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Gabriel Goren

University of California-Irvine

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An Exploratory Study of Organizational Procurement Policies for Personal Computers

Gabriel Goren
University of California-Irvine

ABSTRACT

Recent literature suggests that microcomputers will be quickly adopted by organizations, often without forethought, as to the appropriate policies that should be followed in such adoption. An exploratory study of five medium-sized city governments reveals that, at least in some kinds of organizations, carefully thought-through policies for adoption of personal computers are being followed. *Compatibility* is the main problem, often brought up by professionals as a reason for the need for a procurement policy. This problem is explored and the reasons for the development of these policies are discussed.

Introduction

In the past three years declining prices and increasing capabilities of personal computers[†] have stimulated their adoption in a number of markets. Although first used by hobbyists, and occasionally by small businesses, they are now being used in increasing numbers by larger organizations with traditional data processing capabilities (IDC Report, 1983). By the end of 1983, over six million personal computers had been sold.

Assuming that PC use will continue to grow, we wonder what form this growth will take. Most predictions of growth in PC use over the next few years focus on the number of units sold or the dollar volumes of sales, usually broken down by kind of market. The forecasts vary from the PC becoming the dominant factor in the computer market, to wholesale replacement by the PC of most other kinds of computing machinery.

Most of those forecasts, however, are based on what could happen and not on what is actually happening today. This study views the current state of events, compares it to the expectations and analyzes the reasons for the difference. We want to find the extent to which managers plan for PC's, what they do and why.

A main concern of DP professionals is *compatibility*. They claim that unless organizations plan ahead, compatibility between different types of PC's and between PC's and mainframes is going to be a major problem. The study

explores this claim. We look at three aspects of the organization: technical problems related to the introduction of PC's, organizational policies, and organizational practices.

The Problem

There is no doubt in the minds of DP professionals that the next major step, after the initial period of learning and adaptation of PC's in large organizations, will be the connection of those PC's to a network with existing mainframes and other machines. This is a logical step to be taken from all aspects.

PC users will want to use the valuable information stored in central sites. They will also realize the limitation of their micro machines for some types of applications and will want to log in to the mainframes occasionally. Since PC's will replace current terminals, their users will also want to use them as a node in the network for mail systems and other communications. In order to respond to all those new demands, organizations will need careful planning and appropriate changes in the existing systems and procedures. The changes needed seem to be quite complicated to achieve, and it is not clear that all parties concerned will be cooperative in an effort to work them out successfully.

The main issue will be *compatibility*. The best known types of compatibility problems are hardware oriented,

[†] For this purpose we define a personal computer as follows: an independent computer, operated mainly by one person, includes operating system and file management, has some I/O functions, a disk or diskette or tape, and is priced under \$15,000. The distinction between PC's and larger computers in terms of CPU or memory is getting less clear every day.

like communicating from a DEC machine to an IBM machine. But problems may rise from other sources. Communication problems like incompatible modems or multiplexers, communication protocols, or speed limits on existing networks may occur. Operating systems may not talk to each other. Application software may also be a problem where programs written for mainframes will not run on the PC's. Programs written for a 32 bit machine may need changes to run on 16 bit machines. Database management systems may have problems working with different architectures and operating systems. This is only a partial list of sources of incompatibility, and we have excluded problems such as security and data integrity. We want to see what different managers are doing in response to the problem of compatibility and why.

Common Descriptions of the Current State and Usual Predictions

We identify five issues that are typically embodied in descriptions of PC adoption in organizations.

THE GROWTH CURVE

One common point of reference is the growth curve in sales across the industry, particularly as compared to sales of minicomputers and mainframes. The numbers are impressive. By the end of 1983 six million PC's had been sold; by 1986 IDC (1983) forecasts sales of 57 million (37 million in homes, 20 million in organizations). This projects phenomenal growth indeed; it implies that by 1986 there will be one PC for every three white-collar worker in the U.S., and one for every two homes.

There are still debates about the dollar value share of the market, since one mainframe may cost as much as 1,000 micros, or more. However, there is no doubt that in terms of the number of people involved in direct interaction with computers, the number of units sold, and the overall effect on organizations and society, we are facing major changes. The questions are whether the *rate* of change will be as predicted and to what extent the adoption of procurement policies will affect the growth rate.

