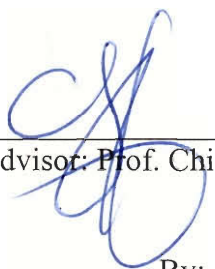# Medical Database Implementation

Sponsor: University of Massachusetts Memorial Medical Center

Liaisons: Jeffrey Paster and David Vogel

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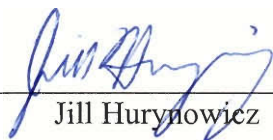Advisor: Prof. Chickery Kasouf

By:

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Sara Bullis

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Estelle Houde

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Jill Hurynowicz

Abstract

The University of Massachusetts Medical Center was changing their computer platform to a Windows-based application of the Eclipsys Corporation. This software package is called Decision Support Objects (DSO), and is primarily designed to display in graphical and tabular formats cost accounting information from their (TSI) cost accounting system. DSO was created so end users who were not familiar with the former mainframe could access and understand quickly the cost accounting information available through TSI.

The DSO package contained no documented material about usage and navigation. There was also no means of interpretation of the various graphs and tables, which is critical for those who have little to no cost accounting background. The purpose of this project was to create the necessary documentation to help users interpret output and provide paths for navigation in the DSO system. This was accomplished by the following:

1. Learning the DSO software: navigation, tricks, shortcuts, and the features that are not obvious

2. Receiving feedback about the pilot group's computer proficiency through the use of a pre-assessment questionnaire.

3. Creating a documented plan (DSO User Manual).

4. Executing the documented plan.

5. Engaging in feedback with the pilot group through training sessions

6. Revising the documented plan.

7. Executing the revision.

These methods will then be used to teach individual workers to set up their own customized DSO workstation.

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Acknowledgements

We would like to thank Jeffrey Paster and David Vogel as our liaisons at the University of Massachusetts Memorial Medical Center for all of their help throughout the production of this project. We would like to extend special thanks to David Vogel for all the time he volunteered towards the production of the manual. Lastly, we would like to recognize and thank our advisor Professor Chickery Kasouf for his help throughout the process.

Chapter 1: Introduction

Advanced information technology is helping the health care industry attain more cost efficient management. This technology will lower both administrative and clinical transaction costs. Currently, patient records are paper-based which can often lead to incorrect documentation of care given and a delay in the delivery of health care services. Computer based records and expert information systems alter this situation by providing a endless flow of easily accessible data. This technology limits the amount of contact necessary between different departments, as access to the system is provided to all who may need the information.

The University of Massachusetts Memorial Medical Center (UMMMC) is implementing a new decision support system that will help upper level employees interpret cost accounting data. This system is named Decision Support Objects (DSO), and is the new face of the former program, Transaction Systems Inc. (TSI). TSI was not user friendly, and the user interface made the program difficult to operate. UMMMC has opted to update to DSO to alleviate the problems employees have with TSI. DSO provides a friendly, Windows-based graphical user interface, and once learned it is simple to navigate through. However, the problem lies in the analysis of the data presented by the graphs provided by DSO.

The main problem posed by the introduction of DSO is the issue many employees have with computer proficiency. In general, there is a lack of knowledge among the staff about navigating through any Windows-based operation. Since DSO is Windows-based, our hope is to facilitate their successful use of DSO through a production of a simple user manual.

To develop this manual, we first learned the program ourselves. Our computer literacy is higher than average, therefore no problem was encountered in this learning process. Our

familiarity with Windows-based systems and Internet browsers provided us with the necessary background to navigate though DSO. The problem was located in the interpretation of the data represented on the graphs produced by DSO. Thus, we achieved a better understanding of cost accounting and budgetary concerns in order to infuse our knowledge into a user manual.

The company that produces DSO, Eclipsys, did not produce any documentation on how to navigate through the system, or on how to assess the graphs displayed in DSO. There is an extensive Help file, but it is not convenient for the average user. The user manual we produced is the result of information given to us as to the level of computer proficiency presented by the trainees.

The main goal of the user manual was to document how to navigate through the DSO applications, where and how to find what one wants, and how to troubleshoot. It also focused on the many different ways data can be viewed, and how to modify those views so they are worthy of presentation. Other subject matter presented within the document was the development of a report on the data, such as ad hoc reporting, sharing the data with other applications, and mock variance reports in MS Word.

In essence, the goal of our Interactive Qualifying Project (IQP), as with any, was to provide insight into how technology impacts societal structures and values. Our study at UMMMC was a quintessential case of such an impact, as working professionals had to integrate new technology into their jobs. They were forced to incorporate this technology into their daily routine, and they had to be informed on its use in order to effectively perform their jobs. We wanted to help the staff use DSO to its full potential, for that is what it is ideally designed. The following chapters will discuss how we incorporated information into a manual so UMMMC staff members would better understand this new technology.

Chapter 2: Background

Chapter 2 discusses three major issues within our project. The first is technology in the healthcare industry, which comprised a large portion of the project because of the impact a new software program had upon the hospital and its efficiency. Secondly, a discussion of adult learning is presented. The nature of this project required strong background knowledge of adult learning because the people trained were adults and it was vital to know how they thought and learned. Lastly, the topic of computer training is discussed with the key issues that affect its effectiveness. This last section was crucial due to the need for information on how to properly conduct computer training.

Section 2.1   Computers as Facilitators of Communication

As the healthcare industry maintains its status as the single largest industry in the United States, it strives to advance itself as technology grows, especially in the area of information technology. Computers can be seen as a means to establish communication between departments in healthcare organizations and also provide a way to store information and control costs. Communication in an institution such as a hospital can be seen as a key factor in the success or failure of the hospital. For success, a hospital must have a working system where members of different departments can not only exchange information readily, but also understand each other's work following implementation of an integrated medical information system (Aydin, 1989). Interdepartmental relations are especially important in more complex healthcare environments where most tasks are successfully done with the cooperation of several departments and healthcare professionals. Because the hospital is such a highly specialized

organization, the requirements for a successful coordination between people and departments is far greater than those of most other organizations or similar size (Aydin, 1989). Hospitals have long been trying to find a system to better ensure the precision of stored information. The most basic data systems found in the healthcare industry serve to provide a dictionary of health problems or display background information on patients. "More sophisticated systems, often referred to as "expert" or knowledge based systems can actively assist clinicians in the decision making process" (Legnini, 2000). With these new systems, clinicians are given assistance in determining the proper drug dosage, administering preventive services to patients at specific times, and diagnosing conditions.

Aydin (1989) presents a valid argument in this article stating that the actual impact of technology in healthcare institutions is not fixed, but depends on a number of factors such as the characteristics of the computer system itself, what the organization and its members do with the technology, and how the implementation process is managed.

The use of information technology in hospitals should fulfill a specific set objectives. The efficiency of information transfer within the community should be improved. Health information networks should provide for communication of patient information including clinical, demographic, and cost data. In a well-run program, all important patient data should be easily accessible from any point in the continuum of care (Leonard, 2000).

Both hospitals and clinics are comprised of many different interdependent departments. Aydin (1989) suggests that each of these departments can be viewed as its own "social world." Some departments may consist of employees all involved in one field of work such as a pharmacy. Other departments may be comprised of employees from several different occupations such as administrative workers, nurses, and physicians. Regardless of who makes

up a department, all departments are unique social worlds where individuals interact regularly, identify themselves as a distinctive group, and share a set of specific problems. Departments in a hospital truly are unique. Most even have there own vocabulary that sets them apart from others. Structural shifts, however, often accompany technological innovation. There is the new factor of isolation that comes into play as computer systems can decrease the number and frequency of interpersonal interactions needed. Workers can now access information through remote terminals. There are new integrating capabilities such as the newly shared information that can be accessed by more people.

Aydin (1989) offers several hypotheses:

- Hypothesis 1: "Individuals who are involved in the computer implementation process will interact more with other departments."

- Hypothesis 2: "Individuals who communicate with others about the system will interact more with other departments."

As individuals in different areas or departments access and share data from a common database, many aspects of communication should advance. These aspects include common terminology, quality control, and better allocation of tasks. By merely using the system, each department will gain expertise in the program itself as well as learn more about the interdependence between their own departments and others. Shared information is of especially great importance in medical environments.

- Hypothesis 3: "Individuals who use the computer system will interact more with other departments" (Aydin, 1989).

The implementation of a computer system often comes with unplanned changes in interaction between departments, roles, responsibilities, and distribution of tasks. System

managers can foresee many of these changes, however others are not so predictable. Workers have to adapt to new tasks and therefore create new work patterns. The implementation process is long and slow, and requires much more than the simple installation of computer systems. "The stumbling block is seldom the technology itself, but the people who use it, for whom change may not be easy" (Legnini, 2000). This idea goes along with Aydin's fourth hypothesis.

- Hypothesis 4: "Computer implementation will be accompanied by both planned and unplanned changes in departmental tasks and roles" (Aydin, 1989).

Aydin (1989) goes on to formulate Hypothesis 5, which deals with the idea that departments that experience task changes between departments will interact more with the other departments. People in specific occupations may experience role changes that often come with computer implementation. It is said that a measure of power in an occupation is the ability of the occupation to retain all of its tasks after the computer implementation (Aydin, 1989). This information provides knowledge of how computer systems create increased interdepartmental relations. In our project specifically, this information is pertinent because with DSO, directors of the hospital will be able to compare and contrast graphs and charts of all departments, which would have been an undoubtedly harder task prior to this program's implementation.

Section 2.2 Potential Benefits of I.T. in Healthcare Organizations

Aydin (1989) clearly shows how departments in a healthcare organization, specifically a hospital, can be affected by computer implementation. The manner in which information is exchanged changes dramatically in most cases. By and large there is greater administrative control over the whole healthcare organization.

It is the belief of many that better technology automatically means better care in the healthcare industry. Even though computer and Internet use has risen in the United States, computer information technology has not seen the enormous benefits that many would have expected. Costs have increased and quality problems have persisted (Alemi, 2000).

There is evidence that computer services can potentially reduce the costs of care. However, healthcare organizations have either unsuccessfully tried to make the necessary changes or they have tried and failed. Alemi (2000) states that management innovations make the difference between success and failure of new technology. With large amounts of available funds, technology can easily be bought, but it will most likely not be effectively used if management does not change its practices and it will most definitely not be used to its full potential if this is the case. It is said that money and time will be wasted unless management changes the nature of its business.

As care is increasingly being administered remotely, the quality of care may be apt to suffer. One example in which care has suffered is the basic case of the medical record. The coordination of care through medical records becomes increasingly important to the remoteness of care. Patient care can be substandard to several different circumstances surrounding the standard medical record. Records can be unavailable because they are being used by another provider, in transit, or even kept in another location. Computerized medical records can solve many of these problems. They can be used to improve care and eliminate the problem of incorrect documentations and long paper trails. Also, electronic records make data easier and quicker to access. This information shows how computer information systems could be potentially beneficial in the health care sector. More specifically, we know the potential benefits of DSO at UMMMC. It is important to note that these benefits can only be attained if the

program is used correctly and therefore our training manual needs to be properly administered and used.

Section 2.3 The Utilization of Technology to its Maximum Potential

It is evident that management innovations make or break technological advances at an institution such as a hospital. Healthcare systems must be organized and the relationship between clinicians and patients must be perfected. Technology should be bought to change clinical processes and not to just merely continue with existing practices.

Clinical decision support systems have started to emerge that have the potential to lower costs and improve patient healthcare. It is important to recognize that these technologies have been slow to be fully adopted. Some explanations state that the high complexity of the medical practice makes it harder for information technology to be implemented than for industries such as banking. In banking, the well being of a human is not at stake if a computer application goes wrong. Others believe that due to their age or mindset, the doctors themselves are reluctant to incorporate information technology into their work. Also, individual providers of care do not have great incentives to make the investment into information technology as no one else in the field has done so.

Basic data systems provide standard information on health problems to clinicians and can also display general background information on specific patients. Expert or knowledge based systems such as clinical decision support systems can more beneficially aid healthcare professionals in the actual decision making process (Wong, 2000). They can serve many specific functions including giving assistance with diagnosing a patient's condition, assisting in determining proper drug dosage, and reminding providers to administer preventative services to

patients at certain times. Also, assistance in carrying out procedures is also evident in clinical decision support systems. This includes specific treatment recommendations, reminders to perform particular procedures, alerts regarding potential adverse reactions, as well as feedback based on previous orders (Wong, 2000).

A clinical decision support system will work and save money and time if healthcare workers are willing to incorporate it into their routines. Time saving benefits can include computerized ordering of drugs and electronic lab results. The most important factor, however, is to integrate the system into the worker's work process, rather than be a separate entity that forces the clinician to break away from the normal daily routine.

Wong (2000) develops three pertinent lessons in her study:

"1. The widespread adoption of clinical information technology depends on having the right organizational and individual incentives.

2. Although clinical decision support systems and clinical information technology are powerful tools, they cannot redefine workflow or processes.

3. While the pace of implementing information technology systems in healthcare has lagged, many of the obstacles are diminishing." (Wong, 2000)

The healthcare industry in the United States employs 750,000 physicians in fifty-two hundred hospitals. In 1997, 1.1 trillion dollars worth of expenditures were made industry wide. This was a twenty-one percent increase from 1991. This high volume of expenditures has sparked employers, consumer groups, and the federal government to pressure the healthcare industry to find more cost efficient methods (Uncapher, 1999). Each year large amounts of funds are spent on such tasks as copying, faxing, and data entry. These administrative costs do not nearly come close to the high price of MRIs, CAT scans, and medicine. However, it is thought that administrative costs could be corrected by electronically storing high volumes of information. The Information Technology Association of America believes that an 18.1 billion

dollar industry-wide investment would yield a savings of over 120 billion dollars over a period of six years (Uncapher, 1999).

Advanced information technology could also provide other high tech benefits. This could include successfully providing physicians with the means to perform telemedicine or long distance consultations. Healthcare could become more readily available in generally under-serviced communities (Uncapher, 1999).

The benefits of information technology in the healthcare industry certainly appear to be plentiful. As some sources state, however, it is through the orderly and well-managed implementation of these systems that this technology can truly be appreciated and labeled as a success. This was true with DSO. A user manual can only go so far to promote success in an application. From this data we have learned that not only does a computer system need to be implemented, but it also needs to be managed well.

Section 2.4 Introduction to Learning

Many approaches to learning emphasize the different ways in which individuals perceive and process information. Research suggests that the amount an individual learns from an educational experience has to do with whether that experience is directed towards his/her particular learning style. Learning styles are the ways that individuals prefer to engage and process information in learning activities. Most people develop these learning styles based on their personality and past experiences (Sinnott, 1994). "The learning style theory is based on research demonstrating that, as the result of heredity, upbringing, and current environmental demands, different individuals have a tendency to both perceive and process information

differently" (On Purpose Associates, 1998). The different ways in which individuals may perceive and process information are as follows:

- Concrete perceivers absorb information through direct experience, by doing, acting, sensing and feeling. These learners prefer to process physical aspects of information through the senses.

- Abstract perceivers diffuse information through analysis, observation, and thinking. People of this type process information through reason and intuition that is usually not physically visible.

- Active processors make sense of an experience by immediately using the new information. These people learn by trying things out and working with others.

- Reflective processors make sense of an experience by reflecting on and thinking about it. For them, learning is achieved by thinking things through and working alone.

Active learners acquire information best by doing something physical with the information, while reflective learners do the processing in their heads. Learning and instructional styles are dependent on each other for achieving successful learning and comprehension on part of the student. Most educational experiences direct their teaching to abstract perceivers and reflective processors causing some individuals to be at a disadvantage. The teacher should shift approaches and experiment with instructional styles to incorporate all of the learners' styles. In order for instruction to connect with all learning styles the teacher should use alternating combinations of experience, reflection, conceptualizations and experimentation. A wide variety of experimental formats should also be incorporated, including sound, music, visuals, movement and experience as well as talking. Guidance, opportunity, and practice can help students acquire different learning styles and expand their potential for success in a variety of situations (On Purpose Associates, 1998).

"When learning, human beings can use three facilities: the mind, to consider ideas or cognitive material; the heart, the affective faculty, or feelings; and the muscles, in psychomotor

activities" (Vella, 1995). Effective learning uses all three of these aspects as often as possible. Included in these facilities is the fact that learning is more effective when it is an active, rather than a passive, process. People learn more when they are involved in the learning and doing what they are learning, rather than when they are merely listening to someone talk about it. Participation from learners is not only an indication that they are learning; it is how they learn. Most concepts are never really learned until one utilizes them (Vella, 1995).

The previous discussion addressed how to instruct a group of learners. Teaching must incorporate the learning styles of individual students while keeping the students active. The use of presentation software, simulations, models, and past experiences will do just that. To be most effective the teaching method should also encourage the students to gain new styles of learning so as to make them more well rounded.

Section 2.5 Adult Learning Theories

Because of the wide diversity among human beings, instructional settings, and fields of study, no general theory has been formulated that is applicable to all educational psychology. Instead, psychologists work on developing theories about particular phenomena in learning, motivational development, teaching, and instruction. Throughout time there have been many changes to assumptions made about adult learners. John Hilton Knowles (Galbraith, 1991) made four basic assumptions about adult learners:

1. Their self-concept moves from dependency to independency or self-directedness.

2. They accumulate a reservoir of experiences that can be used as a basis on which to build learning.

3. Their readiness to learn becomes increasingly associated with the developmental task of social roles.

4. Their time and curricular perspectives change from postponed to immediacy of application and form subject centeredness to performance centeredness.

Adult have a need for self-direction and integration of their life experiences into the learning process. People who take initiative in educational activities seem to learn more and better than those who remain what Knowles called "passive." "As organizations design and implement training programs for the adult learner, greater attention should be given to learning climates that foster self-direction and not dependency. When the dependency needs of adult learners are decreased, the goals of training will be more effectively met" (Sinnott, 1994). When the student learns on his or her own the information is better absorbed because that student is not just following what the teacher knows. People will believe more in knowledge they have discovered themselves than in knowledge presented by others. Adults can integrate information with experiences in ways that have greater personal meaning, making the learning experience more enjoyable. "Training has too often been dominated by technical concerns, with not enough consideration given to the broader aspect of a worker's values, motivation, and goals" (Sinnott, 1994). This is an explanation of why some thought to be well developed training programs fail.

