DEVELOPMENT OF RESOURCE SHARING SIMULATION SYSTEM (RSSS) : A COMPUTERIZED DECISION SUPPORT SYSTEM FOR LIBRARY RESOURCE SHARING NETWORKS

YOGENDRA P. DUBEY
Department of Library and Information Science
Banaras Hindu University
Varanasi-221005.

The Library of Congress gave practical meaning to cooperation in cataloguing and to the first law of cataloguing administration, i.e., Never create a bibliographic record for a document if you can more cheaply acquire and use a satisfactory record originating elsewhere. It began to sell its bibliographic records to other institutions in 1901 in the form of 7.5 x 12.5 cm catalogue cards. In 1969, the Library of Congress started the weekly shipment of newly created records through a different technology, namely L C MARC format on magnetic tape[1].

The L C MARC tape served as a catalytic agent for the development of automation in libraries and online library networks. The development in the early stages took two directions. Firstly a small number of libraries that included some of the largest research libraries and some very small specialized libraries, each of which began to develop its own independent automated systems for bibliographic control (acquisition, cataloguing, serials and circulation control etc.). These libraries either used locally owned or leased hardware and developed software in-house[2].

In the second type of development, a large number of libraries, originally almost academic libraries within a region formed consortia or network with the goals of developing online bibliographic control systems and the cooperative creation of bibliographic databases. In doing so they acknowledged that to develop systems independently would be too expensive, that sharing with smaller institutions would not necessarily mean accepting an inferior system or database, and that there are positive benefits of cooperation[3].

The systems that were being developed independently ceased soon because of the higher costs involved in them. The later type of development culminated in the form of national bibliographic networks that include the spectacular Ohio College Library Center, now called the On-line Computer Library Center.
(OCLC), Research Libraries Group's (RLG's) Research Library Information Network (RLIN) and Washington Library Network (WLN). In Canada a similar type of national bibliographic network, University of Toronto Library Automation System (UTLAS) was developed.

In a network, libraries are linked together via telecommunication facilities to share library operations and resources through a machine readable data base centrally stored and maintained but cooperatively created. A library as a network node can now provide services from the resources physically present in its own collection and from the resources that can be accessed remotely. A library node also shares operations thereby it is able to reduce its operational costs and improve productivity and efficiency.

DECISION MAKING IN A NETWORK ENVIRONMENT

Library networks are a system of complex and dynamic nature precluding that the variables affecting organization and management of a library node are in constant flux. New ideas, concepts and procedures are emerging from the network environment which influence the library management in ways that require a different mode of decision making. The factors that make a library network a complex system can be identified as the following:

1) Topology of networks (i.e., star, hierarchical, distributive, mixed, etc.)

2) Types of libraries forming a network (i.e., academic, research, public, special etc.).

3) Types of resources being shared by the library nodes of a network (i.e., books/monographs, serials, nonbook material etc.).

4) Operations performed by a network (i.e., acquisition, cataloguing, inter library loan, circulation etc.).

5) Types of networks and their financial level (i.e., public, private, local, regional and national, general and special; profit and not for profit).

6) Network governance.

Networks become more complicated because of the incompatibility of hardware and software, telecommunication problems, difference in management and staff, factors that threaten financial stability, political climate, professional attitude and concern of library origin[4].

The dynamic nature of library networks emerges from their structure. They are analogous to any industrial organization. Melese[5] applying the systems approach has identified transverse systems in an industrial organization. Similarly, it can be said that a library network constitutes transverse systems such as libraries, materials, operations, economic and legal systems, technology, communication, personnel etc. Each transverse system has its own logic and condition and controls specific flows into the network and its environment. The network is a place where the logic of the transverse systems is superimposed. The dynamic behaviour of a network emerges due to the inherent contradictory logic of the transverse systems. Networks also exhibit dynamic behaviour because the factors that interplay in their operation are time varying.

Librarians as managers operating in a complex and dynamic networking environment are concerned at least with three important considerations. First, a major issue is the mechanics of a network- can materials be delivered in a timely fashion, or can operations be performed without delay? Second, a related issue is political. Network participation requires some sacrifice - immediate access is certainly one. Librarians may need to convince the administrators and users about the economic and social payoffs resulting from the investment to the network. Third issue is financial. Librarians must justify the network costs in relation to the benefits received[6].

