LEBANESE AMERICAN UNIVERSITY

CREATIVITY ENHANCING DSS

THE EFFECT UPON MANAGERIAL DECISION MAKING
- EXPERIMENTAL DESIGN -

BY

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To my Parents,
Siham and Riad,
whose love and discipline
brightened the way for my
achievements.

For Manal -
who served in so many
ways, only one of which is
her ceaseless efforts to help
accomplishing this work.

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My hope and expectations are that this effort will be a helpful work towards assisting further studies aiming to reveal the relationships between various types of Decision Support Systems and the behavioral conducts and quality performance of potential users in Lebanon as well as other concerned countries.

Preface

"If you combine powerful technology with fantasy, you create something very distinct, Good Words for modern managers to live by."[1]

Nicolas Hayek

Decision making has never been easy; however, it is especially challenging for today's managers. In an era of accelerating change, the pace of decision making has also progressed rapidly. A team of experts, Morgan McCall and Robert Koplan, dealt with the subject of decision making by using the analogy of a stream:

> If decisions can be viewed as streams -streams containing countless bits of information, events, and choices- then how should decision makers be viewed?... The streams flowing the organization do not wait for them. The streams do not serve up problems neatly wrapped and ready for choice. Rather, they deliver the bits and pieces, the problems and choices, in no particular order...
>
> In short, decision makers in an organization are floating in the stream, just led capriciously by problems popping up, and finding anchors through action at a given time in a given place.[2]

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[1] William Taylor, "Message and Muscle: An Interview with Swatch Titan Nicolas Hayek", Harvard Business Review, (No. 71, March-April 1993), p. 101.

[2] Robert Kreitner, Management, (Boston: Houghton Mifflin Company, 1995), p.228.

Taking these environmental challenges and changes into consideration, the demand for creativity in the practice of management has become increasingly important. Nearly all managerial problem solving requires a healthy measure of creativity as managers are expected to mentally take things apart, rearrange the pieces in new and potentially productive forms, and look beyond normal frameworks for new solutions. Some people naturally seem to be more creative than others. However, it does not mean that those who feel the need cannot develop their creative capacity.

In fact, this research was conducted with the assumption that all people have the potential to become more creative. Thus, creative ability can be learned, in the sense that the creative energies of individuals can be released from the bonds of convention, lack of self-confidence, and narrow thinking. This, of course, could be achieved if individuals were provided with the proper environment and tools needed to enhance their creative abilities. The computer technology could offer a lot of such supportive tools.

Examining the market of computer technology, one can find out that computer applications for management support are on the rise. The microcomputer revolution -both hardware and software- made computers available for all types of managerial information processing requirements. It also facilitated the use of computerized analysis in the process of decision making in today's environment which is becoming more challenging and increasingly complex. With such facilities, managers are believed to make better decision because they have more accurate information within reach.

However, despite all these technological developments, the use of computers for managerial decision making is still highly limited, if at all available, to support simple decisions. Decision Support Systems (DSS) is one of the major technologies designed to change this situation. It is a computer-based technology being developed to improve the effectiveness of managerial decision making, especially in complex semi-structured and unstructured tasks that are

more based on qualitative than on quantitative measures. Such systems provide the means for interactive, user-controlled, human-machine dialogues that would support managers in their decision making processes. Two fundamental aspects of DSSs are:[3]

1. A support rather than a replacement of human cognitive processes, and
2. An attempt to follow and facilitate the natural human processes rather than to force-fit it into a designer's notion of the best process.

The purpose of this study is to define the various kinds of the DSS technologies, especially the advanced ones, and to investigate their use or potential use in organizations operating in the Lebanese market. An experimental design was conducted where participants were given a certain case to make a decision about using a DSS. This was done to investigate the following points:

1. The effect that a creativity enhancing DSS might have on the quality of the decision made,
2. The attitudes and perceptions of users about the DSS being used, in terms of its usefulness, case of use, and friendliness, and
3. The major aspects that should be taken into consideration by DSS designers and developers to provide users with an efficient and effective DSS technologies.

It is hoped that this effort will assist in furthering the studies aimed at improving the level of computer usage in organizations operating in Lebanon and at investigating the factors that are most likely to play a critical role in designing and using effective DSS.

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[3] Lawrence Young, Decision Support and Idea Processing Systems, (IOWA: Wm. C. Brown Publishers, 1989), p. 3.