Like Knowles, Carl Rogers (Sinnott, 1994) had his own view of adult education and developed his own set of hypotheses that could be applied:

1. We cannot teach another person directly: we can only facilitate his learning.

2. A person learns significantly only those things which he perceives as being involved in the maintenance of, or enhancement of, the structure of self.

3. Experience which, if assimilated, would involve a change in the organization of self tends to be resisted through denial or distortion of symbolization.

4. The structure and organization of self appear to become more rigid under threat; to relax its boundaries when completely free from threat. Experience which is perceived as inconsistent with the self can only be assimilated if the current organization of self is relaxed and expanded to include it.

5. The educational situation which most effectively promotes significant learning is one in which (a) threat to the self of the learner is reduced to a minimum, and (b) differentiated perception of the field is facilitated.

These hypotheses are thoroughly explained in Sections 2.6 and 2.7.

Lastly, Houle found that people generally participate in learning activities for goal-oriented, activity-oriented, or learning oriented reasons (Galbraith, 1991). These theories provide a means to comprehend the various methods utilized when educating adult learners.

This section provided a background as to where thoughts into adult learning originated. It described the need for adult learners to incorporate previous life experiences into the learning process. It also emphasized that students who are actively in control of their learning retain more than those who are not. These ideas will be discussed more in detail in Sections 2.6-2.7.

Section 2.6 Adult Variability

Teachers of adults, as well as program planners and educational administrators, are more concerned with the majority of adult learners who are the average learners than those adults who are above or below that point. "The goal is to arrive at a realistic balance between recognition of individual idiosyncratic characteristics and identification of those normative characteristics that allow us to consider adult learners as a group" (Galbraith, 1990). In order for learning to be effective the learner must be motivated, and in order for an adult learner to be motivated there must be some anticipated benefit.

An adult's focus on learning is most often based on some external circumstance or some social condition to which the individual responds. They are motivated by internal incentives and curiosity, rather than external rewards. They are also motivated by the usefulness of the material

to be learned and learn better when material is related to their own needs and interests. Other sources of motivation are becoming a better informed person, preparing for a new job or occupation, becoming better qualified for the job currently held, spending spare time more enjoyably, meeting new and interesting people, better carrying out everyday tasks and household duties, and getting away from a daily routine. These motives for education differ according to age and sex. Younger to middle-aged adult motivation is mostly job oriented, they strive to learn in order to get a better job or to move up the executive ladder, while older, retired, adults are motivated by self-fulfillment. Young and middle-aged learners also have generally higher self-confidence and goal-directedness than older adults. Both males and females are similar in that they are both motivated by their family needs. Most females are less motivated than males because once they reach a point where they are happy with their lives they prefer to stay there and be able to be with their family. On the other hand, most males will strive to continue rising up the ladder for the betterment of the family economically (Sadler-Smith, 2000; Galbraith, 1990).

Section 2.6.1 Physiological Issues

In addition to motivation there are several physiological variables that affect learning in aging adults. It can be assumed that most of the adult individuals in a learning situation will have some kind of vision problem. In most cases, these problems have been corrected, although there are those individuals whose prescription is out of date, who resist trying bifocals, or are having difficulty adjusting (Galbraith, 1990).

Hearing loss is another problem suffered by adults, although less noticeable. Unlike vision correction, hearing loss is a more costly problem to fix and many adults will not consider

a hearing aid if given the opportunity. "The difficulties for learning posed by diminished auditory ability may be more significant than changes in eyesight. This is true, first, because hearing problems are seldom corrected; second, because the learner may not be fully conscious of the problem; third, because others in the group may ignore the possibility; and fourth, because so much instruction is based on auditory methods" (Galbraith, 1990). It is noted that older learners expressed greater concern about the effects of reduced hearing ability than they did about problems with vision (Galbraith, 1990, 1991).

Age, health and the amount of energy available to learn are problems presented by many adult learners. The learner's attention levels diminish as fatigue increases. This condition is worsened by teacher insensitivity to the reality of diminished energy and may cause the adult learner to physically withdraw from the learning situation. As aging progresses, memory deteriorates. Problems with memory in adults occur when they are faced with meaningless learning, learning that involves reassessment of old knowledge, and pure memorization. Also, in the older years, reintegration must be emphasized because these learners tend to be more passive and less flexible. Therefore, adults appreciate any teaching devices that add interest and a sense of liveliness, variety of method, audiovisual aids, a change of pace or a sense of humor to the learning process. Lastly, health is a significant variable in the education of adults. Pain can have an adverse effect in the amount of energy one possesses and can also affect the amount of attention that person puts toward the subject at hand. Medication taken before class can significantly affect awareness (Galbraith, 1990, 1991).

Section 2.6.2 Psychosocial Variables

"A number of significant psychosocial variables are important when we seek to understand adult learners: cognitive characteristics, personality characteristics, experiential characteristics, and role characteristics" (Galbraith, 1990). It has been established that people with different outlooks define identical situations differently. The way a person interprets and perceives is associated with their existing beliefs and value systems. Personality structure may determine, to some extent, what is learned. Experience is a significant consideration in adult learning. A rich learning environment can be developed in which past experiences can be reflected upon new learning activities. Adults organize their experiences differently; they can be applied to situations outside as well as within the classroom. Role transitions among adults tend to limit learning activities only to work-related content or skill. "Obligations of parent or worker take precedence over learner/student role obligations" (Galbraith, 1990). Therefore, the learner/student role is a low priority when assumed by adults.

"Each learner who enters an educational encounter has experienced different marker events, transitions, roles, and crises. Such experiences provide a fertile opportunity for reappraisal and exploration of ideas and actions" (Galbraith, 1991). Adults come to a new learning situation with a sense of themselves, which has been shaped by their cumulative life experiences. These include self-concepts and self-esteem, past successes and failures as learners, attitudes and values, potential assets and possible liabilities, and directly or indirectly related experiences and skills. Adult learners are more realistic and have insights about what is more likely to work and what is not. They are more readily able to relate new facts to past experiences. Adults enjoy having their talents and information made use of in a teaching situation. They bring their own experiences and knowledge into the classroom, which they like

to use as a resource for learning, which in effect gives them practical learning activities to build on and use their prior skills and knowledge.

Section 2.6.3 Personal Needs and The Learning Process

The personal needs of an adult learner may range from an internal desire to accomplish something for oneself or to meet some external requirement, such as job demand, as quickly as possible. Adults have needs that are concrete and immediate. They tend to be impatient with long dissertations on theory and like to see theory applied to practical problems. They are task or problem-centered rather than subject-centered. This does not mean they are not interested in theory, but they need to also see the practical applications of the theory. Their learning is not complete until it is expressed in appropriate action. Adults are less tolerant of 'busy work' that does not have immediate and direct application to their objectives. If they do not see the relevance of content, no matter how crucial that content may appear to the teacher, the learners quickly determine that they do not need to know it (Galbraith, 1991; Weinstein, 2000).

Gender has been a source of study as to the differences in adult learners. It is suggested that males and females differ in the way information is processed. Males are seen to process information faster than females but at a more superficial level. It is also argued that males do best when their cognitive style suits the demands of the task while females do not, particularly in situations where processing time is limited. Lastly females are believed to be more analytical than their male counterparts (Sadler-Smith, 2000). From this, an understanding of the various psychological and physiological differences of adult learners can be used to maximize the learning potential.

The previous statements emphasize that the kind of information presented and the way it is presented will have an effect on how much is retained. All of the physical and psychosocial variables must be taken into account when planning training. It is important that the students are continually motivated. Chunking or putting together information that fits in the same category allows the learner to increase his or her memory capacity. Lessons should be flexible in order to incorporate the needs of the adult learner.

Section 2.7 Ideal Learning Conditions

Adults posses diverse levels of education, experience and expectations, and when given the opportunity most adults prefer to be in charge of their own learning. "Self-direction in learning appears more in tune with our natural process of psychological development" (Galbraith, 1991). Self-direction allows the adult learner to absorb the material being taught at their own pace allowing for a better understanding and a feeling of self-satisfaction.

The context or climate in which the learning takes place has a definite effect upon the learner and the facilitator. Mager has identified five universal positives and negatives which could provide valuable insights regarding learning climate. These universals are: physical comfort or discomfort, security or fear of anxiety, success or frustration, self-respect or humiliation and embarrassment, and involvement or boredom. Material must be organized carefully; new concepts must be presented in a logical, sequential manner so that they're easy for learners to store and retrieve; ideas need to be kept simple; and new material must be presented clearly and in short segments to keep learners' attention. A relaxed atmosphere allows adult learners to feel they are in control and to be obliged to ask questions, request clarification and to risk making mistakes. Adult learning is a challenging and creative activity that demands the

facilitators and learners constantly reexamine their educational purposes, processes, values, needs, and desires in relationship to potential self-growth as well as to the enhancement of society (Galbraith, 1991; Weinstein, 2000).

This information can be applied to the learning environment in order to gain the most success from a training session. The students must be given the opportunity to direct their own learning. The information must also be presented in such a way as to keep the adult learner motivated while keeping the amount of frustration low. It is also important that as many positive universals are achieved as possible so that the learner can feel free to ask questions and enhance oneself through self-growth.

Section 2.8 Characteristics of Adult Learners During Computer Training

The emphasis of modern adult learning is placed on training in computer usage. For the past two decades children have been educated to use computers as commonly as they are taught the multiplication tables. The time has come for older generations to draw level with respect to computer literacy. Technology has advanced to the point where many jobs require daily computer use. In order to keep up with these advances, efforts must be made to improve adult computer literacy.

The difference between teaching children to use a computer and training adults lies in their respective backgrounds. Children do not bring much to a training session other than a mind that can be easily taught new ideas; adults bring much more. After a lifetime of different experiences, adults have great variances in their backgrounds and interests. The diversity that adults bring to a training session threatens the instructor's teaching capacities and technical abilities (Grupe, 1995).

There is a considerable amount of knowledge brought to a training session by adults. Their many experiences at work, home, and within society enable them to integrate what is being taught into a broader perspective. Life experiences provide a foundation on which to implement new ideas. Therefore, using analogies is an effective teaching mechanism to introduce and explain new ideas (Brookfield, 1986).

It is important to consider why an adult would pursue computer training. Most likely they are seeking career advancement, and have developed important business and personal skills that children lack. Thus, when training adults in computer usage it is important to remember that they are adults, and they have come to expect a degree of respect and deferential treatment (Grupe, 1995). In an organization, it is important to place a training session in a professional atmosphere where improving one's job skills seems like the goal rather than learning. For trainees to have a positive outlook on the training situation, all levels in the hierarchy should be present. If computer use is associated with those who perform menial tasks, its importance becomes futile. There must be a potential reward for those who participate in computer training sessions. Promotions, merit pay, and job descriptions are all items that should have some base in computer training (Grupe, 1995).

Diversity among the training session population can be positive because of the democracy it achieves; however it also has a negative impact. Ego can lead to a troubled situation when supervisors feel awkward training with subordinates, and the subordinates are intimidated to train with their supervisors (Brookfield, 1986). For this reason, it can be beneficial to tailor training sessions to specific groups of workers. The choice of mixing, or not mixing, training sessions is a decision that needs to be made by each individual organization.

Another fact to take into consideration when designing computer training is the importance adults place on their time. Professionals are time-managers who like to make the most of their time. Thus, training should be direct and thorough, and no time should be wasted on extraneous matters. Training needs to begin and end on time and, if a group is large, assistants can be brought in to alleviate any user problems quickly (Grupe, 1995).

It is also important to remember that training session participants are peers, and that they are critical learners. They will know whether or not a training session is beneficial and if it is serving their purposes. A trainer should avoid acting superior, as a session works best if the trainer works as a facilitator of learning (Brookfield, 1986). The best way to facilitate learning is to provide as much hands-on training as possible.

Information on the characteristics of adults in computer training was quite pertinent to our project because it provided suggestions about what to anticipate from the trainees. It was a way to gain an advantage and to be prepared for any difficulties that may arise during computer training.

Section 2.9 Effect of Mood on Computer Training

Another important aspect to take into consideration during computer training is the trainee's mood. Mood has a great effect on people's motivations and intentions toward computer training (Venkatesh, 1999). Large amounts of research have been conducted on motivation, and there are two broad categories—intrinsic and extrinsic. According to Venkatesh (1999), "Intrinsic motivation refers to the pleasure and inherent satisfaction derived from a specific activity, while extrinsic motivation emphasizes performing a behavior because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity such as increased

pay and improved job performance." These combined motivations influence a trainee's inclination to follow the training and their actual performance in the training session (Venkatesh, 1999). The potential bonuses that come with learning a new skill, such as increased pay and promotions, are the extrinsic motivators that drive trainees to further their computer literacy. There is also the motivation caused by the enjoyment many people have when using a computer effectively.

Motivation is dependent on mood, thus when a trainee is in a negative mood, motivation lacks. A lack in motivation results in decreased productivity in a training session. For this reason, an instructor will have the best results when working with trainees who have a positive mood. Boredom is another mood that can have a negative effect during a training session. Generally, the physical environment of the training room causes boredom.

Being aware of the impact a trainee's mood has on the overall effectiveness of the training is essential because it is a forewarning of what to expect from people with different moods. We tried to attain a general good mood amongst the trainees for maximum training effectiveness.

Section 2.10 Effect of the Physical Environment on Computer Training

There are some items to take into consideration in order to alleviate this boredom. These include: poor lighting, uncomfortable temperatures, noise, and furniture arrangement. Furniture needs to be arranged so everyone can see the trainer. Often, the computer monitor is too large to see over and trainees cannot see the trainer. Trainees then have a live computer desktop distract them from what they are there to learn (McDermott, 1998). The solution to this distraction is to give control of individual computers to the trainer via a local access network. The instructor's

screen, mouse movements and keystrokes can be broadcast to each individual workstation while the trainer is demonstrating, and then control can be returned to the trainees for hands-on practice (McDermott, 1998).

Poor room design also causes interference of view. Redesigning the room into a format where trainees are placed in a semicircle around a conference table with the trainer at the head of the table is optimal for demonstrations. Then the trainees can turn around and use their own workstations to practice. This set-up is best because trainees are focused on the trainer and they have little chance to be distracted by their own computer.

It was useful to know how room design and setup effects computer training. However, we did not get to make any sort of changes to the training area, as the goal of this project was to develop a user manual, not to recommend an overall training scheme. Thus, the training area was inspected for any possible negative impacts on the training session, and that was taken into consideration during our assessment of the training process.

Section 2.11 Effect of the Computer Interface on Computer Training

Trainees who are lost in the user interface create a distraction for themselves by having to continually find their way to where to trainer is in a program. The graphical user interface (GUI) is the connection between a user and the computer. There are three major types of GUIs— command-based, such as disk operating systems (DOS), direct manipulation interfaces (DMI), as seen in Windows and the desktop set-up, and menu-based interfaces which have users select commands from lists or menus (Davis, 1993). This IQP, and almost every organization, deals with a DMI, thus the other interfaces can be neglected.

DMIs provide direct representations of appropriate assembled contexts. This interface has the advantage of reducing the need for interpretation of input and output, thus computer training can use this interface to focus on other important topics besides visualization. A DMI also has the advantage of reducing the amount of time necessary to reverse errors or operations, so trainees are encouraged to explore the system and learn without the fear of causing an irreversible error.

Davis (1993) suggests that, "synergistic relationships exist between an interface and training method." DMIs promote the exploration form of training, where a trainee can point and click on icons and buttons and see what happens. Instruction-based training can also be utilized with a DMI because it encourages a deductive learning mechanism. This type of reasoning process is also associated with a highly programmed and planned out instruction manual with low learner control, and it focuses on the features of a program. Trainees prefer exploration learning because they have control, and they can learn by trial and error. This method focuses on tasks within a program and usually incomplete learning materials are provided.

Knowing how the computer interface affects computer training was key. The interface was where the trainee interacted with the computer, and for that reason it could have been one of the biggest obstacles during computer training. In order to learn DSO and use it effectively, a trainee must first be knowledgeable on how to navigate in Windows and on how to access DSO.

Section 2.12 Computer Training Models

Many sources suggested allowing plenty of time for trial and error practicing. A training model developed by Krissoff (1998) suggested four parts: the operating system, hardware basics and troubleshooting, software basics and troubleshooting, and search concepts and techniques.

For our purposes, a general introduction to the operating system was needed in order to access the program, followed by plenty of information about navigation and interpretation of the program. It was important to establish clear objectives for the manual, and it was also essential to take into account the diversity of trainees' learning styles and perceptual strengths (Krissoff, 1998). The manual needed to be practical, and it also necessitated a conceptual framework so trainees can improve their abilities to draw logical conclusions about emerging technologies (Krissoff, 1998). These suggestions were taken into consideration during the construction of the training manual, as they were certain to improve the quality of the training session. The user manual was as clear as possible with many visualizations of what the trainee will encounter.

Chapter 3: Methodology

The first phase of this project, contained in Chapter 2, involved gaining background knowledge of the various aspects of adult learning, computer training and the impact of technology on health care. This information was then applied directly to the development of the manual. The next step consisted of the development of a pre-assessment questionnaire, during Week 2 of B-term, which provided information on the various computer literacy levels throughout the staff of the departments in training. We then developed a user manual during Weeks 3-7 of B-term and Weeks 1-3 of C-term, after several drafts. This manual provided instruction on navigation as well as graphical interpretations of the cost accounting data.

Our pre-assessment questionnaire, developed in conjunction with our UMMMC liaisons, contained questions that tested the trainees' computer proficiency and their familiarity with cost accounting data and graphs. Questions 1 through 5 were designed to show the trainees' proficiency with computers and the regular operations performed on a computer. Questions 2 and 3 distinguish using Microsoft Windows at home and work to show if the trainees have any other source of computer usage other than work, where they are essentially required to use computers. Trainees who use computers at home in their recreational time are assumed to be more proficient and comfortable with them.

Question 6 was created to show how familiar the trainees were with the task of copying and pasting into Microsoft Word, which is a frequently performed operation in DSO. Questions 7, 8, and 11 were designed to reveal the trainees' capability with cost accounting data and the graphical and report formats of that data. Question 9 was intended to show if any of the trainees were resistant to the change from TSI to DSO, and if so the training should provide time for the

trainees to adjust to DSO. Question 10 was formulated to show whether or not the trainees had

any knowledge of how to access DSO, and if they did not, it would provide a means to assess the

manual's instructions on accessing DSO.

