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2. CHALLENGES OF EMERGING TECHNOLOGIES

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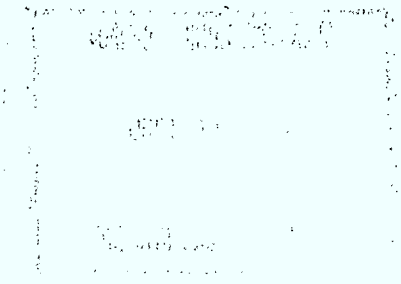
SEMINAR
FOR
DEPARTMENT OF COMMUNICATIONS
GOVERNMENT OF CANADA

SEPTEMBER 17, 1984
HULL, QUEBEC

TRIGGERING TECHNOLOGIES

- COMPUTERS AND COMMUNICATIONS
- ARTIFICAL INTELLIGENCE
  EXPERT SYSTEMS
- ROBOTICS
  COMPUTER — ASSISTED DESIGN
  COMPUTER — ASSISTED MANUFACTURE CAD/CAM
- OFFICE AUTOMATION

Comments on



COMPUTERS AND COMMUNICATIONS

INVENTIONS, DEVELOPMENT		CONSEQUENCES
COMPUTERS		
• STORED PROGRAM ELECTRONIC DIGITAL COMPUTERS		• CHEAPER • FASTER MORE RELIABLE } COMPUTING
• TRANSISTOR, CHIP, VLSI		
• MEMORY HIERARCHIES	⟶	• SYMBOL MANIPULATION APPROAC
• MACHINE ARCHITECTURE PARALLEL PROCESSING, MICROCOMPUTERS		• LARGER PROBLEMS
• LANGUAGES, OPERATING SYSTEMS		• DISSEMINATION OF COMPUTER TECHNOLOGY
• SOFTWARE INDUSTRY		
COMMUNICATIONS		
• NEW CHANNELS (COAXIAL CABLE, MICROWAVE, SATELITES, OPTICAL FIBRES)	⟶	• BANDWIDTH ABUNDANCE • LOWER COSTS
• ELECTRONIC SWITCHING		• LOWER ERROR RATES
• DIGITAL REPRESENTATIONS OF SIGNALS, DATA		• DATA COMMUNICATIONS
• NETWORKS		• INTEGRATED SERVICE DATA NETWORKS (ISDN'S)

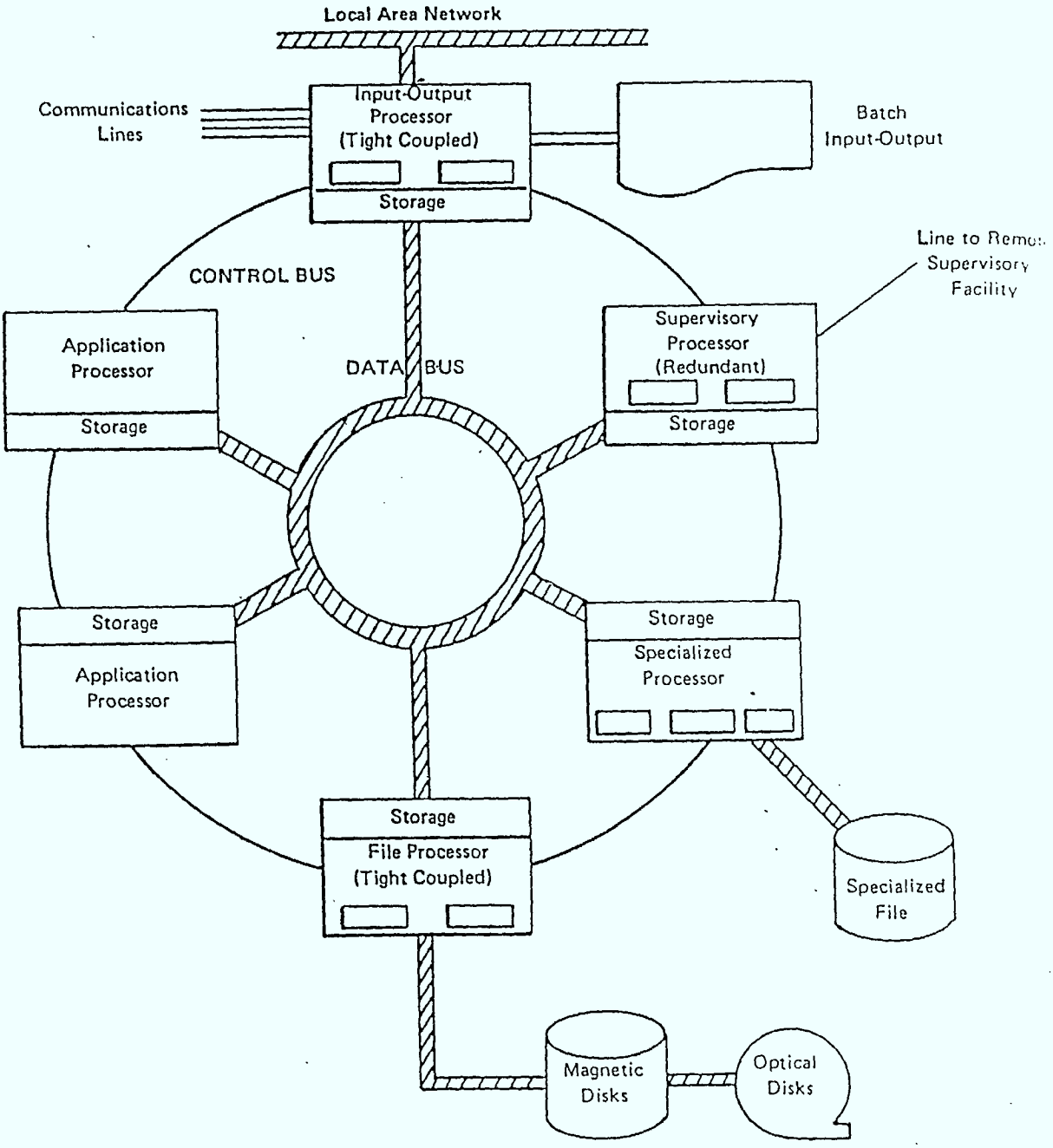
MERGING OF COMPUTERS AND COMMUNICTAIONS TECHNOLOGIES

- MORE COMMUNICATIONS IN COMPUTERS
- MORE COMPUTERS IN COMMUNICATIONS
- GROWTH OF COMPUTER - BASED COMMUNICATION SERVICES
  - RESERVATION SYSTEMS
  - ONLINE DATA BASES
  - VIDEOTEX
  - INVENTORY SYSTEMS
- MARKET FLUIDITY
  - MULTIPLE OPTIONS
  - SECTOR EROSION

* Services based on both computer/communications.
really in our terms new applications as opposed of Services.

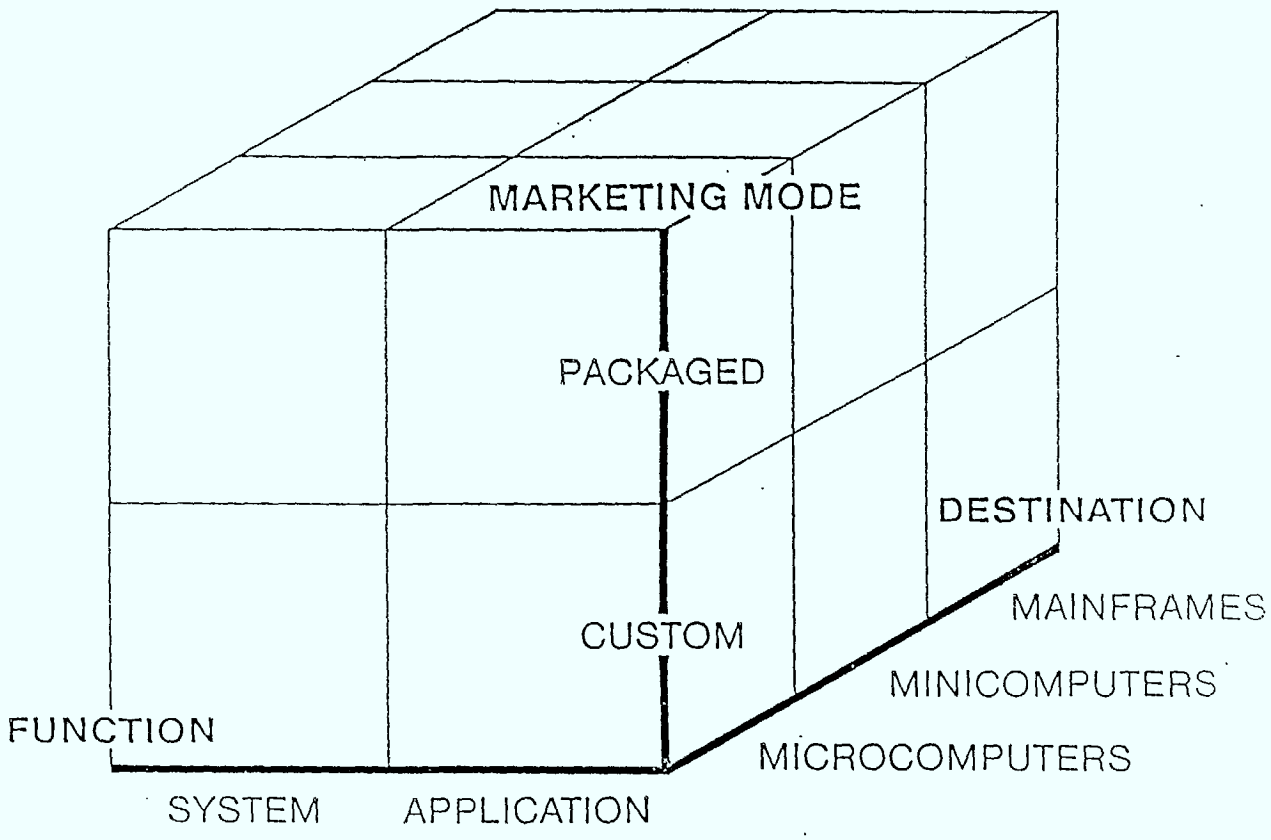
(*) Public Policy Issue for Govt
Bell Canada in Comput
IBM in communic.

. This became reason for major players in one to go into other.
eg IBM interested in Communic.
SNC - Communications.
ATT → Computers



FUTURE GENERAL-PURPOSE COMPUTER SYSTEM

TAXONOMY OF SOFTWARE



ECONOMIC CHARACTERISTICS

- FRAGMENTED
- HIGHLY LABOUR - INTENSIVE
- LARGE CAPITAL INVESTMENT FOR MARKETING, **NOT** PRODUCTION
- LIFE CYCLE OF PRODUCT: SHORT
- FIRMWARE REPLACEMENT?
- DISTRIBUTION OVER PRODUCTION
- HIGHLY PROFITABLE
- EXTRAVAGANT REWARDS FOR "BESTSELLERS"
- FIERCELY COMPETITIVE
  - LOW BARRIER TO ENTRY
  - LARGE BARRIER TO EXIT

MARKET SEGMENTATION

- MAINFRAME VS. MICROCOMPUTER
- FLUX
- SHAKEOUT?

SOFTWARE INDUSTRY WORLDWIDE

- GLOBAL SOFTWARE INDUSTRY
  1980 $ 9 BILLION (SEPARATELY PRICED SOFTWARE)
  1990 $ 90 BILLION

- SUNRISE INDUSTRY HOPES IN OVER 20 COUNTRES

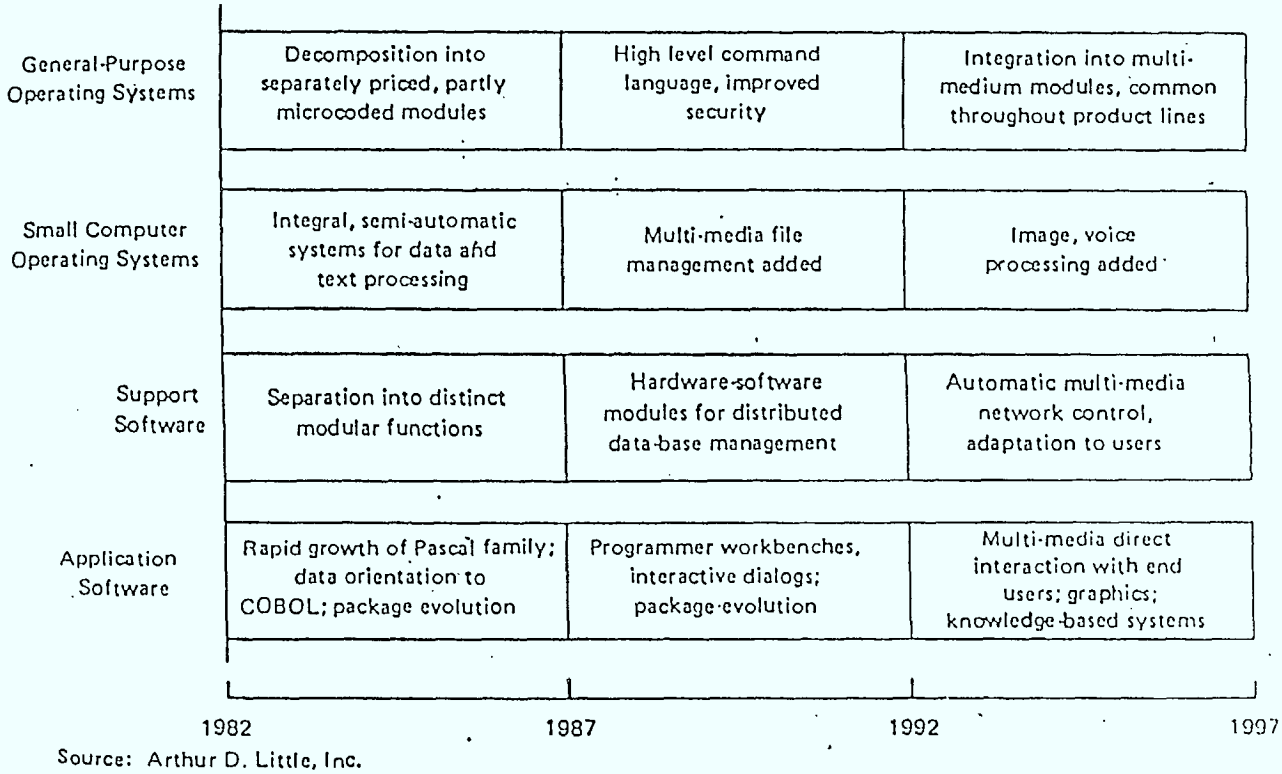
- U. S. A.
  JAPAN
  WESTERN EUROPE
  (FRANCE, UK. WEST GERMANY, ITALY,
  SWEDEN, IRELAND)
  OTHERS
  (HUNGARY, ISRAEL, AUSTRALIA, BRAZIL,
  BERMUDA, INDIA, SINGAPORE, SOUTH KOREA,
  CHINA, HONG KONG, TAIWAN)

USA

- HALF OF GLOBAL MARKET
- SOFTWARE: 15 - 25 % REVENUES
- CONSUMPTION OF SOFTWARE WILL EQUAL CONSUMPTION OF ENERGY BY 1990 S
- 13 000 COMPANIES
- 150 COMPANIES OVER $ 10 MILLION
- IBM: $ 1 BILLION/YR
- TOP SEVEN: HARDWARE MFGRS
- ACQUISITIONS/MERGERS - SHAKEOUT?
- MICROSOFTWARE EXPLOSION: 5 000 PRGMS
- 30 000 PACKAGES
- 500 000 PEOPLE EMPLOYED
- PLAYERS: IBM
  DOD
  JUSTICE
  DISTRIBUTORS

U.S. SOFTWARE INDUSTRY

	ACTUAL		PROJECTED	
	1980	1982	1983	1985
System Software				
US $ Millions	1,500	2,633	3,434	5,796
% Growth	36.4	31	30	29
% Total	25	29	31	35
Applications Software				
US $ Millions	1,100	2,361	3,322	5,769
% Growth	22.2	44	41	26
% Total	18	26	30	35
Custom Built Software				
US $ Millions	3,500	4,089	4,320	4,945
% Growth	29.6	7	6	7
% Total	57	45	39	30
TOTAL				
US $ Millions	6,100	9,080	11,076	16,510
CDN $ Millions	7,630	11,350	13,845	20,637



Source: Arthur D. Little, Inc.

SUMMARY OF SOFTWARE FORECASTS

SECTOR EROSION

SERVICE	COMPETITORS
ELECTRONIC MAIL	USPS, IBM, GTE, TYMESHARE, IPSH.
TELECONFERENCING	AT&T, IBM, HILTON, ALLSTATE
MAIL DELIVERY	UPSP, UPS, AMERICAN EXPRESS
LOCAL TELEPHONE SERVICE	AT&T, NEW ENGLAND TELEPHONE, NEW YORK PORT AUTHORITY
EDUCATION	UNIVERSITIES, WANG INST. OF GRADUATE STUDIES, CONTROL DATA CORPORATION
EFTS	BANKS, USPS, AT&T
SATELLITE TRANSPONDERS	WESTERN UNION PUBLIC BROADCASTING SERVICE SATELLITE BUSINESS SYSTEM

- Very major blurring of traditional roles of Co's & merging.
- Eg Holiday Inns - teleconferencing. [Who is the customer? Who is the supplier?]

get Hanley Irwin - ?

TELECONFERENCING SERVICES

COMPANY	MAIN BUSINESS
WESTERN UNION	TELEGRAPH
AT&T	TELEPHONE
IBM	COMPUTERS
AMERICAN SATELLITE	SATELLITE BROADCASTS
VIDEO COM NET	VIDEO BROKER
HOLIDAY INN	HOTEL
HILTON INTERNATIONAL	HOTEL
INTERCONTINENTAL MOTEL	HOTEL
WETA TV	PUBLIC BROADCASTING
MACOM	ELECTRONIC HARDWARE
ALLSTATE	INSURANCE
BELL AND HOWELL	CAMERAS
DATA POINT	MINICOMPUTERS
CALIFORNIA MICROWAVE	ELECTRONIC EQUIPMENT

U.S. MARKET SIZE

ITEM	$ BILLIONS 1980	PROJECTED
BROADCAST	10.3	23.0 (1990)
TV SETS, VIDEO DISC, VCR	5.1	16.4 (1985)
CABLE TV	2.3	21.5 (1989)
PAY TV	1.6	12.7 (1987)
SATELLITE SERVICES	0.2	2.5 (1989)
TELECONFERENCING	0.55	5.0 (1987)
PERSONAL COMPUTERS	0.75	10.0 (1980)
HOME INFORMATION SYSTEMS	1.5	5.0 (1985)
ELECTRONIC MAIL	1.0	4.7 (1987)
MICROCOMPUTERS	4.5	18.5 (1987)
CELLULAR RADIO	0	2.7 (1987)
PRIVATE SATELLITE SERVICES	0.146	2.9 (1991)
OFFICE INFORMATION SYSTEMS	11.3 (1983)	36.6 (1988)

SOURCE: IRWIN TELECOMMUNICATIONS AMERICA

SELECTED ACTUAL AND PROPOSED ACQUISITIONS AND JOINT VENTURES

Agfa-Gevaert — Compugraphics
Amdahl — Tran Communications
American Broadcasting — MacMillan
American Express — Warner Cable (Warner Communications)
Bell & Howell — Applied Dynamics
Burroughs — Redactron; Context; System Development; Memorex
CAP Gemini — DASD Corp.
Computer Peripherals (Control Data, NCR, ICL) — Centronics
Continental Telephone — Executone; World Cablevision; American Satellite
Datapoint — nine foreign distributors
Dow Jones — Continental Cablevision
Dun & Bradstreet — National CSS
Eastman Kodak — Atex
Fujitsu — TRW, ICL
GE — Intersil, Calma
GTE — Telenet
Gould-SEL, DeAnza
Harris — Farinon, Logicon
IBM — British Aerospace
MCI — WUI
McDonnell Douglas Automation — Microdata, Excalibur, Bradford National
McGraw Hill — DRI
Motorola — Four-Phase Systems
NCR — Comten; Applied Digital Data
Olivetti — Compuscan, Data Terminal Systems, Hermes (Swiss)
Racal Electronics — Redac
Rockwell — Wescom
Schlumberger — Fairchild, Applicon, Manufacturing Data Systems
Sun Co. — Communications Group
Thomson-CSF — Fortune Systems
Time — American Telephone & Communications
United Telecommunications — North Supply; United Computing; Insurance Systems
Viacom International — Sonderling Broadcasting
Wang Laboratories — Computer Resources
Ziff — Wharton Econometric Associates

USER OPTIONS

- ELECTRONIC MAIL VS POST OFFICE
- LOCAL BROADCAST VS CABLE VS DIRECT BROADCAST SATELLITE
- TRAVEL VS TELECONFERENCING
- LECTURES VS TV COURSE VS COMPUTER AIDED INSTRUCTION
- TELLERS VS AUTOMATIC TERMINAL VS HOME TERMINALS
- NEWSPAPER VS TV NEWS VS VIDEOTEX NEWS
- PERSONAL SHOPPING VS CATALOGUE SHOPPING VS VIDEOTEX SHOPPING
- VCR VS VIDEO DISC
- PUBLIC LIBRARY VS ONLINE BIBLIOGRAPHIC SERVICE
- LOCAL AREA NETWORK VS PBX

ARTIFICIAL INTELLIGENCE

DEF'N: MACHINE SIMULATION OF HUMAN BEHAVIOUR

PHYSICAL OR MECHANICAL BEHAVIOUR (MUSCLES AND SENSES)

- MANIPULATION OF OBJECTS
- OPTICAL CHARACTER RECOGNITION
- VISUAL PATTERN RECOGNITION
- SPEACH FORMATION

MENTAL BEHAVIOUR

- GAME PLAYING
  CHECKERS, CHESS, GO, BRIDGE,...
- PROBLEM SOLVING
  MATHEMATICS, PUZZLES
- LEARNING
- CONCEPT FORMATION
- UNDERSTANDING

  KNOWLEDGE DATA BASES
  QUESTION ANSWERING SYSTEMS
- NATURAL LANGUAGE
  UNDERSTANDING (PARSING, CONCEPT IDENTIFICATION,...)
  TRANSLATION

EXPERT SYSTEMS

EXPERT — LIKE DEDUCTION OF CONCLUSIONS FROM OBSERVATIONS

EXAMPLES — CARDIOGRAM ANALYSIS

— DRUG PRESCRIPTION

— MEDICAL DIAGNOSIS

— INTERPRETATION OF SEISMIC DATA FROM WELL DRILLING

— INTERPRETATION OF BUBBLE CHAMBER PHOTOGRAPHS

— INTERPRETATION OF SATELLITE PHOTOGRAPHS

EXPERIENCE WITH SUCH PROGRAMS, AND WITH OTHERS, E.G. FOR PLAYING CHESS AND FOR INSTRUCTING A ROBOT TO PLACE BLOCKS WHERE COMPLICATED VISUAL SCENE ANALYSIS IS NEEDED

SUGGEST THAT

WHERE THE RANGE OF DISCOURSE IS NARROWED SUFFICIENTLY COMPUTER PERFORMANCE AND "UNDERSTANDING" CAN EQUAL THAT OF EXPERTS

AI TECHNIQUES

- CASE ANALYSIS / PATH TRACING IN TREES
- OPTIMISATION
- RECURSIVE GOAL SEEKING
- HEURISTIC TESTING
- LOGICAL DEDUCTION

THE ARTIFICIAL INTELLIGENCE MARKET
(US $ MILLIONS)

Market Area	1984	1985	1986	1987	1988	1989	1990
Expert Systems	32	55	95	160	270	460	780
Natural Language Software	32	55	100	175	300	525	920
Computer Aided Instruction	12	20	30	50	80	125	200
Visual Recognition	55	85	130	202	320	490	760
Voice	17	25	40	60	90	130	200
Total	148	240	395	647	1060	1730	2860

SOURCE: DM Data Inc., Scottsdale, Arizona.
Technology Trends Newsletter, February/84.

