1-1-1990

Cooperative Processing: An Agenda for Research

Wita Wojtkowski
Boise State University

Waclaw G. Wojtkowski
Boise State University

This document was originally published by IEEE in *Proceedings of the Twenty-Third Annual Hawaii International Conference*. Copyright restrictions may apply. DOI: 10.1109/HICSS.1990.205271

COOPERATIVE PROCESSING: AN AGENDA FOR RESEARCH

Wita Wojtkowski

W. Gregory Wojtkowski

Computer Information Systems & Production Management
College of Business
Boise State University
Boise, ID 83725

ABSTRACT

The purpose of this paper is to explore the potential research agenda for Cooperative Processing (COP). COP is a method of processing in which communications is an integral part of the process of executing an application. Numerous innovative products that support COP are starting to appear on the market. However, as is usually the case with any new technology, many organizations have not yet implemented COP. They have embraced a "wait and see" attitude. Such a stance can be attributed to the newness of the applications operating in COP mode and to the lack of data demonstrating COP's uses and benefits. For example, no data, at present, demonstrates basic COP efficacy.

Among many possible research areas this paper suggests topics such as: potential COP users, types of applications benefiting from the COP processing mode, and organizational and technological factors involved in COP implementation.

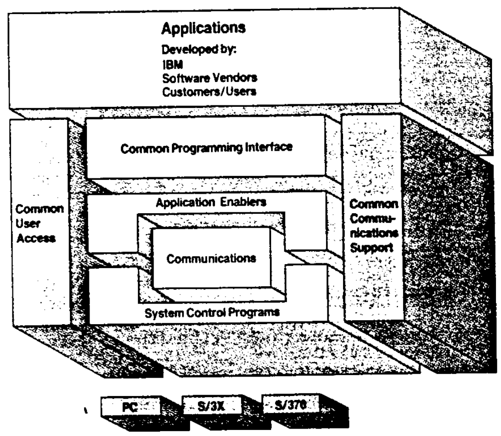

Figure 1
The SAA Framework

INTRODUCTION

The micro-to-host market is clearly migrating to COP [Corr, 1987; Gillon, 1987; Edwards, 1988; Lyne et al., 1988; Conlon, 1988 and 1989; Battelle, 1989; Guptill, 1989; Musich, 1989]. This mode of processing is now beyond the conceptual stage [Pervez, 1987; Wszolek, 1987; Horwitt, 1989; Linnel, 1989, Nilekani, 1989].

The advent of IBM's Systems Application Architecture (SAA) appears to have been pivotal to the acceptance of COP in many organizations [Nilekani, 1989; Barney, 1989; Gibson, 1989]. SAA itself is more tangible since the first release of the IBM's OfficeVision software that conforms to SAA [Keefe, 1989].

In essence, SAA is the cornerstone of IBM's communications strategy for the 1990s. (Information concerning SAA is summarized briefly in Appendix A.) SAA is key to IBM's success in migrating from hierarchical network design to a peer-to-peer environment [Wheeler and Ganek, 1988]. Most importantly, one of the goals of the SAA approach is the implementation of COP [Scherr, 1988; Mahnke, 1988; Mullen, 1988; Moad and McWilliam, 1988]. Figure 1 outlines SAA framework.

We can trace the concepts involved in COP back to the development of Local Area Networks (LANs) and of the ability to swap data files among multiple applications. The Logical Unit 6.2 (LU6.2) definition of peer-to-peer communications provided primary groundwork for COP. This allowed the evolution to SAA and the delineation of IBM's Advanced Program-to-Program Communications (APPC). SAA concepts and the advent of COP have the potential to significantly transform our current models of computing. A possible transformation is shown in Figure 2.

In essence, COP replaces the distribution of individual <u>applications</u> with the distribution of individual <u>functions</u> within an application [Konagaya et al., 1987; Kaneko, 1988]. The COP model allows the application to be broken into pieces, each to be executed on different hardware platforms, in order to derive the benefits of each.

In COP, different processors (accessed through data communications) work on whichever parts of the application they can handle best. (For example, some processors are called on to do heavy calculations, some to perform high speed parallel operations, some to move and look-up data, some to present results, and so on.)

