Installation management—The next ten years

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INTRODUCTION

In this paper we will give our extrapolation of the exciting challenges facing installation managers in the coming years and how we expect to react to these challenges. We view the evolution to the present stage as having gone through three generations of installation management. The first generation was marked by the early computers with small memories and relatively crude input devices in which the operation of the computer was done mainly by the person using the computer. In this early generation the computer installation manager had the hardy pioneer spirit and knew most of his customers by first name. One of his main worries was how fast he could get the next model of the computer.

The second generation was marked by the introduction of tape operating systems and some primitive disc systems which required that the person operating the computer be very nimble and able to react quickly to the need for changing tapes so that computer utilization would not drop. In that generation the customer moved away from being in direct contact with the computer but there were still many customers who used the computer directly. Input and output were becoming a problem. The installation manager now had to start worrying about planning the layout of the I/O area carefully and was looking forward to the coming generation for order of magnitude improvements.

In the third generation we found the introduction of multiprogramming facilities through the use of primitive drums and improved disc facilities. And here, as in the second generation, the need for competent operation of the equipment became of increasing importance. One then had many jobs requiring tapes and discs running at the same time. The I/O problem increased even further and the great hope of eliminating it through terminal access was dismally smashed. The utilization of remote job entry stations did finally ease the problem in the latter part of this generation. By using remote job entry stations, most customers no longer required their own computer nearby to get adequate computing service. In this generation the installation manager had to face up to the full problems of being a production specialist, a resource accountant, a businessman and a technocrat.

In what we now view as the fourth and present generation at Carnegie-Mellon University the distinction between the generations becomes hazier. We will list the main characteristics of this generation. Awareness that computers cost large sums of money and that poor utilization is not uncommon here become permanent issues with the economic decline. The possibility of inexpensive mass secondary storage is becoming very real and in some cases is almost here. At times our complex systems appear to be working stably. Computer installations are no longer simple one machine, one vendor sites.

Telecommunication is now as big a problem as the computers and people are asking what they are getting for their dollar rather than how fast they can get the next piece of equipment.

The fifth generation we project will be characterized by low cost mass secondary storage, so inexpensive and efficient that tape drives will become uneconomical to use in many cases. Telecommunications will be reliable and economical, so that we will not hesitate to use a computer at the opposite end of the country. Time-sharing systems will actually work reliably. No one will take note of using the system with several hundred people on it. Computer installations will become rather amorphous entities consisting of complex inner connections of many different CPUs' memories, and various storage devices.

In the fifth generation, management information systems will become paramount. Low-cost mass storage will make implementation easy and the interconnections of networks will make distributive data bases a reality. The challenges in the coming years are put into the
innovation and implementation of automation is not interest and it should be and probably will be the main theme for the foreseeable future.

By meeting some of the challenges mentioned, Carnegie-Mellon University (CMU) was able to cut its Computation Center costs by 40 percent and at the same time improve service, deliver more computing power, and increase customer satisfaction in a short period of a few months. Some details of this accomplishment have been covered elsewhere. In our experience, innovation and implementation of automation is not an easy straightforward process, but the challenges can be met.

PERSONNEL AND ORGANIZATION

One of the largest voids in today's information processing technology is the lack of qualified educators to train the personnel we need. The ACM Curriculum Committee on Computer Education has presented reports which will probably form the foundation of many curricula for training our future personnel.

The increasing complexity of the computer installation requires a shift to more technically competent personnel for daily operations. Unfortunately this shift in general has been too slow and many present installations suffer with reduced productivity due to less than optimally trained personnel.

Several years ago there were studies which revealed that the difference in the productivity of programmers can be an order of magnitude.

Unfortunately, evaluating programmers remains in a state of witchcraft. We cannot hire enough experienced programmers, and we are willing to train or hire inexperienced persons. Hopefully, by evaluating them over a period of employment, we can get a few very good ones from the crop. CMU receives big dividends in minimizing the actual number of personnel while maximizing on the competence of individuals. In other words, the incremental cost of properly compensating the excellent programmer is well worth the price if we are lucky enough to have him.

