Decision makers have to be supported in their tasks by systems such as Decision Support Systems, regardless of the level of management. The system will integrate and present information aggregated or not depending on the management type.

To begin, the difference between Information and Decision must be shown. Decision makers must take into account information coming from several different entities and have sometimes a high quantity of information to aggregate in order to reach the best solution. They need a personal and direct control on systems, which are designed for them. Decision and Information have to be classified referring to the level of management. It is possible to distinguish three levels of management: operational level, control level, and strategic management level. According to Sprague and Carlson (1982), at the operational level, information is numerous and very detailed. The same phenomenon could be observed for decisions; there are a lot of decisions to make at an operational level, and usable information is also in great proportion. At the control level, information is less numerous than in the previous case, and decisions are more important. Information at this level is more aggregated. At the last level, strategic management, information is aggregated and not numerous, and decisions have a very high impact on management.

According to Simon (1977), a decision is defined as a process including four steps: intelligence, design, choice, and review. This process has been drawn by observing reasoning modes in the problem solving cognitive process.

In the first step, the limits of the case study are drawn. Information is collected, and the problem is globally studied. The actual state is drawn, and the “to-be state” is defined. Even if this step must remain relatively short in order to keep only pertinent information; it is the longest phase in the whole process, and it has a high influence on the others. One tool in this step could be to separate the problem in sub-problems, et cetera.

In the second step, the decision maker analyses the problem, designs different scenarios, and then the third time, he chooses the scenario that will be executed. Solutions being examined, the three following situations are possible. The first situation is the perfect information: there is a complete and precise knowledge of scenarios and consequences. The second situation is the risky situation: there are several consequences for different scenarios, but they have known associated probabilities. The last situation is the uncertainty situation. In this case, the consequences of scenarios are unknown. The last step, the review step, consists of an evaluation of scenarios and an evaluation of past actions.

This process is nor linear nor sequential. The four steps could be mixed together.

In the decision process itself, a distinction has to be drawn on the nature of the decision. Simon (1977) distinguishes two kinds of decisions: non structured decisions or semi-structured decisions, and well structured decisions. In fact, there are different levels of decision structuring; on one side, structured decision, and on the other side, non structured decision. In the first case, decisions could be described by rules and procedures, and then they could be programmed and executed by a system. In the second case, non structured decisions, Decision Support Systems are useful.
Decisions can also be classified by the type of management to which they refer. There is operational decision for operational management, decision for control in management control, and strategic decision for strategic planning. The developed systems would be different for different kinds of decision.

Before going in deeper details, it is important to define decision making. Decision making supports decision makers by giving them solutions for the problem to solve. Decision makers have difficulties describing decisions to make, but they use conceptualisation objects, such as diagrams and figures, in order to understand and explain decisions to make. Each of them has his own knowledge, style, and tools that are very specific. They need a personal and direct control on decision support tools. According to Roy (1985), decision making “is the activity of those basing his reasoning on clearly explicit models but not necessarily completely formalised, support to obtain pieces of answers to questions asked by actors involved the decisional process.” In this definition, the model takes an important role and the whole process of modelling. The modelling process could be defined as follows.

In this process the distinction between abstraction domain and reality domain is very clear. A modelling phase is described coming from the problem to solve going to the model of the problem; in the second phase, a theoretical solution is found but is not necessarily usable in the reality; a third step consists then in an interpretation of the theoretical solution giving an applicable solution; and in the last step a new process begins by putting applicable solution near from the problem in order to enrich it. It is important to notify that the notion of models is very important here. Designers and analysts include part of their own background in the model of the problem. One problem model is always relative to one or two persons.

According to Simon (1977), decision makers do not have a clear idea of the problem or solutions to consider. Decisions are made one by one in a limited area. The future evaluation is limited, and it is impossible to envisage all scenarios, because information itself is limited. Decisions are made in the framework of a progressive process. Decision makers could use contradictory criteria. It is not always easy to design a global utility function (though this statement is in contradictory with Von Neumann and Morgenstern (1954)). This phenomenon is called the limited rationality principle. The objective is no longer to obtain an optimal solution to a problem but is to reach a *satisficing* solution. The decision maker obtains his solution that satisfies himself on respect of a number of criteria. DSS takes their definition in the research of *satisficing* solution.