INDUSTRIAL ROBOTS

DEFINITION: REPROGRAMMABLE MULTIFUNCTION MANIPULATOR

APPLICATIONS: PICKING UP OBJECTS
PARTS ASSEMBLY
WELDING
PAINTING

BASIC TYPES: EXPLICIT CONTROL (PROGRAM LANGUAGE)
MODELING (THROUGH EQUATIONS)
* TEACHING BY SHOWING

SENSING DEVICES: TACTILE — COMMON NOW, STRAIN GUAGES MEASURE AND CONTROL FORCES APPLIED
OPTICAL — WITH VISION, INTELLIGENCE NOW BEING INSTALLED

ROBOT PRODUCTIVITY IMPROVEMENT BY APPLICATION – %

Application	Average
Integrated Circuits	18.0
Engineering Analysis	6.0
Template	5.6
N/C Applications	5.6
Mapping	5.0
Charts	4.5
Structures Detailing	4.5
Wiring	4.0
Publications	4.0
Design Studies	4.0
Schematic	4.0
Sheet Metal	3.4
Plant Layout	3.0
Printed Circuits	3.0
Piping	3.0
Structural Modeling	3.0
Civil	3.0
Mechanical Assemblies	2.3
Mechanical Details	2.0

Source: Arthur D. Little Co.

U.S. Robotics Industry

	1980	1981	1982	1983	1985	1990
Sales (mil $)	90	155	205	270	540	2070
Production (units)	1450	2100	3075	4000	7715	31350

Source: Robots VI Conference, 3/2/82

	1980		1985		1990	
	% of unit prod'n	% of value	% of unit prod'n	% of value	% of unit prod'n	% of value
"High-grade" robots (having instruction retrieval, sensory, and reader functions)	7	30	18	44	25	55
"Low-grade" robots (simple task-repetition capabilities only)	94	70	82	56	75	44

Source: BIE

THE ROBOT MARKET INTO THE '80S (U.S.)

($ thousands)

	1979	1981	1983	1985
Electrical Machinery	15,840	41,108	58,400	163,812
Automotive	14,880	21,156	32,120	53,874
Fabricated Metals	16,480	26,144	56,648	67,014
Electronics	1,600	11,696	12,264	70,080
Heavy Machinery	12,240	18,576	23,944	12,702
Others	18,960	53,320	108,624	70,518
Total	80,000	172,000	292,000	438,000

Source: Frost & Sullivan Inc., New York

MARKET SHARE FOR ROBOTS

COUNTRY	ACTUAL 1980	PROJECTED 1985	1990
JAPAN	51	62	46
USA	14	13	22
SWEDEN	8	4	2
W.GERMANY	6	10	10
UK	3	6	15
FRANCE	3	0	0
ITALY	3	3	2
OTHERS	15	2	3

SOURCE: US DEP'T OF COMMERCE, 1983

US ROBOT PRODUCERS

DOMESTIC SALES ($ MILLIONS) AND MARKET SHARE (%)

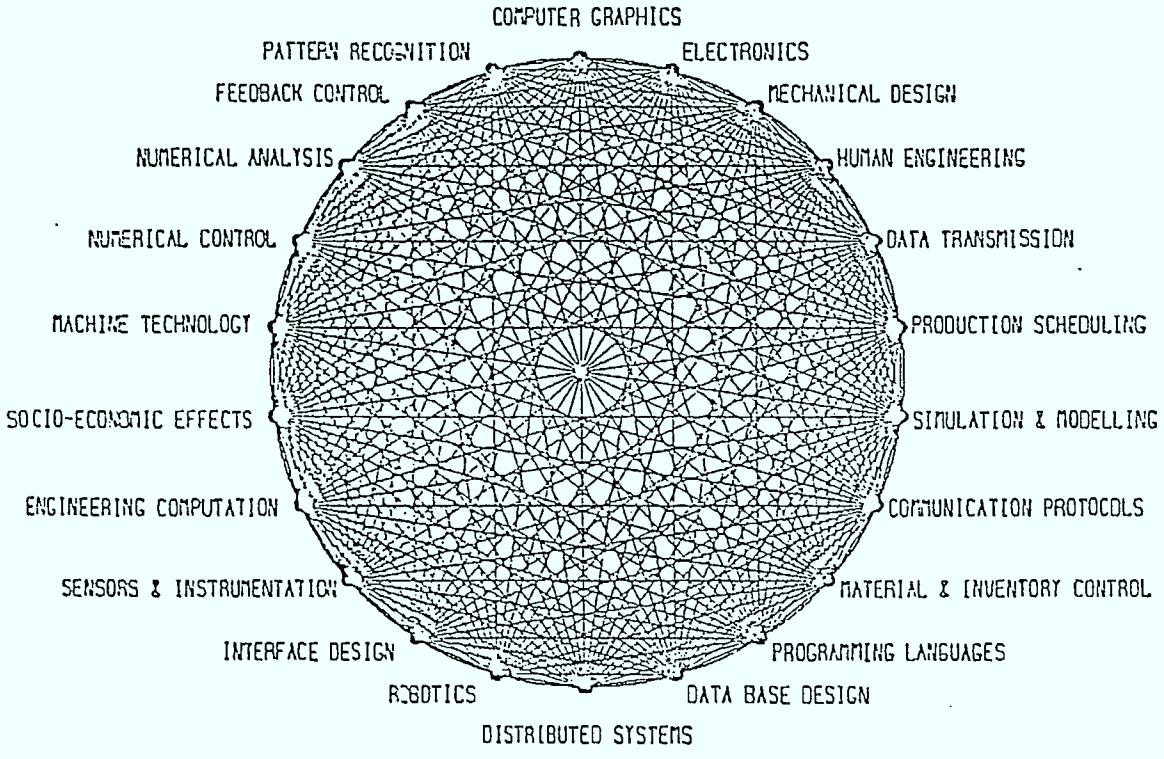
COMPANY	1981	1982	1983
UNIMATION	68.0 (41.0)	65.0 (32.0.)	60.0 (23.0)
CINCINNATI MILACRON	50.0 (32.0)	42.0 (21.0)	42.0 (16.0)
DEVILBISS	6.0 (4.0)	15.0 (7.0)	18.0 (7.0)
ASEA INC.	9.0 (6.0)	14.0 (7.0)	19.0 (7.0)
PRAB ROBOTS INC	8.0 (6.0)	8.0 (4.0)	11.0 (4.0)
CYBOTECH	—	10.0 (5.4)	11.0 (4.0)
AUTOMATIX INC	3.0 (2.0)	8.0 (4.0)	20.0 (8.0)

CAD / CAM

COMPUTER AIDED DESIGN / MANUFACTURING

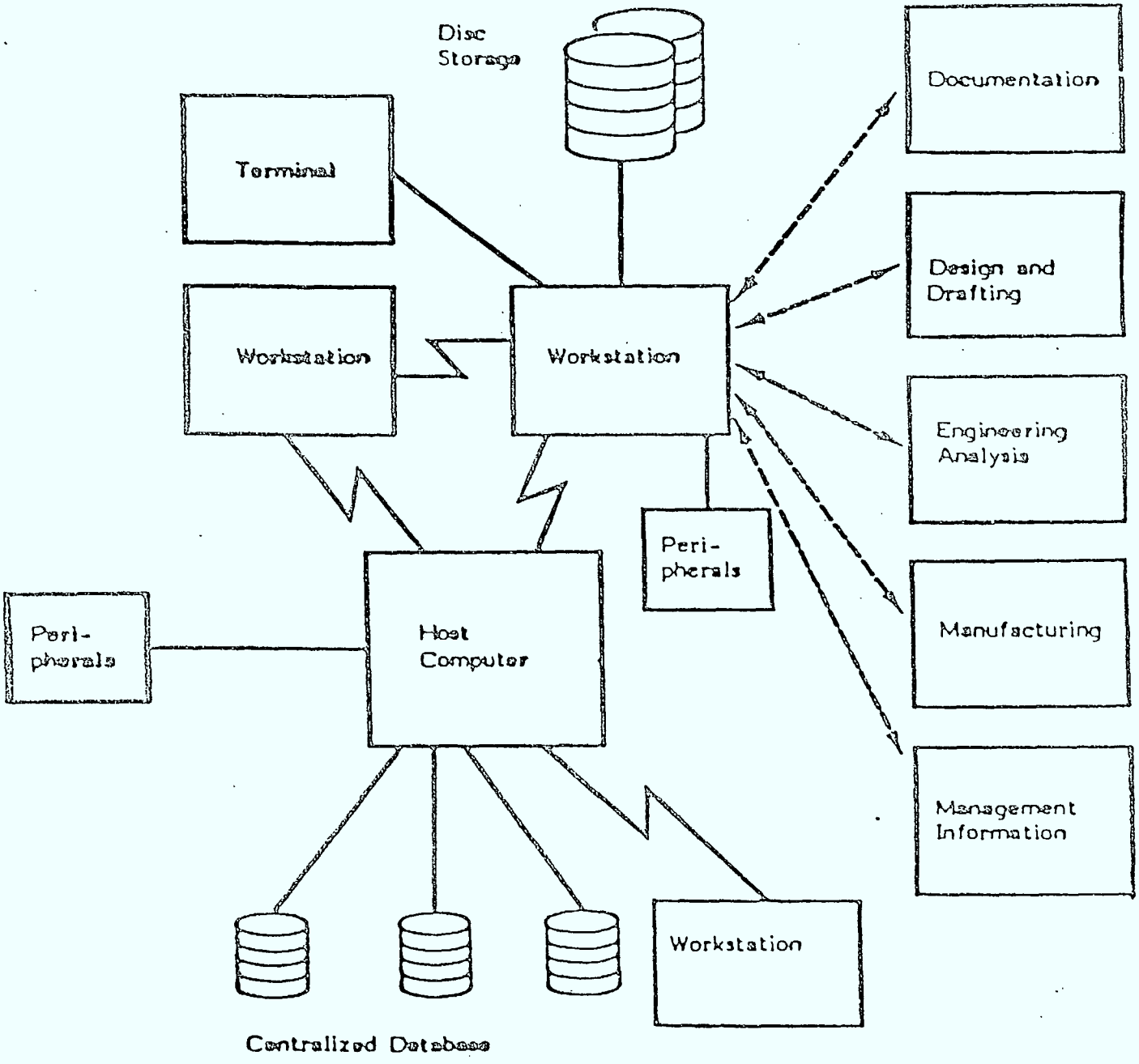
- GRAPHICS
  - PLOTTING
  - REPRESENTATION OF 3-D OBJECTS IN 2-D
  - PROJECTIONS
  - SHADING
  - STEREOSCOPIC VIEWS
  - ANIMATION
- ENGINEERING SPECIFICATION OF DRAWINGS
- DOCUMENTATION
- COMPUTER–CONTROLLED MACHINE TOOLS

CAD/CAM TECHNOLOGIES AND THEIR INTERRELATIONSHIPS

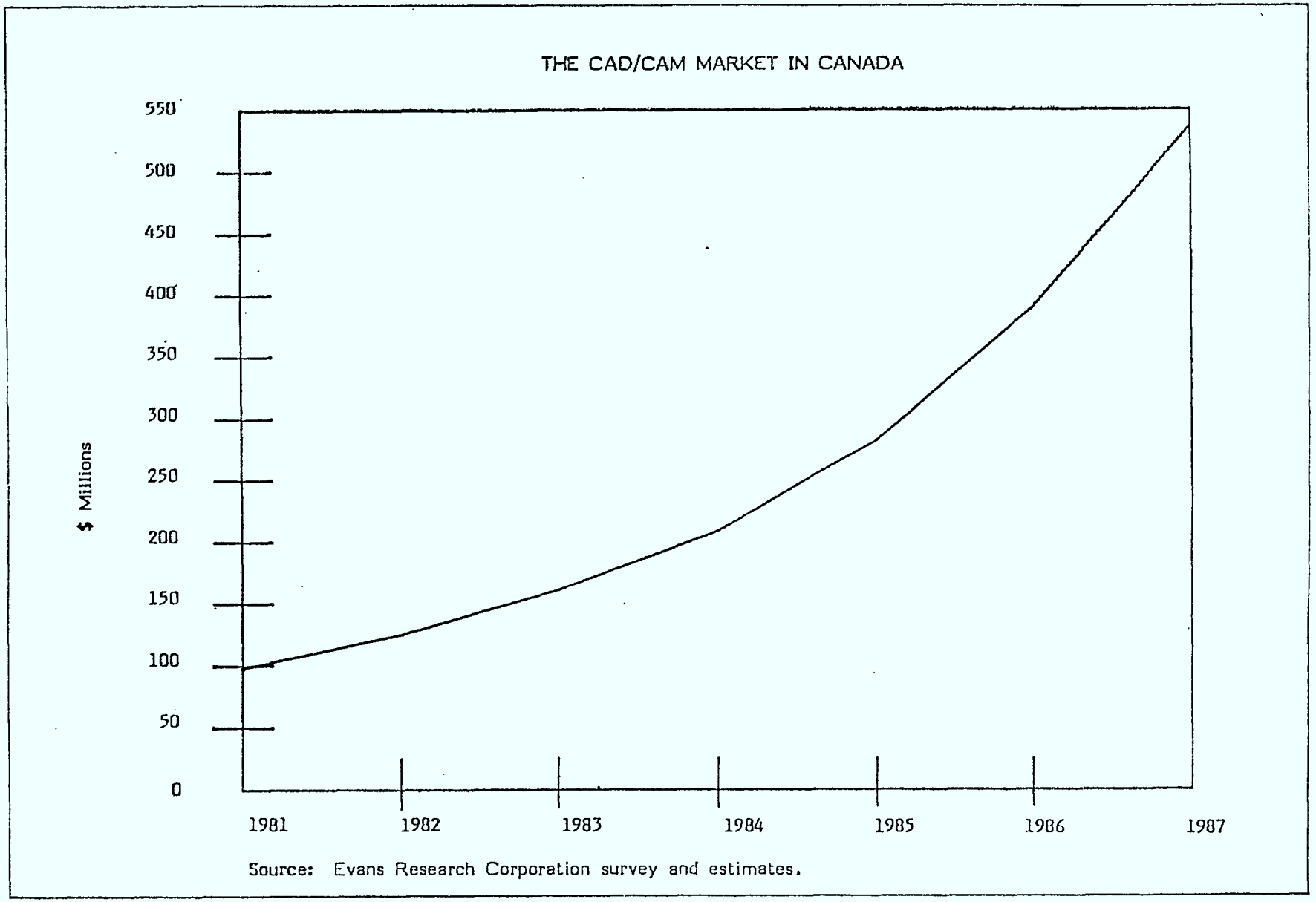


Source: Department of Industry Trade & Commerce
Computer Graphics by Cadsys Ltd., Vancouver

DISTRIBUTED PROCESSING FOR CAD/CAM

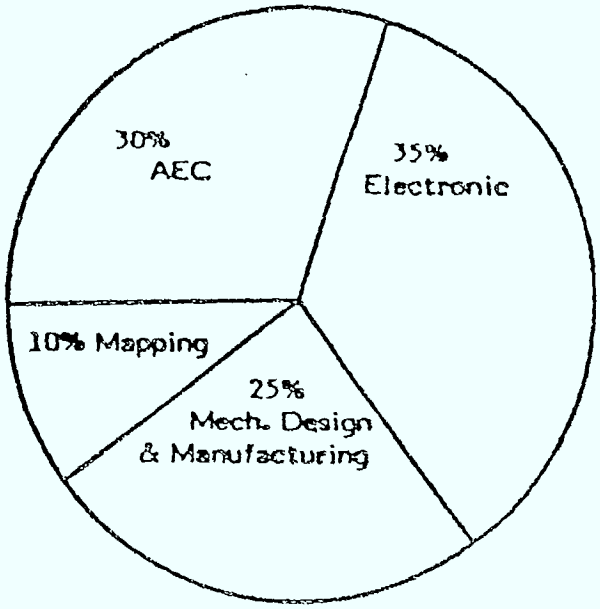


Recent developments include the ability to operate workstations with built-in processors remote from the host computer.

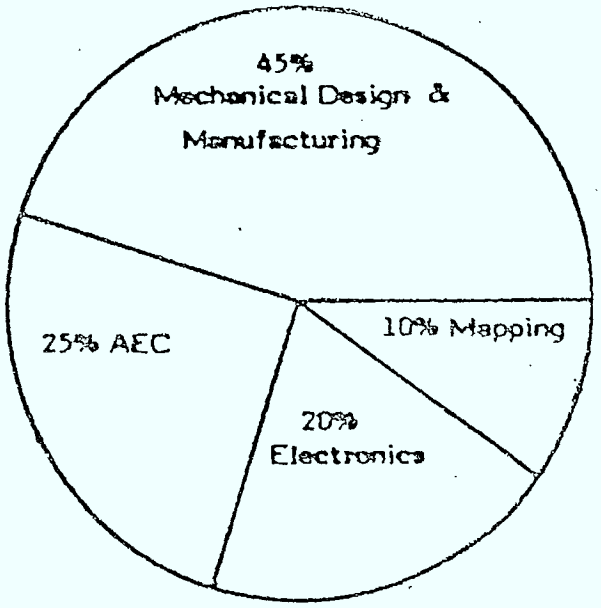

THE CAD/CAM MARKET IN CANADA
$ Millions
550
500
450
400
350
300
250
200
150
100
50
0
1981
1982
1983
1984
1985
1986
1987
Source: Evans Research Corporation survey and estimates.