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CHAPTER I

Introduction and Theoretical Background

1.1. General Overview

The business world today has reached the age of evolving information technologies upon which competing successful organizations are depending to improve productivity and enhance performance at all levels of management. Each of these organizations is dealing with myriad of information whether by collecting it, processing it, storing it, or using it as a base for their decision making. For this purpose, Management Information Systems (MIS) have developed to include the computer element, and progressed to the level of Computer-Based Information Systems (CBIS), which have invaded most aspects in the daily lives of all people. Their impact is prominent in organizations affecting the way work operations are being handled, commitments being met, and information exchange among employees being done. The rapid advancement of information technology (IT) which is taking place at a high pace and the importance of information as a management vital resource, along with the higher growth rate of end-user computing, have put all organizations before the challenge of keeping themselves up-to-date with all what technology can offer in terms of efficiency, effectiveness, productivity, better quality work, and thus

competitive advantage. Managers, whose support and involvement are crucial to the successful adoption and implementation of computer-based information systems, could realize that computers can provide them with value-added information processing power, the fact that led them to consider these machines as real assets and not as technological costs. The way to such a view was paved by what technology could offer in terms of hardware and software availability at lower prices and better compatibility, and the accessibility to software tools that could help managers in their major and most crucial task, decision making. In fact, managers, in carrying out their management functions and activities, are involved in a continuous process of decision making, and it is the quality of this process and the way it is applied that would determine the success or failure of organizations.

The role that tools offered by technology to support the managerial decision making process can play has become highly pervasive with today's rapid changing environment and increasing complexities. Such changes and complexities within the business and its environment take place in factors that have had an impact on managerial decision making including technology, competition, global markets, political stability and others. The trend of change in these factors along with the results associated to these changes are shown in *Figure 1.1*. An organization can not be viewed as operating in a vacuum; rather, it is a part of a system that affects and becomes affected by various changing factors surrounding it. The decision making process will be influenced, and will thus become a complicated process. This could be majorly attributed to three basic

reasons[1]. First, the decision-maker will be faced with various alternative courses of action to evaluate and select from. Second, the occurrence of errors can be highly costly due in fact to factors such as competition availability, large size of operations, cost of automation, and the effect that an error in one part of the organization system may have on the other parts, and third, the higher level of uncertainty with which the manager will operate. Here comes the importance of developing computer-based technologies that would improve the effectiveness of managerial decision making.

Figure 1.1 - Factors Affecting The Managerial Decision Making.

Factor	Trend	Results
Technology	Increasing	More alternatives to chose from
Information/ Computer	Increasing	
Structural Complexity	Increasing	Larger cost of making errors
Competition	Increasing	
International Markets	Increasing	More uncertainty regarding the future
Political Stability	Decreasing	
Consumerism	Increasing	
Government Intervention	Increasing	

Source: Efraim Turban, Decision Support and Expert Systems, (N.Y.: Macmillan Publishing Company, 1993), p. 9.

Furthermore, in cases of uncertainty where the problems to be solved move away from being structured or programmed, and become broader with various aspects and associated probabilities, creative solutions and decisions will be required. Keeping the previously mentioned factors, changes and effects in mind, "It can be argued that those firms that can generate creative strategies for

[1] Robert P. Vecchio, Organizational Behavior, (London: The Dryden Press, 1991), p.

coping with decisions may enjoy an important competitive edge."[2] Here comes another important factor in developing computer-based technologies, and that is establishing and improving the tools that would enhance the creativity of decision makers reaching more effective and profound decisions. In the following sections several aspects of decision support systems (DSS), creativity and enhanced creativity DSS along with shedding the light upon the need and purpose of this study will be discussed.

1.2. Managers' Major Role As Decision Makers

Management has traditionally classified problems and opportunities into a variety of categories including: long-run, short-run, internal, external, company, departmental, job, recurring and nonrecurring types. Management faces the task of solving problems and seizing opportunities in the decision making process. Decision making, the act of selecting a preferred course of action among alternatives, enters into almost all of a manager's activities; in fact, it is the essence of a manager's job. Managers must reach decisions about objectives and plans for their organizational units. They must decide how to organize, direct, and control. A considerable amount of the manager's time is spent in gathering and evaluating information upon which a decision is based.

The importance of the managers' role as decision makers lies in the fact that businesses and other organizations survive by making and implementing

360.

[2] Ibid., p. 361.

enough of the right decisions. If the making and implementation are separated and taken alone they may not lead to the expected success. Timing and implementation here are crucial since organizations might fail either because they make the right decisions, but are unsuccessful in implementing them, or succeed in implementing the wrong decisions. The success of an organization hinges upon the managers' ability to make good decisions at the proper time and implement them well. This direct relationship between the success of the organization and the quality of the managers' decisions become more and more emphasized when the rapid changes and increased complexity of today's business environment are taken into consideration as was previously mentioned.

Considering the prevailing conditions, the nature of the manager's decisions becomes quite varied. It could be a simple one where, in making the final choice, a manager can rely on simple guidelines and techniques such as rules, policies, procedures, or basic quantitative analysis. At other times, it is a complex one where the manager must resort to judgment, intuition, and supportive mathematical tools and techniques. In deciding how to approach each particular situation, the manager needs an understanding of the basic nature of decision making. Specifically, this requirement involves reviewing the situation, understanding the types of decisions that will be involved, determining the conditions under which the decision will be made, and having an adequate grasp of the techniques involved in making effective decisions.[3] The following sections will examine these kinds of required knowledge.