Decision Support Systems come from the mixed between the limited rationality principle and the evolution of computer science. Computers are more and more efficient; numerous calculi can be executed and can give answers rapidly. Decision support systems aid managers in their semi or unstructured tasks by calculating solutions until they obtain their *satisficing* solutions. The idea of DSS emerged by opposition of Information Systems, which were not used by managers. The expression has been introduced in the seventies by Morton (1971). These systems are considered as included in the Information System of the organisation and as an element of the decision process.

Definitions of these systems are numerous. One of the most known definition has been introduced by Keen & Morton (1978): DSSs the imply computers use for 1) support decision makers in their decision process for semi-structured tasks, 2) help rather than replace decision makers judgement, 3) improve decisions effectiveness rather than efficiency. This definition points out the fact that DSSs are included in the decision process, and also that efficiency is no longer the central objective. Another definition completes the previous and has been introduced by Sprague and Carlson (1982): DSSs could be characterised as interactive computer systems that support decisions makers by using data and models to solve unstructured problems. This definition introduces another dimension of DSSs: interactivity. The solution is found interactively between the user and the system.
This definition gives an idea of DSS’ architecture. The classical architecture was introduced by Sprague & Carlson (1982), and is described as follows. DSSs are composed by a Data Base Management System (DBMS); a Model Base Management System (MBMS) and Dialog Generation Management System (DGMS). Data related to the problem to solve, external, and internal data are kept in stock in the DBMS. Scientific models related to the real problem and the algorithm(s) to solve the problem belongs to the MBMS. The aspect essay-error is very important in this kind of systems; the interface (DGMS) or graphical user interface (GUI) takes then an important place. According to Keen & Morton (1978), the system seen by the user is limited to the GUI.

This kind of systems design must integrate different constraints as: the system must be flexible in terms of use, adaptable in terms of needs, and evolutive in terms of maintenance. Different methodologies to design DSSs have been defined by Sprague & Carlson (1982) for the ROMC approach and by Courbon, Drageof, and Tomasi (1979) for the evolutive approach. This book will describe the last approach. This approach consists in a prototype design at the beginning of the DSS design process. This prototype is a common tool between the user and the designer to communicate. This prototype could be included in a classical water-fall life cycle of the system. The DSS life cycle has been defined by Zarate (1991) as a waterfall life cycle, in which a step of prototyping is included.

These systems support individual decisions. They have now evolved and systems designed for group decisions or distributed DSS are presented in the following section.

**COLLABORATIVE DSS**

According to Bui & Pigneur (1999), as the information superhighway continues to pave the way for both inter- and intra-organisational connectivity, many organisations are looking for ways to expand their business activities beyond their traditional physical boundaries, and to use DSS to support their increasingly complex business decisions. With the realisation of anytime, anyplace connectivity, business managers and technology leaders must now be able to outline a new DSS development and deployment strategy. It is the new problematic asked by the Electronic Commerce. These new DSSs are generally distributed in different place and use the World Wide Web to communicate.

One DSS based on this kind of technology has been developed by Mattaralli, Maniezzo, and Haastrup (1997). The authors present a DSS whose modules are geographically distributed and interfaced both amongst each other and with users via the World Wide Web. The data management sub-system consists in an Oracle database, resident on a host at the Joint research Centre, while the model management sub-system consists in a set of optimisation routines installed at the University of Bologna.

This DSS could be used for collaborative work. Different people could collaborate to achieve a task through an internal or external network of the organisation. DSSs able to support group decisions, are called Group Decision Support Systems (GDSS). These kinds of systems are implemented in a room, devoted for this activity: group decision. Computers are connected through a network and with a special computer those of the facilitator who must support the group in its decisional process. According to Fjermestad and Hiltz (1998), the most frequently employed mode in Group Support Systems experiments is synchronous (decision room) studies, or GDSS, in which group members are gathered at the same time and place (generally, each with their own computer, through a few studies employed a DSS at a single room, with group members gathered around it). In the Decision Room GSS mode, group members are able to combine communication via the computer system, and “face-to-face” mode, includ-
ing non-verbal communication. A second “distributed” mode of Group Support System (GSS) is same
time/different place mode in which audio and/or video links may be used in addition to the GSS to tie
together participants distributed in two or more locations. All these systems labeled GSS are primarily
decision support rather than communication support systems; they have features such as voting and
statistical displays, and presume that at least some of the communication will be conducted via another
media. All these kinds of system belong to the Groupware technology. According to Johson-Lenz &
Johnson Lenz (1982) the groupware could be defined as “an intentional group process plus software to
support them.” Groupware is a combination of collaborative tools, processes, and techniques to leverage
the intellectual capital of groups and thereby increase their productivity.

