability of outside computer services, and other variables. To that extent, the partial chargeout system represents a situational approach.

In our opinion, users should pay a fair price for the computer resources that they use. After all, the resource should serve a purely economic function for the user. If he does not pay fully,

he will be tempted to use the resource for less than marginal applications. If he must pay more than the service is worth, he will abstain from using the computer for applications that are profitable from the company's viewpoint.

Ideally, then, we feel that the full chargeout system is the control system toward which most companies should work. For the present, however, until companies gain experience in controlling the resource, full chargeout will cause many problems, and most companies would be well advised to adopt partial chargeout systems fitted to their particular stages of computer development.

The next question to answer, therefore, is this: How should a company approach the question of which partial chargeout system fits it best?

Framework for design

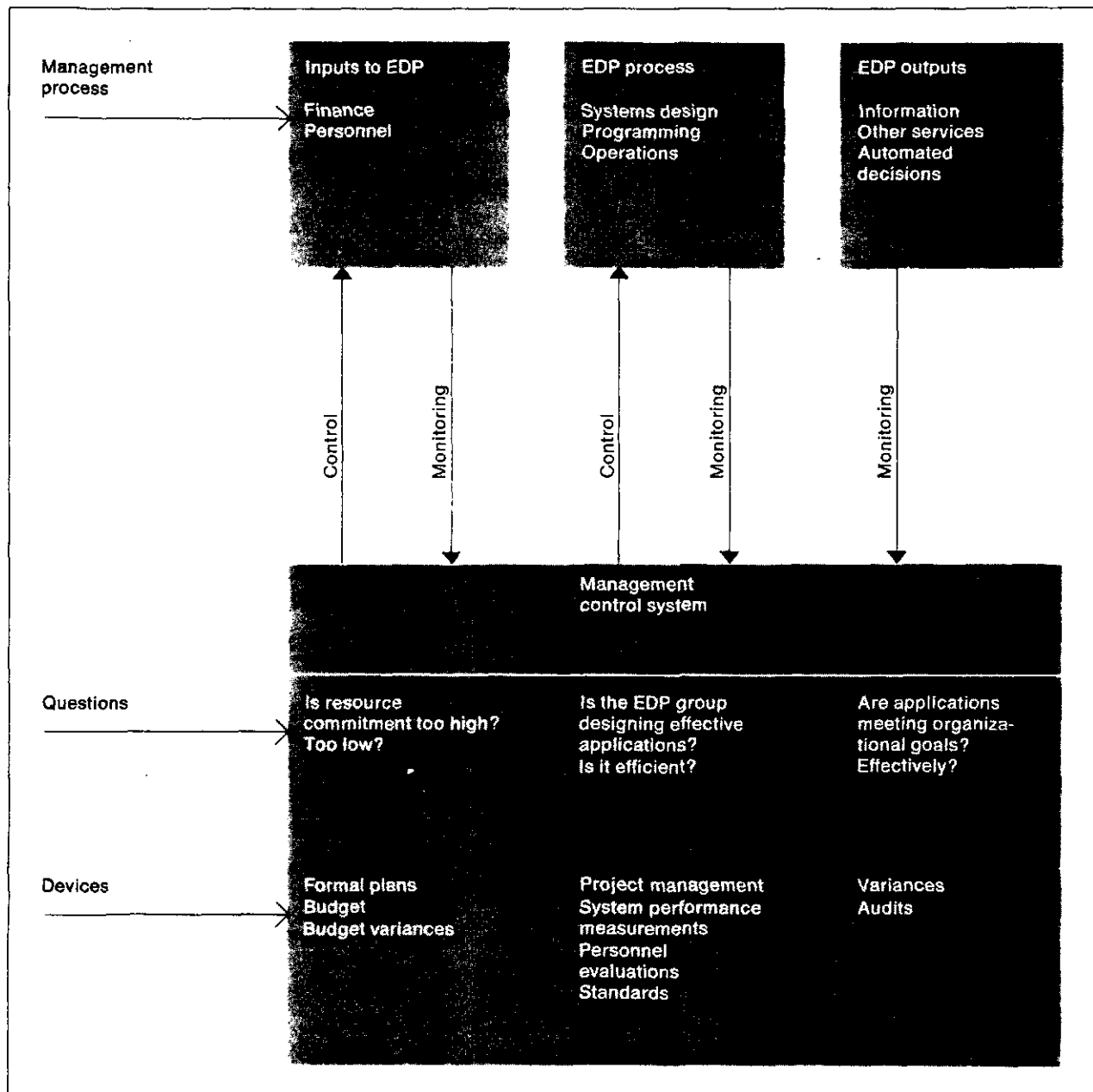
To begin with, four levels of analysis are needed. First, the company must generate guidelines on how much to spend on computing, what systems to develop, and how it will judge efficiency and effectiveness. Hence it should look at the kinds of information it can generate to help formulate these guidelines. Its information may simply be inadequate.

Second, as the stories of Company A and Company B illustrate, the control system itself significantly affects the EDP operation on all fronts. Hence a company should assess the way in which its control system functions to evaluate, motivate, and communicate among the various groups involved. *Exhibit III* outlines the elements of the analysis. Note that the main *monitoring* points are inputs, processing, and outputs. The main *control* points are processing and inputs (since outputs can be controlled only by altering inputs and processing).

Third, once a decision is made on how much to commit to computing—in finances and in personnel—both efficiency and effectiveness must be monitored and controlled. As the exhibit shows, both should be heavily monitored and controlled in the process component. Project management is the primary control mechanism in this component, and it would be difficult to overstate its importance.

Finally, the major topic that a company should debate about the output component is this: How should the EDP group alter the services provided—through new applications or the modification of existing ones—to continue to be

Exhibit III. Framework for management control of the resource



effective? The analysis of output, which necessarily will be a *historical* analysis, will help top management see what actions should be taken to control the input and process components.

Companies may find the questions listed in Exhibit IV useful in making these analyses.

What to do!

In preparing such an analysis and moving toward good control, top management's first step

is to establish a functional, senior-management steering group to decide (a) what the company can afford to spend on computing and (b) what company priorities are for the development of computer-based systems.

Its second step is to establish a project management system that accommodates the unique characteristics of computer-based systems development projects. A workable project management system will alleviate much of the wastefulness of uncontrolled computer projects that is experienced by companies today.

Exhibit IV. Approaches to nonchargeout/chargeout decisions

	Spectrum				Spectrum		
	Non-chargeout	Partial chargeout	Full chargeout		Non-chargeout	Partial chargeout	Full chargeout
Managerial awareness				Organizational issues			
1. Are the major opportunities for computer applications known and understood by users and management?	No		Yes	1. Is the company's operating philosophy one of centralization? If so, do the management control system and the location of the resource reflect this fact?	Yes		No
2. Are users knowledgeable about the costs and limitations of computers?	No		Yes	2. Is the company's operating philosophy one of decentralization? If so, do the management control system and the location of the resource reflect this fact?	No		Yes
3. Are users highly susceptible to "overselling" of the computer resource?	Yes		No	3. Do users require very highly advanced technology (e.g., for graphics, on-line data entry, software) with an extended time horizon?	Yes		No
4. Alternatively, are their needs diverse - for example, for graphics, mathematical modeling, and routine accounting work?	No		Yes	4. Can they justify these requirements on the basis of company strategy?	No		Yes
5. Do most potential users have standardized needs?	Yes		No	5. Does security dictate that many data and programs be processed in-house?	Yes		No
Management issues							
				1. Do complex priorities make it difficult to generate needed management information on schedule?	No		Yes
				2. Are outside services readily available?	No		Yes
				3. Is it necessary to monitor and control EDP management closely?	No		Yes

The third step is the most tricky: one must juggle a number of factors and decide to what degree the user can be held accountable for the services of the resource. In deciding on an approach to control—nonchargeout, partial charge-


out, or full chargeout—management may wish to use the questions presented in Exhibit IV. Each helps to crystallize the principle that the functions of the EDP department should be ultimately attuned to a purely economic rationale.

Blueprint for MIS

William M. Zani

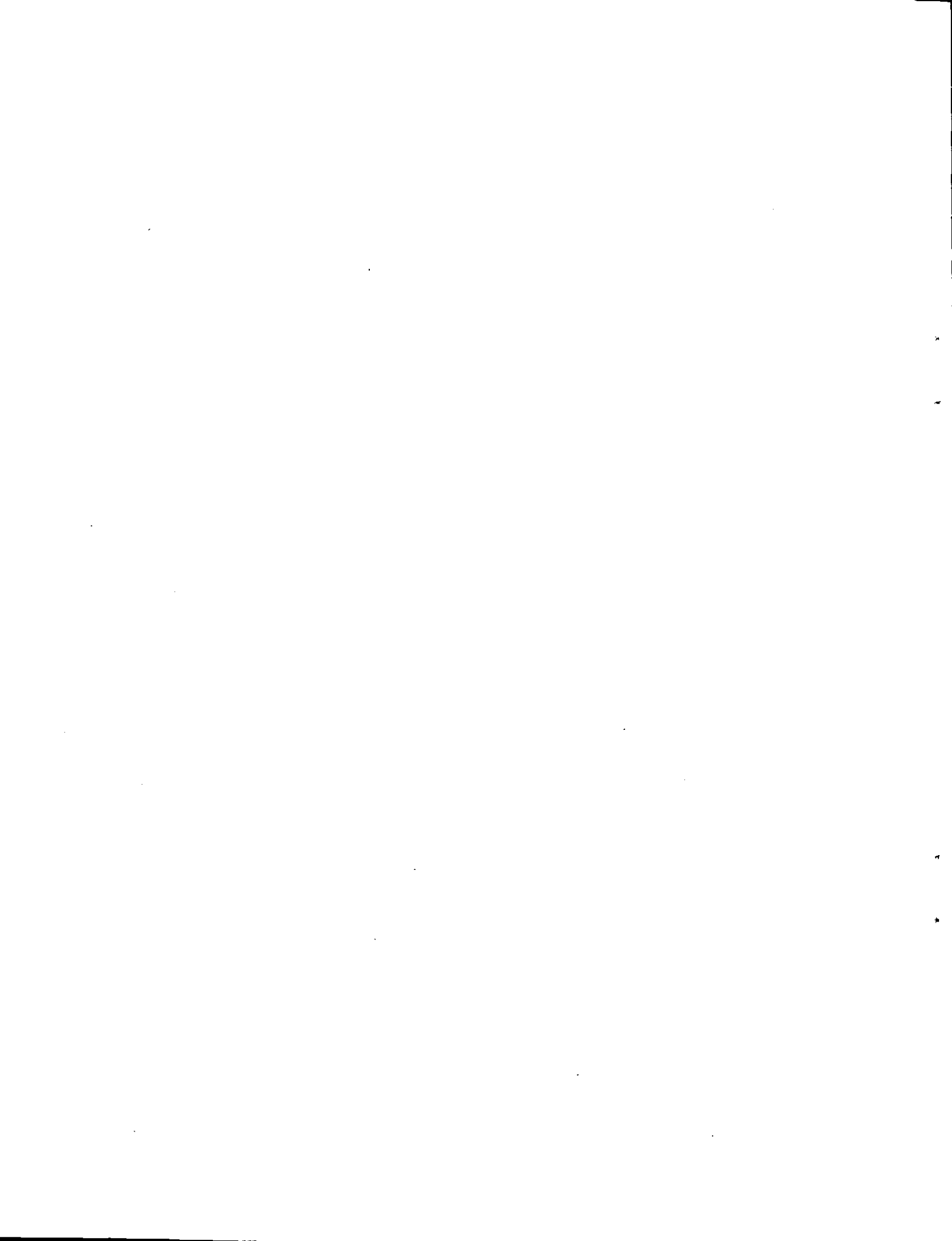
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William M. Zani

Blueprint for MIS

*A general scheme for relating systems
to the jobs they are really supposed to do*

Foreword

Most companies have not conceived and planned their management information systems with any significant amount of attention to their intended function—supporting the manager as he makes his decisions. As a result, companies have been disappointed with their systems, and have tended (quite unfairly) to discount the value of the MIS concept in general. Here is a framework for designing any system so that it will fulfill both its function and management's expectations of the potential of information systems at large. The key to good design, as the author explains, is a thorough understanding of the major decisions man-

agers make at various levels in a company, because it is these decisions that define the kinds of information required, and hence define the basic design parameters of the system itself.

Mr. Zani is Assistant Professor of Business Administration at the Harvard Business School. He has taught at l'Institut pour l'Etude des Methodes de Direction de l'Entreprise in Lausanne, Switzerland, and he has worked both in designing and in managing computation centers. His current area of research is managerial implications of time-shared computer systems, a field in which he has published extensively.

Traditionally, management information systems have not really been designed at all. They have been spun off as by-products of the process of automating or improving existing systems within a company.

When a company's information system comes into existence in this second-hand manner, it is largely fortuitous whether the information the system provides is exactly the sort of information the managers in the company need to help them make their decisions. If it does turn out to be exactly what they need, then, well and good. If it does not—and this is much more likely to be the case—then clearly the so-called "management information system" is merely a mechanism for cluttering managers' desks with costly, voluminous, and probably irrelevant printouts.

No tool has ever aroused so much hope at its creation as MIS, and no tool has proved so disappointing in use. I trace this disappointment to the fact that most MISs have been developed in the "bottom up" fashion that I have just described. An effective system, under normal conditions, can only be born of a carefully planned, rational design that looks down from the top, the natural vantage point of the managers who will use it.

Rather than mirroring existing procedures, in other words, an information system should be designed to focus on the critical tasks and decisions made within an organization and to provide the kind of information that the manager needs to perform those tasks and make those decisions.

This obvious truth has largely escaped the at-

tention of businessmen, information specialists, and computer specialists alike. In this article I should like to present an approach to MIS design that is oriented squarely to decision making. I have presented this approach in the framework shown in *Exhibit I*, which diagrams out the major determinants of MIS design and their relationships to one another. These determinants are:

- Opportunities and risks.
- Company strategy.
- Company structure.
- Management and decision-making processes.
- Available technology.
- Available information sources.

These are the factors that should structure the characteristics of information provided to management, and therefore the design of the system itself.

From the top down

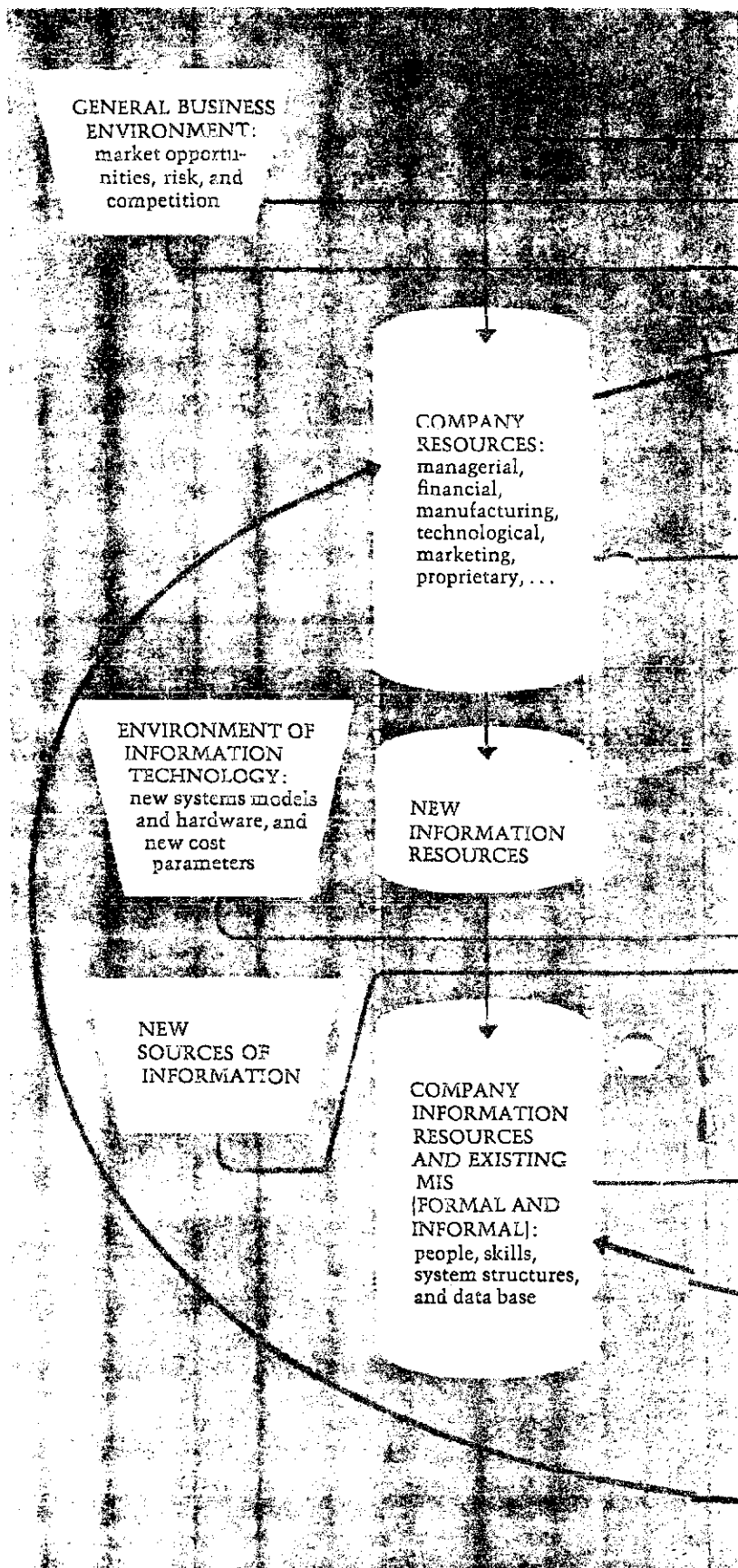
By exhibiting the relationships between these factors, the framework helps establish goals and priorities for MIS development, and hence focuses information technology where it will do the most good. If management sees to it that this framework is used when an information system is being designed, then the resulting system will be smartly tailored to the company from the top down, and not merely patched together from the bottom up in a crazy quilt of residues from automated clerical procedures.

The system, in other words, is likely to support the critical areas of decision making in the company effectively, as it should.

To ensure that the framework will actually be used, however, top management must take a more prominent role in the design process than it has hitherto. Most experts agree that top-management support and participation are necessary for effective system design, but they generally state that this support is necessary only for budget control and control of the data-processing group.

The framework I am presenting, however, implies a much more extensive participation than this. It assumes that top management itself must start the design process—i.e., must first delineate the organization's strategy, structure, and decision-making processes for the specialists in the design group, and then make sure

Exhibit I. Blueprint for MIS design



NEW RESOURCES FROM IMPLEMENTING PLANS

ORGANIZATIONAL STRUCTURE: specific plans, objectives, decision guides, and tasks and their interrelationships

STRATEGIC PLANNING DECISIONS: policies for managing objectives and resources

STRATEGY: general plans, objectives, and decision guides

MANAGEMENT CONTROL: methods that assure resources are obtained and used effectively and efficiently

SPECIFIC INFORMATION REQUIREMENTS

OPERATIONAL CONTROL: methods that assure specific tasks are carried out effectively and efficiently

KEY SUCCESS VARIABLES: factors and tasks that determine success and failure

MIS STRATEGY AND PLAN FORMULATION

NEW SYSTEMS

MIS IMPLEMENTATION

NEW INFORMATION SYSTEMS CAPABILITIES

that the specialist designers integrate these elements fully into the basic system design.

An ideal, not a recipe

I do not offer this framework as a panacea that will solve all of a company's information problems, nor as a step-by-step procedure for the whole design process. I offer it as a concept—an ideal, if you will—of how top management should think about the whole question of the management information system.

Its application does not guarantee that managers at all levels will be fully informed at all times about all matters important to the organization. This is obviously impossible. Further, there is nothing about the framework that implies that management can create a finished system by a single masterstroke of planning and development. Quite the contrary—the framework is only a guide to be used in the ongoing process of creating useful systems large or small, simple or complex, for immediate purposes or purposes farther away in the future. But, as such, it has enormous value.