1. I am comfortable with computers.	1	2	3	4	5
2. I use Microsoft Windows often at work.	1	2	3	4	5
3. I use Microsoft Windows often at home.	1	2	3	4	5
4. I browse the Internet often.	1	2	3	4	5
5. I use Microsoft word often.	1	2	3	4	5
6. I know how to cut and paste items from one Microsoft Windows application to another	1	2	3	4	5
7. I am familiar with fiscal and accounting terms (e.g. Flex Budget, Variable Cost, Fixed Cost, Indirect Cost, Variable labor).	1	2	3	4	5
8. I am comfortable using graphical representations of data to understand data better.	1	2	3	4	5
9. I am comfortable incorporating DSO into my regular work routine.	1	2	3	4	5
10. I am familiar with accessing DSO through the Windows start menu..	1	2	3	4	5
11. I am familiar with how to write and interpret departmental variance reports.	1	2	3	4	5

Figure 3.1 The pre-assessment questionnaire given out to the trainees at their first training session.
1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

We developed a pre-assessment questionnaire to be used as a mechanism to develop

specialized training groups. The assessment would provide insight into the various levels of

computer proficiency presented by the trainees, allowing us to decide what the base level of the

user manual should be. The pre-assessment was administered to groups of UMMMC staff shortly before their training began. Ideally, the trainer would disperse the pre-assessment questionnaires in advance of the first training session so groups can be prepared ahead of time. The groups can be formed in two ways: by pairing the people who are skilled in computers with those who are lacking the ability; or by grouping trainees according to their computer proficiency. The idea behind the pairing system is that a person skilled in computers would be able to learn DSO quickly and could hasten the inexperienced person's learning of DSO. Constructing large groups of people at the same level of computer proficiency may also work well because boredom will be minimized along with level frustrated because the groups will be taught at a pace equivalent to their computer ability.

Prior to training we collected input from David Vogel as to what would be effective in the manual and what could be changed in order to make it clearer and easier to understand. This information was used to modify the user manual throughout the training process. The effectiveness of our user manual could be tested in two different ways: the first way is through the observation of the trainees' progress in sessions; the second method involves the usage of a post-assessment questionnaire, which could be developed in the future, to interpret whether or not the trainees can perform tasks they were unable to perform before training. The post-assessment could be conducted with groups of UMMMC staff after their DSO training to discern the effectiveness of the instruction. Unfortunately, due to the time constraints of this IQP, the manual's effectiveness could not be assessed since the trainees had only undergone one session of training. Thus, we leave our suggestions of assessment, the pre- and post-training questionnaires, to UMMMC if they should ever choose to do so.

Chapter 4: Integration

During the development of the manual (see Appendix A), it was important to include the information presented in Chapter 2. The reasoning behind this lies in the nature of the project. We are students at WPI with no formal training in user manual development. Thus, we had to learn, from many sources, all the valuable points that needed to be taken into consideration. Chapter 4 discusses how we took that information and incorporated it into the manual.

Section 4.1 Key Issues of Adult Learning

In order to develop a user manual for adults it was important to use the adult learning information presented in Chapter 2. The manual was developed to accommodate all the different learning styles, specifically the concrete and the abstract perceiver, by presenting numerous pictures, boldfaced writing, and a margin on the side for one to write notes. By using this method no individual is at a disadvantage. The manual also incorporated all three facilities used by humans when learning (Vella, 1995). It allowed the <u>mind</u> to consider ideas or cognitive material through the use of bold type, underlined words, and pictures. The facility of the <u>heart</u> or feelings considered in the development of separate modules to allow one to take in the material a little at a time keeping one's confidence up and frustration low. The last facility of the <u>muscles</u>, in psychomotor activities was heeded by the development of a notes section on every page.

As described in Chapter 2, John Hilton Knowles (Galbraith, 1991) made four basic assumptions about adult learner, two of these assumptions were used in the development of the manual. They allow for one's self-concept to move from dependency to independency or self-directness. A person that is dependent on structure will find much help through the step-by-step modules and the glossary. For those who have a need for self-directness, the manual has a

simple format so that one may jump into a section of the manual in which one is having difficulty and figure out that part of the program on one's own. This allows for better learning because, as noted in Chapter 2, people will believe more in knowledge they have discovered themselves than in knowledge presented by others. The introduction to the manual tells the learner the significance of the program to his/her work. This encourages one to see that the program can be used in the enhancement of one's job.

The addition of the introduction page in the manual also helps the learner to see how it will benefit him/her, for a learner must be given some anticipated benefit in order to be motivated (Sadler-Smith, 2000). They are motivated by the usefulness of the material to be learned and learn better when material is related to their own needs and interests.

The manual also accounted for the physiological issues that may be presented by a learner (Galbraith, 1990). Vision problems were taken into consideration with the use of a larger print and many pictures. For the older learners, the modules allowed for a slow and steady pace to keep the amount of fatigue to a minimum and to maximize the amount of information retained. The manual itself allowed for reintegration of material that may have been forgotten and for some flexibility in doing so.

The manual was specifically created for the personal needs of an adult learner who has an internal desire to accomplish something for themselves or to meet some job requirement as quickly as possible. Because adult learners tend to be impatient with subject-centered material, the manual was set up to be strictly task and problem-centered. To keep anxiety, frustration and boredom to a minimum, the material was organized carefully; the new concepts were presented in a logical, sequential manner so that they were easy for the learners to store and retrieve. The new material was presented clearly and in short segments in order to keep the learners' attention.

Section 4.2 Key Issues of Computer Training

Module 1 was designed to be as simple as possible, with many pictures and basic directions in order to ease the reader into the format of the manual. Due to the variances amongst individuals, Module 1 presented the concepts of logging into DSO, changing passwords, and accessing the home screen in a general manner that can be understood by all. This manner included the screenshots of the entire computer screen that the user would encounter, as well as detailed instructions on how to perform each operation. We decided to avoid analogies as a mechanism to introduce new concepts because we did not want to confuse the reader. Analogies are better suited for verbal communication. The format of the manual was designed to be as professional as possible, since the readers are skilled individuals in a business-like atmosphere. This is seen in the use of a column for notes, as well as clear headings and directions to make reading simple.

Directness and thoroughness are two ideas that needed to be incorporated into the manual. The manual necessitated directness since the concepts involved need to be presented as simply as possible, however thoroughness was shown in the presentation of both a picture and written directions of all the concepts. The manual was also designed to be used as a guide to hands-on training, which is the most effective method of computer training. This design was seen in the step-by-step directions and pictures of the screens a trainee would encounter while performing a given operation.

Chapter 2 also presented the issue of mood, and how it affects a person's motivation. With this information in mind, we created the manual with divisions, so that a trainee would not become frustrated with too much information at once. We felt that this would alleviate any issues of mood because it would be easier to accomplish one module at a time rather than a

whole manual. It was also hoped that trainees would become motivated to continue on with later modules as they became proficient with the operations contained in the beginning modules.

The physical environment can also affect the success of computer training, however this cannot be controlled through manual development. Thus, it is suggested that trainers and trainees refer to Section 2.10 for information on the ideal physical environment to conduct a training session in.

When we designed the manual, we eliminated the problems caused by the GUI (Graphical User Interface) by providing full screenshots of the screen that the user would encounter during a given function. We also cropped the screenshots where necessary to show a single window or menu that was being discussed so the user could not be confused by any extraneous material in the picture.

Section 2.12 discussed training models that we could follow for our manual. For our purposes, a general introduction to accessing the program was needed, followed by plenty of information about navigation and interpretation of the program. It was important to establish clear objectives for the manual, and it was also essential to take into account the diversity of trainees' learning styles and perceptual strengths. The manual needed to be practical, and it also necessitated a conceptual framework so trainees can improve their abilities to draw logical conclusions about emerging technologies (Krissoff, 1998). These suggestions were taken into consideration during the construction of the training manual, as they were certain to improve the quality of the user manual.

Section 4.3 Module 1

Clarity and simplicity were the two main ideas used to design Module 1. Since this is the introductory module, it needed to be as simple and clear as possible so readers could understand it. Module 1 presents the issues of accessing DSO from the Start menu on the desktop, as well as logging into DSO, changing passwords, and accessing the Home screen. These are the first procedures that must be done in order to work in DSO, thus it makes sense for these items to be presented first in the manual. Module 1 also associates the reader with the toolbar, since it is useful and basic within the program.

Section 4.4 Module 2

The menus and toolbars of DSO are presented in Module 2, as the objectives of that module are to familiarize the reader with the drop-down menus and the toolbar icons. Module 2 breaks down each drop-down menu and describes the functions that can be performed under each menu. Cropped screenshots of each menu are shown with the options available under each. This makes is simple for the reader to see that they are in the correct menu for the given operation they wish to perform. Within the descriptions of the options in the menus, the shortcut toolbar icons are shown if there are any available for that option. We felt that the shortcut icons should be incorporated under the menu descriptions so the readers could learn the easier ways to perform functions. If a given function results in a special screen or window to appear, we incorporated screenshots of those images into Module 2.

Section 4.5 Module 3

The objectives of Module 3 were to present the steps involved in accessing departmental data in both tabular and graphical format, as well as to show the reader how to maneuver within the organizational structure. Detailed directions tell the reader exactly where to click, and screenshots show the reader what will happen when they click on a given item. The concept of the organizational structure is presented with instructions on how to "drill down" within the structure to reach a more specific set of graphs, and how to "drill up" from those graphs.

Section 4.6 Module 4

The goals of Module 4 are for the reader to have a better understanding of what the different kinds of variances are and what they mean to the graphs and reports, and for the reader to understand how the use narrative reporting. The various kinds of variances are broken down into different categories so the reader can absorb chunks of related material rather than large quantities of confusing information.

Chapter 5: Conclusions

Section 5.1 Impact on UMass Medical Center

As mentioned in Section 2.1, the impact of technology in a healthcare institution is not fixed, but depends on several factors. For an information system such as DSO to meet expectations, these factors must be acknowledged and effectively dealt with. The first factor is a measurement of the performance of the system itself. The best management innovations cannot take the place of inadequate technology if the application is lacking in that area. This was not the case with the DSO package. After having reviewed the program it was evident to us that there were more merits than flaws and it was established that the software was of high quality and usefulness. Information in DSO is effectively gathered from different systems throughout the organization and made easily accessible to the user. DSO also provides several different views of data relationships to a large number of users. The information is very accurate and can be seen at the finest level of detail. DSO takes the traditional concept of an information system such as a basic data system that would serve to provide a dictionary of health problems or display background information on patients and turns it into a system that could truly aid the decision making process. This expert system allows for progress and outcomes to be continuously monitored at UMMMC.

It is therefore evident that the tools for success are available and it is now up to the UMMMC staff to grasp the technology and maximize its potential. This goes along with the second and third factors mentioned in Section 2.1 which convey the idea that the impact of technology in healthcare institutions is ultimately determined by what the organization and its members do with the technology and how the implementation process is managed.

Our contribution to this impact was our integration of the principles of adult learning and computer training into the development of a manual that facilitates the incorporation of technology into the daily routines of the UMMMC staff. The staff would not receive the benefits of this technology if they could not understand it. Thus, our manual facilitates their learning of this technology so they have a clear understanding of its value. After that is achieved, the next most important factor is to integrate the system into the staff's work process, rather than allow it to remain as a separate entity that forces the user to break away from their normal daily routine. Key decision makers at UMMMC must now be ready to evaluate this information and be able to implement changes that will translate into a cost savings for the institution.

Section 5.2 Future Use of the Questionnaire

As stated in Chapter 3, a questionnaire was formed in order to assess the users' general computer literacy, as well as their proficiency with cost-accounting data. Unfortunately, due to time constraints and the small number of people involved in the pilot group, the results of the questionnaire, which were originally intended to provide insight into the trainees ability, could not be used in the initial production of the user manual. It is our sincere hope that the questionnaire is ultimately administered to a substantial training group and that the results can then be used to serve as guidelines that should be taken into consideration when revisions of the manual are made. The manual should be tailored to the user's needs and learning ability and be used as not only a training manual but as an every day reference guide as well.

Section 5.3 Link to Objectives of the IQP

The general idea behind an Interactive Qualifying Project is the manifestation of a link between technology and society. The implementation of the Decision Support Object software program will have a large impact on UMass Medical Center as an institution, but will also have a large impact on the employees of UMass Medical Center as individuals. Their daily routines and work processes will undoubtedly change as a result of this program. The user manual that we produced can be seen as one of the first steps and mechanisms of change. It will aid them as they begin to adjust to accessing information in a new way and learning how to evaluate this information. No longer will paper documents be the norm, and for people who have been dealing with them exclusively for many years this will in fact be a major change. Users will have to be able to not only understand what the graphical and tabular information means, but also have to be able to make crucial decisions based on how they interpret the data. These decisions could potentially play significant roles in the financial status of the hospital, as they are involved with major budgetary concerns.

Bibliography

Alemi, Farrokh. "Management Matters: Technology Succeeds When Management Innovates." *Frontiers of Health Services Management*, (Fall 2000).

Aydin, Carolyn E. "Occupational Adaptation to Computerized Medical Information Systems." *Journal of Health and Social Behavior*, Vol. 30, No. 2. (1989), pp. 163-179.

Bailey, T.C. "Information and Decision Support Systems in the National Health Service." *Statistician*, Vol. 34, No. 1, Statistics in Health. (1985), pp. 107-124.

Brookfield, Stephen D. *Understanding and Facilitating Adult Learning*. Jossey-Bass Publishers, 1986.

Caudron, Shari. "Building Better Bosses." Workforce 79, no.5 (May 2000), 32-39.

Davis S.A., R.P. Bostrom. "Training end users: an experimental investigation of the roles of the computer interface and training methods", *MIS quarterly*, 17, 61-86, (1993).

Galbraith, Michael W. *Adult Learning Methods*. Malabar: Robert E. Krieger Publishing Company, 1990.

Galbraith, Michael W. *Facilitating Adult Learning, A Transactional Process.* Malabar: Kreiger Publishing Company, 1991.

Grupe F.H., F.W. Connolly. "Grown-ups are different: computer training for adult Learners", *Journal of Systems Management*, 46, 58-64, (1995).

Krissoff A., L. Konrad. "Computer training for staff and patrons: a comprehensive academic model", Computers in libraries, 18, 28-32, (1998).

Leonard, Kevin J. Kevin Mercer. "A framework for information systems evaluation: the case of an integrated community-based health services delivery system.*" Leadership in Health Services*, 13, 2000.

Legnini, Mark. "The diffusion of Decision Support Systems Healthcare: Are we there yet?", *Journal of Healthcare Management*, 45, p.240, (July 2000).

McDermott I.E. "Solitaire confinement: the impact of the physical environment on computer training", Computers in libraries, 18, 22-27, (1998).

On Purpose Associates. "How Do People Learn?" *About Learning/Theories.* 1998.

http://www.funderstanding.com/learning_theory_how6.html (September, 2000).

Sadler-Smith E., De la, C.W. Allinson, and J. Hayes. "Learning Preferences and Cognitive Style: Some Implications for Continuing Professional Development." *Management Learning* 31, 239-256, (Jun 2000).

Sinnot, Jan D. *Interdisciplinary Handbook of Adult Lifespan Learning.* Westport: Greenwood Press, 1994.

Uncapher, Mark. "The Information Technology Healthcare Challenge." *Information Impacts Magazine.* Nov 99. (http://www.cisp.org/imp/november_99/11_99uncapher-insight.htm)

Vella, Jane. *Training Through Dialogue. Promoting Effective Learning and Change with Adults.* San Francisco: Jossey-Bass Publishers, 1995.

Venkatesh V., C. Speier, "Computer technology training in the workplace: a longitudinal investigation of the effect of mood", *Organizational behavior and human decision processes*, 79, 1-28, (1999).

Weistein, Margot B. "Thirty-Three World Class Competencies." Training and Development 54, no. 5 (May 2000), 20-23.

Wong, Holly J. "The Diffusion of Decision Support Systems in Healthcare: Are We There Yet?" *Journal of Healthcare Management.* (July/Aug 2000).

Decision Support Objects

Appendix A
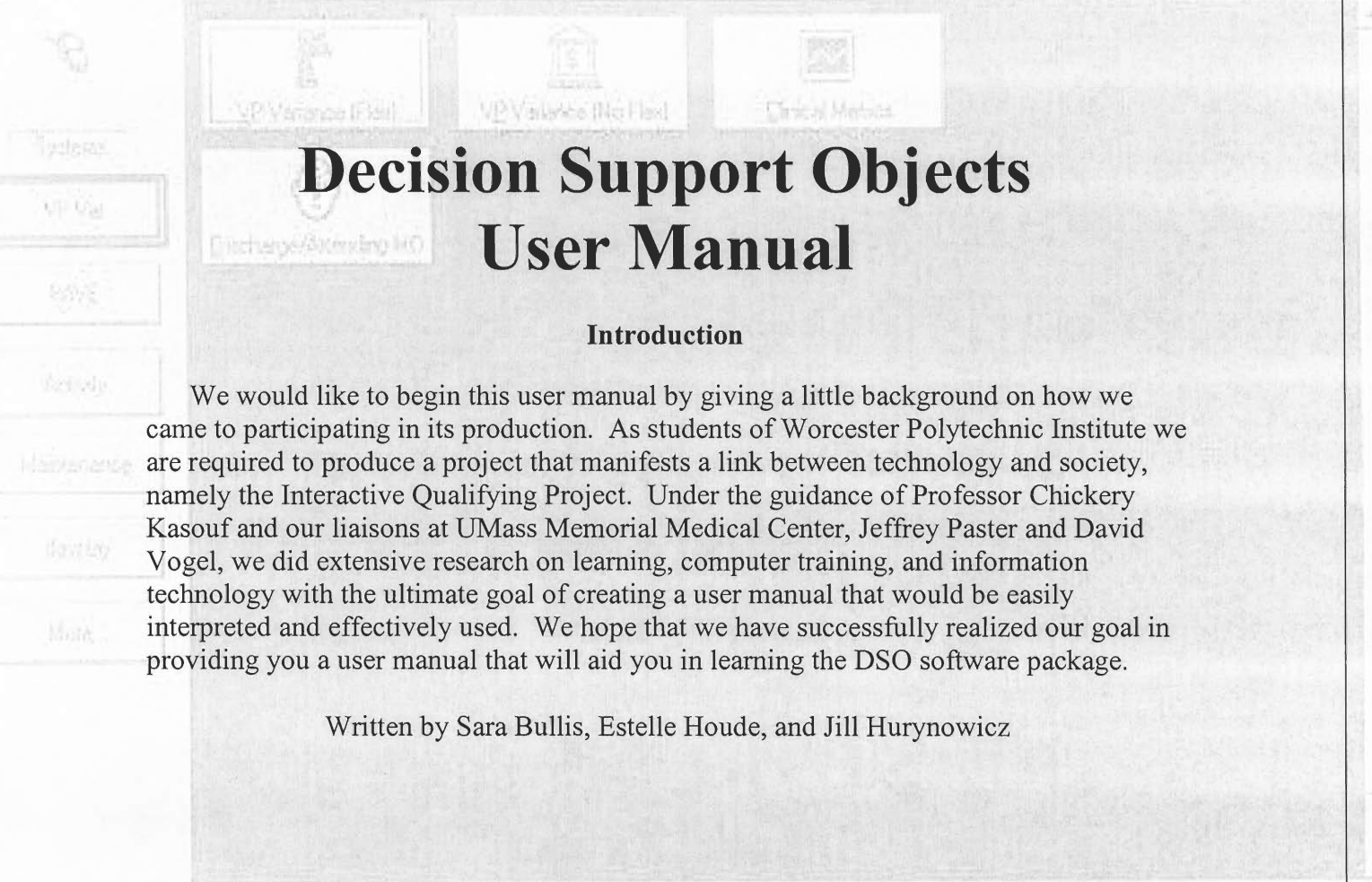
Decision Support Objects
User Manual

Introduction

We would like to begin this user manual by giving a little background on how we came to participating in its production. As students of Worcester Polytechnic Institute we are required to produce a project that manifests a link between technology and society, namely the Interactive Qualifying Project. Under the guidance of Professor Chickery Kasouf and our liaisons at UMass Memorial Medical Center, Jeffrey Paster and David Vogel, we did extensive research on learning, computer training, and information technology with the ultimate goal of creating a user manual that would be easily interpreted and effectively used. We hope that we have successfully realized our goal in providing you a user manual that will aid you in learning the DSO software package.

