Ten years of research into improving decision making

Roy J. Adams
De Montfort University
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Adams, Roy J.
De Montfort University, United Kingdom

De Montfort University first began to carry out research into systems for supporting decision making and the application of performance indicators to library management in the mid 1980's. Since then it has undertaken a number of projects for the UK government and for the European Commission. This paper discusses just some of the major themes which have resulted from the work of the team at Leicester and looks at a number of outstanding issues.

The role of decision support systems

The decision making role of librarians has become more important as demands grow, new technologies develop, funding sources require more accountability and the unit of resource available to librarians decreases. Decision making is about taking the best way forward. The exercise of making a decision reflects life, in that it contains a high proportion of uncertainty. It is this uncertainty which reduces confidence to go forward to reinforce the decision with adequate resources and vigour. Decision support systems have as their goal the reduction of uncertainty in the decision making process. This has an obvious pay off to the user of such systems both through the establishment of greater confidence and through the ability to concentrate on those aspects of the challenge where uncertainty cannot be eliminated. The extent to which uncertainty can be reduced is dependent on the complexity of the decision, the frequency with which the decision has been processed in the past, and the amount of data which is available to support the decision making process. All types of management information help with these factors.
Manipulating management information

MIS - Management information systems are orientated to the collection of data and their presentation through report generators. They often present large sets of data which the user is invited to sift through for the most important or significant elements. Management information systems are characteristically used to support policies and cases.

Advanced MIS - Advanced management information systems provide simple facilities to sort data sets thus making the objects of most use more accessible. They may sort by an element into ascending or descending order, differentiate between data which falls within and outside certain criteria.

Dss - Decision support systems provide facilities through which models can be constructed and run against data sets to analyse current activity and test possible scenarios. They provide an investigative tool. Decision support tools are characteristically used to investigate cases and test solutions.

EIS - Executive information systems provide an environment tailored to a specialised group such as senior executives within an organisation. They are often seen as decision support systems for one person. They usually feature a set of key indicators which are developed through the use of pre-prepared queries.

Intelligent assistants - Intelligent assistants provide an environment in which data is analysed against a series of proscribed environments. Conclusions are reached and the system produces some form of justification for its conclusion. Many of these systems are based on models created through eliciting information from "experts" in the area, using their knowledge of the environment and their learned successful strategies to produce preferred actions. Most of these systems use artificial intelligence techniques and differ from the techniques above as these are designed to make and justify decisions themselves rather than provide support for decision making.
Decision support systems consist of:

1. A database relevant to the topic under consideration, often drawn from a wide range of sources
2. Models generated using the computer to analyse the topic and to test the effects of possible decisions. A widely used method of creating models is to base them on computer spreadsheets
3. The end user, usually the decision maker themselves who are able to select the most relevant data and models and modify them where necessary
4. Software capable of managing the database, models and the interaction between the user and the system

Decision support systems are geared to making decisions through their capacity to contribute to all aspects of decision making. Simon’s concepts of decision making illustrate the relevance of a decision support system throughout the decision making process:

1. The intelligence phase. Where information is gathered so that problems and opportunities calling for decisions can be identified
2. The design phase. Where the problem or opportunity is analysed and possible decisions developed and tested
3. The choice phase. Where one of the possible decisions is chosen and implemented.

Decision support systems should not be designed to meet today’s needs but should be environmental shells in which developments can be pursued. A dss should be capable of dealing with questions which were not envisaged when it was first designed. They should be able to deal with changing circumstances or elaborating on responses initially received from the system. The answer to a question may be a question.

An analysis of a library resource cycle shows the relevance of decision support systems to the librarian. The cycle begins with resource definition and the decision support system enabling the librarian to provide a profile of the use of services, demands made and their relevance to users’ requirements. At stage two, when the budget is
determined, the dss is used again to help decide the allocation of resources to different needs and priorities. The dss will enable the librarian to model possible changes in resource provision and to assess the impact of different strategies. In the third phase the dss system is used to assess the inputs which are introduced into the total service as a result of the resource allocation profiles and the changes in use and satisfaction investigated. In the four areas of the cycle the impact of the changes are assessed and new proposals for service enhancement are explored. This leads to a definition of resource needs and the cycle starts again.