1.2.1. Types of Decisions

The manager needs to have a fundamental grasp of the various types of decisions. A basic way to differentiate among the types of decisions was proposed by Herbert Simon, who based his categorization upon whether decisions "are fairly routine and well-structured or novel and poorly structured."[3] The former kind is termed as programmed decision, and the latter is termed as nonprogrammed.

Programmed decisions are those that are traditionally made using standard operating procedures or other predetermined and well-defined methods. Some standard modern techniques include the use of operations research, mathematical analysis, and computer simulation tools. These decisions are considered the easiest for managers to make because they can be based upon preestablished patterns or programs to provide an answer.

Nonprogrammed decisions are unique and nonroutine. Here, no predetermined pattern or procedure can be followed. As put by Simon, these decisions are ill-structured, one-shot decisions. "Traditionally, they have been handled by techniques such as judgment, intuition, and creativity. More recently decision makers have turned to heuristic problem-solving approaches in which logic, common sense, and trial and error are used to deal with problems that are too large or too complex to be solved through quantitative or computerized

[3] Ibid., p. 343.

approaches."[4] Computerized approaches, however, have been recently introduced and are still being developed in ways so as to provide decision makers with supportive tools that would enhance their creativity and add to the effectiveness of the decision making process they get involved in. Because managers, especially those at the tactical and strategic level, are faced most of the time with situations requiring such kind of decisions, "many management training programs are designed to help managers think through problems using a logical, nonprogrammed approach."[4] Thus, they learn how to deal with irregular, unique, and nonroutine situations. *Table I* shows the traditional and modern techniques of decision making applied onto the two types of decisions as being proposed by Herbert Simon.

It is worth noting here, and based on what has just been mentioned, that decisions are made under one of three conditions depending on the amount of information a manager has an access to regarding the problem he or she considers for solution. These three conditions are certainty, risk, and uncertainty. Under conditions of certainty, the manager has enough information to know the outcome of the decision before it is made. Uncertainty exists when the probabilities of the various outcomes are not known. Under this condition, the best approach a manager could follow is to gather data on the alternatives or to make assumptions that allow the decision to be made under the condition of

[4] Richard M. Hodgetts & Donald F. Kuratko, Management, (NY: Harcourt Brace Jovanovich, Inc., 1988), p. 79.

risk.[5] In fact, most managerial decisions are made under conditions of risk. Risk exists when the individual has some information regarding the outcome of the decision but does not know everything. When making decisions under conditions of risk, the manager is most likely to assign probabilities to the various alternatives. Here, a good decision will depend upon how accurate the assigned probability is.

Table I - Traditional and Modern Techniques of Decision Making

Types of Decisions	Decision-Making Technique: Traditional	Decision-Making Technique: Modern
Programmed: Routine, repetitive decisions Organization develops specific processes for handling them.	1. Habit 2. Clerical routine: Standard, operating Procedures. 3. Organizational structure: Common expectations. A system of subgoals. Well-defined informational channels.	1. Operations research: Mathematical analysis. Models. Computer simulation. 2. Electronic data Processing.
Nonprogrammed: One-shot, ill-structured, novel policy decisions. Handled by general problem-solving processes.	1. Judgment, intuition, & creativity. 2. Rules of thumb. 3. Selection and training of executives.	Heuristic problem-solving technique applied to: a. Training human decision makers b. Constructing heuristic computer programs.

Source: Herbert A. Simon, The New Science of Management Decision, rev. ed. (Englewood Cliffs, N J: Prentice - Hall, 1977), p. 48.

Source: Hodgetts & Kuratko, Management, p. 79.

[5] Ibid., p. 81.

