

*Why differ  
because  
appears to  
badly managed  
some case maybe  
or maybe he doesn't fit there.*

On Large Scientific Computer Centres

Introduction:

It is quite common nowadays that the subject of computing be brought up at most any meeting, formal or informal, of scientific or technically oriented people. If a meeting involves employees of any of the large research laboratories it is highly probable that the subject of computing will be discussed. It may be that the purpose of the meeting is to foster an interchange of ideas between the staff of various scientific computer centers in which case computing is the only subject discussed. (Well - having been to a few such meetings - may be we should say - almost the only subject discussed.)

On the other hand, scientific research is so heavily dependent on computers nowadays that the subject is often discussed at a meeting made up mainly of research staff from one or more of the laboratories. As a matter of fact, the large research laboratories have played an important role in the development of present day computer technology.

Not only is computing a popular subject at these sort of formal meetings, but also at meetings in the laboratory hallways, chance get-togethers while waiting for aeroplanes, <sup>during</sup> coffee breaks, lunches, etc, etc.

Once the subject of computing has been introduced (for whatever reason) it is quite common for the discussion to evolve into comparisons of one scientific computer center with another. Along with comparisons come complaints, criticisms and sometimes even commendations.

Scientific computer centers at large research laboratories are different, so it is not at all <sup>strange</sup> ~~difficult~~ and in some sense quite natural ~~for~~ <sup>that</sup> comparisons to be included in most any interchange on computing.

*included in "different" are value judgments such as better/worse than another, successful, as viewed by staff, lab, other lab, other centers, funding agencies, etc, users, etc.*

*Comparisons usually end up by saying - Bad Management.*

This paper gives some examples of how scientific computer centers are different and then turns to the question of why they are different. In developing the answer to this question we aim towards the conclusion that the scientific computer center is a product of the management philosophy and techniques practised at the research laboratories and that (in turn) the management philosophy and techniques are significantly influenced by the personalities of the individuals involved. *Bad <sup>computer</sup> management may contribute since most had no training.*

No search of the literature was made prior to writing this paper. Hence the ideas and observations noted herein may well have been previously expressed. In any case, we feel it worth while to express our own thoughts on the subject. This paper is based on observations and experiences spanning a number of years of experience as a user and as an administrator of a large scientific computer center.

## 1. SCIENTIFIC COMPUTER CENTERS ARE DIFFERENT

The scientific computer centers within the large research laboratories are really all quite different. To those whose lives are closely associated with large research laboratories, this fact comes as no real surprise. It is the exception rather than the rule that one is able to take a <sup>computer</sup> program that has been developed at one research laboratory and run it straight away at the computer center of another laboratory. The exception, of course, occurs when some deliberate (and in some cases considerable) effort has been made to ensure compatibility. Most programs are written to fit the computer center environment at the particular laboratory where they were developed. This is especially true of programs that use large amounts of available computer resources. (For example, they may consume great quantities of computer time, or they may require a lot of central memory.) Such programs are in fact fine tuned to match their local environment.

So, scientific computer centers within the large research laboratories are different in that they are operationally incompatible.

## 2. HOW ARE THEY DIFFERENT?

Let us explore some of the incompatibilities. If one wants to make use of one of the scientific computer centers the first thing one does is to get

a copy of the Computer Center Handbook or Users Guide as it is called at some installations. Each one is different since it is based on the various hardware and software installed as well as the operational conventions adopted at that particular computer center.

To begin with, not all installations have the same kind of computer main frames. Not only can they be of different manufacture but even if the brand is the same, there are different model numbers. For example, CDC 6600, CDC 7600, IBM 195, IBM 168, etc. In addition there is a wide variety of peripheral equipment that can be attached to any given computer main-frame. Some centers will use mostly peripherals made by the manufacturer of their main-frame while others (depending on the resources available at their laboratory) will interface all sort of other manufacturers' hardware. These interfaces not only provide interconnections to hardware of similar operational characteristics but may be used to attach rather unique equipment. Here one thinks not only of the various on-line networks for attaching experimental apparatus, but various kinds of remote batch terminals, interactive terminals and (in some instances) IBM photo digital storage devices. As mentioned earlier, depending on the resources available (engineering personnel, and shops, etc.) some of the equipment is partially or perhaps totally fabricated in-house. So, computer centers are different because they have different hardware.

Second, even if some installations do have the same computer main-frames and basic peripheral equipment, they may have different software. Some use what one refers to as standard software (i.e. that supplied by the manufacturer).

