AN ON-LINE CONCEPT OF IMPLEMENTATION

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ABSTRACT

Systems supporting new products or services and driven by organizationally dictated deadlines limit user imput and planning prior to design. An on-line model of implementation is proposed calling for constant re-evaluation and re-direction of the implementation as these shifting projects develop. An application of the model with a 200,000 line government systems is described.

An On-Line Concept of Implementation

Introduction

Successful implementation depends on a match between user needs and system design. This match is achieved through assessment of organizational and individual variables affecting implementation outcomes. Such an assessment requires extensive planning before the first line of a program is written.

Yet, extensive planning and assessment is not always possible. Systems are sometimes developed before the units they support are operating, preventing an assessment of the organization. Similarly, systems may have to be developed before a user group is clearly identified, limiting user input to system development. Moreover, time constraints may preclude such extensive planning and assessment.

This paper describes an implementation effort which took place under these adverse circumstances. The system was developed by the U.S. government to monitor environmental standards in each state; the final system contained some 200,000 lines of code. Organizational change consultants developed a strategy for implementing the major-system, when the agency it would support had not been created, user groups had not been identified and system start up dates were mandated by Congressional legislation.

Implementation Under Adverse Conditions

Researchers have related a host of variables to the successful implementation of systems. Huysmans [5] has developed a model that relates successful implmentation to the match between the cognitive style of users and system design. Ginzberg [3] has developed a model, relating the process of implementation to users' satisfaction with the system.

Lucas ([7], [8]) proposes a descriptive model that relates user attitudes toward systems, decision style, and situational and personal factors to system use. Based on his research Lucas makes several recommendations for the design process. First, he warns analysts against attempting new systems in the presence of serious organizational problems or climates characterized by hostility and conflict. System applications are implemented with difficulty under the best of circumstances and implementation during organizationally turbulent times increases that difficulty.

The second recomendation for the design process is to encourage the design team to collect data about the organization. The analyst may begin by collecting data on individual and organizational variables thought to impact successful implementation like decision style of the user, attitudes toward systems and the impact of the system on organizational power relationships.

Thirdly, Lucas recommends, that to the degree possible, users be responsible for the design of the system including reports, imputs and the logic of the system. Most familiar with the tasks they perform, users are the logical source of information on the decision situation. Analysts translate these user descriptions into the lines of code that make up the system, often in the form of a prototype. Once developed the pilot is tested on a sample of users for technical validity and general acceptability. The pilot invariably suggests modifications, and these are made before the system experiences wide spread use.

All that remains of the implementation process is the training of users. Those users exposed to the pilot are an excellent source of trainers, and users and designers often work well together as a team. The implementation is complete when the system becomes the working tool for all in the population for which it was targeted.

This model seems to require several conditions of the implementation situation. First this design process assumes that the situation permits planning time, and that system objectives are stable over the course of implementation. Secondly, the design process assumes that the organization is in operation before its systems are designed. Further, the Lucas model assumes that users are identifiable and are capable of supplying meaningful inputs.

This model applies to an implementation ideal not always achievable in practice. First, organizations sometimes deny adequate planning and assessment time. Organizations encourage analysts to build systems before their purposes and benefits are well understood; analysts are not permitted needed front end planning time.

Frequently, analysts design systems for moving targets. A system prototype developed from early user inputs may be drastically altered by management decisions made later in implementation. In this case the system must be reconceptualized. Analysts cannot always assume that the organization will exist before its systems are developed. Some organizational arrangements are possible only with central and significant information systems support. In these organizations systems development will predate formation of new organizational units.

Finally, this implementation ideal suggests a level of user involvement not always possible. Involving users assumes that user groups can be identified and located. Users of very large systems may work at many different sites and may be drawn from several organizational levels. Pin-pointing and assessing these constituencies can be a major challenge. Nor can the analyst, having located his client group, assume that users will provide meaningful input. System users may not know the situation being modelled. This lack of knowledge is particularly true for systems supporting new products or new organizational functions. Users agreeing in principle to the proposed innovations may be of little assistance in their development.