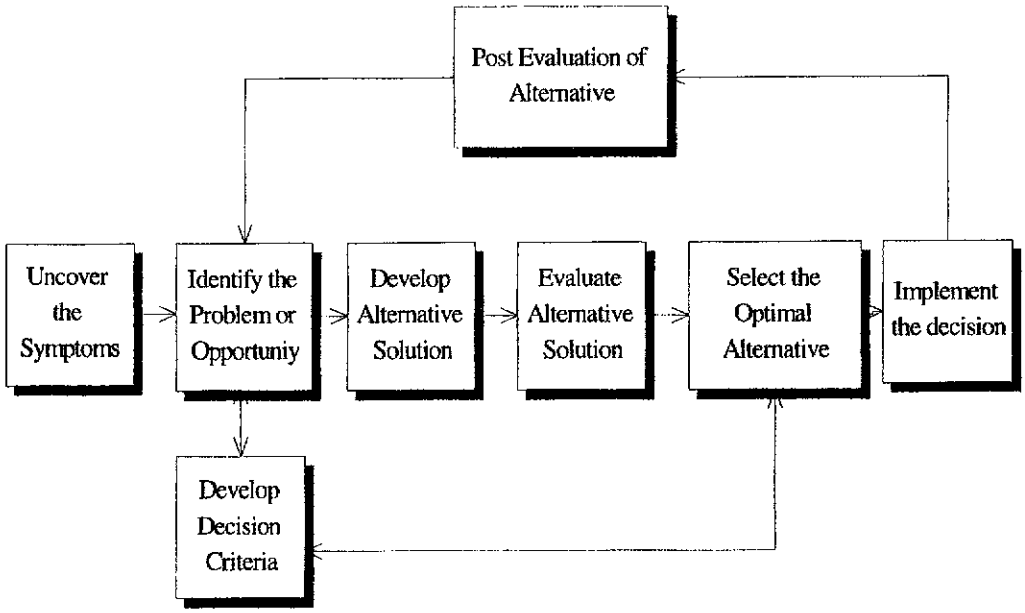
1.2.2. The Process of Decision Making

In this section, the steps involved in the decision making process will be presented based upon two views: The classical decision theory and the behavioral decision theory.

1.2.2.1. The Classical Decision Theory

This theory, which is often referred to as rational-economic decision making model, describes how decisions are made in the ideal. Nevertheless, when the problem or issue is a simple one that is addressed in a logical fashion, the steps as outlined in *Figure 1.2* describe how decisions are made. As the figure shows, the first step is to uncover the symptoms of the problem. The symptom will be considered as a set of circumstances leading the decision maker to recognize that a certain problem or opportunity exists. Recognition of the problem or the opportunity is an essential step since it will result in the occurrence of the decision making process. The next step would be to develop criteria for evaluating the alternative courses of action. After this, the decision maker lists all of the possible solutions to the problem. These alternative solutions should be evaluated according to the predefined criteria and based on the information collected about them. From this evaluation, a single optimal solution will be selected. The final step in the process would be to implement the selected decision. Post evaluation here is important to determine the effectiveness of the alternative and to determine whether further action should be put into effect.

Figure 1.2 - Steps Involved in the Rational Decision Making Process



Source: Hodgetts & Kuratko, Management, p. 83.

A major criticism of the classical decision theory is that it includes a lot of deficiencies. "One major set of deficiencies... lies in its assumption that all alternatives will be considered, that the consequences of each alternative will be considered, that accurate information is available at no cost, and that decision makers are totally rational beings."[6]

[6] Vecchio, Organizational Behavior, p. 345.

1.2.2.2. The Behavioral Theory of Decision Making

Because the rational-economic model is an ideal one, the behavioral theory of decision making, also called the administrative model, has come as an alternative model providing a more descriptive view of managerial behavior. This model is based on the concept of bounded rationality which means that managers are restricted in their decision making process and must work to reach to something less than an ideal solution. In this case, they "satisfice" rather than "maximize."[7] That is, instead of attempting to find the best or optimal solution, a decision maker considers each alternative until an acceptable one is reached. A model of the behavioral theory of decision making is presented in *Figure 1.3.*

1.3. Enhancing the Process of Decision Making through Supporting Techniques

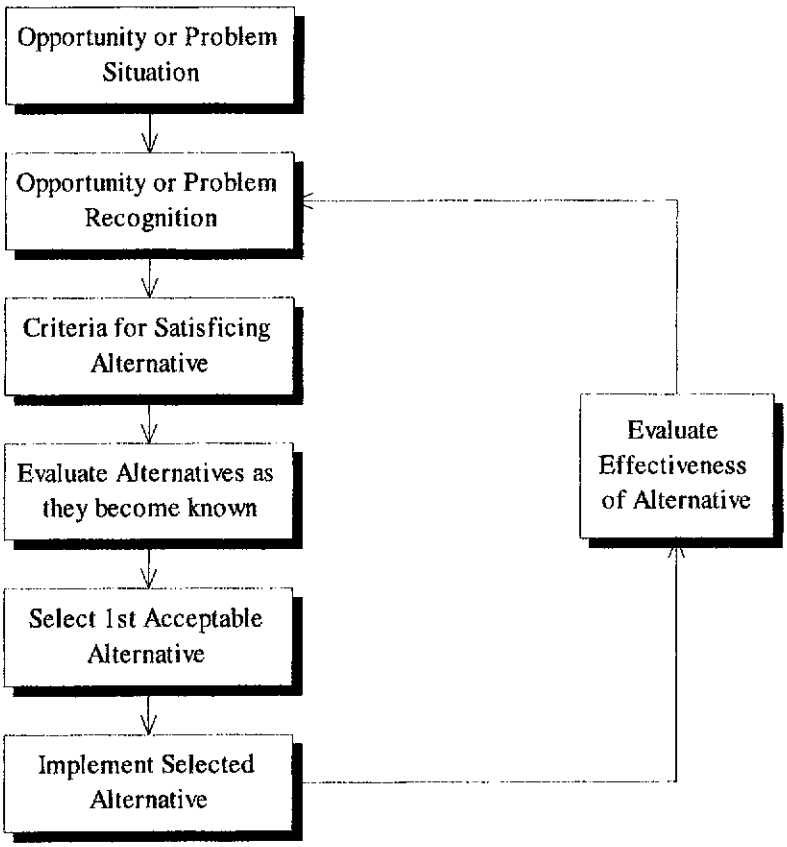
In looking for ways that would lead to more effective decision making, it was found through many studies that, in general, there are certain effective techniques that would establish a format for making a decision. These techniques take advantage of the positive features of group decision making including:[8]

