
An Introduction to Expert Systems

An expert system is a knowledge-based information system; that is, it uses its knowledge about a specific area to act as an expert consultant to users. The components of an expert system are a knowledge base and software modules that perform inferences on the knowledge and offer answers to a user's questions.

Expert systems provide answers to questions in a very specific problem area by making human like inferences about knowledge contained in a specialized knowledge base. Expert systems can provide decision support to end users in the form of advice from an expert consultant in a specific problem area.

Expert systems are being used in many different fields, including medicine, engineering, the physical sciences, and business. For example, expert systems now help diagnose illnesses, search for minerals, analyze compounds, recommend repairs, and do financial planning. Expert systems can support either operations or management activities.

Expert Systems Structure

The components of an expert system include a knowledge base and software modules that perform inferences on the knowledge in the knowledge base and communicate answers to a user's questions.

The knowledge base of an expert system contains Facts about a specific area, Heuristics (thumbs of rule) that express the reasoning procedures of an expert on the subject. There are many ways that knowledge is represented in expert systems:-

- **Case-based reasoning:** Representing knowledge in an expert system's knowledge base in the form of cases.
- **Frame-based knowledge:** Knowledge represented in the form of a hierarchy or network of frames. A frame is a collection of knowledge about an entity consisting of a complex package of data values describing its attributes.
- **Object-based knowledge:** Knowledge represented as a network of objects. An object is a data element that includes both data and the methods or processes that act on those data.
- **Rule-based knowledge:** Knowledge represented in the form of rules and statements of fact. Rules are statements that typically take the form of a premise and a conclusion such as: IF (condition), Then (conclusion).
- **Software resources:** An expert system software package contains an inference engine and other programs for refining knowledge and communicating with users. The inference engine program processes the knowledge (such as rules and facts) related to a specific problem. It then makes associations and inferences resulting in recommended courses of action for a user. User interface programs for communicating with end-users are also needed, including an explanation program to explain the reasoning process to a user if requested.

Differences between DSS and ES

It is possible to integrate ES with DSS. There may be some components which may look similar in DSS and ES. But one should understand the differences between them. It then becomes clear as to how integration of ES with DSS can be realized.

- A DSS helps manager to take a decision whereas an ES acts as a decision maker or an advisor to the manager.
- A DSS is meant only for decision making whereas an ES provides expertise to the manager.
- The spectrum of complexity is high in DSS and low in ES since ES addresses issues related to specific areas only.
- DSS does not capability to reason whereas an ES has.
- A DSS cannot provide detailed explanation about the results whereas an ES can.

Hence by integrating the two it is possible the blend their advantages and derive the best out of the two.

Expert Systems Business Applications

Expert systems help diagnose illness, search minerals, analyze compounds, recommend repairs, and do financial planning. So from a strategic business point, expert systems can and are being used to improve every step of the product cycle of a business, from finding customers to shipping products to providing customer service. ES provides a cost reduced solution, consistent advice with low level of errors, solution to handle equipments without the interference of human. It provides a high degree of

reliability and faster response time. It helps to solve complex problem with in a small domain.

It is capable of analyzing the problem and can construct a business model appropriate to the characteristics of the application. Based on the model necessary objectives and constraints are identified. It identifies appropriate tools to solve the model. It uses the tools to solve the problem and also does the what -if analysis aimed at understanding the sensitivity of the model.

Group Decisions Support System

Group Decisions support system (GDSS) is an interactive computer-based system facilitating group decision-making processes to solve unstructured problems. In GDSS, members meet interactively together in specially designed rooms with online telecommunication and video conferencing facilities over Internet, extranet or private network. The decisions they arrived has group support. The decisions are largely rational, and unlikely bounded rationality-probably unbounded rationality since members have wide exposure, wide experiences and exploring all alternatives with intensity.

Knowledge Management Systems

Knowledge Management systems (KMS), Workers create, organize, and share important knowledge wherever and whenever it is needed. For example, many knowledge management systems rely on Internet and intranet Web sites, knowledge bases, and discussion forums as key technologies for gathering, storing, and disseminating business knowledge.

KMS systems deal with information (although Knowledge Management as a discipline may extend beyond the information centric aspect of any system) so they are a class of information system and may build on, or utilize other information sources.

The idea of a KM system is to enable employees to have ready access to the organization's documented base of facts, sources of information, and solutions. For example a typical claim justifying the creation of a KM system might run something like this: an engineer could know the metallurgical composition of an alloy that reduces sound in gear systems. Sharing this information organization wide can lead to more effective engine design and it could also lead to ideas for new or improved equipment. A Knowledge Management system could be any of the following:

1. Document based i.e. any technology that permits creation, management, sharing of formatted documents such as Lotus Notes, web, distributed databases etc.
2. Based on AI technologies which use a customized representation scheme to represent the problem domain.
3. Provide network maps of the organization showing the flow of communication between entities and individuals.