APPLICATIONS

There are a number of suggested applications for PC's found in the literature (Aranda, 1983; Firris, 1983). The most common are word processing and spreadsheets. These are often augmented by support programs providing database management and graphics display capabilities. These applications are based on the as-

sumption that most PC's will be used as a stand alone only. However, most projections of organizational PC use go beyond these stand alone applications to include intra-organizational communications (eg. office automation), terminal emulation (so the PC can be used as a terminal to a mainframe), report generation and local analysis of larger shared databases, and provision of a "user shell" for larger integrated applications. Such applications require the development of procurement policies that insure that the PC can be integrated into the larger organizational computing environment. To the extent that these integrated applications are seen as important justifications for procurement, the development of policies to provide for them is essential.

NETWORK SUPPORT AND COMMUNICATIONS

Network support and inter-machine communication will be a critical issue for the future development policy. There are many ways that currently available PC's can be lashed together in crude networks, usually through use of (somewhat) standard communications protocols and 300 or 1200 baud modems over telephone lines. But such arrangements are fraught with trouble for many users. Even getting such simple capabilities within an organization can be difficult, and there are often problems with noisy communications lines resulting in transmission errors. The communications protocols used by different machines frequently cannot supply all the possibilities their developers claim for them. And even when these arrangements work as planned, their limits on speed of transmission can cripple major tasks. For example, uploading or downloading a full double-sided/double-density diskette on a 1200 baud line can take hours. The eventual solution, so the promoters claim, is the establishment of local area networks (LANs) with high-speed communications capabilities to link together various components of a network. But despite some optimistic claims about widespread use of LANs in the near future, this technology is both complex and costly, suggesting that the adoption of LANs might be slower than many expect. What considerations will guide organizations in making policy for the connectibility of PC's into organizational networks?

DISTRIBUTED ACCESS TO CENTRAL DATABASES

A typical PC is not able to handle large jobs efficiently, and the economies of building extensive capabilities for special jobs (e.g., high-speed laser printing, large file management) into every PC are prohibitive. The concept of sharing resources through use of telecommunications and LANs appears to be a possible solution to this.

However, beyond the problems of getting devices to communicate with one another, there are difficulties involved in providing access to large shared resources by arbitrarily distributed machines. This is especially true in the case of central databases. Most large databases are not designed to accommodate access from different machines because their database management systems are tightly coupled with the operating system of their host. The enormous investment in large databases, particularly those operating under DBMS, suggests that there will be few quick fixes to enable such remote and arbitrary access.

Beyond this problem, there is a question of how to insure security and database integrity when access is provided to remote users who have the potential (given their local processing power) to alter data and perform transformations that might erode the utility of the database for the larger organization. Finally, there is a question of how many copies of databases (or parts of databases) the organization wants to maintain. One objective of DBMS is to reduce data redundancy, but how will this be accomplished when many users can download all or large parts of databases to their own systems? Development of organizational policies is essential for dealing with these issues.

COMPATIBILITY ISSUES

Possible reasons for compatibility problems were presented in a later section. The diversity of hardware vendors was one of the main reasons mentioned. A survey by Data Decisions (1983) shows a variety of PC brands in use. IBM and APPLE are leading by large percentages but other brands are also found in significant numbers. Usually there are more than two different brands in one organization.

We do not have data on the distribution of software packages and operating systems but the assumption is that there are many of these in one organization, often related to the hardware brand.

It is usually agreed that in the case of a PC connected to a mainframe, the PC has to be made compatible and not the mainframe. The question of compatibility among the PC's is a different issue which is usually less pressing at first.

SUMMARY

The discussion above suggests that PC procurement in organizations involves many factors. Most of these factors are not currently supported in the organization and their implementation is not trivial. A procurement policy

is needed to take into account all the factors listed above. To see what actual policies are, we studied five organizations which are beginning to procure PC's.