- Nominal Group Technique (NGT), where seven to ten individuals are brought together to participate in a highly structured exercise. The members here will silently record their ideas about how to solve a problem and present their ideas without discussing their merits. Then, ideas will be clarified and

[7] Ibid., p. 346.

evaluated, followed by the individuals silently and independently voting on each idea.

Figure 1.3 - The Decision Making Process: The Administrative View.



Source: Vecchio, Organizational Behavior, p. 347.

- Delphi Technique, which is similar to NGT, but differs significantly in that the decision makers never actually meet. The options of a group of expert will be surveyed via mailed questionnaires. These opinions will be analyzed,

[8] Ibid., p. 360.

summarized and sent again to the expert for further responses and opinions. This process will be repeated until a consensus is reached.

- Bootstrapping, which is sometimes called expert systems, is a device used for improving both individual and group decision making. It is a procedure of analyzing an individual's decision making process and using the resulting model. This method is based on the concept that a decision maker starts with mere intuition, then states a certain set of rules that can be employed as a formal decision model.

1.4. The Concept of the DSS as a Supporting Tool

The above mentioned techniques can be used to enhance individual and group decision making; however, a question that poses itself now is the following: In this era of computers and information technologies, what is the role of CBISs in aiding managers in accomplishing their major task of decision making? In fact, as a result of the end-user computing trend, technological advancements in hardware, software, and telecommunications are providing managers with facilities that can assist them in their jobs. Computer applications are moving from those involved in transaction processing and report generating to those involved in problem solving and decision supporting.[9] Such management support systems technologies include:(1) Group Decision Support Systems

[9] Efraim Turban, Decision Support and Expert Systems, (NY: Macmillan Publishing Co., 1993), p. 5.

(GDSS), (2) Executive Information Systems (EIS), (3) Expert Systems (ES), and (4) Decision Support Systems (DSS) - the focal point of this study.

1.4.1. What is a DSS?

Decision Support Systems (DSS) is a term used to describe information technology systems that support, not replace, managers in their decision making activities. As its name implies, a DSS provides managers with decision support; that is, it helps them reach a decision through simulation, interaction dialogues, and models. In addition, they are used for decisions that are only partly structured (i.e., semistructured) or unstructured. In such cases, a decision maker should resort to his/her judgment. As reported by Sprague and McNurlin, Sprague and Carlson gave a definition that includes the major aspects of DSS. This definition considers DSS as "computer-based systems that help decision makers confront ill-structured problems through direct interaction with data and analysis models."[10] Technically speaking, a DSS needs not to involve high technology. For example, to a writer, a selected group of library journal and text resources may serve as a part of a decision support system. Or, to a manager involved in a great investment project, the advice provided by an expert consultant in the field may be a part of the managers' decision support system. In this technology-oriented research, still, it will be assumed that all of the DSSs being discussed are CBISs.

[10] Ralph H. Sprague & Barbara C. McNurlin, Information Systems Management In Practice, (London: Prentice - Hall International, Inc., 1986), p. 363.

1.4.2. Properties of DSS

Most textbooks and works of research agree that all DSSs are characterized by at least three properties: (1) they have a semistructured or unstructured decision focus, (2) they are flexible to changing needs, and (3) they are easy to use.

1.4.2.1. Semistructured or Unstructured Decisions

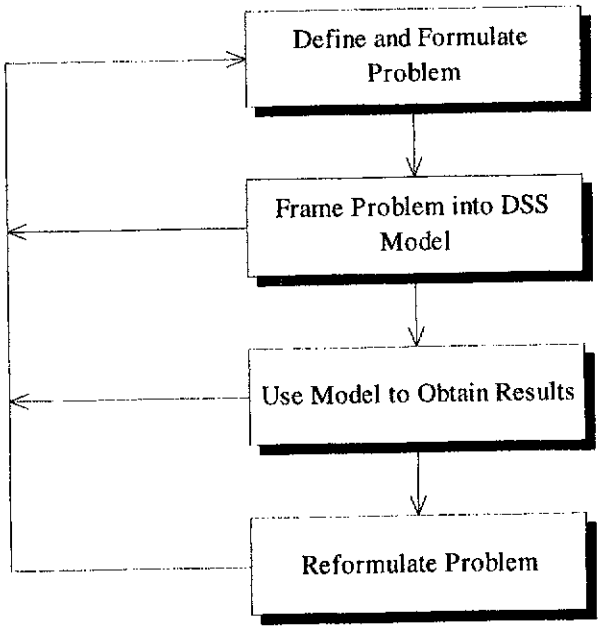
The DSS is particularly well adapted to help with semistructured or unstructured decisions. Unstructured and semistructured decisions are decisions for which information obtained from a computer system is at most only a portion of the total information needed to make the decision.

