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SO YOU THINK YOU ARE READY FOR REMOTE SENSING - IMPLEMENTATION CONSIDERATIONS OF REMOTE SENSING TECHNOLOGY IN A PRIVATE INDUSTRIAL ENVIRONMENT

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I. ABSTRACT

One of the most perplexing and continuing problems of research at all levels, is applying and implementing the results in an operational situation. Although no statistics are offered here, it is suspected that the amount of monies allocated each year for research destined for obscurity or strictly academic residency, must be enormous. It is probably no exaggeration to say the most frequent criticism of any industrial management toward research is how pitifully little seems to filter down to the "grass roots" level.

This paper explores the "how come" of this criticism within the private industrial sector, and suggests the problem is one of dual responsibility between the technical and user communities. Although remote sensing technology is specifically addressed, the technology/user exchange involved is not unique, with many parallels available from which experience can be gained. It is further suggested that the problem of industrial implementation of remote sensing is primarily one of people. As such, this sector is but a microcosm of all organizations everywhere and many considerations discussed will have broad application.

II. INTRODUCTION

Generalities are normally made with an element of danger as to their universality. To say; "the world in which we live is a dynamic one", is such a generality, but probably a pretty safe one. Not only is the world, its components and inhabitants, in a constant state of flux, but very few things are established or fixed as fact, including the so called "scientific laws", many of which have undergone revision as new knowledge has become available.

The mission of ferreting out new knowledge and developing techniques of detecting, monitoring and measuring change is a proper function of research activity. Every discipline needs this growing edge to progress, and must allocate appropriate resources toward this end. Research and the development of technology within any discipline must be related to the operational or functional aspects of that discipline to be effective.

Once operational feasibility is at least demonstrated, any new technology must first be transferred and then implemented. The difficulty in transferring research results seems almost to be inherent, and is the failure of either or both the technical and the user communities.

For the purposes of this discussion, the technical community comprises a coalition between scientific disciplines as may be employed by the private, public or academic sectors, and the various academic disciplines as generally found in institutions of higher learning. These would include not only the research scientist, but other disciplines as might be brought to bear on any given problem. The user community implies the public or private industrial sector who looks toward remote sensing technology as an operational tool, capable of being implemented as an on-going functional part of the operation.

Ideally, the technical community addresses problems as defined by the users and as such serve to respond to user needs; however, this is not always the case.

At the outset, the technical sector must realize that operating systems do not operate within an idealistic vacuum, but rather respond to very real stimuli and needs of day-to-day activities. Some compromise or innovations to the purest approach will have to be effected to achieve a reasonable level of practical reality.

On the other hand, users or potential users are generally ignorant of available technology, although constantly burgeoned with myriads of technical publications. If and when they do become aware of new technology, the significance is often lost. There is a need for a conscious effort on the user's part to become informed and to fight the lethargy that leads to obsolescence, by maintaining a technological growing edge. Whet-stones for such an edge are constantly offered by short courses, seminars, meetings and current literature.

Successful implementation begins, then, with an exchange between both communities wherein the problem is jointly defined, tasks or responsibilities assigned, products or results presented and the applications articulated. In this, a joint responsibility must be shared by the technical and user communities within their sphere of expertise, and in bridging the gap between the disciplines. Without question, the problem of the operational implementation of research results demands a multi-disciplined approach if a solution is to be reached.

III. TECHNICAL RESPONSIBILITY

The ultimate successful implementation of remote sensing technology depends to a large degree on the effectiveness of the offering made by the technical community to the potential users. This effectiveness in turn depends upon how aware the potential user is to the implications of this technology to his operation. How much modification is necessary to render the techniques truly successful? Research efforts must be sensitive to the needs of the user by asking the questions before, not after the procedures have been developed. User participation must be solicited at the outset of the investigation activity. By involving the user early, an awareness of the potential utility of the technology will be realized and the chances of the results being directly applicable to the operation will be much greater. In addition, the user then feels he has been a participant, a strong psycological plus for achieving implementation.

Once the basic research and development efforts have taken place, the product of the research must be placed on the "shelf" and advertised. In effect, the technical community must say "we have heard and responded to your needs, users, here is what we have developed presented to you in terms you can understand and relate to". Unfortunately, technologists and other professional people have a propensity for talking to themselves and entertaining each other with displays and demonstrations. Too often, this is as far as it goes. In addition, many papers and articles are written supposedly, to dissiminate research results, but are really prepared as peer group "show and tells", replete with all the neo-vernacular invariably associated with such activity. The fact that the practitioner cannot relate any of this to his application does not seem to matter much, and so the communication gap is perpetuated and the gulf of credibility between the groups is widened.