Obviously communications is an integral part of COP. This part is crucial for the overall process of completing an application in a cooperative mode.

This discussion paper ponders a list of research

0073-1129/90/0000/0307$01.00 © 1990 IEEE

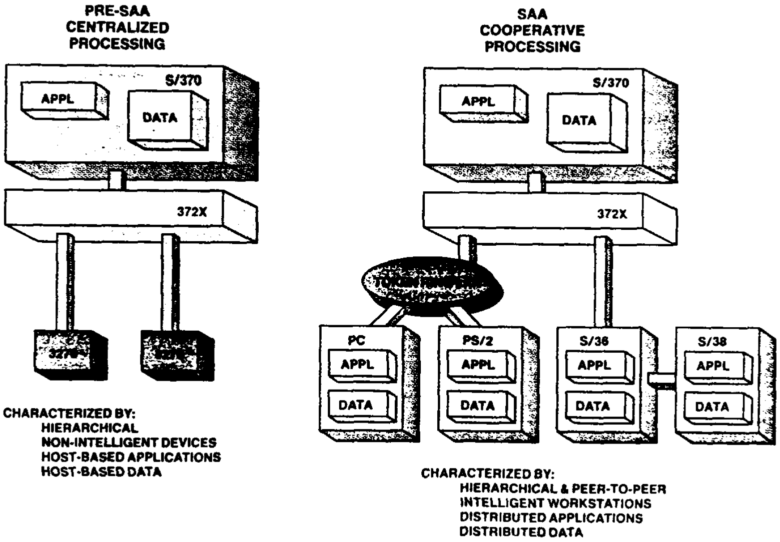

Figure 2
Changed Models of Computing

problems that address the evaluation of COP. We spotlight a variety of questions in an attempt to elucidate the notion that new information technologies are creating innovative organizational structures that tend to alter the ways in which firms conduct their business. The ultimate question is to what extent information technology will be allowed to play a role in the process of organizational design.

The format of this paper is as follows. Section I describes model of COP in some detail. Section II discusses COP investigative agenda, including the possible impact of COP on organizations and individuals. A final Summary and Conclusion section completes the paper.

MODEL OF COOPERATIVE PROCESSING

Figure 3 represents one possible model of COP that comprises the PC (driver) and mainframe (server) processing pair, realized through a fourth generation language (4GL) namely, NOMAD [Wojtkowski and Wojtkowski, 1990], functioning on a PC as well as on a mainframe.

To appreciate COP products and the COP method of processing applications, we briefly consider the multilayered nature of data communication systems.

The international Standards Organization's (ISO) Open System Interconnect (OSI) communications model (Datapro Report CMS20-010; Linnel, 1989] has, at its lowest layers, link definitions and protocols that shape the message that is to be communicated. Higher layers handle message routing, end-to-end communications, and all the essential communications tasks. Highest layers are concerned with presentation and application. Figure 4 shows the OSI reference model (its layers assembled into two functional groups).

The highest layers as well as end-to end-communications layers of the OSI model are required for COP to take place. Table 1 summarizes the purpose of each layer of the OSI reference model.