In view of the high expense involved and the problems associated with joining and remaining in a network, most librarians would prefer to conduct an objective economic analysis before coming to a decision regarding joining a network for sharing an operation or resources. Economic analysis involves collecting relevant information, identifying alternatives and selecting the optimum decision(s). The analysis is done to measure costs and benefits. Rouse and Rouse[7] argue that while the benefits of resource sharing seem intuitively logical, library managers need to identify the criteria which can be used to measure the costs and benefits offered by the library network. However, because of complex and dynamic behaviour of library networks, cost and benefit analysis would be required recursively, which most library managers would tend to avoid because of lack of training and interest. Tversky and Kahneman[8] in their famous study have concluded that most managers avoid statistical and mathematical methods.
because of their poor statistical intuitive ability. Moreover, because of the inherent stochastic processes and complex interaction of a large number of variables, decision problems including cost/benefit analysis associated with networking, defy standard mathematical methods so that they cannot be routinized and automated. They can however be best approached heuristically - an adhoc mode of decision making. Individual managers follow heuristic mode of decision making because of the cognitive strain leading to a break-down of cognitive process which occur when the informational demand of the decision problems exceed their information processing capacity[9]. The heuristics, however can be improved by studying and analyzing the problem with the aid of modelling and computer simulation techniques. Kent[10] has proposed the use of modelling and simulation by computer to predict economic break even points in a networking environment.

MODELLING AND SIMULATION TECHNIQUES IN DECISION SUPPORT SYSTEMS

A computerized information system which is an advancement over the management information systems has come into being in the recent years. This information system commonly known as decision support system aids the decision making processes of individual decision makers. According to the survey conducted by Alter[11] two categories of DSSs can be identified namely data oriented and model oriented. The model oriented DSSs use simulation and suggestion techniques. DSSs using simulation techniques permit evaluation of alternative courses of actions based on facts and assumptions with computerized modelling of the concrete system and processes in order to represent actual decision making under the conditions of uncertainty. Modelling and simulation techniques in a decision support system thus facilitate experimentation so that more or less random search for alternatives guided by a few heuristics become feasible[12].

GENESIS AND DEVELOPMENT OF DECISION SUPPORT SYSTEMS

The natural evolutionary advancement of electronic technology and its use in the organizational context has led to the development of information systems from Electronic Data Processing (EDP) to Management Information Systems (MIS) to the current decision support system (DSS) thrust. In the early 1950's, EDPs were installed in organizations, which were oriented primarily toward data storage, processing and retrieval, efficient transaction processing including pay roll, inventory control, record keeping and production of summary reports for managers. The EDP were largely related to the paper pushing operations and the focus was primarily on clerical and routine work. The managers were primarily concerned with the output of these activities. These early efforts did not aim at supporting the decision making processes of managers[13].

Further development in electronic technology made it possible to focus on a new level of information activities to some management needs. The new focus elevated the EDP to the management information system (MIS). The management information system placed emphasis in integration of the information system with the decision making activities in an organization. However, the data processing was performed by the computer to support the tasks that were routine and clerical in nature and easy to be automated. The MIS therefore, did not lend support to the decision processes of individual managers in dealing with complex problems. According to Argyris[14], a recurring theme in the literature of management science is that MIS have been disappointing in so far as they currently have failed to meet the expectations of managers. Indeed, there is evidence that the information that managers use in critical decisions does not emanate from the formal MIS[15]. Wagner[16] has stated that for EDP/MIS, OR/MS and other analytic disciplines, the need is to bridge the gap between their specialized world and that of the managers.