Once the product has been placed on the "shelf", the shades should be raised, and the doors opened to just as many as possible. Information describing or advertising the virtues of remote sensing technology must be put in a language oriented toward the marketplace or user community, even if this means in "Golden Book" terms. Although this may be repugnant to a serious researcher, the fact remains, if the results are to be used an interface with the potential user must be established, and to this end part of the research resource must be allocated.

The technical community also has the obligation not to over-sell the product, either by direct claims or by inference, and must make clear to the potential user just what is needed in terms of user input, and prerequisite materials and information. Very seldom can new technology or results from research by applied directly without some prior preparation by the user. It is not enough to announce a great new data source is now available in the form of digitized spectral renditions from the LANDSAT's, and their probable successors, with the implication that, all is needed is to plug it in and "let 'er rip". In fact, when considering the precision levels of information derived from LANDSAT, a rather sophisticated series of sub-information systems must be already in place, if the user is to achieve resulting data base commensurate with his needs.

IV. BRIDGING THE GAP

Bridging the gap between the disciplines is a joint responsibility. The transfer and exchange of technology and needs between the user and the technical community constitutes the very essence of bridging the gap between the two disciplines. Figure 1 schematically illustrates how such an organization might look. It is assumed in this organization that the process is initiated by a requirement or a need of the user community being presented to the technical community. Known capabilities and potential areas for successful research are identified, resulting in a joint definition of the problem. In this case, it well may be that the user, a private industrial enterprise involved in natural resource management, sees a real need for an improved data base with a broader sphere of coverage in a repeatable and timely basis. This particular organization has a Research and Technical (R & T) group through which such needs are generally transmitted. Through its interface with the technical sector, the possibilities of utilizing remotely sensed data as a viable data source is manifest, and the need is articulated to the technical community (university, National Science Foundation, NASA or other government research agencies, or any one of several private research institutions). Whether it is a scientific group or an academic institution, the total available technical information on the subject (remote sensing) is pooled, and together the two disciplines establish a problem definition which outlines the tasks to be performed by the technologists and the input or prerequisite activity required from the user.

It will be noted that the technical element has within it an applications function. It is the role of this segment of the activity to articulate research results to the user through the R & T group. As interim results are achieved, they are transmitted to the user, where the applications are given an operational test. Changes or modifications are fed back through R & T to the technical applications group. This completes the interface between the two major elements providing the two-way exchange of technology vital in developing an operational system. The allocation of part of the technical resource to test results in an applications environment is analogous to milestone or decision point entries in a working time line.

Whatever technical source or user group is involved, the interface vehicles as represented by the technical applications and R & T functions are absolutely essential. From the user's standpoint, a generalized exposure to remote sensing will have undoubtedly been made to all levels of management. It is from R & T where follow-up is expected. In fulfilling its obligations, R & T will educate and inform executive and operations management, and will bring to the organization an operational data acquisition system that is simple to implement, functionally attractive and enjoys the confidence of management at all levels.

For its part in bridging the gap, the applications function of the technical community must provide opportunities by which the R & T groups can be educated in remote sensing technology. It must also learn from the user its needs and be receptive to change or modifications. The technical applications and R & T group functions not only as a technical/operations interface, but as an educational and feedback mechanism within their own discipline elements.

While this organizational design for tying together these two basic functional elements is a bit idealistic, perhaps, it does represent a truly multidisciplined approach to remote sensing implementation. In such an approach lies the greatest hope, for operational success as it applies to the private industrial sector.

V. USER RESPONSIBILITY

In addition to providing the vehicle for technical/user exchange through its R & T group, the user has two major responsibilities; to be aware of developed technology and to implement the demonstrated technology, however tailored, in an operational mode.

