

DESIGNING AN INFORMATION SYSTEM - A SUPPORT SYSTEM FOR A STATISTICAL INFORMATION SERVICE

By Reija Helenius

Abstract: The author discusses the various functions involved in designing of information systems and describes the projects implemented in Library of Statistics in Finland. The primary aim of the project is to devise an information system which would be of use to persons employed in statistical information services. The project was launched with an extensive survey in 1990, and the programs are currently under testing.

The system analysis carried out at the Library will be discussed together with the relevant information system designing functions.

1. Introduction

The designing of information systems is currently part of the everyday working routines of persons employed in libraries and information service positions. In addition to the compilation of library catalogs, librarians and information specialists may be engaged extensively in the designing of information systems, a task which used to be largely in the hands of computer experts and guided by the nature of the existing technology. Nowadays, however, a mere mastery of technology is no longer sufficient to produce efficient systems which satisfy the needs of their users

The designing of information systems can be taken as a problem which involves human sciences (e.g. the social sciences, psychology and linguistics) and technology. The former as such do not provide any ready-made methodology which could be used to support designing, but rather supplement the existing designing methods used by computer specialists, such as systems methods, in emphasizing the role of the user (Ref 1).

It is emphasized in the research into information needs and seeking carried out in the fields of library and information science that the designing of functional

Ms Helenius' paper was delivered at 59th IFLA Council and General Conference, Barcelona, Spain, 22-28 August 1993 and revised for this issue of INSPEL.

information systems should set out from users' needs, which requires an understanding of why and how humans seek, process and utilize information. Information systems should be capable of being used for decision making and problem solving purposes and possess a sufficient degree of flexibility so as to meet the requirements of various types of users (e.g. Refs 2, 3, 4).

Persons engaged in the designing of information systems should be capable of identifying with the user throughout. Each instance of designing requires case-specific considerations, and stereotyped solutions are not applicable to each and every designing situation.

The present paper discusses the various functions involved in the designing of information systems and describes the designing projects implemented in Library of Statistics in Finland. The primary aim of the project is to devise an information system which would be of use to persons employed in the statistical information services. The project was launched with an extensive survey in 1990, and the programs are currently under testing.

The Library of Statistics, the main institution of its kind in Finland, possesses extensive collections of statistical documents obtained from Finnish sources, international organisations, the statistical authorities in various countries, and other publications on statistical topics.

2. Statistic points for the development of a computer-based reference support system

Persons engaged in reference and information services are often required to answer difficult questions of many kinds and thus to master a large amount of highly detailed information. The traditional means of information search, such as library computer catalogs and bibliographies which only consist of references, do not always offer the necessary assistance in problem-solving.

Information and reference services also require other means of answering to difficult questions and of jogging the memory. Various memory card files, e.g. reference information files or problem card files, and registers have so far been employed as corporate memories which are used to store pieces of information found at a given time for subsequent use. Such files thus contain answers to difficult questions and references to relevant sources of useful information, thus reducing the need for acting solely on the basis of one's own memory.

The development of information technology has increased the need for converting manual memory files to computer-based systems. Some computer systems have already been implemented in the United States to support reference and informa-

tion services (Refs 5, 6, 7). A computer-based support system can be defined as an information system which can be used to facilitate and enhance a certain function, such as an information service. The difference between a bibliographic or library catalog database and a reference support system could be described by saying that in bibliographic database the searcher wants to retrieve all the relevant records regarding a topic, while the primary aim of a support system is to provide the user with direct factual information or a list of the best sources available.

The memory card file which has been maintained in the Library of Statistics for a couple of decades is currently being used to develop a computer-based statistical information system. This is considered necessary as the running of a statistical information service requires advanced knowledge of innumerable aspects of society. Additional requirements include familiarity with a number of statistical classifications, concepts and definitions. Clients also expect to receive the answers without delay, so that there is simply not enough time to employ a method based on trial and error.

Persons engaged in information services do their best to find the most satisfactory answers to questions or inform the client of the right reference books. The 10,000 questions received by the Library of Statistics each year cover a wide range of topics, such as index numbers, trends in gross national product, distribution of religions, trends in the productivity of work in various countries, or even the numbers of trawlers operating in given fishing grounds. More extensive inquiries may involve a survey of the market for furniture (imports, exports, production) in various countries and years, or a compilation of the latest basic economic indicators at the international level.