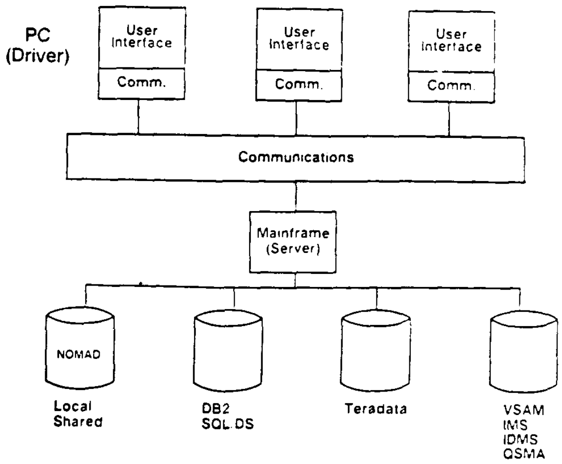

Figure 3
Example of Cooperative Processing Model

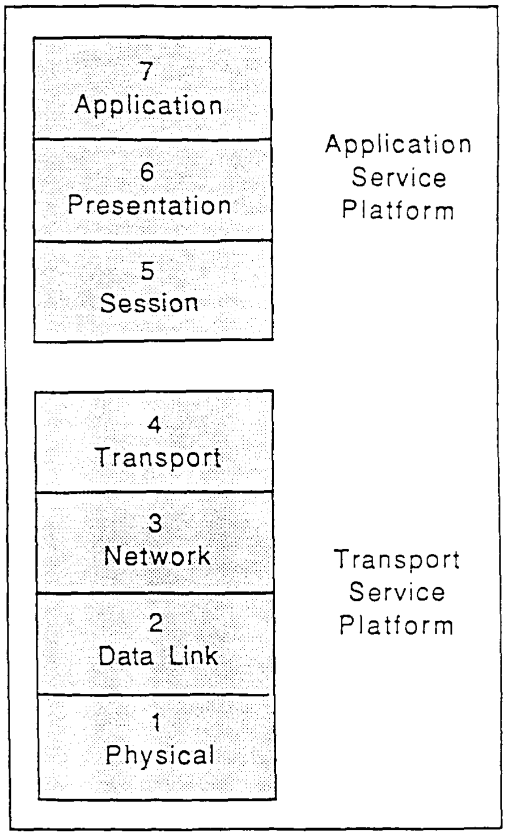

Figure 4
OSI Reference Model and Its Two Functional Groups

The current COP products are generally of two types:

1. Applications built on the underlying communications link foundation (application implementation category)
2. Tools designed to help users develop applications built on the underlying communications link foundation (cooperative processing tool category)

An example of a COP application implementation category product is Cooperative Processing from Global Software Inc. which encompasses both mainframe and PC software in a complete system.

An example of a COP tool category product is Peer Services from Tangram Systems Corp. Peer Services defines an application programming interface (API) that PC-based transaction programs use to control the Figure 3 interface to remote application. API is a collection of subroutines that correspond with verbs defined in IBM's Advanced Program-to-Program Communications (a set of protocols that enables the application programs to interact directly with each other on a peer-to-peer basis, even when the programs are on separate and remote processors) [Mullen, 1988; Horwitt, 1989].

Some 4GL products, such as NOMAD, also fall into this category [Wojtkowski and Wojtkowski, 1990, pp. 212-213]. NOMAD (available for mainframes, minicomputers and microcomputers) instead of simply transferring files between the mainframe and the PC, shares the actual processing in dialog between platforms, enabling the COP mode of operation. By distributing tasks like menu and window management, data

Layer	Name	Purpose
7	Application	Application/information content displayed in layer 6.
6	Presentation	Code conversion and data formatting; terminal standards, display rules.
5	Session	Coordination of interaction between end-application processes; English language translated into network technology.
4	Transport	End-to-end data integrity and quality of service; assembles and disassembles data packets for layer 3.
3	Network	Switching and routing of information.
2	Data Link	Transfer of units of information to the other end of a physcial link, responsible for data integrity between nodes.
1	Physical	Transmission of the bit stream to the transmission medium.

Table 1
Purpose of Each Layer of the OSI Reference Model

validation, and report generation to the microcomputer, mainframe power is conserved for simultaneously processing transactions against a shared database.

IDENTIFYING COP IMPACT

No investigative agenda relating to COP practice and research exists as yet. Hence, enduring general frameworks for information systems can serve as useful guideposts (Gorry and Morton, 1971; Mason and Mitroff, 1973).

All general frameworks of information systems recognize these three fundamental elements:

1. Technological
2. Organizational
3. Individual

When we examine these elements in detail, we recognize that they are essentially intertwined (Benbasat et al, 1981; Kemerer, 1989, p. 222]. Nevertheless, when we consider the controlling technological element (such as COP), the following issues arise:

- Applicability of a technology to a particular undertaking
- Extent of the technology's use
- Level of skill used in applying the technology

Although each of these issues poses some difficult measurement questions [Wrigley and Dexter, 1988; Kemerer, 1989] an agenda for setting up research questions that relate to the use and future impact of COP technology on organizational and individual domains is nevertheless possible.

Case Studies

Since the technology required to run COP applications is so new, no case studies exist as yet. Therefore, COP case research will probably end up being the first descriptive analysis we have of COP itself. Relevant analysis of COP implementations is possible if we undertake multisite case studies, especially if they are examined longitudinally.