Description of the Study

The city government organizations of five medium sized cities in Orange County, California were used in this study. These organizations were chosen because they provide useful characteristics for assessing policy formation. They all engage in similar operations and functions; they have similar managerial and organizational structures; they are all approximately the same size and (being public organizations) they offer easy access for study. Since this is an exploratory study, we do not claim that these organizations are representative of all organizations, or even of city governments in general. We conducted this investigation to ascertain whether, at least in one set of comparable organizations, there are well-developed policies for procurement of PC's and, if so, what rationales underlie those policies.

SITE SELECTION AND DATA COLLECTION

The characteristics of the five cities are shown in Table 1. The cities range in population size from 73,00 to 219,00, making them "medium-sized" among U.S. cities. Their operating budgets range from \$19 million to \$72 million annually, and they employ between 381 and 1,286 people (full time). All have been using in-house computers for administrative data processing for at least a decade. All have procured at least two PC's.

Data collection took place through structured interviews with DP managers, and users, and top city administrators (usually assistant city managers). Interviews lasted between one and four hours with DP managers, between fifteen minutes and one hour with end users, and about one hour with top city managers.

COMPUTING IN THE ORGANIZATIONS

City 1 is one of the oldest and largest cities in the county. The primary data processing activities of the city are performed by the DP department under the assistant city manager for finance. Processing takes place on a Burroughs 2900 computer. The police department has its own computing facility with two DEC PDP 11s (an 11/70 and an 11/44). The Burroughs and DEC machines are not connected in any way. PC use in this city started with the procurement of stand alone word processors, but demand has shifted to complete PC's. All PC procurement decisions are made by an organizational in-

Table 1

General data about the cities

City	#1	#2	#3	#4	#5
Population	219,067	178,706	72,934	105,561	85,709
# of Employees	1,286	934	381	725	537
Annual Budget 1983	79,687,800	50,066,600	19,475,492	46,782,652	35,233,585
To Whom Does DP Report?	Finance & † Asst. City Mgr.	Chief of Adm. Services	Asst. City Mgr. Adm. Services	Asst. to the City Mgr.	City Manager
Is There a Steering Committee for PC's?	Yes	Yes	No	No	No
DP Budget	600,000 & 500,000 †	500,000	350,000	380,000	800,000
# of DP Employees	14 + 6	14	6	5	15
Mainframes	B 2900 & PDP 11/70 ‡	B 3900 PDP 1/70 ‡	Honeywell 6	HP 3000 3	IBM 4331

† City # 1 has two different departments; one traditional DP department and another department for PC's only.
‡ For the police.

formation system committee chaired by the assistant city manager for administrative services. The committee contains the IS manager, the DP manager and representatives of major departments. Training on PC's is provided by the DP department. The PC's are not yet connected to mainframes, but the city has adopted a policy for procurement that requires any PC purchased to be compatible with the Burroughs machine. Other requirements for purchase include demonstration of benefits in excess of costs, although no formal guidelines for what constitutes such benefits exist.

City 2 receives most of its data processing service from a data processing department under the city's chief of administrative services. The DP department operates a Burroughs 3900 computer. The police department has its own PDP 11/70, which is connected to the Burroughs machine. The city began to procure PC's as stand alone word processors, but demand for full PC's is growing. As yet there are few PC's in the city. Nevertheless, any PC purchase must be approved by an EDP committee chaired by the chief of administrative services. The committee consists of the DP manager (a fairly powerful leader in the government), and heads of the six major city

departments. Requirements to qualify for a purchase are largely determined by the DP manager, and include demonstration of benefit in excess of cost, adherence to hardware and software guidelines, and DP technical judgement that the proposed application is sensible.

City 3 is one of the newest and wealthiest cities in the county. Most of the city has been built over the past fifteen years. Data processing is provided by a DP department under the assistant city manager for administrative services, using a Honeywell Level 6 computer. Control over DP is highly centralized, including procurement of PC's. PC procurement decisions are approved by the DP manager, based on justification by users and conformance with technical standards the DP manager sets. This arrangement has full support from the city manager. As yet there are few PC's in use, although it is expected that there will be modest growth in acquisition. The city is the only study site with an existing LAN, a unique system consisting of two clusters of terminals (including the PC's.). Linking within clusters is by fiber optic cables, while linking between the clusters and the mainframe takes place over the city's traffic light control network at a 19K baud rate (faster rates are possible).