MARKET SHARE FOR MAJOR APPLICATION AREAS (CANADA)

1982



1987



OFFICE AUTOMATION EQUIPMENT

- WORKSTATIONS
  - TERMINALS
  - WORD PROCESSORS
  - COMPUTERS
  - PLOTTERS
- COMMUNICATION DEVICES
  - FACSIMILE TERMINALS
  - DISPLAY PHONE
  - COPIERS
- PRINTERS
  - LOCAL
  - REMOTE HIGH SPEED (LASER)
- FILE SERVERS
  - OPTICAL MEMORIES
- LOCAL AREA NETWORKS
  - COMPUTER BASED
  - PBX BASED

OFFICE AUTOMATION FUNCTIONS

- WORD PROCESSING

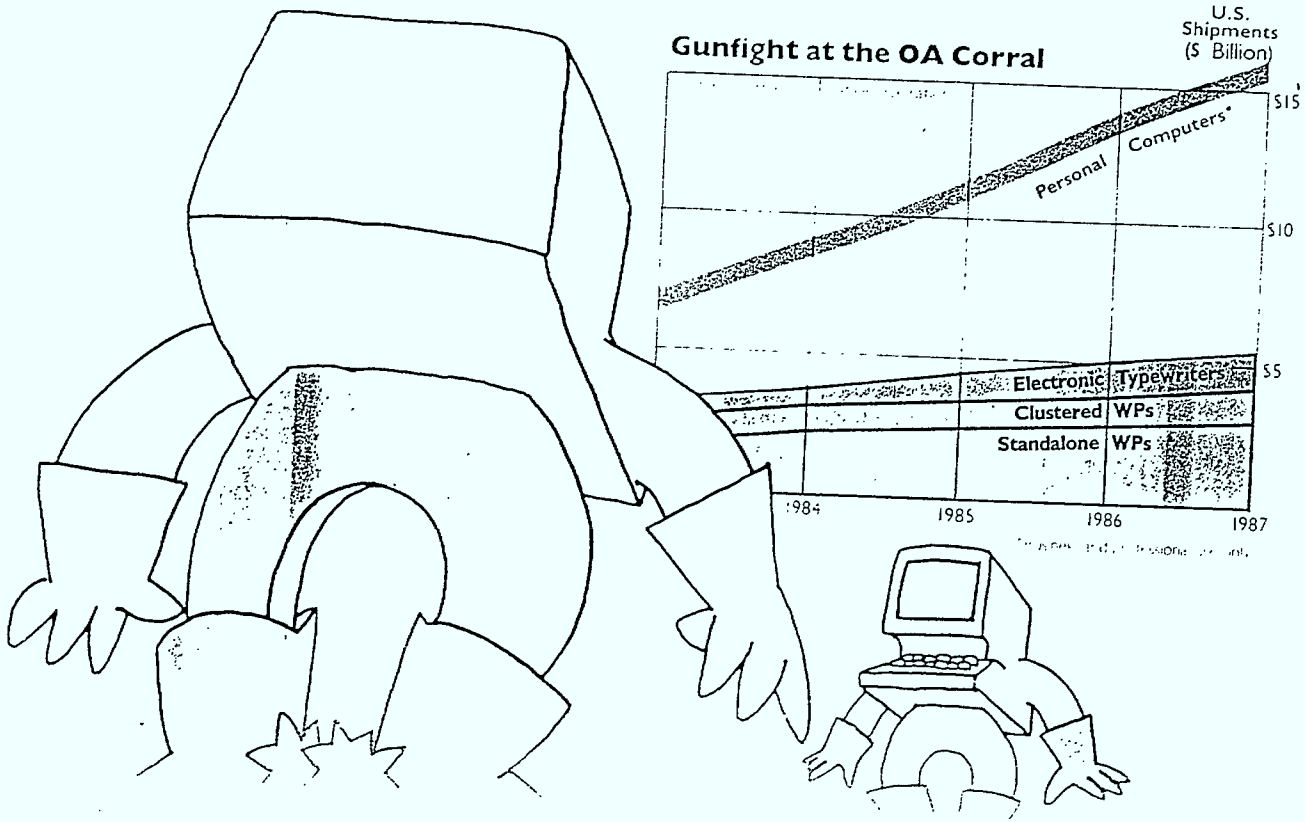
- ELECTRONIC MESSAGING
  - MAIL (VOICE, ELECTRONIC, INTELLIGENT...)
  - TELECONFERENCING

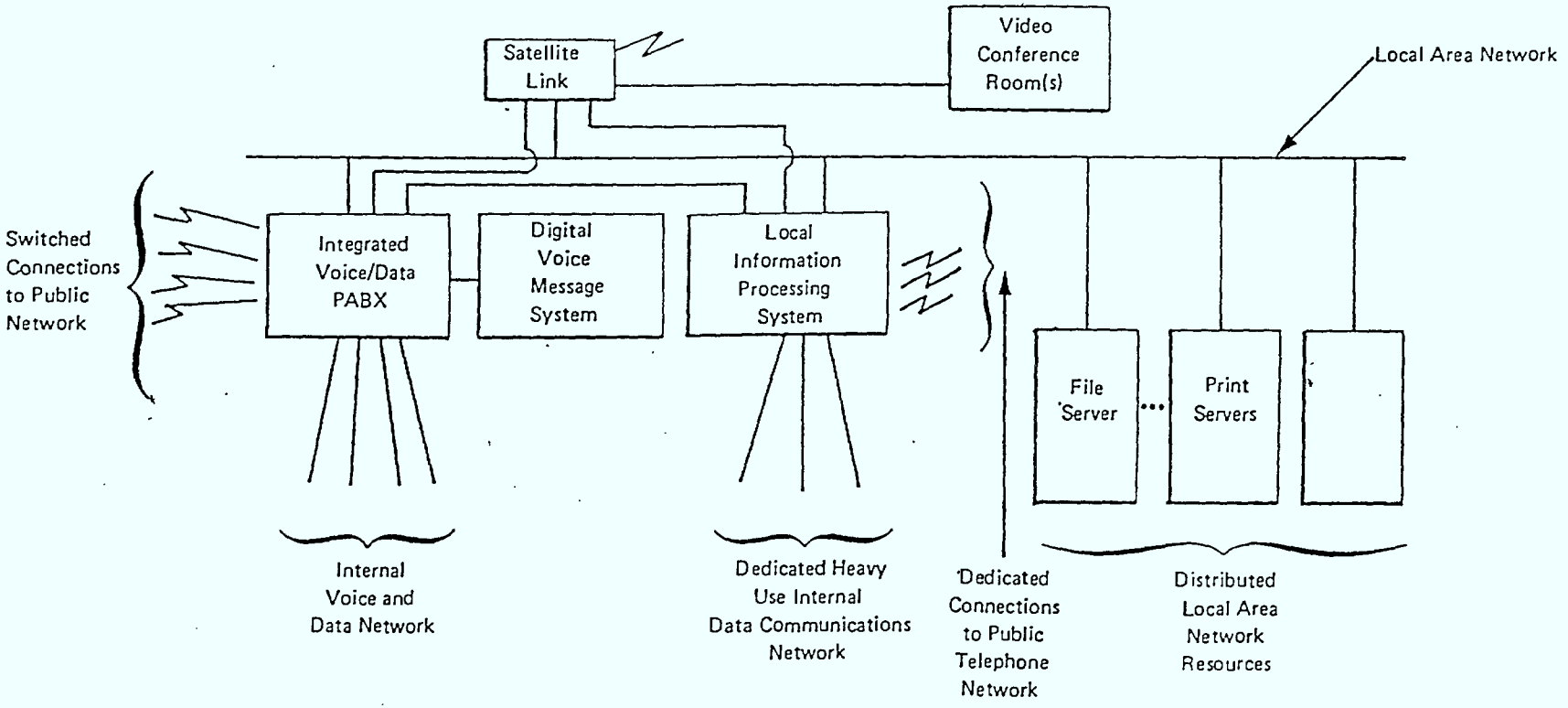
- RECORD MANAGEMENT
  - INDEXING, ACCESSING
  - CREATION
  - STORAGE
  - DISTRIBUTION
  - ARCHIVING

- ADMINISTRATIVE SUPPORT
  - CALCULATORS
  - CALENDARS
  - BUDGETING AIDS (SPREADSHEETS, PLOTTERS,...)
  - PROJECT CONTROL SYSTEMS
  - POLICY AND PROCEDURE INFORMATION
  - TRAINING PROGRAMS

- POLICY FORMULATION SUPPORT SYSTEMS.
  - Mgt Decision Making.

[?]


Gunfight at the OA Corral
U.S. Shipments ($ Billion)
$15
$10
$5
Personal Computers*
Electronic Typewriters
Clustered WPs
Standalone WPs
1984
1985
1986
1987



LATE 1980's LOCAL COMMUNICATIONS NETWORK

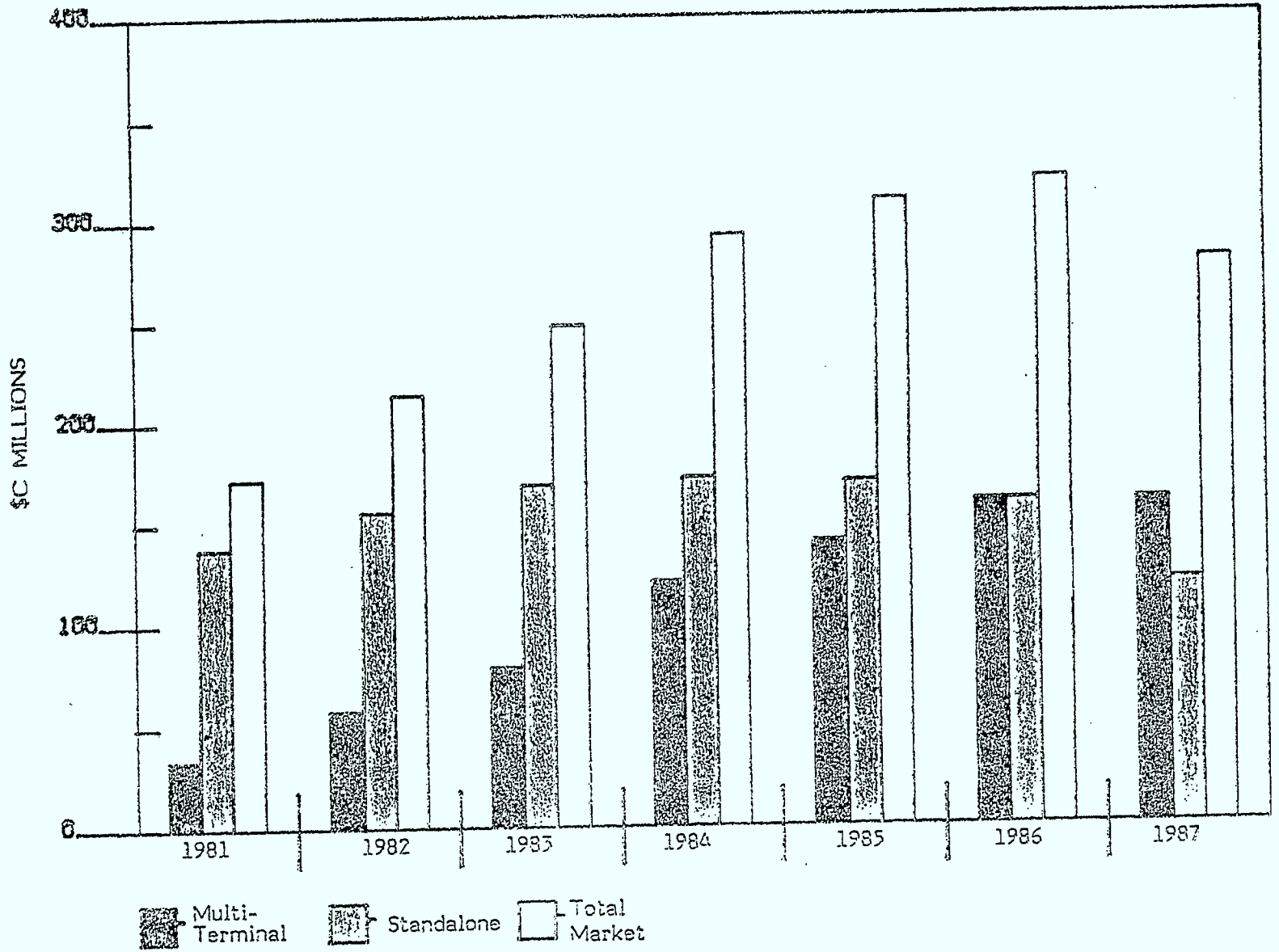
LARGE ON - LINE SYSTEMS IN CANADA

Owner	City	Terminals/Ports(P) 1982	1984
FINANCIAL:			
Bank of Montreal	Van	700	700
	Tor	???	1712
	Mon	1178	1178
Banque Nationale du Canada	Mon	155*	1003
Canada Trustco	Lon	???	2005
Canada Permanent Trust	Tor	537	537*
Canadian Imperial Bank	Tor	1207	5500
		-	1000
Corporation Desjardins	Mon	2500	2500
		-	3400
Credit Union Federation	Cal	533	1441
Richardson Greenshields	Win	302	602
Royal Bank	Van	708&	135&
	Tor	936*	175&
	Mon	706&*	923P
Vancouver Stock Exchange	Van	61	508
INSURANCE:			
Confederation Life	Tor	243	673
Great West Life	Win	1003	1003
London Life	Lon	???	900
Insurance Corp of B.C.	Van	412	1157
Manulife	Tor	440	504
Mutual Life	Wat	370	1100
Royal Insurance	Tor	30P	559
Sante & Securite au Travail	Mon	400	1200
Sun Life	Tor	606	626
The Cooperators	Mis	150	1001
SERVICE BUREAU:			
Canada Systems Group	Mis	497P	6300
		-	1505(*2)
CNR Data Processing	Win	627	627
Control Data	Mis	176P	548P&
Datacrown	Tor	2809	3323
IBM	Tor	482	893
I.P. Sharp	Tor	1200P	3000P
Manitoba Data Services	Win	625	891
The Cooperators Data Serv.	Reg	750	1710
GOVERNMENT:			
B.C. Systems Corp.	Vic	158	1065
City of Edmonton	Edm	416	560
City of Toronto	Tor	255	583
Gouv. du Quebec/Justice	Mon	-	945
/Revenu	Que	237	565
Ontario Gov.	Tor	480	1750
		173	1326

R.C.M.P.	Ott	200	1325
	Van	1919	
Revenue Canada	Ott	1300	1300&
EDUCATION:			
Carleton Univ.	Ott	400	500
Concordia Univ.	Mon	256	509&
Univ. of Alberta	Edm	1200P	1200P*
Univ. of Cal.	Cal	512P	878
Univ. of B.C.	Van	750&	900
Univ. of Man.	Win	407P	1622P
Univ. de Montreal	Mon	203	500
PETROLEUM:			
Amoco Petroleum	Cal	576	636
Dome Petroleum	Cal	620	720
Nova Corp.	Cal	160	820
Petro Can	Cal	260	812
TRANSPORTATION:			
Air Canada	Tor	???	8200
CN Marine	Mnc.	48	512P
Canadian Pacific	Mon	958	1114
CP Air	Van	1200	2000
TELECOMMUNICATIONS:			
B.C. Tel	Van	1000&	2348&
Bell Canada	Tor	???	2010
	Mon	1009	2010
Bell Northern Reseach	Ott	916	200??
CNCP Telecommunications	Mon	207?	500
DISTRIBUTION:			
Direct Film	Mon	10	1006
Hudson's Bay	Cal	260(*3)	580
	Van	260(*3)	600
	Win	260(*2)	500
	Tor	260(*3)	100P??
	Mon	260(*2)	600
Simpsons-Sears	Tor	69	674
UTILITIES:			
B.C.Hydro	Van	500	367&
Can. Utilities	Edm	322	634
Hydro-Quebec	Mon	535	823&
MEDICAL:			
Edmonton Gen. Hospital	Edm	2006P??	288P
Saint John Reg. Hospital	SJn	192P	512P
MANUFACTURING:			
Ford Motor	Oak	503	568
RESOURCES:			
Kidd Creek Mines	Tim	64	1063

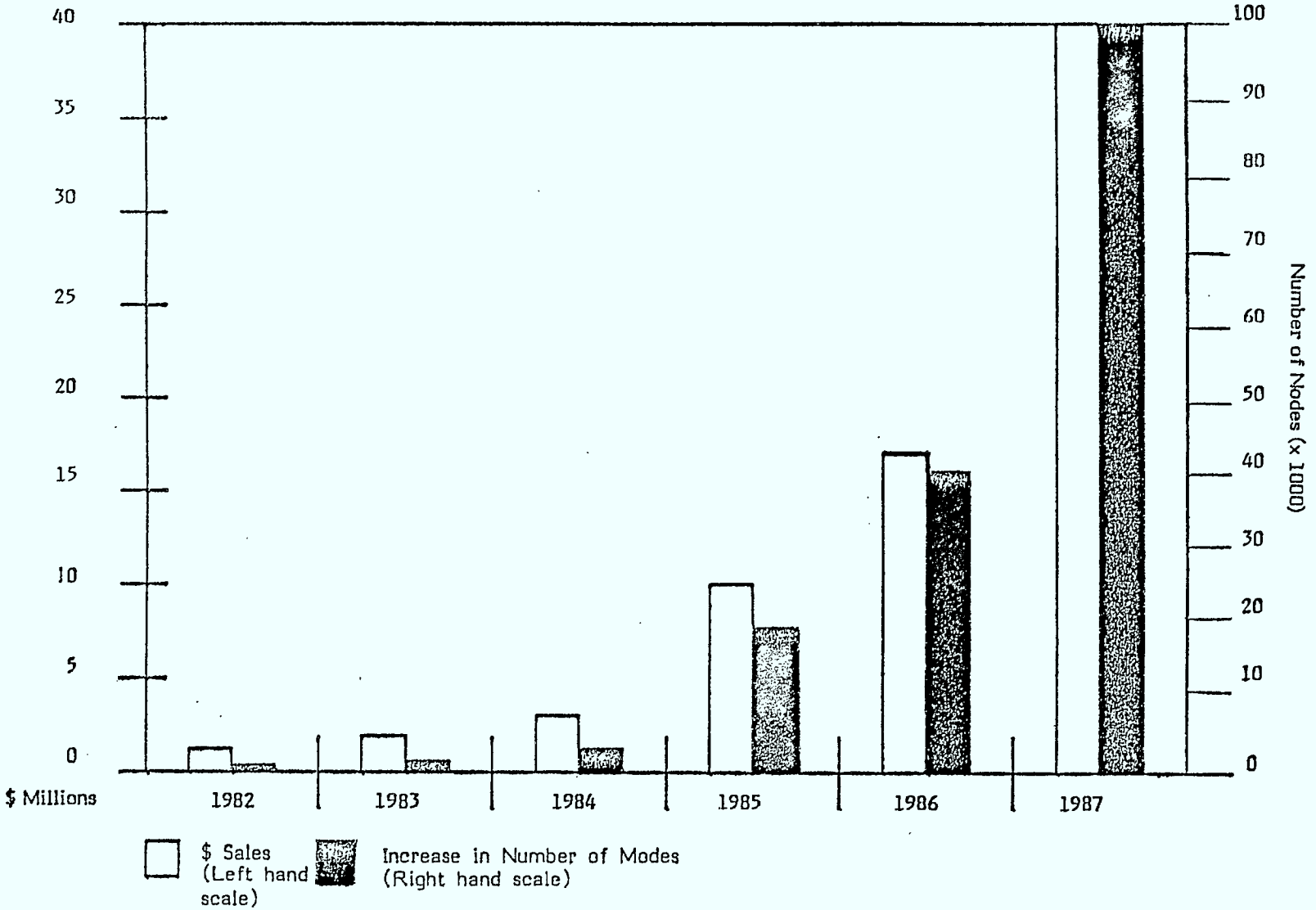
HOSPITALITY:			
Queen Elizabeth Hotel	Mon	757	757
MISCELLANEOUS:			
Infomart	Tor	-	1025P
Loto-Quebec	Mon	1957	4000
Western Canada Lottery	Win	6	1440

CANADIAN MARKET FOR DEDICATED WORD PROCESSING AND OFFICE AUTOMATION EQUIPMENT

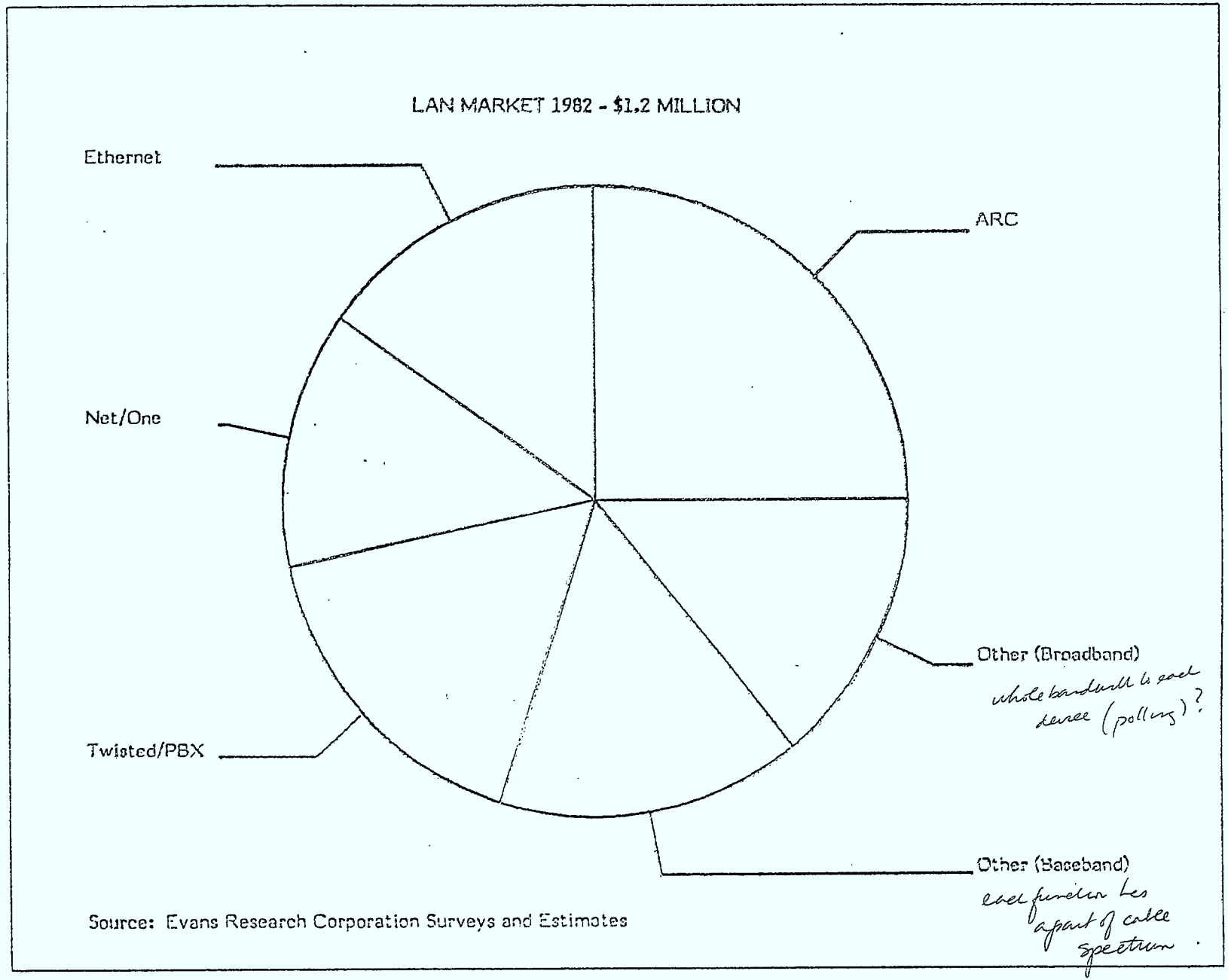


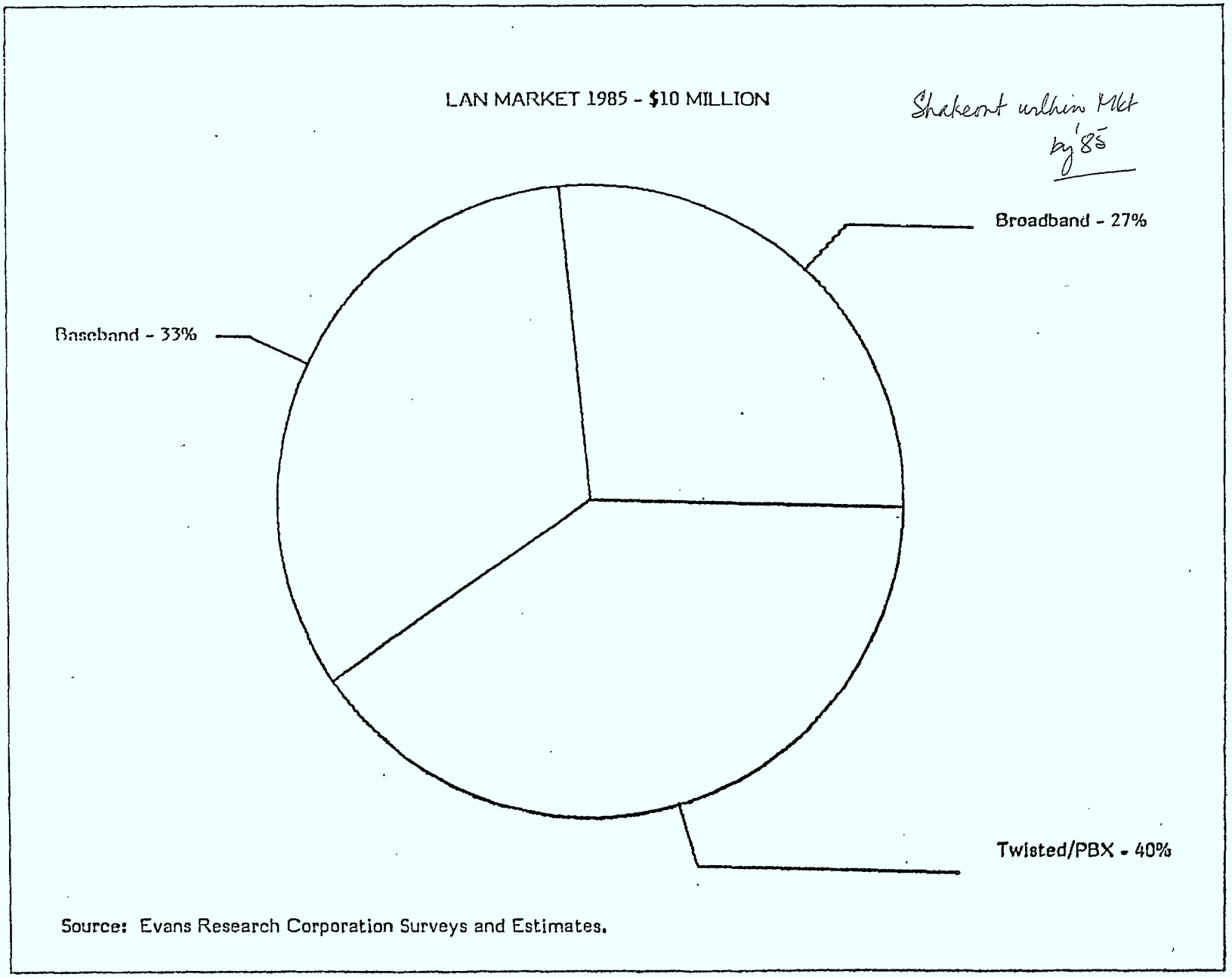
Source: Evans Research Corporation surveys and estimates.