Framework of MIS design

The upper left quadrant of *Exhibit 1* indicates that a company strategy is a blend of internal company resources with external forces—market opportunities, risks, and competitive activities. The general strategy then determines organizational structure and also the practical strategy for augmenting the company's resources with new ones via short- and long-range planning.

The study of corporate strategy has occupied many books and journals, but the implication of corporate strategy for MIS design has largely escaped attention. Strategy should exercise a critical influence on information system design, to ensure that the resulting system is on the same "wave length" as the company as a whole. If, for example, a company changes its strategy so that its MIS focuses on factors no longer relevant—if it now urgently needs cash-flow data, say, where it formerly needed sales data—then the system is no longer valuable. Strategy dictates firm, explicit objectives for system design.

Key success variables

Opportunities, risks, competences, and resources, plus the strategy derived from them, yield

the company's organizational structure. This structure subdivides the essential tasks to be performed, assigns them to individuals, and spells out the interrelationships of these tasks. These tasks, and the organizational structure they compose, determine the various information needs of the company.

Internal resources, external forces, strategy, and organizational structure define the key success variables of a company. These variables are activities on which the company must score high if it is to succeed. For example:

◇ For a consumer goods company manufacturing nondifferentiated products, the key success areas might be product promotion and understanding customer responses to product, marketing, and competitive changes.

◇ For a manufacturer of commodity products, manufacturing and distribution cost control and efficiency might be the major determinants of success.

The key success variables name the key tasks of the company and thus help identify the priorities for information system development. The system must provide information that makes the individual managers' performance of these tasks easier and better.

Decision analysis

The only way to isolate the specific information requirements of individual managers is to isolate the nature, frequency, and interrelationships of the major decisions made in the company.

One can ask a series of questions which will help isolate the specific information requirements for these decisions:

- What decisions are made?
- What decisions need to be made?
- What factors are important in making these decisions?
- How and when should these decisions be made?
- What information is useful in making these decisions?

It is obviously not possible to answer all these questions for every decision made, in even the smallest organizations. But the key success variables help identify the *major decision areas* for detailed analysis.

The decision-analysis section of the framework is divided into three segments—*Strategic*

planning decisions, Management control, and Operational control. Examples of activities falling under these headings are given in Exhibit II.

It is particularly important and useful to recognize these three distinct subprocesses of management in information system design because each requires different types of information and

Exhibit II. The characteristics of input into the three decision-analysis processes

Strategic planning process

- "External" data
 - Market analyses
 - Technological developments
 - Government actions
 - Economic data
- Trends
- Predictions

Management control process

- Control
 - Internal formation
 - Historical summaries
 - Goal performance comparisons
 - Monetary reports
 - Rhythmic reports
- Decision making
 - Future trends & past trends
 - Monetary & nonmonetary reports
 - Special studies
 - Rhythmic reports
 - Product & market data
 - Market share potential market share
 - Customer & product profiles
 - Production-process efficiencies, etc.

Operational control process

- Precise logistic and product data
 - Inventory reports
 - Production schedules
 - Product costs
- Nonmonetary reports

analysis. Within the operational control area, for example, many decisions can be programmed --that is, one can build a program that identifies the time at which a decision is needed, the alternatives available, and the criteria for selecting the best alternative under different circumstances.

Within strategic planning, on the other hand, it is frequently extremely difficult to determine when a decision is needed, and developing alternative solutions to a problem of strategic planning is a creative process that cannot be predefined or prescribed. Hence, the kinds of information and analyses needed for strategic planning are quite different from the kinds

needed for operational control. Exhibit III displays the informational characteristics required by each of these subprocesses.

Systems designers who fail to understand the differences between these subprocesses and fail to take them into account may make the mistake of applying to all of them a system that is applicable to only one subprocess and not to the others. Decision analysis should filter information requirements for the appropriate management subprocess. Thus far, then, the framework makes explicit:

- Objectives dictated by strategy.
- Specific tasks and their interrelationships, displayed via organizational structure.
- Key success variables.

Using these elements as a base, an analysis of a company's decision-making patterns in strategy, managerial control, and operational control draws out the specific information requirements for the critical areas of company operations. It is by identifying these factors and guiding their analyses that managers make their contribution to MIS development.

To fulfill their roles properly, managers must be aware of the major sources of information, of alternative methods of supplying data, and of the impact of the major changes of information technology. The major contribution to information systems in these areas, of course, must come from the information and data-processing specialists.

Information technology

The field of information technology has undergone and will continue to undergo rapid change. One funnel in Exhibit I symbolizes the influence of change in information technology, and also of information sources, on the development of information systems. Through this funnel are added new methods of processing and storing data, new models, changes in computer and peripheral equipment, and changes in the costs of hardware and software development to the design process. These generate new system ideas and make them feasible.

The barrel labeled "Company information resources..." is a reminder that new systems cannot and should not be developed in the abstract. Existing systems and practices cannot be changed overnight, and many times it is too costly and risky to change the existing systems

Exhibit III. Examples of activities in the three decision-analysis processes

Strategic planning	Management control	Operational control
Choosing company objectives	Formulating budgets	
Planning the organization	Planning staff levels	Controlling hiring
Setting personnel policies	Planning working capital	Controlling credit extension
Setting marketing policies	Formulating advertising programs	Controlling placement of advertisements
Setting research policies	Selecting research projects	
Choosing new product lines	Choosing product improvements	
Acquiring new divisions	Deciding on plant rearrangement	Scheduling production
Deciding on nonroutine capital expenditures	Deciding on routine capital expenditures	
	Formulating decision rules for operational control	Controlling inventory
	Measuring, appraising, and improving management performance	Measuring, appraising, and improving workers' efficiency

Source: Adapted from Robert N. Anthony, *Planning and Control Systems: A Framework for Analysis* (Boston, Division of Research, Harvard Business School, 1965), p. 19.

radically. Proposals for system changes must also consider the level, quality, and kinds of skills present in the data-processing group. And finally, of course, the computer configuration is fixed in the short term and may be difficult and expensive to alter. New systems must therefore be designed and developed with the limitations and constraints of the old systems clearly in mind.

Using the framework, then, encourages understanding of the critical areas of operations, identification of specific information requirements, and recognition of the technological, economic, and personnel constraints within which an MIS develops. As important as anything else, perhaps, is the fact that systems are of necessity dynamic, changing with the environment and the organization.

In essence, the difference between my viewpoint on MIS design and what I call the bottom-up viewpoint is analogous to the difference between the new, customer-oriented concept of marketing and the old marketing concept. Philip Kotler has spelled out the latter difference as follows:

"The new marketing concept replaces and to some extent reverses the logic of the old one. . . . The old concept starts with the firm's existing products and considers marketing to be the use of selling and promotion to attain sales at a profit. The new concept starts with the firm's

existing and potential customers; it seeks profits through the creation of customer satisfaction; and it seeks to achieve this through an integrated, corporate wide marketing program."¹

The old MIS design approach begins with existing systems, and produces benefits by chance. The approach I advocate focuses on key tasks and decisions leading to more effective decisions, and then attacks the problem of designing information systems to support those tasks.

The framework I have proposed helps management structure MIS so that it can and will influence the decision-making processes in the critical areas of the company, and thus focuses information technology and resources where they do the most good. It also demonstrates that general and operating management must be directly involved in the design of systems. Only management's understanding can delineate the organization's critical success factors for the information specialist or systems designer.

If the design of management information systems begins on a high conceptual level and on a high managerial level as well, a company can avoid the unfortunate "bottom up" design phenomenon of recent history and begin to develop the real, and very great, potential of MIS as a tool for modern management.

¹ *Marketing Management* (Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1967), p. 6.

Problems in planning the information system

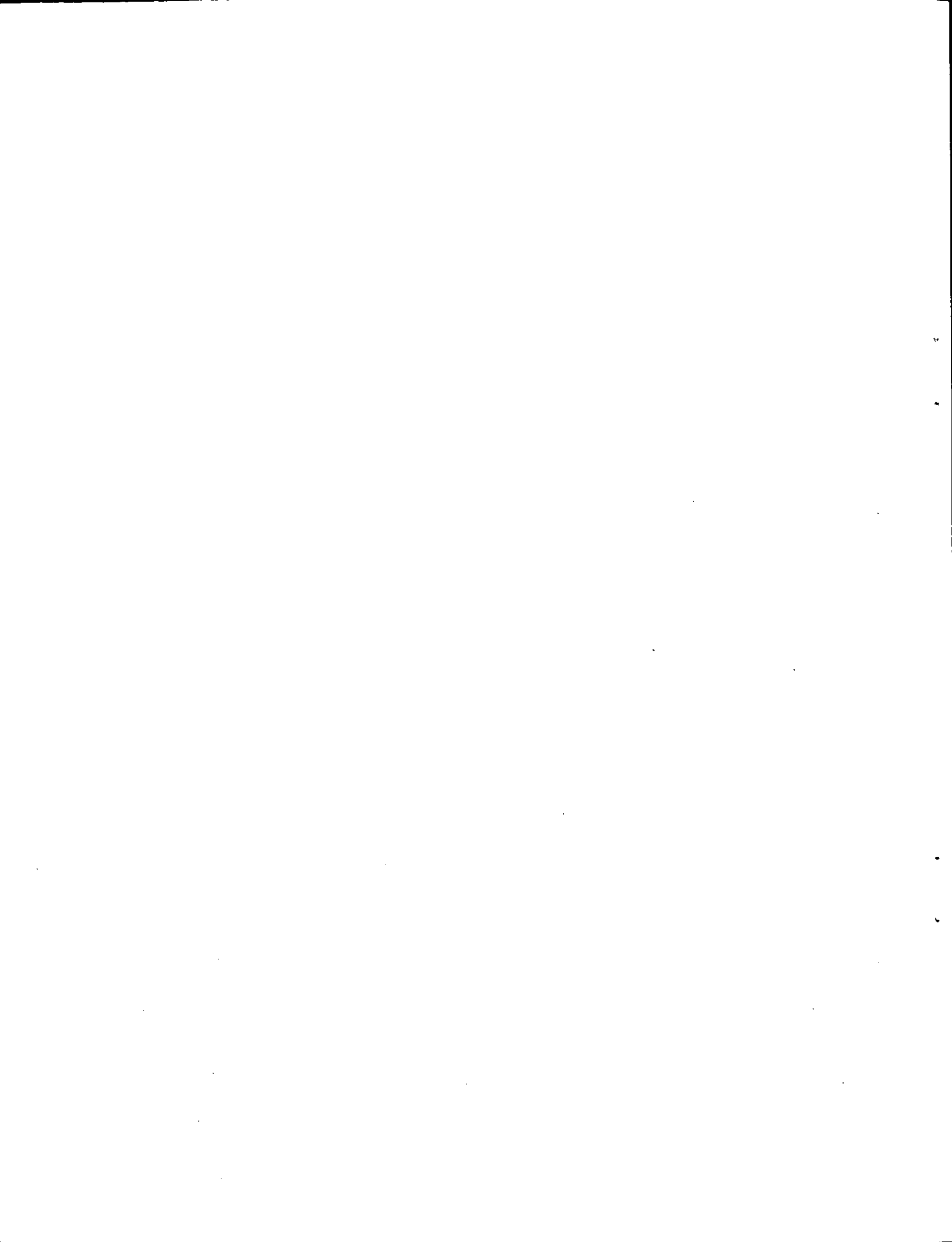
F. Warren McFarlan

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Problems in planning the information system

The pressures that force a company to plan its information systems strategy help determine the shape its plan shall take

Foreword

Putting flesh on the concepts of planning is always a difficult thing to do, especially in a new and fast-moving area of activity like computer-based information systems. The author makes planning in this area more manageable by outlining the factors that a company must consider in developing its strategies. He also defines some administrative structures that have worked out well in practice—structures for developing the plans themselves and structures for planning control. Much of the information that is present-

ed in this article has been gathered in recent studies of companies that have been effective in planning their systems.

Mr. McFarlan is Associate Professor at the Harvard Business School, where he teaches in both the regular MBA Program and the Advanced Management Program. His research area is formal planning for the development of computer-based information systems. He has coauthored a number of books, and consults with several major U.S. companies.

As computer applications have multiplied in size and complexity over the past decade, the task of managing a company's computer-based resources has become tough and intricate. To maintain good managerial control over this activity, companies are beginning to develop formal plans and formal planning methods for their computer-based information systems (CBIS's).

This development is well justified. Recent field work shows that companies that formally plan their CBIS's have more *effective* CBIS's than companies that do not. A recent study by McKinsey and Company demonstrates this; the pertinent data are given in the ruled insert on page 78.

Also, a recent study of my own fully corroborates this finding. My associates and I visited 15

companies that use CBIS's extensively and have a reputation for using them effectively. We interviewed key executives, other users, and EDP personnel in these companies (a) to determine firsthand how effective their systems are, and (b) to analyze the planning processes behind the systems. (See *Exhibit I*, page 76, and the ruled insert, page 77.)

By comparing each company's approach to CBIS planning with its effectiveness as a user of CBIS's, we have reached certain hard conclusions on what constitutes good planning practice in this area today. In this article I should like to sketch this kernel of good practice step by step. To do this, I shall proceed as follows:

◇ Discuss the pressures, both external and internal, that induce a company to plan formally.

(These pressures define the parameters of the planning process and of the formal, or written, plan itself.)

◊ Exhibit the elements of the planning process in a diagram showing how they ought to interact.

◊ Summarize my conclusions on the relations that ought to exist between a company's CBIS planning effort and its corporate planning.

◊ Next, briefly analyze the critical issue of centralization versus decentralization of divisional CBIS facilities within a company. (This issue bears heavily on organization and corporate planning.)

◊ Finally, present two examples of effective CBIS planning which, although they are widely different, serve to illustrate basic principles by both their strengths and weaknesses. (In a sense, these two examples define the range of possibilities of contemporary information systems planning.)

Of course, the *full* range of planning possibilities is still undefined because this field is very new and evolving fast. Only one company of those we examined had been planning its CBIS systematically for as long as four years.

In general, CBIS planning today is at roughly the same stage of development as corporate planning was in 1960. As a refinement and elaboration, CBIS has naturally lagged behind. The same interest and enthusiasm that attended corporate

planning a decade ago attends CBIS planning now, as well as a parallel confusion about how to approach the task.

Every company we visited had sweated with this confusion, and each had experienced enormous changes in its planning processes over the past three or four years. For example:

Three years ago, one multibillion-dollar company completely exhausted its thoughts about the future of its EDP activities in three pages of project names and weak documentations of schedules and costs.

Currently its formal plan is 150 pages long, and is substantively and qualitatively superior to the earlier one in every critical dimension. Its statements of goals and estimates of manpower and facilities needed two years hence are the result of intensive, detailed analysis, and, as such, are worthy of considerable attention.

This company has gone through a learning process that is paying off today in the remarkable effectiveness of its information systems.

Pressures to plan

Learning to plan is never easy, but the general conclusions we have drawn from the experience of the pioneering companies in our sample may make it easier to understand how to structure the CBIS planning process and to define the senior manager's role in it.

Let us first look at the pressures that make it so attractive—indeed, necessary—for a company to plan in this area.

Technical improvements

Because technological change in hardware and software occurs so rapidly, both company staff and consulting groups should hold regular, coordinated reviews of replacement and improvement options to identify significant shifts in cost/performance relationships and develop contingency plans to handle them. A planning system provides a focus for ensuring that this is done.

Also, the lead time for acquiring new equipment is often long, and, once acquired, a new piece of equipment must be thoroughly integrated with a company's existing configuration. This integration task is frequently so complex that integration procedures dictate the timing and sequence of acquisitions.

Together, lead time and integration considera-

Exhibit 1. Profile of companies studied

	Number of companies
Sales volume	
Under \$200 million	2
\$200 million to \$499 million	1
\$500 million to \$999 million	1
\$ billion to \$1.9 billion	9
\$2 billion and over	2
Number of EDP personnel	
Under 100	3
100-499	3
500-999	3
1,000 and over	6
Industry	
Government agency	3
Aerospace	2
Electronics	3
Paper	2
Insurance	1
Oil	2
Railroads	1
Utilities	1

What is 'effectiveness'?

The 15 companies in the study sample are a diverse group of heavy EDP equipment users. The size of their annual EDP manpower and hardware expenditures ranges from \$2 million to \$22 million; the size of their system and programming groups varies from 50 to more than 300 men. *Exhibit 1* describes other characteristics of these important users. In our interviews in each of these companies, we focused on the scope of its EDP applications, its current approach to planning, and the overall *effectiveness* of its EDP activity.

Measuring effectiveness of information systems in such a wide variety of contexts is a complex task, and necessarily is heavily subjective. Still, we tried to give objective recognition to the following factors:

The comparative quality of a company's applications in its own critical problem areas—In my view, an application is successful if it is demonstrably profitable, in money or intangible benefits.

The level of service and support furnished by the central computer staff—The best criterion for judging this is user satisfaction.

The innovativeness of the applications—The managerial excellence of a company's basic data flows and

management reporting systems is a much more reliable yardstick here than sheer technological sophistication (which might be reflected in extensive real-time system simulation, linear program modeling, etc.).

The competence of the company's professionals—A specialist is best evaluated by his experience, the depth of his background, and his potential for assuming key leadership positions in other, highly progressive organizations.

The tautness, efficiency, and reliability of the EDP operations.

For maximum effectiveness, then, a superior professional group would devise clever, straightforward, up-to-date applications for the areas in which a company needs them most, and keep the data flowing on schedule to the satisfaction of every user in the company.

On these dimensions, we found 10 of the 15 companies highly effective—of these, 9 engaged in serious CBIS planning. Of the 5 marginal ("somewhat effective") companies, 2 engaged in serious CBIS planning. These figures themselves demonstrate the correlation between planning and effectiveness.

tions demand that a company plan with an extended time horizon—four years, in one company studied.

At the present time, this particular company has seven decentralized, "stand alone" computer installations, all within a 100-mile radius. They are all medium-sized, and the company is using equipment from two computer vendors.

The company plans first to phase out the equipment of one vendor and then to install two large central processing units (CPU's) at existing locations 15 miles apart. The medium-sized equipment at the other five locations will be converted to remote terminals for batch processing. Once installed, the two new CPU's will be connected for multiprocessing, and, finally, a third large CPU will be added to the network within 50 miles of the other two.

Company management states that laying out this particular technical plan has dramatically increased the effectiveness of its developing applications and its short-term decisions on hardware acquisitions.

Volatile environment: As new products appear, as the laws change, as mergers and spinoffs take place, the priorities a company assigns to its various applications are likely to change as well.

Some low-priority or new applications may become critically important, while others previously thought vital may diminish in significance.

This volatility places a real premium on building a flexible framework within which such change can be managed in an orderly and consistent fashion. Hence recognizing it is vital to planning an effective CBIS.

In a similar vein, every information systems plan is built around very specific assumptions about the nature and rate of technological evolution. If this evolution occurs at a different rate from the one forecasted (as is often the case), then major segments of the plan may have to be reworked.

For example, if the present speed of access to a 10-million-character file were suddenly increased by one order of magnitude with no change in cost, most of the plans we have seen in use would have to be seriously revised, with dramatic reshufflings of priorities and applications structures. And such an increase is by no means farfetched.

Some executives choose to interpret this volatility as a pressure *against* planning. One installation manager stated that while his superiors required him to plan three years ahead, this single factor of technological uncertainty

McKinsey study on effective users

In 1968 McKinsey & Company conducted a study of the computer systems employed in 36 major companies. The sample was designed to cover a wide range of sizes and types of industry, as shown in Table A. McKinsey then ranked the companies on three criteria—measurable return on the computer investment, range of meaningful computer applications, and the CEO's assessment of the computer effort—and divided them into "more successful" and "less successful." The results are shown in Table B.