There are several ways of creating a decision support environment:

1. Analyse current data collected for management information purposes and introduce models. The system is simple to set up with minimum overheads. It is driven by current "needs" but these "needs" may just reflect the history of data collection rather than focusing on data required to enable projection of needs. Some data important in decision support may not collected by the library using the old data collection model.

2. Provide a total data set which may be relevant to the development of the environment. A library service is influenced by so many local and national factors that the development of a total system approach will result in a data set which cannot be managed and is not economic to gather or hold.

3. Analyse the factors which are critical to the development of the service and generate from this a list of required data sets which will provide insights into the pictures which will be needed to illuminate these pictures. This technique requires continual reassessment of the service and its operational environment. Libraries using this method need to have clear goals and strategic planning techniques in place.

Performance indicators provide a useful starting point for this third approach. Among other uses they:

- Indicate the relative situation of the library internally, year on year
- Indicate the relative position of the library compared with others
- Signal up areas of particular concern
Provide the basis for an exploration, further investigation

PIs should, by their nature, look at the critical factors which indicate the development of a service. There is of course a debate on the relevance of more general PIs which are used in national databases. These may be useful but they may need some supplementing to provide a base which reflects the issues of each library. They do however provide a base from which useful information can be gleaned from the decision support system early in its development and so encourage the further development of the system to a true exploratory tool.

**Proscriptive and elaborate approaches**

The approach taken to the development of a decision support tool can reflect the organisation in which it works or it may itself lead to change. Where change is likely to be the result of a particular approach to decision support, the library’s management must understand this clearly. Unless they do, stresses can appear in the organisation. Compilers and users of data sets can view information in different ways, as a can of beans or a can of worms.

The can of beans approach uses data to explain and to compare. A "can" of data is opened by the librarian who then spoons the information out, places the "beans" on a plate and lets those gathered around the table consume them. This is typical of traditional management information systems.

This approach is also characteristic of the concept of intelligent assistants as they are currently developed. Intelligent assistants are proscriptive, they are dependent on being able to describe the future through the knowledge of the past. Such an approach has its use in stable, well-established situations. One could make a case that in libraries the recent changes in the resource base, the demands made on services, and changes in the
political environment result in a situation where established reactions to a new stimulus may not be appropriate.

Intelligent assistants provide models of domains which are applied to the data stored. Scenarios of a higher order are required. The system digests the information through the models, reaches a conclusion and justifies it. This might be viewed as a retrospective decision maker or, why I justify what I have concluded. Such an approach can be effective in a well-defined and established domain but it pushes at no decision barriers. It is a "user safe approach" which has limited application with areas which are evolving to meet changing needs. Expert knowledge needs to be elicited to form the models for such systems and, in rapidly changing situations, it can be difficult to find sufficient repeat cycles to verify the logic of successful strategies and tactics. This type of approach fits in well with a more managed style from the head of service. It provides information on activities within existing frameworks but it tends not to invite challenges to existing patterns of operation.

The second approach is the "can of worms" approach. In this situation the librarian takes their can opener and reveals a container full of writhing components winding around each other. As one is carefully removed it brings with it another. As the user attempts to get to the bottom of the can to empty it the route is hidden by more worms. The elements are difficult to control but, as they come in different sizes and shapes, they are interesting. We do not of course eat these creatures. Some of us will enjoy them more than others, but we all know that put into our ground and allowed to go free they will help to ventilate it.

Traditional dss tools are elaborative in their approach. The database, which may initially consist of information used to establish PIs enables the user to construct and run models of possible scenarios. These can be tested and further explorations carried out into the background of any interesting results by investigating data and by examining new avenues. The process encourages the investigation of possible pathways to conclusions. It enables the user to construct scenarios and to test these. It can
provide hints for new ways of approaching problems and enable new strategies to be considered. The application of the techniques needs time and some skill and, of course, the ultimate data base. The lack of such data is often the constraining factor in this approach. It can be considered a "user risky" approach. Through such open systems one can learn about the service but it naturally requires an open team work approach, not just to the decision support model but also to the total working environment.

**Decisions beyond the PI model**

While traditional performance measurements assist in assessing services, other factors are now being incorporated to form a more complete picture of services. The first of these is direct input from users. This is now being taken on board by some suggested performance indicator models. We can collect data on user activity both directly through analysing automated systems and indirectly through observation. In addition we can derive information on the service through questionnaires covering service use, satisfaction and priorities. These enable us to examine not only activity but the importance that users place on that activity and the success with which users believe the service is provided.