Nevertheless, all these kind of systems do not correspond to one of the enterprises’ attempt that is
being competitive. In order to achieve this objective, organisations need to dispose pertinent information
that could support decision makers.

DATA WAREHOUSING AND DATA MINING

In the decisional process, in every enterprises sector and at every stage, high quality information access
is a determining factor. The base of this information is composed by data. The nature of these data is
more and more diversified: images, sounds, camera pictures, cards. These data constitute a knowledge
warehouse that must be absolutely used. In an organisation following phenomenon could be observed:
external and internal data volume to treat is more and more important, computers which treat them are
very heterogeneous, and sites that give them are often remote. Nevertheless even if the data volume
increases, the information quantity that arrives to the user is very poor. Classical Information Systems
are principally oriented to the enterprise productivity improvement; tasks that until now were realised
by hand have to be treated more rapidly.

In answer to this problem a second computer science was born; it is connected to the notions of
Information System, Executive Information System (EIS), and is symbolised by the Data Warehouse.
This new science is oriented to the client in order to better know its needs and to facilitate decision
making directly with the client. Data Warehouses are principally tools to share and communicate data:
they allow to gather together big sets of data, to organise them, to enrich them with external data com-
ning from big data banks, and above all, to facilitate access to data at every stages of the organisation.
The advantages to this kind of systems are numerous: improvement of reactivity (the enterprise could
react more rapidly than its concurrent), professionalism. The objective is then to construct a pertinent
and coherent data base. The notion of Relational Data Base Management System (RDBMS) is then in
the centre of this kind of tool.

The fact is then to manage the enterprise knowledge. This kind of system is in the Knowledge Engi-
neering and Knowledge Management problematic. These fields have for objective to make knowledge
enterprise emergent, to construct an organisational memory. Nevertheless, even if a system like a Data
Warehouse is able to manage a high amount of data, data have no value if they cannot be transformed
into pertinent information. From quantity of data given by the Data Warehouse, after a first step that
is extract an exploitable data, it is important to determine hidden tendencies, previsions, discover rela-
tions among variables, construct models that explain data behaviour, confirm hypothesis, et cetera. The
principal tools to extract this kind of knowledge are statistical analysis, and more recently, Data Mining.
This latter is based itself on statistical methodologies and tools. These new tools are indispensable for
a decisional framework.
FROM INDIVIDUAL DECISION TO COLLECTIVE DECISION

A major trend in decision support in the past 20 years has been the migration from individual decision-making to collective decisions. Nowadays, virtually every industry or business, as well as any political or personal activity, has to deal with vast amount of data and information that travel via the Internet. The future of Decision Support Systems (DSS) cannot ignore these impacts, which should provide context-sensitive collaboration tools to decision-makers. The Internet has a substantial impact on consumers and the general public through the way it informs and connects them. This trend has been followed by dynamic and collaborative decision-making within Spatial-temporal environments. Both these trends stem from crucial changes in work conditions: geographical dispersion linked to internationalization of business, concurrent work to compensate for time delays, permanent, instant access to new or updated information owing to the global reach of the Internet, and the ease of information sharing via local area networks and the Internet. These developments, along with enhancements and widespread use of electronic communication tools, have increased the amount of information available and analyzed by decision-makers. A further challenge to decisions in the Internet Age is therefore the credibility and legitimacy of scientific and informal information/knowledge on the Internet.

Since the late 1990s, descriptive theories of decision-making have been documented as suffering critical violations when tested on the Internet. Currently, we encounter critical problems when trying to use conventionally developed DSS on top of web platforms. In 2002, “Decision Support Systems in the Internet Age” was the central theme of an international conference, which identified the need to develop new approaches to decision-making and decision support in order to face the many changes brought by the Internet Age. Since then, many isolated research efforts have emerged. However, the need for innovative context-specific Web-based collaborative decision-making solutions still remains.

CONCLUSION

The main challenge for the next decade is to develop DSS able to be used on the Internet, in every kind of situation: distributed asynchronous situation as well synchronous face to face situation. The challenge is also to develop tools for individuals able to really support decision makers by sorting out information in an efficient way. This sorting out implies that the developed tools must follow up the decision makers in their decisional processes by profiling systems or suitable recommender systems.

P. Zaraté
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