In the early 1970s, efforts were made to develop computer based systems directed toward supporting the individual managers in their decision processes. These information systems as mentioned earlier, known as decision support systems, give emphasis in providing support by affording an interface between the manager and the computer aimed at simplifying the steps from problem formulation to the problem solution permitting him to handle information by applying his own knowledge of the nature of information and the problem to reduce the memory load. This form of manipulating information tends to reduce cognitive strain.
FACTORS CONTRIBUTING TO THE DEVELOPMENT OF DSS

The decision support systems have evolved from two main areas of research; the theoretical studies on organization decision making done at the Carnegie Institute of Technology during the late 1950s and early 60s and the technical work on interactive computer systems mainly carried out at the MIT in the 1960s. The key concepts provided by the Carnegie School emphasized upon bounded rationality in the individual's decision process with the implication that extending the limits on the bound could improve effectiveness. In the recent theories of administrative decision making, it is this notion of bounded rationality that commonly serves the basis for explaining departures from rationality- the concept on which the methods of modern management science such as Operations Research, Programming and Planning Budgeting System (PPBS), Management by Objective (MBO) etc., which aim at optimization, have been developed.

UNDERSTANDING OF THE ORGANIZATIONAL DECISION PROCESS

All the managerial activities in an organization revolve around decision making. Forrester[17] suggests that management is the process of converting information into action. The conversion process is called decision making. It is obvious then that a manager's success depends primarily on what information is chosen and how conversion is executed by him. According to Yovits et. al. [18], information is data of value in decision making and information gives rise to observable effects through the decision making. Cherry [19] argues that information aids the decision maker by narrowing the range of hypotheses. Information thus reduces the decision maker's uncertainty by narrowing his range of viable alternatives. Uncertainty is the relative difference between the amount of information required to perform a task and the amount of information already processed. As noted by Galbraith[20] the greater the task uncertainty, the greater the amount of information must be processed by the manager during the task execution in order to achieve a given level of performance.

From the concept of uncertainty, it can be discerned that firstly, uncertainty is not a trivial concept that it can be handled easily by refining the optimization techniques such as Operations Research (OR)/Management Science (MS) or EDP/MIS. Secondly, uncertainty reduction is dependent upon the information processing capability of the manager and his perception of the problem.

Management Science/Operations Research, Electronic Data Processing and Management Information Systems were largely concerned with the decision making from a rational view. This view emphasized the decision making activity to be highly normative based on mathematical formulation and logic of optimal choice. The rational view is the classic conception of decision making in an organization developed from microeconomics, which views a manager as an economic man completely informed, infinitely sensitive, indifferent to the strains, costs and cognitive limitations. The manager must give emphasis to the decisions that aim toward optimization.

The Behavioristic School of “March-Cyert-Simon” challenged the rational view of decision making as a completely unrealistic approach [21]. They argued that because of the cognitive limitations, human beings cannot make a rational decision. Newell and Simon [22] made a thorough study of the cognitive behaviour of human beings and proposed a model according to which human beings are treated as an information processing system. According to the model, the human information processing system (HIPS) involves the following

1. Processing of symbols which are symbolic in as much as they are a sensory referent or are combination of other symbols.
2. Utilizing the two levels of internal memory, a long term and a short term. The long term memory has unlimited capacity but slow access. Short term memory has very small capacity. Miller [23] has found that humans were capable of retaining only about seven chunks of information in short term memory. That ability to recall information in a continuous short term memory tends to decline as storage load increases. Therefore memorization in short term memory needs rehearsal.
3. Featuring serial processing of symbols.
4. It has elementary processing times of the order of fifty milliseconds.
5. It implies the existence of a problem-space within the limits set by the task environment. The task environment is the problem-space as it exists in the real
world. The problem-space is the abstraction of the real world conceived by the HIPS in order to work on it. It is the representation of the task environment.

Human beings as information processors exhibit limitations due to slow access to data, sequential processing, small capacity of short term memory, and the reduction and simplification of the real world into problem-space. Due to these cognitive limitations, human beings cannot make a rational decision which assumes that: 1) all possible alternatives are known; 2) preferences for every outcome are known and; 3) preferences for every outcome can be ordered.

March and Simon[24] have suggested that human cognitive inability to deal with complexity in decision making leads to bounded rationality which means that human decision makers act rationally only within the boundaries of their perception of the problems. These boundaries generally have been found to be quite narrow when compared to the scope of complexity typifying most organizational problems[25].