A research and/or technology service function is almost essential in any organization involved with the management of natural resources. Depending upon the size of the operation and its objectives, this service can be supplied by one person or a group. The R & T function reflects the technical community within the organization. As such, interfaces must be established between operations and executive management. In the case of operations, the interface is usually direct. In the case of executive management, the interface can be direct, through a corporate technical operations group or a corporate technical director. Any implementation is dependent on ardent management support at all levels, but especially from the top. It is from here where the relative weights of corporate activities is expressed and the climate established for receptive participation by operations in R & T activities. No matter how great remote sensing technology sounds, both executive and operational management have viable questions that must be addressed and resolved before support is forthcoming.

A. Executive Management Considerations

In any corporation dealing with natural resource management, three major factors contribute to top management's potential receptiveness to new and more sophisticated data collection schemes as represented through the development of remote sensing technology.

1. The need for the data -- the essential need for a current data base from which complex management decisions can be made.

2. Timeliness of the data -- to be effective, management decisions must be made as a response to a set of planned alternatives, rather than an after-the-fact reaction generated by a set of circumstances already a foregone conclusion.

3. Acquisition of the data -- the apparent inability of current data collection techniques to adequately provide and maintain an updated information source available to all levels of management at any point in time.

Except for a few satellite color renditions appearing on walls, top management's concern with remote sensing is mostly indirect, being only a data source for their total information system. In weighing the value of investing in such a data source, management is faced with several concerns, some of which are:

1. Introduction of new technology to replace or augment tried and true, albiet, inefficient old systems. Predictable and repeatable results must be demonstrated with commensurate levels of precision.

2. High cost of proto-type equipment and data processing. Although most companies have access to adequate computer hardware, most are on a time-shared basis. The time required for complete classification may be prohibitive.

Intricate and sophisticated peripheral equipment such as image display units, digitizers and mini-processors are financially out of reach, at least at the outset. Access to this type equipment must be provided during the applications development stage.

3. Cost/Benefits. The "64 dollar" question is "what do we have now we didn't before at 1/10 the price". The answer, of course, is the price will go up in all likelihood, but so will the benefits when it is considered that a new dimension has been added not available before.

Because of the high initial costs of start up and unfamiliar if not complicated procedures, a modular approach should be taken with each segment building on the one before. As each segment is completed confidence of over-all success is improved. Such improvement tends to enhance the resources allocated to the project.

B. Operational Management Considerations

Operational management includes the field manager who uses updated information in his day-to-day decision-making process, middle management responsible for development and implementation of medium to long-range management plans and the various service departments including the technical group providing specialized services to both operating and executive management.

Some of the considerations to be addressed in securing operational management support include:

1. A basic resistance to change -- this is inherent in human nature. If the technologists tend to talk to themselves, operations people tend to bury their heads in sand. It is often said "don't make a wave" or "why change, what we have works, and by the time all that new-fangled stuff gets into the system we'll never get answers. After all, look what computers did to us?". What is said here is partially true, brought about largely by the failure to properly define the problem in the beginning. We have come a full circle; nevertheless, new technology always has growing pains, start-up "blues" and transition problems before it is finally integrated into the system. The user is obligated to be open minded and tolerant. It is here during the transition where his input is most valuable in making the technology work, but he has to want to make it work, if he doesn't, the effort is doomed to failure.

2. New terminology -- almost as a prerequisite, new technology is introduced replete with a "jargon" of its own. This generally contributes to a user's passive disinterest if not open rebellion to the inclusion of such methodology within an on-going system. Of course, some new terminology is inevitable and necessary but for the most part, new technology in general, and remote sensing in particular, can be presented in an understandable and interesting manner. With the potential of remote sensing in data acquisition, such a down-to-earth presentation will almost guarantee a receptive audience.

3. Maintaining an on-going program -- unfortunately, the world does not stop while the new technology is being developed operationally. On-going data collection activity, generally coordinated by the technical group, must be continued if any information is to be generated. The on-going system must be established and well enough documented to allow regional delegation of this responsibility releasing some personnel resources to develop remote sensing procedures.

4. Interface with established information system -- this phase is very critical and means the commitment of many people to make it work. It again will be a multi-disciplined effort between the various in-company disciplines including computer analysts, operating managers, operations systems analysts, remote sensing specialists, and the various counterparts in the technical community.

A written report is no guarantee of implementation regardless of the volume or repetitiveness of the exercise. Operational implementation will be assured only by hard work by a lot of people in a coordinated multi-disciplined atmosphere. Usually, neither the time or inclination is exhibited for such an effort. A written report often raises as many questions as it answers and given no follow-up does not provide the vehicle needed to apply the results.