The actual organization of a computation center is not so important since the organization should reflect an attempt to optimize the contributions of the individuals and inter-personal relationships with respect to the objective function of the group. Therefore, one would reasonably expect the organization to change in time as the different members of the team come and go. Though the usual organizations are somewhat reluctant to be highly dynamic, the rapid change in the advance- ment of information processing technology presently allows one to have a flexible organization without having the appearance of a continual card shuffle.

At CMU the shift to better qualified personnel has taken the route of the control center concept with the elimination of the usual operations groups. The computation center staff sections are hardware, information, and software systems and with few exceptions every professional takes his turn being in charge of the control center. The programmer in charge of the control center may have as many assistants as the load requires. This approach is parallel with more automated operations requiring more technical skill and has significantly reduced operating costs. Better service and a more stable system result because of the increased technical ability of the personnel in charge to answer inquiries and react to contingencies.

Personnel are the only important resource. Whatever machine we have today will certainly be outdated in five years whereas our personnel will be more valuable in five years if we give them the proper motivation to keep abreast of our challenging field.

THE EXECUTIVE GAP

Most computer installations are a part of a greater organization which the installation serves. With the increasing utilization of computing resources the importance of the installation to the parent organization is increasing. The rising costs of these computing resources to the parent have forced many organizations to recognize the need for an executive position with the responsibility for coordinating and integrating the organization's computing resources. This executive must be technically and administratively competent.

In most organizations today there is not an executive position with adequate technical competence for the magnitude of importance of the organization's computing resources. One or more installation's managers have been given default technical responsibility without proper administrative authority for effectively handling the responsibility. One common symptom of this executive gap is separate computer installations for "administrative" and "scientific" computing. The managers and their organizations who recognize and react to this common gap in their executive structure have much to gain in better utilization and reduced total costs.

* These studies were attempts to evaluate the relative merits of time-sharing versus batch processing as a means of programming. Although the intended results were inconclusive, the wide range in programmer productivities was repeatedly demonstrated.
Until the executive gap is filled the installation managers must understand the requirements of the organizations they serve as well as keep abreast of computer technology if their service is to be efficient. This requirement of having an executive position which must be alert to developments in the rapidly changing computer technology is one of the toughest challenges to be met if our organizations are to receive the proper benefits of our technology.

CONFIGURATIONS

Will the small computer installation disappear and be absorbed by the giant emerging ones or will a small computer installation have a place in the future? The answer to this question obviously depends on the circumstances. Just as a small switchboard has a place in our present day telephone system, there are many circumstances where the small switchboard doesn’t belong. In our projection it will be more than ten years before the small computer installation is really threatened in the same way as a small telephone switchboard. Certainly the installations that will exist over the next few years will become more amorphous entities rather than one single CPU or one single manufacturer. Reliability will be markedly improved through new circuitry, improved hardware technology, and better software. Emerging large mass storage systems will permit a greater degree of automation and accommodate the developing management information systems. The general population is beginning to understand the basic principles of machine configurations. We now have our first book characterizing in a systematic way the various computer structures. The minicomputers won’t replace the large CPU’s but they will certainly supplement and complement them. Every large CPU probably will have numerous minis around in various functions for which the larger CPU is less cost effective.

NETWORKS

Computer networks are another area in which the small computer installation is threatened by replacement with a remote job entry facility or a few terminals. This will eventually happen, but we certainly do not think it will be in the next few years. It is, however, definitely a possibility in five to ten years. Communication problems have held the development of networks back many years. However, the great thrust provided by the underwriting of the ARPA Network has provided the enthusiasm for exploring the present potential of networks.

Actually there will be two forms of networks, the local network and nonlocal or long distance network. There are many advantages to local networks which haven’t been properly realized by the installation manager. Many installations have various computers with duplicated hardware and software facilities.

The linking of local computers and the reduction of redundant facilities will result in the elimination of duplicate costs and also in increasing cost effectiveness because jobs will be easy to run on the appropriate machine. This was successfully accomplished recently at CMU with sizable cost saving (capital and operational), increased effectiveness, and added functional capability for the customers which formerly used each system as an independent entity.