Written by Sara Bullis, Estelle Houde, and Jill Hurynowicz

What is DSO (Decision Support Objects) and what is it used for?

Eclipsys' Sunrise™ Decision Support Manager™ provides health care organizations with functional information about the process of care and its clinical, financial, and patient satisfaction outcomes. It enables one to measure the progress of money saved and the outcomes achieved. Based on fundamental principles of management control, Decision Support Manager enables healthcare organizations to apply those principles to all areas of focus, including processes, cost, revenue, utilization, and outcomes. With useful information taken from any number of disaggregate data sources, clinicians and managers have all the tools they need to act on that information to effect change within the organization.

DSO is a Windows-based program, making cutting and pasting of information to other documents possible. DSO is also richly multi-layered. The base data reside on a server in a series of related tables, which one may drill down through to get to greater and greater specificity. DSO is malleable, if you do not like the way it looks, you can change it to your liking. If you want to see different time frames, change them. If you want to see only a specific set of graphs in a specific order, you can create a FlashPath. You may also trim outliers to make a graph more presentable. DSO is an effective way to view and create your financial report.

This program will help you to easily analyze information and create a professional report. It can help you to interpret the graphs by generating a narrative report of a specified graph. If you are not familiar with Windows-based programs, this manual will help to show you many aspects of the program that are similar to other Windows-based programs. The following modules will describe the login procedure, the toolbars, menus and other commands, how to analyze and interpret your data, and how to create a narrative report.

Decision Support Objects

Module 1:
Getting Started

Performance Objectives

In this module, you gain confidence in your ability to:

- Login

- Change password

- Access the Home Screen

DSO Login Procedure

In order to start the Eclipsys DSO application click on the
following: In the left hand corner of the screen you will find the **Start
Button,** then roll up to **Specialized Apps,** then roll across to **Eclipsys
Corporation**, and finally roll across to **Sunrise Decision Support
Objects** and click on it.
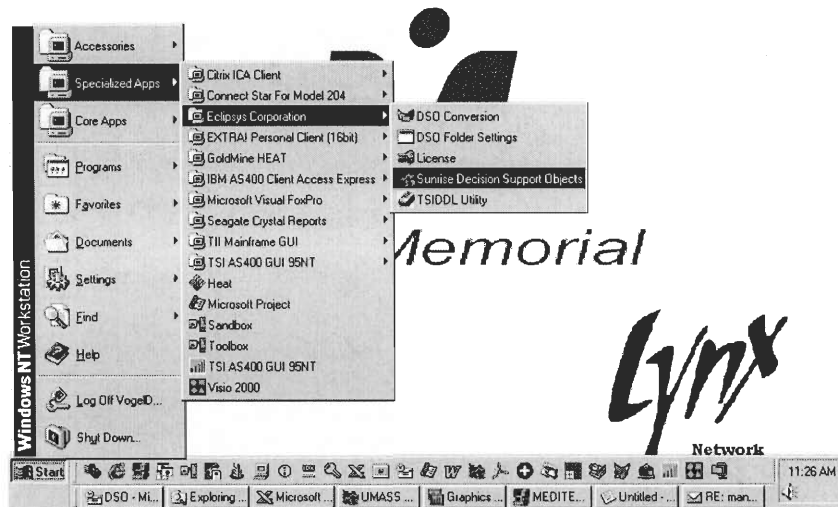
After you have selected **Sunrise Decision Support Objects,** a
SECURITY box will appear. Enter your User Id, which is the same as
your LYNX/NT ID. Then enter in your password. *Note: the first time you log
into DSO, the password is the same as the User Id. It is recommended that you change
your password the first time you log in. In order to change your current password click
the box titled Change Password After Successful logon, and then click OK.*
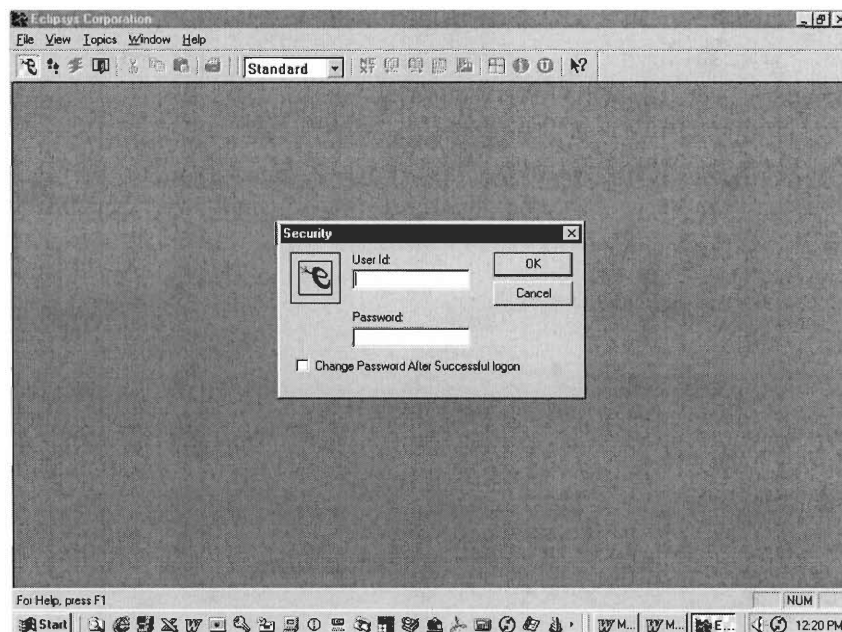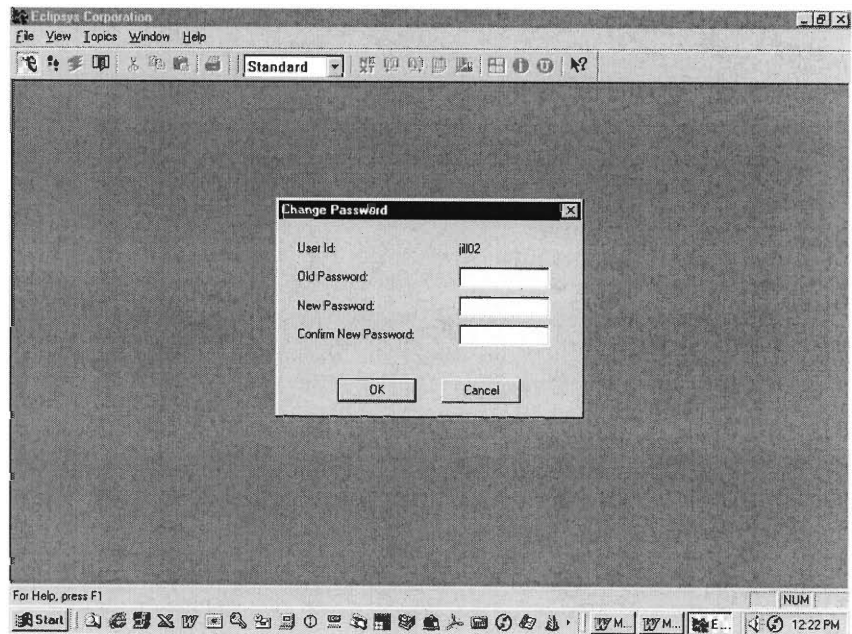
The Change Password box will appear. Fill in the appropriate boxes and click the OK button. Old Password is your User ID, you must decide on a New Password and enter it in the New Password and Confirm New Password boxes.

The DSO home screen will appear.
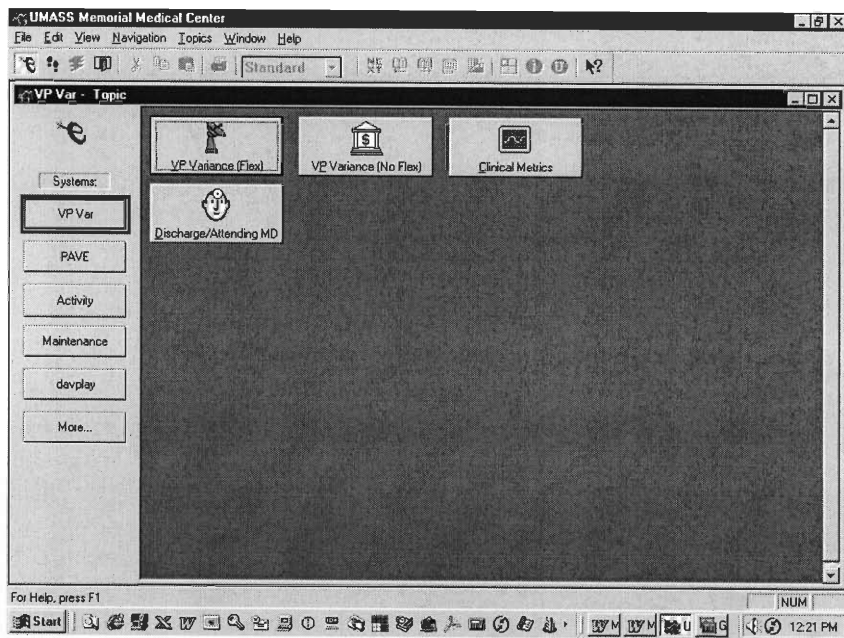
The navigation of DSO is done primarily with the aid of menus and toolbars. The menus and toolbars provide options for the user to navigate and manipulate the information within DSO.

The menu bar is directly below the UMASS Memorial Medical Center heading. Below that is the navigational toolbar. Take a moment to hover your mouse over each picture in the navigational toolbar. A "balloon" will display the function performed by that icon. Further information on menus and toolbars can be found in Module 2.
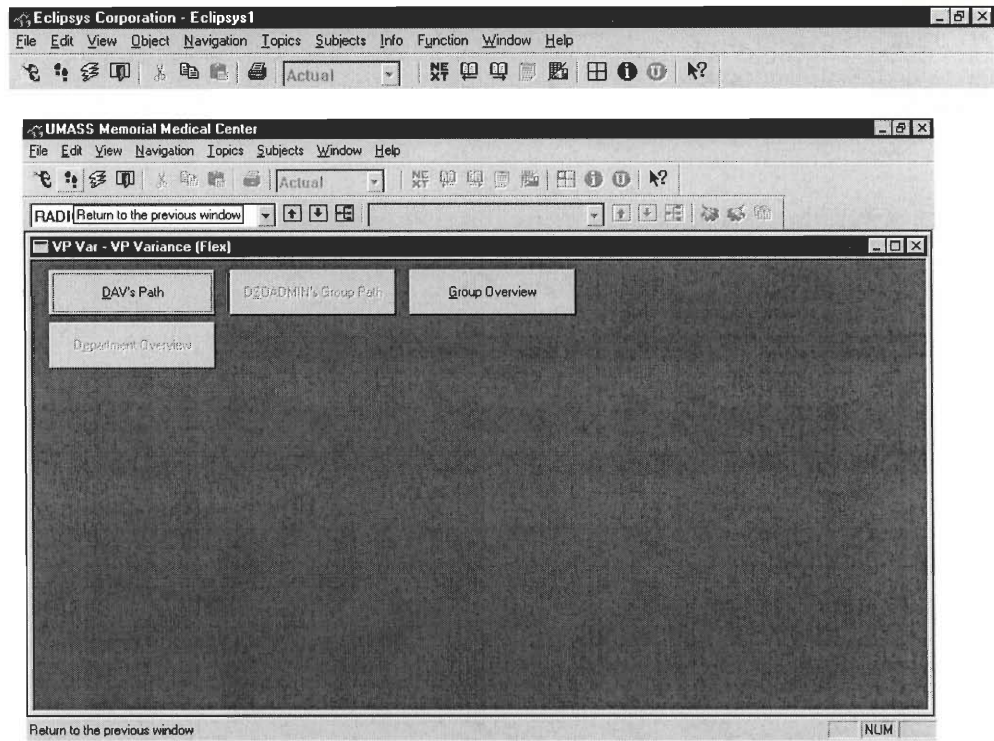
The above picture is an example of a "balloon" help text pop-up.

The Footstep icon is an especially useful button for navigating DSO. To return to the previous screen if you get lost during navigation, click the Footstep icon.

In the DSO home screen, click on the VP Variance (Flex) button. This will bring up a window that asks you to choose a Department Structure and timeframe. Choose the structure and timeframe of interest and click OK.
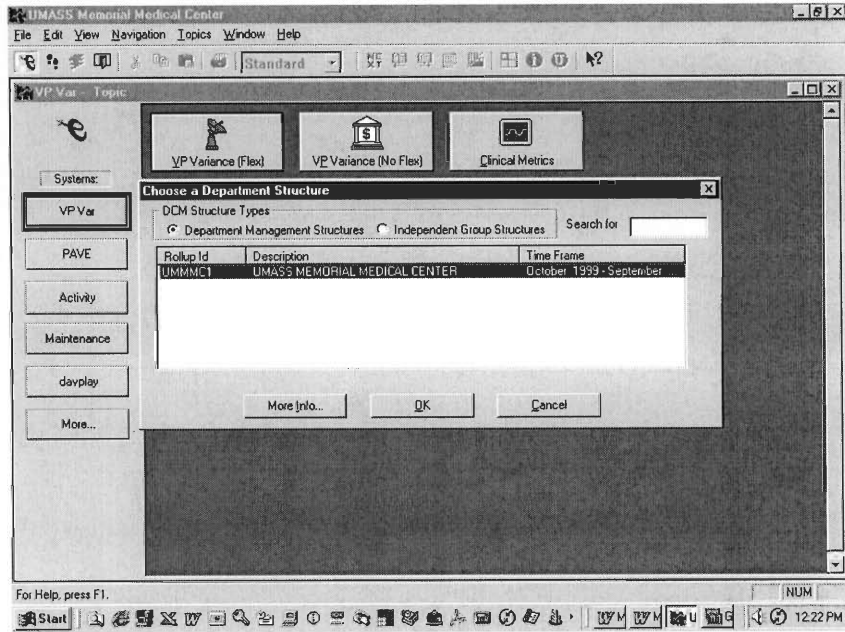
You will now be working within the specific area of your department. See the information within Module 2 on the Navigation Menu for directions on how to use that menu to work within a Department Structure.
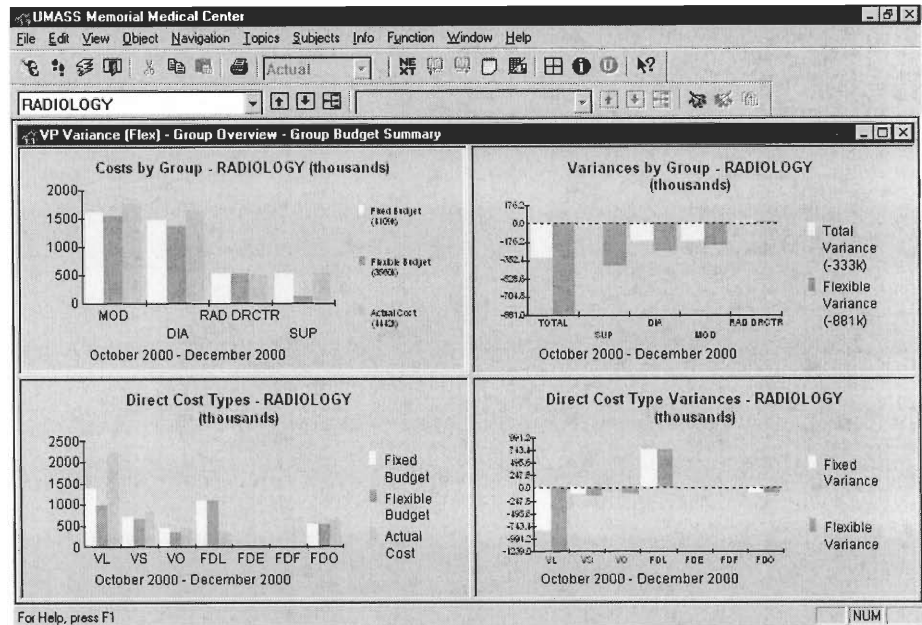
Decision Support Objects

Module 2: Menus and Toolbars

Performance Objectives

In this module, you gain confidence in your ability to:

- Use drop-down menus

- Use toolbar icons to perform menu functions more conveniently

While working in DSO you will use the dropdowns menus and toolbars located beneath the heading UMass Memorial Medical Center. Dropdown menus contain options that can be seen by clicking on the heading of the menu.