COP case studies can help us explore the applicability of COP. and help to elucidate the following questions:

- Where will COP will be most effective ?
- Who should and why use COP ?

Obviously, these questions relate to all three domains - organizational, individual, and technological.

Technological

Many technological inquiries are possible because the COP approach represents new technology. Those inquiries could include:

- What tools should be used to assess COP programs and operations?
- Is cooperative processing across heterogeneous environments really possible now?
- Are cooperative processing applications making full use of PC and the host resources ?
- What constitutes efficient cooperative data processing?

Since problems that COP tools must resolve are quite different from those that are associated with single-platform environments, several questions relating to applications development might be posed.

- How would CASE tools for designing and developing COP applications differ from those for non-COP modes?
- Would COP change the way applications are built?
- Is it more difficult to develop applications for COP mode then any standard mode?

COP suggests a fundamental change in host/terminal based systems which leads to questions such as:

- What changes brought about by COP are most predictable?
- What is the potential use of COP in distributed manufacturing applications?
- What is the effect of splitting up applications and distributing them across platforms?

Organizational

On the elemental level, using COP in organizations can increase firms' computing power. From the point of view of controls, COP offers the best of centralized and decentralized processing. Perhaps one of the most important issues to ponder, is whether or not COP would lead to new organizational structures through changes in staffing and in the nature of organizational controls.

Ultimately, empirical research will be necessary to identify most relevant organizational issues which, of course are intertwined with the technological ones. Examples of questions to ponder are:

- How does COP influence institutional and cultural environments in organizations, if at all?
- What (organizationally) is required to adopt COP computing model and how COP changes current organizational model of MIS?
- What problems, related to organizational control and

management may arise in COP ?

The effect of COP on a firm's MIS structure is a special case to consider. Relevant issues include:

- What is the effect of COP on MIS structure and staffing?
- Can tying desktop, midrange, and mainframe computers together for, for example, cooperative office applications help MIS regain control of the many islands of micros in their organizations, and pull stand-alone PCs into the network?
- What is the long term impact of COP capabilities on MIS services in an organization? Does the impact depend on organizational structure?

Several questions relating to the portfolio of applications in a given organization might also be posed:

- How can a firm efficiently convert to COP and what applications should be converted?
- On what should a decision be based to implement a major application using COP?
- When is COP economically feasible? What are hidden costs, if any?

Individual

Individual factors of concern to COP are closely related to the previously published research framework for investigating the human/computer interface [Benbasat, 1981]. In essence, they relate to the user's education and experience as well as to the COP's specific technological features.

The principal questions to ask are:

- Does COP provide the most cost-effective way to give users the computing power they need while maintaining the integrity of corporate data?
- Most system managers have not been trained in any form of COP computing. What type of training is most efficient?
- How to help people develop applications that will run in a COP environment?

The specific research agenda for studying the impact of COP on individuals depends on the category of users involved. The users can be divided into two categories:

1. Business users, such as marketers, planners, project managers, and finance specialists.
2. Technical users, such as systems developers and CAD/CAM users.

The first category of users usually has varied levels of computer expertise, because user computing evolves in phases--from developing technical proficiency to developing applications. Although the users' position on this evolutionary scale usually dictates a researcher's specific questions, a general question that arises is: Would COP be useful to the naive or infrequent user, or is it only appropriate for the organizational "power" user?

Related questions include:

- Who are innovators in the use of COP?
- What impact does the business "power" user using COP have on the role of MIS?

For the second category of users, desktops and workbenches running CASE products are changing developer environments in the same way and for the same reasons that PCs are proliferating among business users. (For example, system developers continue to be paid to design, document, compile, link-edit, and debug applications, but they can do it cheaper and faster with PCs.) The general question that arises is: Would COP and distributed workstations have a positive effect on the software development process?

Related questions include:

- Would the ability to cooperatively use CASE tools change developers' work?
- Would COP capability be important to computer graphics users, and what effects would it have on graphics use?
- Can COP be applied to PSM (Production System Management) through horizontal integration of the factory floor?