In cases where the software is the same brand, there exists the high probability that it has been altered by local modifications. These local modifications may simply take the form of a different scheduling algorithm or may be more extensive in order to accommodate some non-standard hardware. If the (standard) software is supplied by different manufacturers, it is bound to be not compatible.

There are scientific computer centers where the user language software and/or the operating systems software is designed and written by the local systems programming staff. This in-house software may, or may not, bear close resemblance to the standard, manufacturer supplied, software from the users' point of view. So, computer centers are different; in that they use different software.

Third, scientific computer centers are not all the same due to different emphasis, different conventions and the resulting different operational approach. Whereas one center will develop a highly efficient batch processing operation, another will emphasize interactive computing. As a result, some services provided by one computer center may not exist at another center, or if similar services do exist, they may be inferior or even incompatible because of the variation in emphasis.

Fourth, scientific computer centers are different in that they are managed differently. Although in most instances this point is strongly coupled to emphasis, conventions and operational approach mentioned above, it is purposely separated out here for reasons which should become obvious once we get into "why" computer centers are different. In any case, the computer center management, in particular the department head, defines the organizational structure. Although most of the time, one is able to cross identify fairly limited functional areas from one computer center to another, the organization is different. The difference lies in the way the various well defined functional areas are put together at a higher level. For example is Applications Programming and Systems Programming put together under a group called Programming, or is Applications an entity by itself and Systems Programming part of some other branch of the structure? Although we stated that it is usually possible to cross identify limited functional areas within computer centers, these sections do not always have the same range of responsibilities and most likely not the same degree of authority or importance.

In some cases, the upper level management are in constant contact with the day-to-day goings on in the computer center and in other cases they are quite far removed, having delegated that activity to lower level administrators.

There are scientific computer centers that are managed in a very formal manner; in these cases the pecking order is rigidly adhered to. At other centers the structure is there, and it is used, however it only really becomes obvious (outwardly formal) in very serious situations.

In summary, scientific computer centers at large research laboratories are different. How are they different? They have different computer hardware, they use different systems software, they have different emphasis, and are managed differently.

### 3. THEY ARE COMPARED

These differences (incompatibilities) have subjected the scientific computer centers to a multitude of complaints, criticisms, and comparisons. Some of the sources of the complaints, criticisms, and comparisons are the computer users, various brands of auditors, officers and staff of funding agencies and the computer center department staff themselves.

From the users, for the most part scientists who visit other laboratories, the complaints are directed mainly at the service provided by the computer centers. They tell of poor turn-around time, a bad experience with a consultant, there was no one to help them at all, or after spending several weeks attempting to make changes in their program so that it would run they gave up in utter hopelessness.

Auditors complain about the <sup>effort involved</sup> ~~time consumed~~ in trying to understand <sup>and sort out</sup> the various computer time charging algorithms. One is probably safe in saying that there exists no two charging algorithms that are identical. Auditors also claim they cannot find written management guidelines. How can there possibly be any management control without having it spelled out in detail. (Part of an auditor's job is to find out if an operation is conforming to the rules - so he does not have much to do if there are no written rules for him to base his investigations on.)

Personnel within funding agencies and regulatory branches look at all of the non-uniformity of scientific computer centers in complete horror. Volumes of rules and regulations pour out of the agencies. There are rules that spell out procedures that must be followed in the procurement of computer hardware and software. There are regulations requiring the existence of written procedures governing computer center management controls and reviews.

END  
should  
ask what  
no lab. attend  
the meeting  
is meeting that  
goal - not  
overall rules  
for all.

One agency puts out manpower levels which are meant to be upper-bounds on the number of personnel a laboratory may have engaged in computer associated activities.

*staff, including*

*expand*

Computer center, department heads, are critical of one another. Not only do they question each other's hardware acquisitions, but they also at times wonder why some other manager runs his shop the way he does.

Complaints and questions concerning the non-uniformity of the computer centers come from many directions. They are also accused of too much duplication of effort (re-inventing the wheel).

So then, scientific computer centers are different and as a result are subjected to comparisons and criticisms.

4. WHY ARE THEY DIFFERENT?

We have so far explored some of the ways in which scientific computer centers differ. We are now ready to tackle the question of why it is that they are not all alike. *Why don't they have the same computer hardware? Why don't they use the same software, and why is it that the computer centers are managed differently?*

*expand*

To begin with, let us look at the research laboratories of which these centers are a part. One laboratory may be heavily involved in weapons research in which case it is immediately different from a laboratory that is not involved in any classified research at all. (By classified research we mean work in an ~~any~~ <sup>all</sup> area that has been associated with national security and therefore ~~any~~ <sup>all</sup> information regarding such activities is handled on a need-to-know basis.) A laboratory engaged in classified work must establish rigid security measures. Once a laboratory is compelled to set up a security system, it automatically follows that the computer center must be secure. This is the case because a great deal of sensitive data passes through the computers. A whole new layer of parameters is imposed on the computer center that finds itself placed in the position of having to operate in a secure environment. For example, only people with the proper kind of security clearance are permitted to have free access to the computer room and the computers. This of course

includes programmers; and not all programmers will agree to work in a classified environment.