Also the reliability of the total installation will be improved since one can transfer a job more easily from one machine to another. The non-local or long distance networks will satisfy peak load demands and actually permit installations to run at a greater average capacity because they will not have to have an excess capacity to satisfy peak loads. The result will also be an increased cost effectiveness. The non-local networks will allow each installation to give one stop service to a broad spectrum of functions which will be available through the networks to which it is connected.

RESOURCE ACCOUNTING AND CONTROL

The measurement of computer systems has now come of age with the first annual workshop on software system performance evaluation held last year and installations are developing their own means of implementing primitive measurement facilities. In the coming years manufacturers may actually supply measurement facilities as parts of the standard system. We should not have to buy a computer as though it were a car without a speedometer or gas gauge or odometer. The question of pricing, cost accounting, and the administration of computer resources is now considered an integral part of the resource accounting and control schemes. The marketplace will demand the facilities to measure and record utilization. Whether one should lease or buy and how and why one should write off purchased equipment is a commonly discussed issue. The marketplace will discover that

* With proper accounting and pricing sometime during the coming years we will stop referring to our customers as 'users.' The label 'user' has adverse psychological effects for the 'user' and the ones 'used.'
purchasing equipment and using some sort of declining balance depreciation is the proper and logical way to cost account for equipment resources of a changing technology.

HARDWARE PROJECTS AND MAINTENANCE

This area is becoming a challenge due to the increased in-house capability of installations not only to maintain but also to fabricate and enhance their equipment. The recent emergence of the 'Brand X' peripherals has created a problem in many installations with multi-vendors. Now the installation requires at least one person competent in hardware logic to minimize the potential conflicts between various vendors. For those with the capability, a potential savings of some magnitude exists for in-house maintenance of equipment.1 But for those who do not prefer this route there are third party vendors who will furnish maintenance for various manufacturers' equipment.

SOFTWARE PROJECTS AND MAINTENANCE

Software still continues to be one of the biggest challenges. The Third ACM Symposium on Operating Systems2 last year gave us the impression that perhaps operating systems were now being comprehended.

In general we are beginning to see logical structures and approaches to putting systems together. Three annual conferences have been held on software engineering. Their accompanying proceedings34-38 project that an emerging profession is developing in software engineering. In the next few years we will even be getting the handbooks or cookbooks which will tell our software engineers what pieces to use for the type of system we want to put together. The education, training, and development of programmers and operators is still somewhat of a controversial subject.39 Some curricula are becoming standardized and our first book on management of computer programming was recently published.40 Perhaps people have not learned that we still have to develop the art of managing a large software project. It has been our experience that the project employing more than three programmers is likely to have serious problems without careful structuring of the project40 and software.41 With the continual unbundling that is occurring perhaps the vendor software groups will have to stand on their own or face up to competition from the outside. Then the quality of the vendor software will be improved or the purchaser will not opt to take it. This will hopefully create more competition where installations can go to third party for maintenance of their standard operating system and have more options to buy software packages built to order for them.

CONTRACTS AND LAW

Contracts40 and law unfortunately tend not to be recognized as the challenge they are, although many of us have recognized this the hard way. Monopolistic tendencies of the various competitors in the marketplace require the installation manager to have an understanding of the Antitrust Laws.41 The field of law is also now becoming aware42 of the particular requirements of the computing technology.

STANDARDS

An old and difficult challenge is still with us. The emergence of the networks has shown that if the networks are going to work, which they surely are, people will be forced to use standards.43 The developing of microprogramming44 capabilities hopefully will allow not only better standards but also allow a standard operating system which would run on most computers and still allow the computer to have its own unique capabilities.

