CREATIVE USES OF INFORMATION SYSTEMS
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ABSTRACT
This paper explores the creative uses of information systems using the SAS System. As the list of new features available on the SAS System for mainframes and for personal computers grows, the capabilities for developing sophisticated end-user applications become limitless. Numerous techniques and examples are presented illustrating the strengths found within the SAS System.

INTRODUCTION
The integration of mainframe SAS software and PC SAS software has opened the door to the end-user. In part, this integration has started a new era for SAS System users. It has rejuvenated the interest among experienced users while stimulated idle curiosity among a breed of new users. It is a significant period in the history of SAS System software, something akin to a renaissance, because all end-users will have the capability to build and access sophisticated applications and process data stored in one or more data bases. The future will be bright, since new and ingenious ways of using SAS software will result in creative uses of information systems.

APPLICATION STRENGTHS
As individuals from all professions become better acquainted with the SAS System, a greater understanding and wealth of application areas will surface. As stated by Martin (1), "End-users can and should create certain types of applications. Only in this way can their unique knowledge be fully harnessed." Applications using the SAS System are being developed in greater numbers. Many of those applications are experiencing significant and positive results even as the odds appeared to initially mount up against their success. One only needs to review one of the many issues of the SAS Users Group International (SUGI) Proceedings to validate this claim.

As greater demands are placed on the competitive marketplace, end-users are approaching computing requirements using a variety of innovative methods. The SAS System has numerous products and tools to assist end-users in the development of their applications. As noted by Curtin and Porter (2), software application strengths can be seen in such diverse areas as (1) integrated capabilities, (2) integrating programs, (3) project management, (4) idea processing, (5) desktop management, (6) accounting (database), (7) utility, (8) vertical applications, and (9) expert systems. Each area and its specific relevance to the SAS System will be discussed in turn in the following subsections.

1. Integrated Capabilities
The SAS System offers end-users five general types of integrated capabilities, word processing, spreadsheet, database, graphics, and communications. These are considered to be the most requested software needs by end-users. In addition to these capabilities, specific features are designed into each to make them desirable to end-users. The first feature, known as common commands or structure in all functions, provides end-users with integrated products that have adequate features to perform

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the work at hand. As a result, "specialized" standalone products from different vendors are not needed since the integration of one vendor's product provides the required tools.

2. Integrating Programs

Many end-users have learned and used a variety of vendors' products for their application needs. They may have developed these applications using one or more wordprocessing, spreadsheet, database, graphic, or communication software. End-users falling in this category usually choose the product that best meets their needs at the time. As is often the case, many end-users are reluctant to switch to a new product even though they have reached certain limitations with the old one. Reasons for these end-users not wanting to change range from "I feel comfortable with the way the software works, so why change?" to "Why should I spend my time learning a new product when the one I have can do most of the things I need?". Of course the reasons are too numerous to list here, but you get my point. The fact is, end-users are correct, why should they change to another product unless the particular application warrants the change or unless they want to.

Specific features are inherent with integrating programs. First, end-users pick and choose from the array of available programs in the marketplace. Second, programs operate under their own set of commands. Finally, end-users will only use those programs that they like to use. The SAS System allows end-users to continue using their integrating programs whenever they choose. However, it should be noted, this may indulge in excessive interfacing requirements, such as undesirable file conversions or possible data integrity issues. After considering the consequences, end-users may inform the SAS System to access any number of database files, wordprocessing files, spreadsheets, etc., that were previously created so further analyses can be performed to satisfy requirements. These files may be treated as a DIF - Data Interchange Format or as a DBF - Data Base File.

3. Project Management

The SAS System offers a third application strength, project management. Joseph J. Mader and Cecil R. Phillips broadly define project management (3), "as the planning and scheduling of projects on the basis of past experience with similar projects, applying judgment to the particular conditions of the project at hand. During the course of the project, one must continually replan and reschedule because of unexpected progress, delays, or technical conditions." Tools used within the SAS System for performing tasks utilizing project management techniques can be found in the SAS/OR package.