These questions represent just the beginning of a possible research agenda. Each question obviously generates many more. And this has been precisely the intent of this paper.

SUMMARY AND CONCLUSION

Present technology (hardware, software, and communications) permits the implementation of COP approaches. PCs that rival mainframes in power and computer technology that is increasingly dispersed on desktops throughout the corporate setting are diluting the influence of today's information services center, which has important consequences for the models of MIS and for the location of organizational controls.

COP is emerging as an important technology in the marketplace. We feel that a large number of both application and research areas involving the technological, organizational, and individual factors related to COP are worth considering. We hope that this paper initiates the discussion and identifies some promising areas because it is becoming more and more important to understand the effects of the confluence of such technologies as those that enable COP.

REFERENCES

1. Alper, A., "Two Firms Go Cooperative to Ease Strain on Mainframes," Computerworld, Vol. 2, No. 27, July 4, 1988, pp. 19-21.
2. Baer, D., "Cooperative Processing: Distributing Functionality to Workstations Is Nice In Theory, But it May Be Out Of Reach For Now," Computerworld, Vol. 2, No. 46, Nov. 14, 1988, pp. 141-144.
3. Barney, D., "SAA Spurns Software Scuffle," Computerworld, Vol. 23. No. 20, May 15, 1989, pp. 1, 108.
4. Barney, D., Brandell W., and Gibson, S., "IBM Pegs Office as SAA Proving Ground,"Computerworld, Vol. 23, No. 14, Apr. 3, 1989, pp. 1, 6.
5. Baron, R. C., "Picking the Varied Fruit of Open Systems," Manufacturing Engineering, Vol. 100, No. 5, May 1988, pp. 52-54.
6. Battelle, J., "Mac Workstation Is Interface Builder," MacWeek, Vol. 3, No. 12, Mar. 21, 1989, p. 6.
7. Benbasat, I., Dexter, A., and Masulis, P., "An Experimental Study of the Human/Computer Interface," Communications of the ACM, Vol. 24, No. 11, Nov. 1981, pp. 752-762.
8. Bonner, P., "Cooperative Processing Outgrows IBM," PC Week, Vol. 4, No. 12, Mar. 24, 1987, pp. C1-C3.
9. Cobankiat, M., Heng, S. H., Koh, T. T., Ong, K. C. K., and Wang, X., "ISS Office: Intelligent Support System for the Office," Conference Proceedings on Mini and Microcomputers and Their Applications, International Society of Mini and Microcomputing, Sant Feliu de Guixols, Spain, June 27-30, 1988.
10. Conlon, T., "PCs-Mainframe Cooperative Processing Now Supported by Enhanced AION ADS," MIS Week, Vol. 9, No. 19, May 9, 1988, p. 29.
11. Conlon, T., "Tangram Aims to Educate MIS on Cooperative Processing," MIS Week, Vol. 1, No. 11, Mar. 13, 1989, p. 32.
12. Corr, R. M., "OS/2, 'Cooperative Processing' Will Expand Personal Computing Horizons," Infoworld, Vol. 9, No. 43, Oct. 26, 1987, p. 62.
13. Datapro Report, "Network Architecture Concepts," Datapro, Report CMS20-010, May 1988.
14. Datapro Report, "International Standards Organization Reference Model for OSI," Datapro, Report CMS20-010, April 1989.
15. Datapro Report, "IBM SAA," Datapro, Report CMS20-491, April 1989.
16. Datamation Staff Report, "Workstations and Networks Are Prime-Time Hits," Datamation, May 1, 1989, pp. 24-30.
17. Edwards J. L., "PCs on LANs: Dumb Terminals or Application Team Players?" Data Communications, Vol. 17, No. 8, Aug. 1988, pp. 125-130.
18. Feuche, M., "SAA Puts Heat on CASE Developers," MIS Week, Vol. 10, No. 20, May 15, 1989, p. 23.
19. Gabel, D., "Cooperative Processing: One Step Beyond," Computerworld, Vol. 2, No. 5, Feb. 6, 1989, pp. 69-80.
20. Gibson, S., "IBM Kick-Starts SAA onto Office Track," Computerworld, Vol.23, No. 21, May 22, 1989, pp. 1, 119-121.
21. Gillon, C., "The Cooperative Processing Advantage: Integration Involves More Than Software," Computing Canada, Vol. 1, No. 13, June 25, 1987. pp. 28-10.
22. Gorry, G., and Morton S., "A Framework for Management Information Systems," Sloan Management Review, Fall 1971.
23. Greenstein, I., Distributed Processing Sparking Shifts in Industry," MIS Week, Vol. 10, No. 19, May 8, 1989, p. 2.
24. Guptill, B., "From Emulation to Cooperative Processing: Micro-to-Host Links," Network World, Vol. 6, No. 3, Jan. 23, 1989, pp. 39-48.
25. Hodges, P. "LAN Growth Surges," Datamation, Apr. 15, 1989, pp. 32-36.
26. Horwitt, E., "Peer-to-Peer Software on Tap for DEC-IBM SNA Shops," Computerworld, Vol. 23. No. 20, May 15, 1989, p. 109.
27. Kaneko, S., "An Experimental Facility for Cooperative Processing in APL," Proceedings of the ACM APL-88 Conference, Sydney, NSW, Australia, Feb. 1988, pp. 1-5.
28. Keefe, P., "OfficeVision Plan Hinges on LAN," Computerworld, Vol. 23, No. 21, May 22, 1989, pp. 1, 120-122.
29. Kemerer, C. F., "An Agenda for Research in the Managerial Evaluation of Computer Aided Software Engineering (CASE) Tool Impact," Proceedings of the Twenty-Second Annual Hawaii International Conference on System Sciences, Kona, Hawaii, Jan. 1989, pp. 219-228.
30. Konagaya, A., Nakazaki, R., and Umemura, M., "A Cooperative Programming Environment for a Back-End Type Sequential Inference Machine CHI," Proceedings of the International Workshop On Parallel Algorithms and Architectures, Suhl, Germany, May 1987.
31. Linnel, D., "Cooperative Communications (OS/2)," PC Technical Journal, Vol. 7, No. 2, Feb. 1989, pp. 52-61.