COMPETITION IN THE MARKETPLACE

Do you really have competition in the marketplace? With the folding of RCA Commercial Computer Division and with GE electing to get out of the field, some think that competition is decreasing rapidly to zero. Of the many and various extreme views on this subject one of the more moderate was expressed by Larsen.45 He said, "Hurting IBM is easy; solving national problems is tough and difficult. A good solution requires all of the business and technical skill at the industry's disposal. It also requires that we care—not about IBM, but about the United States, if we are to keep the United States in its lead of the computer technology." Larsen, unfortunately, did not cover the case of an international monopoly.

The real question is whether or not our workable but competitive system gives the marketplace a fairly priced and up-to-date product. If one company spends more on research and development than most of its "competitors" gross45 is it possible to compete rather than just trail behind and subsist on leftovers? Could Fortran and OS/360 have survived in a free and knowledgeable marketplace? How many installations have
computing contracts tailored to their requirements and explicitly hold their vendors liable for failure to deliver as promised rather than the “standard” contract loaded with the “come hell or high water the installation will pay the vendor” clauses? Does the installation have the engineering specifications for equipment worth millions? What can the installation do if its equipment is not maintained properly? Go to another company for maintenance? We must decide if the answers to these and many other such questions are satisfactory. If the answers are not satisfactory then one of the most difficult and important challenges facing us is what to do to obtain a marketplace where the competition benefits the customers.47

The motivation behind present day monopolies is not usually the hungry greed of the communist’s stereotyped capitalist, but rather nothing more than the desire for the easy life (i.e., a secure well-paying job). To quote Judge Wyzanski,48 “Some truth lurks in the cynical remark that not high profit but a quiet life is the chief reward of monopoly power. And even if a particular enterprise seeks growth and not repose, an increased rate in the growth of ideas does not follow from an increased concentration of power.” This understandable motivation permeates the bureaucracy of the monopolistic organizations with the result that the monopoly power is not overtly exercised by anyone individual but by a collective effect sometimes expressed as, “It is our policy”, “We must treat everybody the same”, or “We can’t make exceptions”. The salesman representing the monopoly, though benefiting from the monopoly, is quite helpless at combating his company’s policy. This indirect collective effect can only be effectively changed by collective effort. Why can’t the customer groups make their own standard contracts?

The Justice Department has historically acted very slowly on monopoly power. The large organizations with power to act do not want to “cast the first stone.” The small installation cannot afford the time and money, and may times is justifiably afraid to fight. A giant organization is a fierce and ruthless opponent49 but our obligation to society demands that if we decide detrimental monopolies exist, then we must face the challenges.

MANAGEMENT INFORMATION SYSTEMS

Corporations and private communities are recognizing the need for and the potential benefits of being able to make more informed decisions through the use of computers. Unfortunately these areas perhaps have been the hardest to penetrate due to the classical conservatism of the management50 which will use these systems. Operating systems have not been outstanding successes in delivering past promises, but now that operating systems have become reliable, many different management information systems exist. Businesses are demanding the implementation of systems.51,52 In fact the Government53 feels they are absolutely essential to the future of the congressional operation.

INNOVATION AND AUTOMATION

Innovative operations through automation should be the theme of the installation manager. He has at his disposal the machines which represent enormous advances made in automated processes and which, by means of information systems, have furnished us the ability to make informed decisions. Why hasn’t the installation been able to exemplify the pinnacle of automation and innovation by allowing the machine to control the routine operations? With our society’s becoming suspicious of computers54 and their encroachment upon privacy, installation managers will have to be innovative to impress society55 that the powerful facilities are in competent hands. In the post-industrial56 era, with information doubling every 12 years,57 the challenge of keeping track of one’s own installation will continue and should be met with our own technology.

SUMMARY

Innovation and automation: with this as the theme of our coming years, the installation manager should set the goal of making his installation the pinnacle of innovation and automation. He will have to be prepared to justify to management not only that his present equipment is cost effective but that what he proposes to get in the future will improve the installation’s cost effectiveness. Management is forced to recognize the large cost that information processing technology is now starting to represent with respect to the organizations’ total budget. We are all very lucky to be a part of this exciting era but we must not make the mistake of leaning so much on our lessons of the past to extrapolate our actions into a very innovative and challenging era which may be totally different from our past experience.

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