Using a DSS to solve a problem will follow the model presented in *Figure 1.4*. As it is shown, the problem will be first defined, then, it will be modeled with DSS software. Next, the model is processed on the computer to provide results. In reviewing these results, the decision maker might decide to completely redefine the problem, adjust the model, or use the model to obtain other results.

1.4.2.2. Flexibility to Changing Needs

Because of the unavailability of a predetermined set of rules to which semistructured and unstructured decisions conform, the DSSs that support those decisions need to provide for enough flexibility to enable users to model problems according to their information needs. Flexibility in a DSS is of high importance since information requests made to a DSS will often be relatively unsystematic and might be within various formats requiring various formulas, functions, graphs, formal models, and so on.

Figure 1.4 - Steps involved in Solving a Problem with a DSS.



Source: Charles S. Parker, Management Information Systems, (N.Y.: McGraw-Hill Publishing Company, 1989), p. 434.

1.4.2.3. Ease of Learning and Use

As a product of the end-user computing trend, DSSs are often built and operated by users rather than computer professionals. As such, the tools that accompany DSSs should be relatively easy to learn and use. Software tools often employ user-oriented interfaces such as grids, graphics, nonprocedural 4GLs (Fourth Generation Languages), natural language, and easily read documentation to make it easier for users to perform the decision making process. Moreover, interactive systems which a DSS may employ will enable the user to base each

new request on the system's response to earlier requests. These interactive systems help to make DSSs friendly and useful.

The above mentioned major properties of DSS along with other properties are presented in *Table II*. After presenting the major properties of DSS, it is interesting now to look at some of the tasks commonly performed by DSSs. Four common tasks performed by DSSs are information retrieval, data reconfiguration, calculator activities, and analysis:[11]

Table II - Properties of DSS

A- Most DSSs are characterized by:
- Support for Semistructured and Unstuctured decision making
- Flexibility in specifying output requirements
- Ease of use and ease of development for nonprofessionals
- Fast response
- High degree of user control and interaction
B- Many DSSs are characterized by:
- Top management focus
- Interactive display technology
- Use of models
- Dificulty in cost justifying
- Evolutionary development
- Focus on effectiveness rather than efficiency

Source: Parker, Management Information Systems, p. 437.

Information retrieval in a DSS environment usually refers to extracting information from a database or from data files in order to make a decision.

[11] Charles S. Parker, MIS, (NY: McGraw-Hill Publishing Co., 1989), pp. 440-447.

DSSs also reconfigure data into forms other than the way they are logically represented in the computer system. They do this by enabling users to sort, exchange fields, join data, and use presentation graphics.

A DSS also enables users to perform calculator activities -a set of tasks that is normally done with a calculator. Such activities are implemented either by having the user write out a complete formula or by having him or her call a function built into the DSS. Functions are prestored formulas that perform calculator-type tasks.

A DSS is performing analysis when it allows users to review facts and draw conclusions based on those facts. DSS provides users with four kinds of analysis: Statistical tools, Optimizing tools, What-if analysis, and Artificial Intelligence. Statistical tools allow users to perform statistical analysis functions that would help in establishing forecasting and estimation models. Optimizing tools provide users with the ability to use mathematical tools such as inventory control techniques and queuing theory to recommend certain alternatives to the decision maker. What-if or Sensitivity analysis is a simulation technique that allows a user to reformulate a problem many times with different values for the problem variables in order to get useful information for decision making. Finally, Artificial Intelligence (AI) techniques also improve the analysis function by providing the user with the facility of the "Why-analysis." With this technique,

the user, by using a natural language, can ask DSS to explain why something happened. [12]

In fact, managerial decisions are generally broad and based to a large extent on intuition. Such aspects are reflected in the manager's decision making environment, which is itself characterized by unstructuredness, a high degree of uncertainty, a future orientation, and a low level of detail. To meet these challenges, DSSs are being developed in a way so as to provide managers with advanced facilities that would enhance their creative thinking abilities. This, of course, will open the way before the managers to think more productively of alternative solutions and reach more creative types of decisions. However, how does the way a manager thinks get affected by the kind of DSS being used? How would managerial activity in decision making be enhanced? To answer these questions entails getting into knowing the various types of thinking, the factor of creativity, and the aspects that are most likely to be associated to creativity enhancement.

