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INFORMATION REQUIREMENTS

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By

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INTRODUCTION

There is and continues to be an awareness in society that accurate and timely information is a vital resource of any organization, and that an effective management information system is a means of providing the needed information. In an answer to the question: why do organizations process information? Daft [4] presents two answers. Organizations process information to reduce uncertainty and equivocality. As information increases, uncertainty decreases. In situations where organizations are faced with a high degree of uncertainty, a large number of questions has to be asked and more information needs to be acquired to learn the answers. The assumption underlying this approach is that the organization and its managers work in an environment where questions can be asked and answers obtained. On the other hand, organizations and managers might face situations where they are not certain what questions to ask, and if questions were asked, the situation is ambiguous such that a clear answer will not be found. The existence of ambiguity and multiple conflicting interpretations about an organizational situation is called equivocality. In order to design an information system that helps the organization reduce uncertainty and equivocality, the information needs has to be determined fully and accurately.

The broadening of the scope and context of organizations nowadays make the understanding of organizational issues a critical factor to arriving at the correct set of requirements. One should determine design requirements for an organization support system to match the information requirements and the
characteristics of the organization and the management.
The issue of requirements determination involves a great deal of communications between the management and the system builder. The system builder generally assumes that the manager knows his needs and can express them clearly and accurately. On the other hand, managers assume that the system builder is capable of solving all kinds of problems and adapt his system to meet all the needs even if they were not completely specified. Specification of information requirements should be clear and consistent. Unclear requirements are often the result of imprecise communication and documentation, thus formal documentation of requirements is of vital importance in many situations. A formal specification of requirements provides several advantages:

1. It replaces reliance upon the intuition of users and interpretation of the system designer.

2. It helps keep all steps well documented so that mistakes are not repeated during the iterative process of defining the requirements.

3. It provides an effective control over the development process and avoids surprises after the completion and implementation of the system.

The traditional approach of asking the user what information the existing system provides and what other information is desired was no longer adequate to determine the requirements for complex integrated information systems. An approach to avoid some of the problems inherent in the traditional approach is to supplement it by also determining the decision responsibilities of managers in order to derive information system requirements.

There are three levels at which information requirements need to be established in order to design and implement computer-based information systems:

1. Organizational Information Requirements:
Defining information requirements at the organizational level is a prerequisite to planning the information system, identifying applications, and planning the information structure. Obtaining such requirements demands the definition of the organizational subsystems, clarification of managerial responsibilities and decision making process in each subsystem, the definition of information requirements for each subsystem, and the synthesis of these requirements for the organizational level.

2. Data Base Requirements:
Strategies for determination of data requirements for data bases include development strategy based on overall architecture, evolutionary development strategy by letting the data base evolve through usage, and the anticipatory development strategy.

3. Application Level Information Requirements:
Information system application requirements include: behavioral requirements based on job design, individual role and responsibility assumptions, organizational policies, and technical requirements to specify outputs, inputs, stored data, information processes, and the interface requirements between the system and the user.

METHODOLOGIES FOR DETERMINING INFORMATION REQUIREMENTS

Several methodologies are discussed in the literature to provide a framework for the requirement determination process. Yadav [10] presents a survey of most of the work reported in the literature on information requirement determination. Research in the field of organization and management include Anthony's [1] work which recognizes the fact that information needs are
different at different levels of managerial activity. Simon’s [8] work imply that Information Requirement specifications must include techniques to support various types of decisions. Gorry and Scott Morton’s [6] framework provides useful insight about the characteristics of information needed for different levels of management activities and for different types of decisions. Research in requirement engineering include work on automating documentation techniques, work based on the infological view, and work on modeling an object system.

Problem Statement Language (PSL), Problem Statement Analyzer (PSA), and Requirement Statement Languages (RSL) are examples of automated documentation aids. Business System Planning (BSP) for identifying business requirements, and Rocart [7] Critical Success Factors (CSF) approach to define information needs of executives are examples for work based on the infological view. Weatherbe [9] presents the Ends/Means Analysis approach to identify effectiveness and efficiency measures of an information system as it processes "means" to reach the "ends."