CANADIAN LAN MARKET



Source: Evans Research Corporation Surveys and Estimates.


LAN MARKET 1982 - $1.2 MILLION
Ethernet
ARC
Net/One
Other (Broadband)
Twisted/PBX
Other (Baseband)
Source: Evans Research Corporation Surveys and Estimates


LAN MARKET 1985 - $10 MILLION
Shakeout within Mkt by '85
Broadband - 27%
Baseband - 33%
Twisted/PBX - 40%
Source: Evans Research Corporation Surveys and Estimates.

NEW INFORMATION TECHNOLOGIES AND EMPLOYMENT

- HISTORICAL PERSPECTIVE
- THE CURRENT DEBATE
- NATIONAL DIFFERENCES

TECHNOLOGICAL UNEMPLOYMENT
HISTORICAL CONTEXT

- TECHNOLOGICAL UNEMPLOYMENT IN IMPERIAL ROME: VESPASIANUS 75 AD
- LUDDITES 1811 - 1813
- TECHNOLOGICAL UNEMPLOYMENT ISSUE SINCE XIX.CENTURY
- AUTOMATION HYSTERIA 1960s
    - DON MICHAEL (1962): *CYBERNATION - THE SILENT CONQUEST*
    - THE NATIONAL COMMISSION ON TECHNOLOGY, AUTOMATION AND ECONOMIC PROGRESS (1966): *THE OUTLOOK FOR TECHNOLOGICAL CHANGE AND UNEMPLOYMENT*

    "AUTOMATION IS NOT DRAMATICALLY DIFFERENT FROM ANY OTHER TECHNOLOGICAL CHANGE"

    "GROWTH IS THE ANSWER TO UNEMPLOYMENT"

    - GHOST OF THE REPORT WITH US

TECHNOLOGICAL UNEMPLOYMENT
PRESENT SITUATION

- BETTER UNDERSTANDING OF THE DIFFUSION RATES OF NEW TECHNOLOGIES
  BETTER UNDERSTANDING WHY THE ALARMISTS OF 1960s WERE WRONG

- IS TODAY'S SITUATION DIFFERENT?

  - MICROELECTRONICS IS SAID TO DIFFUSE 7 - 10 TIMES FASTER

  - BACKDROP OF HIGH UNEMPLOYMENT - 28 MILLION OUT OF WORK IN OECD COUNTRIES

  - RESTRUCTURING OF GLOBAL MANUFACTURING SYSTEM

- IS AUTOMATION JOB SWEEP COMING WITH VENGEANCE?

TECHNOLOGICAL UNEMPLOYMENT
"OVERVIEW OF CURRENT DEBATES" REPORT

HIGHLIGHTS

- THE NATURE OF THE DEBATE IS ABOVE ALL POLITICAL

- SHARP POLARIZATION OF VIEWS
- OPTIMISM IN THE US AND JAPAN, PESSIMISM IN WESTERN EUROPE
- DIFFICULTY OF ASSESSMENT: NUMEROUS OTHER FACTORS AT PLAY
  (SUPPLY SIDE)
    - BABY BOOMERS
    - WOMEN
    - IMMIGRATION

  (DEMAND SIDE)
    - GLOBAL JOB MIGRATION
    - LACK OF DEMAND FOR OBSOLETE PRODUCTS
- DISTINCTION BETWEEN STRUCTURAL CHANGE AND TECHNOLOGICAL CHANGE
- JOB CREATION & DESTRUCTION SIMULTANEOUSLY

- NO ONE KNOWS WHAT THE NET JOB BALANCE WILL BE

- NO INHERENT REASON WHY HUMAN CANNOT BE REPLACED BY TECHNOLOGY

- DIFFICULT TO BUILD CONSENSUS

TECHNOLOGICAL UNEMPLOYMENT
THE CURRENT DEBATE SUMMARY

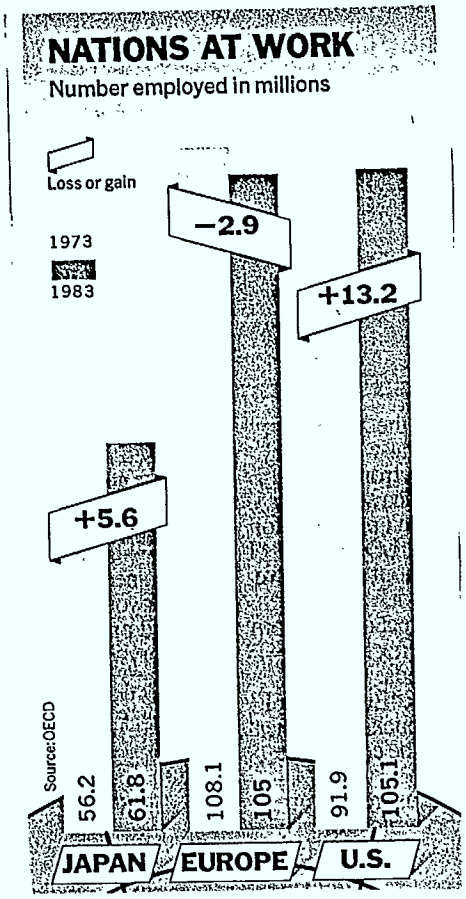
- A SHARP POLARIZATION OF VIEWS OF "OPTIMISTS" VS. "PESIMISTS"
- NO CONSENSUS ON THE NET JOB BALANCE
- DOES MICROELECTRONICS DESTROY MORE JOBS THAN IN CREATES?

    ★ UNRESOLVABLE AT PRESENT

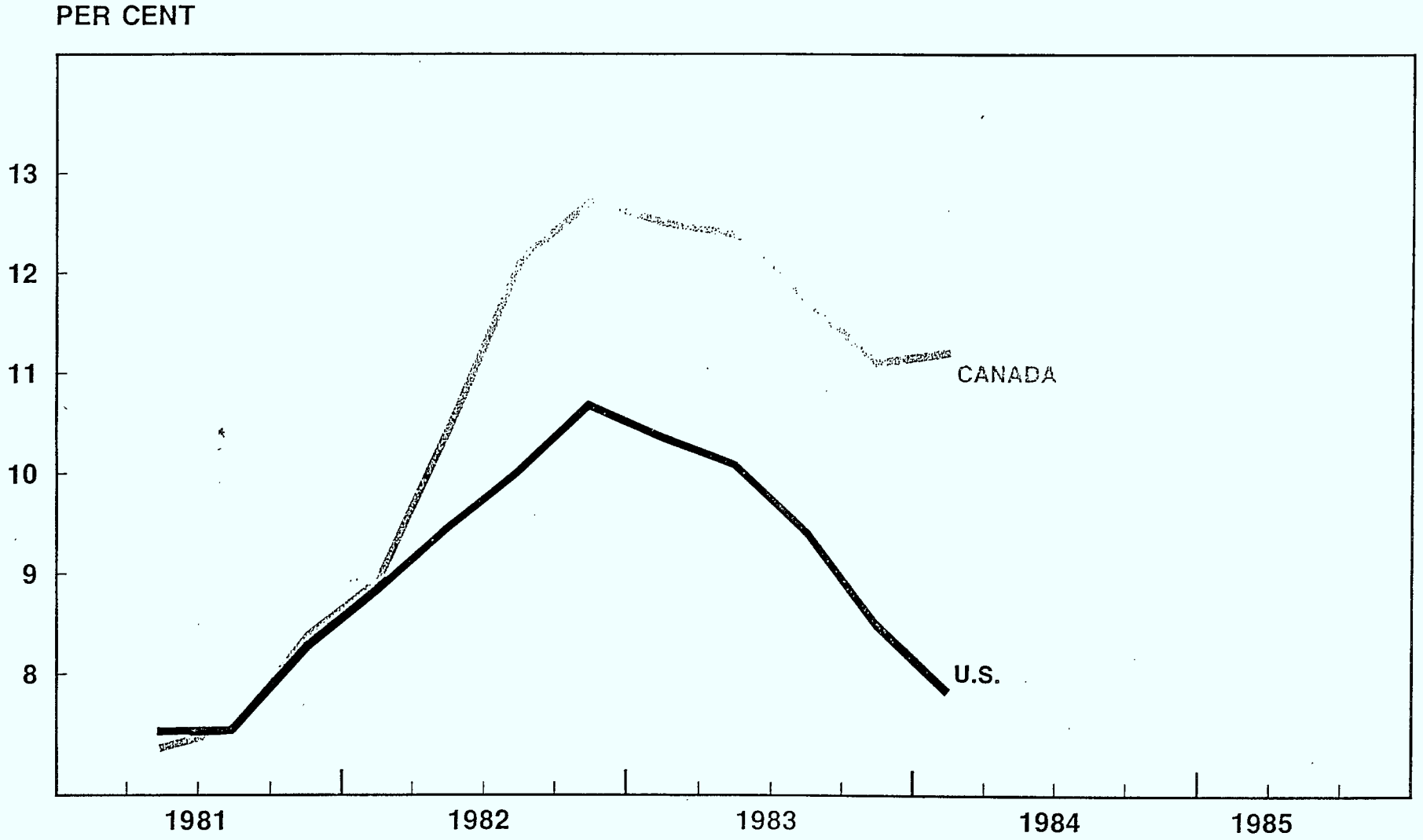
- OECD PESSIMISM

  "ONLY 60 PERCENT OF DIRECTLY - REDUCED JOBS WILL BE OFFSET BY 1990"

- INTERNATIONAL COMPETITIVNESS AND "JOB WARS"

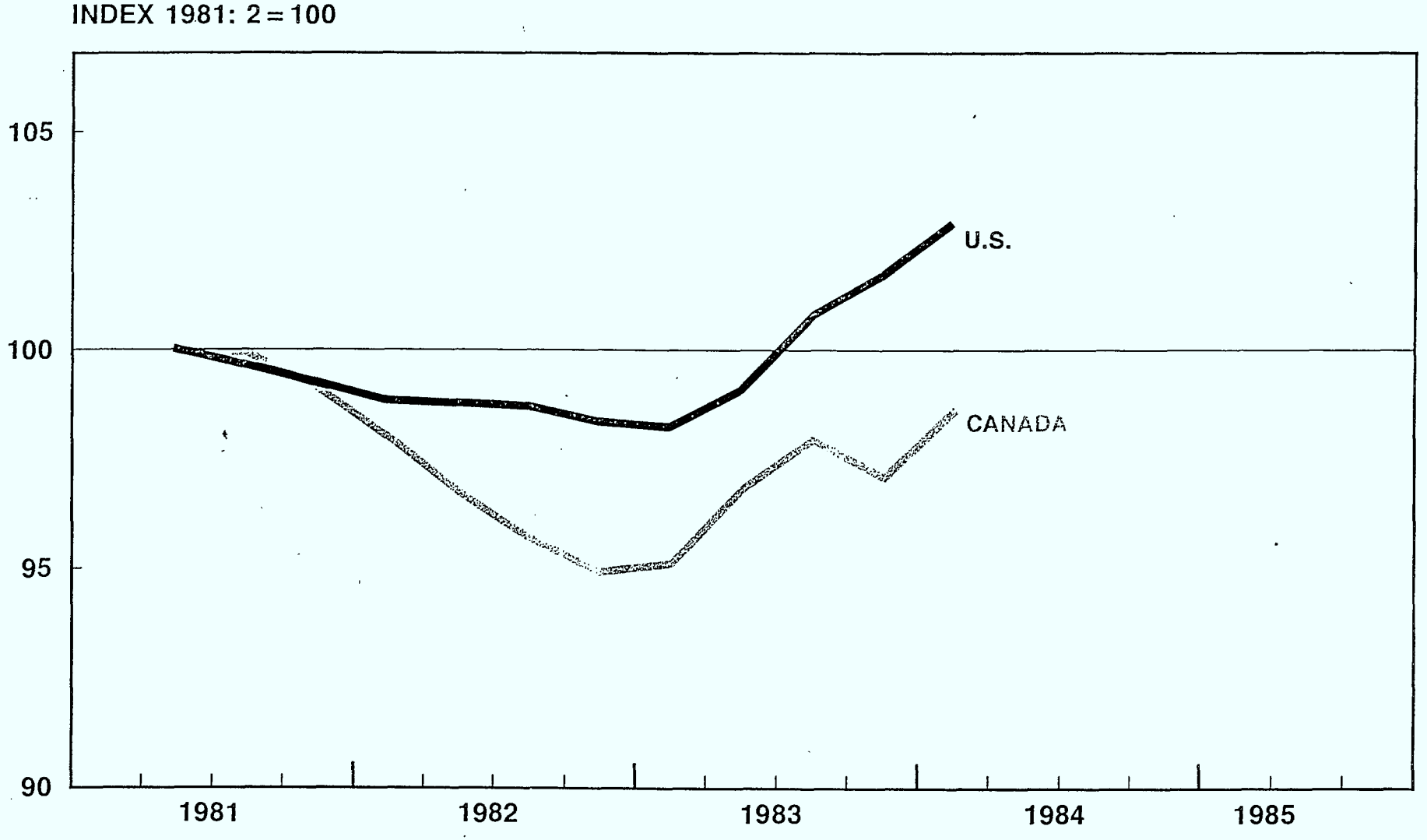

NATIONS AT WORK
Number employed in millions
Loss or gain
1973
1983
−2.9
+13.2
+5.6
56.2
61.8
108.1
105
91.9
105.1
JAPAN
EUROPE
U.S.
Source:OECD

UNEMPLOYMENT RATE



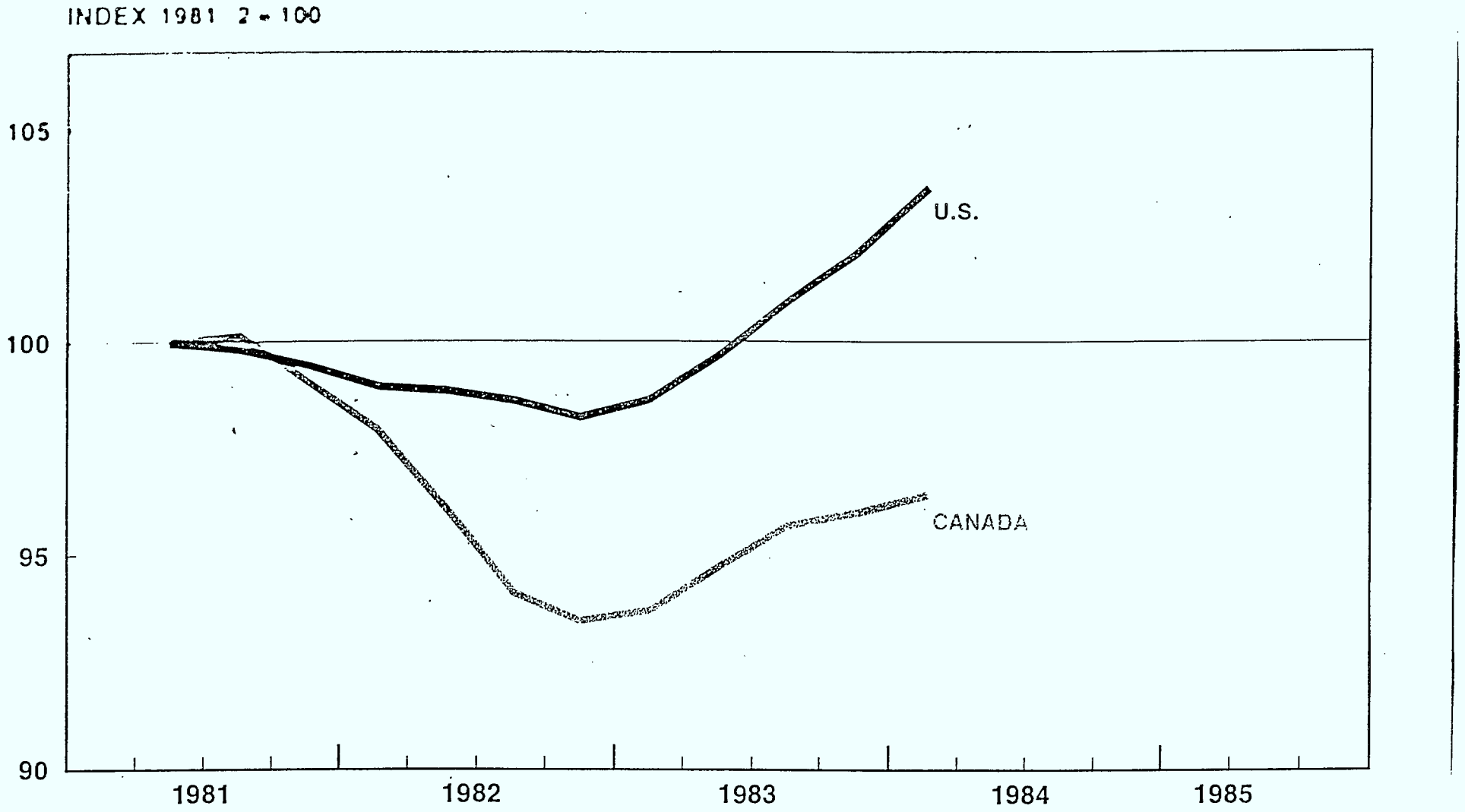
Source: Based on data from Statistics Canada and U.S. Department of Labor;

EMPLOYMENT



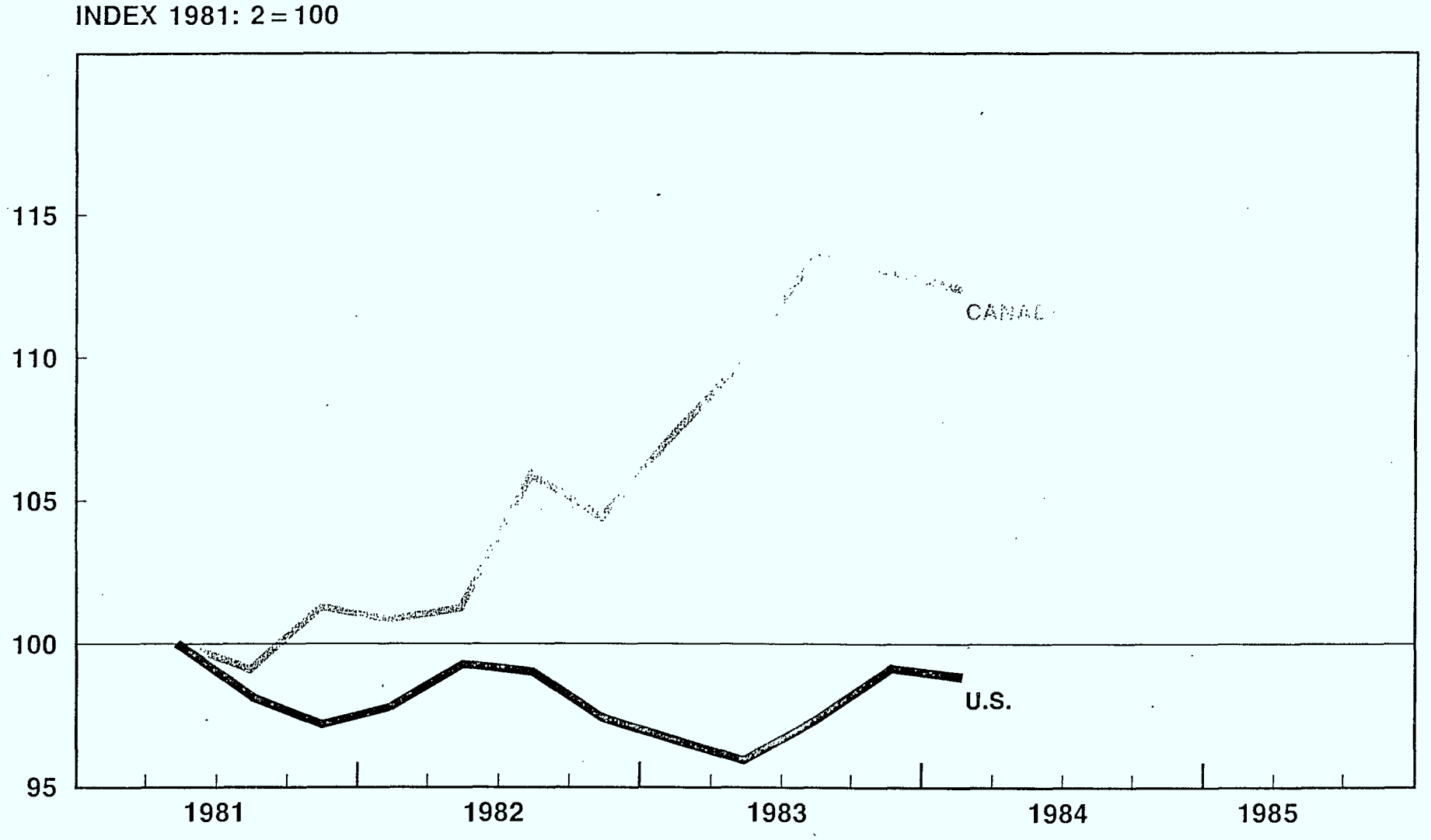
Source: Based on data from Statistics Canada and U.S. Department of Labor;