4. Idea Processing

The SAS System provides end-users with the ability to gather, organize, and store ideas. The process of accessing these ideas and utilizing them within applications begins to enter into the world of Artificial Intelligence. A more detailed presentation of how a subfield of artificial intelligence can be applied within the SAS System is found later in the section describing expert systems.

5. Desktop Management

Desktop management within the SAS System allows end-users to combine different functions within the same application. This would enable one to perform some operation without exiting the existing program session. As in the case of accessing an appointment schedule without impacting or exiting the program product that is currently active. The SAS System has a variety of special windows that are designed to make your terminal (PC) an intelligent workstation. The purpose of these windows are to improve the effectiveness of the workstation operator.

6. Accounting

The SAS System offers a sixth application strength, accounting or data management. Mary E.S. Loomis (4) defines data management "as the activities that ensure that high-quality data are available to produce needed information and
knowledge. The objective of data management is to keep data assets resilient, flexible, and adaptable. The SAS System and SYSTEM 2000, as in any database management system (DBMS), provide end-users with one or more methods of capturing, storing, organizing, managing, accessing, manipulating, presenting, and protecting data. According to Loomis, "Effective data resource management is thus driven by user needs, not just by data-processing hardware and software capabilities. Consequently, the database approach emphasizes managing data rather than applications."

7. Utilities

Utilities are programs oriented toward a single task. End-users will find that utilities are small in size, generally inexpensive, perform useful but limited functions, and consist of single-task programs. The SAS System contains many useful utilities that enable end-users to perform concatenations of datasets, dataset backups, sorts, DIF-to-SAS and SAS-to-DIF transfers, DBF-to-SAS and SAS-to-DBF transfers, and dataset contents display.

8. Vertical Application Programs

The majority of end-users who decide to use the SAS System build applications that are designed with a specific purpose in mind. These specialized applications are called vertical application programs since they are developed to satisfy some special need(s) of the business and/or government sector. Typically, programs of this type serve the lowest common denominator. Consequently, an organization, department, or end-user is served by the program and would have little or no value to others outside of the organization, department, or to another end-user.

9. Expert Systems

As defined by Barr and Feigenbaum (5), "Expert systems are computer systems that can help solve complex, real-world problems in specific scientific, engineering, and medical specialties." Although no mention is made to business specialties, we know of several small prototypes that have been applied with moderate success in the corporate law, investment banking, and auditing arenas. They go on to say, "These systems are most strongly characterized by their use of large bodies of domain knowledge - facts and procedures, gleaned from human experts, that have proved useful for solving typical problems in their domain."

Expert systems are a branch of artificial intelligence that concerns itself with the simulation of human reasoning. It typically is subject related where a sophisticated, computerized branching program is used to represent the logic relationships between the facts and procedures. End-users generally interact with the expert systems via a question-answer dialog.

Process of Developing Expert Systems

Developing an expert system requires a great deal of work. The process can resemble a prototyping methodology where adjustments and modifications to the basic set of rules and procedures are made until the system mimics human reasoning. The following steps illustrate the process of developing a typical expert system.

- Define the system objectives
- Define each task
- Define the extent of the available knowledge
- Select methods of inferencing or deriving conclusions in logic by induction or deduction
- Define interrelationships
- Build the knowledge base
- Debug and refine the knowledge base

Building the Knowledge Base

A knowledge base consists of collections of facts, procedures, and inferences that are obtained from humans who are considered experts in their field. According to Barr and Feigenbaum (5), "For an expert system to be truly useful, it should be able to learn what human experts know, so that it can perform as well as they do, understand the points of departure among the views of human experts who disagree, keep its knowledge up to
date as human experts do (by reading, asking questions, and learning from experience), and present its reasoning to its human users in much the way that human experts would (justifying, clarifying, explaining, and even tutoring)." The building of a knowledge base can be accomplished using either the method of 1) expert transfer or 2) a structured editor.