Because of the bounded rationality, most decision makers resort to problem solving strategies leading to satisficing[26], which means that the goals of any decision maker is to get a good enough answer not necessarily the best possible one. Evidently the term satisficing entails finding and selecting a satisfactory alternative as opposed to the best one that achieves a minimally acceptable solution. Problem solving strategies for satisficing are based on heuristics, rules of thumb that give solutions that are good enough most of the time. Keen and Scott Morton[27] suggest that one can usually improve one's heuristics, although at the often unacceptable cost of increased cognitive effort. A decision support system may provide this improvement at a lower cost in terms of cognitive strains.

Although the term decision support system bears many connotations indicating that at present there is little consensus, the principal characteristics have been defined by Keen[28] as the following

1. The emphasis is on decisions in which there is sufficient structure for the use of computer and analytic aids to be of value, but where the manager's judgement is essential.
2. The payoff is in extending the range and capability of the managers' decision process to help them improve their effectiveness.
3. The relevance for managers is the creation of a supportive tool, under their control which does not attempt to automate the decision process, predefine objectives or impose solutions.
4. The system is able to respond quickly to the changing needs of the decision makers.

Decision support systems allow the manager to combine his/her judgement with computer output in a man-machine interface for producing meaningful information to support the decision process. They aid in solving complex problems with the query capabilities that permit obtaining information by request. As appropriate, they utilize mathematical and statistical models as well as data base elements for solving the problems.

TAXONOMY OF DECISIONS AND CONCEPTUAL FRAMEWORK FOR DSS

As information is something that reduces uncertainty, an information system is a means of coping with uncertainty. Therefore, an information system must refer to the characteristics of the decisions which are an information dependent activity. This implies that the information systems must be designed and developed in accordance with the conceptual framework of decisions and their information requirement. This necessity led to the development of taxonomies of decisions which provided conceptual framework on which decision support systems have developed.

Gorry and Scott Morton[29] have developed a model of decision making in organization by synthesizing Simon's[30] decision typology and Anthony's[31] levels of decisions, each requiring a specific type of information system. The types of decisions are (i) structured (ii) semi-structured, and (ii) unstructured. The levels of decisions include (i) operational control, (ii) management control, and (iii) strategic planning.

In order to sharpen the concept of decision support system, a brief discussion of the types and levels of decisions is given next.

TYPES OF DECISIONS

Structured decisions allow identification of all the elements in the decision process. The manager is in control of all important parameters surrounding the decision process. The problem variables are easily quantifiable for determining a rational solution. Problems are repetitive and...
routine to the extent that a definite procedure can be worked out for handling them so that they don't have to be treated de novo each time they occur. They can be easily programmed to be automated and can be delegated to the clerical staff for execution. The EDP/MIS or OR/MS are useful in their case [32].

Semistructured decisions are those that are hard to routinize perhaps because of the size of the problems or the conceptual complexity and the precision needed to solve them. The models of management science or mathematical formulation alone are inadequate because the solution should involve judgement and subjective analysis.

Unstructured decisions are those that are either not capable of being structured or that have not yet been examined. They contain more variables than human beings can comprehend or variables that are subject to influences one cannot control or predict. They are non-programmable and nonsequential and there is no cut-and-dried method of handling them.

LEVELS OF DECISION

The three levels of management activities can be thought of as referring to activities that take place at different levels of managerial hierarchy.

Strategic planning is concerned mainly with the broad objectives, goals and future planning. Decisions are carried out by top management. For the decisions, the external sources of information that center on economic conditions, technological development, governance, operations, services and facilities available and the like matter assume paramount importance.

Management control decisions are concerned with structuring the resources to create maximum performance potential. They are middle management-oriented and can be subdivided into:

a) Organization structure - involving structure of authority and responsibility relationship, work flow, information flow, distribution channel, and location of facilities.

b) Resource acquisition and development, improvement in operations, financing, acquisition of facilities, personnel development, equipment etc.

Operation control is primarily concerned with maximising output in the current operations. The key decisions involved are reduction of labour costs, improving services, maximising output by reducing waiting time and improvement in overall operations [33].

The matrix given in Table 1 (adapted from Keen and Scott Morton [34]) with examples from the resource sharing network environment, shows the levels and types of decisions and the information system required for each as a support system to the decision making.