Table A. Breakdown of companies in the McKinsey study

	Number of companies
Sales volume	
Under \$200 million	6
\$200 million to \$499 million	5
\$500 million to \$999 million	10
\$1 billion to \$1.9 billion	9
\$2 billion and over	6
Computer outlay as a percent of sales	
Under 0.25%	7
0.25%-0.49%	7
0.50%-0.99%	14
1.0%-1.99%	7
2% and over	1
Industry	
Airlines	2
Apparel	1
Chemical	8
Feed	3
Forest products	1
Insurance	3
Machinery	6
Paper	1
Petroleum	3
Primary market	2
Railroads	1
Textiles	1
Transportation equipment	4

Table B. Ranking of the study companies

	More successful users	Less successful users
Companies that plan EDP activities and audit results against plan	9	3
Companies that plan EDP but do not audit results	7	3
Companies that neither plan EDP nor audit results	2	12

made it impossible for him to estimate realistically more than one year in advance. He said he goes through the long-range planning process as an elegant ritual that makes his superiors happy, without any personal conviction that his output is meaningful.

However, this narrow view of the effective time horizon for CBIS planning was certainly not common among the companies studied. The great majority of those interviewed feel that in this area it is now more effective to work from plans with multiple-year horizons, even though these plans must be revised unexpectedly from time to time, than to try to manage without them. They perceive a difference between revising from an established base and constantly improvising from scratch.

Manpower scarcity

The scarcity of trained, perceptive analysts and programmers, coupled with the long training cycles needed to make them fully effective, has been the chief factor restraining CBIS development in the companies we studied. To circumvent this restraint, planning is definitely necessary.

An excellent illustration of this appeared in a company whose main business is information systems of a specialized kind—its major product is financial services. The company's primary EDP applications, on which its whole product structure is highly dependent, are intricate financial programs requiring the largest available computers.

When I visited this company, a new, sophisticated set of financial services, deemed significant and potentially very profitable by the executive vice president, had recently been developed in rough outline form. Bringing these services on-stream meant extensive systems design and programming—so extensive that, after a careful review of existing EDP operations, management concluded that this new product could not be operational for 4½ years. Independent consultants subsequently confirmed this estimate.

This estimate assumed that the company would devote 4 of its best analyst-programmers to the job, plus 10 assistants. Assistants could not be spared from regular operations, however, and hence would have to be recruited from outside.

The main reason for such a long preparation was this: the complexity of creating the new

service package and the difficulty of consolidating it with existing applications was so great that a new assistant, even one with a strong financial background, would need to pass through a two-year training cycle before he could be fully effective on the project.

Management considered that even this relatively modest rate of recruitment would reduce departmental efficiency on necessary maintenance and developmental work, since senior analysts would have to spend more time than formerly on training and less on developmental work.

The company decided to proceed with the introduction of the new services, but, because of the hiring and training problem, the process is proving very painful and difficult. Planning it earlier would have made it easier. Planning it now, step by step, to make every move count, is smoothing the process somewhat. In general, the scarcity of critical manpower and the length of training cycles make formal planning in this field a virtual necessity.

Scarcity of corporate resources

Another critical factor that induces companies to plan is the limited availability of precious company resources, both financial and managerial.

CBIS development is merely one of many strategic investment opportunities for a company, and cash invested in it is often obtained only at the expense of other areas. In most of the companies surveyed the EDP budget is charged directly against earnings. Hence this is a matter of intense interest and a critical limiting factor for new projects in companies under profit or cost pressure.

One must also mention the scarcity of EDP managers available within any given company. Companies' inability to train sufficient project leaders and supervisors has significantly restrained CBIS development. As a result, companies have delayed implementing various valuable applications.

In one case, a company needed to install new systems for message switching, sales reporting, and production scheduling, all at the same time, while maintaining satisfactory service levels on other existing applications. This simply could not be managed with the company's thin group of skilled project leaders.

Together with the difficulty of hiring qualified people "off the street," the problem of juggling

these resource restrictions has stretched the necessary CBIS planning horizon to three or even five years in the companies studied.

Planning as resource drain: Even within the EDP area, of course, assigning a man to planning diverts dollars away from system and program development. The extent to which financial resources can be effectively and profitably diverted to planning is still very much a question.

For example, of the companies studied, the one with the heaviest commitment to planning has assigned only 1.5% to 2.0% of its total information service group to planning as a full-time activity. This may not be a sound yardstick, however, because a major part of its planning task is done by executives, project leaders, and analysts as part of their own general responsibilities; the company has made no attempt to estimate the total size of its aggregate planning effort.

Four organizations studied are quite concerned about the wisdom of establishing a planning group as such, regardless of the contribution it could make. As a highly visible overhead item, the group would be vulnerable to sharp budget cutbacks during periods of economic stress, and these companies realize that this effect would seriously compromise the quality of their CBIS planning. They feel the better strategy is to needle planning in as a component of many people's jobs, thus ensuring the continuity of the effort, albeit at some cost in reduced effectiveness.

Legitimate competitor for funds: In general, therefore, these companies are aware of the connection between formal CBIS planning and CBIS effectiveness, and such planning certainly is becoming a serious, legitimate competitor for budgeting funds and managerial personnel.

One company that has chosen to set up an independent planning department has recognized the difficulty and complexity of the task of managing CBIS planning by pulling together a full description of the planning manager's function. This is shown in *Exhibit II*. This manager's department consists of six full-time planners, and many of the company's other 880 analyst-programmers and EDP employees are actively involved in its work.

The reader will recognize many of the items in the manager's job description as parameters defined by the pressures to plan which I have been discussing. Before I go on to the details of

the written plans themselves, I should mention one additional pressure of great importance.

Trend to systems integration

Systems design is currently evolving in the direction of integrated arrays of program packages. Failure to recognize and plan for interdepen-

ency and coordination of different packages can lead to major reprogramming in the future or, worse still, to complete revision of a system that cannot accommodate new requirements.

To install a new personnel information system in one major utility, for example, six pieces of information had to be added to the employee's master record used in the payroll system

Exhibit II. Job description of a planning manager

POSITION TITLE: Manager of Divisional EDP Planning

REPORTS TO: Manager of Divisional EDP Department

WHO REPORTS TO: Controller

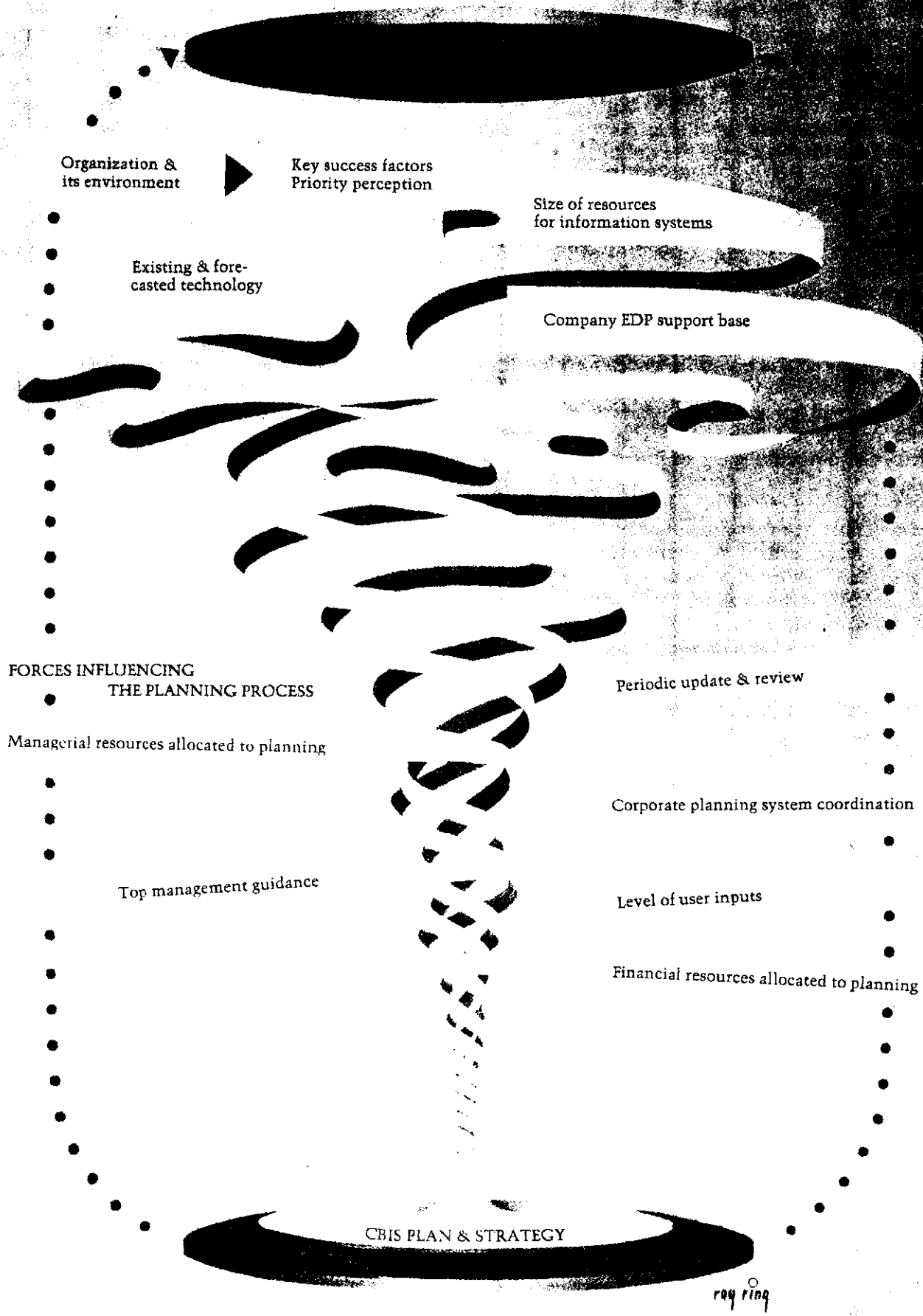
SUMMARY:

Develops and maintains a divisionwide, short-range operating plan and long-range strategic plan by which to optimize the return on the investment of resources in information processing systems. Provides planning guidance and direction to EDP division management to maintain consistency of EDP planning and implementation with the overall objectives of the division.

PRIMARY TASKS:

1. To develop and maintain, in consort with operations personnel, short- and long-range objectives and plans for systems to obtain maximum cost/effectiveness both in the EDP function and in the division facilities it services.
2. To help corporate planning management integrate EDP objectives and plans developed at the division into general corporate objectives; and to help corporate planning management optimize cost/effectiveness.
3. To see that resources allocated to the EDP function are adequate for maintaining a rate of technical progress that will enhance the division's competitive position.
4. To see that resources allocated to the EDP function are directed to objectives that will result in maximum return to the division.
5. To review all proposals and requisitions for consistency with established short- and long-range plans.
6. To develop planning techniques and documentation methods that minimize planning effort and maximize planning utility.
7. To review performance evaluations and identify the causes of differences between plans and achievement.
8. To revise plans as dictated by division information requirements.
9. To keep abreast of developments in information technology so objectives and plans of the division reflect the latest advances in the field.

Exhibit III. Information systems planning process



(among other places). The original system design was not structured to accommodate this type of change; consequently, 50 programs had to be patched, requiring 6 months of straight time and 2½ man-years of effort.

Because of the inordinate expense incurred in accommodating these changes, the company inaugurated a systematic effort to plan its CBIS two months later.

Exhibit III indicates the various factors that must be creatively consolidated in the planning process:

○ The evolving technology—the state of the art, forecasts of hardware and software improvements, and external computer utility resources.

○ The company's EDP resources—its CBIS support base and the resources associated with it.

○ The company as a working whole—its organizational structure, resources and capabilities outside the EDP area, its market opportunities, and its strategic planning.

The dynamic model in this exhibit is in some ways similar to that presented by Professor Zani in his recent article, "Blueprint for MIS."¹ However, Zani's point of view and my own differ in the following dimensions:

□ I stress the need for a formal, periodic planning process as the driving mechanism which ensures that a company's CBIS will evolve as a

viable entity. In a sense, Zani seems more concerned about covering all possible variables; I am more concerned with establishing an analytic process.

□ I stress the importance of scanning the technological environment to ensure that new concepts are identified, and, when appropriate, assimilated.

□ I distinguish sharply between CBIS planning and administration. When a company's CBIS plan and strategy have been formulated, as at the bottom of *Exhibit III*, the administrative function takes over to make them operational. This administrative implementation naturally augments the company's systems support base (shown at the top of the exhibit); but this administrative function is essentially distinct from the planning function because the two have essentially different missions.

The written plan

The most significant factors differentiating the companies that are effective CBIS users from those that are not are the quality and content of their written plans. An outline of overall plan contents taken from the actual documents appears in *Exhibit IV*, but it is important to dis-

1. HBR November-December 1970, p. 95.

Exhibit IV. The contents of a CBIS plan

A. Introduction

1. Summary of major goals, a statement of their consistency with corporate goals, and current state of planning vis-à-vis these goals.
2. Summary of aggregate cost and savings projections.
3. Summary of manpower requirements.
4. Major challenges and problems.
5. Criteria for assigning project priorities.

B. Project identification

1. Maintenance projects, all projects proposed, and development projects.
2. Estimated completion times.
3. Manpower requirements, by time period and job category.
4. Computer capacity needed for system testing and implementation.
5. Economic justification by project—development costs, implementation costs, running costs, out-of-pocket savings, intangible savings.
6. Project control tools.
7. Tie-ins with other systems and master plans.

C. Hardware projections (derived from projects)

1. Current applications—work loads and compilation and testing requirements.

2. New applications—work loads and reruns.

3. Survey of new hardware, with emphasis on design flexibility which will allow the company to take full advantage of new developments in hardware and in software.

4. Acquisition strategy, with timing contingencies.

5. Facilities requirements and growth, in hardware, tape storage, offices, and supplies.

D. Manpower projections (derived from projects)

1. Manpower needed by month for each category.

- a. General—management, administrative, training, and planning personnel.

- b. Developmental—application analysts, systems designers, methods and procedures personnel, operating system programmers, and other programmers.

- c. Operational—machine operators, key punchers/verifiers, and input/output control clerks.

2. Salary levels, training needs, and estimated turnover.

E. Financial projections by time period

1. Hardware rental, depreciation, maintenance, floor space, air conditioning, and electricity.

2. Manpower—training and fringe benefits.

3. Miscellaneous—building rental, outside service, telecommunications, and the like.

tinguish the following as the key features of the sound plan:

□ The sound plan defines a 2- to 4-year time horizon, with detail declining in the later years. Most of the effective plans specify considerable detail concerning project features, manpower needs, and hardware timing requirements for the first year and then grow more general in format for each succeeding year.

□ It embodies a series of detailed descriptions of specific projects. These descriptions include goals and economic analyses for the projects, the projects' aggregate manpower requirements by skills categories, its hardware time requirements for both program testing and ongoing operation], and gross project flow charts, accompanied by whatever volume of supporting material is necessary. This last is usually considerable.

□ It states a strategy for CBIS development and a broad conceptual scheme for the "final form" of the CBIS. These statements are invariably general in nature; they are loosely related to substantive action proposals and loosely coordinated with the other components of the plan.

There is considerable concern within the companies about the utility of this section of the plan. On many dimensions, executives feel that the overall plan is best conceived as a sophisticated project management system that ensures effective use of resources, and hence it may be best not to try to state final objectives in too detailed a form.

□ It develops a detailed exposition of future hardware and physical facility requirements. Specific pieces of equipment are identified, along with the optimum timing for their arrival, estimated usage rates, and so forth. These requirements have been systematically developed from existing work levels, new project plans, and specific assumptions concerning overall increases in activity. Software packages such as SCERT, which translates specific program descriptions into estimated running times and hardware requirements, are frequently used to assist in these analyses.²

□ It includes technology forecasts that name assumptions about the pace of change in EDP hardware and software and assess their impact on the company's information systems activity. The sophistication of these forecasts varies widely.

□ It also includes aggregate forecasts of future manpower and training levels, estimates of manpower requirements by job classification, em-

ployee turnover rates, and other like factors. These are derived from each specific project.

These key factors, once again, reflect the primary pressures to plan.

Naturally, the precise content, form, and quality of a company's CBIS plan are strongly molded by some additional factors, one of the most important of which is the quality of the company's corporate long-range planning. Top management participation and the planning structures used are also important.

Relation to corporate planning

We found a strong correlation between a company's ability to develop an effective CBIS planning process and the maturity and scope of its corporate planning process.

Four of the companies studied went so far as to postulate a formal relationship between the two planning activities, corporate and CBIS. The two activities are connected in the company budgets, of course, but the real relationship between them is far more meaningful than a mere formal budgetary connection would suggest. In fact, one company took its CBIS manager directly from its long-range planning department.

When this relationship is a strong one, it appears to contribute three concrete advantages:

1. The CBIS group is made explicitly aware of overall company objectives. This helps it develop priorities realistically.

2. In the reverse direction, a strong relationship helps executives in other areas to know and understand the goals and targets of the CBIS group. (Incidentally, this wider publicity and exposure enhance the commitment of EDP personnel at all levels to their work.)

3. Perhaps most important, the corporate planning group's expertise can be transferred to the CBIS planning and administrative groups.

These advantages can help to combat a very real communication problem. In one organization, for example—a large, successful bank—no one in the corporate planning department had ever spoken to, or even knew the name of, anybody in the CBIS group. The problems of planning are generic, to some extent, and it is a pity to isolate CBIS planning groups from experienced corporate planners if these are available.

Where no planning expertise is available, on the other hand, the company that is contemplating a CBIS should beware. The controller of one

company I visited was particularly proud of his new budget system, the company's first in the 110 years of its existence. The company employed 50 analysts and programmers in its ordinary applications; but, not too surprisingly, its written plan consisted only of 3 pages of project titles. The EDP manager discoursed at great length on his company's CBIS plan for the future, but, while his verbal virtuosity impressed me, I could not help wondering if any vestige of the planning document would survive the next couple of months.

It seemed to me that this management was expecting too much from too little too soon. Developing a formal CBIS plan is a slow process; a company benefits from a secure base of planning skills and attitudes in the organization.

Relation to top management

Like corporate planning itself, CBIS planning stands a better chance of getting off the ground if the chief executive backs it personally. Also, the closer information systems activity is to the CEO, the more emphasis is placed on planning it formally.

Those organizations in which two or more layers of management lay between the CBIS department and the CEO ranked lower in effectiveness and planning ability. In this respect our findings are consistent with Neal J. Dean's.³

Structures used for CBIS planning

Of the 15 companies studied, 9 use a well-defined, formal planning structure to write and update their plans annually. This structure for creating and revising plans is laid out either as a series of operating procedures or as a corpus of job descriptions, or both.

There is, of course, wide variation among these nine companies, with respect to the specific methods used to develop plans and decide what personnel shall be involved at each stage of plan development. One large organization has gone so far as to print a 250-page manual that details the working procedures, reporting formats, and groups participating at each stage—committees, dates, printout formats, and the like are all well defined.

In another organization, judged equally effective as a user of CBIS, the EDP manager prepares the annual plan, consulting with a steering committee and with users throughout the company

as he thinks necessary. This organization is small in size, and the manager has a genuine user orientation and excellent communication skills; so this informal procedure is entirely workable.

But in all nine cases, in addition to existing formal structures for planning, the companies have installed special informal procedures—safety valves, really—to accommodate unusual needs or circumstances arising during the year. Overall, the structures are characterized by flexibility and responsiveness, their primary function being to provide a framework for managing change, rather than to create ironclad documents to be administered regardless of consequences.

I shall have more to say about structures and their flexibility and responsiveness as these are reflected in two examples of CBIS planning. Before presenting these examples, however, I wish to discuss the critical issue of centralized versus decentralized planning of companywide CBIS. An understanding of this issue will help the reader to appreciate the examples.

Centralized planning

In the companies in the sample, planning tends to be done on a decentralized basis around local computer centers or islands of automation. Companywide coordination between different centers is generally very weak, except when there is only one major computer center in the organization; this is particularly true when there is any significant geographic separation between computer centers within a company.