FULL-TIME EMPLOYMENT



Source: Based on data from Statistics Canada and U.S. Department of Labor;

PART-TIME EMPLOYMENT



Source: Based on data from Statistics Canada and U.S. Department of Labor:

LABOUR FORCE FORECAST

(ALL FIGURES IN MILLIONS)

	1991	2001
POPULATION	26.5	28.0
FEMALE 15+	10.5	11.4
MALE 15+	10.2	11.0
PARTICIPATION RATE		
FEMALE	58%	61%
MALE	78%	78%
LABOUR FORCE	14.0	15.6
FEMALE	6.1	7.0
MALE	8.0	8.6
EMPLOYMENT (NET ADDITIONAL JOBS REQUIRED*)		
UNEMPLOYMENT 6%	13.2 (2.4)	14.7 (3.9)
UNEMPLOYMENT 8%	12.9 (2.1)	14.4 (3.6)
UNEMPLOYMENT 10%	12.6 (1.8)	14.0 (3.2)
UNEMPLOYMENT 12%	12.3 (1.5)	13.7 (2.9)

(*ASSUMES 1984 EMPLOYMENT AT 10.8 MILLION)

- NOTE SLOWDOWN IN LF GROWTH AFTER 1990
- NOTE THAT EMPLOYMENT HERE MEANS JOBS NOT PERSON-HOURS WORKED

SOURCES OF GROSS EMPLOYMENT LOSS

EMPLOYMENT REDUCTIONS LIKELY FOR PRODUCTION OF PRESENT LEVEL OF GNP

1. ORGANIZATIONAL SLIMMIMG

   - REDUCTIONS IN MIDDLE MANAGEMENT, OVERHEAD AND WHITE COLLAR SUPPORT ACTIVITIES (THE INFORMATION SECTOR!)
   - MUCH ALREADY ACHIEVED IN PRIVATE SECTOR
   - PUBLIC SECTOR LAGGING BUT WILL BE PRESSED
   - IN GROSS TERMS MAYBE 10% OF EMPLOYMENT

2. INCREASED PRODUCTION EFFICIENCY

   - APPLIES TO DIRECT PRODUCTION ACTIVITY
   - IN GOODS AND SERVICES, WHERE REPETITIVE THROUGHPUT IS THE MODUS OPERANDI (THEREFORE INCLUDES SUCH THINGS AS DATA ENTRY, WORD PROCESSING, POST OFFICE, CHEMICAL ANALYSIS, ASSEMBLY LINE WORK, FARMING)
   - DIRECT PRODUCTION ACTIVITY ONLY 30-40% OF TOTAL EMPLOYMENT (EVEN IN MANUFACTURING ONLY ABOUT 70%, AND LESS IN HIGH WAGE SECTORS)
   - IMPACT LIKELY TO BE 50-100% INCREASE IN OUTPUT PER DIRECT PERSON HOUR WORKED IN THESE DIRECT PRODUCTION ACTIVITIES (E.G. TEXTILE AND CLOTHING 100% ESTIMATE; SUPER COWS; AUTOMATED SAWMILLS; AUTOMATIC TELLERS)
   - THEREFORE COULD BE 10-15% GROSS EMPLOYMENT IMPACT

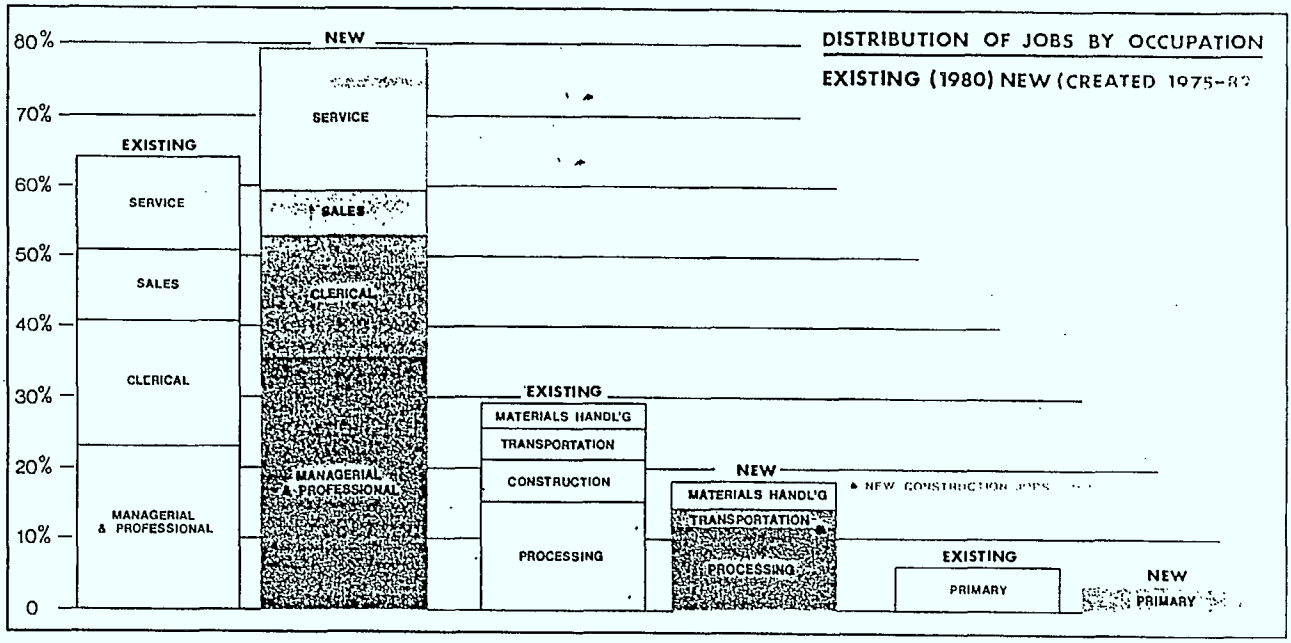
3. LACK OF COMPETITIVENESS

   - SOME WILL COME FROM DEPLETED RESOURCE BASES
   - THE REST SHOULD BE MAINLY IN LOW WAGE, LOW SKILL AREAS, IN THE FACE OF THIRD WORLD COMPETITION
   - BASICALLY THIS IS GOOD, BECAUSE IT REFLECTS GROWING PROSPERITY, HIGH WAGES AND EXCHANGE RATE, AND INCOME PROSPECTS FOR THE THIRD WORLD
   - WOULD BE BAD IF LOSSES COME FROM UNCOMPETITIVENESS BECAUSE OF LACK OF PRODUCTIVITY, BECAUSE WE FAILED TO SUFFER LOSSES IN CATEGORIES 1 AND 2 ABOVE
   - TOTAL IMPACT 5-10%

GROSS LOSSES IN ORDER OF 25-35% ..... 2.7 - 3.8 MILLION

SOURCES OF EMPLOYMENT GROWTH

1. GROWTH OF CONSUMPTION OF EXISTING "BASKET"
   - POPULATION INCREASE 11.6% TO 2001
   - PLUS PERHAPS 1% PER ANNUM INCREASE IN GNP PER CAPITA WITHIN THE PRESENT "BASKET" (MORE SPACE PER PERSON; MORE CARS PER FAMILY; MORE STEAK, LESS HOT DOGS; ETC.)
2. SERVICES BASED ON MICRO-ELECTRONICS
   - SOFTWARE, TRAINING, APPLICATIONS CONSULTING AND DESIGN
   - BUSINESS AND PERSONAL INFORMATION SERVICES
   - COMPUTER/TELECOMMUNICATIONS SYSTEMS MANAGEMENT
3. DECISION-SUPPORT SYSTEMS
   - DECISIONS AS THE KEY OUTPUT OF THE INFORMATION ECONOMY
   - TURNING DATA INTO INFORMATION AND INFORMATION INTO ADVICE
4. HEARING-EAR PERSONS
   - ACT AS TRANSLATORS (EARS) TO ENABLE MACHINES TO WORK WITH PEOPLE (AND WITH OTHER MACHINES)
   - E.G. TICKET AGENTS; TELLERS; DOCTORS?; PILOTS?
5. CHECKERS
   - PEOPLE WHO HAVE SOME CLAIM TO BE CONSULTED ABOUT THINGS
   - E.G. AUDITORS; LOBBYISTS; CITIZEN GROUPS; SOCIAL SCIENCE RESEARCHERS
   - TYPICALLY MORE CONCERNED WITH DISTRIBUTION THAN WITH PRODUCTION
6. CARING
   - ESPECIALLY FOR THE ELDERLY AND FOR CHILDREN OF WORKING MOTHERS
7. IMPROVEMENT
   - SELF (FITNESS; CONTINUING EDUCATION)
   - HOME (OFFSETS LOSSES IN NEW CONSTRUCTION)
8. LEISURE
   - TV PROGRAM PRODUCTION; RESTAURANTS; RETAIL



	New jobs created per $10 billion, 1975-82		Current jobs, 1980		
	Number	Percentage	Number	Percentage	Ratio of new to current percentage
Managerial & professional	118,000	35.0%	2,441,000	22.9%	1.53
Clerical occupations	59,000	17.5	1,871,000	17.6	0.99
Sales	19,000	5.6	1,106,000	10.4	0.54
Service	70,000	20.8	1,414,000	13.3	1.56
SUB-TOTAL	266,000	78.9	6,832,000	64.2	1.23
Processing	40,000	11.9	1,646,000	15.4	0.77
Construction	– 1,000	0.3	650,000	6.1	– 0.05
Transportation	9,000	2.7	437,000	4.1	0.66
Materials handling	12,000	3.6	418,000	3.9	0.92
SUB-TOTAL	60,000	17.9	3,151,000	29.5	0.61
Primary (resource)	11,000	3.3	672,000	6.3	0.52
Total	337,000	100.0	10,655,000	100.0	1.00

NEW EMPLOYMENT

- NO SHORTAGE OF WORK TO BE DONE
- POSSIBLE SHORTAGE OF ACCEPTABLE PAID WORK?
- THREE JOB CREATING MECHANISMS:
    - REDUCING HOURS WORKED PER PERSON
    - MONETIZATION OF UNPAID WORK
    - SPECIALIZATION
- NEW VIEW OF WORK?

IMPACT OF NEW TECHNOLOGIES ON ORGANIZATIONS

- SIZE
- STRUCTURE
- MANAGEMENT CONTROLS

IMPACT ON OGANIZATIONS

WHAT DO WE KNOW?

- SOCIOLOGICAL ACCOUNTS WEAK AND CONFLICTING
- NO PAUCITY OF CONFLICTING IMAGES BY THEORISTS:

  ACCOUNTS OF BOTH STRENGTHENING AND WEAKENING OF THE POWER OF LOWER - LEVEL PARTICIPANTS IN AN ORGANIZATION

- IMAGES RELATIVELY REMOTE FROM EMPIRICAL STUDIES
- MOST OF EMPIRICAL STUDIES ARE EXPLORATORY, WEAK BOTH THEORETICALLY AND METHODOLOGICALY
- STAFF STUDIES: CLERKS
  MANAGERS

  BUT NOT OTHER GROUPS

IMPACTS ON ORGANIZATIONS

- MUCH LARGER IMPACT ON INDUSTRIAL PROCESSES THAN ON HUMAN ORGANIZATIONS

- SUBSTANTIAL CHANGES IN THE SIZE AND SHAPE OF ORGANIZATIONS

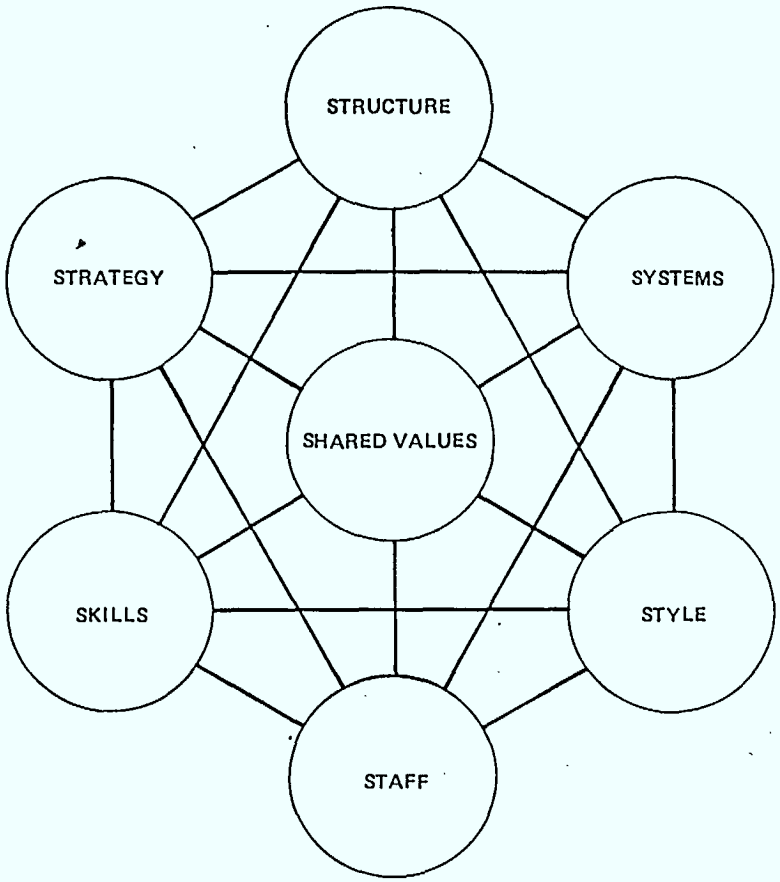
- WOODWARD,J. (1965): *INDUSTRIAL ORGANIZATION*

- "HAPPY ATOM" MODEL (Mc KINSEY)

- CHANGES IN SYSTEMS
  IMPLY CHANGES IN STAFF

- CHANGES IN STAFF:
  - — REDUCTION OF CLERICAL/SUPPORT STAFF
  - — SHRINKING OF MIDDLE MANAGEMENT

McKINSEY 7-S FRAMEWORK ©



THE IMPACT OF TECHNOLOGY ON ORGANIZATIONAL BEHAVIOUR

DIRECT EFFECTS	• IMPROVEMENTS IN PRODUCTIVITY VIA INCREASED SPEED AND EFFICIENCY • CHANGES IN PHYSICAL AND MENTAL REQUIREMENTS OF TASKS • CHANGES IN LOCATION • CHANGES IN REQUISITE BEHAVIOUR
SECOND ORDER EFFECTS	• CHANGES IN REQUIREMENTS FOR CO-ORDINATION OF ACTIVITIES • CHANGES IN ROLES AND RELATIONSHIPS • DEVELOPMENT OF IMPLICIT PSYCHOLOGICAL CONTRACTS INVOLVING TRADE-OFF BETWEEN REQUISITE BEHAVIOUR AND REWARDS • CHANGES IN ATTITUDES TOWARD ORGANIZATION
THIRD ORDER EFFECTS	• CHANGES IN CRITERIA FOR LIVING AND PERFORMANCE • DEVELOPMENT OF ORGANIZATIONAL STRUCTURE: FLUID AND ADAPTABLE OR STABLE AND RIGID • DEVELOPMENT OF SELF-CONCEPT AND IDENTIFICATION WITHIN THE ORGANIZATION
FOURTH ORDER EFFECTS	• CHANGES IN INTERORGANIZATIONAL RELATIONS • CHANGES IN RELATIONS WITH LARGER SOCIETY

Source: Based on Pasmore, *et. al.*, (25, *op. cit.*).

IMPACT ON ORGANIZATIONS

- IMPACTS ARE NOT RIGID AND DETERMINISTIC
- A CONSIDERABLE RANGE OF CHOICE EXISTS IN PRINCIPLE
- GROWING IMBALANCE IN SOPHISTICATION BETWEEN TECHNOLOGY AND SOCIAL SUBSYSEMS

(Blumberg, Gerwin)

Technology determines
Things more than need be
" social subsystems
are not keeping up

IMPACTS ON ORGANIZATIONS

SIZE

EXISTING ORGANIZATIONS

- TRENDS BOTH WAYS
  TOWARDS LARGER/SMALLER SYSTEMS

- ENLARGEMENT
  TREND TOWARDS A TRANSNATIONAL NETWORK OF ON-LINE TERMINALS CONNECTED TO LARGE CENTRAL COMPUTERS

- DOWNSIZING:
  SKELETON CREWS OF FEWER GENERALISTS PLUS INFORMATION NETWORK REPLACES MORE SPECIALISTS

  TRENDS TOWARDS SELF - SERVICE BY CLIENTS

IMPACT ON ORGANIZATIONS

SIZE

NEW ORGANIZATIONS

- NEW TECHNOLOGY IS
  ENABLING A MUCH FASTER
  GROWTH OF THE ORGANIZATION

- NEW MINI — MULTINATIONALS

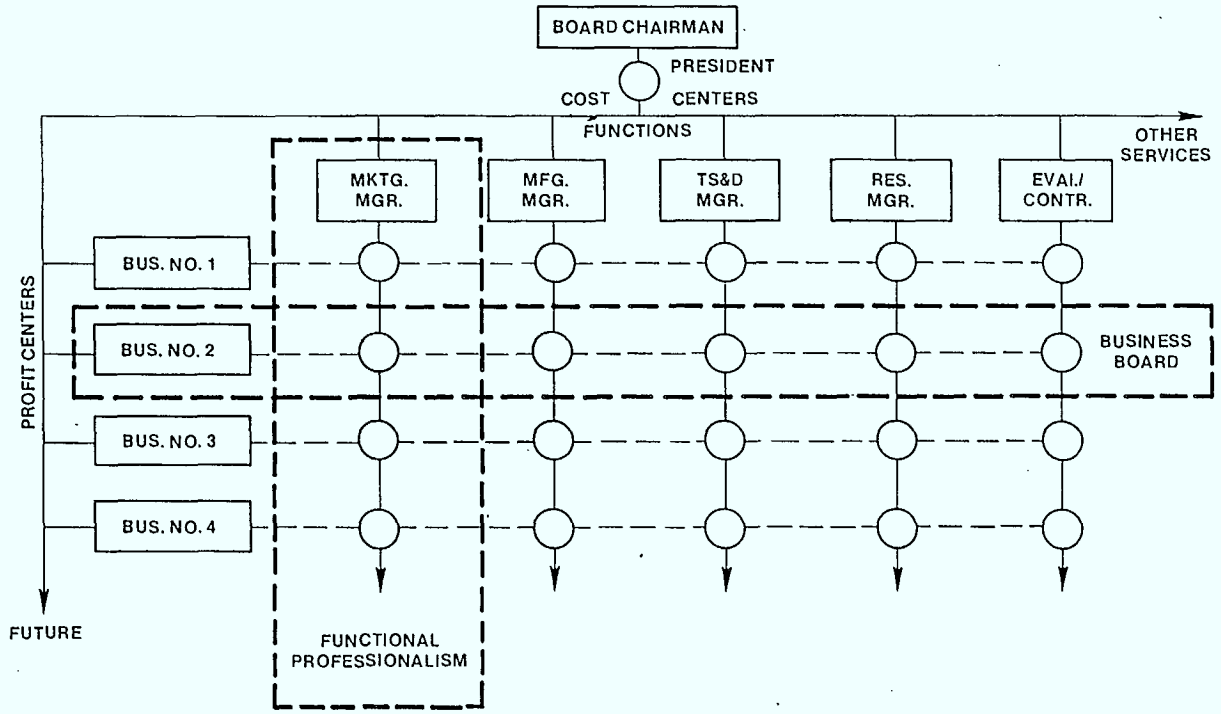
E.G.MITEL

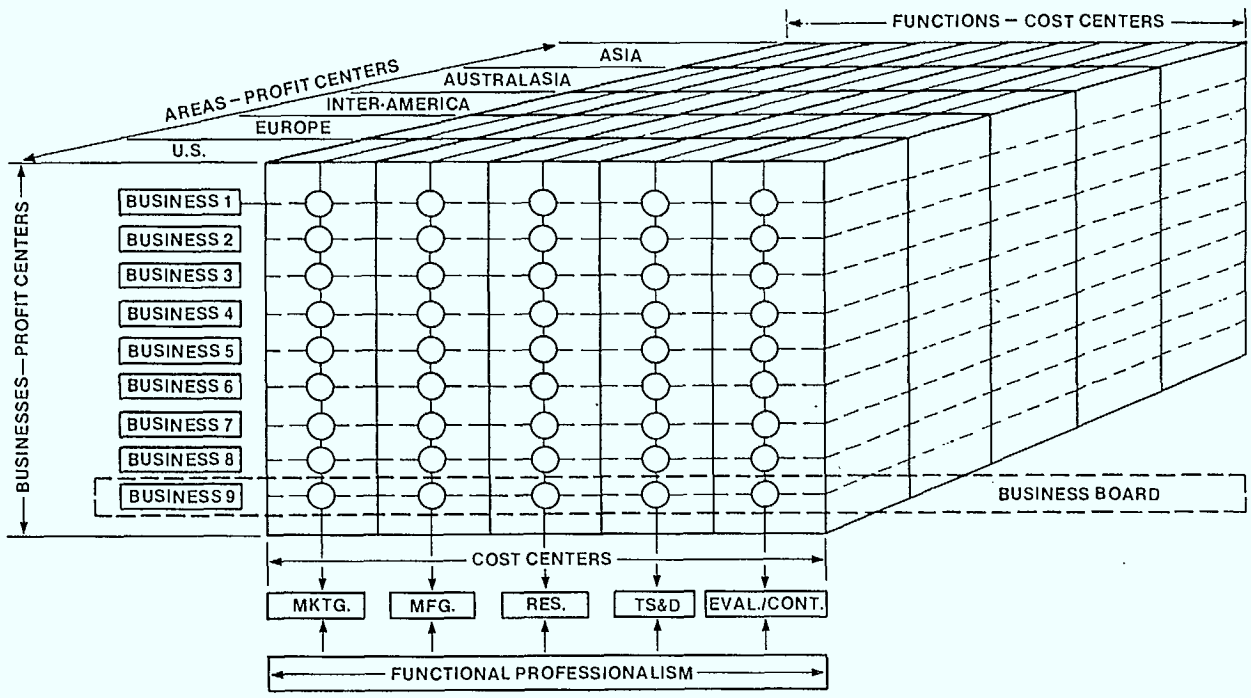
IMPACTS ON ORGANIZATIONS

SHAPE

- TRANSFORMATION OF THE HIERARCHICAL STRUCTURE
- FLATTER STRUCTURE
- BARREL STRUCTURE
- X — STRUCTURE
- MATRIX STRUCTURE
- SOGOSHOSHA STRUCTURE