32. Lisker, P., "It's Time to Get Ready for New Cooperative Processing," PC Week, Vol. 4, No. 10, Mar. 10, 1987, p. C6.
33. Lisker, P., "Cooperative Processing: Detente with Big Blue," MacWeek, Vol. 2, No. 46, Nov. 15, 1988, pp. S26-S29.
34. Lyne, R., Iida, J. B., and von Simson, C., "Cooperative Processing: Solving the Network Problem," Information Week, No. 195, Nov. 14, 1988, pp. 66-68.
35. Mahnke, J., "IBM Taps Microdecisionware for Cooperative Processing," MIS Week, Vol. 9, No. 47, Nov. 21, 1988, p. 33.
36. Mahnke, J., "IBM Adds a Suite of Packs for Cooperative Processing," MIS Week, Vol. 10, No. 21, May 22, 1989,
pp. 25-28.
37. Mason, R., and Mitroff, I., "A Program for Research in Management Information Systems," Management Science, Vol. 19, No. 5, Jan. 1973, pp. 475-487.
38. Moad, J., and McWilliam, G., "SAA: The Yellow Brick Road to Cooperative Processing," Datamation, Vol. 3, No. 13,
July 1, 1988. pp. 39-44.
39. Moran, R., and Gobson, S., "SAA Pep Rally to Be Independent's Day," Computerworld, Vol. 23, No. 19, May 8, 1989, pp. 1, 8.
40. Mullen, J., "Advanced Program to Program Communications Facility Will Help Usher in the Cooperative Processing Era," MIS Week, Vol. 9, No. 49, Dec. 8, 1988, p. 41.
41. Musich, P., "MSA Eyes Cooperative Processing," PC Week,
Vol. 5, No. 47, Nov. 21, 1988 pp. C1-C2.
42. Musich, P., "IBM CICS Software for OS-2 Strengthens PC-to-Host Links: Move Toward Cooperative Processing Noted," PC Week, Vol. 6, No. 10, Mar. 13, 1989, p. 41.
43. Nilekani, N., "It Will Fly with a Little Help from Its Friends: Despite Apparent Obstacles Cooperative Processing Can Take Off," Computerworld, Vol. 2, No. 7, Feb. 20, 1989,
pp. 75-79.
44. Nolle, T., "Cooperation, UNIX Style," Computerworld, Vol. 23, No. 16, Apr. 17, 1989, pp. 57, 62.
45. Norman, R., Integrated Development Environments in Support of Information Systems Design Methodology and Systems Analyst's Productivity, PhD. Dissertation, University of Arizona, 1987.
46. Pervez, K., "Designing a cooperative processing Application to link PROFS and TELEBOX for Cross System Electronic Mailing," Proceedings of the Information Technology Conference: Emerging Opportunities and Challenges, 2nd. Pan Pacific Computer Conference, Singapore, Aug. 26-29, 1987.
47. Raman, V., "Bridging UNIX and DOS," Mini/Micro Systems, Vol. 21., No. 8, Aug. 1988, pp. 58-64.
Scherr, A. L., "SAA Distributed Processing," IBM Systems Journal, Vol. 27, No. 3, 1988, pp. 370-383.
48. Schussel, G., "What's Next for Application Development Tools?" Canadian Datasystems, Vol. 20, No. 3, Mar. 1988, pp. 64-72.
49. Weinberg, P., "Transparent Integration Between PCs and VAXs," Hardcopy, Vol. 7, No 7, July 1987, pp. 116-20.
Wheeler, E.F., and Ganek, A. G., "Introduction to Systems Application Architecture," IBM Systems Journal, Vol. 27, No. 3, 1988, pp. 250-263.
50. Wojtkowski, W. G., and Wojtkowski, W., Application Software Programming with Fourth Generation Languages, Boston, Boyd and Fraser Publishers, 1990.
51. Wrigley, C., and Dexter, A., "A Model for Estimating Information Systems Requirements Size: Preliminary Findings," Proceedings of the 9th International Conference on Information Systems, Minneapolis, Dec. 1988. pp. 245-255.
52. Wszolek, D., "Proliferation of PCs Brings New Concepts in Processing to the Corporate Environment," Hardcopy, Vol. 7, No. 6, June 1987, pp. 85-92.