Summarizing then, practitioners sometimes implement systems where inadequate time has been allocated for planning, system design predates organizational design, and user groups are unspecified and unable to assist in development. Analysts need design techniques suited to the great variety of circumstances surrounding such an environment.

II. The Case

In 1974 Congress passed legislation aimed at standardizing water quality on a national basis. Citizens and environmentalists were anxious for a unified water policy and had lobbied heavily for these environmental initiatives. A Washington Parent Organization (WPO) was charged with developing the regulations to enact the legislation. Once developed, the regulations would replace those in the States. WPO would be responsible for implementing and enforcing the regulations as well.

The regulations drafted by WPO monitored water purity, sample collection procedures, and violation reporting. Through these regulations, hundreds of organic and inorganic substances were to be measured for lakes, rivers, and underground sources. Samples were to be taken from each water system, as many as five hundred times a month. With some States having up to 20,000 public water systems, regulation compliance in the States would be a formidable task.

System Design

WPO and the States needed a means for managing the mountain of data complying with these regulations would produce. The States requested development of an information system, but rejected a centralized system recommended in a feasibility study. One observer commented,

> In the past the relationship of WPO to the States has been an advisory one. We offered technical assistance and funneled monies to the States as requested. Understandably, the States are wary of the formalization of our relationship and control from Washington. They can be expected to resent the further intrusion a centralized system might bring.

Thus, a decentralized system was adopted as a primary guideline for design.

A division of a midwestern university was awarded a contract to design a decentralized system. The system would store and retrieve the water data produced by compliance. Adding to the complexity of the design was the fact that the States were not at all similar in their computing facilities. While some states possessed extensive IBM systems others operated in Univac environments with minimum capabilities. Still other states regulated their systems manually.

Keeping with the periodic reporting needs of WPO a batch system was proposed. In the system baseline was the state's water regulation background infomation such as the quantity of water pumped and the communities served by the water department. This baseline information was seldom changed. The other major input to the system was the water quality data which included levels of particulates, chemicals, and bacteria in each water sample. These inputs were stored in the system and formed the basis of computer generated reports, some of which went to WPO while others were for the states own use. In all the system produced seven types of documents including water quality reports, enforcement action reports, and water sampling schedules.

Thus the proposed system would provide two major benefits over the individual state systems. It would store large quantities of water data and second, it would permit the states to be more responsive to water quality infractions. The 200,000 lines of Cobol in the system required six thousand pages and twenty volumes to document. As the parameters of this large system materialized, it became clear that the states would require training to effectively use the system.

Training Teams Formed

A study commissioned to consider the feasibility of training concluded that training the states would be an extremely difficult task. The information system was complex and users differed widely in their experience with computers. Further, most users had not yet accepted the need for the uniform regulations nor their more formal relationship with WPO.

To reduce loads placed on single individuals, training teams were recommended. Composed of trainees and change consultants, these teams would travel to the States presenting seminars to system users. A unique feature of the training teams was use of a change consultant. Conflicts often appeared in the early days of implementation between the team and state personnel. The consultant played an integral part in managing the conflict. The team concept was adopted, and the teams were housed at the University. The interorganizational structure of WPO, the teams, and states is shown in Figure I.

place Figure 1 about here

Early Implementation

Giving in to government time pressure the teams began implementation with the 200,000 line system untested. Oklahoma was the first state to adopt the system. Surveys of participants revealed that few had more than "a little bit" of experience with information systems and only "some" knowledge of the guidelines this system was designed to monitor. In fact many trainees were unaware that the system had been adopted and thought they were present to view a sales presentation. Difficulties materialized quickly. The immediate problem was poor front-end planning. Making arrangements long distance, implementation in this first state was marred by poor organization. WPO did not clearly understand the structure of the water department in Oklahoma and many crucial water personnel were not present at the training sessions. Misunderstandings about the computing environment of Oklahoma foiled many hands-on experiences, a central feature of the training. Similar experiences with other states prompted the training teams to reconsider the implementation process.