Davis [5] lists four strategies for determining information requirements: asking directly, deriving from an existing information system, synthesizing from characteristics of the utilizing system, and discovering from experimentation with an evolving information system. The underlying basis for selecting a strategy is uncertainty with respect to the requirements determination processes. The uncertainty is based on the characteristics of four elements: the utilizing system, the information system or application, the users, and the system builder. Davis [5] states that the characteristics of the above four elements affect the uncertainty of determining information
requirements by affecting three process uncertainties:

1. uncertainty with respect to existence and stability of a usable set of requirements.

2. uncertainty with respect to users ability to specify requirements.

3. uncertainty with respect to analyst's ability to elicit requirements and evaluate their correctness and completeness.

THE BANKING SYSTEM CASE

BACKGROUND

Historically, Arab National bank started as a foreign bank owned by a Jordanian bank - Arab Bank Limited - based in Ammam, Jordan operating in Saudi Arabia through five branches one in each major city. Each branch was autonomous in a way that a branch manager has almost full responsibility in the branch and reports to head offices in Jordan. In 1979 the government of Saudi Arabia initiated a law to regulate banking in the country by making banks as corporations with Saudi nationals to hold sixty percent of the shares and the parent foreign bank to hold the remainder forty percent. Accordingly a new board was formed with sixty percent of the members representing Saudi share holders. The name of the bank was changed to Arab National Bank. A general management was established and staffing of the head office was underway at the time of the study for the bank automation. As a result of this ownership change and the organizational changes that followed, the bank was allowed the opportunity of expansion by opening new branches in new cities and towns and adding to its branches in the major cities. Late 1981, I joined the bank to start a project for developing computer based information systems. The bank was using a manual system, thus the development process was to include
establishing an MIS department, determine the information requirements, issue a request for proposal to suppliers, procure the equipment and software, develop a system that meets the special requirements of the bank, and implement the system.

In order to determine the organizational information requirements in the bank, a study of the organizational activities at the branch and general management level was conducted by the system analysts. The method of collecting data included observation, analysis of data flow, interviews with managers of the branches, interviews with supervisors of the functional units in the branches, managers of the functional units in general management, and meetings with the board of directors of the bank. As a result of the study and an iterative process of discussions with key personnel in the bank, the following elements were defined:

1. **The major application subsystems:**
   The subsystems at the branch level include withdrawal, deposit, clearing, branch accounting, transfers, letters of credit, loans and facilities, foreign currency exchange, and bills and collection functions. The subsystems at the general management level include credit, corporate accounting, research and planning, investment, foreign exchange markets, and administration.

2. **Clarification of the goals and objectives of the bank:**
   A special meeting with the board of directors of the bank was arranged where a presentation was made about current practices in bank automation in developed countries. Alternative approaches of information system structures as well as the role of top management in the planning for the information system were presented and discussed. As a result of the meeting, the following
resolutions were passed.
- The goal of the bank is to provide a high quality service to customers in the different parts of the country in a timely and accurate fashion.
- The objective of the bank is to reduce the time of completing a customer transaction from an average of 30 minutes in the current manual system to an average of one to two minutes after the implementation of the computer based system.
- The bank is adopting an expansion process to reach 100 branches from current 15 branch over 5 years.
- An MIS department is to be established and staffed with MIS manager reporting directly to the general manager of the bank to plan, develop and implement the computer based information system.
- The bank organization is to consist of a hierarchy of branch management, regional management, and general management. Regional management is to be established in the future.
- The information system structure is to follow and support the organizational structure through adopting a distributed processing approach for both hardware and databases.
- The computer based information system should accept and produce bilingual input and output (Arabic/English).
- A steering committee is to be established to supervise and oversee the planning, development, and implementation of the information system.