Table 2

Profile of computing and PC activities

City	#1	#2	#3	#4	#5
# of PC's	9	4	2	7	2
Main Kind of Use	stand alone	stand alone	stand alone	stand alone	stand alone
Main Applications	word proc. spreadsheets database	word proc. spreadsheets database engineering	word proc. spreadsheets engineering	word proc. spreadsheets database	word proc. spreadsheets
Is There a Central Policy for PC's?	Yes	Yes	Yes	Yes	Yes
DP Control of PC Acquisition	moderate	moderate	strong	strong	strong
Training Provided by DP	alot	very little	very little	limited	none
PC # in Two Years Predicted by DP	30-50	10-15	5-8	10	5-10
Is There a Working DBMS?	No	No	Yes	Yes, limited	No
Type of Access to the DBMS Planned	read only	read only	read & update update-batch	read only	read only
Is There a Network For Terminals?	Yes	Yes	Yes	Yes	Yes
Is There a LAN?	No	No	Yes	No	No

The city is also one of the few study sites to use database management, but the DBMS is not particularly sophisticated.

City 4 has no internal data processing facility, and instead uses an outside service bureau under contract. The assistant city manager, who has no professional background in data processing, administers this contract for the city. The service bureau runs the city's applications on a HP 3000 mainframe. Until recently, departments had the authority to purchase PC's for their use, and there are now eight in various departments. Recently, a procurement policy has been established that requires approval from the assistant city manager

before a PC can be purchased. There is no training available to PC users, so they must fend for themselves. There is a limited database management capability available on the mainframe that the PC's could use, but users report that it is not useful. There is no LAN, and there are no plans to install one.

City 5 uses an internal data processing department directly under the city manager. Major data processing is done using an IBM 4331. The city has only two PC's at this time, but has established the policy that any PC purchase request must be approved by the DP manager. There is no use of DBMS, and there is no networking (although there are remote terminals connected to the

4331). Limited initial training of new PC users will be provided by DP, but users are expected to proceed on their own from that point.

Discussion of Findings

THE GROWTH CURVE OF PC ADOPTION

The first point to observe about all the cases is that the number of PC's currently in use and the predicted numbers for acquisition in the near future are much lower than one would expect. This is reinforced by the findings of the IDC Report (1983) which showed lower numbers than expected in most places. One possible reason for the high estimates is the strong publicity of personal computers lately. The advertisements show PC's in many homes so one expects to find them at work as well. Since neither managers nor potential end users typically have clear ideas of what things can be done by PC's, few requests are turned in and some of those are turned down. The usual initiation of a request comes from an end user who saw one application for a PC as a stand alone and wants to use it.

It is reasonable to expect that the more end users there are in an organization and the higher the skills they have, the more users will realize the advantages of PC's and demand acquisition. These things take time, however. In most cases the few PC's in use have been around for only a few months to a year, knowledge of their capabilities is limited.

In the local governments of Orange County one finds less than ten PC's, and, while the predicted number for the next two years range from a few more to 50, most predictions are low. The people we talked to believe that personal computers are "the wave of the future." This may also explain the fact that people think there is a lot more going on concerning PC's in other places than facts show.

APPLICATIONS IN THE STUDY SITES

There were no surprises in the kinds of applications which were used in local governments. As in most other kinds of organizations, word processing, spread sheets, and database systems were popular. Some special software was provided for professionals who handle problems like traffic control, water systems, and road maintenance.

The police department has special needs and, in most cases, has special hardware and software, independent of the DP department. This usually includes a mini-computer serving as a mainframe for the police depart-

ment only. In the case of professionals using special software, the end user was the one who decided what software to purchase. When more general types of software (like word processing) were considered, DP usually makes the decision about what package will best fit their needs.

Word processing was an interesting case where many places went through the stage of dedicated word processing machines and a special service center for word processing. Currently the dedicated machines are being replaced with general purpose PC's and word processing is being merged with DP.