The solution developed by the consultants, the training teams and WPO management was a pre-managment conference. Before installation implemention team managers would visit the state to meet with key water personnel. The participating parties would collaborate in setting implementation goals, acquiring needed resources, and overviewing the regulations themselves. Following the conference agreed upon arrangements were made by the implementation team and state personnel before actual implementation. In subsequent states the pre-management conference was recognized as a valuable step in smooth system adoption and it became a permanent aspect of state implementation.

Once organizational difficulties were overcome through the pre-management conference difficulties with the system itself surfaced. State personnel familiar with water purification immediately spotted system defects. As trainers took them through system output the participants found statistics with impossible ranges. Some of these turned out to be simple programming errors while others were the result of major system defects. The merging of files had not occurred or the length of data fields were inconsistent throughout the system, causing digits to be lost.

The existence of several versions of the system necessary to accomodate dissimilar computing environments exacerbated the problem. Note this conversation heard by a consultant during training.

Florida: I'd like to say once again that there is some problem with the job control statements on our Univac system.

Trainer: Yes, we're aware of it, that's why we wanted you here during training.

Florida: That's fine except that you don't have anyone here who knows Univac.

Trainer: We got Greg F (one of the original system analysts) to come down to help you out.

Florida: Good. Discussing the system on IBM helps me very little.

Consultant: Maybe it would expedite matters if you could develop a list and some clear examples of the problems you've been discussing.

Florida: That's a good idea. When will Greg get here?

So it went in each state. At the end of training the implementation team would return to the University with a laundry list of suggested modifications to the system. Each modification was considered, but changes were slow. Because the regulations had been legislated, precautions had to be taken to preserve their integrity. For example, programmers had to insure that changing the length of a data field would not change the intent of the regulation. Each suggested modification underwent careful study and approval by several levels of management.

Completed Implementation

The installation continued through 1977. The training teams traveled throughout the country bringing the system to additional states. As the number of states installing the system increased so did the list of suggested modifications. A Watts line was installed at the University to expedite modifications suggested by the States. Problems with the system were documented and remanded to the software designers and WPO for study. Documenting, researching and instituting system modifications demanded increasing amounts of the training teams' time. Processing user questions and suggested modifications began to compete for the team's attention to training State personal. With an obligation to train additional States on schedule a process was needed for handling the overload.

As a last modification to the implementation process the change consultants recommended the formation of regional users groups. Each of the twelve regions would organize its own group. These groups would convene periodically to discuss possible modifications to the water system. Modifications agreed upon by the States at these forums were sent to WPO for approval. The sharing of experience with the system was encouraged through a system update newsletter written by users. The training teams took advantage of these meetings to disseminate system updates and to conduct additional training.

Once the user groups were put into place the implementation teams were free again to devote more of their time to adding states to the network. The Watts line installed, in part, to process suggested modification went to an "emergency only" status. Training in the remaining states completed the implementation process. Near project completion, WPO complemented the University for the smoothness with which it had implemented the system. A second contract soon followed for a new project.

III. Discussion

The water system was initially developed with little input from users. It was implemented without testing, and trainers were recruited from outside sources rather than user groups. The design paradigm presented in the introduction would predict that implementation would fail. However, WPO considers the project a success; the system was accepted by users and is meeting its objectives.

The implementation was carried out under considerable uncertainty. Relationships between WPO and the states were shifting and users were difficult to identify. It is argued that this implementation was successful because it was responsive to uncertainty and was able to cope with it. The implementation process was continuously updated and procedures were developed to accomodate new developments. The procedures described above represent an "on-line" implementation process that continuously re-evalutes and redirects itself.

Judging from the first step of the Lucas model timing of the implementation for the water system was poor. The new regulations altered the tasks of water control in the states and formalizing relationships between the states and WPO meant significant organizational change. System design is difficult during such organizationally turbulent times. Design was further hampered because users could not be identified. Having just acquired jurisdiction over the states and being separated from them geographically, WPO was removed from potential users.