Most of the staff of the Library of Statistics are employed in answering direct questions from the public, which in turn increases the need for a support system, and all the employees make some use of the existing memory card file which provides background support for new staff in particular but is also of use for the more experienced librarians. It can thus be regarded as a 'collective memory'.

3. Support system designing functions

It is common in connection with the designing of information systems to speak of systems analysis and systems planning, which point to "an organised approach to, or a methodology for, the introduction of computerized systems" (Ref. 8). It is possible to employ a wide variety of approaches and methods in a systems analysis.

The systems analysis carried out at the Library of Statistics will be discussed in the following, together with the relevant information system designing functions. The model suggested by Soergel (Ref 9), used as a framework for the systems analysis, is discussed here in a modified, simplified form.

3.1 Delimitation of the system and setting of objectives

The first stage in designing is to determine the functional requirements for the system to be designed, in which careful thought should be given to what is relevant and what is irrelevant. Objectives can then be set for this system. The designing should set out from an overall objective, which for an information service support system could be to assist the staff in answering problematic questions.

In addition to these overall aims, more specific objectives and requirements should also be set in order to create criteria for the evaluation of alternative programs and means of implementation (Ref 9). Various types of criteria have been developed for the evaluation of information systems which can be used primarily as general evaluation guidelines (e.g. Refs 10, 11, 12, 13). It should be noted, however, that each and every instance of evaluation requires an approach of its own and application of the existing lists of criteria.

A total of 11 criteria connected with information content, the user interface (search and print functions) and updating facilities were laid down for the reference support system in the case of the Library of Statistics. These were derived from results obtained by means of a requirements analysis, examples collected from the literature and practical experience. The system which met the given criteria was termed the desired system.

3.2 Requirements analysis

A requirements analysis involves a survey of the requirements that a user of a system may have. Its purpose in this case was to find out the type of information needed by employees as a precondition for successful work and the other demands they may have regarding the system (Ref 14). The needs of all information system users should be explored in this way (Ref 13). If it is impossible to obtain information from all prospective users, representatives of each user group at least should be available (Ref 15).

There are a number of means of examining needs which are of relevance to information systems, and they can be used simultaneously. They include interviews, inquiries, protocol analyses, brain stormings, other forms of group work, and the analysis of existing systems. Information on the needs of the user organization's

staff can also be derived from features and functions of the existing system (refs 14, 16), or by means of action research.

3.2.1 Inquiry methods

Inquiry methods such as interviews and brain stormings are as such an insufficient means of exploring user's requirements (Ref 16). It may be difficult for users to express their visions of a new information system or describe their requirements without any concrete knowledge of how to use it. They may also tend to think only of approaches which would not cause any changes in their working methods, unaware of the fact that an information system enables the adoption of entirely new working methods. Similarly, users may feel that an automated system is only capable of providing answers but fail to recognise that it could in fact alter the questions (Refs 12, 17, 18).

Users may also think that the designer understands their working tasks better than he in fact does, while the latter may regard users as possessing a better understanding of their working tasks than they actually do. A belief in the apparently unlimited capacity of computers on the one hand and a resistance to all changes on the other may produce unrealistic, prejudiced responses. In addition, opinions also tend to become easily confused with actual facts (Ref 14).

Users' needs in the Library of Statistics were examined by means of theme interviews, the choice of which was justified by the fact that they enable all potential users to express their opinions on the project. This may have promoted favourable opinions and reduced resistance. All persons employed in information service functions were interviewed, and attention was also paid to the needs of clients, who constituted another prospective user group.

The interviews indicated that there is a need for developing an efficient information support system. The library information service section is currently characterised by a constant pressure of work. A mastery of extensive fields of experience is required, and current working aids are inadequate, forcing the staff to rely largely on memorization. In addition, it is difficult to find the correct references or to understand the content of many concepts. It was thus no wonder that properties such as ease of use, speed, exhaustiveness of content and up-to-date information were required from the system. The replies also suggested that some kind of thesaurus would be required to facilitate the search for individual pieces of information. The possibility of providing the library's clients with access to the system would call for further investigation.