3. Clarifying the managerial responsibilities and the decision making processes:

Through meetings with the steering committee which consists of managers of the functional units at general management and meetings with branch managers,
the managerial responsibilities and the decision making process has been clarified as follows:
- The branch managers have full responsibilities and control over the functions of the withdrawal, deposit, clearing, accounting, transfers, letters of credit, and bills and collection subsystems. Summary reports of such activities are prepared monthly and forwarded to general management as confirming information and for statistical analysis and consolidation. As for the currency foreign exchange subsystem, the prices are set daily by the foreign exchange department at general management and telexed every morning to branches. The prices are set as ranges for buying and selling thus leaving flexibility for the managers to fix the price depending on the customer and the volume.
Loans and facilities to customers initiate at the branch level and are granted or rejected if the amounts are within the authority limits of the branch manager, otherwise the request will be forwarded to the credit manager who decides on it within the limits of his authority, otherwise it will be presented to a credit executive committee formed from the board members for action.
Branches are divided into four types according to size and activities. Each manager has authority limits according to the branch type. Personnel, marketing, maintenance, administrative affairs, and planning are control functions at general management.

4. Definition of information requirements for each subsystem:
A preliminary study was done to analyze the activities involved in each subsystem at the branch level. Data flow diagrams were prepared to reflect the inputs, processes and outputs of each activity. Meetings with branch managers and operations department personnel in general management resulted in an understanding of the flow of work in each subsystem as it is done in
the manual system. The operations department started preparing documentation on the processes and decisions involved in each subsystem. Those procedures defined the initial requirements of the subsystems, which helped in formulating the general design of the branch information system. The requirements for the computer based information system were not clear as to how the system will process and integrate these activities.

THE CONTINGENCY APPROACH

Looking at the four elements in process and analyzing the characteristics affecting requirements determining uncertainty, the following facts became apparent:

1. The utilizing system characteristics.
   - The organization itself was going through continuous change. New branches are being opened every month. New employees were hired to staff the branches with less than adequate experience in banking, usually after a crash training program. Experienced employees in old branches were transferred to take lead positions in the new branches. New personnel were hired to staff the functional units in general management. This kind of change was creating obstacles to the process of defining requirements.
   - The concept of distributed organizational structure has not been implemented yet. Thus the requirements for interfacing the branch activities with the regional and central functional units has not been set forth or anticipated with any degree of certainty.
   - The organization has no experience in computer based systems.
   - Manual operating procedures were not current and in some cases not documented. There was great reliance on the experience of the branch managers
and supervisors of the old branches.

- The decision processes were not prespecified, and in certain cases were implemented under the discretion and responsibility of the branch managers within the framework of the bank interest.

2. The Information System:

The current information system is manually based. The only form of automation is the use of magnetic card accounting machines for posting transactions and keeping records of customer statements. The system is mainly a form of manual transaction system with no support for management activities. Predefined reports were filed manually to summarize branch activities and financial status and were sent to general management for consolidation. Data analysis and variance analysis were rarely done due to difficulty of doing such analysis manually. The proposed information system is a comprehensive on-line banking system which requires complex interfaces between the different subsystems at the branch level and interfaces between the branches, the regional and general management. This situation made the process of determining information requirements a difficult and complex one.

3. The Users:

The bank employees in both the branches and general management have no experience in using any computer based system. The majority lack the understanding of principles of computing and have no way of anticipating what the computer system can offer. Thus participation of the users in planning the information system and defining the requirements was not expected to come forth using traditional methods of participation through meetings, interviews, etc.
4. The System Builders:

The constraint set by the board of directors - which calls for development of bilingual computer based information system - made the selection of hardware and software to support the information system more difficult. The request for proposals from distributors of the major international computer companies required supply of terminals and printers working bilingual and called for support of the vendors in locating a bilingual banking software package or supporting the development of a customer tailored system. After evaluation of all proposals it was found that no such software package exist in a complete working condition. Thus the decision was made to develop a special system tailored to the needs of the bank. A local distributor of Digital Equipment Corporation was awarded the contract to supply the needed bilingual hardware and to develop the software according to specifications and requirements set by the bank. Thus the job of determining information requirements was taken by a team from two system analysts from the MIS department of the bank, with good experience in computer and banking information systems, two managers from the operations department, and two system analysts from the vendor with strong background in planning for information systems but no bank applications experience. The design, development and implementation in the first three branches was the sole responsibility of the vendor. Acceptance testing and further implementation is the responsibility of the MIS and bank operations department.