The basic criticism leveled at the outset by operational management of so little research reaching the operational level is largely valid, and applies within as well as between, organizations. Unless a communications link is established through a R & T group and a persuasive argument forwarded to insure a managerial commitment, the basic criticisms of research being developed in a vacuum will be a continuing one.

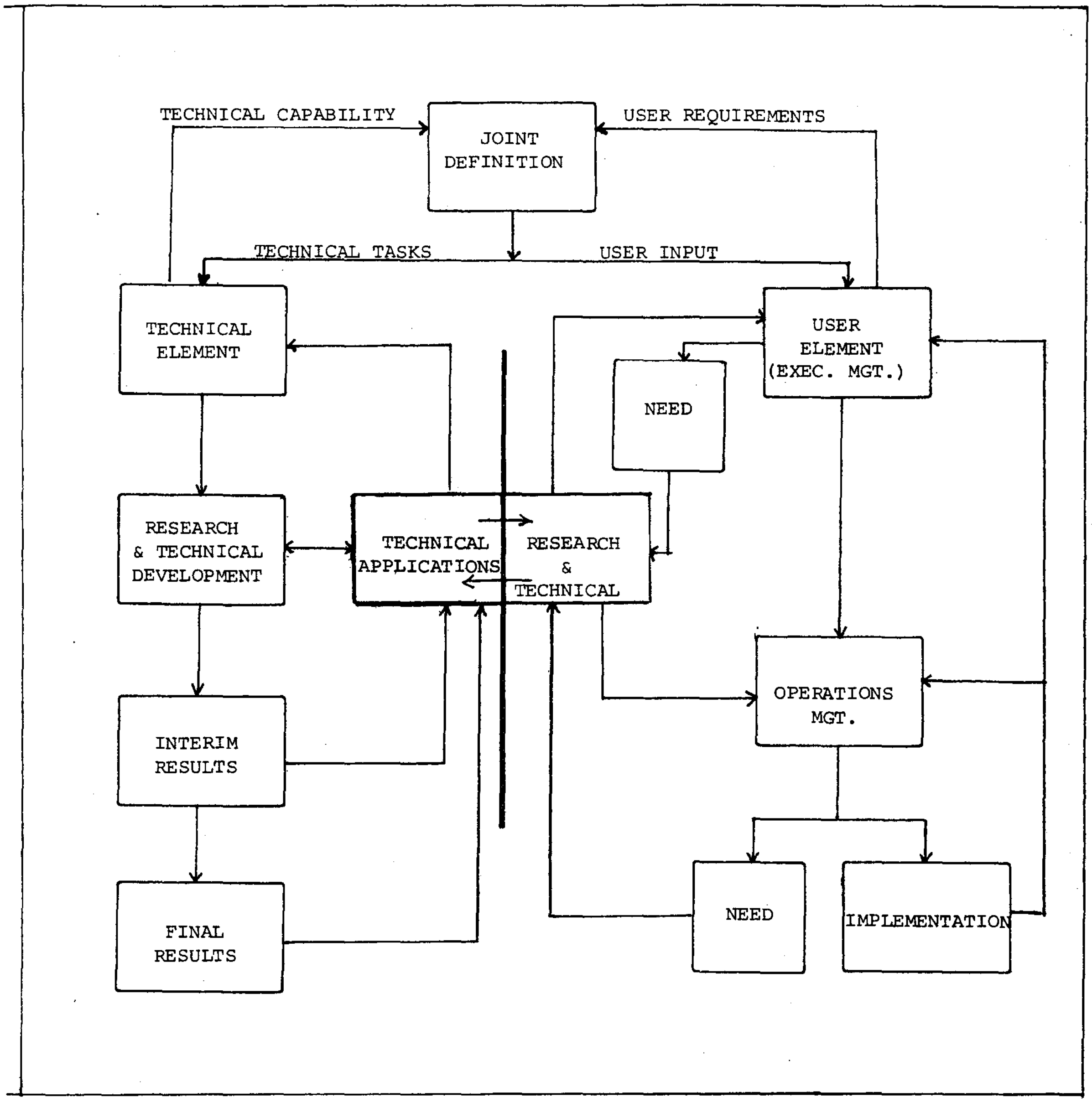

Figure 1. An Idealistic Flow Chart of the Technical/User Community Interface.