FILE MENU

The file menu contains basic functions can be done to the file itself.
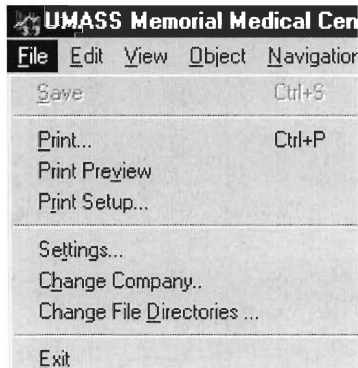
Save will never be available as an option.

Print will print selected views or all views.

Print setup will give you options for different ways of printing In order to select a view, click on one of the graphs and a yellow box will appear around it. This will allow you to print just that graph when you select the Selected View button in the print options box (shown below). To print all graphs, select the All Views button in the print options box. Enable Color Printing will show a color background on the graphs when printed.
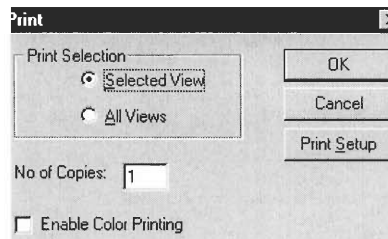
 Use this icon as a shortcut to print.

Print preview will preview the way the page will look if you print the graph or graphs you are viewing.

Settings is an advanced user feature.

Change company accesses a selection list of all the companies defined in the system so you can switch to a different company if you wish, UMass Memorial is company 100.

Change file directories *WARNING settings in this dialog box should never be changed.

Exit will terminate the program.

 Use this icon as a shortcut to exit.

EDIT MENU

While using DSO, you will find yourself using the edit menu to copy data from DSO into another program, such as Microsoft Word. The other commands in this menu are never available to you as the user.

Copy copies the area you highlighted without removing the area from the window, and adds it on the clipboard.

Use this icon as a shortcut to copy.

UMASS Memorial Medical Center				
Edit	View	Object	Navigation	Top
Cut				
Copy				Ctrl+C
Paste				Ctrl+V
Paste Special...				
Paste Link				
Clone				
Delete				Del
Delete All				
Change Fonts...				
Default Fonts				
Change Print Font...				
Change Icon...				
Links...				
Insert New Object...				
<<OLE VERBS GO HERE>>				
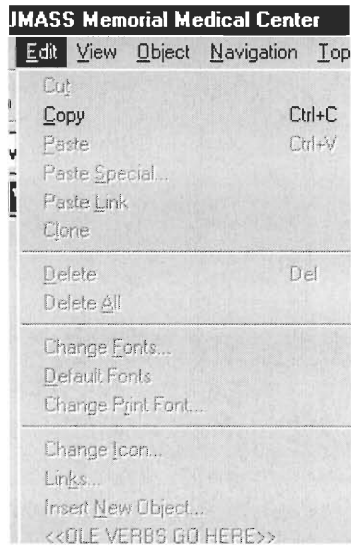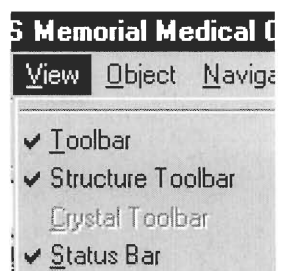
VIEW MENU

The **View Menu** allows the user to select various toolbars to have available while using DSO. By clicking on View and then dragging the mouse down to the item you wish to select, it will either engage or disengage the toolbar you have selected. The check mark means that you currently have that toolbar engaged.

NAVIGATION MENU

Learning the navigation menu is crucial to learning DSO because these functions allow the user to move about the program successfully. By clicking on Navigation in the menu bar you can drag your mouse down and click on the function that you wish to perform. For convenience, icons on the toolbar will perform the same functions. They are shown below.
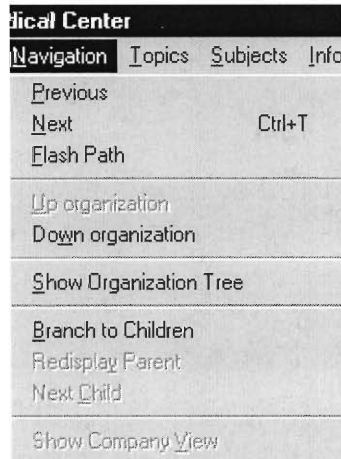
As an exercise, practice performing the same navigational tasks first by using the menu and then by using these convenient toolbar icon buttons.

Previous goes back to the previous information frame

Next advances to the next information frame. If there are no more information frames, then it advances you the next subject.

Flash Path activates a previously created flash path.

Up organization moves upward to higher levels of the organizational structure.

Down organization moves downward to lower branches of the organizational structure.

Show Organizational Tree displays the organizational structure and allows the user the select a node.

Branch to Children branches out to the "child nodes" which are the next lower levels of the current structure.

Redisplay Parent returns from a branch (child node) of the current structure to the previous level (parent node) of the structure.

Next Child moves to the next group of children if there are more than 4 to display.

TOPICS MENU

A topic is a main area within DSO which has a special function. The Topics menu will show those topics you have access to.
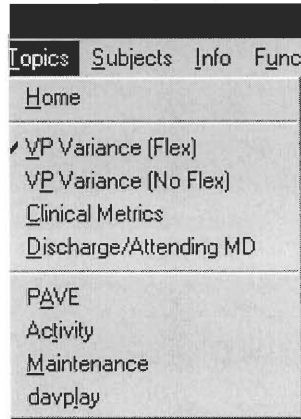
The important command in this menu is the **Home** command. This allows you to return to the DSO Home window. You can also click on the icon shown below to return to the DSO Home window.

SUBJECTS MENU

A subject is a collection of information frames belonging to a specific topic. Subjects on the Subjects menu belong to the selected topic.
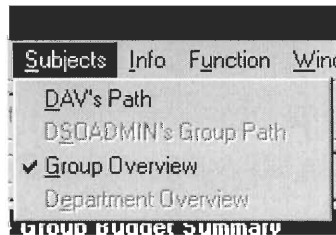
INFORMATION MENU

The options available to you on the Information Menu depend on where you are in the DSO application. This menu can be seen in both the group and department levels.
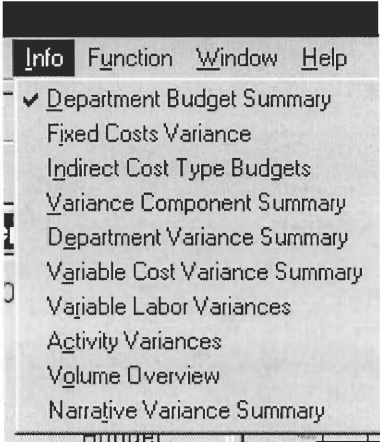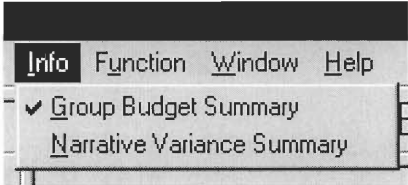
The picture on the left shows the list of possible information frames that can be seen under the Group level. The one on the right is the list of possible information frames that can be seen under the Department level.

FUNCTION MENU

The function menu has options for working with data and its display and reporting. The options available to you on the Function Menu are specific to the active pane from which you access the menu. The following menu displays all the options available:

Function	Window	H
Data	▶	
Display	▶	
Reset	▶	
User Flash Path	▶	
Group Flash Path	▶	
Notes...		
Ad hoc Graph		
Show Standard		
Summary Info..		
Time Periods...		
Related	▶	

Click one pane of information to access a context-sensitive Function Menu specific to that pane.

Function Data Menu
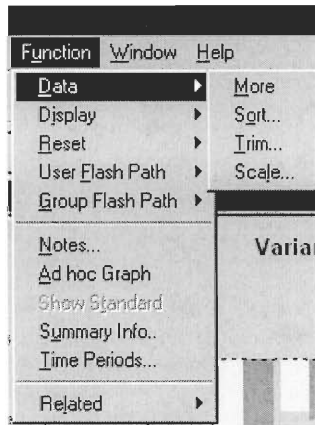
More: Gives additional data points that did not fit on the graph.

Sort: Access a sort selection dialogue box. To change the presentation of the data in the active pane, you can:

- Select one or two sort keys
- Indicate whether you want the items to be displayed in ascending or descending order
- Select the number of points to display
- Select the number of data point labels to display
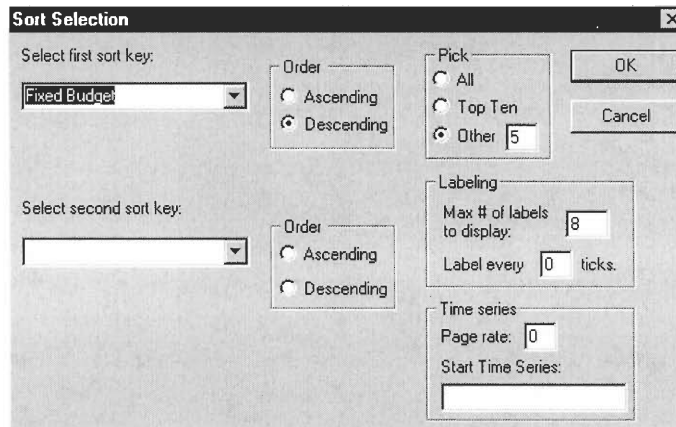
Trim: Used to remove unwanted points on the graphical pane.

Scale: Used to change the scale of the graphical pane

View Trimmed: Shows the results of the Trim command

Function Display Menu
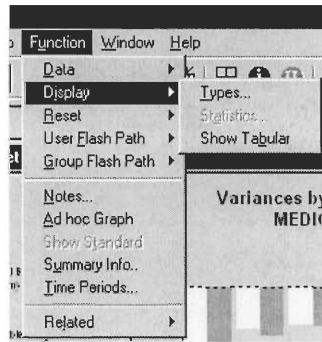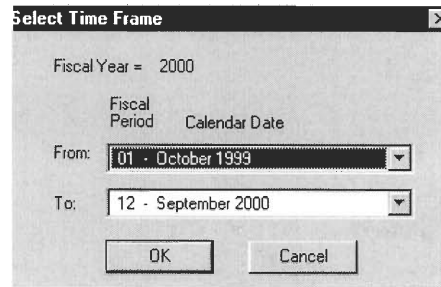
To access graphical or tabular displays of the data in the active pane select Display followed by Types. You may also toggle between graphic and tabular displays of the data in the active pane by clicking on the following icon:

The following pictures show a graph and a modified graph with data in tabular format.
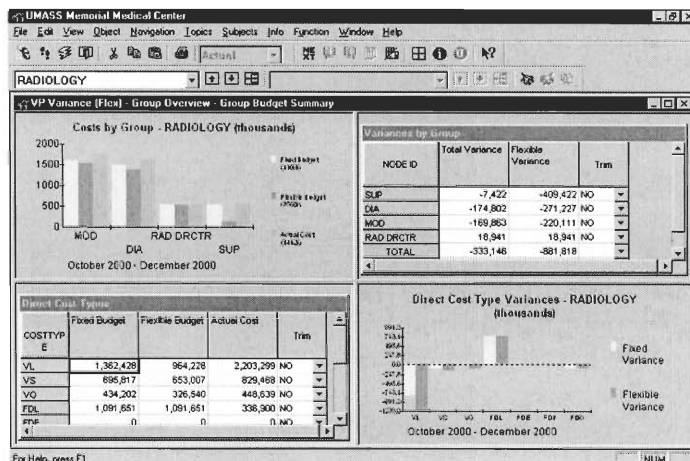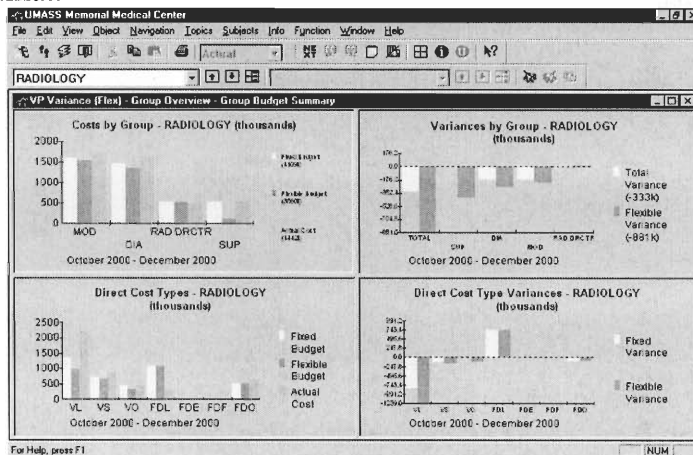
Function Time Periods

Select Time Frame

Fiscal Year = 2000

	Fiscal Period	Calendar Date
From:	01 - October 1999	
To:	12 - September 2000	

OK   Cancel

This allows the user to select the time period that they want the data to represent. You cannot use a timeframe greater to when the set was run.

Reset Commands

Function	Window	Help
Data ▶		
Display ▶		
Reset	**Reset Pane**	
Flash Path	Splitter Bar	
Notes...		
Ad hoc Graph		
Show Actual		
Summary Info..		
Related ▶		

Click on the Reset option you want.

The size of a graph/pane and the position of the splitter bar can be changed by clicking on the splitter bar on the screen and dragging it to the preferred position.

Use the **Reset Pane** option to return to the original pane format.

After you have resized a pane of a multi-pane window, reset the bars between the panes to the positions they had when you first accessed the window by using the reset splitter bar option or clicking on the following icon:

This picture shows the typical four graphs before any panes have been modified.
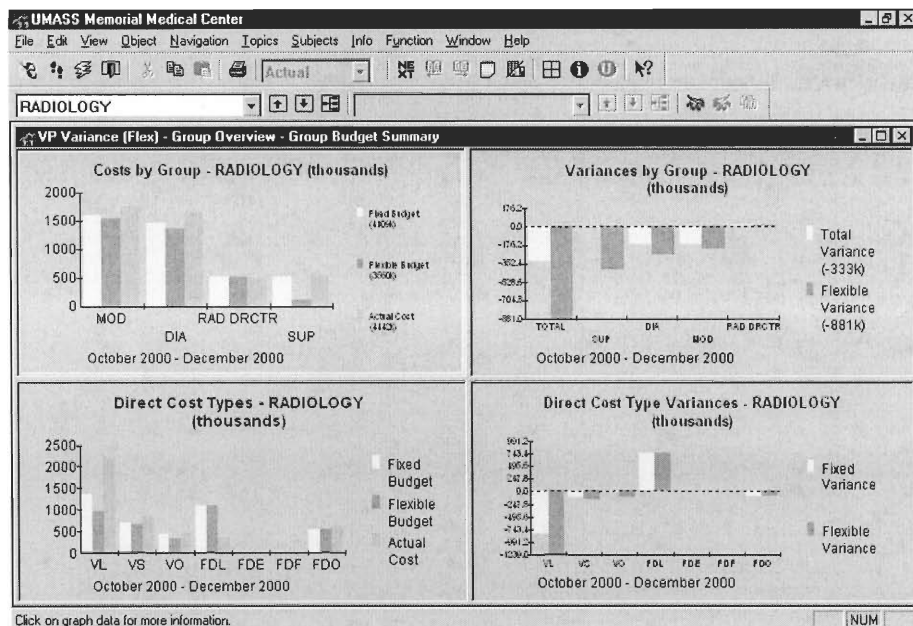
This picture is an example of how the pane size can be modified by dragging the axis.
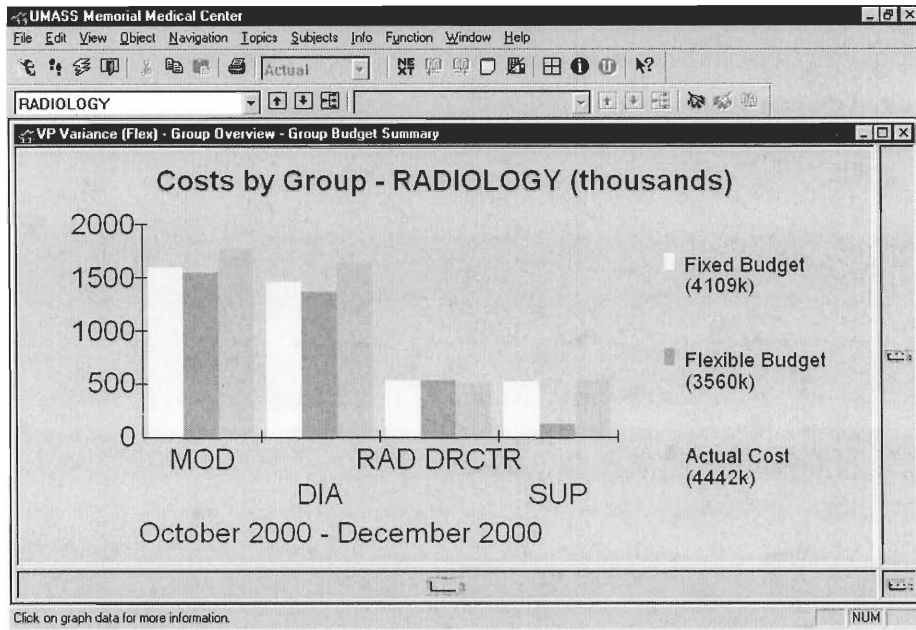
(Note the three possible changes to the cursor shape when positioning cursor over split bars: up-and-down arrows, left-to-right arrows, and four-way arrows if the cursor is over the intersection point of the horizontal and vertical split bars).

Flash Path Menu

The Flash Path option on the Function Menu enables you to select and arrange information frames in a customized sequence that you want to see on a regular basis.
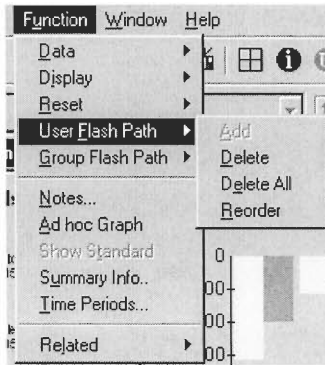
Add: Add the current information frame to your flash path.

Delete: Delete the current information frame from your flash path.

Delete All: Delete all the information frames from you flash path, thus deleting the flash path itself, too.

Reorder: Change the sequence of information frames that are on your flash path.