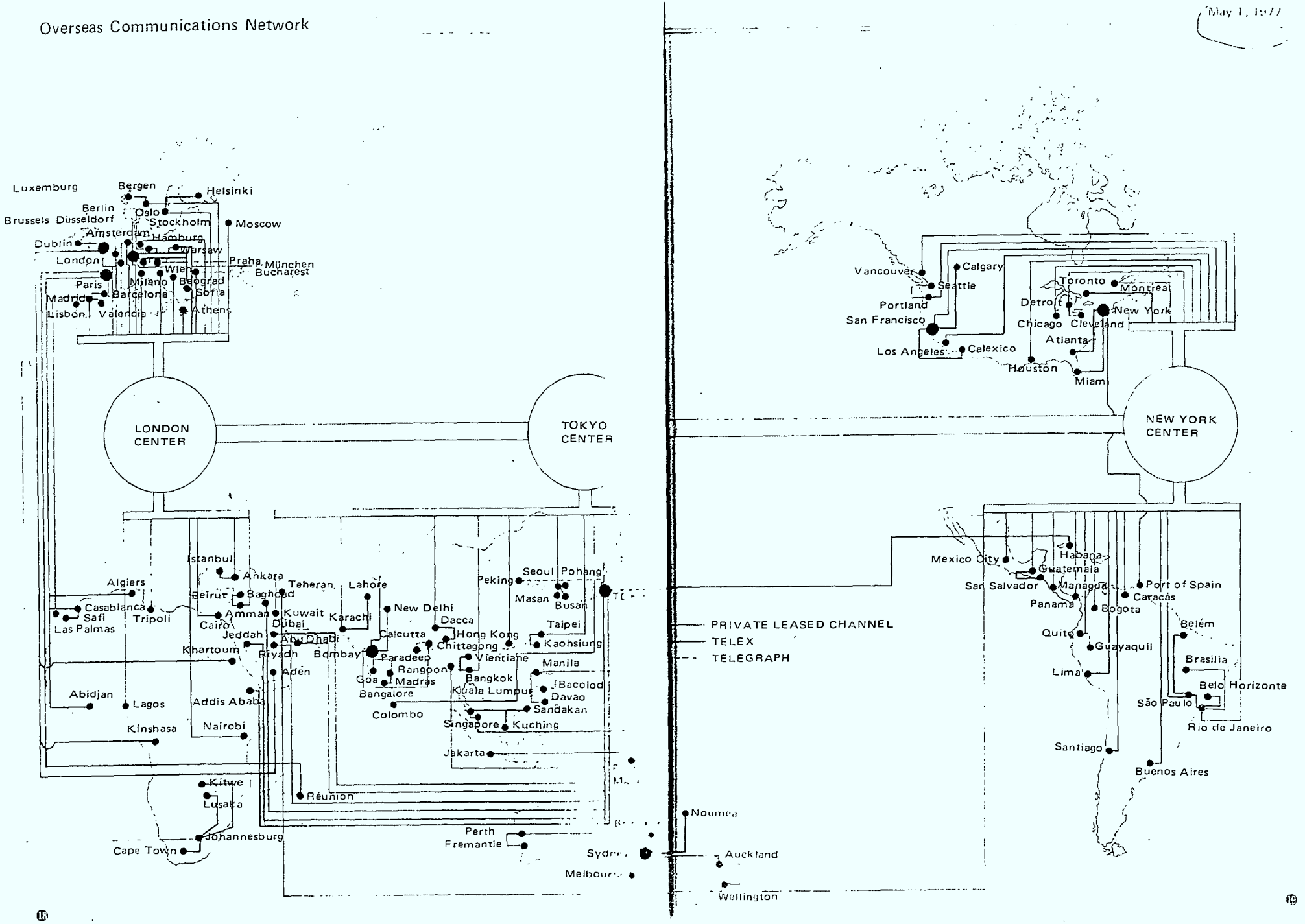
Dow Corning — From Product-Function Matrix . . .
To Multidimensional Organization





Overseas Communications Network

May 1, 1977



IMPACTS ON ORGANIZATIONS

NEW ORGANIZATIONAL FORMS

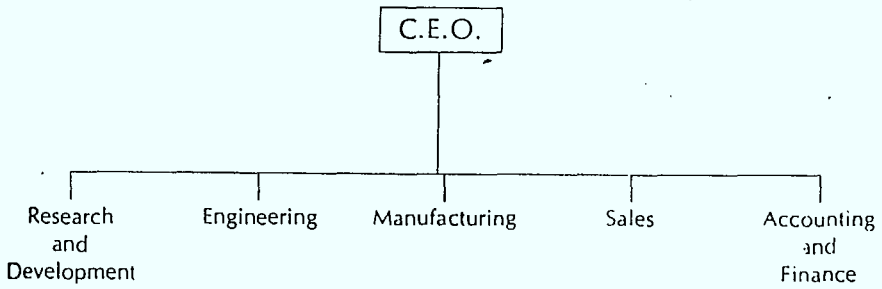
- ONE PERSON, TWO ROBOT COMPANY
- PARTNERSHIP
- NEW MINIMULTINATIONALS
- CONSTELLATIONS

IMPACT ON ORGANIZATIONS

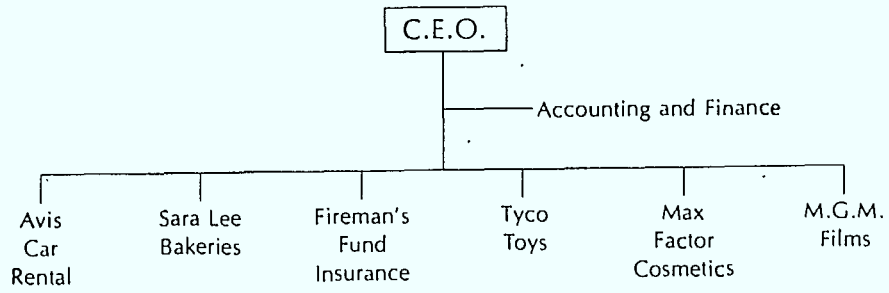
MANAGERIAL CONTROL

- TRENDS TOWARDS EMBEDDING THE OGRANIZATION EXPERTIZE IN THE COMPUTER SOFTWARE
- GATHERING INFORMATION AND USING IT TO CONTROL OPERATIONS: INCREASING PRIORITY
- MANAGERIAL CONTROL OF THE ORGANIZATION THROUGH SIX FUNDAMENTAL PRINCIPLES OF "SCIENTIFIC MANAGEMENT" AND "ORGANIZATIONAL DECENTRALIZATION" NOT ERODED, BUT STRENGTHENED
- DECREASE OF CLOSENESS OF SUPERVISION DUE TO NEW TECHNOLOGIES IS REPORTED

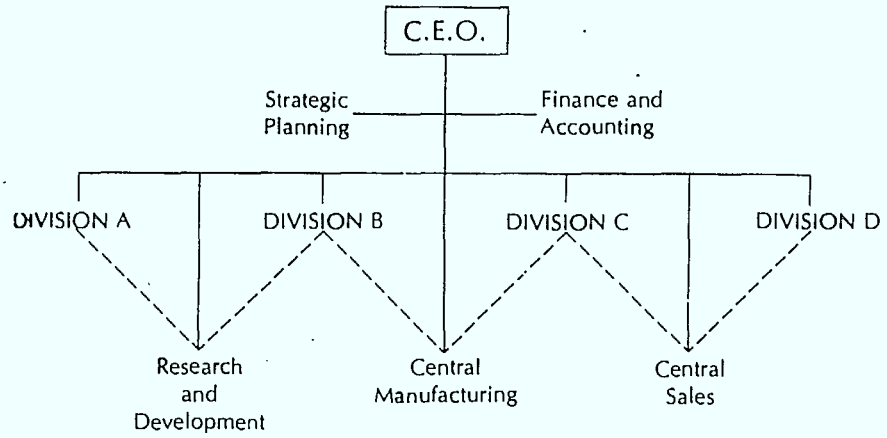
(Kling, 1978)



U-FORM ORGANIZATION



H-FORM ORGANIZATION



M-FORM ORGANIZATION

SIX MANAGERIAL CONTROL PRINCIPLES

SCIENTIFIC MANAGEMENT: BRAVERMAN (1974)

1 "DISSOCIATE THE LABOUR PROCESS FROM THE SKILLS OF THE WORKERS"

2 "SEPARATE CONCEPTION FROM EXECUTION"

3 "USE THIS MONOPOLY OF KNOWLEDGE TO CONTROL EACH STEP OF THE PROCESS AND ITS MODE OF EXECUTION"

ORGANIZATIONAL DECENTRALIZATION: CHANDLER (1962)

4 "ASSOCIATE RELATED WORK RATHER THAN ASSOCIATE IDENTICAL FUNCTIONS"

5 "GIVE FULL AUTHORITY AND INDIVIDUAL RESPOSIBILITY TO THE BUSINESS UNIT MANAGER"

6 "CERTAIN ORGANIZATION FUNCTIONS SHOULD BE CENTRALIZED"

TRENDS IN CAPTURING EXPERTIZE FOR OPERATIONS CONTROL

A CASE STUDY (Clement, 1984)

1 ON-LINE DATA SYSTEM "KNOWS" INCREASINGLY MORE ABOUT THE WORK DONE

2 COMPUTER PROGRAMS REPRESENT A RADICAL SEPARATION OF CONCEPTION FROM EXECUTION

3 TREND TOWARDS MONOPOLY:
ON-LINE COMPUTER "KNOWS" PROCEDURES AND POLICY INFORMATION, BUT NOT YET MANAGEMENT INFORMATION

4 CREATION OF SELF-CONTAINED OPERATING UNITS

5 INDIVIDUAL RESPONSIBILITY WITH AUTHORITY

6 RETAIN OVERALL CONTROL

IMPACT ON ORGANIZATIONS

CENTRALIZATION AND DECENTRALIZATION

- CENTRALIZATION: REASONS
  - ECONOMY OF SCALE
  - COORDINATION OF INTERDEPENDENT ACTIVITIES
  - CONTROL LOWER-LEVEL ACTIVITIES FOR HIGHER-LEVEL GOALS

- PERCEPTION OF AUTONOMY
  KAUFMAN, H. *FOREST RANGER*

- EFFECTS OF COMMUNICATIONS TECHNOLOGY
  - COUNTERVAILING TRENDS
  - PROBLEM OF ABSORBING INFORMATION
  - ROLE OF THE MANAGEMENT STYLE

- EFFECTS OF COMPUTER TECHNOLOGY
  - MODELLING AND ANALYSIS
  - INFORMATION STORAGE AND RETRIEVAL
  - ALTERNATIVE ANALYSES FEASIBLE
  - LOCUS OF DECISIONMAKING MORE DIFFUSED
  - QUALITATIVE CHANGE IN DECISION MAKING

IMPACT ON ORGANIZATIONS

ORGANIZATIONAL POWER

- WHAT IS POWER?
- INCREASE OF INFLUENCE OF DATA CUSTODIANS
- ALTERNATION OF PATTERNS OF INFLUENCE
  - UNINTENDED
    (COPENHAGEN STUDY, 1977)
  - CONSCIOUS MANOUVRES
    (IRVINE STUDIES 1978, 1979)
- INCREASE OF INFLUENCE OF TOP MANAGMENT
  (DOWN, 1967)
- NEW SYSTEMS OFTEN SERVE AS POLITICAL POWER - REINFORCING INSTRUMENTS

COMPUTERISATION AND SKILL LEVELS

QUESTION: DO COMPUTERS REQUIRE MORE
OR FEWER SKILLS FOR JOBS?

ANSWERS: DIFFICULT BECAUSE

- SKILLS ARE HARD TO MEASURE
  - FORMAL REQUIREMENTS
  - HIGHER EDUCATION

DO NOT NECESSARILLY MEAN MORE SKILL NEEDED

- CONTROLLED EXPERIMENTS RARE
- OTHER FACTORS AFFECT PERFORMANCE
  - ATTITUDES
  - TRAINING
  - MANAGEMENT APPROACH
  - UNION CO-OPERATION
- THERE IS A TENDENCY TO OVEREMPHASIZE IMPORTANCE OF NOVELTY
- CLOSELY - RELATED, BUT DIFFERENT FACTORS ARE IMPORTANT
  - ACCURACY
  - RESPONSIBILITY

SKILL CHANGES ON INTRODUCING COMPUTERS

CHANGES IN SKILL LEVEL - %

INDUSTRY	PROCESS	LABOUR DIRECT	LABOUR OVERALL
BANKING	DEPOSIT ACCOUNTING	+ 9.8 + 15.8	+ 26.0
STEEL MAKING	ANNEALING	+ 23.3 + 8.8 + 50.0 - 3.0	+ 4.7
AEROSPACE	MACHINING	- 2.5 - 10.0	
POWER GENERATION	PLANT OPERATION	+ 43.8 + 95.5	- 6.3
PETROLEUM	CRACKING PLANT	0.0	- 11.6
AIR TRANSPORTATIONS	RESERVATIONS	+ 18.5 + 5.0	

(CROSSMAN AND LAMER 1969)

RECENT CONCLUSIONS

MICROELECTRONICS, PRODUCTIVITY AND EMPLOYMENT
OECD, PARIS, 1981

- INDUSTRIAL PRODUCTION
  - FEWER WORKERS DOING ROTE ASSEMBLY
  - CRAFTSMEN REPLACED BY ROBOTS
  - INCREASED NEED FOR THOSE INSTALLING, MAINTAINING MACHINES

- SERVICE SECTOR
  - REDUCED NEED FOR ROUTINE, INFORMATION HANDLING JOBS CLERKS, TELLERS

- MANAGEMENT
  - REDUCED NEED FOR LOW - LEVEL JOBS
    - SUPERVISION
    - SCHEDULING
    - REPORT PREPARATION
  - INCREASED ROLE TOWARDS PREPARING AND TRANSMITTING INFORMATION FOR SENIOR MANAGEMENT

GENERALLY

- UPGRADING OF SKILLS MORE USUAL BUT HIGHLY INDUSTRY - DEPENDANT

- AT RISK ARE
  - UNSKILLED WORKERS
  - THOSE WITH LOW TECHNICAL, EDUCATIONAL QUALIFICATIONS
  - WOMEN

- MUCH RETRAINING NEEDED

- BECAUSE OF UNCERTAINTY ABOUT KINDS OF SKILLS NEEDED PERIODIC RETRAINING MUST BE EXPECTED
  - FLEXIBILITY IS ESSENTIAL

THEORETICAL DEBATE

ONE SCHOOL: (BRAVERMAN, WOOD,...)

COMPUTERS ARE MOST RECENT DEVELOPMENT
IN A LONG PROCESS DESCRIBED/ADVOCATED BY
ADAM SMITH, CHARLES BABBAGE, FREDERICK TAYLOR

MANAGEMENT SEEKS TO SIMPLY/CONTROL WORK PROCESS

RESULTS IN WORKERS WHO:

- HAVE LIMITED SKILLS
- ARE EASILY TRAINED, REPLACED
- ARE PAID LESS

EXAMPLES: CANADA POST
TITLES AT MANULIFE

ALTERNATIVE SCHOOL

QUALITY OF WORKING LIFE (QWL)

SOCIOTECHNICAL SYSTEMS FRAMEWORK (STS)
BO HEDBERG, ENID MUMFORD, ...
ERIC TRIST, HANS VAN BEINUM, KEITH NEWTON,...

THE INCREASED PRODUCTIVITY ACHIEVED THROUGH APPLICATION OF TECHNOLOGY MAKES POSSIBLE A REDESIGN OF WORKPLACE IN WHICH THERE IS

- CODETERMINATION ABOUT WORKING PROCEDURES, ENVIRONMENT
- TASK ROTATION
- SYSTEMATIC PLANNING
- ANTICIPATORY/CONTINUOUS LEARNING

QUESTION

UNIONS IMMEDIATE CONCERNS

- JOB SECURITY
- RETRAINING
- ACHIEVING A SHARE OF PRODUCTIVITY GAINS

IF QWL/STS APPROACH IS ACCEPTED

WILL UPGRADING OF SKILLS
INCREASED RESPONSIBILITY OF WORKERS

MEAN A BLURRING OF LINES OF DISTINCTION
BETWEEN WORKERS AND MANAGEMENT?
WEAKENING OF CLASS DISTINCTIONS AND UNIONS?

THE PRESENT INFORMATION PROCESSING MARKET

Segment	Approximate 1981 Revenue
Date Processing	$41 billion[1]
Mainframes	
Minicomputers	
Peripheral equipment and terminals	
Personal computers	
Software and services	
Media and supplies	
Office Equipment	$10 billion[1]
Typewriters and word processors	
Copiers	
Microimage systems	
Facsimile equipment	
Communications	$69 billion[2]
Telephone service	
Telex and data services	
Customer-premise equipment	
Information Dissemination	$30 billion[2]
Newspaper and magazine publishing	
TV and radio broadcasting	

1. Arthur D. Little, Inc., estimates.
2. *1982 U.S. Industrial Outlook, Bureau of Industrial Economics, U.S. Department of Commerce*

BRAVE NEW WORLD

- NEW DUOPOLY OF THE USA AND JAPAN
- ELECTRONIC PRODUCTION OF MAJOR COUNTRIES

	1965		1980	
	US $ Billion	%	US $ Billion	%
USA	18	69	104	58
JAPAN	1	7	38	21
TOTAL FOR MAJOR 6 COUNTRIES	25	100	179	100

SOURCE: MITI, 1982

CANADA'S POSITION IN THE WORLD INFORMATION PROCESSING INDUSTRY

- GROSS WORLDWIDE REVENUE — 1981 US $ 150 BILLION
  1991 US $ 450 BILLION
- CANADIAN SHARE SHOULD BE SOME 4 PER CENT
- WORLDWIDE REVENUE — 1984 US $ 260 BILLION
- 4 PER CENT — US $ 10.5 BILLION
- CANADA ACTUALLY — 1984 US $ 6.4 BILLION

CANADIAN SHARE IS 2,5 PER CENT

- WORSENING OF THE SITUATION

TECHNOLOGICAL CAPABILITY

COMPUTER HARDWARE
- COMPONENTS
- MAINFRAMES
- MINIS
- MICROS

COMPUTER SOFTWARE

DATA COMMUNICATIONS

SATELLITES

R&D CAPABILITY
MAINPOWER, EDUCATION, TRAINING

MARKET SHARE
EXPORT CAPABILITY

NATIONAL TECHNOLOGICAL STRATEGY
- R&D
- TECHNOLOGY TRANSFER
- PUBLIC AWARNESS

C&C STRATEGY
- GOALS
- ARTICULATIONS
- INSTRUMENTS (BOTH SUPPORTIVE AND INHIBITIVE)
- INSTITUTIONS
- THRUSTS

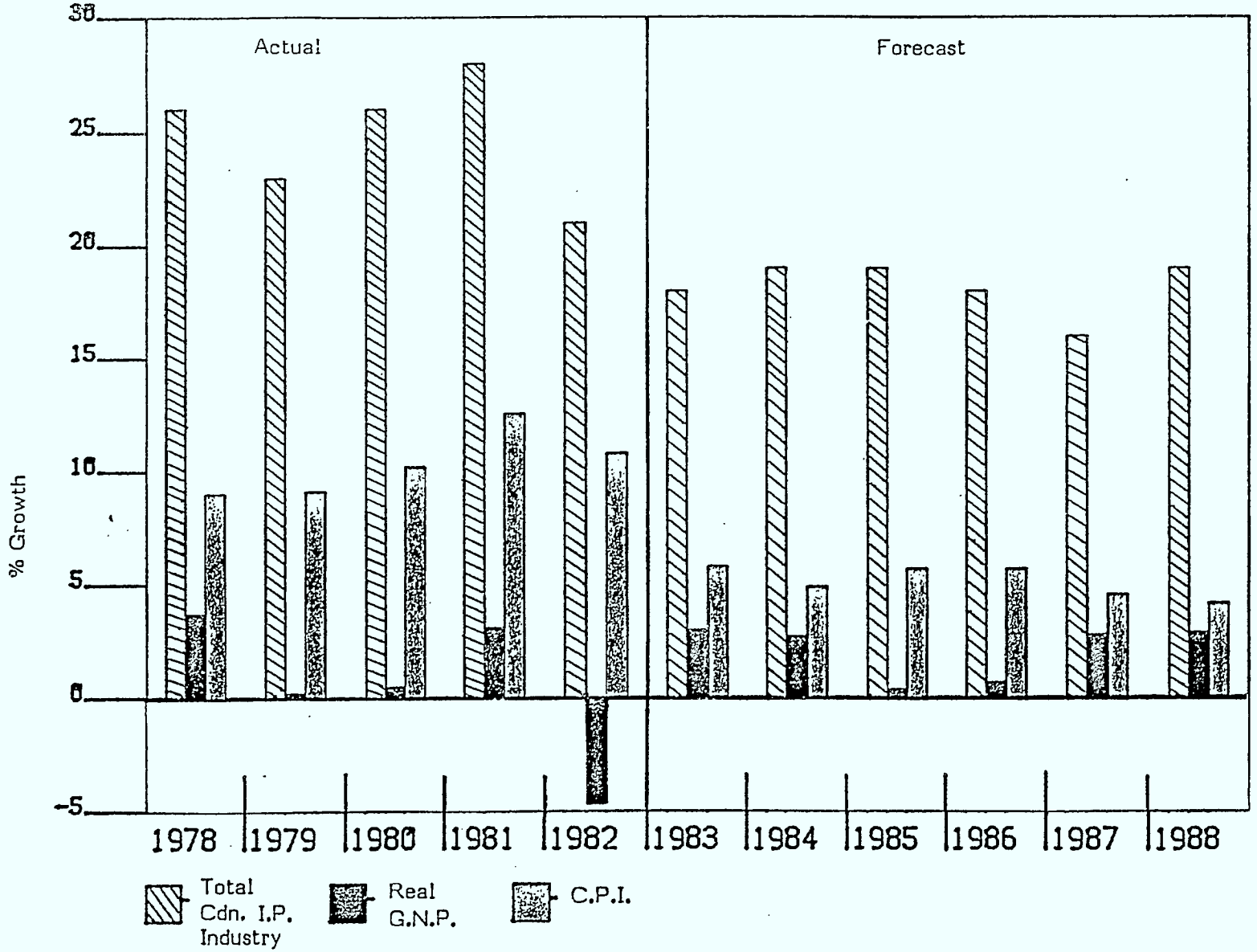
CANADIAN INFORMATION PROCESSING INDUSTRY REVENUE FORECAST TO 1988

(C$ Millions - Includes Exports)

	Actual			Forecast					
	1980	1981	1982	1983	1984	1985	1986	1987	1988
Hardware									
Sales, Lease, Rental	2,183	2,770	3,415	4,030	4,830	5,785	6,860	7,925	9,400
Maintenance	450	600	730	860	990	1,140	1,310	1,485	1,750
Total Hardware	2,633	3,370	4,145	4,890	5,820	6,925	8,170	9,410	11,150
Annual Growth (%)	25	28	23	18	19	19	18	15	18
Services									
Software									
Application Packages	62	95	154	220	310	410	560	725	1,010
Systems Packages	111	164	221	290	370	475	620	780	1,010
System Development	172	216	265	315	380	500	600	710	820
Total Software	345	475	640	825	1,060	1,385	1,780	2,215	2,840
Annual Growth (%)	50	38	35	29	28	31	29	24	28
Consulting, Education, Misc.	210	270	310	380	450	525	620	710	840
Annual Growth (%)	24	29	15	23	18	17	18	15	18
Processing Services	550	655	700	755	800	840	880	910	940
Annual Growth (%)	17	19	7	8	6	5	5	3	3
Total Services	1,105	1,400	1,650	1,960	2,310	2,750	3,280	3,835	4,620
Annual Growth	27	27	18	19	18	19	19	17	20
TOTAL REVENUES	3,738	4,770	5,795	6,850	8,130	9,675	11,450	13,245	15,770
ANNUAL GROWTH (%)	25	28	21	18	19	19	18	16	19

Source: Forecast by Evans Research Corporation based on (1) Statistics Canada figures for 1980 and 1981; (2) Evans Research Corporation's annual survey of the top firms in the Canadian computer industry.