With little promise of involving these unknown users, system design was contracted to outsiders, the university. The states' participation in the design was limited to response to the original feasibility study. This response was similar to the "straw man" approach to user-generated design Manley [9] has successfully employed with large government systems. In this approach, a system draft, the "straw man," is developed and circulated to various user groups. Comments made on the draft are incorporated into a second draft. The process is repeated until an acceptable design is developed. However, time pressures prevented these draft iterations with the water system, and design was largely centered in the university.

The limitations of centralized design processes became apparent in the first state, Oklahoma. Users misunderstood the objectives of the system, the purpose of the training, and crucial water personnel were not present. Oklahoma was unprepared for the new system.

Re-evaluating the implementation process, the training team proposed pre-management conferences to allow each state to provide their input before the system was installed. Users were located and special requirements in each state were aired before implementation. This was the beginning of a user - oriented approach to implementation.

The task of implementation became more user-oriented as implementation progressed. Searching for a means to expedite processing of suggested modifications, the teams recommended the Watts line. The Watts line was another way for users to initiate system modifications they were unable to make previously.

User involvement could have been furthered by recruiting the training teams from the ranks of the users. Unfortunately, like the early phases of design, user involvement in training was restricted by the implementation situation. Lack of familiarity with the users would have made the selection by WPO of a state trainer difficult. The difficulty of taking users from their jobs in one state to train another state also discouraged the use of user/trainers.

Another option to increasing user involvement in implementation was the formation of user groups. In this final step in the implementation, use and modification of the system was turned over to water personnel and users assumed responsibility for the future direction of the implementation. Implementation was now complete.

There can be little argument that the system was implemented under considerable uncertainty. Relationships in flux and unspecified users created a situation Alter [1] describes as "risky implementation." Geographically and organizationally separated from system users, WPO opted for a centralized design process during early implementation.

These problems stimulated a solution that stressed user-oriented design in the same spirit as the Lucas approach. However, new techniques had to be developed to fit the uncertain organization and environment. At critical junctures throughout implementation the process was evaluated and other methods of involving users were sought. As the Pre-Management Conference, the Watts line and user groups were added to the implementation process user participation was increased. At each juncture previous steps were evaluated and new ones planned. That is, planning, implementing and evaluating occurred throughout the project.

The salient point of this case is that with implementation under uncertainty, planning can not be completed at the project's beginning nor can all implementation be controlled by pre-planning. Analysts working in these circumstances must constantly re-evaluate and re-direct the implementation to meet shifting circumstances. From Galbraith [2]

> ...the greater the task uncertainty, the greater the amount of information that must be processed among decision makers during task execution in order to achieve a given level of performance.

Under uncertain circumstances, system's implementors must strive to build in mechanisms that continuously answer organizational/individual needs and update the implementation process in real-time. Others have recognized the importance of re-evaluating and redirecting changes introduced to organizations (Ginzberg [4], Kolb and Frohman [6]).

On-line implementation means that information about the design process is continuously examined and the approach to design is altered in response. In this approach, the steps of assessment, planning, and implementation are iterative. The implementation approach in the beginning of design may change over the life of the system. Figure 2 shows the on-line implementation process.

Place Figure 2 about here

IV Implications

An on-line approach to implementation has several implications for information systems practice and research

- Implementation requires a contingency based approach. Varying circumstances require alternative implementation strategies. For example, recruiting trainers from user groups may be appropriate in one case and not be in a second.

- System design requires knowledge of implementation and organizational change principles. The change consultants in this case were an important resource for interpreting user needs and they provided much of the implementation strategy.

- Permit the implementation process to be flexible. Early organizational assessment may indicate centralized system design, while later assessment may indicate heavy user involvement is needed. A creative implementation process will be sensitive to such shifts.

- Assess the level of uncertainty under which the system is adopted. Take random samples of identifiable users and assess their perceptions of the proposed system. Difficulty in determining who is impacted by the system and disagreement over its purposes indicate system adoption under uncertainty.