NETWORKS AND COMMUNICATIONS

There is, as yet, little use of networked and integrated applications. The limited networks that do exist consist of dumb terminals linked to a mainframe: in short, standard teleprocessing. PC's are used mainly as stand alone machines, or when hooked to a mainframe, as dumb terminals. This corresponds with uses found in other organizations (IDC Report, 1983). There was discussion among several of the DP managers about developing LANs using Ethernet technology, or even the local cable TV network, but these developments were not even in the planning stages. The only city with a network-like arrangement was City 3 which was using its traffic control network as a carrier to connect remote terminals to its computer center. This city is an exception, however, in that it is a truly new city with a recently installed traffic control network. Few cities have this luxury.

ACCESS TO CENTRAL DATABASES

As noted above, PC's tend to be used only as dumb terminals when they are connected to mainframes. Thus there is little sharing potential other than for data from central databases. This too is limited at present because of the lack of database management systems in the study sites. The DP managers claim that they are aware of the need to support remote access provided in any of the sites is read-only access, and users in those sites complain that they really do not have practical access. Only in City 3 is there a workable read-only DBMS, with planning underway for an update capability. Experienced end users of PC's felt they would gain considerably if given access to remote databases, and give this a high priority for development. This reveals a fundamental difference in perspective between the DP managers and end users.

COMPATIBILITY ISSUES

With no exceptions, current mainframes, and their software, are the dominating factors when considering com-

patibility issues in these cities. In other words, PC's have to be compatible with the mainframe and not vice versa. Even in extreme cases, where the mainframe is technologically obsolete and should be replaced soon, PC's still have to be compatible with the old machine. (PC's, by the nature of the market, are almost always the latest technology).

The main reason for this policy is the large investment in software for the mainframe, software which is responsible for some functions vital to the basic operation of the organization. Those software packages are hard to rewrite or convert to different architectures or operating systems. This is also the reason why organizations tend to stay with the same family of computers, or at least the original vendor.

With the exception of a few machines which were bought before policy was established, all the cities have one PC vendor, possibly a second, but no more. There is an attempt to restrict the operating systems to one or two and to standardize the software packages in use. If these policies are carried out these local governments should be able to reduce the compatibility problem to a minimum.

Organizational Policies in the Cities

A survey by Data Decisions (1983) showed that only 18% of DP managers mandate which system to purchase and only 48% participate in the decision. This is not the case in the local governments we studied. In all cases there is a clear policy concerning PC acquisition and DP (or MIS) departments play a central role in those policies.

Usually a committee has to approve (or recommend) the request. The DP manager is always on these committees and often is the strongest member, due to his/her expertise. The DP people first realize the need for planning. They explain it to management, and as a result, a policy is made. Top managers do not understand the technical details of the problem but generally know the need for control and planning, and support the control of DP (at least partially).

The DP manager's approach to PC's and his/her role in the organization varies from case to case. All are aware, to some extent, of the major role PC's will play in the future. What they are trying to do about it depends on their relative power in the organization, their estimates of the number of PC's and types of use in the near future, their personal approach to changes, and other factors.

If, for example, they think that in the next two or three years PC's will only be used in limited numbers for stand

alone special applications, they may be satisfied with some standardization of the hardware and software and not worry too much about changes in current routines. In one case the introduction of PC's to the organization caused a shift of responsibilities; DP maintained the traditional services and a new group under a different department was created to take care of PC's. Interaction between the two departments is limited. Some political issues were probably involved in this decision. Inner politics are also involved in PC committees, and representatives of major departments often sit there.

The following are some major points found in most of the written policies:

- Limited number of hardware vendors, 2-3
- Compatibility with the organization's mainframe,
- Technical specifications like minimum memory, disk space, CPU speed, etc,
- Operating systems which have to be supported,
- Programming languages needed,
- Upper price limit,
- Procedure of submitting a request and the responsibilities of each party.

DP POSITION

In most cases the DP department was traditionally associated with finance, reporting to the manager of finance. This was due to the fact that financial applications were the first and main ones to be used. It is still true that financial applications are vital to the basic operation of the organization and therefore get priority.

What we saw in these cases was a shift of data processing from finance to administration, reporting directly to the city manager. Our assumption is that this trend has to do with the managers' higher awareness of the importance and power of data processing. This awareness led to the separation of DP and finance, which is no longer the only user. In the one case where DP is still under finance, a new department for personal computers was established under the assistant city manager for administration.