1.5. Human Thinking

Being in the stage of presenting the effect of enhanced decision support tools upon the way managers think and get more creative, it is important to reveal certain aspects related to the human brain -the source of all thinking power- and to the various types of thinking.

[12] Ibid., p. 436.

1.5.1. The Human Brain

In our attempt to understand the effect of certain supportive tools upon the way a manager thinks, examining how the human brain functions can prove beneficial. To start with, it is important to recall that the human brain consists majorly of two halves: the 'left hemisphere' and the 'right hemisphere'. As to the types of mental processes with which each hemisphere deals, the following had been discovered:[13]

Left Side	Right Side
Logic	Rhythm
Reasoning	Music
Language	Imagination
Numeracy	Images
Analysis	Color
Linearity	Shape recognition
Digital	Daydreaming
Abstract	General Creativity

A research conducted by Roger W. Sperry at the California Institute of Technology during the 1950's and 1960's and reported by Nadler, Hibino and Farrell[14] showed that both hemispheres of the brain are capable of complex modes of thinking. These are briefly summarized in *Table III.*

As described by Sperry, the two mental modes that are associated with each half of the brain are the verbal and the nonverbal one. The former is controlled by the left hemisphere and the latter by the right. The left hemisphere

[13] Simon Majaro, Managing Ideas for Profit, (London: McGraw-Hill Book Company, 1992), p. 61.

[14] Gerald Nadler, Shozo Hibino & John Farrell, Creative Solution Finding, (LA: Prima Publishing, 1995), pp. 244-247.

works in a computer-like fashion with logical and analytical tools. Thus, mathematicians, statisticians, or analysts have the left functions dominant. On the other hand, the right hemisphere is responsible for complex synthesizing which characterizes the performance of artists, musicians, or daydreamers. As could be derived from what has been just mentioned and from the list of characteristics presented in *Table III*, the right-brain is more involved with the creativity factor than the left-brain. However, Sperry's work has shown two major interesting things:[15] (1) The brain is capable of performing more complex tasks than has been thought, and (2) when encouraging to develop the weaker functions of their mental process, people will be capable of strengthening all areas of their mind's performance. These two important points have their implications that will be referred to in later discussions.

Table III - Characteristics of Left- and Right-Brain Thinking

Left - Brain	Right - Brain
Intellectual	**Intuitive**
Covergent	**Divergent**
Digital	**Analogical**
Propositional	Imaginative
Linear	Nonlinear
Rational	Affective
Sequential	Multiple
Analytical	Holistic
Objective	Subjective

Source: Nadler, Hibino & Farrell, Creative Solution Finding, p. 245.

[15] Majaro, Managing Ideas for Profit, pp. 62-63.

1.5.2. Types of Thinking: Convergent vs. Divergent

As could be noticed from *Table III*, convergent thinking is a left-brain characteristic, whereas divergent thinking is a right-brain characteristic. In fact, a review of the writings pertinent to this field shows that there are three types of thinking: Cognition, Divergent, and Convergent thinking. These three types of thinking were identified and explained by the psychologist, J. P. Guilford, who found that human decision making involves three distinct but interrelated thinking processes, which serve the decision maker with different functions and applicability.[16] To start with, cognition thinking allows the decision maker to acquire a clear understanding of the situation he or she is facing. Cognition is the process by which "that raw information is given sense and structure,"[17] and this is an essential first step of letting the decision maker see where he or she is.

Talking about convergent and divergent thinking requires talking about Conventional and Full-Spectrum thinking. Conventional thinking "focuses ever-more-narrowly inward on ever-smaller parts of a problem and then, from an understanding of a minute part, assumes that answers for each part of a problem can be put together to solve the whole problem. On the other hand, Full-Spectrum thinking develops outward and follows an ever- expanding hierarchy of purposes to understand first the whole, then, through an understanding of the whole, to

[16] Robert Miller & Stephen Heiman, Conceptual Selling, (NY: Warner Books, Inc., 1987), pp. 182-183.

[17] Ibid., p. 184.

comprehend the parts as well."[18] In conventional thinking, convergent thinking is used to arrive to what is regarded as the one "right" solution to a problem. It is called convergent thinking because when a decision maker converges on a solution, he/she is narrowing and focusing his/her view point. Divergent thinking may be thought of as "brainstorming"[19]- a technique believed to help people, groups and organizations to become more creative. The basic philosophy of this technique is that idea generation must take place in a relaxed environment independent of any attempt to evaluation or criticism. Applying this pattern of thinking - the divergent thinking -, a decision maker can discover many alternative solutions to his/her problem. This type of thinking works best when there are no constraints put on the person who is looking for solutions. The point here is to explore the various possibilities and not to exclude them.[20]

After presenting the various types of thinking and associating them to the concept of creativity, it is important now to tackle this concept more elaborately, especially from the perspective of managerial decision making.