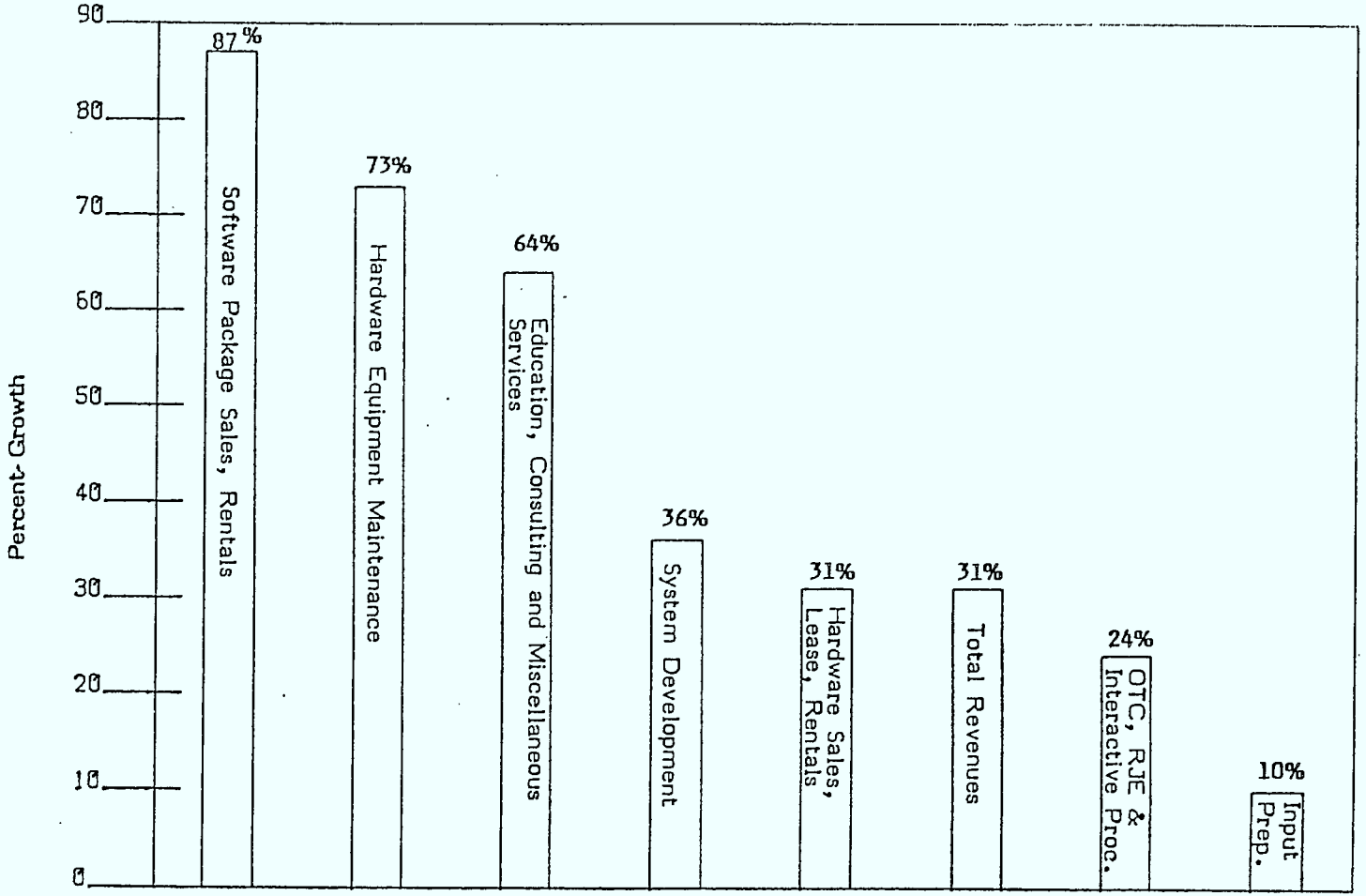
REVENUE GROWTH IN THE CANADIAN INFORMATION PROCESSING INDUSTRY



Source: G.N.P. and C.P.I. actuals - Statistics Canada. G.N.P. and C.P.I. Forecasts - Conference Board of Canada. Information Processing Industry actuals and Forecasts - Evans Research Corporation

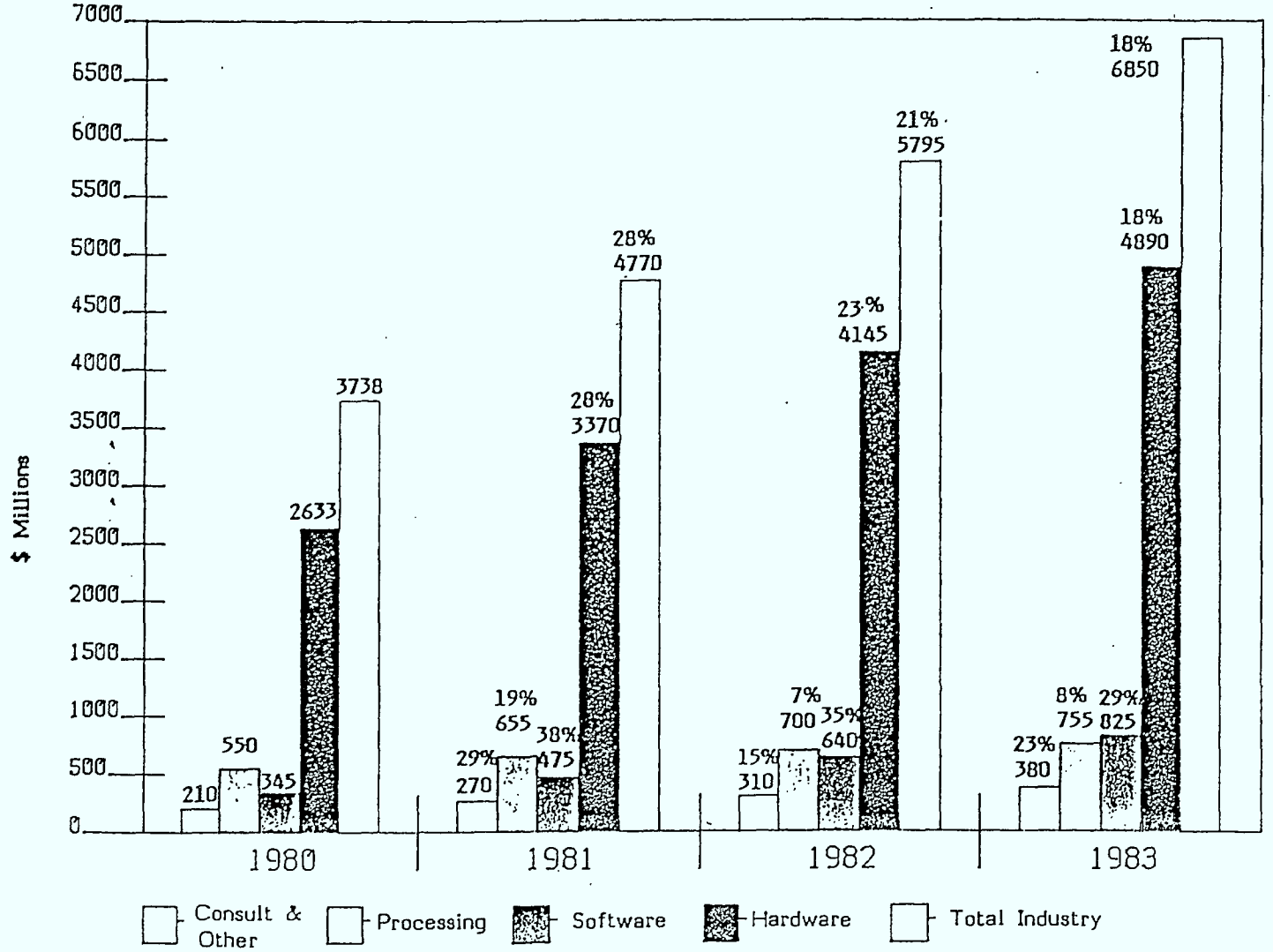
COMPUTER SERVICES INDUSTRY AVERAGE ANNUAL REVENUE GROWTH RATES

1979 TO 1981



Source: Statistics Canada, Catalogue 63-222, Computer Services Industry, 1979, 1980 and 1981. Includes only those companies classified by Statistics Canada as primarily engaged in providing computer services.

CANADIAN INFORMATION PROCESSING INDUSTRY REVENUES



Source: Evans Research Corporation

THE TOP 13 COMPANIES IN THE CANADIAN COMPUTER INDUSTRY OVER $ 100 MILLION

	COMPANY NAME	OWNERSHIP	TOTAL REVENUES 1983	EDP REVENUES 1983
1	IBM CANADA LTD.	U.S.	2,462	2,164
2	DIGITAL EQUIPMENT OF CANADA LTD.	U.S.	308	308
3	CONTROL DATA CANADA, LTD.	U.S.	240	240
4	PHILIPS INFORMATION SYSTEMS LTD.	NL.	187	187
5	NCR CANADA, LTD.	U.S.	199	173
6	SPERRY INC.	U.S.	325	144
7	BURROUGHS CANADA	U.S.	154	142
8	CANADA SYSTEMS GROUP LIMITED	CAN.	140	140
9	AES DATA INC.	CAN.	134	134
10	HEWLETT - PACKARD (CANADA) LTD.	U.S.	194	112
11	HONEYWELL LTD.	U.S.	334	112
12	COMMODORE BUSINESS MACHINES LTD.	BAH.	n/a	110
13	AMDAHL LIMITED	U.S.	104	104

CANADA'S LEADING SOFTWARE AND EDP CONSULTING COMPANIES

COMPANY NAME	% OF TOTAL 1983	% OF TOTAL 1982	EDP REVENUES 1983	EDP REVENUES 1982	% CHANGE '82 TO '83
1 SYSTEMHOUSE LTD.	24	25	49	39	27
2 DMR&ASSOCIATES	22	22	46	34	34
3 SYDNEY DEVELOPMENT CORPORATION	9	7	19	11	65
4 COGNOS INCORPORATED	9	8	18	13	41
5 CULLINET CANADA INC.	4	3	9	5	59

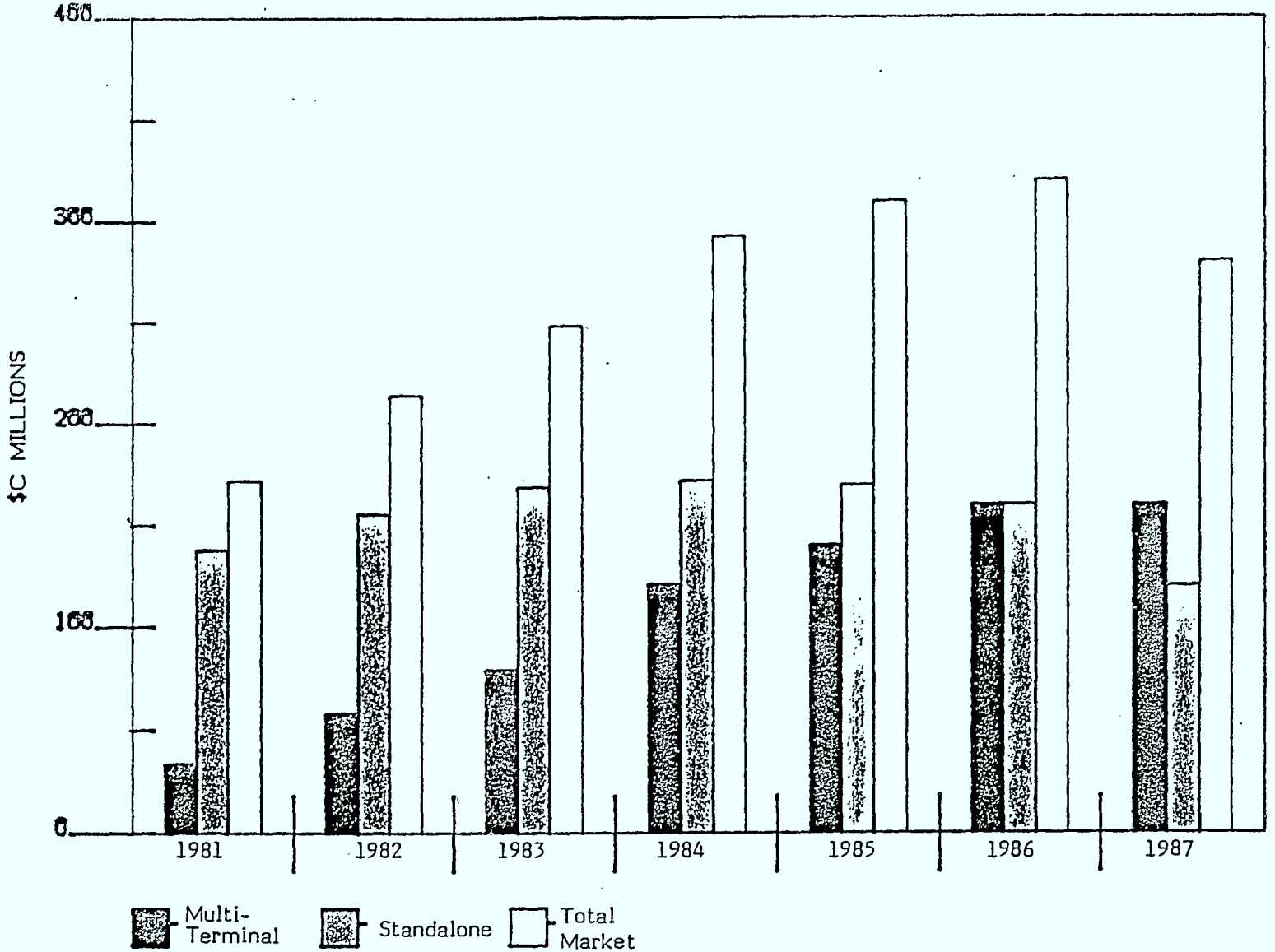
THE TOP SERVICE BUREAUS IN CANADA

COMPANY NAME	% OF TOTAL 1983	% OF TOTAL 1982	EDP SERVICES REVENUES 1983	EDP SERVICES REVENUES 1982	% CHANGE '82 TO '83
1 CANADA SYSTEMS GROUP LIMITED	20	19	140	127	10
2 DATACROWN INC.	12	13	84	88	- 4
3 BRITISH COLUMBIA SYSTEMS CORPORATION	9	9	65	65	0
4 I.P. SHARP ASSOCIATED LIMITED	6	7	47	51	- 8
5 IBM CANADA LTD.	6	6	44	44	0

CANADA'S LEADING OEM'S, SYSTEMHOUSES, DISTRIBUTORS AND THIRD - PARTY COMPANIES

COMPANY NAME	% OF TOTAL EDP REVENUES 1983	1982	EDP REVENUES 1983	1982	% CHANCE '82 TO '83
1 NABU MANUFACTURING CORPORATION	15	10	49	26	85
2 LANPAR TECHNOLOGIES INC.	10	8	32	21	53
3 CANADIAN GENERAL ELECTRIC COMPANY LIMITED	8	8	27	21	30
4 ALTEL DATA	7	8	25	21	19
5 CMI COMPANY CANADA	5	6	18	15	18

CANADIAN MARKET FOR DEDICATED WORD PROCESSING AND OFFICE AUTOMATION EQUIPMENT



Source: Evans Research Corporation surveys and estimates.

CANADIAN SOFTWARE INDUSTRY

(EVANS, 1983)

- 1,000 COMPANIES :
  - 500 : LESS THAN 2 % OF THE MARKET
  - 450 : 20 - 25 % OF THE MARKET
    (ALL SMALLER THAN $ 1 MILLION/YR)
  - TOP 50 : 75 - 80 % OF THE MARKET

- TOTAL MARKET
  - $ 1 BILLION IN 1983
  - GROWTH 30 %/YR
  - $ 5 BILLION IN 1990

- EMPLOYMENT : DIRECT 4,400
  TOTAL 39,000

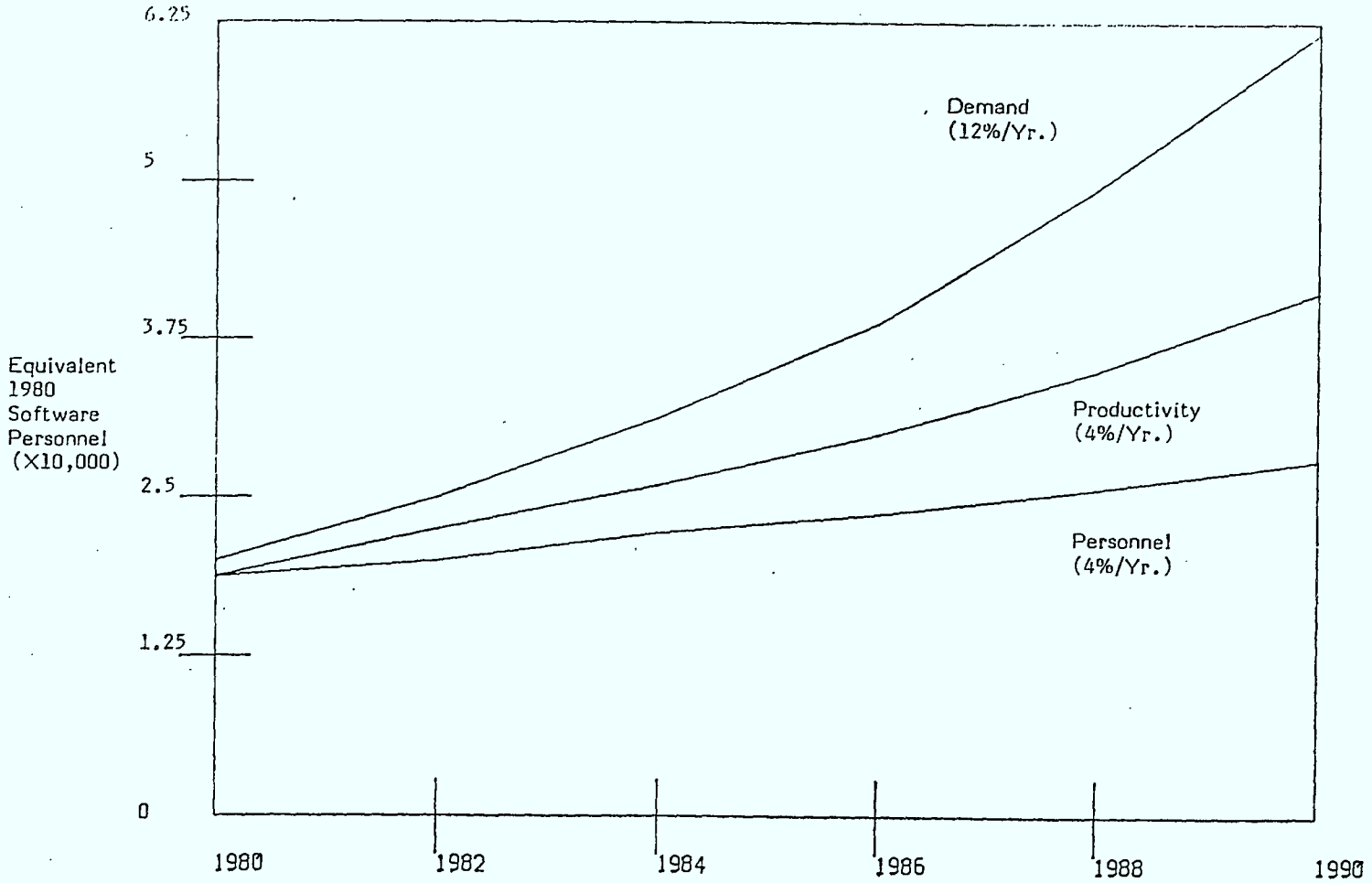
- OWNERSHIP : 65 % US
  1 % OTHER
  34 % CANADA