The Evolution of Support Systems

The first applications of computers did repetitive, large-volume, transactions-computing tasks. As the cost of computing decreased and computers' capabilities increased, a new breed of information system, started to develop. These systems accessed, organized, summarized, and displayed information for supporting routine decision making in the functional areas. Office automation systems (OAS) such as airline reservation systems were developed to support office workers. Computers also were introduced in the manufacturing environment, with applications ranging from robotics to computer-aided design and manufacturing (CAD/CAM).

Additional increasing computing capabilities and reduced costs justified computerized support for a growing number of non-routine applications, and decision support systems were developed to provide computerized support for complex, non-routine decisions. The microcomputer revolution, which started around 1980, began the era of end-user computing, in which analysts, managers, and many other professionals can build and use systems on their own desktop computers. Decision support expanded in two directions: first, toward executives and then managers (executive support systems and enterprise information systems), and second, to people working in groups (group support systems).

Eventually, interest in programming computers to perform intelligent problem solving led to commercial applications known as intelligent support systems (ISSs). These include expert systems, which provide the stored knowledge of experts to non-experts, and a new breed of intelligent systems

with machine learning capabilities such as artificial neural networks and case-based reasoning that can learn from historical cases.

A major innovation in the evolution of support systems has been the development of data warehousing. A data warehouse is a database designed to support DSS, ESS, and other analytical and end-user activities. The use of data warehouses is a part of business intelligence, the gathering and use of large amounts of data for query or analysis by DSS, ESS, and intelligent systems.

The latest support system in organizations is mobile computing. Mobile computing supports mobile employees, those who are working with customers or business partners, at least part of the time, outside the physical boundaries of their companies. The mobile employees carry portable devices, which can access the Internet. These devices enable communication with organizations and other individuals via wireline or wireless networks.

Executive Support Systems

Senior managers use executive support systems (ESS) to help them make decisions. ESS serves the strategic level of the organization. They address non-routine decisions requiring judgment, evaluation, and insight because there is no agreed-on procedure for arriving at a solution.

Executive support systems (ESS's) are designed to incorporate data about external events, but they also draw summarized information from internal MIS and DSS. They filter, compress, and track critical data, displaying the data of greatest importance to senior managers.

ESS employs the most advanced graphics software and can present graphs and data from many sources. Often the information is delivered to senior executives through a portal, which uses a Web interface to present integrated personalized business content from a variety of sources.

Unlike the other types of information systems, ESS is not designed primarily to solve specific problems. Instead, ESS provides a generalized computing and communications capacity that can be applied to a changing array of problems. Although many DSS are designed to be highly analytical, ESS tends to make less use of analytical models.

ESS assist in answering include the following: In what business should we be? What are the competitors doing? What new acquisitions would protect us from cyclical business swings? Which units should we sell to raise cash for acquisitions? Figure (30) illustrates a model of an ESS. It consists of workstations with menus, interactive graphics, and communications capabilities that can be used to access historical and competitive data from internal corporate systems and external databases such as Dow Jones

News/Retrieval or Standard & Poor's. Because ESS are designed to be used by senior managers who often have little, if any, direct contact or experience with computer-based information systems, they incorporate easy-to-use graphic interfaces. This system pools data from diverse internal and external sources and makes them available to executives in an easy-to-use form.