Analysts will continue to be called upon to design systems under high uncertainly. Systems design will drive organizational design in·situations where new organizational components and products are possible only with extensive EDP support. The spirit of on-line implemntation stresses information processing, feedback and modifications to the design approach. It is recommended as particularly will suited in designs situation where the organization does not yet exist and users have not been specified.

FIGURE 1

THE INTERORGANIZATIONAL STRUCTURE

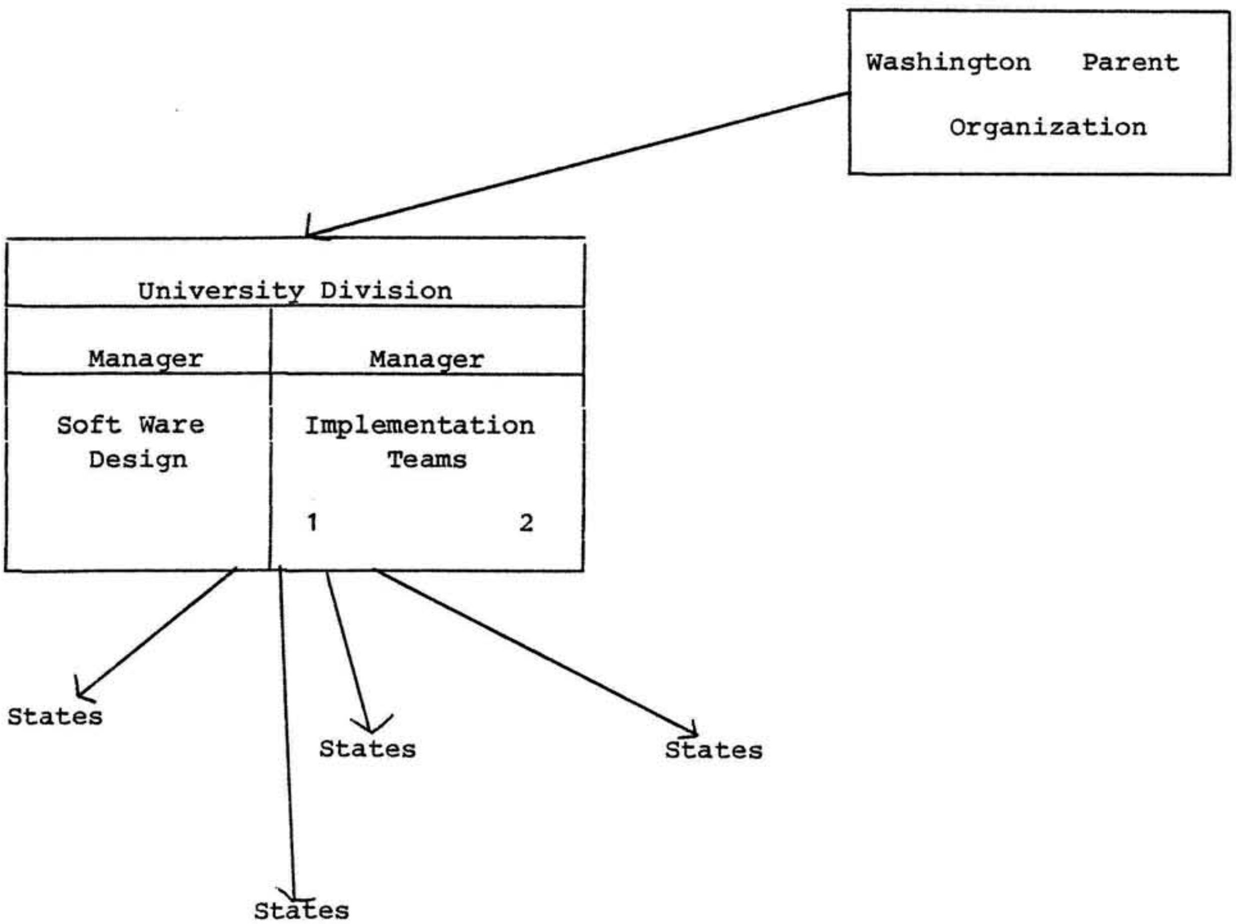
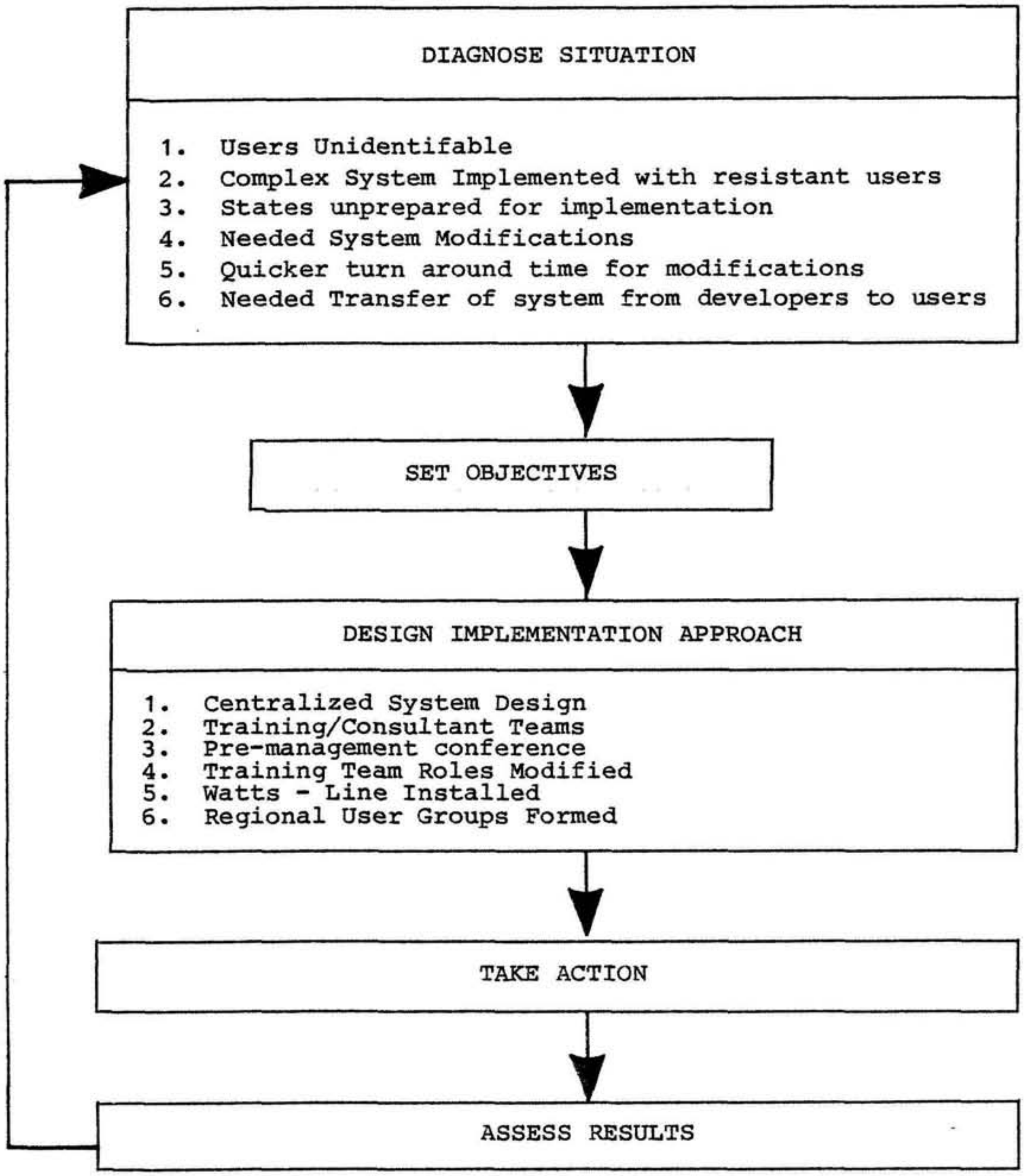


FIGURE 2

A MODEL OF
ON-LINE IMPLEMENTATION
(AFTER HAMMOND [4])



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