SOFTWARE INDUSTRY CANADA

	ACTUAL		PROJECTED	
	1980	1982	1983	1985
Systems Software				
$ millions	128	233	313	568
% growth		34	35	34
% TOTAL	28	29	30	31
Application Software				
$ millions	114	223	310	596
% growth		41	39	37
% TOTAL	25	27	30	33
Custom Built Software				
$ millions	215	341	428	669
% growth		27	26	24
% TOTAL	47	45	41	37
TOTAL $ millions	457	797	1052	1833
% growth		31	32	31

Source: Input/Evans Research

TRENDS IN SOFTWARE SUPPLY AND DEMAND



CANADIAN - OWNED COMPANIES' MARKET SHARE OF EDP REVENUES

HARDWARE	1983	1982	1981	1980
Total Revenues	5,052	4,462	3,669	2,855
Revenues of Canadian - Owned Companies	489	456	374	280
	9	10	10	9
SERVICES				
Total Revenues	1,215	1,064	924	752
Revenues of Canadian - Owned Companies	974	854	732	597
Canadian - Owned as a Percentage of Total	80	80	78	79
TOTAL				
Total Revenues	6,268	5,526	4,587	3,596
Revenues of Canada - Owned Companies	1,464	1,310	1,098	878
Candian - Owned as a Percentage of Total	23	23	23	24

WORLDWIDE AND CANADIAN JOBS PROVIDED BY A SAMPLE OF IP INDUSTRY MULTI-NATIONALS WITH WORLDWIDE HQ OUTSIDE CANADA

Company	Worldwide HQ	1982 Reported No. Jobs		1982 Reported Revenues ($ Millions)			Jobs/U.S.$ Millio Revenues	
		Worldwide	Canada	Worldwide	Canada		Worldwide	Canad
1. Apple	U.S	3,391	60	U.S. 583	U.S. 19**		5.8	3.2
					C 24			
2. Burroughs	U.S.	62,000	1,222	U.S. 4,186	U.S. 98		14.8	12.5
					C 121			
3. Commodore	Bah.	4,100	650	U.S. 304	U.S. 97		13.5	6.7
					C 120			
4. CDC	U.S	57,000	2,000(e)	U.S. 3,301	U.S. 187		17.3	10.7
					C 231			
5. Digital	U.S	67,100	1,800	U.S. 3,881	U.S. 236		17.3	7.5
					C 295			
6. Honeywell	U.S	94,062	3,757	U.S. 5,490	U.S. 272		17.1	13.8
					C 340			
7. IBM	U.S.	364,796	11,580	U.S. 34,364	U.S. 1,790		10.6	6.5
					C 2,210			
8. Sperry	U.S.	88,720	2,050	U.S. 5,571	U.S. 281		15.9	7.3
					C 347			
9. Wang	U.S.	17,700	500	U.S. 1,159	U.S. 53		15.3	9.4
					C 65			
		758,869	23,619	U.S. 58,839	U.S. 3,033		12.9	7.8
					C 3,753			
Percentage of Worldwide Jobs And Revenues			3.1%			5.2%		

Source: Company Announcements In Canada and Annual Reports In The U.S.

** 1982 exchange rate was U.S. $0.81 = C $1.00

MARKET SHARE OF KEY CAD/CAM COMPETITORS IN CANADA

	Revenues $ MIL	Market Share %
	1983	
Vendors		
Intergraph	$ 18	23
Computervision	9	11
Calma	7	9
Auto - trol	4	5
Applicon	3	4
Omnitech	3	4
Orcatech	3	4
Calcomp	3	4
Systemhouse	2	3
McAuto	2	3
Others	4	4
Total Vendors	$ 58	
Hardware Manufacturers		
IBM	8	11
Digital Equipment	3	3
Prime	2	3
Hewlett - Packard	2	3
Data General	2	3
Others	2	2
Total Hardware Manufactures	$ 19	
TOTAL MARKET	$ 78	100%

Source: ERC Surveys and Estimates

NUMBER OF HIGH TECHNOLOGY COMPANIES AND EMPLOYEES IN OTTAWA-CARLETON BY TYPE OF BUSINESS - DECEMBER 1982

	LOCAL MANUF.'S		SALES & SERVICE		TOTAL	
	Cos.	Employees	Cos.	Employees	Cos.	Employees
Computer Systems & Equipment	15	1,712	45	997	60	2,709
Computer Consultants and Software	11	222	54	1,575	65	1,797
Data Processing - Consultants, Sales & Service	4	140	40	1,578	44	1,718
Electronics Components & Instruments	28	5,265	63	468	91	5,733
Scientific/ Technical R & D	11	279	8	2,425	19	2,704
Telecommunications/ Communications	21	2,620	24	4,972	45	7,592
Industrial Suppliers	22	638	8	146	30	784
Radio Chemical Prod.	1	975	0	0	1	975
Environmental Controls	0	0	3	145	3	145
Mechanical Energy - Nuclear Energy Systems	0	0	1	425	1	425
TOTAL	113	11,851	246	12,731	359	24,582

Source: Commercial and Industrial Development Corp. of Ottawa-Carleton

NUMBER OF HIGH TECHNOLOGY COMPANIES AND EMPLOYEES IN SANTA CLARA COUNTY

1979

	TOTAL COMPANIES	TOTAL EMPLOYEES
MANUFACTURERS	722	166,000
C&D COMPUTER SERVICES	258	18,700
DISTRIBUTION	395	7,600
TOTAL	1,375	192,300

Source: California Employment Development Department

CANADA'S POSITION IN THE WORLD INFORMATION PROCESSING INDUSTRY

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  1991 US $ 450 BILLION
- CANADIAN SHARE SHOULD BE SOME 4 PER CENT
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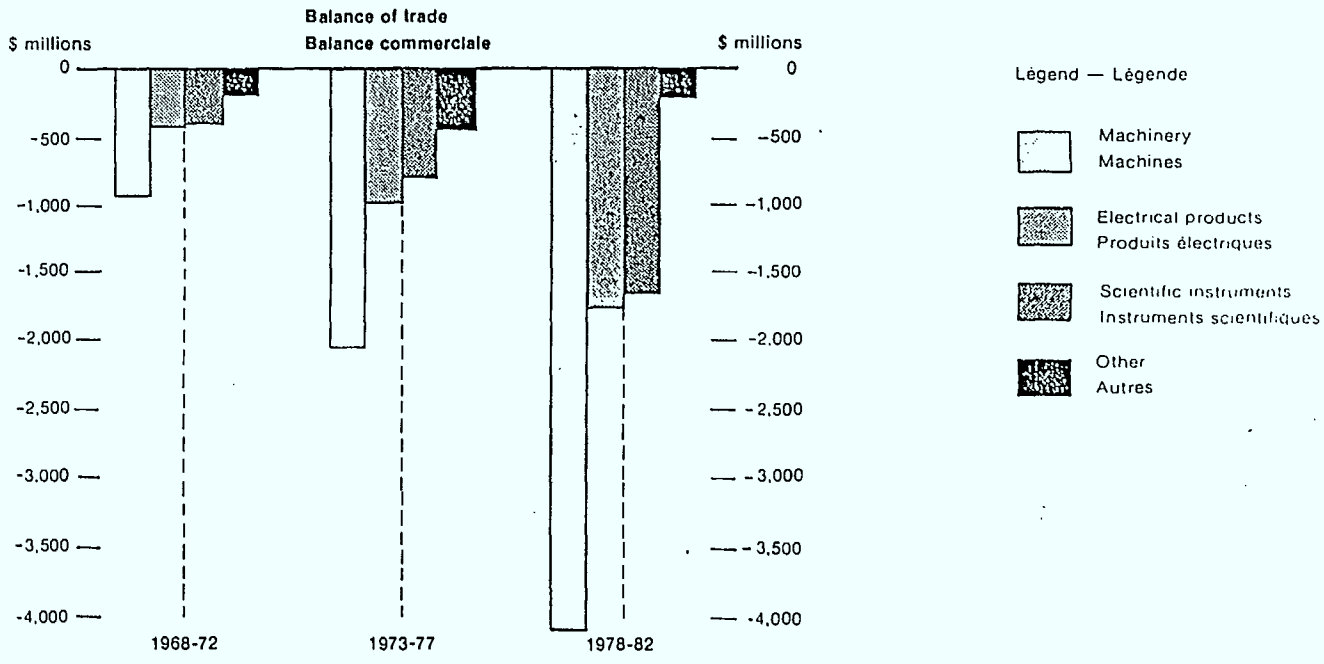
- 4 PER CENT — US $ 10.5 BILLION
- CANADA ACTUALLY — 1984 US $ 6.4 BILLION

CANADIAN SHARE IS 2,5 PER CENT

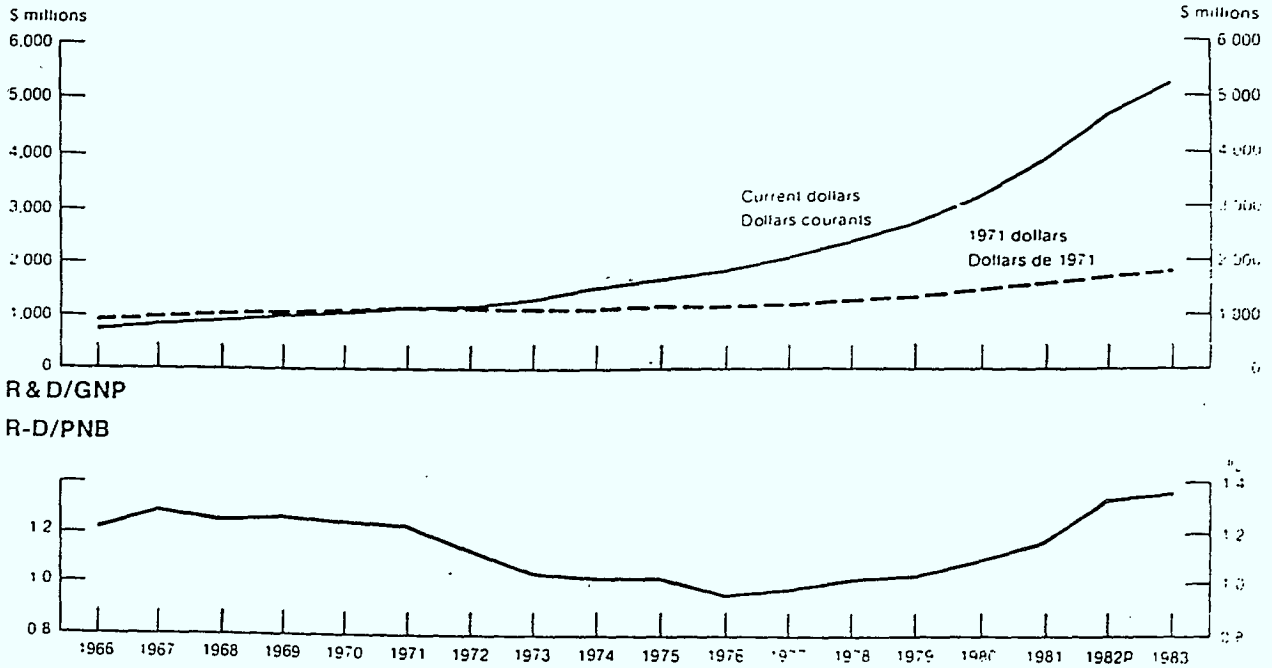
- WORSENING OF THE SITUATION

External Trade in High Technology Commodities
Commerce extérieur en produits de fabrication hautement technologique



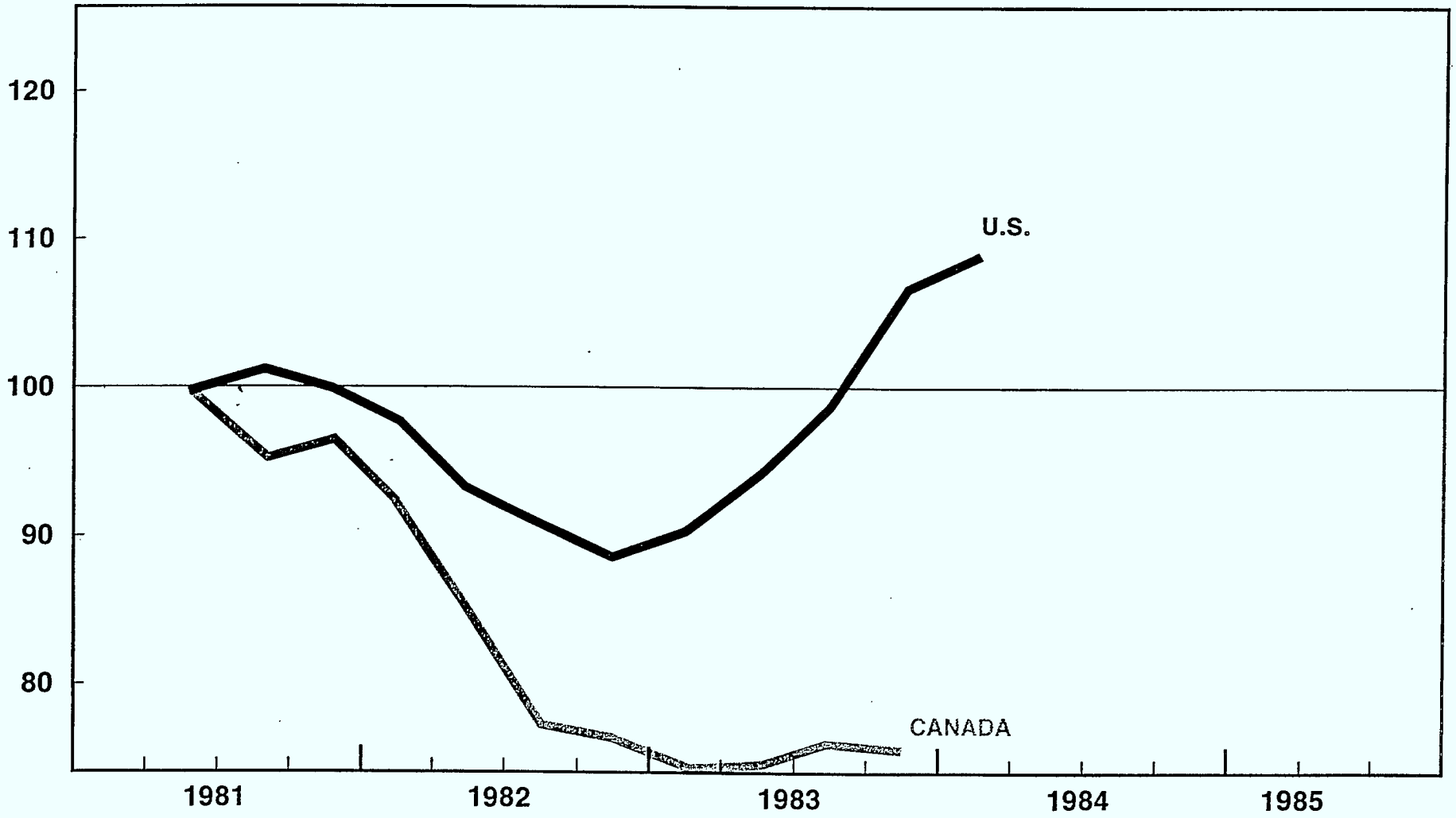
Total Expenditures on R & D in Canada

Dépenses totales au titre de la R-D au Canada



REAL BUSINESS INVESTMENT IN MACHINERY AND EQUIPMENT

INDEX 1981: 2 = 100



Source: Statistics Canada and U.S. Department of Commerce;
Arthur J.R. Smith Associates Inc.

CANADIAN SITUATION

- CANADA= SMALL, OPEN ECONOMY
- TECHNOLOGY POLICY TO DATE HAS FOCUSSED ON VERTICAL TRANSFER
- DOMINANT CONTRIBUTION TO TECHNICAL ADVANCE VIA HORIZONTAL TRANSFERS
- SYSTEMATIC SEARCH FOR NEW INNOVATIONS ABROAD NEEDED (WILL NOT SOLVE SERENDIPITY)
- PROPOSED TECHNOLOGY COUNCIL
- COMPARATIVE ADVANTAGE: LOCATION
  - PROXIMITY TO THE U.S.
  - PROXIMITY TO JAPAN
    - COMPARED TO OTHER OECD COUNTRIES

COMPARISON OF NATIONAL C&C STRATEGY ARTICULATION AND EFFECTIVENESS

Effectiveness of C&C Strategy

Country	Computer Strategy Articulation	Indigenous share in domestic computer market	Export Capability	Technology Diffusion	Awareness of social impacts
U.S.A.	Implicit	Almost total	Strong	High	Medium
Japan	Explicit	High	Medium	High	Low
U.K.	Implicit	Modest	Medium	Medium	High
France	Explicit	Modest	Medium	Medium	High
West Germany	Implicit	Modest	Medium	Medium	High
Sweden	Implicit	Low	Weak	Medium	High
Brazil	Explicit	Low	Weak	Low	Low
Canada	Partial Formulation	Modest	Weak	Medium	Medium

CANADA'S STRATEGIC CHOICE IMPERATIVE:

- PRE-EMINENCE IN HI-TECH IS BEYOND REACH
- INTRODUCING HIGH TECHNOLOGY INTO A BROAD RANGE OF INDUSTRIES
  (WORKABLE BOTH ECONOMICALLY AND POLITICALLY)
- GOAL: HIGHER VALUE - ADDED
  MORE SPECIALIZED SEGMENTS OF TRADITIONAL INDUSTRIES
- MEANS: TECHNOLOGY TRANSFERS

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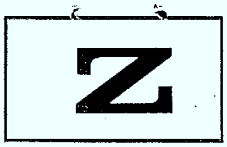

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BIOGRAPHY - ZAVIS P. ZEMAN

President of his own consulting company, ZZ International of Toronto, Zavis P. Zeman has been a consultant to various agencies of the Government of Canada, the Government of Ontario, Gouvernement du Quebec, Shell Canada, Bell Canada, The Niagara Institute, University of Toronto, Canadian Artificial Intelligence Products Corporation, the C.B.C., The Royal Commission on the Economic Union and Development Prospects for Canada, the United Nations and other clients.

The 1984 studies include Software Industry in Ontario, Work Place Automation Research Centre: Strategic Study, Trends in Electronic Banking, Cape Breton: Challenge of New Technologies, and Artificial Intelligence Markets in the UK, France, and West Germany.

Over the six years between 1977 and 1983 as the Project Leader and later as the Director of the Technology and Society Program at the Institute for Research on Public Policy in Toronto, he directed over thirty five studies of some probable impacts of foreseeable technological and economic changes facing Canada. He is the author of Electronics/Communications and Employment: Overview of Current OECD Debates and The Men with the Yen: Some Foreseeable Japanese Developments and their Relevance to Canada; co-author (with C.C. Gotlieb) of Seven National Approaches to Computer/Communications Strategy; and co-editor (with D. Hoffman) of The Dynamics of the Technological Leadership of the World; Japanese Challenges and Probable U.S. Responses. Most recently, he is principal co-author of Les Strategies de Communications dans Quatre Pays.

Prior to joining the Institute, Zavis Zeman was a research professor at the Universite de Montreal, teaching graduate courses in Systems Analysis. From 1969 to 1972, he was project manager with Groupe de recherche et d'elaboration d'un systeme d'informatique de gestion universitaire, designing a Management Information System for Quebec universities. He served as a member of the Task Force on Microelectronics and Employment, commissioned by Labour Canada. Its report, In The Chips, was released in November of 1982.

Educated and trained at the Czech Technical University in Prague in Industrial Engineering/Economics, he did postgraduate work at the University of Saskatchewan, the Massachusetts Institute of Technology and at McGill University.

He is a member of professional associations, such as ORSA, CIPS and CORS. He is a member of the Scientific Advisory Board for the Nexa Corporation of Nepean, Ontario, and an International Correspondent for Computer World Canada.

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CALVIN C. GOTLIEB
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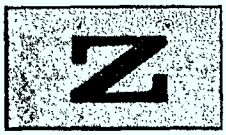
Prof. C. C. Gotlieb is Professor in Computer Science and in the Faculty of Library and Information Science at the University of Toronto. He is Chairman of the University of Toronto/University of Waterloo Cooperative on Information Technology, and President of C.C. Gotlieb Consulting Ltd., and UCompute Service Bureau Inc. He is a member of the Editorial Board of the Annals of the History of Computing of AFIPS, former editor-in-chief of the Journal of the Association for Computing Machinery (JACM), of the Communications of ACM, and is a former President of the Canadian Information Processing Society. He was Chairman of the IFIP Technical Committee (TC-9) on the Relationship between Computers and Society (1975-81), is a member of a number of scientific national and international organizations, and has been a consultant to the United Nations on Computer Technology and Development and to the Privacy and Computers Task Force of the Canadian Federal Departments of Communications and Justice. His publications (total number over 80) include "High Speed Data Processing" co-authored with J.N.P. Hume, research and survey papers in many areas of computer science and information processing. A book "Social Issues in Computing" (co-authored with A. Borodin) was published by Academic Press, Inc., New York, in 1973. Another book "Data Types and Structures" (co-authored with his son, Leo Gotlieb) was published by Prentice-Hall, Inc. in 1978. An occasional paper "Computers in the Home - What They Can Do for Us and to Us" was published by the Institute for Research on Public Policy, Montreal, Canada, in 1978. A book "The Economics of Computers" will be published by Prentice-Hall in 1985.

Professor Gotlieb's interests cover a wide range of computing machine applications, and include combinatorial applications, business data processing, information structures, computing centre operations and administration, bibliographic utilities, and the economic and social implications of computing.



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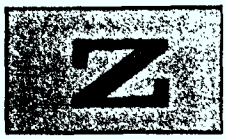

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