For example, in one electric equipment manufacturing company with \$500 million in sales and 16 divisions, there is a very strong tradition of centralized financial control. All divisions use the same chart of accounts and standard procedures manual, and these materials can be altered only on direct instruction from corporate headquarters.

But, at the same time, IBM 360/25's and 30's and 40's are scattered through the divisions, and the EDP managers of the various divisions have little (if any) contact with one another. During my group's research, for example, it was discovered that no less than six of these installations were currently working to develop the same production scheduling applications. Parallel design teams in competition often produce a better result than an individual team, but with six groups competing, the company had obviously reached the point of diminishing returns. Some

3. "The Computer Comes of Age," HBR January-February 1968, p. 83.

centralized coordination was obviously required.

Another large company has three EDP installations, each budgeted in excess of \$10 million. The only formal communication and coordination between these installations is a really quite informal two-day meeting of eight to ten of the installation managers every three months. The key topics discussed in these meetings are:

- Salary and wage guidelines.
- Projects to develop classification standards for operators, programmers, and analysts.
- Joint purchase contracts and standards for items such as tapes and discs, for which economies of scale are obviously available.
- Systems to measure computer-room performance more accurately.
- Procedures for sharing reports on the failure rates of machine components.
- Limited joint development of program packages. (Development of operating systems was felt to be a particularly appropriate topic for discussion.)
- Company hardware capabilities and personnel capabilities for specific studies.
- Evolving hardware technology and its implications.

Other companies in the survey also focused primarily on these topics, which, as a group, surely represent the bare minimum for planning CBIS administration and growth. They cover some basic operations, but do not touch the "big picture" at all.

In general, I sense, the companies realize this. More than half strongly expressed the sentiment that much more centralization of CBIS planning is desirable.

Attractiveness of multiprocessing

In part, this desire for centralization is a consequence of companies' growing awareness of the new multiprogramming and multiprocessing environment, in which it is eminently feasible to connect a large central computer via telephone lines to remote batch-processing facilities. Many companies now have several medium-sized computers at discrete locations. The idea of turning them in for a central-control computer facility is becoming more and more attractive, for the following reasons:

- ◇ Large-machine economies mean more computation per dollar expended.
- ◇ Software development can be coordinated to serve several installations.

◇ Hardware-software planning and development can be more sophisticated.

◇ Integrating the data files from many discrete locations into a single file structure makes more data available for companywide use.

◇ There is a critical mass of programming and development activity that a company must reach before it can attract truly competent analysts. Large-machine installations are much more likely to achieve this critical mass than small or medium-sized installations.

Such arguments apply more readily to companies having several small, geographically proximate installations than to companies having two or three massive installations in which economies of scale have already been achieved.

Some companies, however, even among those for which multiprocessing should be attractive, are resisting the trend toward centralization, apparently because they either fear the task of managing a very large installation or are concerned that a centralized system will not be responsive to local needs. Companies that fear decreased responsiveness argue that poor communications with local management might warp application priorities and structures.

Thus, when to centralize and how rapidly to centralize are points that are far from clear. (They are now the subject of ongoing research.) For example, economies of scale are extremely complex to calculate when a company contemplates consolidating two installations, each with a budget in excess of \$15 million.

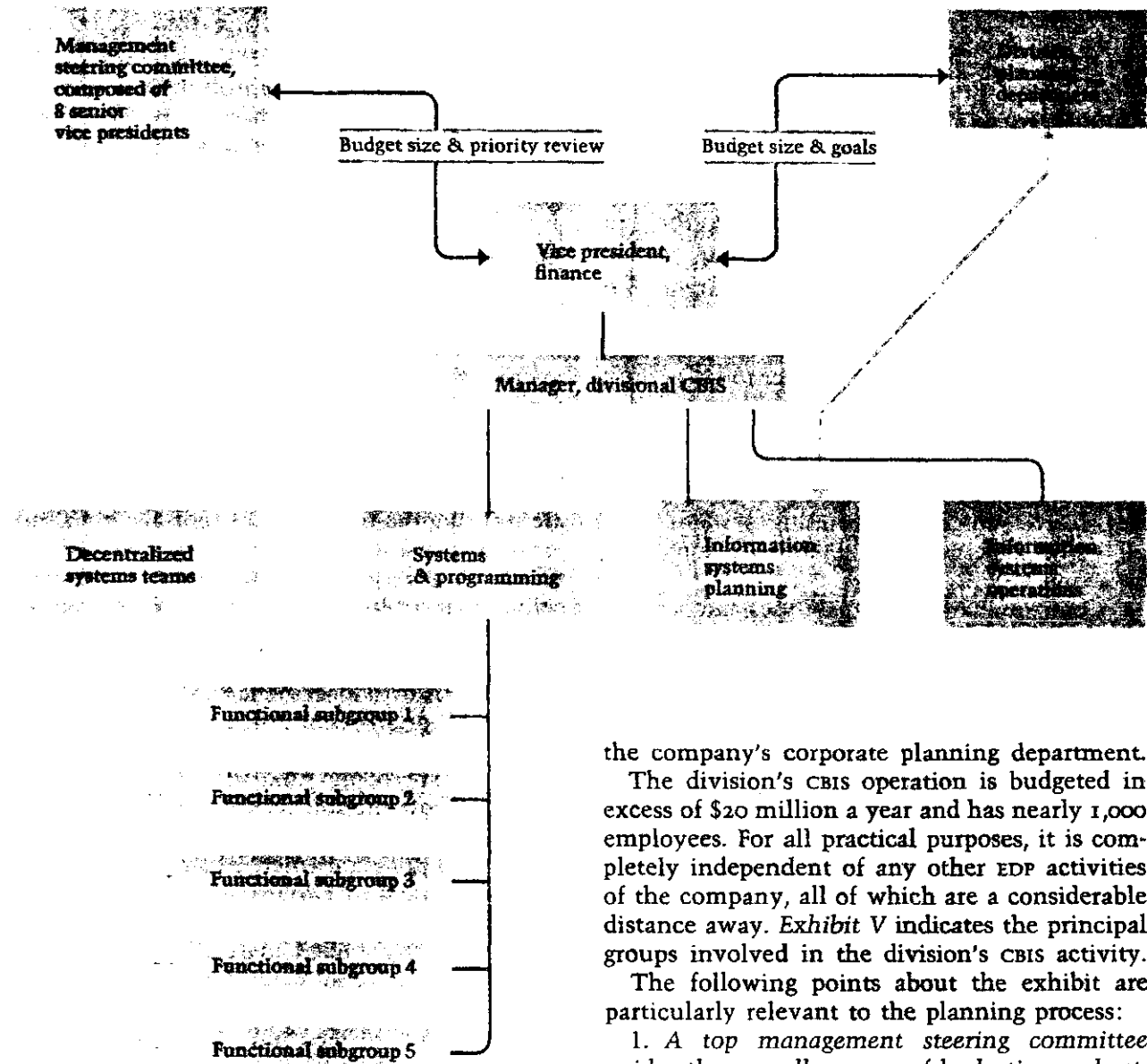
One company studied, in exactly this position, decided *not* to consolidate, describing the situation as one in which a reverse critical mass would be created—i.e., one that would create more disadvantages than advantages. On the other hand, other companies in closely similar situations have decided to proceed with consolidation, and have been glad they did so.

More work and research in the area may produce guidelines on when and how fast to centralize, but we found overwhelming evidence that companies are tending toward consolidation. This trend increases the need for, and the payoffs from, central CBIS planning.

Two companies' methods

To draw the foregoing analysis together and give the reader some feeling for the diversity of approaches a company can take to integrate the

Exhibit V. Framework of CBIS activity in a major aerospace company



the company's corporate planning department.

The division's CBIS operation is budgeted in excess of \$20 million a year and has nearly 1,000 employees. For all practical purposes, it is completely independent of any other EDP activities of the company, all of which are a considerable distance away. *Exhibit V* indicates the principal groups involved in the division's CBIS activity.

The following points about the exhibit are particularly relevant to the planning process:

1. A top management steering committee guides the overall process of budgeting and setting priorities.

Composed of eight vice presidents, this steering committee meets once a month to review progress and priorities. It continually faces the job of making broad policy for a very technical area, the underlying complexities of which are largely foreign to its members. Installed by the company, abandoned as unworkable, and then reinstated because of a sharp disruption in communication, this group serves primarily as a safety valve for pressures of extreme dissatisfaction from divisional users.

The same basic feature is present in 12 of the 15 companies studied; it ensures the participation of and guidance from the top.

2. "Decentralized systems teams" link the vice

process of CBIS planning with its other operations, I present two case examples: one, a division of a major aerospace company, and the other, an international manufacturer of electrical and mechanical equipment. Both have sales in excess of \$2 billion annually.

In aerospace

This company division has been active in CBIS planning for four years. With respect to this relatively long planning history, it is significant that the division's information systems manager spent a large part of his early career working in

presidential steering committee with the functional subgroups.

This is the key organizational mechanism in this division, so far as CBIS planning and administration are concerned. The EDP department is not laid out to correspond with its array of activities and systems. Rather, over one third of the division's analysts are on the staffs of the eight vice presidents and report directly to them, instead of reporting to the information systems manager. These staff members work both on special projects of particular interest to the vice presidents and on regular projects, where they join with departmental information systems analysts to form the so-called decentralized systems teams.

As members of these teams, their role is to communicate the peculiar needs and requirements of regular projects to the vice presidential level, and to assure the vice presidents that the system designs created for these regular projects are adequate.

A small fraction of the decentralized team members have come originally from the information systems department. The great majority, however, have been either hired directly into the functional department to fill this special role or transferred from some non-EDP position within the division and then trained. Division personnel judge this to be an extremely effective arrangement.

3. *The existence of an information systems planning department.*

This department of five people is directly responsible for coordinating and implementing the process of formal planning. The job description of the manager of this department is the one given in *Exhibit III*; that exhibit provides insight into the scope of his responsibilities and the vital task of the group—to ensure that the planning process is carried out in a timely and apt fashion.

4. *The influence of a strong bottom-up planning process.*

CBIS planning begins in the five subgroups of the systems and programming area. Working alone, or in conjunction with the analysts from the various vice presidential staffs and with user-managers, as they see fit, the members of these five subgroups have the basic responsibility for putting together a two-year plan.

They then forward these plans to the information systems planning department, which coordinates them and begins to integrate them, matching costs against available budget dollars.

The manager of divisional CBIS and the vice president for finance participate in this process.

Within the divisional CBIS framework, there are three main issues to be resolved. The first is the degree of involvement vice presidents should undertake and how they can provide meaningful guidance to the CBIS activities as they evolve. By the time the consolidated plan is passed up to them through the levels, all the basic decisions have been made, in a very real sense, and it is most difficult for them to reverse this momentum and make substantive changes. As the company uses this framework, then, the real challenge is to find means to bring the vice presidents into the planning process in a meaningful way, given the enormous time pressures under which these men labor.

Second, the planning horizon currently being used is under fire. At present the period is two years, and in the startup stages of planning (which are still in the recent past) this relatively close horizon made sense because it cut the planning job down to manageable proportions. But today the company can handle a more extended horizon, and there is considerable pressure to extend it by one year. It takes about 4½ years for this company to develop a new aircraft, and both the steering committee and the EDP department realize the desirability of extending the planning horizon toward this ideal limit.

Third, the divisional CBIS activity is isolated from similar activity elsewhere in the company. There is only limited coordination with the other company EDP centers, and it is possible that opportunities are being lost through not sharing hardware-software expertise and not working out joint applications.

On balance, however, this department provides an example of a highly organized, comprehensively planned organism built around a major computer installation.

In international manufacturing

A quite different picture is presented by a major international manufacturing company.

Operating in over 60 countries, with the equipment of 6 different computer manufacturers, the company has an annual hardware rental bill which runs to nearly \$100 million. More than 95% of this is spent in its 40 largest installations.

Until two years before our research project, these installations developed largely indepen-

dently of one another. Concerned with rising aggregate costs of the company's CBIS activities, top management founded a control group, staffed from corporate headquarters, that was split 50-50 between personnel with user orientations and personnel with technical strengths. This group's role is currently threefold.

First, the group must approve acquisition of any hardware renting for more than \$2,000 per month. When such an acquisition is contemplated, a feasibility study must be prepared and submitted to this group, which then draws on its knowledge of the hardware at other company installations and evaluates the economic justification presented in the study to make its decision. The company feels that this mechanism has significantly improved its technical decisions by bringing a quality of expertise to bear on them that was simply not possible before.

Second, and more to the point of this article, the group has installed, and now monitors, a formal planning system. Each division is required to submit a two-year CBIS plan to headquarters under the signature of the vice president in charge of the division. This procedure forces senior division management to review plans in detail, a fact that has produced startling results in several instances.

In one case, when division CBIS management presented its proposed plan to senior division management, the vice president made the startling discovery, about 15 minutes into the presentation, that the document, which represented one man-year's worth of work, had been prepared under a completely different set of assumptions about division goals from those contained in the division's strategic plan. Needless to say, it was resoundingly rejected, and there ensued a period of considerably closer relations between the headquarters control group and the division CBIS management.

As of now the group has developed standard procedures specifying plan format and contents to guide the individual division in preparing its plan. This guidance will hopefully improve the overall quality of the different divisions' efforts, which has varied widely in the past.

Third, the group visits at least once a year with the manager of each division's CBIS operation, either at corporate headquarters or at the division's offices. This helps extend the already strong informal contacts of the headquarters group with the individual installations, and enables it to monitor continually for opportunities for joint efforts between different installations.

This particular corporation does not have a geographical "home base" hardware facility to build on because its applications are diffused worldwide. Hence, in the foreseeable future it is unlikely to find physical consolidation an appropriate goal.

Rather, the company has found it effective to develop a planning and control structure that rations scarce technical expertise in hardware in a particularly efficient fashion, facilitates communication about EDP operations and goals between its far-flung divisions, and coordinates these divisions' EDP activities.

These two examples show that the nature of the CBIS plan and the structure that creates it must be tailored to company needs. The items covered by a CBIS plan are relatively constant, since the pressures to plan are relatively omnipresent, but they can and must be dealt with in a fashion that meets specific company operating requirements. The range of possible planning structures is clearly very great.

Key issues for the future

Information systems planning is still in an early stage of development in most organizations, and numerous critical issues must still be clarified—especially the following.

1. What are the comparative benefits of the top-down and bottom-up approaches to planning?

The effective organizations studied to date have been primarily oriented to the bottom-up approach. With this approach, different interest groups, both inside and outside the EDP department, lobby for specific projects. As these groups and their projects achieve formal recognition from above, they are assigned priorities and receive more or less formal supervision to ensure optimum resource utilization.

The main difficulty of the bottom-up approach is that top management does not actively participate in structuring the projects themselves or the general plan that grows out of them. Thus the real challenge in this area appears to be how to channel top management guidance into the planning process right from the start.

2. What level of detail can be meaningfully incorporated in plan formation?

The more complex plans now include flow charts and time estimates for computer runs

(made via SCERT or similar packages). But for no significant projects are there comfortable guides either for assessing the appropriate level of detail for current-year plans or deciding how rapidly this level should decline for ensuing years.

3. What should the time horizon of a sound plan be?

The effective companies believe it is appropriate to prepare detailed plans for one to two years, with additional statements for two to six years that encompass general goals, objectives, manning levels, and hardware strategy. Still, in all cases there is uncertainty concerning the appropriateness of these horizons and a desire to re-think them. Executives stated that a short horizon had been used to reduce the setup work required to develop an adequate initial plan, and

that they intend to place more emphasis on the long-range aspects in the future.

4. How should a company scan for outside EDP services?

Service organizations offer specialized data bases, statistical services, time-sharing services, and special program packages. Traditionally, coordination between company CBIS's and outside service has been minimal; flexible integration of the two may become a watchword in the future.

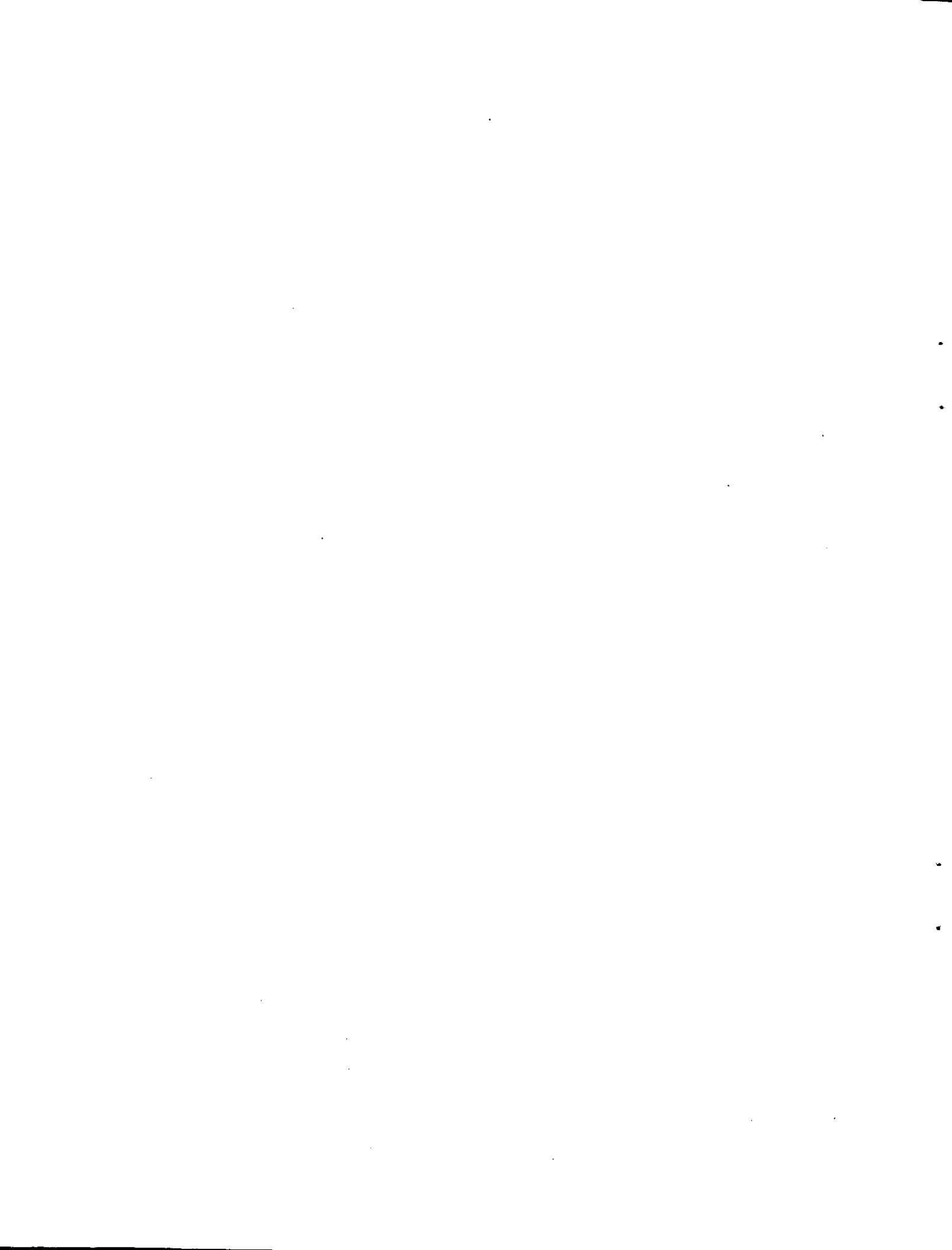
Additionally, the two companies studied that included outside services in their information systems planning feel that they thereby stimulated a broad, thorough review of such activities and the potential benefits which they might contribute, and that this review was in itself a great benefit.