For structured decisions of the operating, managerial and strategic levels, management information systems (MIS) are useful. The problems are straightforward and yield to algorithmic solution to be easily automated. Semistructured decisions of operating, managerial and strategic planning level involve large number of variables with many complex interrelationships. Neither computer nor the decision maker alone can deal with them. The informational demand of the decision maker alone can deal with them. The information demand of the decision problems exceed the information processing capacity of the individual managers. Therefore, they resort to heuristic mode of decision making leading to satisficing. Computers can be used to increase the heuristics and the decision-makers' ability to reach a satisficing solution by integrating computer and human information processing capabilities. The way this integration is achieved is discussed after Table 1.

COUPLING OF COMPUTER AND HUMAN INFORMATION PROCESSING CAPABILITIES

Simon's [35] research in computer information processing capabilities has had bearing on the practicality of computer systems for assisting human decision making process, as the computer is the only means currently available with the potential for handling and replicating human thought process. Ackoff [36] showed that managers develop an appropriate mental model of a problem to work at. Mintzberg [37] found that managers collect and piece together various scraps of information until patterns begin to form a mental model which describes various aspects of a problem. With the sophisticated development in computer systems, especially the development in data management which has progressed from the use of simple files to the more complex techniques of Artificial Intelligence (AI) and Data Management Systems (DMS), and Model Management Systems (MMS) computers can be programmed in ways corresponding loosely to the faculties of human
RESOURCE SHARING SIMULATION SYSTEM

Table 1
Taxonomy of decisions

<table>
<thead>
<tr>
<th>Types of decisions</th>
<th>Operational Control</th>
<th>Management &amp; activity</th>
<th>Strategic Control</th>
<th>Information System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured</td>
<td>Routine operations, searching, input data of records in data base</td>
<td>Flexible budget, cost analysis</td>
<td>Network topology, location of data base, branches, terminals</td>
<td>MIS, MS</td>
</tr>
<tr>
<td>Semi-structured</td>
<td>Backlogs mean reduction in operational time, costs reduction</td>
<td>Forecasting, service promotion, estimating network capabilities for satisfying demand, cost effectiveness analysis, effects of network synergy</td>
<td>Centralization/Decentralization, mechanics of information transfer, mode of communication.</td>
<td>DSS</td>
</tr>
<tr>
<td>Unstructured</td>
<td>Need assessment, group behaviour</td>
<td>Hiring personnel, motivation, pay-offs in social and financial returns</td>
<td>Planning, goal setting, objective</td>
<td>Human intuition</td>
</tr>
</tbody>
</table>

memory and reasoning. For example, certain data base management systems, providing the ability to retrieve information in ways that meaningful patterns and correlation can be discerned, augment memory. Modelling and simulation techniques based systems can be seen as an extension of an executive's reasoning power. Models of the real world environment stored in computer data base help executives to experiment so that they are able to envision possibilities for the future, foresee consequences, and identify and select alternative solutions. Decision support systems incorporate such kind of highly sophisticated data base systems (DBS) and data base management systems (DBMS) and model management systems (MMS). Early DSSs dealt with the modelling of a particular problem area within an organization, for example, portfolio management. Now with the development of highly sophisticated modelling languages, decision support systems incorporate capabilities extending to coordinated modelling of several problem areas in a complex decision environment, e.g., Interactive Financial Planning System. One particular noteworthy aspect of the IFPS is the use of Monte Carlo Risk Analysis, which permits a decision maker to express intuitively patterns of uncertainty and immediately gain insight into different alternatives.

RESOURCE SHARING NETWORK SIMULATION SYSTEM

The recent literature of library and information science shows that computer simulation techniques have been proposed and used in an ad-hoc manner to analyse certain library management problems. Rouse[38] has developed several computer-based models for predicting technical performance of library networks. One model was proposed to evaluate alternative configurations of library networks. Another model developed by Kang and Rouse[39] addressed the problem of forecasting monthly demands for library networks service so that budgeting and staffing could be planned.

Chorba and Bommer[40] have proposed an approach to design a data oriented decision support system for the management of academic libraries. A decision support system with modelling and computer simulation techniques has been developed by the School of Library and Information Science, University of Pittsburgh, to support the financial decision making processes for librarians operating in a networking
environment. The programme was initiated by Professor Allen Kent and was funded by the National Science Foundation of the U.S.A. [41].