3.3.2 Analysis of the current system

Examination of the existing system constitutes a form of requirement analysis. As the system in use at a given point in time was originally created to meet certain requirements, it can also be used to draw conclusions about users's needs at that time. The existing system and its operation can be described in a variety of ways, e.g. verbally or in the form of a matrix and operational diagram (Ref 19). Such a description brings out the primary aspects of the content and structure of the system and the way in which it is used. In addition, information can also be obtained on its advantages and weaknesses and on the grounds on which the introduction of a new system would be desirable (Ref 13).

Thus description of the existing system was used as a second requirement analysis method at the Library of Statistics in addition to the theme interviews. The process involved examination of the entire memory card file in order to determine the essential features of the system. Information of the content of each card was recorded on a separate form. The aim of the analysis was to obtain an overall picture of the system and its content, and the results obtained underlined the need for a new system.

Instead of an analysis of the existing system, it would also have been possible to supplement the interviews by examining the various functions within the organisation using the system or by constructing a prototype. Davis (Ref 16) recommends the parallel use of more than one requirement analysis method.

3.4 Implementation constraints

It is also necessary to examine any restrictions which may arise from the following factors:

- investments in new equipment,
- investments in programs and applications,
- staff resources, and
- need for computer support and computing expertise.

The identification of such constraints will provide a concrete framework for the designing of the system.

3.5 Selection process

When a process is initiated to find a system which will meet the user's requirements, sufficient information should be available on the existing implementation opportunities. It should also be possible to evaluate these with respect to case-

specific requirements, to predict future trends in technology and to outline the requirements imposed by these trends on the systems designed.

Modern technology enables the application of systems of various types. The main problem is how to obtain information on all the opportunities offered by the technology and how to benefit from these.

Ideas and application alternatives can be collected from the literature or generated oneself. General information is provided by systems descriptions in directories and software manuals, evaluations of systems and applications and discussions of future trends. Visits to organisations in which an interesting program is already in use are also important, and it may also be possible to learn from colleagues' experiences. Other sources of useful information are exhibitions and conferences (Refs 8, 10, 20).

Once all applicable alternative systems have been explored, an assessment can be made of their practicability with respect to the purpose for which they will be used. Attention is first paid to whether some of the alternatives should be abandoned by virtue of the known restrictions, so that the remaining ones can be evaluated relative to the criteria employed (Ref 9). This evaluation is part of a cost-benefit analysis which concentrates on the advantages to be gained from particular alternatives, i.e. comparison of their costs and benefits (Refs 13, 20). The best alternative is selected for implementation.

Four types of system differing in their basic structure were examined in the case of the Library of Statistics:

1. information retrieval systems,
2. database management systems,
3. hypertext systems,
4. expert systems.

The actual program evaluation, in which attention was paid to basic structural features, information search facilities and applications which could be implemented by means of these systems, took place only after the general characteristics of the four various system types had been examined. Future trends and questions regarding the designing and implementation of the system were also considered.

The applicability of the four various system types was evaluated relative to the criteria employed. This evaluation indicated that none of the alternatives available corresponded fully to the aims laid down for the system, and it was difficult to place them in order of preference. The types of system were found to differ in terms of their range of uses and the support they provided for the user. Information retrieval systems and database management systems do not support the work

of the user, but serve as 'search devices' which retrieve the desired piece of information. These systems differ in that the former are intended for the retrieval of textual information and the latter for the management of structural information. Hypertext systems can best be used to manage free-form information and to promote associative browsing. Expert systems operate at an entirely different level. They can be consulted regarding a narrow subject fields and provide the appropriate recommendations.

The investigations performed at the Library of Statistics indicated that it was only expert systems which were entirely unsuited for the purposes of an extensive statistical information service, thus strengthening the notion that it will be even more necessary to aim at combining the properties of the various alternatives in future. The system aims specified for the Library of Statistics contained features of a number of system types, and all of these had to be taken into consideration in the actual comparison of the programs. Information retrieval systems and database management systems were found to correspond best to the criteria.