Leadership and delegation

David E. Lilienthal,
The Road to Change, 1955-1959,
Vol. IV of *The Journals,*
New York, Harper & Row, Publishers,
1969, p. 225. © 1969 by David E.
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I'm simply not cut out to rely wholly on staff. I *had* to, in the AEC, because I was keeping the political wolves at bay, or having to fight, all over the country, for the principle of sensible secrecy, and had so little time for detailed understanding of our operating problem. In the TVA I was happiest when I ran the power program in the early years, even including rate design and policy and negotiations with [Wendell] Wilkie, *et al.* When the organization "matured," then I did delegate these things to staff. But, as a consequence, I began to be bored as hell and used my excess energies in writing my TVA book, or promoting inter-regional freight rate reform. These were real contributions to the TVA idea. But if I hadn't first been saturated in the *operating facts* of the Valley and of my job I couldn't have later provided TVA with more generalized leadership.

The executive who over-delegates the "details" (as they are usually dubbed) usually becomes little more than a figurehead.



Managing the costs of information

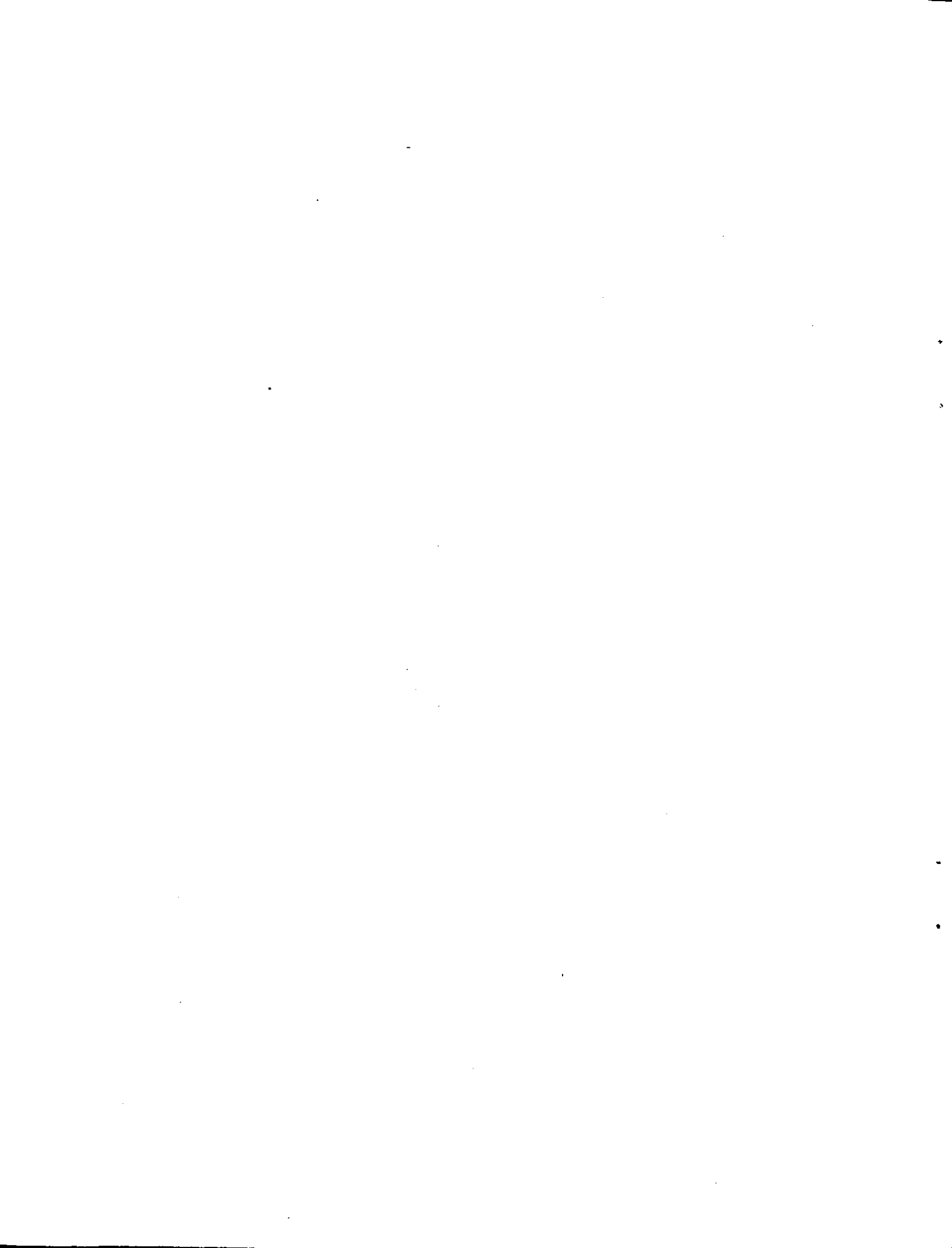
Paul A. Strassmann

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Managing the costs of information

*The data manager's job
goes far beyond the computer—
to management of all
its information resources*

Paul A. Strassmann

As organizations begin to harness the full power of information technology, the framework for analyzing information systems requires broadening. To make any sense of further computerization, all labor costs surrounding the computer—at both the input and the output end—must be accounted for. By means of nine steps toward total management of information resources for greater productivity, the author offers help to information managers seeking trade-offs among office automation, office labor, and office performance.

Mr. Strassmann is with the Xerox Corporation and was formerly the director of its Information Services Division. Currently he has worldwide staff responsibility for all of Xerox's administration and information systems.

*Drawing by
Robert Pryor.*

Industries and governments all over the world are currently struggling to contain rising administrative and clerical overheads by automating information handling in the office. In the past 20 years, white-collar labor has been the fastest growing component of the work force in every industrialized country. Yet this labor segment consistently shows lower increases in productivity than such blue-collar employment sectors as farming, manufacturing, and mining, where the management of capital versus labor investments is much better understood.

If bureaucracy (in the most benign sense of the word) is indeed the premier growth industry of the foreseeable future, then the dollars spent on white-collar automation must assume prime importance, particularly for the top information-systems executive in an organization. My purpose here is to show that managing information systems now goes far beyond just managing computers and to suggest a series of steps for managing this enlarged function effectively.

Information processing in today's large, complex organization really encompasses three sectors. The first is the by now well-understood and well-defined data processing sector. Aside from the costs of computers, terminals, and peripherals, this sector includes expenses for such things as computer services, time sharing, data processing supplies, data communication, programming support, operating labor, and consulting. It has been estimated that, in 1973, organizations in the United States spent about \$26 billion in this area of information processing.

Now the problem is that all too many of today's information processing executives define their jobs

largely within the context of data processing—they focus their energies on integrating the explosive data processing technologies into their organizations. This task has not been easy, but overemphasis on it has led managers into the trap of ignoring a second major sector of information processing, which for lack of a better term I call “administrative processing”—a sector on which an estimated \$42 billion was spent in the United States in 1973.

This sector is rarely aggregated under a single expense heading, yet it accounts for the largest and most frequently used set of tools and facilities for handling information transactions. It includes everything from typewriters, word processors, and dictating equipment to telephone and Telex networks, recording devices, copiers and duplicators, facsimile-transmission devices, microfilm equipment, and even such relatively mundane necessities as office supplies, mail, and simple filing systems.

These administrative tools are quite diverse and often isolated from one another, so that the expense involved in their use tends to become highly diffused. Historically, little trade-off has been possible among such individual office “technologies.”

Indeed, only rarely is an organization dedicated to the vital task of integrating these noncomputer aspects of information handling. But it is precisely here that the fastest expense growth is occurring in today's office environment; competition across several new administrative processing technologies is already here. This means that if we are to control rising expenditures for white-collar automation, careful expense accounting for these technologies must come under the rubric of information systems management.

The third sector of expense that should fall within the purview of the modern information systems manager involves people. After all, neither data processing nor administrative processing is an end in itself. The payoff from all sorts of office devices and facilities, from computers to mail rooms, lies in increasing the productivity of office labor—secretaries and typists, switchboard operators and clerks, administrative personnel and people who process applications, claims, orders, and inquiries of all sorts—that host of office employees classified as nonmanagerial and nonprofessional.

What makes the office labor sector so important for information systems people is the fact that it is the

largest single occupational category—approximately 22%—in the U.S. labor force. What's more, in 1973 the total annual expense associated with such personnel, including benefits, pensions, office space, and other allocated overhead, has been estimated at about \$350 billion.

The work that these people do, while vital to our organizations, represents almost entirely an overhead burden—and a fast growing one, too. From 1950 to 1970, the proportion of employees in these “overhead” categories as a percentage of the total U.S. labor force grew by more than 6%, while those in categories representing “direct” labor in areas of high productivity (for example, farming and manufacturing) decreased their share by more than 9%. Thus office labor represents a rich source of cost saving indeed for the information systems manager. If the myriad information transactions that this segment of our work force performs can be systematized and made efficient through modern information-handling techniques, the financial benefits will be great.

To accomplish this, we must abandon the traditional practice of managing excessive overhead labor growth by periodic pruning. Data processing, administrative processing, and the work that office labor does have become too intertwined and interdependent for the one-shot surgical approach to work anymore. Rather, we will have to design self-adaptive cost-control methods into each organization's systems and procedures. We must learn how to install advanced office automation techniques that will safeguard productivity improvements as conditions change.

In the face of uncertainties about the future volume of information transactions, the relative importance of various cost elements, rapid changes in technology, and shifting attitudes toward office automation by labor and government, we must harness the power of information technology through a more responsive control mechanism. Let us explore briefly the objectives of such a mechanism and then move on to the action I recommend to achieve it.

Once we accept the notion that the top information executive's job encompasses much more than managing data processing expense, we still have to articulate, in terms of precise objectives, just what the job calls for in today's business environment. In my view, the new job definition would include the following objectives:



□ Ensuring the integration of data processing, administrative processing, and office labor productivity programs.

□ Instituting accounting, cost-control, and budgeting innovations that will subject *all* information systems overhead activities to the disciplines traditionally applied to direct labor.

□ Subjecting office labor automation programs to analyses comparable to those applied to all other forms of capital investment.

□ Conceiving organizational designs that will permit information to be handled as a readily accessible and easily priced commodity rather than as a bureaucratic possession.

□ Creating within the organization an internal market for alternative information systems products, so that trade-off decisions, even technologically complex ones, can be decentralized into the hands of local user management.

□ Fostering a technique of pricing that will allow decisions on introducing new technology, or abandoning obsolete technology, to be made on a decentralized basis.

□ Installing and monitoring measurement methods that will protect improvements in productivity achieved by automation programs.

These objectives are far from easy to achieve. However, from experience with information systems in several large organizations, I have developed a set of nine guidelines, or steps, that have proved helpful in my work. They have been sufficiently tested to make me feel quite confident in offering them here as a practical route for any organization to follow in an effort to control its own information systems programs.

I should emphasize, however, that all of them may not be valid, or even acceptable, in every organization, for they do involve some major restructuring. Nor can they all be instituted quickly. Changing a whole organization's perspective on information systems management to the broader view I have set out here must be a gradual process. Thus the steps outlined in the balance of this article constitute a rough road map to guide an organization toward the total management of its information resources.

Managing costs

The sequence should start with the budgeting process. It must identify all of the components of information processing cost and segment them by (1) *function*, for example, the total cost of performing the billing function, from order entry until receivables are reconciled, (2) *technology*, for example, what portion of the billing cost is done clerically and what portion by computer, and (3) *organization*, for example, what the various billing systems of one organization are.

Step 1: identify costs

Identifying computer and telecommunication costs is relatively easy. The tough part begins in identifying budget elements of corresponding administrative processing and office labor cost. Classifying expenses and people can be difficult, since organizational boundaries do not translate readily into functional or technological definitions. This step will probably require major modifications in the organization's job classification scheme, so that job categories for white-collar personnel become more detailed and comparable job functions become consistent across organizational lines.

In addition to this internally oriented, personnel cost analysis, careful attention must be paid to external purchases of services and technology. Because the budgeting process focuses on expense levels or a particular organizational element, costs incurred outside do not readily surface when an attempt is made at a functional profile of costs.

For instance, in arriving at the total cost of the billing function, you need to make sure that the costs of mail and banking services are included. The overall billing expense should include investment costs as well as new systems-programming or minicomputer-development expenses that are to be amortized over a period of years. Since for accounting purposes most information systems costs are now expensed rather than capitalized, it is important that your cost identification process discriminate between these different classes of costs.

Finally, a word of caution: step 1 is not an easy, one-shot effort. Depending on the size and complexity of the organization, it may take up to five years of

continual changes in the budgeting process before consistent data are obtained. The new cost identification scheme must become the accepted way of looking at the cost structure of *all* information activities. And this takes time.

Step 2: keep score on unit costs

Knowing what each information transaction costs is critically important for all that is to follow. It is the only way to monitor productivity trends independent of changes in volume, work element mix, and inflation.

After wrestling for years with the problem of getting comparable data on the consequences of computer automation, I have concluded that, to really control administrative costs, one must begin by tracking "real," deflated unit costs for discrete output end products. By these, I mean items like cost per service call, cost per payment, cost per purchase order, cost per printed page, and cost per inquiry. Only by keeping score over a number of years on such consistently defined unit output measures is it possible to observe real improvements in cost performance.

In unit costing, it is important to define the measurements in sufficient detail that assigning responsibility for them at the working level is easy. Defining a measurement too broadly forces excessively high aggregations such as one finds in divisional overhead-burden ratios, where little can be done to trace the consequences of specific productivity improvement programs.

Also, be sure to include total unit costs for each unit output measure you choose. For instance, the cost of management overhead, employee benefits, and capital must flow into unit transaction costs before you can make valid comparisons between various means of improving productivity through office automation.

In describing these first two steps, I am considering information processing services as an *industrial process* rather than as an undifferentiated overhead. This is quite deliberate, for in my experience it leads to a much better understanding of how costs can be controlled in this rather amorphous and "messy" domain.

Step 3: establish standard costing

Setting a standard cost for each element of measured information output is essential for several reasons.

First, when cost reductions are planned, they must be locked into the planning and budgeting system by means of standards against which operating management can be measured. All too often, existing charge-out or full-cost-absorption costing systems disguise cause-and-effect relationships in expensive information processing activities and make it practically impossible to look at period variances from planned expense levels in a way that keeps management accountable for results.

Second, standard costing for information services is essential for making long-term commitments to users. If they have a predictable cost picture, users can feel more confident in making new investments and in decentralizing systems investment decisions.

A third reason for standard costing is its ability to reflect variability, so that the organization supplying information services can no longer cite "fixed costs" or "undisplaceable overhead commitments" as excuses for not achieving productivity improvements.

The basic tool for achieving standard costing is a job process sheet containing the cost profile for every resource used to create an output transaction. Each job step is costed out just as if it were part of a manufacturing assembly operation. The job process sheet should focus on all pertinent costs, such as those for handling, editing, output preparation, mailing, and reproduction or storage. In this way, analysts searching for cost reductions can do a thorough evaluation of the thousands of discrete activities that make up the total information processing budget.

In a well-run operation, such improvements do not come easily; saving a penny here or a nickel there is typical of most paper-work activities. This situation means that the basic tool—the job process sheet—must be designed with sufficient detail to permit an ongoing review of operating costs for every information transaction involved.

Aside from making it easier to track operating costs and thus to highlight opportunities for savings, the most important consequence of standard costing is that it changes the attitudes of managers supplying central information services. Standard costing also tends to shift the staff and planning people to the working levels of the organization, where they are

closer to being a part of direct product cost. Also, such managers become more wary of commitments to fixed technology costs.

The reasons for both of these attitudinal changes lie in the imperatives of standard costing—that indirect overhead be kept small and that technology costs be responsive to changes in volume or to obsolescence in methods.

The experience with standard costing at Xerox has so far been good. We now operate over 40 internal information services groups that derive a large part or all of their revenues from standard revenue per unit of output. As a minimum, each of these groups must liquidate its entire cost structure, including all overheads and management charges, from a changing revenue mix. The overall result has been a sharpening of the ability of managers to respond to a changing information systems environment, while maintaining good accountability for cost performance.

Organizing functions

The action steps discussed so far—identifying costs, tracking unit costs, and establishing standard costs—are all procedural aspects of information systems control. To be effective, they need an organizational focus. Cost-accountability centers, in which people engaged in functional office activities are assigned to product-oriented units, will provide this.

Step 4: set up accountability centers

The rationale for this approach stems from the recent tendency in business, industry, and government to centralize information processing functions. Centralization, so goes the argument, puts the information processing specialist under one umbrella, consolidates the technology, and concentrates expert management—all this in the guise of "economies of scale."

But the real problem occurs after centralization takes place. Simply put, it is this: How do you manage large agglomerations of clerical and administrative people without sacrificing the attributes that make them effective in their local environments? For in-

stance, how do you justify taking personal secretaries away from individual managers and grouping them into better equipped word-processing centers without losing in motivation what you gain from computerized text-editing typewriters?

The answer seems to lie in finding an organizational compromise between centralized efficiency and decentralized effectiveness of people. At Xerox, we have achieved this middle ground by creating small teams—sometimes as few as 10 people but never more than 30 to 80—to handle well-defined information-output tasks.

For example, our manager of the payroll processing center has complete control over his product, which is payroll checks and payroll-related reports. He is, in effect, an entrepreneur in the payroll processing business. He is responsible for his cost reductions per payroll check—weighed against error rates, document turnaround time, cash management, and so on. He sees himself, in turn, as being in a highly competitive payroll business, in which he must not only optimize his total resources but also aggressively seek opportunities for providing new and better services.

More important, we encourage this manager to make trade-off decisions among a variety of resource deployment choices that are available for improving his overall financial results. Thus he may trade off such options as training investments versus salary levels, information investments versus manpower expense, teleprocessing cost versus data processing expense, and in-house service versus external procurement.

In my view, the true test of "decentralization" is not an organizational one; rather, it is whether a manager responsible for an end product has the freedom to make trade-offs like those just cited in getting the job done. In such an environment, it is then possible to charter data processing or administrative processing activities without getting bogged down in organizational definitions. Output becomes the proper focus. When information processing functions become the accountability centers, they are in effect little businesses, buying and selling goods and services as needed.

For instance, our payroll processing center (to use the same example) "buys" batch-processing and time-sharing from our "centralized" computer service units, and "sells" the reports and analyses that are by-products of its payroll work to decentralized

personnel departments within the company. Although people in computers and personnel may regard the payroll processing center as a centralized function, it operates in the independent, decentralized way I have described.

In short, one person's centralization becomes another's decentralization. The labels become meaningless after a while. In the end, it is accountability for the cost of information processed that matters.

Step 5: apply competitive pricing

In information processing operations, it is not easy to establish standard costs and create accountability centers. There are two reasons for this: technologies can change radically, and the costs of computerization are hard to set realistically. Let me explain briefly what I mean.

When a new technology such as data base management software or time-sharing appears, the cost of converting to it, learning how to use it, and getting "customers" to employ it will make it appear non-competitive with established methods. Thus the manager of an information processing operation may be reluctant to try the new technology. In contrast, obsolescent technologies always appear more attractive in the short run, since they are well established and it does not really cost much to add to the bag of tools already being used.

Comparing the cost of computerization with the cost of the human wages that will be displaced is also a very tricky business. Manpower is always valued at the going "market" rate for salaries plus benefits, whereas the cost of computerization varies according to the company's cost-accounting practices in allocating the initial introduction cost.

The up-front cost of buying a computer is usually written off separately, with the result that the price of computer time—at "marginal cost"—is almost always substantially lower than the market price offered by commercial service bureaus. We then have the incongruous situation that, when labor and machines compete, labor savings are valued at market price, whereas computer time is costed at a heavily subsidized level. It thus becomes impossible to compare the two costs realistically.

The solution to both of these difficulties—accommodating new technology and making valid cost comparisons—is to open internal information pro-

cessing operations to competitive market forces by basing their revenues on prevailing competitive prices for equivalent services.

Establishing a market price for each information service rather than pricing it at "cost" accomplishes several ends: (1) it simplifies cost accounting by avoiding complex overhead allocations, since all automation facilities become fixed expenses if viewed from a sufficiently short-term standpoint; (2) it stimulates the introduction of new technologies because it permits cost averaging of such innovations over program life; and (3) it allows simulated "profit" objectives to be assigned to the lowest levels of an operation, so that even first- and second-level management has a clear understanding of what it can and cannot do.