Besides differences that are related to security problems, laboratories have different emphasis. A laboratory with a major program in the area of reactor research and development may place <sup>other kinds of</sup> ~~different~~ demands on the computer department than the laboratory whose main area of interest is particle accelerators. One computer center may have a library that contains tens of thousands of reels of magnetic tape. The reason for such a large tape library could simply be that the laboratory has a very strong (and also very active) program in experimental high energy physics research. This kind of experimental program involves an enormous amount of data. As a result the computer center is very tape oriented. The system is tailored to make it convenient for the user to read and write multi-reel tape files. At an installation that makes considerably less use of magnetic tape, it may still be possible to process programs that make heavy use of data stored on magnetic tape; however, one might have to work harder in order to do so.

Laboratories that have adopted the philosophy that all experiments are to be connected "on-line" to the central computer facility force a different set of conditions on <sup>their</sup> ~~the~~ computer center<sup>s</sup> than does a laboratory that uses the "boy on the bicycle" principle. (Boy on the bicycle is another way of saying that data from experiments <sup>are</sup> ~~is~~ gathered on magnetic tape at the experimental site and the tapes subsequently transported to the computer center for processing). For if the experimental equipment is directly on-line to the central computer it is probably the case that the connection is used for more than just sending the data across <sub>A</sub> to be stored for later use. More likely the connection is used in both directions. Experimental data <sup>are</sup> ~~is~~ sent to the central computer but in addition some of the data <sup>are</sup> ~~is~~ periodically processed by the central computer. The results are then transmitted back to the experimental site and either used directly by the data gathering apparatus or displayed so that the scientist can determine how the experiment is progressing.

It is quite easy to see that the more of these on-line connections there are, especially the kind that demand fairly short response times, the larger the impact will be on the computer center. This sort of utilization of the central computer has requirements that go to the very heart of the operating system.

large amount

So then, ~~another~~ <sup>one of the</sup> reasons that scientific computer centers are different is because they are a part of research laboratories that have different missions, or different emphasis which in turn impose their own individual demands on the centers.

*To be sure*  
~~another~~, one would expect the laboratories not to approach things in the same way because they are engaged in research. A research environment must necessarily be a free environment if it is to have an atmosphere that promotes true scientific endeavour.

*add p. 9*

*insert*  
*(X) →*

5. MANAGEMENT INFLUENCE

We have recalled some ways in which scientific computer centers differ. We have stated that ~~one of the reasons as to why~~ they are different ~~is~~ because they belong to research laboratories that are not the same and ~~therefore~~ *because* present their computer centers with requirements that do not necessarily *they may* match from one laboratory to another. *be in different stages of development.*

*Then of page*  
*?*

Let us ~~now~~ turn to the subject of management itself.

We conjecture that what follows applies to all areas of management in the scientific community in general. However, we wish to concentrate on management of scientific computer centers and so will confine our remarks to management within research laboratories in developing the following theme.

*Indiv. who end up in admin positions*

~~Scientists~~, by and large, do not receive any formal management training during the course of their education. Some may take a course in economics during their undergraduate years but probably nothing of the sort during their more concentrated graduate program. By management training, we include such topics as personnel matters, topics having to do with budgets, organizational structures, management leadership and direction, etc. *concentrated*

In the scientific community, the call to serve in a managerial position usually goes to those who have made a scientific or technical contribution. This situation is quite understandable from at least two ~~different~~ *separate* viewpoints. First, a scientist is in a better position to understand, and communicate with other scientists than is a person from a different field (say business or law). Second the person who has made some contribution (not necessarily earth shattering at all) usually has *gained* the respect of his colleagues and hence

is more acceptable to them as a manager.

Once placed in the position of a manager what forces come to the surface? Some people who find themselves in top level management of a research laboratory have previously performed administrative roles at a lower level ( as a "group leader" say). Such a person has some, so to speak, experience under fire. No doubt, they have served on committees of one sort or another since committees are quite popular in scientific communities. These are the committees that "advise" the laboratory management.

*expand*

So then, here we have an accomplished, respected scientist, with no formal administrative training, who may have <sup>been the leader of a research group</sup> ~~served as a group leader~~ and has <sup>probably</sup> served on a number of policy and advisory committees, <sup>and now</sup> who is called upon to serve in a position of high trust and authority.