The integration of such information extends the dss into an area where it can provide some useful indicators on "quality" issues. We are now focusing on outcomes rather than inputs and outputs. The questions we may ask users can help to illuminate user needs and their true use of facilities. Simple measures such as gate counts can be supplemented by information on, for example, the nature of student use. Gate counts measure gate counts and do not measure use or users. The loan of a book is simply that, dominated by the issue period. It does not show how much an item is used, just its initial attractiveness as a "take home" item.

These types of consideration lead to the most interesting area for dss that is what are we considering when we seek information through dss We really are looking at the impact of our actions on the environment and how change can be managed successfully through interpreting reliable data. However, at the level of making a difference to
users attempting to examine the data we collect as indicative of a library's efficiency leads us - not very far. To make a difference we need to turn to the way in which user groups operate and prefer to use the service. Given that the d.s.s system user can drive down into particular data sets and levels of activity the characteristics of defined groups can be explored. The "groups" will of course depend on the particular environment the librarian wishes to explore, but they could naturally include particular courses and years, they may differentiate undergraduates from post graduates. Through this process of "digging down" into the data, comparisons of users and service can be exposed. This is the point at which academics become really interested. Universities are more interested in the impact of the library on students than on the operational issues surrounding library provision.

The analysis of information can be viewed from the focus of the academic process rather than the efficiency of the library service and through this approach bring in new roles for the decision support system approach. Information produced for library decision support systems are now moving conceptually into a new role, that of the strategic information tool. As more Universities provide learning rather than teaching environments and independent learning becomes a focus for most students, the use of library services will increase and the range of services on offer will expand. The development of IT in libraries providing this new style of environment will, through data collection and analysis find out what, how and to what effect student groups are involved in the learning process. In an open learning environment this becomes information of strategic importance. If for example we can analyse student activity for a particular full-time course we may well get strong indications of how we could provide the course in other modes. If we can see just what students are doing we may be able to better target resources. We now have a strategic information system.

Some major issues within the area of dss which are outstanding: To provide an integrated environment we need to be able to relate the results of objective measurement, sampled activity, user observation and user satisfaction and priorities measures. Some of the data will be in the form of counts, others in the form of scores. Relating counts of use to opinion scores on facilities, to perceptions of
service can still continue to be viewed as an art. Analysts need to appreciate the strong influence of user expectations.

Measuring outcomes and environmental impact rather than outputs and integrating these into the decision support process remains difficult. We lend a book but do we know how often and how long it is being used for and how useful it was to the user? The impact of electronically presented information will help in the developing environments, as measures on use can analyse use in more detail. For the moment, however, we still need to decide how we interpret use such as library gate entry.

References to work carried out at De Montfort University into decision support and performance indicators


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So far librarians and publishers have in general worked well together. Indeed, the scholarly communication system has worked well, despite the misgivings expressed at times by each participant in the process. Researchers have found publishers to be remarkably flexible in creating new channels for the dissemination of the results of their research. Librarians, while grumbling about price increases, have nevertheless been able to persuade their academic institutions to make ever more money available for journal purchases. Universities and other large organizations, they argue, should expect to pay the same price for a journal regardless of where it is located. The argument is that they have expressed a real reservation about the volume of research publications that are necessary to maintain a good research record. And it is true that the relatively low price at which libraries pay journals is a reflection of the large increases in international investment in university research. Publishers, of course, have been happy because they see that their services are wanted, both by authors and by libraries, and have done well financially from journal publishing. But the picture is far from the one once projected. The number of paper copies has increased, but the number of countries and the number of libraries that have access to the journals is far below what was once hoped for. Researchers will not pay to read what they cannot get. And what they cannot get is the full text of everything. Libraries are beginning to ask publishers to disseminate material as long as libraries continue to communicate effectively and efficiently. But they have not been successful. Librarians will have to be a lobbying force to make sure that libraries can continue to communicate effectively and efficiently. The libraries must work to make sure that they have access to everything they need to do their work. Otherwise, libraries will not be able to provide the service that is necessary for the dissemination of knowledge. The libraries must be able to communicate with each other, and with the world, in order to disseminate knowledge. Libraries are important for the communication of knowledge, and they must ensure that they have access to everything they need to do their work.