An example of this last advantage is our experience with word-processing centers. When we first created them, we found it difficult to establish their scope and performance measures. Using competitive prices from local firms, we then allowed the text-preparation technicians (that is, the ex-secretaries who work in these centers) to charge their "clients" for secretarial services. The results were gratifying, because we found that, to remain competitive, we had to back off from many fancy technical solutions.

There are, however, two serious disadvantages to using market pricing formulas for internal transfer of information services. Automation opportunities may be turned down that would be justifiable under a marginal costing approach. Second, an efficient internal information processing operation may accumulate a large surplus of revenues over costs, and most bureaucracies simply do not have accounting conventions for dealing with internal profits.

The issue of too little automation can be easily resolved by regarding new automation investment opportunities as a part of the conventional capital funds budgeting process and applying the same criteria for choice used there. The recent progress in the technology of information processing suggests that there will be no dearth of automation investment opportunities over the next decade or so.

Establishing comparability between office automation and other capital investment opportunities should simplify the decisions on how to allocate scarce resources. The cutoff level between approved and disapproved automation projects will then be roughly consistent, regardless of the way investments are priced.

As for the issue of accumulated profits, each organization must resolve it within the context of its own rules. One way of looking at such profits is to use them as an indirect measure of how efficiently a particular service unit is investing in information technology over the long term. If it invests its funds wisely—in technology that makes its people really productive—the unit should not only be able to keep up with rapidly dropping market prices for information transactions (and thereby garner new customers) but also to use the accounting surpluses for making new investments (and thereby prepare for the future).

Step 6: plan for the long term

Here I want to focus briefly on a basic dilemma facing the manager of an information systems department in a large organization. The people using the services he provides usually want some new task done right away—in three months or at most a year. The trouble is, meeting such a new demand often requires information technology or processing methods that take a long time to install.

This, plus the fact that total information processing costs can exceed 15% of a large organization's expense budget these days, is why the planning of long-term information strategies warrants the same processes as are applied to functions like marketing, manufacturing, distribution, procurement, and personnel.

In this step, therefore, I strongly recommend that information systems investment decisions be shifted from an annual funding basis to two- to five-year planning commitments initiated by the functional user departments in the organization. This suggestion means that the information systems department, even if it is completely decentralized, should not contend for corporate budget funds as an independent cost center.

Rather, its budget levels should be set through renewable long-range contracts with the *users* of its services, that is, with the people accountable for end product costs containing various elements of information transaction expense.

Step 7: let the users control

This step is a logical outgrowth of the shift of planning initiatives regarding information systems from

the suppliers of information services to the users. Users should control not only the initial procurement but the execution as well. After all, they are the ones who understand the trade-off opportunities between information and other variables in functions as diverse as manufacturing, engineering, marketing, personnel, and procurement. Computer people and administrative specialists like to claim that they know what is best for their clients, but information systems are just too important to the success of an organization to be left entirely in the hands of the suppliers of information services.

To achieve the necessary degree of control, I recommend that key aspects of information systems management—business analysis, methods planning, and applications training—be moved organizationally as close to the ultimate user as possible. This arrangement not only enables the user to make intelligent procurement of data processing and administrative processing services but also creates a powerful mechanism for balancing the business needs of the user against the claim of the information technicians.

I am frequently asked how to structure the user's organization to accommodate the systems planning and systems implementation personnel. There are many possible organizational combinations. However, my experience leads me to favor assigning business systems analysts to the planning mission for each functional area, since these are the people who are concerned about the future or about methods for changing the operating environment.

In preparing for new ways of doing business, we must increasingly rely on information systems as a means of achieving goals. Therefore, I am convinced that the user's planning area is the logical place to put information systems development and control staffs.

Redirecting emphasis

Over the past few years, I have become convinced that the greatest opportunities for lasting productivity in information processing lie in job redesign and job enrichment rather than in improving the efficiency of existing data processing operations. To be sure, new computer technology and new systems approaches are frequently essential in improving the work done in offices. But there should be no mistake

about what should come first—human work needs, not technology.

Step 8: deemphasize the technology

I am recommending here a significant deemphasis of technology in information processing operations. This reorientation means that top information executives face a new challenge. Whereas their primary skills have been focused on technical management, the enlarged scope of information processing calls for a humanistic, nontechnical, and general management perspective rarely found among more specialized executives.

How can the transition from an excessive computer orientation be engineered? Perhaps our experience aterox can point the way. Recently, we have begun increasing our investments in methods, procedures, and training. For years, these activities atrophied as talent moved into the more glamorous and better paying computer-related activities.

The payoff from this redirection has been gratifying. For instance, in the information network we are currently installing, analysis of methods and work flow has shown that computer terminal access to central data bases allows us to rearrange accountability for work functions. Under the old system, work had to be broken up into specialties: accounts receivable specialists handled accounts receivable; equipment order entry clerks handled customer orders; credit was still another specialty. The new approach allows us to make versatile generalists out of narrow specialists. Since our people can now see the total results, job satisfaction has increased substantially.

Such a change is not free. I estimate that the costs involved in changing procedures, redesigning jobs, and training people to do them (all of which I call the "soft software") have exceeded the technical costs for setting up the computer terminals network itself (which I call the "hard software").

The important fact, however, is that the soft software aspects of the project have been given the same care and attention as the heretofore more glamorous hard software aspects. We have begun our own campaign of deemphasizing technology by increasing the importance and influence of the people who develop the soft software.

I should point out that deemphasizing technology in information processing operations does not neces-

sarily mean getting rid of your technical people. It does mean, however, that you can shift many of them into administrative systems positions, where there is plenty of systems work to be done.

A goodly portion of the money formerly spent on computer problems can thus finance efforts to standardize technologies, to automate programming and testing tasks, to devise output measurements, and to improve quality control—all of which will increase the productivity of your technical resources. What this step comes down to, then, is a rebalancing of talent, not a purge.

Step 9: use job enlargement

This recommendation elaborates a bit on the previous step. I single it out for emphasis because it calls for transforming our current rigidly designed information systems, with their emphasis on single-task work stations, into a different mode—one in which systems tasks are enlarged to include many of the attributes of computer-aided learning.

One of the problems I see in most existing information systems that rely mainly on computer terminals is their relatively narrow task orientation. People do not fit readily into such an environment. The training levels of individuals vary, and their attitudes toward work fluctuate. Therefore, designing terminal procedures to the lowest acceptable performance level, and leaving output volume as the only performance variable over which the operator has control, is clearly unsatisfactory, since it lessens productivity and discourages the operator.

For this reason, I recommended that terminal operating procedures be designed as a combination of tutorial and job execution devices—a combination that permits changes in both task content and job scope. As I see it, terminal systems should encourage people to deal with situations of increasing complexity as organizations and individuals continue to grow in their experiences.

As organizations perceive that increasing portions of their expense budgets are being devoted to information processing, judgments will have to be made about where to place the responsibility for overall information systems management. Making such decisions requires that both information systems executives and top management take time to reappraise their roles. To be specific:

□

Top management will have to decide whether to strengthen its control over increasing complexity and interdependence by gathering the functional costs related to information processing.

□

Explicit choices will have to be made among investments in computers, software development, training, methods development, telecommunications, job design, technologies available, and compensation levels.

□

Most important, top management will have to decide whether some of the steps presented in this article can be applied in their own organizations. Even if it is found, for example, that information processing cost-accountability centers and productivity improvement through job enlargement are desirable, will there be adequate management talent available in the existing information processing operation to support such a major change?

□

The information systems manager will also have to reappraise his role. Can he learn to delegate the management of technology to others? Can he break free of the disciplines that shaped his entire career and enter into competition with management generalists? Can he acquire the new skills needed to motivate white-collar workers toward greater involvement in their work? Can he broaden his background to include the complex economics of information handling?

There is no doubt that arriving at answers to such questions will be difficult. Initially, only a small number of organizations will find switching to information-cost management sufficiently urgent to make these issues matters of central concern. In all likelihood, they will become central in information-intensive organizations like insurance companies, banks, credit card organizations, government social service agencies, income tax departments—places where information processing is a principal occupational concern. But as the pace of technology quickens and as shrinking margins make it necessary to employ resources more economically, most large organizations will have to consider the issues of information cost management as inseparable parts of overall business planning.

MIS is a mirage

John Dearden

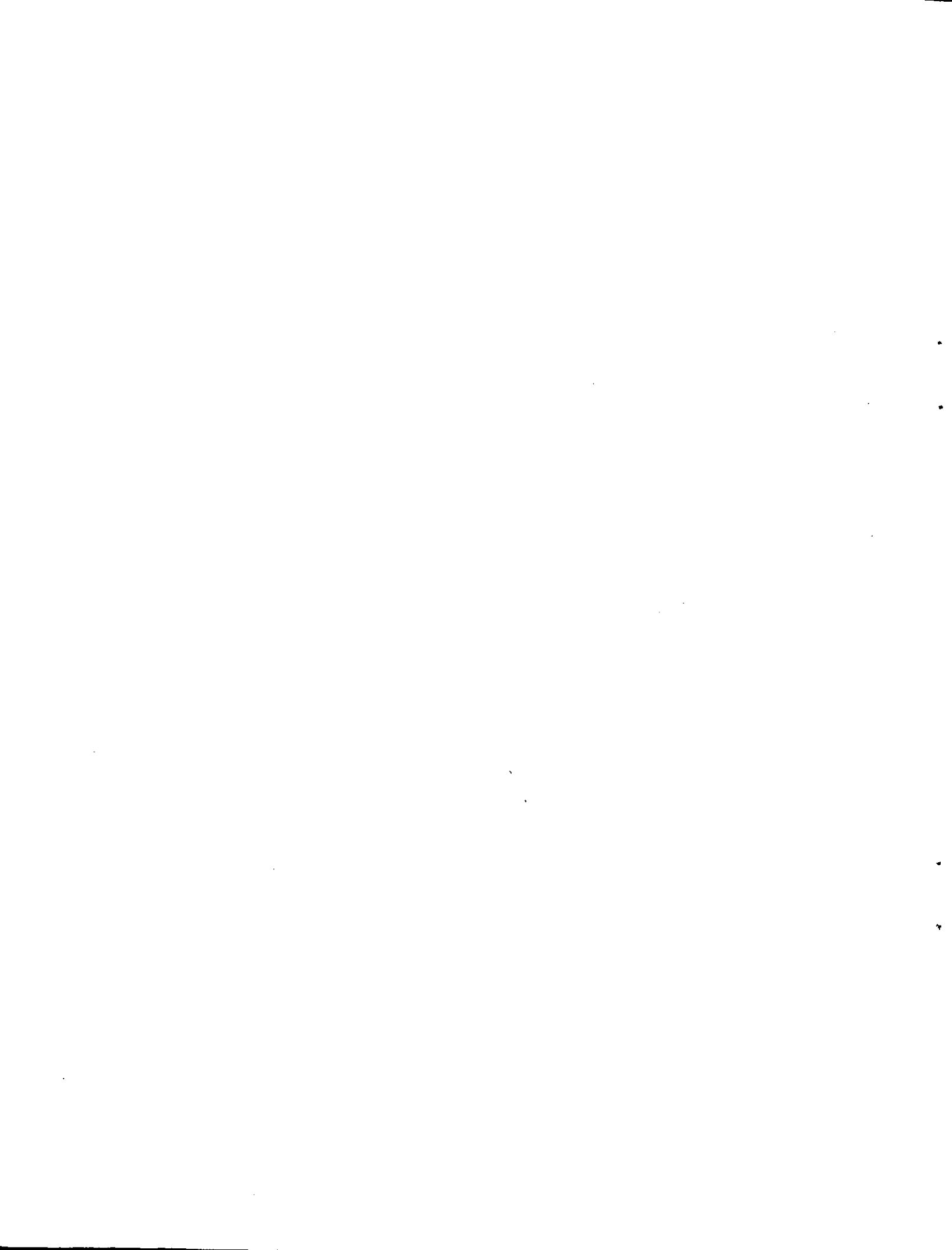
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John Dearden

MIS is a mirage

*Can a single, integrated system be devised
to fill all of management's information needs?
Only if Superman lends a helping hand*

Foreword

Every company of any size has many information systems, both formal and informal. The formal systems it uses cover such a variety of territory that one man cannot possibly comprehend the mass of details and principles required to design a single supersystem that embraces them all. Even a group of systems experts cannot create such a supersystem, the author argues, because the components that must be amalgamated are too different in their natures to be fused

together effectively. After demonstrating the futility of the MIS approach, the author recommends practical steps for reforming defective information systems.

Mr. Dearden is Professor of Business Administration at the Harvard Business School. He is well known to HBR readers, especially for his significant contributions to the theory of divisional control. (A list of Mr. Dearden's previous HBR articles on information systems appears in the ruled insert on page 98.)

Some years ago I expressed the opinion that "of all the ridiculous things that have been foisted on the long-suffering executive in the name of science and progress, the real-time management information system is the silliest."¹

I no longer believe this statement is true. We now have something even sillier: the current fad for "the management information system," whether it is called the Total System, the Total Management Information System, the Management Information System, or simply MIS.

I certainly do not mean to suggest that a company does not need good management information systems—nothing could be further from the truth. But the notion that a company can and ought to have an expert (or a group of experts) create for it a single, completely integrated supersystem—an "MIS"—to help it govern every aspect of its activity is absurd.

For many businessmen, it is probably inconceivable that the lofty phrases and glittering

promises surrounding the MIS conceal a completely unworkable concept. Yet this is exactly what I propose to demonstrate—that a company that pursues an MIS embarks on a wild-goose chase, a search for a will-o'-the-wisp.

Let me first try to explain what I understand by the "MIS concept" and examine its alleged advantages, and then show why the concept is unworkable. Then I shall be in a position to recommend some practical remedies for defective management information systems, which certainly constitute a real problem for executives today.

Confusion between terms

It is difficult even to describe the MIS in a satisfactory way, because this conceptual entity is embedded in a mish-mash of fuzzy thinking and incomprehensible jargon. It is nearly impossible to obtain any agreement on how MIS problems are to be analyzed, what shape their solutions might take, or how these solutions are to be

1. "Myth of Real-Time Management Information," HBR May-June 1966, p. 123.

implemented. This confusion makes it very difficult to attack the concept, because no matter what assumptions a critic makes about the nature of the MIS approach, a proponent can always reply that *his* use of the term is different from others'.

But there is a common thread which runs through the various uses of the term, a thread that at once unifies but also subverts the MIS literature. This thread is the computer-based information system.

Computer-based activity . . .

Wherever the MIS is discussed, it is almost invariably stated that a management information system does not necessarily require a computer and that many forms of management information are not computer-based.

Yet, if one looks at what is actually being discussed, he quickly discovers that the term "MIS" is used, essentially, to stand for "computer-based information systems." For example, a recent article in *Business Week* read as follows:

"[Some], concerned that systems analysts are . . . a 'mixed bag' whose training and knowledge are a hit-or-miss proposition, are convinced that management information systems (MIS) is the emerging field in business administration. Both Wharton and MIT have tailored programs especially for systems specialists, but no school has gone further than the University of Minnesota, whose B-school now offers MS and PhD degrees in management information systems and has launched an MIS research center. Since the center's opening three years ago, MIS Director Gordon B. Davis and his staff have worked to develop 12 new systems-related courses—from on-line, real-time systems to a seminar on software. In addition, the program's 50 MS and 22 PhD candidates spend a good portion of their time alone and in teams at work on actual computer problems in industry."²

It seems evident to me that MIS education as described here is principally education in computer-based information systems.

It is vital to note, first of all, that the information generated by this kind of system does not include a great deal of the information that is most important to management—especially, important *qualitative* information. Second, a specialist group that develops such a system is usually responsible for implementing only one part of any of a company's individual manage-

ment information systems—namely, that part that interfaces directly with the computer. For example, such a group has little (if anything) to do with specifying the nature of an accounting and financial control system, although it may be responsible for the computer programming this system employs.

My conclusion, therefore, is that such a group has little impact on most of the information supplied to management, particularly at upper levels. Consequently it is ridiculous to say that it creates (or *can* create) a total management information system.

. . . vs. MIS

To the extent that MIS refers only to company information systems that use a computer base and to the extent that everyone understands this limitation, I have no serious quarrel with the trend to MIS; it is vital that management tightly control its computer-based information systems, and in general the so-called MIS groups seem designed to guarantee a tight rein to management.

In my experience, however, such a limited definition of MIS is not what advocates of this approach to information systems mean when they use the term. They intend something novel and far more global, some entity that can provide revolutionary benefits we cannot derive from the traditional approach. Walter Kennevan suggests this definition of the MIS:

"A management information system is an organized method of providing past, present and projection information relating to internal operations and external intelligence. It supports the planning, control and operational function of an organization by furnishing uniform information in the proper time-frame to assist the decision-making process."³

This is approximately what I perceive most people to mean by MIS. And if this definition seems grandiose, I can only remark that "the management information system" describes a grandiose idea. If the definition were less global in its scope, it would not measure up to the term. If, for example, one were to limit the definition to the context of a company's financial accounting programs, he would have to speak of the *financial* MIS of the company, rather than its general MIS.

2. June 5, 1971, p. 96.

3. "MIS Universe," *Data Management*, September 1970.

However, in practice, no such limitations are intended. Kennevan's inclusive definition of the MIS approach is quite consistent with the nearly universal benefits claimed for it.

The MIS approach

Given this inclusive definition, how is management to apply it? In other words, how should management think about the problem of setting up an MIS?

Fundamental assumptions

First, it appears that if management wishes to subscribe to the theory of the MIS, it must make up its mind to accept two fundamental (if highly questionable) assumptions that are quite different from traditional ones made in this area:

1. Management information is a subject for study and specialization. That is, it is sufficiently homogeneous so that a set of principles and practices can be established for evaluating all management's information needs and satisfying them. In short, the MIS approach attacks all the problems of management information as a whole, rather than by individual areas, such as finance and marketing. This homogeneity is a necessary assumption, since without it there is no reason why general solutions to a management's information requirements can be found.

2. The systems approach can and should be used in analyzing management's information requirements. Proponents claim the systems approach is necessary for mastering the sprawl of requirements and for synthesizing the general MIS solution. (I shall have more to say about the systems approach later.)

Diagnosis & development

Once management has accepted these two assumptions, it can begin to develop an MIS program. As the theory goes, there seem to be two techniques for setting to work:

□ Management can hire an MIS expert to act as a superconsultant to the president of the company. This expert studies the types of problems that the president must solve, the decisions that he must make, and so forth, and recommends methods for satisfying the president's total information requirements. He then drops to lower levels of management and provides the same services there.

In general, the expert depends on others to implement his recommendations. For example, the controller becomes responsible for changing the cost accounting system in the way the consultant recommends.

□ Management can create a staff department that reports to the top. This group is responsible for the company's computer-based systems but also provides the same type of diagnoses and evaluations as the superconsultant.

The staff group, unlike the consultant, usually has responsibility for implementation.

Its alleged advantages . . .

Under this approach, then, either a single person or a group of persons is responsible for developing and overseeing the construction of the entire management information system. This concentration of authority and responsibility in the hands of systems experts supposedly creates a number of significant advantages:

□ Experts schooled in the MIS "discipline" can analyze management's information needs more objectively than can the people traditionally responsible for satisfying them. Moreover, these experts can better determine which techniques will best meet these needs.

□ Because the MIS is developed as a unified, single system, rather than as a number of separate systems, it is completely coordinated and completely consistent.

□ Information needs are determined from the top down. Hence the top will be in better control; the frequent practice of letting lower management decide what information will pass upward is eliminated.

□ The company reduces its direct information costs by eliminating systems. Also, the MIS itself is cheaper to run because it has been designed by information experts who know the most economical means for satisfying management's information needs.

□ Since one expert or group is responsible for the system, management's desire that the system's key up-to-date can readily be satisfied.