The project is currently being continued. A total of six programs have so far been evaluated by representatives from the library and the computer department, and two have been selected for test use, and after which a final decision will be made regarding their suitability for use by the information service department.

4. Conclusions

The development and reorganisation of tools and working methods for information and reference services is a significant issue. The traditional means of information search, i.e. library database catalogs, are insufficient, and should be replaced by systems which will correspond more directly to actual information needs. A support system is particularly useful for a statistical information service, as clients expect to receive the desired piece of information rapidly and the employees in the service department, who vary in their education and experience, are required to master an extensive range of statistical topics. The development of support systems can also be assumed to attract a broader interest as it is evident that systems of this kind will be required in other information services such as public libraries.

One important issue which should be taken into consideration is that no computer can be used to replace human expertise and judgement, but computers should rather be regarded as tools which can be used to assist human operations. It is thus obvious that information systems should be designed so as to promote and facilitate human action. The analysis of needs and requirements can thus be considered one of the most important tasks in the designing of such information systems.

References

1. Hyvärinen, M. 1988. Ihmistieteet ja tietotekniikka. Helsinki, PTL-Tele tiedonsiirtopalvelut.
2. Dervin, B., Nilan M. 1986. Information needs and uses. *Annual Review of Information Science and Technology*. 21, p. 3-33.
3. Ingwersen, P., Pejtersen, A.-M. 1986. User requirements - empirical research and information system design. In: Ingwersen, P. et al (Eds.). *Information Technology and Information Use*. London, Taylor Graham. p. 111-124.
4. Rouse, W.B., Rouse, S.H. 1984. Human information seeking and design of information systems. *Information Processing & Management*. 20, 1-2. p. 129-138.
5. Ahtola, A. 1989. In-house databases: an opportunity for progressive libraries. *RQ*. 29, 1, p. 36-47.
6. Butkovich, N.J., Browning, M.M., Taylor, K.L. 1991. The reference expert: a computerised database utilizing Inmagic and a worm drive. *Database*, 14, 12, p. 35-38.
7. Stover, M., Grassian, E. 1989. Toward an automated reference information system: inmagic and the UCLA ready-reference information files. *RQ*. 28, 4, p. 517-527.
8. Rowley, J. 1988. *The Basics of Information Technology*. London, Clive Bingley.
9. Soergel, D. 1985. *Organizing Information. Principles of Data Base Retrieval Systems*. San Diego, Academic Press, Inc.
10. Beiser, K. 1993. Selecting software for libraries. *Database*, 16, 2, p.18-29.
11. Kemp, A. 1988. *Computer-based Knowledge Retrieval*. London. Aslib.
12. Kunz, W., Rittel, H., Schwuchow, W. 1977. *Methods of Analysis and Evaluation of Information needs: a Critical Review*. Munich, Verlag Dokumentation.
13. Tenopir, C., Lundeed, G. 1988. *Managing Your Information. How to Design and Create a Textual Database on Your Microcomputer*. New York, Neal-Schuman Publishers.
14. Lederer, A. 1981. Information requirements analysis. *Journal of Systems Management*. 32, 12, p. 15-19.

15. Fidel, R. 1987. Database Design for Information Retrieval - a Conceptual Approach. New York, John Wiley & Sons, Inc.
16. Davis, G.B. 1982. Strategies for information requirements determination. IBM Systems Journal. 21, 1, p. 4-30.
17. Keen, P.G.W. 1980. Adaptive design for decision support systems. Data Base. 12, 1-2. p. 15-25.
18. Raymond, D.R., Tompa, F.Wm. 1987. The limits of user consultation in database design. The Canadian Journal of Information Science, 12, 3/4. p. 98-106.
19. Kuivalahti, M., Peltoniemi, J. 1988. Tietojärjestelmän sisällön suunnittelu. Helsinki, Valtion painatuskeskus.
21. Järvelin, K. 1986. Kirjasto- ja tietopalvelualan ATK-sovellusten arviointi. In: Nuotio, S. (Ed.). Kirjastot ja ATK. Suomalaisia kirjastoautomaatio-sovelluksia. Helsinki, Suomen kirjastoseura. p. 43-69.

Reija Helenius
Statistics Finland
P.O.Box 504
SF-00101 Helsinki
Finland