The resource sharing network simulation system has been designed to reflect and mimic the conceptual model of the resource sharing network developed for that purpose. The simulation model basically consists of a set of data structures that represent inside the computer the structure of the conceptual model which consists of a number of modules that manipulate the data structures to represent the behaviour of the conceptual model.

The conceptual model developed for the system views a network as a collection of nodes joined together with the explicit purpose of sharing one or more resources. Each node may have characteristics that differ significantly from other nodes but in general it is assumed that there are some underlying commonalities across the nodes of the network.

The philosophy of this network simulation system is that the characteristics, policies and relationship of the nodes define the network nodes or their selected administrative body but it is still necessary to describe each node individually. The basic theoretical framework of the model is that a network consists of a set of nodes and they are connected via some communication facilities (the topology of network). Each node in the network has a set of demands placed upon it and a set of resources needed for the satisfaction of the demands. Demands may be explicitly generated by patrons such as the demands to charge out a particular type of material or implicitly generated by a library policy such as a book selection policy. These demands create the impetus for transactions to be processed by the resources available in the library node or in other network nodes. Demands must be stated in terms of transactions. A transaction is a unit of service that must be provided to satisfy the demand.

A single transaction must be logically independent from all other transactions in the same category. That is, if one of several transactions is not processed it should have no direct effect on those that do get processed. There must be a set of demand categories defined and described for each node in the network. In addition, a named demand category must have the same meaning in all nodes of the network. Not all nodes in the network need to have the same set of demand categories.

Each demand requires that one or more network functions (activities necessary to fulfil a demand) must be performed to provide the service identified in the demand. The same demand at different nodes may be accomplished using different work functions. However, the same work function name must be defined across the network in the same way.

Each work function consumes one or more resources either from the set of resources at the nodes or other nodes in the network. A named work function may consume different resources at the node or other nodes in the network, even though it may have the same name and meaning throughout the network.

Resources are tangible entities such as personnel, terminals, shelf space, disk space, line printer, memory, cpu, etc. At each node there is only one set of resources that the work functions have to share. These resources have a finite capacity (expressed in terms of units). Once the capacity of certain resources are executed, no more demands requesting these resources can be satisfied. A named resource must have the same meaning throughout the network, otherwise sharing of resources would be meaningless.

Associated with each demand and/or resource are a set of policies. These are logical and/or quantitative decisions which affect the model flow. In case of demand, for example, there is a service policy that dictates whether or not accessing the network is permitted by other nodes in the network. A set of policy code is given in Appendix 1.

An important point about the system is that it does not put any constraints on the user or the naming of a certain level or the structure of the network. Nodes, demands, work functions, and resources are defined by the user and are meaningful to that user.

The system permits simulation by time period which is user defined. A time period could be a second, a minute, an hour, a week or even an year.

For the present the simulation model consists of the following modules

1. EDIT: (Data Entry and Routine)
2. MODEL: (Simulator)
3. ECOMOD: (Economic model)
4. Statistical Analysis Model
5. Report Generator

1. EDIT (Data entry Routine) module permits initialization of the data request to run the network simulator. It has been designed to run
in iterative and interactive mode. It consists of
a number of modules each of which is assigned
to handle one level in the conceptual model.
Every module is equipped with the basic editing
functions such as adding, deleting, updating,
etc.

2. Simulation Model is a simulator that permits
the user to mimic the behaviour of conceptual
model. It examines each node and tries to satis-
fy the demands by consuming the resources
at the node first. If any resource is not available
either due to consumption of all of its units or
due to its absence from the node, the simulator
tries to satisfy the unsatisfied demands using
resources in the preferred node list. This can only
happen if the demand service policy permits
network access and the resource policies for the
nodes to be accessed allow external nodes to
utilize their units.

The design of the simulator is based on the
following general approach and philosophy:

- The computation i.e., the attempt by the
  simulator to satisfy the demands is done
  in two passes, pass one and pass two.
  In pass one, demands are tried to be
  satisfied using the resources at the node
  and all the unsatisfied demands, depend-
  ing on the service policy, are either put
  in the network queue or simply treated
  as unsatisfied demand.

- A node cannot distribute demands that
  are placed upon it by other nodes.