POLICE DEPARTMENT—A SPECIAL CASE

The police department is a special case in the local governments studied. It is always a powerful department due to its large share of the budget, control over sensitive and critical activities (to citizens and elected officials), and degree of independence. Concerning computers, the two strong points the police department has are its budget and the need to store and manipulate data which is confidential by law.

Consequently, police departments in the cases we saw were always on the leading edge in purchasing PC's. In some cases they had a separate system including a large mini as mainframe, terminals hooked to the mini, and PC's which were used as stand alones or connected to the mini. In all cases the actual cooperation between the police and the DP center in terms of shared or transferred data was limited or non-existing.

Since, as stated above, the police were usually the first to purchase PC's (or among the first) and since the decision was often made independently, this is a good opportunity to examine the consequences of unplanned computer acquisition. In most cases compatibility to the organization's mainframe was not a consideration when the police purchased their hardware, and consequently they cannot communicate even if they would want to.

Discussion of Policies

As we have seen, the process of PC acquisition is under control in these local governments (and probably in many other organizations). Organizations optimality is still the main goal. Top managers understand enough to realize the potential problems and they rely on the technical expertise of the DP managers. The usual reasons given for this policy are limited resources, unjustified requests, the efficiency of central control, and the need for compatibility.

The question is: Why is this happening? There are several possible answers. Real financial limitations are probably one reason. (As stated before, fifty times \$5,000 is still a lot of money). Another possible reason may be the tradition of centralization in these organizations. Decisions about exceptions are also made by the center. It seems like the pressure from end users is not that strong, as yet. Not everyone is crazy about PC's.

As for the use of the compatibility argument by DP managers, the motivation may come from two sources. For some it may be a real concern, and they believe that this is a major problem. For others it may be used as an excuse for maintaining their power position in the organization. In many cases it's probably a combination of the two.

Forecast

As stated before, there is an agreement among DP professionals that the next step, after PC users gain experience, will be the demand for communication and access to other systems in the organization. One major consequence will be the new domain of compatibility issues. Assuming that in most cases organizations will

try to support such demands, the natural place to go for help will be DP professionals. This may increase the power of the DP departments in the organizations. (Lucas (1984) mentions high interdependence as one of the conditions that lead to a department achieving high levels of power).

There is another source for possible increase in DP department power. As people in different levels of the organization learn more about the problems associated with computing, they will learn to appreciate better the troubles of computer professionals and the complexity associated with their work. On the other hand, there may be some places where the introduction of large numbers of PC's will cause decentralization of DP functions among other departments.

Compatibility issues will put pressure on computer manufacturers to support communication with other types of machines. (Compatibility within the family will not be enough.) The same thing goes for software. Manufacturers who support the most flexible systems will have a strong advantage.

Database management systems will have to support new types of remote access services, more defined types of restrictions on access and enhanced security and integrity procedures.

All aspects of communication will be of main importance. Local area networks will be common and necessary in large organizations. Ethernet-like networks will be installed everywhere. New modems, less expensive and with higher baud rates, will be used. Protocols for communication will be a main concern. In general, the communication part of the system will take a larger share in the budget and will play a central role in the system as a whole. The main point, however, is that it is going to take time. For an average medium sized organization, it will take years to implement some (not all) of these technologies.

Conclusions

The study showed that a lot of the assumptions and predictions concerning PC's are somewhat naive. PC's are certainly coming but probably at a slower rate than predicted. The stand alone type of use dominates and will do so for a while. Many managers and professionals see PC's as advanced terminals from the mainframe point of view. Local area networks and access to central databases are not very common. In general, the fact that some leading edge technology exists does not mean that it is widely used.

Powerful groups in the organizations are able to get PC's (and many other things) with or without policy, while others often have to wait. In that sense computers are no exception.

DP managers and top management are aware of the compatibility problem and try to plan ahead to prevent it. In many organizations there is a well defined policy of PC acquisition. Since the actual numbers are not large, there is still time for planning. This is a good sign for many medium-sized organizations that may still have time to plan and avoid serious compatibility problems.

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