Looking at the characteristics of the four process elements in the bank and the effect of these characteristics on the organizational requirements uncertainty, it was found that:
A look at the above characteristics shows a high degree of uncertainty. Evaluating the four strategies for determining information requirements it was found that while the strategy of asking directly helped determine the fundamental general requirements it was not appropriate to define the specific detailed requirements. The strategies of deriving from existing systems and synthesizing from the characteristics of the utilizing system were not adequate in this context due to the absence of experience with an automated banking system. Thus it was decided that the appropriate strategy for determining organizational requirements is the use of experimentation with an evolving planning and control system.

Determining the application information requirements. The characteristics of the four process elements in the bank discussed earlier have an impact on the ability to determine the application information

<table>
<thead>
<tr>
<th>Characteristics of the Organization</th>
<th>Effect on Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable operational processes</td>
<td>Increases</td>
</tr>
<tr>
<td>Changing management control</td>
<td>Increases</td>
</tr>
<tr>
<td>Low maturity in computer use</td>
<td>Increases</td>
</tr>
<tr>
<td>High complexity and integration</td>
<td>Increases</td>
</tr>
<tr>
<td>Low experience of system builder in bank applications</td>
<td>Increases</td>
</tr>
<tr>
<td>Low experience of users in automated systems</td>
<td>Increases</td>
</tr>
</tbody>
</table>
requirements. In fact, the uncertainty level here is higher than the uncertainty in defining organizational requirements due to the absence of experience in computer based banking information systems for both the users and the system builders. Increase in uncertainty is due to the following characteristics:

- The system should support mixture of programmed and non programmed activities.
- The requirements are not stable and dependant on the decision styles of managers.
- The users do not have a suitable anchor point to adjust from.
- The system builders are inexperienced in this specific banking application.
- The absence of a well defined model for the application.
- The complexity of the interfaces between the subsystems in the branch and between the functional units in general management.

Based on these characteristics, there was high uncertainty as to necessary and desirable requirements, as to the ability of users to specify requirements, and as to ability of the system builders to elicit requirements and assess its correctness and completeness.

Accordingly it was decided that the appropriate strategy for determining application requirements is the use of the experimentation and discovery strategy in which requirements are identified iteratively as the application system evolves.

Determining the Data Base Requirements.

Given the characteristics of basic elements in the bank and the uncertainties
associated with determining the organizational and the application requirements, it was found that an overall development strategy for determination of data requirements for the data base is difficult and expensive. An evolutionary development strategy was adopted to go hand in hand with the strategy of experimentation and discovery adopted for determining the organizational and application requirements.

THE PROTOTYPING METHODOLOGY

Faced with the mentioned uncertainties associated with the ability of users and system builders to determine and elicit information requirements in advance and the expectation that the requirements are subject to significant changes during development, it was decided to use a prototyping approach for determining information requirements for systems development. The decision was based on the simple assumption that users can express their opinions about a working system more easily than they can express what they think they would like in an imagined future system. To bring the size of the project to a manageable size and to quickly present the bank with a working system that solves immediate problems facing the branches i.e. the ability to serve the customers and complete a transaction within the 2 minute objective of top management, the system development process was broken into stages. The first stage is to cover the branch customer information system. The second stage covers the branch accounting system. The third stage covers the other subsystems in the branch and provides the ability to interface the branches with regions and general management enabling processing of interbranch banking. The fourth and final stage is the integration of the branch functions with general
management and the completion of a comprehensive integrated on-line banking system.

A prototype for branch customer information system was developed and delivered to the MIS department for testing. The system was tested by: the bank MIS staff, a group of branch supervisors, branch managers and personnel from the bank operations department at general management.

The prototype was modified to correct the bugs discovered at this stage and incorporate additional requirements identified by the users.

The next prototype was delivered and more extensive tests were implemented using transactions that have been processed through the manual system in one of the branches. This prototype was also used for training branch tellers to get them acquainted with the system. The tests were conducted by:

1. Bank personnel including MIS staff, branch managers, branch supervisors, and tellers.
2. Manager of Data processing of the parent bank.
3. A team of specialists in System Software and banking applications who were invited from Societe General Bank, Brussels, Belgium who use same equipment and same DBMS.

As a result of these extensive tests from the users view, banking rules and procedures, system efficiency and response time, the prototype was modified and installed for live application in parallel mode to the manual system in a selected branch as an initial system. Parallel to this process, development was underway on the second stage of the project.