In short, the proponents promise, experts can design an MIS that is more effective, more efficient, more consistent, and more dynamic than the haphazard aggregate of individual systems a company would otherwise employ.

Thus, the impressive advantages that any manager would enjoy, and doubtless this ap-

proach was developed to solve the real problems of poor information that have been plaguing management with increasing frequency. The growing complexity and the pace of change of modern business, especially in the last ten years, have surely made many information systems obsolete and many more inadequate for present tasks.

Equally, the last ten years have seen the extensive development of information technology, management science, and systems analysis—a development that has been accompanied by rapid growth in the number of experts working in information systems.

To some—that is, the proponents of MIS—it seemed logical to centralize the development and control of information systems in the hands of these experts. After all, the problems that beset information systems have been the result of change and growth, they reasoned; and these problems could perhaps be solved by using the new information technology that had been developing simultaneously.

Several companies have tried this approach, and many people currently advocate it. In spite of its apparent logic, however, I know of no company in which it has worked out. This fails to surprise me because, as I have already implied, I believe the whole MIS approach is fundamentally fallacious.

... ⊕ its real fallacies

There are four fallacies and one serious misconception inherent in the MIS approach, as I have described it. The fallacies are these:

◇ Management information is sufficiently homogeneous so that it can be made an area of specialization for an expert.

◇ If the different information systems ordinarily used by a company are developed separately, the resulting management information system will necessarily be uncoordinated and therefore inefficient and unsatisfactory.

◇ The "systems" approach is a new boon to business administration.

◇ It is practicable to centralize the control over a company's entire management information system.

The misconception is this:

◇ The specialist expertise that creates a good logistics system for a company can extend its talents into the broad domain of general com-

pany activity and create a general management information system.

There is no reason to suppose an MIS group can actually do this—in fact, there is good reason to think it cannot.

Let me refute these errors one by one.

1. *The true MIS expert does not and cannot exist.*

A complete management information system consists of such a huge assortment of different types of activities that no man can possess a broad enough set of special skills to apply to even a small proportion of them. Consider the skills required to build any one of these individual information systems.

The financial accounting and control system: This includes preparation of financial statements, development of budgets and long-range plans, analyses of capital investments, publication of product costs, and so forth.

Traditionally, the controller is responsible for all these financial subsystems; with respect to the financial information systems, he plays the role that the MIS expert is supposed to play in the general management information systems. In complementary fashion, the MIS expert must have a thorough understanding of the controller's systems function.

The logistics information system: This system controls the flow of goods from the purchase of raw materials to the physical distribution of the finished products. Next to the financial control system, it is probably the most comprehensive information system in the typical manufacturing business.

A logistics system normally consists of several subsystems of varying degrees of independence. For example, there could be distinct systems for different product lines. Within each product line, furthermore, there could be subsystems for procurement, production scheduling, finished goods, inventory control, and so forth, and still others for plant utilization and expansion. Depending on its industry, a company has a larger or smaller number of complex, interrelated logistics information subsystems.

The critical point to note here is that the logistics information system is almost completely different from the financial information system. In point of fact, most of the skills needed to develop financial information systems are of

no use in developing logistics information systems and vice versa. Even the user relationships are different. In building a financial information system, the controller develops a system that provides information for management outside the finance function, whereas logistics information is normally developed and used by the people directly concerned with logistics.

Furthermore, logistics subsystems frequently have little in common with each other, so that an expert in one type of subsystem might not be able to transfer his expertise to a different type. For example, there may be little or no similarity between a procurement information system and a finished-goods distribution system. Like the financial system, the logistics information system or subsystem is a job for a specialist.

The marketing information systems: Like the two systems just described, the marketing information system can also consist of a number of subsystems. A company may maintain separate subsystems for separate product lines; and within a product line, it may maintain further subsystems for advertising and sales promotion, short-term sales forecasting, long-term sales forecasting, product planning, and so forth.

Again, the critical point is this—a marketing information system is almost completely different from the other two systems. Consequently, expertise in either or both of the other systems would be of limited value in developing a marketing information system and vice versa.

Legal services, industrial relations, and public relations: One of the major purposes of each of these staff functions is to provide top management with specialized information different from that provided by any other staff office and different from that provided by the three information systems previously described.

R&D reporting: The information system management requires in this area is distinct from all others, and expertise in these other areas offers limited help in developing an R&D information system.

In short, except in the small company (which probably needs only simple systems), there are several information systems that have very few similarities and many wide differences. Consequently, it makes no sense to regard the processes of developing and implementing these several management information systems as

constituting a single and homogeneous activity.

I conclude that few, if any, individuals have the training to call themselves experts in management information systems. Indeed I believe it is much more practical to teach the new information technology to the functional experts than to teach information technologists functional specialties. After all, the man who could master all the functional specialties—the true MIS expert—would have to be an intellectual superman; and hence he does not and cannot exist except, perhaps, as a very rare exception.

If an MIS can be implemented at all, it can only be implemented by a staff group, and one of considerable size.

2. Coordinated systems for functional areas can be developed without a 'total systems approach.'

"Unless you develop the MIS as a single, integrated system, all you will get is a bunch of unrelated, uncoordinated, ineffective systems." If I have heard this statement once, I have heard it a hundred times, and it still is not true.

I have seen many systems that have intricate interfaces with one another and that are still efficient and effective. In the automobile industry, for example, the development of a new model car involves many functions—styling, engineering, product planning, finance, facility planning, procurement, and production scheduling. Each functional unit develops its internal information system for controlling its part of the operation; in addition, at each interface, the functional units exchange the information necessary to maintain coordination between them.

If an information system is ineffective, the cause is very likely to be the incompetence of the people responsible for it, not the absence of the general MIS approach. In this connection I might quote William M. Zani:

"Most companies have not conceived and planned their management information system with any significant amount of attention to their intended function of supporting the manager as he makes his decisions."⁴

Zani goes on to suggest a new approach to developing an MIS as a solution to this situation. My solution would be to make some personnel changes, because anyone who fails to design an information system for its users is incompetent.

Such incompetence is very prevalent. I have seen dozens of companies where management is

4. "Blueprint for MIS," HBR November-December 1970, p. 95.

not receiving half the relevant accounting information that could be made available if the financial information system had been properly designed in the first place. And although I am not sufficiently expert in other types of information systems to know whether the same situation exists there, I have no reason to believe accounting is worse than the others.

To assert that such problems as these result from the independent development of different information systems, rather than from sheer and ordinary incompetence, is simply ridiculous—and to recommend the "MIS cure" is even more ridiculous. To ensure that a company has efficient information systems which are well coordinated with one another, management need only bear down on the personnel in the various functional areas who are responsible.

3. *'The systems approach' is merely an elaborate phrase for 'good management.'*

There are many definitions of the systems approach, but the following is representative:

"The systems approach to management is basically a way of thinking. The organization is viewed as an integrated complex of interdependent parts which are capable of sensitive and accurate interaction among themselves and with their environment."⁵

What does this mean? It took me some time to figure it out.

When the systems approach first appeared in the literature, I had a great deal of difficulty understanding the concept, and my confusion increased until I started asking people this question: "What would an executive do differently if he were to adopt the systems approach in place of the traditional one?"

Without exception, the replies I received made assumptions about the traditional approach that simply are not valid. For example, some assumed that the executive perceives his organization as static, others, that he fails to consider the interaction of related variables. In other words, the replies were predicated on an incompetent, even a stupid, executive.

Thus I concluded that the alleged advantages of the systems approach really result from the difference between an adequate and an inadequate manager. If you doubt this, I invite you to ask the question I did the next time you hear

someone champion the systems approach to management.

It is therefore not surprising that good managers follow the systems approach, because this approach is merely the ancient art of management. Would a competent business executive plan a major expansion program without considering the sources and timing of funds, the availability of people, the possible reactions of competitors, and so forth? Certainly not. And he would consider them in relation to one another.

My conclusion, then, is that the systems approach is precisely what every good manager has been using for centuries. The systems approach may be new to science and to weapons acquisition, but it is certainly not new to business administration.

At this point, let me summarize briefly. First, an MIS would have to be developed by a group composed of experts in the various types of information systems used by management. This must be so because the possibility that a single individual will be expert in *all* types of information is remote. Second, the approach taken by the MIS group would be approximately the same as that taken by any competent and expert manager working in one of the functional information systems.

How, then, does the MIS approach differ from the traditional approach to information systems?

The only difference I can see is that a company's management information system would be the responsibility of one centralized group, whereas, traditionally, the information systems experts have been located in the various functional areas. This brings me to the last fallacy—that such centralization is practicable.

4. *Centralizing the control of a company's information systems in a staff group creates problems that are insoluble; therefore it is simply not feasible.*

It is theoretically possible to assemble a staff MIS group that is sufficiently large and diversified to have expertise in all the formal information systems described earlier—marketing, manufacturing (logistics), finance, and so forth. But to organize this group properly, the company should appoint an executive vice president for information to supervise the work of the group—that is to say, the systems of the staff vice presidents, the controller, the logistics information group, the marketing information group, and so

5. Spyros Makridakis, "The Whys and Wherefores of the Systems Approach," *European Business*, Summer 1971.

forth. But what would this accomplish? Let me ignore the fact that no sane manufacturing or marketing executive would delegate the responsibility for his information system.

One result might be that this executive vice president for information would promote better coordination between functional areas. On the other hand, of course, the problems of coordination would drastically increase in the manufacturing and marketing areas because the responsibility for the information systems had been separated from the people who hold the line responsibility. And in any event, simply having all of the information groups, including the MIS group, report to a single executive would hardly change the *approach* to developing information systems. Thus the special value of the MIS approach is still obscure.

In short, it seems to me that if any of the MIS people are competent to tell the functional experts what to do, they should be in the functional area. I see no logical way to centralize the responsibility for all the management information systems.

Significant misconception

If the MIS approach is as fallacious as I believe it to be, how has it been able to maintain even a superficial credibility?

The answer, as I have hinted earlier, is this: the early success of information technology in renovating logistics systems has been so great that there is a natural inclination to try the same methods on the company information systems as a whole.

This misconception has evolved in a natural enough way. Responsibility for a logistics system has traditionally been divided among several executives—e.g., in purchasing, in manufacturing, and in marketing. This divided responsibility has often resulted in poor coordination throughout the system. Furthermore, the people responsible for the system have often been old-fashioned in their methods and relatively unskilled in information techniques. Thus a vacuum has frequently existed with respect to the responsibility for a company's logistics information system into which the burgeoning information technology has moved easily and successfully.

However, as we have seen, there is no reason to suppose that the principles of information technology used so successfully in the logistics area can be generalized to apply to the other

management information systems within a company or to the management information system considered as a whole.

Thus, when a group of experts has completed its overhaul of the logistics system, it will not be in a position to attack the financial, marketing, or any other system. First, the group will not have the specialist expertise required. Second, the type of problems the group may have found in the logistics area will almost certainly not exist in other areas if the staffs in these other areas are competent. Third, there will be no responsibility vacuum as in the logistics area; the MIS group will not be in a position to take over by default.

If you have any doubt about the validity of these statements, I suggest that you examine the kinds of things that any MIS group is doing. Outside of the routine computer systems, you will almost certainly find them concerned basically with parts of the *logistics* information system only.

Roots of poor information

So far this article has been quite negative. Now I should like to suggest some positive actions to mitigate the information crisis, if it can be called that. Before I propose these actions, however, it is appropriate to review the causes of management information problems.

As I have pointed out, the principal cause of poor information systems is that we have put incompetent or ineffective people in charge of these systems.

The secondary causes are somewhat more complicated.

Growing use of computers

Computers and computer-related systems activities have been growing very rapidly, and currently the cost of these activities has become very significant in many companies. In spite of large expenditures, however, the quality of the information available to management appears unimproved.

One reason is, of course, that some computer installations are not run effectively. Another is that the computer-based information systems have been oversold; management has been led to expect much more than it has received. In other words, management's dissatisfaction with its information occurs, not from any deteriora-

tion in its information systems, but from its inflated expectations.

Interface conditions

Individual systems change and improve at different rates, and this creates problems at the interfaces between them. For example, operations research techniques, used in modern logistics systems, require much more sophisticated cost accounting information than traditional cost accounting techniques can generate. Problems can also occur at the interface between production and marketing, because production-scheduling techniques are frequently much more sophisticated than the techniques ordinarily used in market forecasting.

In general, the benefits of advanced techniques may be largely lost where they are dependent on primitive ones. (To some extent, of course, the problem of proper coordination at the interfaces reflects the competency of the staff involved. Other things being equal, only an incompetent would use an advanced technique whose effectiveness would be undermined by inadequate support.)

Rapidity of change

Many companies are changing very rapidly, and it is necessary that their information systems keep pace. In some companies, information systems are not keeping pace. To some extent, this is caused by the inability of the staff personnel traditionally responsible for information systems to react to change. After all, many people who were once perfectly adequate in a relatively static situation become ineffective in a dynamic situation.

Greater management challenge

Management must always operate with insufficient information. And frequently, the more important the decision, the greater the uncertainty. In many areas the truth of these statements is becoming more salient because, while the role of management is becoming more complex, the new information technology is not helping significantly.

For example, I have spent many years working on control systems for decentralized companies. The problems of control in such companies today are much more difficult than they were ten years ago—increases in size, complexity, and geo-

graphical dispersion have made control much more difficult. Yet the new information technology has been of little help in this area, simply because the problems of controlling decentralized divisions do not lend themselves to computerized or mathematical solutions.

Accordingly, it is important to realize that part of our information crisis results from the nature of the present business environment. We shall simply have to live with it. This does not mean, of course, that we should not continue trying to improve the situation.

Toward real solutions

Any company that believes it is facing genuine management information problems and wants to solve them should consider the following measures.

1. Place competent people in each of the formal information systems.

To my mind there is no question that incompetency is the leading cause of problems in many management information systems. Hence the obvious answer is to retrain or replace the incompetents.

2. Examine the interfaces.

This is best done in connection with system evaluation, and the examination should focus on these evaluative questions:

○ Is there adequate communication between individual groups at all important interfaces?

The executive might bear in mind formal techniques such as scheduled meetings and formal agreements.

○ Does each group involved in an interface know enough about the other interfacing systems to do its job effectively?

This is a question of education. For example, cost accountants should know enough about company operations-research models to be sure these models are providing correct information; or, at the very least, they should be able to explain to the OR group the relevant limitations of the information their group can supply. On the other hand, the OR people should know enough about cost accounting to ask for the right type of data and to appreciate the limitations in the data they receive.

But although this is principally a matter of

education, it may well be that some staff members are not intellectually capable of handling interface requirements, and they may have to be replaced.

3. Examine the logistics system.

Originally many logistics systems were organized for manual data processing and have never been changed. Equally, the procurement, production, and distribution functions typically report to different executives, and consequently no one is formally responsible for the logistics information system. Since it is here that computers and information technology are most applicable, management should evaluate its logistics area and,

Readers particularly interested in this topic may wish to consult these previous HBR articles by Professor Dearden:

"Can Management Information Be Automated?" March-April 1964, p. 128.

"Computers: No Impact on Divisional Control," January-February 1967, p. 99.

"How to Organize Information Systems," March-April 1965, p. 65.

"Myth of Real-Time Management Information," May-June 1966, p. 123.

For more perspective on the CBIS-MIS controversy, readers may also find these HBR articles helpful:

Warren F. McFarlan, "Problems in Planning the Information System," March-April 1971, p. 75.

William M. Zani, "Blueprint for MIS," November-December 1970, p. 95.

where appropriate, reorganize it and make a staff unit, responsible for its logistics information system, report to the company officer who directs the logistic system itself.

4. Organize a central computer group for systems control.

Computer use will continue to expand, and it is vital that management maintain central control over computers and computer-based information systems.⁶ Such a group should be responsible for overseeing all computer-related work—for long-range planning, coordination, and control of all computer acquisitions and applications. In addition, it should be responsible for coordinating

6. See Warren F. McFarlan, "Problems in Planning the Information System," HBR March-April 1971, p. 75.

computer-based systems and might even undertake the systems and implementation work in a situation where several organization groups use the same data base.

Most companies already have such groups. Some are even called "MIS groups," although, in reality, they have authority only over computer-related work.

5. Create an administration vice president, if one does not already exist.

I recommend the creation of an office to which the following report:

- The controller.
- The treasurer.
- The computer and systems group.
- The legal office.
- The industrial relations office.
- Other offices for company relations (that is, public and governmental).
- Organization planning.

The marketing, manufacturing, and R&D groups would continue to be independent.

Such an office has several advantages:

□ It provides better control over the staff activities. The increasing number of staff operations, together with their increasing specialization, has made it nearly impossible for the president to exercise real control here. An administrative vice president can exercise much more effective control over the size and direction of these activities.

□ It provides a practical alternative to locating the computer and systems group in the controller's office. An administrative vice president can provide effective supervision and, at the same time, maintain an objectivity that a controller often finds difficult because of his involvement with specific computer applications.

□ It allows the company to handle miscellaneous projects easily—for example, an evaluation of a functional information system or an analysis of the formal information entering the president's office. To take care of nonrecurring or particularly pressing information systems problems, frequently the best arrangement is to organize temporary task forces that report to the administrative vice president.

□ It simplifies the process of coordinating staff offices.

However, I would not make the administrative vice president or the offices reporting to him

responsible for the *entire* management information system. Marketing, manufacturing, and R&D would all be responsible for their own information systems. Also, the different activities reporting to his office would develop their information systems in relative independence except where interface communications are in question.

Questions for my critics

Inevitably, I shall be accused of setting up a straw issue in this article and then demolishing it.

If the MIS approach really embraces only computer-based information systems or centralized logistics systems, then I have set up a straw issue. No harm has been done, however, because I have at least clarified the meaning of "MIS."

But I cannot believe the concept is meant to embrace only this. I have done my best to discover what the MIS approach really is, through talking with its proponents and studying its literature; and this article honestly represents my best understanding.

If I am correct in believing that the approach

pretends to embrace more than computerized systems and logistics, then I have *not* set up a straw issue. And those who doubt my conclusions, negative as these may be, would be wise to ask themselves the following questions before they take up the pen of protest:

○ Which information systems are to be included in the MIS?

○ What kinds of experts are to be included in an MIS group, and what training shall they have?

○ Where is this group to fit into the corporate organization? In particular, what will happen to the staff groups from the controller's office, the legal department, the marketing research department, and so forth?

○ What authority is the MIS group to have? Is it to have authority to design and implement systems, or is it to serve in an advisory function only?

○ What can this group accomplish that cannot be better accomplished by placing information specialists under functional groups?

Arguing the viability of the MIS approach is pointless unless answers to these questions are set forth clearly. And the clearer the answers, I believe, the more transparent the MIS mirage.