The flash path you create is activated when you click the icon:

Notes Command

Use this command to add notes to the active pane. The note can be displayed by any user, but the user can only modify notes they created.
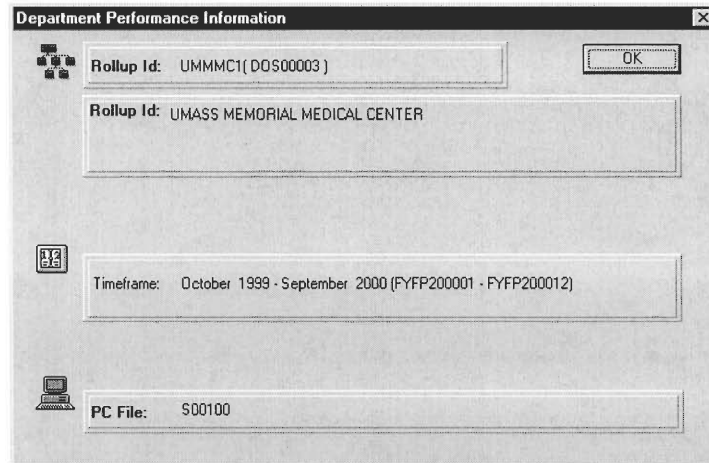
The following icon indicates when a note exists for the active pane:

Summary Information Command

Access descriptive information about the current data file, including:

- PC File
- Time Frame
- Description

This information can also be accessed by clicking on the following icon:

WINDOW MENU
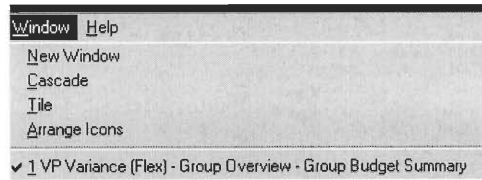
Using any option in this menu is <u>Not Recommended</u>

New Window: Creates a new duplicate window beginning with the
Home window. <u>Not Recommended</u>
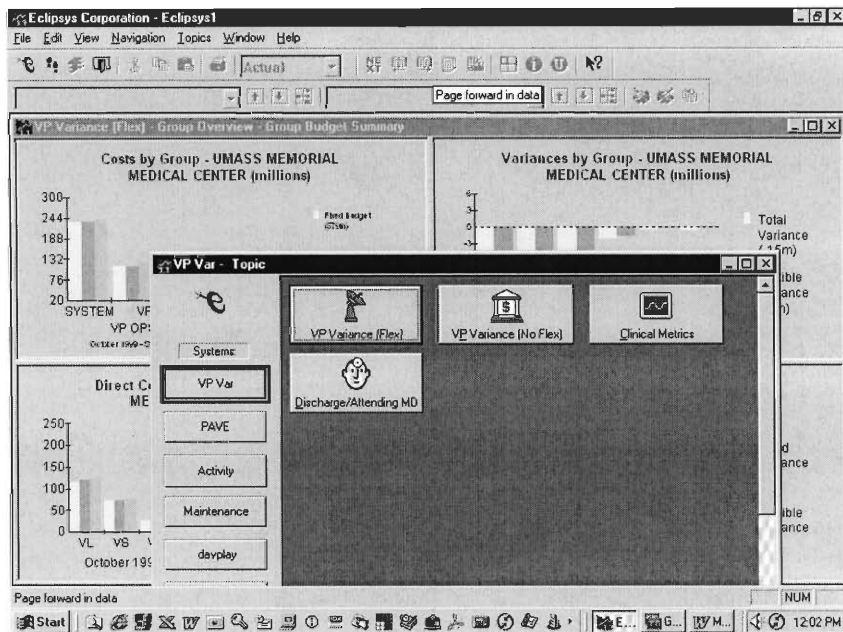
Cascade Command: Displays your open window in a cascade arrangement.
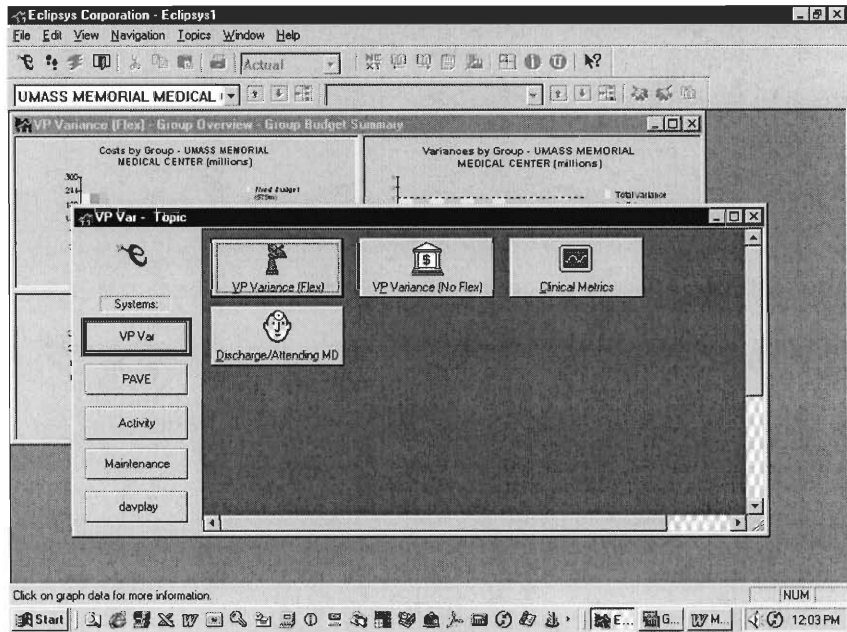
Tile Command: Displays your open windows in a tile arrangement.
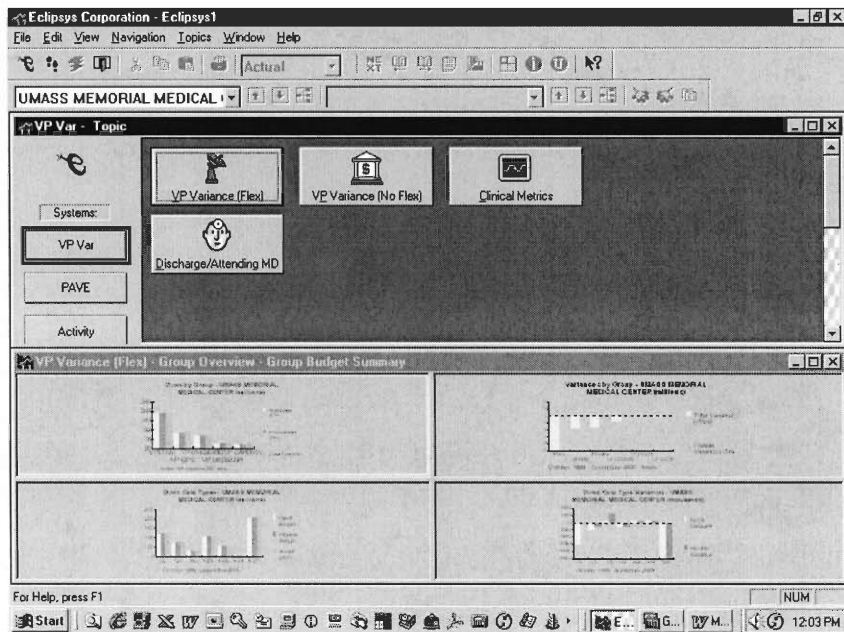
Arrange Icons Command: Arranges the icons of any windows you have minimized.

Status Bar Command: Toggles to display or hide the status bar.

Active Window: A check mark indicates the name of the window
                        that is currently active.

HELP MENU

You can access the Help file or information about the DSO package through this menu.
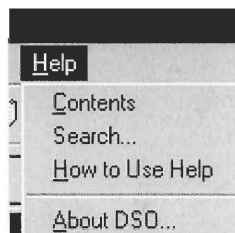
Contents will access the Help file, and **About TSI DSO** will provide information about the software.

Decision Support Objects

Module 3:
Navigation

Performance Objectives
In this module, you gain confidence in your ability to:

- Access departmental data in tabular and graphical form

- Maneuver within the organizational structure

After you have selected VP Variance (Flex) and clicked on O.K. (shown in Module 1), choose a Department Structure and proceed to the organizational tree.
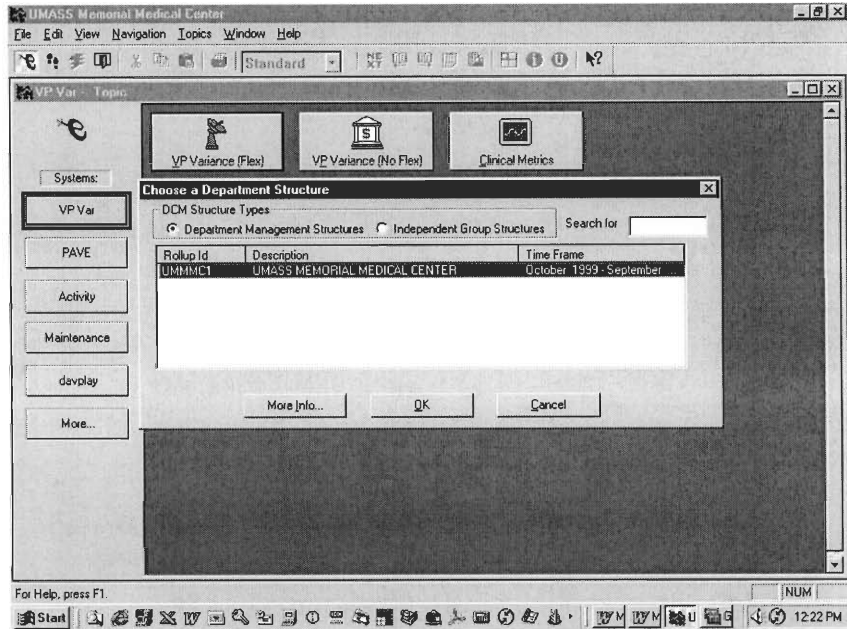
The picture below shows the screen that will appear after you select a Department Structure.
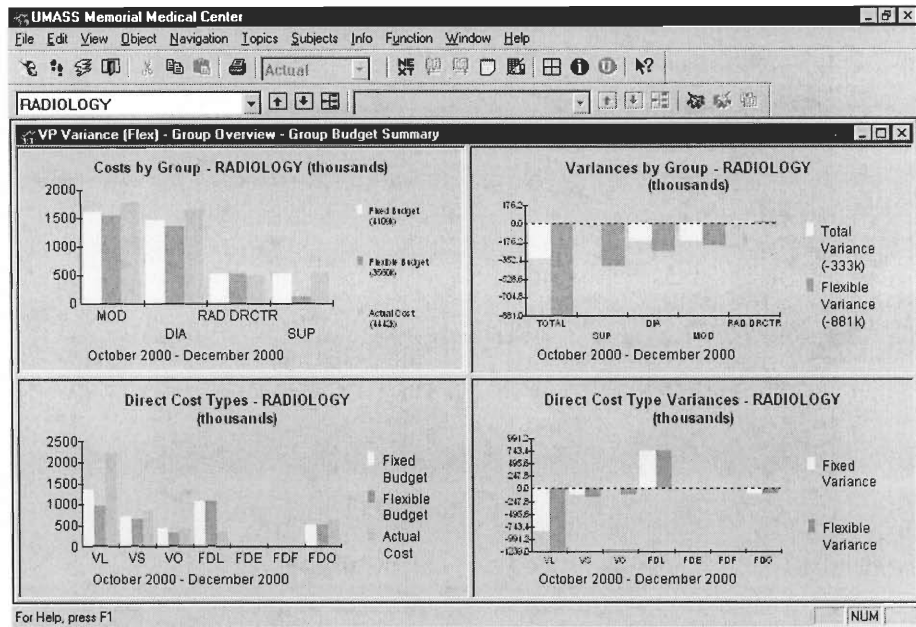
Click on the **organizational tree icon** and drill through the **role-up structure** until you find the group/department cost center you wish to examine. You may expand the role-up structure by clicking on the plus (+) signs next to a selection. Once you have selected the group you want click O.K.

 Organizational Tree icon
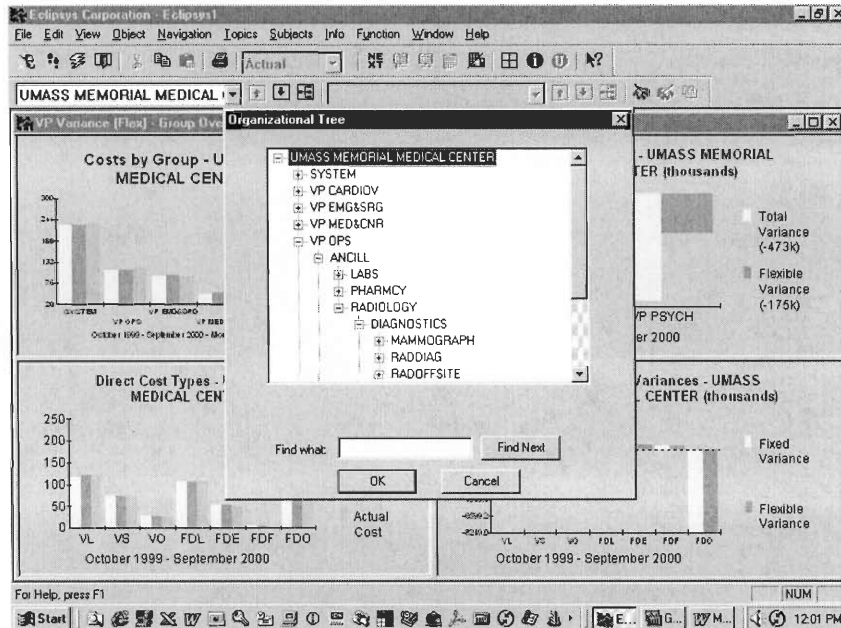
Click on the **group overview** button.
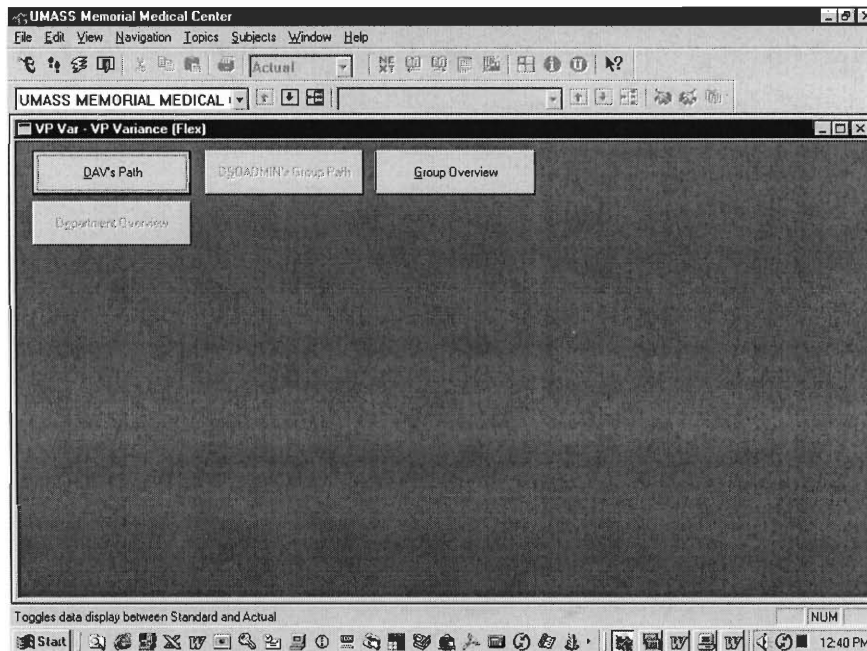
A dialog box will appear in which you may choose to view graphs by clicking on **Group Budget Summary**, or you can view the text-format, analysis summary of the selected group layer by clicking on **Narrative Variance Summary**. For more information on narrative reporting see Module 4.
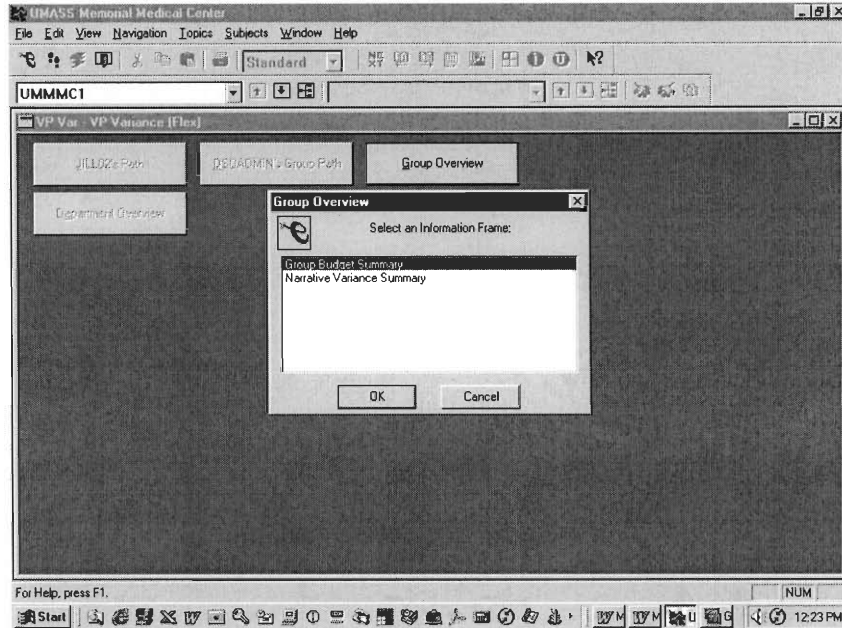
If you choose **Group Budget Summary**, four graphs will appear.
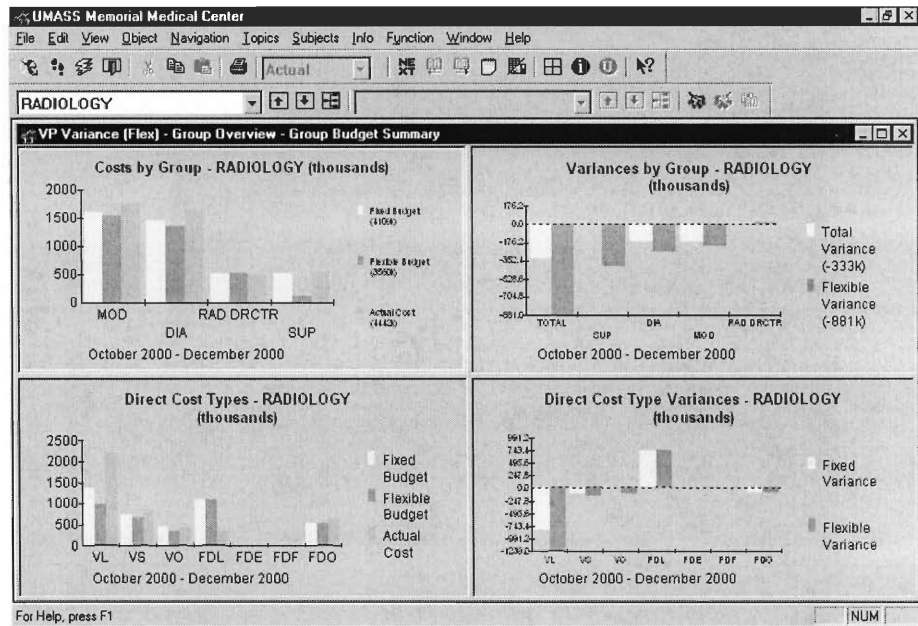
The top left graph is total cost by group, top right is variances by group, bottom left is direct cost types, and bottom right is direct cost type variances.