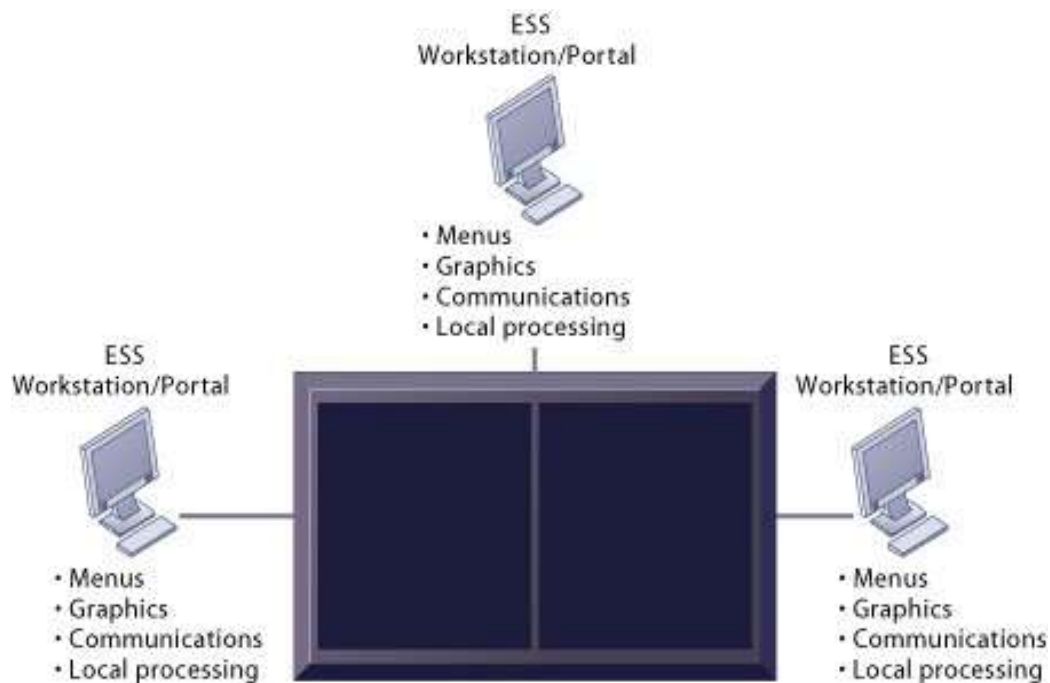


Figure 30: Model of a typical executive support system

Relationship of Systems to One Another

Figure (31) illustrates how the systems serving different levels in the organization are related to one another. TPS are typically a major source of data for other systems, whereas ESS is primarily a recipient of data from lower-level systems. The other types of systems may exchange data with each other as well. Data may also be exchanged among systems serving different functional areas. For example, an order captured by a sales system may be

transmitted to a manufacturing system as a transaction for producing or delivering the product specified in the order or to a MIS for financial reporting.

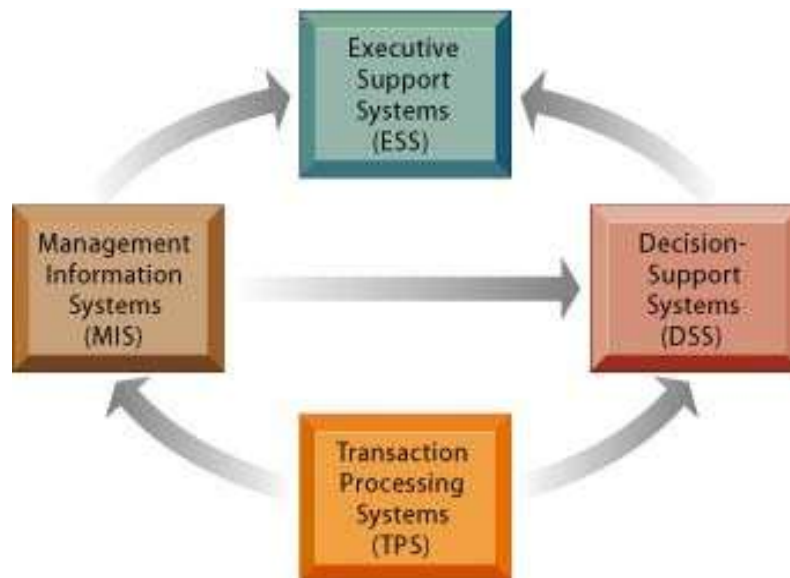


FIGURE 31: Interrelationships among systems

The various types of systems in the organization have interdependencies. TPS are major producers of information that is required by the other systems, which, in turn, produce information for other systems. These different types of systems have been loosely coupled in most organizations. It is definitely advantageous to integrate these systems so that information can flow easily between different parts of the organization and provide management with an enterprise-wide view of how the organization is performing as a whole. But integration costs money, and integrating many different systems is extremely time consuming and complex. This is a major challenge for large organizations, which are typically saddled with hundreds, even thousands of different applications serving different levels and business functions. Each

organization must weigh its needs for integrating systems against the difficulties of mounting a large-scale systems integration effort.

The Evolution of Support Systems

The first applications of computers did repetitive, large-volume, transactions-computing tasks. As the cost of computing decreased and computers' capabilities increased, a new breed of information system, started to develop. These systems accessed, organized, summarized, and displayed information for supporting routine decision making in the functional areas. Office automation systems (OAS) such as airline reservation systems were developed to support office workers. Computers also were introduced in the manufacturing environment, with applications ranging from robotics to computer-aided design and manufacturing (CAD/CAM).