APPENDIX A

BRIEF ON IBM SYSTEM APPLICATION ARCHITECTURE (SAA)

According to IBM, System Application Architecture (SAA) allows development of consistent applications across six software environments running on the three major IBM software computing platforms: Time Sharing Option/Extended (TSO/E), Customer Information Communication System/Multiple Virtual System (CICS/MVS), Information Manangement System/Extended System Architecture/Transaction Mananger (IMS/ESA/TM), and Virtual Machine/Conversational Monitor System (VM/CMS) on System/370 ESA; Operating System 400 (OS/400) on AS/400; and OS/2 Extended Edition on PS/2.

SAA is an evolving set of software programs employing the standard interfaces, conventions, and protocols first documented by IBM in March 1987. Desired end results of SAA include:

- Easier porting or distributing of applications
- Broader applicability of programming skills
- Uniform (hence, familiar) end user access methods

SAA functional elements are:

- Common Programming Interface (CPI)
- Common User Access (CUA)
- Common Communications Support (CCS)

Table 1A lists core program implementations for SAA elements as available in 1989.

An application is an SAA application when it:

- Conforms to CUA
- Uses SAA protocols and interfaces
- Uses relational database
- Runs in SAA environments

An SAA application promotes:

- Cooperative processing principles
- Use of the programmable workstation to provide the user interface
- Sharing of function and data with related SAA applications