To see similar graphs for each group lower in level on the organizational tree click on the **branch icon** in the toolbar. This will show four more graphs on the screen. If there are more than four graphs for that particular function the **children icon** in the toolbar will become active. To view these other graphs click on the children icon. Continue clicking on the icon until you have viewed all of the graphs. At the last set of graphs you may click on the icon again to return to the first set of children (graphs).

Branch Icon: **Children Icon**:

The sequence of pictures below show the branching icons work. The first picture shows before the branch (NOTE that Direct Cost Type graph has YELLOW border: that is the graph to be used in the branch.)
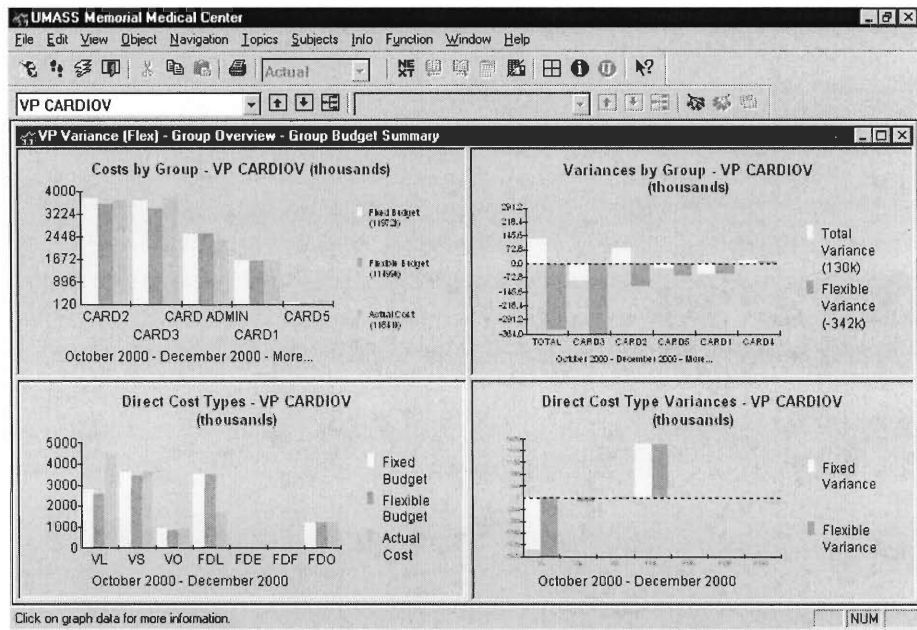
The next picture show what happens after the branch button is clicked (NOTE: the SHOW NEXT SET OF CHILDREN icon is active.)
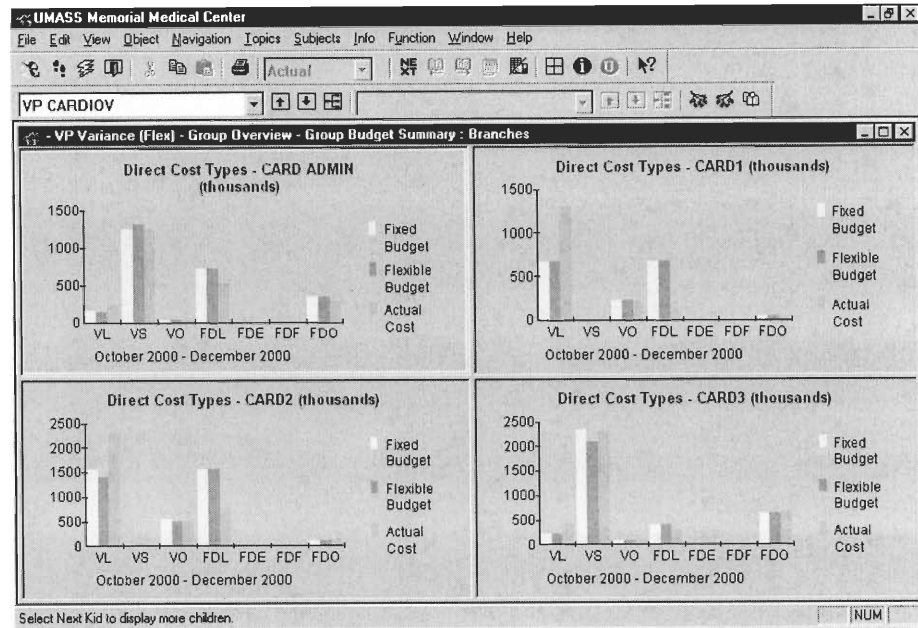
The next pictures shows what happens when you click the SHOW NEXT SET OF CHILDREN icon.
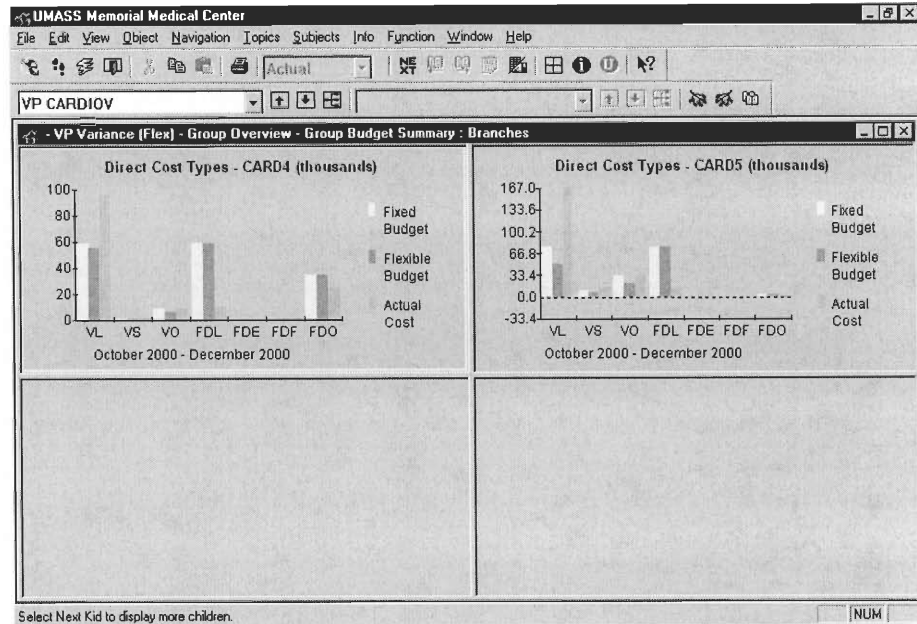
After clicking the SHOW NEXT SET OF CHILDREN icon again, you will have a window pop up as shown below.
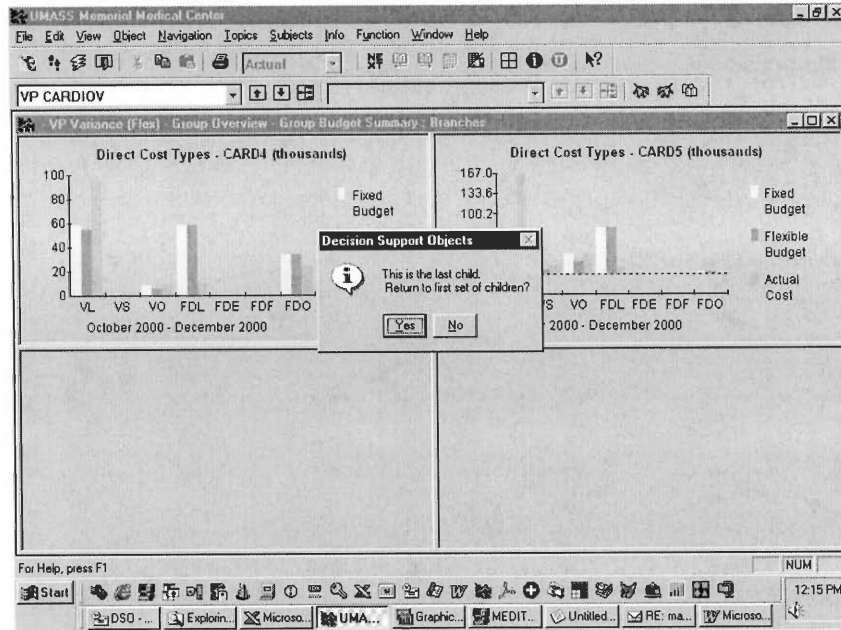
After answering Yes to the dialog, the following screen will appear.
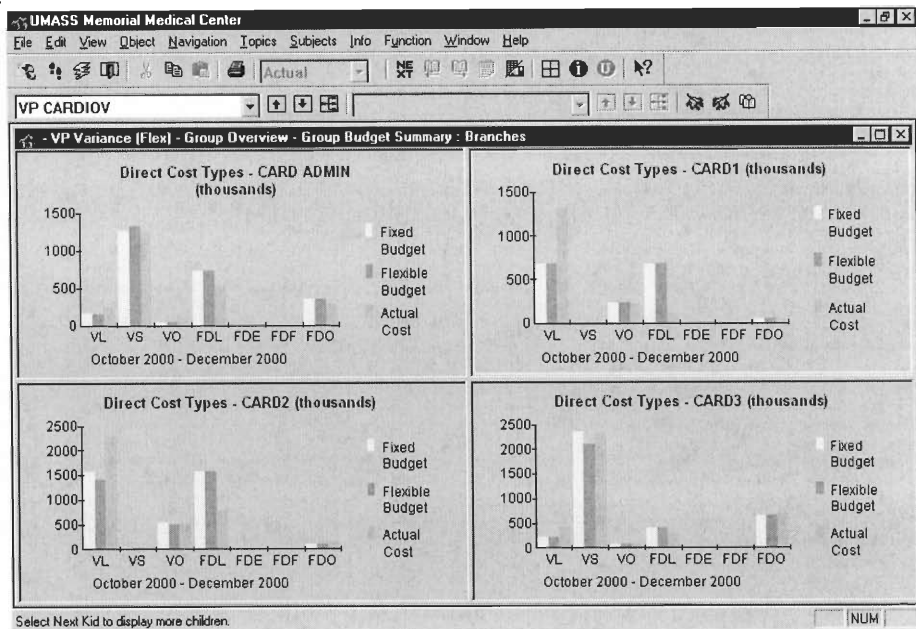
Note that the CARD1 group graph has the YELLOW border: if the REDISPLAY PARENT'S ORIGINAL VIEW button is now clicked, it will return to the view that started this series.
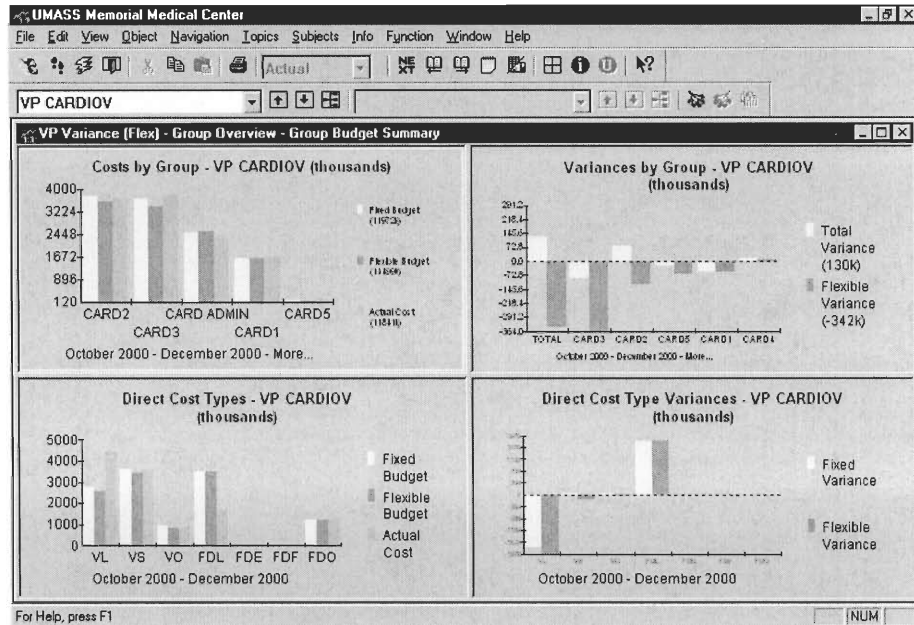
In order to view a group's portion of the total fixed budget, double-click on one of the fixed budget bars (yellow) located in the top left hand graph to obtain data point information.
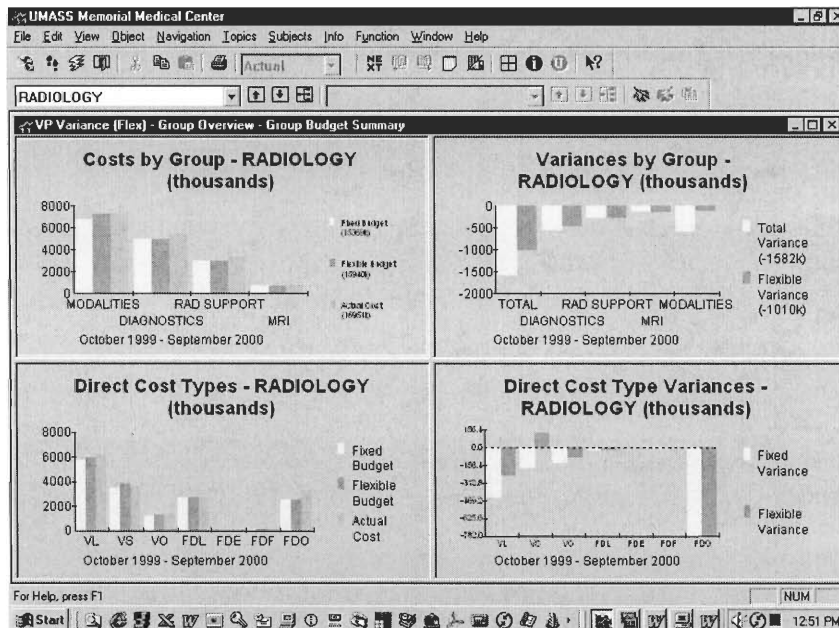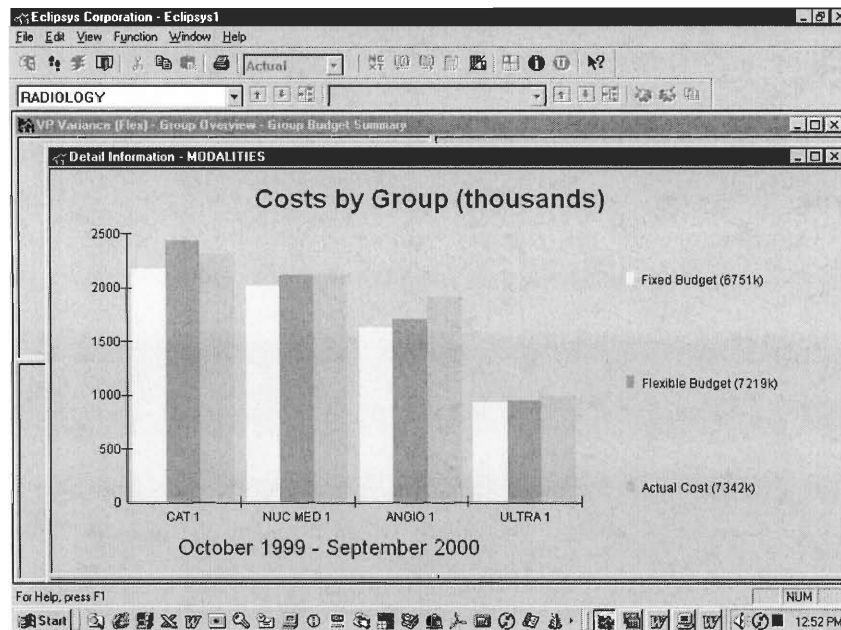
A dialog box will appear as shown below.
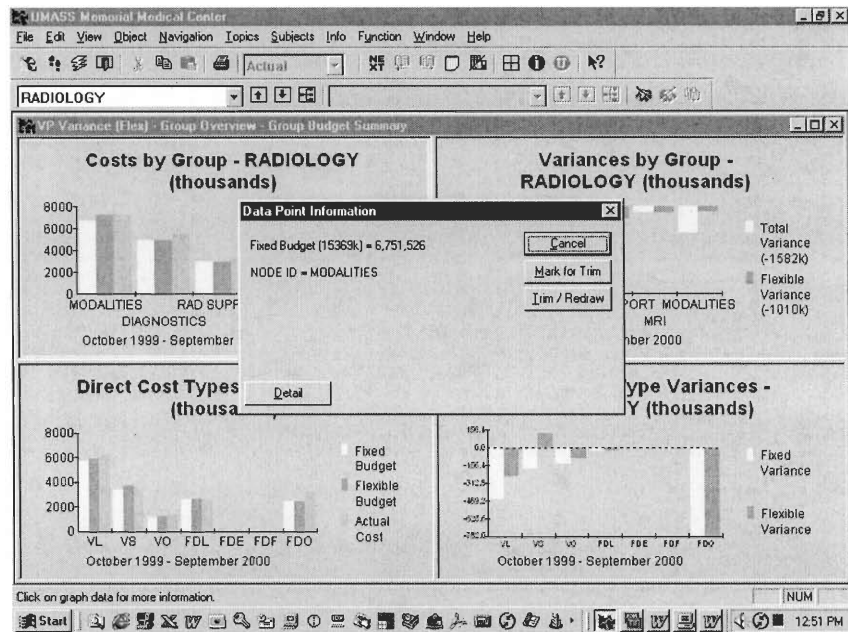
This dialog box shows the portion of the total fixed budget that the selected bar comprises.