1. Expert-Transfer

This method of acquiring knowledge consists of two human beings, one known as a Knowledge Engineer or the person possessing skills in the collection and arrangement of facts, procedures, and inferences. The second individual is the Expert or the person possessing the specific skill or expertise. The process is performed using an interviewing technique where the Knowledge Engineer asks questions of the Expert. Consequently, the information is transferred via one or more question-answer session(s).

2. Structured Editor

This method of knowledge acquisition requires the Expert to enter knowledge into an editor. The knowledge can be added, deleted, or modified as many times as necessary in order to collect a complete and accurate set of rules (facts, procedures, and inferences). When using this method the function(s) usually carried on by the Knowledge Engineer are now performed by the computerized editor. Typically the editor begins by asking simple questions while capturing and assimilating information.

Limitations of Expert Systems

As with any system that collects, manages, and accesses information, the outcome is only as good as what goes into the system. Expert systems are subject to the following limitations, 1) inference speed, 2) quality of knowledge, and 3) improper use.

1. Inference Speed

This refers to the amount of time required to derive conclusions based on an inductive or a deductive process as well as the amount of time to interact with knowledge bases.

2. Quality of Knowledge

The key element of an expert system, namely the Knowledge Base, is also the most vulnerable to such things as incorrect information; omissions of key facts, procedures, or inferences; oversimplification; forgetfulness; limited applications; and various other quality-related problems too numerous to mention. Consequently, the knowledge base is only as correct as the information provided by the Expert.

3. Improper Use

Problems of two types often occur when using expert systems. The first problem has occurred from the time man/woman began working with functions of a complicated nature. It refers to an error related to the interaction between man/woman and some function. These errors correspond to an unintentional misuse or misunderstanding of the function itself.

The second problem refers to an intentional or planned error. Problems of this type can occur when an Expert thinks the expert system will make him/her obsolete or when an ulterior motive exists for sabotaging the knowledge base.

Examples of Expert Systems

A list of a few business-oriented expert system prototypes follow.

- Tax Law Advisor
- Audit Matrix, Scheduler, and Reporting Advisor
- Investment Advisor

The Tax Law Advisor protocol that follows shows the initial and final parts of a sample interaction between an accountant and the system. The system interviews the accountant about a client, collecting information from which it will provide assistance in filling out the client's 1987 tax return.
---Tax Law Advisor---

1. What is client's filing status?
   A) Married filing jointly
   B) Head of household
   C) Single taxpayer
   D) Married filing separate
   Enter A, B, C, or D
   ** A

2. What is age of client?
   ** 37

   Age of client's spouse?
   ** 36

2. Exemption deductions
   Enter personal exemption?
   ** 3,800

   How many children?
   ** 2

   How many are married?
   ** NONE

   Amount of dependency exemption?
   ** 3,800

3. Income Subject to Tax
   Wages, salaries, bonuses, tips?
   ** 85,240

   Interest from savings?
   ** 752

   Interest from loans?
   ** 245

   Investment earnings?
   ** NONE

   Alimony payment?
   ** NONE

   Profits from sale of realty?
   ** YES

   Amount of profit?
   ** 1,673

   List expenses from sale?
   ** 488

   Pension, IRA, SEP, or Keogh?
   ** 4,925

   Rents and royalties from patents, copyrights, and property?
   ** NONE

   Taxable portion of Social Security Benefits?
   ** NONE

FUTURE DIRECTIONS

In the author's opinion, the outlook for the development of expert systems and other artificial intelligence applications is one of optimism. The capabilities for the use of the SAS System is extending to areas beyond typical data processing and computing requirements. End-users from the private, government, and academic areas are experimenting with novel SAS software applications that will be the forerunners of systems that will actually think and learn by doing. The SAS System is turning the corner into the 1990s, a decade of continued growth and wealth of application opportunities.

REFERENCES