Table 1A
Core Program Implementations for SAA

SAA Standard	Key Supporting Program Names			
	MVS/ESA	**VM/CMS**	**OS/2 EE**	**OS/400**
COMMON PROGRAMMING INTERFACES				
Interfaces:				
Communications Interface (CI)	ACF/VTAM	ACF/VTAM	OS/2 EE	OS/400
Database Interface (SQL)	DB2 1.3, 2.0	SQL/DS 2.0	OS/2 EE	SQL/400
Dialog Interface	ISPF	ISPF*	—	—
Presentation Interface	GDDM*	GDDM*	OS/2 EE (2/89)	—
Query Management Interface	QMF	QMF	OS/2 EE	—
Languages:				
Applications Generator	CSP/AD, CSP/AE	CSP/AD, CSP/AE	EZ-Run	A.D. 3Q'89
Cobol '85	Cobol II	Cobol II	Cobol/2	Cobol/400
C	C/370	C/370	C/2	A.D. 3Q'89
Fortran '77	VS Fortran	VS Fortran	Fortran/2	—
Procedures Language	TSO/E (REXX)	VM/SP or VM/XA (REXX)	Shareware-DOS**	A.D. 3Q'89
RPG	—	—	RPG II**	RPG/400
COMMON COMMUNICATIONS SUPPORT				
Session Services:				
APPC LU6.2 Services	ACF/VTAM	ACF/VTAM	OS/2 EE	OS/400
OSI Session Services	OSI/Comm. Subsystem	OSI/Comm. Subsystem	—	—
Presentation Services:				
OSI Presentation Services	OSI/Comm. Subsystem	OSI/Comm. Subsystem	—	—
Networking:				
LEN Low Entry Networking	ACF/NCP	ACF/NCP	OS/2 EE	OS/400 APPN
Data Link Controls:				
Internet OSI CLNS	OSI/Comm. Subsystem	OSI/Comm. Subsystem	—	—
SDLC Data Link	ACF/NCP	ACF/NCP	OS/2 EE	OS/400
Token-Ring LAN	ACF/NCP	ACF/NCP	OS/2 EE	OS/400
X.25 ISO OSI Networking	ACF/NCP-NPSI, OSI/Comm. Subsystem	ACF/NCP-NPSI, OSI/Comm. Subsystem	OS/2 EE	OS/400
Application Services:				
DDM Distributed Data Management	DDM	—	DDM/PC	OS/400
DIA Document Interchange	DISOSS, PS/370	—	PS/PC	PS/400
Network Management Architecture	NetView	NetView	NetView/PC	OS/400 APPN
OSI ASCE Application Framework	OSI/Comm. Subsystem	OSI/Comm. Subsystem	—	—
OSI File Transfer & Mgt. (FTAM)	OSI/File Services	OSI/File Services	—	—
OSI CMIP Managment Protocol	OSI/Comm. Subsystem	OSI/Comm. Subsystem	—	—
OSI X.400 Message Handling	OSI/Comm. Subsystem	OSI/Comm. Subsystem	—	—
SNADS SNA Distribution	DISOSS	—	—	OS/400 APPN
Data Streams:				
3270 Data Stream	TSO, GDDM, etc.	CMS, GDDM, etc.	OS/2 EE	OS/400
IPDS Printer Data Stream	PSF & other AFP	PSF & other AFP	OS/2 EE	OS/400
DCA Document Content Architecture	DW/370	DW/370	—	—

**Current versions of starred programs are precursors that will evolve into the SAA standard.*
***These programs are not designated by IBM as an SAA standard but probably have a close affinity to the coming standard. The PS/2 RPG II is a subset of S/36 RPG II. Shareware is not marketed by IBM, but it is supposed to have been written by the same person who wrote REXX.*
—IBM states the element is planned, but the date of the formal announcement or the availability date has not been released.

ACRONYMS:

A.D.: Availability date to be announced in the time period given.
ACF/VTAM: Advanced Communications Function/Virtual Telecommunications Access Method
AFP: Advanced Function Printing
APPC: Advanced Program-to-Program Communications
CICS: Customer Information Control System
CSP/AD & AE: Cross System Product/Application Development & Application Execution
DISOSS: Distributed Office Support System
DB2: Data Base 2
DDM: Distributed Data Management
DW/370: DisplayWrite/370
GDDM: Graphical Data Display Manager
ISPF: Interactive System Productivity Facility
ISO: International Standards Organization
LU6.2: Logical Unit 6.2
MVS/ESA: Multiple/Virtual Storage/Extended System Architecture
NCP: Network Control Program
OS/2: Operating System/2
OS/400: Operating System/400
OSI: Open Systems Interconnection, an ISO architecture
NPSI: X.25 Network Packet Switching Interface
PSF: Print Services Facility
QMF: Query Management Facility
REXX: Restructured EXtended EXecutive Language (VM/SP Interpreter)
VM/CMS: Virtual Machine/Conversational Monitor System