By clicking on the detail button within this dialog box you can drill down through the groups and the organizational tree. This command will show you the budget for that cost center. The following is an example:

The bottom left graph displays the **Direct Cost Types** for a group or department. Clicking on a bar on the graph will display a dialog with information for that bar. In this example, the Flexible Budget bar for Variable Labor has been checked.
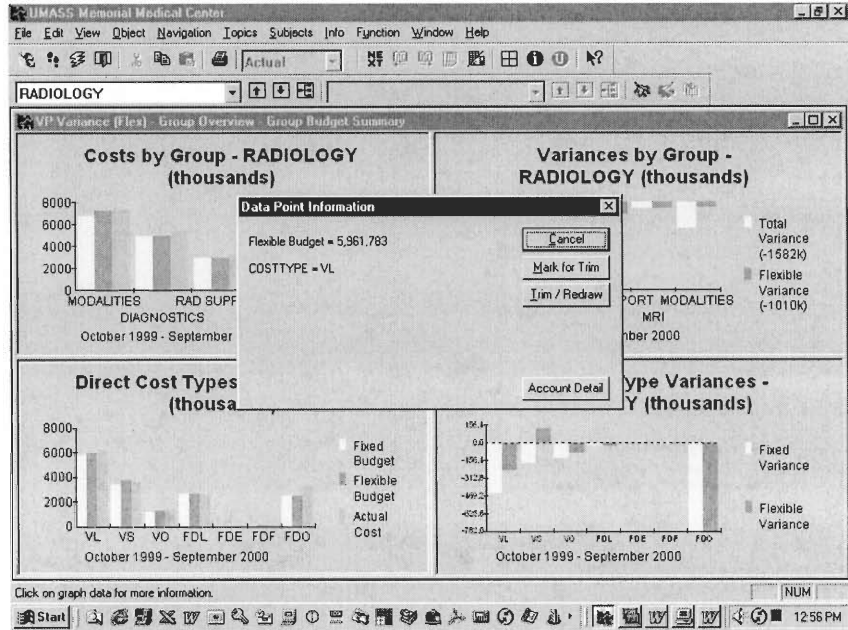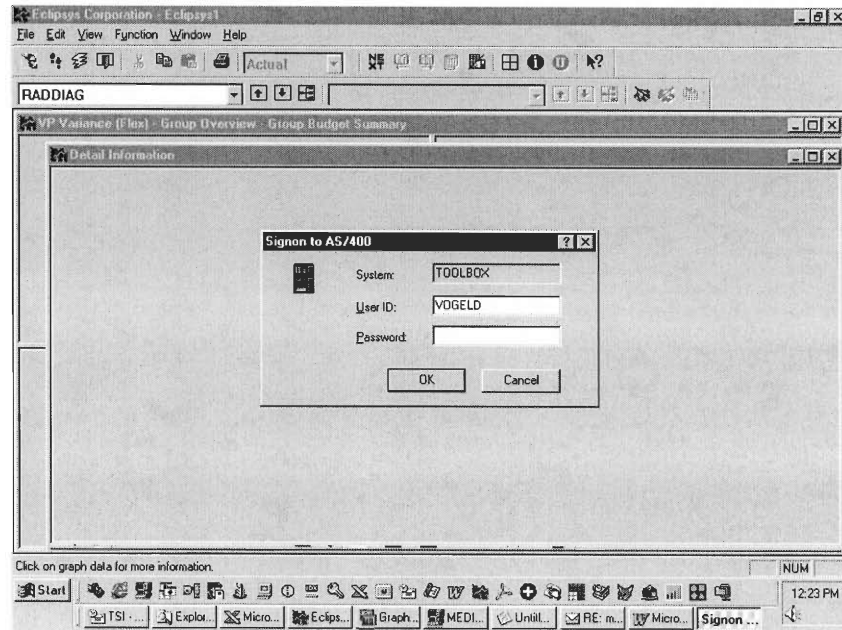

Selecting the account detail button will bring an AS400 screen for the cost type selected as shown below:
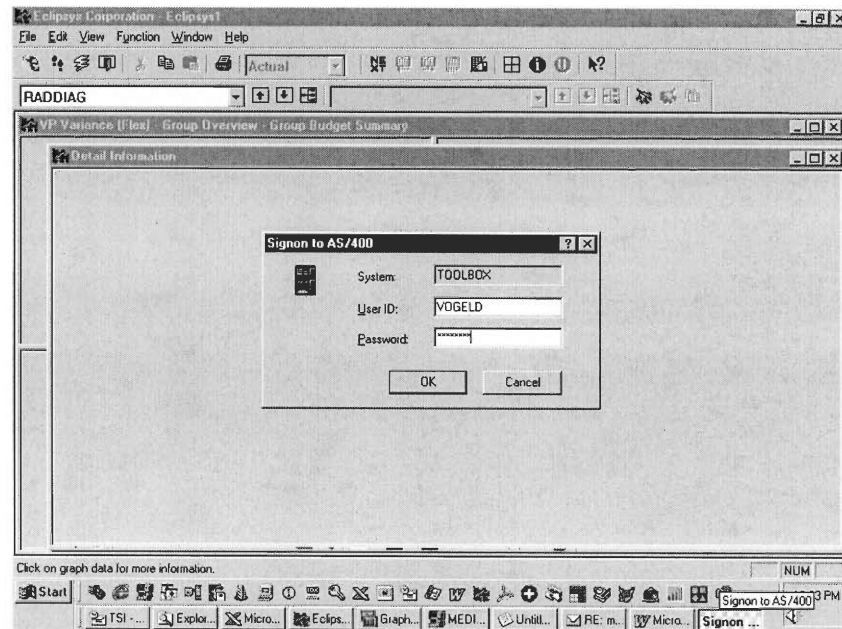

The AS400 program presents a detail information table that shows cost by general ledger job code and also how much is budgeted for a specific job code.

The AS400 login screen is show below.

Enter the same User ID and Password that you use to access DSO. Then click OK.

A confirmation screen will then appear as shown below. Click OK in the dialog box.
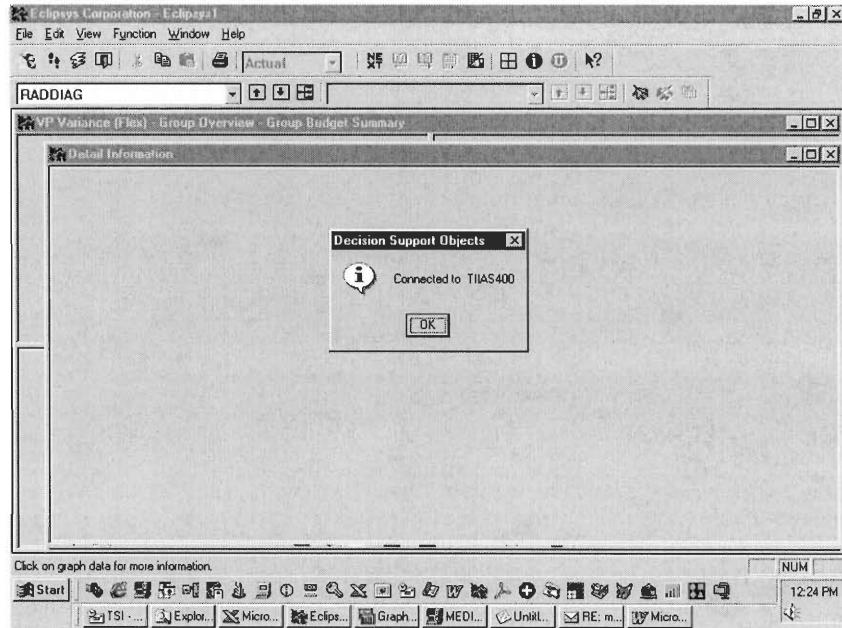
The detail information screen will then appear.
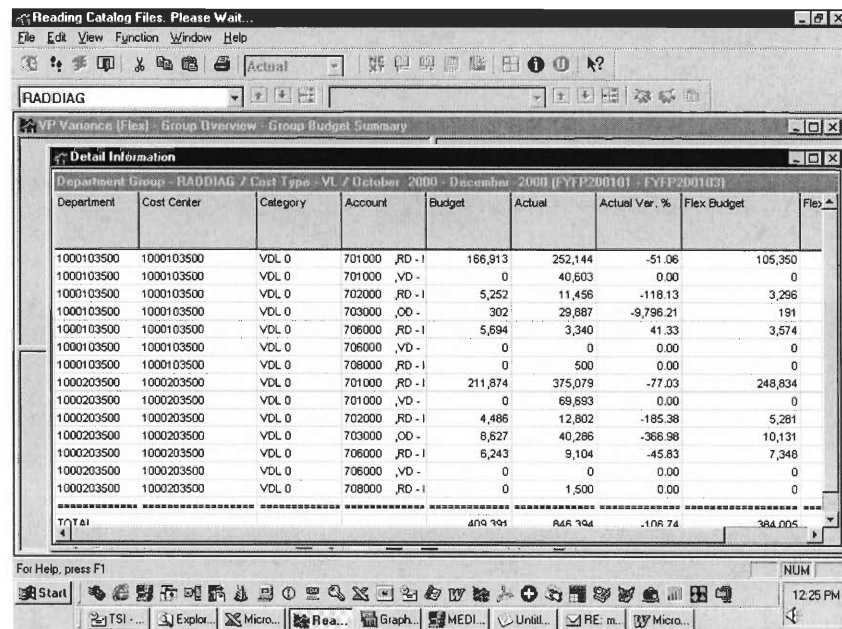
For technical assistance call DSO tech support David Vogel, #856-2186

When crossing the barrier between groups and departments the department overview dialogue box will appear. These two pictures show the options available under the Department Overview.

Department Overview

Select an Information Frame:

- Department Budget Summary
- Fixed Costs Variance
- Indirect Cost Type Budgets
- Variance Component Summary
- Department Variance Summary
- Variable Cost Variance Summary
- Variable Labor Variances
- Activity Variances

OK   Cancel

Department Overview

Select an Information Frame:

- Indirect Cost Type Budgets
- Variance Component Summary
- Department Variance Summary
- Variable Cost Variance Summary
- Variable Labor Variances
- Activity Variances
- Volume Overview
- Narrative Variance Summary

OK   Cancel

Decision Support Objects

Module 4:
Data Analysis

Performance Objectives
In this module, you gain confidence in your ability to:

- Have a better understanding of what the different kinds of variances are and what they mean to your report

- Choose the type of summary that best characterizes the information being analyzed in your report

Factors in Cost Variance

The differences between standard, or budgeted, costs and actual costs, are explained by the following factors:

Volume Variance:

A volume variance is caused by a change in the total numbers of products. Volume implicitly assumes that any increase or decrease in product volumes is in proportion to the budgeted mix of products.

Mix Variance:

A mix variance is caused by a change in the proportion of types of products. Volume may remain constant, but producing more or less costly products than planned will affect actual cost.

The combination of volume and mix variances is called the activity variance

Utilization Variance:

Utilization variance is caused by changes is efficiency and price.
- Efficiency, or utilization, relates to the quantity of resources used in producing each product
- Price variance is the difference between the planned cost of the resources per unit and actual cost of the resources per unit.

Group Overview

The analysis begins with an overview of the performance of the entire department or departments that you can access. Group Overview enables you to look for areas that vary significantly from your fixed budget. The analysis focuses both on actual costs and on the flexible budget, which is the fixed budget adjusted for the actual product volume and mix. This combination gives you a more accurate assessment of performance than actual costs alone would give.

Most of the information frames consist of three graphs showing the following for the specified time period:
- Totals for the highest organizational level you selected
- Group average and totals for the specific groups in the level of the organizational structure you selected
- Trends by month for the highest organizational level you selected

Group overview is presented through the following information frames:

Group Budget Summary

This summary provides a high level picture that enables you to compare departments in the group you selected. The graphs show the following information about the fixed budget, flexible budget, and actual cost for the specified time period:

- Totals for the highest organizational level you selected

Group Variance Summary

This summary presents the total fixed and total flexible cost variances to actual costs for departments in the group. Three graphic panes display the following information for the specified time period:

- Group average and totals for the specific groups that make up the level of the organizational structure you selected

Narrative Variance Summary

Explains the variance for the department or group you selected by describing in words:

- The amount that was expected to be spent according to the fixed budget.
- The amount that was actually spent.
- What the variance means in terms of increases or decreases in volume and mix of tests and procedures.
- How that variance was reflected in the flexible budget.
- How the department or group achieved its favorable or unfavorable variance by detailing the differences that were due to labor price, labor hours, variable supplies, variable other, and fixed cost components.

Department Overview

Department Overview is available only for a specific department, which is the lowest level in the organizational structure. Department Overview enables you to look for areas and products at the department level where actual performance levels vary significantly from the department's fixed and flexible budgets. In addition to focusing on actual costs, the analysis focuses on variances in the department's product volume and mix and on labor utilization, labor rates, supplies, equipment, and other costs, thus helping you see opportunities for controlling costs.

Department Overview provides you with summaries of the following factors in the department:

- Variances in actual costs, activity, utilization, and fixed costs
- Labor price and labor efficiency
- Components of fixed costs
- Variances in product volume and mix
- Unit totals and trends

A narrative report analyzing departmental variances is also included. This analysis is presented through the following information frames:

Department Budget Summary
Graphically displays the following information:
- Total fixed budget, flexible budget, and actual costs for the department
- Departmental trends for fixed and flexible budgets and actual costs for the specific time period

Fixed Costs Variances
Presents the fixed cost variances from the planned, not flexible, fixed cost budget. The information is presented in the following graphical panes for the specified time period:

- The total fixed cost variance for fixed labor, equipment, facilities, and other expense
- Fixed cost variance trended over time

Indirect Cost Type Budgets
Breaks down the indirect costs into fixed and variable components. The following two panes graphically compare costs by showing for each component:
- The fixed budget and actual cost for both fixed and variable indirect costs
- Variances for fixed and variable indirect costs

Variance Component Summary
Graphically presents the following information in four graphic panes:

- The total fixed and flexible budgets and actual costs
- Activity variances by both volume and mix products, showing you the primary cause of the variance between the fixed and flexible budgets
- Utilization variances for variable costs – labor price, labor efficiency, supplies, and other – explaining the differences between the flexible budget and actual costs
- Utilization variances for fixed costs – labor, equipment, facilities, and other – explaining the difference between the flexible budget and actual costs

Department Variance Summary
Consists of the following two graphic panes:
- Total cost variance and flexible cost variance for the department
- Departmental trends for fixed and flexible variances for the time period you selected

Variable Cost Variance Summary
Presents two graphical panes showing the variances for only the variable portion of cost – variable labor, variable supplies, and variable other – in total and trended over time.

Variable Labor Variance
Breaks down your variable labor cost variance into its components of labor price variance and labor efficiency variance. The two graphic panes for the time period selected show the variances in total and trended over time.

Activity Variances
Helps you examine the components of your flexible budget to answer the following key questions:

- Was the overall volume of tests and procedures higher or lower than expected? The volume variance moves directly in proportion to the volume changes.
- Was the mix of tests and procedures more or less intense than expected? The mix variance reflects changes in the types of tests that make up the volume.

The information is presented in the following graphic panes for the specified time period:

- Mix and volume variance totals
- Mix and volume variance trended over time

Volume Overview

Shows the total fixed budget volume and total actual volume, and the budgeted and actual volumes trended over time.

Narrative Reporting

In previous modules you have seen how data is initially accessed in graphical and tabular formats. Therefore, we will now start to put more focus into presenting data in plain English. Using **Narrative Variance Summary**, you can see a narrative report in English.

Taking that same information that you see in graphs and tables and transforming it into text will create a report covering topics including:

- What was the amount supposed to be spent according to the fixed budget and what was really spent.
- What does the variance mean in terms of increase or decrease in volume.
- How the variance was reflected in the flexible budget.

How the department or group achieved its favorable or unfavorable variance reporting the differences that were due to factors including labor price, labor hours, variable supplies, and fixed cost components.

Labor Price Variances

Presents the components of your variable labor costs in the following two graphic panes for the time period selected:

- The hourly rate variance and the overtime variance
- Labor price variance trended over time

Labor Efficiency Variances

Presents the efficiency component of your variable labor cost in the following two graphical panes for the time period selected:

- The total variances for time worked (both regular and overtime), which shows whether there was enough workload to justify the cost of that time, and the total variances for vacation/sick/holiday costs
- Labor efficiency variances trended over time

Decision Support Objects

Glossary

A

Active Pane/Information Frame: The pane or information frame that is highlighted. Commands you initiate from the Function Menu apply to the information frame.

Actual Cost: What a product or service actually costs in terms of its fixed and variable components, such as labor, supplies, and equipment depreciation. Frequently different from the budgeted cost.

C

Cost Variance: The difference between the standard or fixed budget cost and the actual cost.

D

Department Management Structure: The basic administrative structure of your healthcare institution, which includes all departments in your institution.

F

Fixed Budget: A fixed budget is based on the expected volume and mix of tests and procedures at standard cost, taking into account the fixed and variable components of the cost.

Fixed Costs: Costs that remain the same regardless of the case volume.

G

Group Structure: A structure containing a single level of nodes within a larger structure; a subset of the department management structure such as labs or nursing.

N

Net Revenue: The amount of revenue remaining after all deductions, including uncollectables and contractual allowances, have been deducted from gross revenue.

Node: Any specific location in an organizational or rollup structure.

P

Profit: The excess of net revenue over expenditures.

R

Rollup Structure: A structure used to organize a management division structure by identifying the smallest applicable units and then rolling them up into the next highest organizational unit. The rollup continues until each level of the structure includes all of the levels directly below it. The resulting structure can be represented graphically as a tree.

S

Standard Cost: What a product or service should cost in terms of its fixed and variable components.

V

Variable Costs: Costs that vary directly and proportionately with volume.

Variance: The difference between actual and budgeted amounts. Variances can be calculated for costs, revenue, or profit.

Variance Analysis: A process that subdivides the total discrepancy between budgeted and actual amounts in meaningful components.