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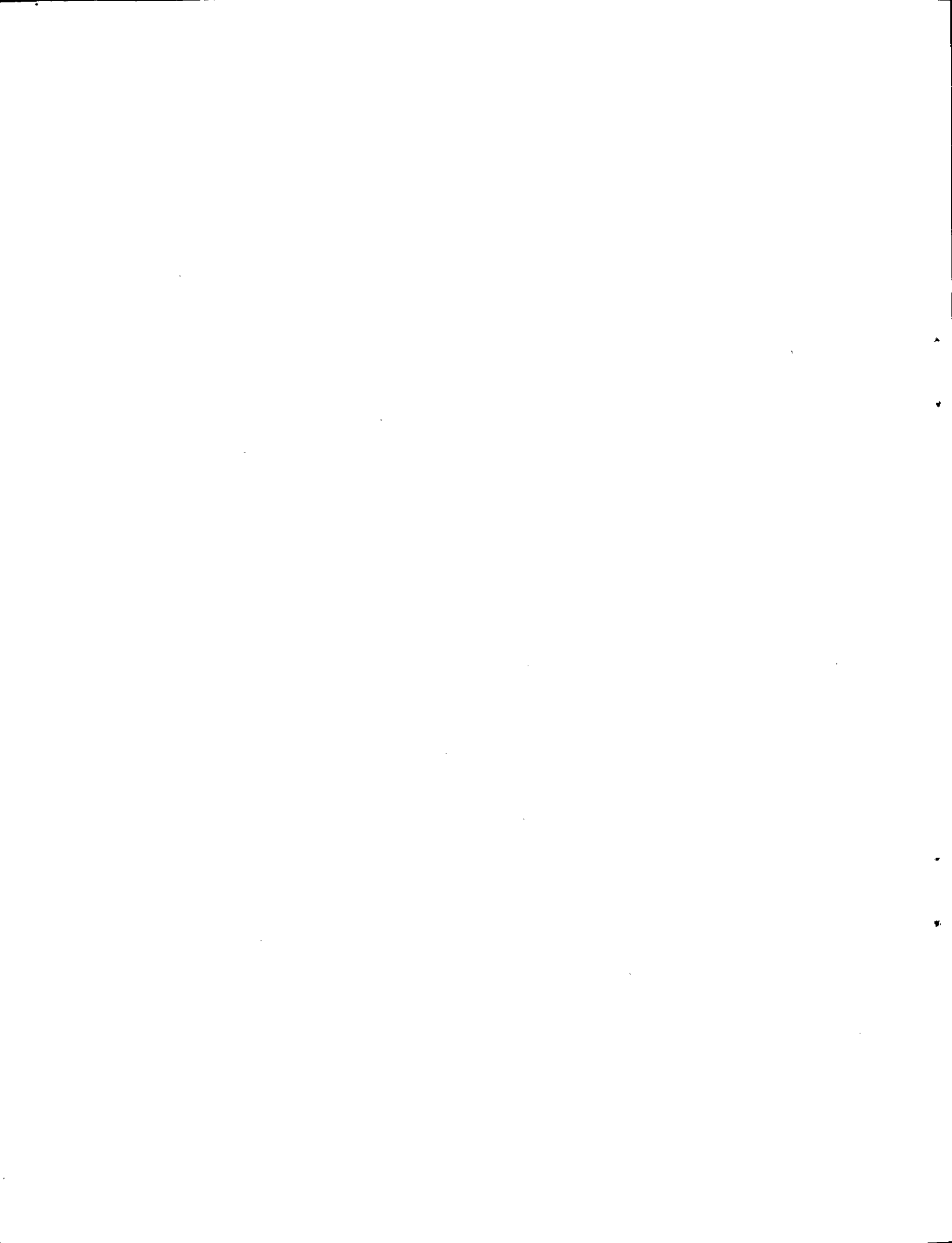
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TRAINING PROGRAM: DESIGN AND USE OF A MANAGEMENT INFORMATION SYSTEM

III. COURSE REFERENCE MATERIALS (CONTINUED)

B. A Bibliography

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SEMINAR/WORKSHOP

DESIGN AND USE OF MANAGEMENT INFORMATION SYSTEM

DEMONSTRATION PROBLEM: ORGANIZATION OF OFFICE INFORMATION SYSTEM

GENERAL

The UN Library in New York is in the process of design and implementation of a computerized document storage and retrieval system ("UN Document Information System"). An integral part is the Computer-Assisted Indexing Program (CAIP) which will support the periodic preparation of the UNDEX Series, a retrieval aid that will facilitate access to the information contained in UN documents and publications. Simply stated, each library item is assigned an identification number, title and address. It is also classified and indexed by date, country, and subject matter. Thus, it becomes possible to generate master files that reflect in any desired order time, country and subject matter and list all pertinent library items - i.e. documents, publications, etc. Further, for each library item there is an abstract on microfilm that can be retrieved; the abstract succinctly describes the content of the particular document. Hence, it is possible to know what is in a document before physical retrieval is made.

SPECIFIC

By analogy it is possible to view the paper work - i.e. correspondence, reports, printed materials, etc. - in any department as a "library." Storage is accomplished manually in files, shelves, desk drawers, etc. Retrieval is also manual and often inefficient, time consuming and incomplete.

Consider the possibility of using the approach described above (with some modification) to facilitate storage and retrieval of the documents in your office.

REQUIRED

To pursue this possibility it will be necessary for you to:

- a) Develop a classification scheme for your office paperwork.
- b) Develop an index-card system to act as an access file and an addressing strategy for all paperwork. An index card design that indicates information (data elements) that will be maintained should be prepared.
- c) The feasibility of such an approach should be analytically weighted in terms of costs and benefits.

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DESIGN AND USE OF MANAGEMENT INFORMATION SYSTEM

DEMONSTRATION PROBLEM: IMPLEMENTATION OF A MANAGEMENT INFORMATION SYSTEM

GENERAL

The design and implementation of an MIS requires the planned and control investment of the time and efforts of many management personnel. Among the tasks to be performed is the management of the efforts of all the participants-- i.e. managers (i.e. Directorate, Professional) and other users (general service) and ADP technical personnel of the various necessary skills. The magnitude and complexity of the tasks involved in the computerization of a project is described in the attached flow chart. Indeed it has become clear that "computerization" should be managed in the same way as other projects as Taking a Census in Cyprus or Setting up a Health or Birth Control Center in India. Techniques like PERT, Bar Charts, etc. are directly applicable and must be supported by an MIS that will permit effective planning and control of personnel, funds, time and overall performance.

SPECIFIC

Consider as a project the design and implementation of a new computerized MIS for your department that deals with, for example, Program Planning and Budgeting. Involved is a significant change in management style and performance of basic planning and control functions. How to effectively accomplish the changes in personnel behavior and general operating systems is therefore a vital concern to your department. It has been decided to design and use an MIS to support the management of the organizational, etc. changes involved.

REQUIRED

The position of project manager has been assigned to you. Therefore, it will be necessary for you to:

- a) Prepare a "time phased chart" of the activities to be performed that indicates "responsibilities" and "milestones." In this connection, major manager/user tasks relate to (1) setting the systems outputs specification, (2) orientation and training, (3) changing over to the new system, and (4) using the new MIS.

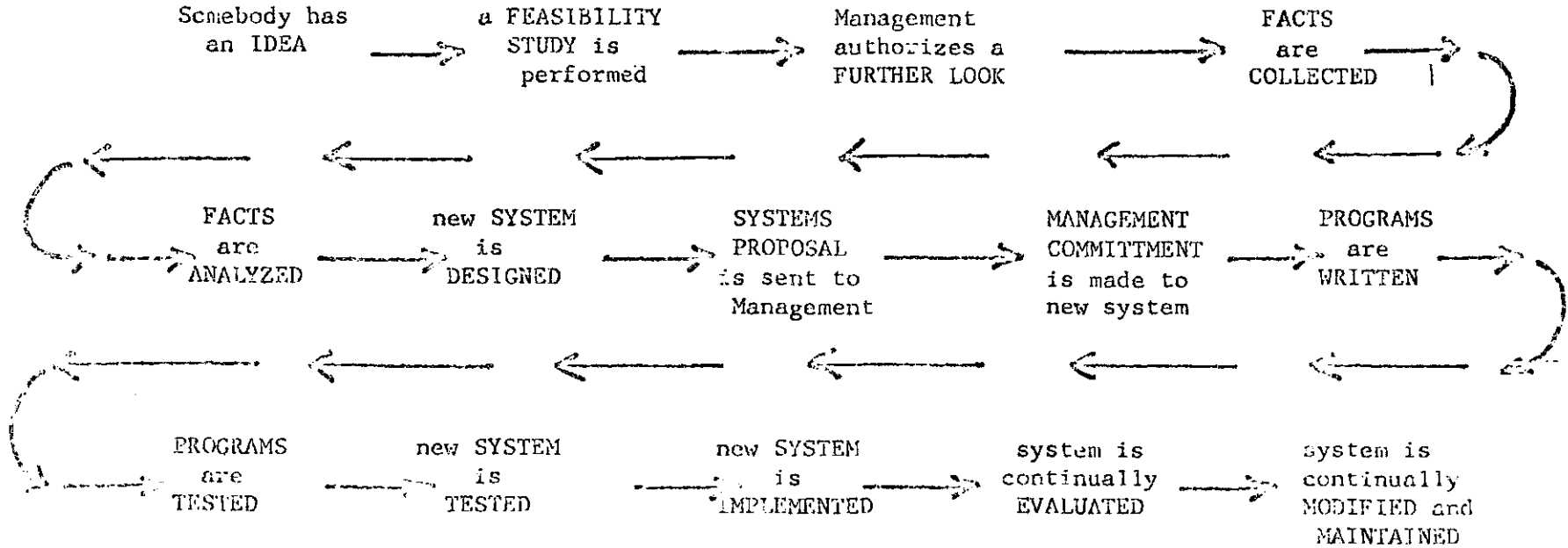
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- b) Effective project management requires identification of the timing of progress reviews and the content of the management information to be obtained. (Prepare a list of data elements that you will need).
- c) Identify the "major problems" you might reasonably expect to encounter in the design and implementation of an MIS and outline approaches, etc. that might prevent and/or correct them.

THE COMPUTERIZATION OF A PROJECT



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DESIGN AND USE OF MANAGEMENT INFORMATION SYSTEM

DEMONSTRATION PROBLEM: PERSONNEL - MIS

GENERAL

The United Nations Development Program (UNDP) has an annual budget of approximately 300 million dollars. This sum is allocated annually to such operating agencies as ILO, UNESCO, WHO, FAO, UNICEF and UN-Office of Technical Cooperation (OTC), for the conduct of development projects. OTC receives approximately \$45 million annually from UNDP which is augmented by special grants and contributions from countries where projects are on-going to create an annual budget of approximately \$60 million.

To administer the allocation of funds for the personnel, equipment, etc. required to implement the various projects conducted throughout the world, OTC has a New York staff of 350. The OTC staff members are part of the general UN personnel system as described in "Staff Rules" -- ST/SGB/Staff Rules/1/Rev. 1 - New York 1966. These rules govern the approximately 6,000 permanent UN employees (of which approximately 5,000 are in New York). These figures include staff members in two (2) grades of Directorate (D) (i.e. Super Grades GS 16, 17), five (5) grades of Professional (P) (i.e. Middle Management GS 11-15), and five (5) grades of general service positions (i.e. GS Grades 5-9). Of the 6,000 permanent UN staff members, approximately 2,000 are in the (D) and (P) categories and the remainder (4,000) are in general service. A roster of all staff members is maintained and information is forwarded to management periodically. A sample personnel MIS report is attached.

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SPECIFIC

OTC estimates that at any time 1,500 experts/specialists are recruited and employed under contract on its various funded projects that are conducted in various countries, i.e. India, Costa Rica, Austria, etc. throughout the world. Turnover is high for many reasons and it is further estimated that 900 new contracts are entered into each year. In addition, OTC estimates that 2,500 local laborers and 200 administrative support personnel are also employed. Here, too, the turnover rate is quite high. Consequently, the task of maintaining effective management control over the personnel related to the various projects has proven to be most challenging.

It has been suggested that the UN-MIS for personnel be reviewed and modified, if necessary, to insure that interested managers throughout the UN organization receive the information they need. Then the suggestion follows that the personnel involved in OTC projects could be included in the general UN-MIS for personnel and that OTC would obtain (as would all UN Directorates, Agencies, Departments, etc.) the information it needs to effectively plan and control the utilization of all types of personnel.

REQUIRED

- a) To guide the evaluation of the UN-MIS Personnel System for OTC and other divisions, prepare a list of all management activities, e.g. planning, hiring/firing, budgeting, etc., that require information regarding staff members. Then develop a list of information pieces required by management to perform the activities enumerated.

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- b) Critically evaluate the attached personnel (roster) report in light of the needs identified in a) above.
- c) Develop a format-record that reflects all the information that should be obtained and maintained for each UN staff member.

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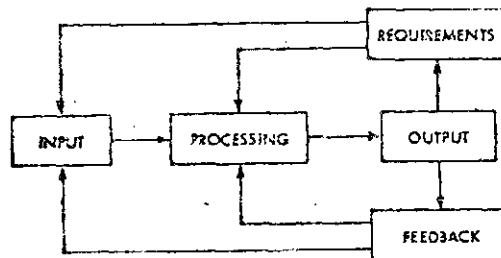
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DEMONSTRATION PROBLEM: UN-PERSONNEL MIS

GENERALIZED: FLOW DIAGRAMS

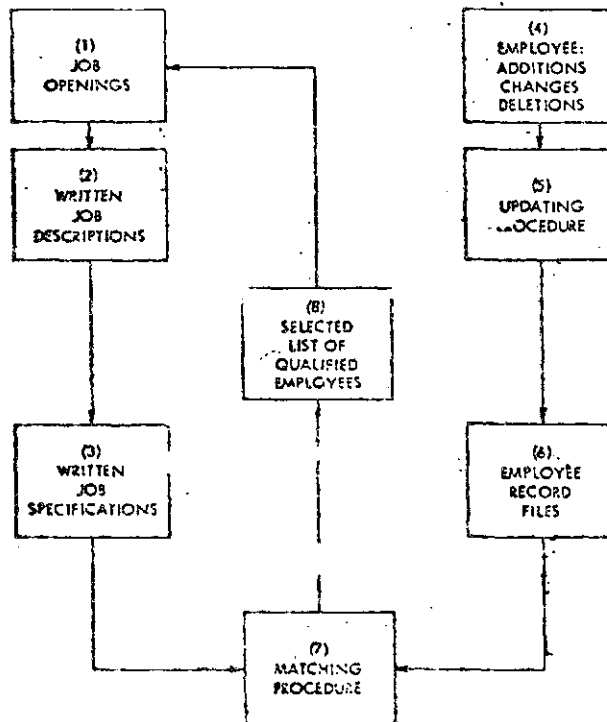
1. Basic Data Flow

ELEMENTS OF A DATA FLOW SITUATION



2. Candidate Matching Cycle

GENERALIZED DIAGRAM OF CANDIDATE MATCHING



INDEX NUMBER	STAFF MEMBER'S NAME	FUNCTIONAL TITLE	NATIONALITY	SEX M. S.	CATEGORY	LEVEL	STEP	ALLOTMENT ACCOUNT NUMBER (FIRST 5 DIGITS ONLY)	OFFICE		ENTER ON DUTY			ACTION	VISAS	CONTRACT		REVIEW OR EXPIRY DATE			BIRTH DATE		SEPARATION DATE		
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254026	SEALEY, GLENN Z		429	1	M	1			1	77	88	25	10	71		5			10	3	07	43			
332888	EVERTS, JACOB		300	2	D	2			9	40	00	01	09	71		2			31	08	3	03	16		
130546	MIRONOV, ALEXANDR A		447	2	D	1			9	30	00	17	01	72		2			11	01	4	05	29		
335210	MWALUKO, ELIEL P		455	2	D	1			9	40	00	22	01	72		2			21	01	4	09	35		
208590	DABEZIES, CARLOS		024	4	P	5			1	31	12	20	03	48		1						02	15		
227795	DESSAU, ERICUS		120	2	P	5			9	40	00	06	09	71		2			05	09	3	07	34		
306430	KIERNIK, STANISLAW		345	2	P	5			1	10	21	15	10	71		4			14	07	2	10	08		
166416	PEREZ-RAMIREZ, GUSTAVO		093	1	P	5			1	31	65	06	01	72		2			05	12	2	10	28		
334518	SILVA-ECHENIQUE, P		084	2	P	5			9	40	00	15	09	71		2			14	09	3	09	34		
295020	YOUKEL, EUGENE		210	1	P	5			9	40	00	05	09	57		1						09	28		
231278	BURNSTAN, MILX S		456	2	P	4			9	40	00	01	02	72		2			31	01	4	09	33		
377820	GRUCHMAN, BOHDAN J		345	2	P	4			1	31	60	05	02	72		2			04	02	4	08	28		
337388	KABAH, AHMAD TEJAN		390	2	P	4			9	40	00	17	10	71		2			16	10	3	02	32		
131565	KOBIALKA, JOSEF		345	2	P	4			1	10	24	23	01	72		2			22	01	5	03	30		
337035	KOVALENKO, EDWARD P		447	2	P	4			9	40	00	15	10	71		2			14	10	3	09	30		
284723	LEQUIEN, JEAN G		147	2	P	4			9	10	00	15	11	71		2			14	11	3	01	33		
286674	MOYER, ROY P		455	1	P	4			9	10	00	01	02	72		2			31	01	4	08	21		
363337	PIJNACKER-MORDIJK, F		300	1	P	4			9	22	04	04	05	61		7						05	23		
243554	RATSINVAARA, HENRI E		267	2	P	4			9	40	00	30	12	71		2			29	12	3	01	32		

CASE STUDY

AN MBA'S STORY

I finished my MBA in May and was hired by the United Nations, New York in June. I worked in the EDP-MIS Office with a small group of newly hired MBA "types" knowledgeable about accounting, systems, and computers. Our little group was given the assignment of converting the accounting groups located in the various office to a new UN-wide computerized cost system that would provide top management with much better information concerning cost and budget performance.

My boss was Henry Froman. Froman had a pretty good reputation in the UN, as far as I could learn, although he had little formal accounting training. He had been hired 25 years previously as a clerk (after two years of business college) and gradually promoted up through the organization to Assistant Manager EDP-MIS. I first developed doubts about his abilities when I came in to see him on some work I had been doing on the accounts at the Geneva Office. It seemed to me that before moving toward computerization, the entire Geneva system had to be changed, and I had a number of suggestions to make.

I had carefully prepared my presentation so that it was concise but logical. When I had finished the presentation upon which I had worked several weeks, he just thanked me, and that was all; no appreciation, no comments. I guess I might have thought this was just a bad day for him or I had said something wrong, but I had the same experience many times. I was discovering all sorts of problems, not only at Geneva but in other parts of the UN accounting procedures. Further, I discovered a way we could cut down on the amount of time-sharing we would require in our new computer set-up, and I presented these ideas to him at various times. Each time he was polite, but it seemed as though the more I went in to see him, the less appreciation I got.

Anyhow, I was anxious to get out into the field and away from the rarified atmosphere at UN-New York. The biggest job was going to be Geneva. It was an established office, and they were set in their ways. My first job was to dig out information about the relationship of their accounting to their actual operating processes. The man I was to work with was the head of the Geneva accounting group, Ell Phillips.

When I met him, I explained that the UN centralized-computerized set-up would begin handling a good deal of their work load as soon as we were able to program what top management would need in the way of information. He said he would be happy to be of help.

Over the next couple weeks, however, I experienced a good deal of difficulty getting data. It was like "dragging it out of them." In fact, I discovered that it was easier to spend my time looking at the data itself rather than trying to get Ell or his staff to help me. I stayed there nearly a month, going back over nearly five years of records.

Some months later, my report on Geneva and other material our little group had collected was incorporated in the new system. It was time to begin testing and debugging the program. The plan was that for some months we would be running parallel accounts at New York (with our computer) and at the office--Geneva, Vienna etc. (with their manual methods). All offices would then be able to evaluate how the new system was working, and we could improve it as we went along.

Well, when the Geneva people began getting the print-outs, they screamed bloody murder. They said a number of key parameters had been ignored, we didn't understand what they did there, and the computer-processed data was useless. Froman called them and said that problems were to be expected, and I would be down to talk with them about changes.

When I got to Geneva, it was a repeat of my previous encounters. I met with Ell and the Chief of Finance and Budget there. I first presented again the rationale behind the whole program and what we hoped to accomplish in better control by centralizing this data analysis. When Ell said it would never work at Geneva, we got into a long, emotional argument over how different they were from the other UN office.

When I got back to New York, I made a number of modifications based on what I had learned. However, the following week there were the same screams from Geneva: it was not providing a true picture of their operations, they argued.

Froman decided to push the work ahead at other locations and let Geneva lag behind. Over the next few months the installation was completed at the other offices like Venna but was not finished at Geneva. When I decided to leave for another job, Geneva was still left out of the system.

1. Comment on the 'BA's view of his job and his problems.
2. What are the processes at work here that he doesn't comprehend?
3. What changes in his behavior might have improved the situation?