At this point we submit that one force that surfaces, a force that plays a significant role (maybe even the dominant role) in guiding, deciding, *and* moulding the character of the research laboratory is that of the manager's own personality. *ments?*

Research laboratories do not have, do not want, nor should have imposed upon them a rigid set of definitions, rules and regulations which would force them into a pre-determined direction or pattern. Given then, the freedoms which must exist in order that a research laboratory maintain an atmosphere conducive to meaningful research and administrators that <sup>are</sup> (unlike most commercial executives) are not formed in the corporate mould and have little managerial training it is only natural that <sup>they</sup> people manage according to their own personalities. ||

*exp. P +*

The management at some research laboratories encourage (while some only permit) strong advisory committees. <sup>In</sup> <sup>instances,</sup> ~~at~~ some, almost nothing happens without a study group spending a considerable amount of time evaluating the pros and cons of a proposal. In fact sometimes these study groups and advisory committees are more than one layer deep.

At other laboratories committees are mainly (or most often) used as communication links between the scientific staff and the laboratory management.

Some laboratory management understand computers, some believe there is a need for computers, some think they understand computers, some do not want to know about computers and some laboratory management have postures that are made up a variety of mixtures of the above (and <sup>still</sup> other) attitudes towards computers. *Those that don't understand are highly susceptible to criticism.*

*assumed*

*others*

In general, some laboratory management are hard-nosed, some are energetic, outgoing, <sup>still</sup> others <sup>are</sup> reserved, <sup>and</sup> some quite formal.

The scientific method is not used uniformly throughout the research laboratory. The personality of the laboratory management has a strong influence on the personality (character) of the laboratory as a whole.

Thus, <sup>(S)</sup> the mission of the research laboratory is defined, various constraints may be set up and certain parameters may become fixed or limits established both with respect to the programatic and the administrative character of the laboratory. *becomes*

The Laboratory's overall constraints and parameters as further interpreted and refined by the computer center management in turn establish the goals, needs, and direction of the computer center. The management of a large, scientific computer center conforms to the general scientific management profile, usually having made some contribution in the area of applied computation. Hence in the final definition of the goals, needs, direction etc. and most important in their implementation, the personality of the computer center management has a very strong influence on the personality (character) of the computer center itself.

*as defined above*

*a bit more*

To be specific, the personality of the Director of a research laboratory strongly influences the character of the laboratory. Second, the personality of the Chairman (Director) of the computer department, within the bounds set by upper management, has a direct influence on the character of the computer center (its hardware, software, structure etc.)

One conclusion that may be drawn from this is that

- 1) given the same computer department chairman, he would perform differently (and hence produce different computer centers) at different laboratories (because of the varying laboratory constraints, parameters, etc) and,
- 2) different computer department managers would perform differently (i.e. produce different computer centers) at the same laboratory (reflecting the managers' different personalities).

As an aside, one might ask, do research laboratories choose their management in the optimal way? It must be true that not all scientifically trained people want to become managers, also a very good scientist is not necessarily a good manager. Of course some are extremely good managers, but we probably would place them in the category of "naturals". Perhaps it would be worthwhile to encourage people to get some formal training in management (not the normal business administration, but rather of a nature that was more tailored to the scientific community).

We began by stating some ways in which large scientific computer centers at research laboratories are different. We then gave some examples of the criticisms <sup>that</sup> arising as a result of these differences. Next we turned to the question of why the centers are different. That question led us to the conclusion that the laboratories are themselves different. We then introduced the subject of management, both laboratory side and computer center management, and we argued that the personality of the management has a strong influence on the final character of the laboratory and of the computer center.

How much, or to what extent, the difference in scientific computer centers is directly related to what we call personalities of the management is a bit difficult to quantify. The main purpose here is to establish the existence of such a force and to suggest its magnitude is significant.

One might ask the question - need such differences exist? The answer to this question may lie in the following observation. Research can only be conducted in a "free" (non-restricted) atmosphere. Such an atmosphere permits (and encourages) differences. Those tools of science that have been "standardized" have withstood the test of time. Even so, some <sup>of them</sup> still crumble beneath the ever advancing search for scientific truth. Among those tools available to the scientist, the computer (and related systems) is still an infant. Perhaps some day, scientific computer centers will be <sup>com</sup>patible, but for now they are subject to <sup>the</sup> differing and changing attitudes and personalities of the researchers who use them and the managers who control them and the environment in which these researchers and managers find themselves.

Developed  
over long  
periods of