- A demand is declared as ‘satisfied’ if
  all work functions for that demand have
  enough resources to do the work. Other-
  wise the demand is declared ‘unsatisfied’.
  In other words, partial fulfilment is not
  permitted.

3. Economic Model permits manipulation of
cost data and has its own data entry routine that
gets the fixed and variable costs for every re-
source. By running the economic module, some
cost data for every demand and resource can
be required.

4. Statistical Analysis Module consists of Statisti-
cal package for the Social Science (SPSS),
which takes data from the simulator and econo-
ic module and manipulates for different types
of statistical analysis, correlation and graphs
etc.

5. Report Generator module consists of report
generating capability using data from the res-
ponses from the simulator, Economic Module
and Statistical Analysis module. The report
allows the user to examine the output values
and input values as well.

An attractive and user friendly interface
module will be developed that will permit users
to use the system in iterative and interactive
mode. The system will prompt the users to use
the system in an easy way and without any
outside help. A schematic representation of the
system is presented in Fig. 1 & Fig. 2.

CONCLUSION
The Resource Sharing Network Simulation
System has been designed and developed to
facilitate financial planning. Of the many func-
tions performed by the librarian in his attempt
to realize organizational goals and objectives in
a networking environment, financial planning
has the most profound impact on the success
of library’s own mission of transferring of in-
formation in a cost-effective way.

The RSNSS does not intend to solve problem
for the librarian but rather to support the deci-
sion making process through a time sharing
computer system located in the University of
Pittsburgh. A library manager using a remote
terminal can use the system by asking ‘what-if’,
‘if then’, question on iterative and interactive
basis. With its report generation, computation,
and storage capabilities, this computer system
extends the cognitive skills of the decision makers
in their sophisticated financial planning. By
running the system repeatedly through the cycle
EDIT, SIMULATE, REPORT a library manager
can examine the effects of several policy changes.
Besides the decisions regarding information
transfer and the sharing of resources, the system
can be used in assessing the performance, resour-
ces or curtailing of current services. The system
permits librarians to speculate on proposed
changes to current operations (or various alter-
native plans) and see the results predicted under
these new conditions.

The system’s economic module output
should serve as cost model of different library
and networking operations that can be used by
the individual libraries or group of libraries in
determining the economically viable alternatives.
The output of the economic module can be
broken down and presented in a form that
individual libraries can input value estimate and
other pertinent data relating to their own de-
mand, the number of transactions and resources
available so that more accurate cost comparisons
Fig. 1

Schematic Representation of the Resource Sharing Network Simulation System

Computer System

Fig. 2

Schematic Representation of the Resource Sharing Network Simulation System
are obtained. The economic module has been designed in such a way that it handles fixed and variable costs separately in tabular form and concisely. This enables the treatment of a table as the basic unit of information in determining economic break-even points and in selecting the cost-effective alternatives in networking environment. The system can be used for planning a network[42].

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Appendix 1

POLICY CODES

Policy Code (BPC)
0 - Ignore budget.
1 - Terminate category service when expenditures exceed category budget.
2 - Terminate service when total expenditures exceed total budget for all categories.
3 - Terminate service when x% of budget is exceeded.

Service Policy for Demand Category Code (SPD)
0 - May not use network, in-house only.
1 - May use the selected list of node for network service.
2 - May use least cost node(s).
3 - May use best service node(s).
4 - May use combined least cost/best service nodes.

Resource Acquisition Policy Code (RAP)
0 - Cannot acquire additional resources for overload.
1 - Will acquire additional resources as needed.
2 - Will increase resources by up to x% over current.

Uncompleted Work Distribution Policy Code (UWD)
0 - Uncompleted work is unserved demand.
1 - Pass uncompleted work to next time period.
2 - Pass a % to next time period, rest is unserved demand.

Network Load Distribution Policy Code (NLD)
0 - To nodes as capacity permits and meets policies.
1 - Equally across list nodes with resources and acceptable policies (least cost, best service, combined).
2 - Function based across all list nodes with resources and acceptable policies.

Function Distribution Policy (FDP)
0 - No function utilized.
1 - Uniform distribution
2 - Exponential distribution.
3 - Normal distribution.

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