Iterative modifications on the initial system resulted in a final version of the branch customer information system which was distributed to all branches.
for live on-line implementation.

THE PROTOTYPING MODEL

Figure [ 1 ] represents the prototyping model used in eliciting information requirements for building the banking system. The model includes the following steps:

Step 1: Define the basic requirements using interviews, data flow diagrams of manual system, bank procedures and manuals.

Step 2: Build the initial prototype to give the users something to respond to and give the system builder the opportunity to test the system software efficiency and the capability to work with bilingual input and output.

Step 3: Test the prototype from a technical point of view first, then let the users experiment with it to detect any errors or inconsistencies with the defined basic information requirements. If critical errors or inconsistencies were found, then the prototype will be modified and retested. If new requirements were to be added or previously defined requirements were to be modified, then those requirements become the basis for building the next prototype.

Step 4: Install the prototype in a branch parallel to the existing manual system. During this step branch managers and operations personnel try to identify if there were any errors or inconsistencies with the defined requirements which call for immediate correction. If new requirements were identified, they will be included in the next prototype.

Step 5: Once the prototype is found satisfactory to the branch, cutover conversion will take place, and the system will be installed and implemented live in the rest of the branches.
Step 1
Define Basic requirements

Step 2
Build the prototype

Step 3
Technical test of prototype

\[ \text{NO} \]
Satisfactory

\[ \text{YES} \]
User experimentation

\[ \text{YES} \]
Inconsistencies

\[ \text{NO} \]
New requirements

\[ \text{NO} \]
Install parallel

\[ \text{YES} \]
Inconsistencies

\[ \text{NO} \]
New requirements

\[ \text{YES} \]
Include in next Prototype

\[ \text{NO} \]
Live Implementation

Figure [1] Prototyping model
CONCLUSION

Currently the system is working and the third stage has been implemented in seventy branches. The final stage of integration is scheduled to be completed by the end of 1987. The following is a time chart to give an idea of the time involved in implementing the final system.

1. Project starting date Sept. 81
2. Completion of preliminary study and issuing the RFP Jan. 82
3. Vendor selection and signing contract April 82
4. Start development of prototype June 82
5. Testing prototype 1 Sept. 82
6. Parallel installation of prototype 1 March 83
7. Live implementation of prototype 1 Oct. 83
8. Implementation of prototype 2 Oct. 85
9. Implementation of prototype 3 Sept. 86
10. Parallel installation of prototype 4 June 87

It was noticed that the prototyping methodology encouraged user participation from the very beginning. Managers and operations personnel were so excited that they became an integral part of the development team. The learning process continued to improve and the user feedback became more positive and their role in defining the information requirements and the user interface design i.e. screen and report layouts was increasingly becoming at the professional level. The following table shows the number of screens and reports in each prototype. The additions were mainly in response to the user needs and feedback.
Prototype  1  2  3  4  
No. of screens  19  25  30  156  
No. of batch reports  6  28  50  60  
No. of on-line reports  --  12  15  20  
No. of inquiry screens  3  8  11  15  

The prototyping methodology through user participation in testing and experimenting with the prototype made possible to elicit information requirements that would have been very difficult to anticipate given the characteristics of the users and system builders. The following data shows the number of change orders that were submitted and implemented during each step in the development process.

<table>
<thead>
<tr>
<th>Step</th>
<th>No. of change orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technical testing of prototype 1</td>
<td>22</td>
</tr>
<tr>
<td>2. User experimentation with prototype 1</td>
<td>80</td>
</tr>
<tr>
<td>3. Parallel installation of prototype 1</td>
<td>60</td>
</tr>
<tr>
<td>4. Building prototype 2</td>
<td>225</td>
</tr>
<tr>
<td>5. Testing prototype 2</td>
<td>127</td>
</tr>
<tr>
<td>6. Building and testing prototype 3</td>
<td>174</td>
</tr>
<tr>
<td>7. Building and testing prototype 4</td>
<td>265</td>
</tr>
<tr>
<td>Total no. of change orders</td>
<td>963</td>
</tr>
</tbody>
</table>
REFERENCES