Additional increasing computing capabilities and reduced costs justified computerized support for a growing number of non-routine applications, and decision support systems were developed to provide computerized support for complex, non-routine decisions. The microcomputer revolution, which started around 1980, began the era of end-user computing, in which analysts, managers, and many other professionals can build and use systems on their own desktop computers. Decision support expanded in two directions: first, toward executives and then managers (executive support systems and enterprise information systems), and second, to people working in groups (group support systems).

Eventually, interest in programming computers to perform intelligent problem solving led to commercial applications known as intelligent support

systems (ISSs). These include expert systems, which provide the stored knowledge of experts to non-experts, and a new breed of intelligent systems with machine learning capabilities such as artificial neural networks and case-based reasoning that can learn from historical cases.

A major innovation in the evolution of support systems has been the development of data warehousing. A data warehouse is a database designed to support DSS, ESS, and other analytical and end-user activities. The use of data warehouses is a part of business intelligence, the gathering and use of large amounts of data for query or analysis by DSS, ESS, and intelligent systems.

The latest support system in organizations is mobile computing. Mobile computing supports mobile employees, those who are working with customers or business partners, at least part of the time, outside the physical boundaries of their companies. The mobile employees carry portable devices, which can access the Internet. These devices enable communication with organizations and other individuals via wireline or wireless networks.

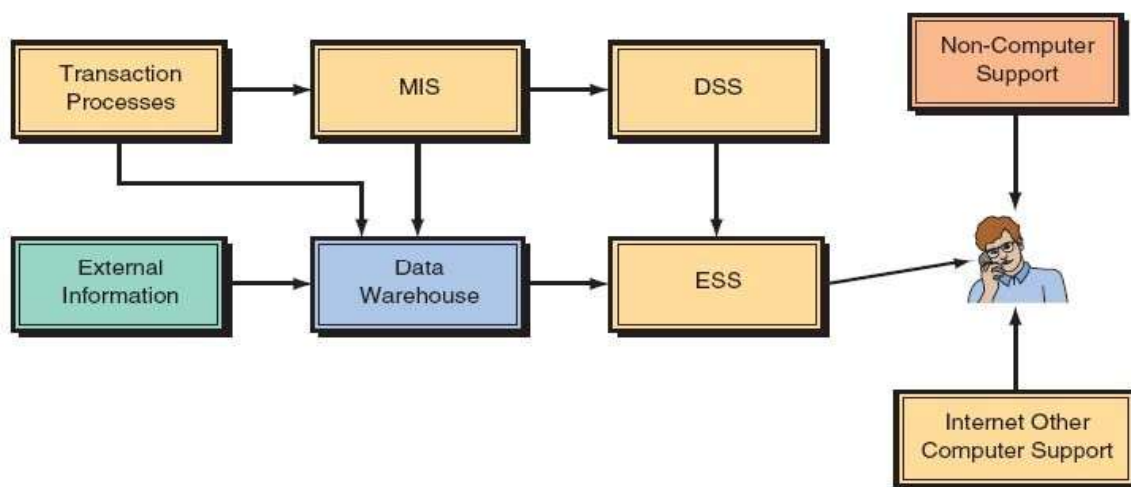


Figure 32: Interrelated support systems.

Table 8: Evolution of Support Systems

Systems	Employees Supported	Description
Transaction processing system (TPS)	All employees	Processes an organization's basic business transactions (e.g., purchasing, billing, and payroll).
Management information system (MIS)	All employees	Provides routine information for planning, organizing, and controlling operations in functional areas.
Office automation system (OAS)	Office workers	Increases productivity of office workers; includes word processing.
CAD/CAM	Engineers, drafts people	Allows engineers to design and test prototypes; transfers specifications to manufacturing facilities.
Document management system (DMS)	Office workers	Automates flow of electronic documents.
Decision support system (DSS)	Decision makers, managers	Combines models and data to solve Semi-structured problems with extensive user involvement.
Executive support system (ESS)	Executives, senior managers	Supports decisions of top managers.
Group support system (GSS)	People working in groups	Supports working processes of groups of people (including those in different locations).
Expert system (ES)	Knowledge workers, non-experts	Provides stored knowledge of experts to non-experts and decision recommendations based on built-in expertise.
Knowledge work system (KWS)	Managers, knowledge workers	Supports the gathering, organizing, and use of an organization's knowledge.
Data warehouse	Managers, knowledge workers	Stores huge amounts of data that can be easily accessed and manipulated for decision support.
Business intelligence	Decision makers, managers	Gathers and uses large amounts of data for analysis by DSS, ESS and intelligent systems.
Mobile computing systems	Mobile employees	Support employees who work with customers or business partners outside the physical boundaries of the organization.