1.6. Creativity: Definition and Concept

In early ages, the term creativity was used to describe people who were successful artists, innovators, or poets. Recently, the methodology of creativity has been deeply extended to business. Driven by embarrassing shortfalls in

[18] Nadler, Hibino, & Farrell, Creative Solution Finding, p. 320.

[19] Ibid., p. 321.

[20] Miller & Heiman, Conceptual Selling, p. 186.

productivity and the loss or failure of business, organizations are recognizing the need for innovation, and hence the value of the creativity of inventors, entrepreneurs, and business consultants in various fields. Simply put, creativity is the ability to come up with ideas, and then to develop these ideas appropriate for innovation, problem solving, or decision making, i.e., it is " the thinking process that helps us generate ideas."[21] It is "seeing what everyone else sees, but thinking what no one else thinks."[22]

A creative person is the one who owns a few, if not all, of the following characteristics:[23]

a- Conceptual fluency : being capable of generating many ideas in response to a given situation within a short time period.

b- Mental flexibility : being capable of changing a line of thought and taking a lateral leap towards a related frame of reference.

c- Originality : having the ability to give unusual answers to questions or unique responses to certain problems.

d- Suspension of judgment : having the ability to express comments, opinions, and ideas at a later stage and only after the advantages of each idea have been explored adequately and in depth. This is advantageous in order to avoid the resistance and objection of others.

[21] Majaro, Managing Ideas for Profit, p. 6.

[22] Stan Kossen, The Human Side of Organizations, 1983, p. 46.

e- Impulse acceptance : having the tendency to accept an idea because it simulates his or her inner imagination and fantasy.

f- Attitude towards authority : having the readiness to challenge authority and an unwillingness to accept the idea that what the top authority says is always correct and inviolable.

g- Tolerance : having a high threshold of tolerance towards the ideas of colleagues, subordinates or bosses.

One would expect to find differences in the creativity level among people, and this is true since there are different types and modes of thinking, perceptions, and personal attributes. To start with, the mode of thinking used to find solutions is the link between how people perceive a problem and how they implement a change. Many solution finding approaches can be considered but all are summarized in four basic approaches: do-nothing, chance, affective, and rational. Assuming that people want to solve their problem, the chance approach includes trial-and-error method and focuses on accidental problem solving. Affective approaches rely on intuition, insights, feelings, and divergent thinking. Rational approaches are distinguished by structured, systematic, methodical "scientific" processes.[24] Accordingly, depending on the approaches used, the mode of thinking will be altered, thus affecting the level of creativity in problem solving.

[23] Majaro, Managing Ideas for Profit, pp. 68 - 73.

[24] Nadler & Hibino, Creative Solution Finding, p. 119.

As to perceptions, it is commonly believed looking at a problem from different perspectives will help managers find veiled solutions in which their problem becomes workable and ready to be solved. Finally, as to personal attributes, there are four psychological functions that encompass the basic attitudes affecting conscious behavior. These functions -sensing, intuition, thinking, and feeling- form the cognitive style of the individuals who have preferences for certain types of data in their thinking. Sensation-dominant people for example prefer accurate and specific data since they are realist concerned with the immediate problem. The other functions-dominant people vary in terms of the way they make decisions, the extent to which they use reasoning and logic and evaluate data, and their reliance on their judgment as well as their experience. The four deduced personality types - (1) Sensing-Thinking; (2) Intuition-Thinking; (3) Sensing-Feeling; and (4) Intuition-Feeling - result in people or managers acting differently across a diversity of situations with distinct creative abilities.

1.6.1. The Creative Process

In the various proposed models of the creative process, four major steps were included:[25]

1- *Preparation*: This is a stage of sustained study where the cognitive memory is the predominant mode of thinking. In this stage, two things

[25] Nadler, Hibino, & Farrell, Creative Solution Finding, p. 246, and Vecchio, Organizational Behavior, p. 363.

take place: opportunity or problem recognition, and immersion where the individual collects and recalls information that is relevant to the situation.

2- *Incubation*: In this phase, the information collected and recalled will ferment in the person's subconscious. Although one is not appearing to be actively focusing on the problem, he/she is subconsciously rearranging the available information into new patterns.

3- *Illumination* or *Insight*: At this time, while a person is engaged in an unrelated activity, a good idea will come to mind.

4- *Verification*: As a final step, the person tests out the solution by logic or actual experimentation.

1.6.2. Enhancing Creativity

A developing climate that would enhance creativity in organizations requires an "imaginative, consistent, persistent and integrated program of work"[26] aimed at modifying the attitudes of persons and groups and simulating their enthusiasm. In the attempt to achieve these aims, it is very important to remember that a number of barriers can impede the way towards this goal achievement. Such barriers include a lack of organizational slack, where the employees are not allowed to "waste" time on thinking, exploring ideas or momentarily daydreaming, a heavier weight being put on doing rather than thinking, the organizational structure, and others.

[26] Majaro, Managing Ideas for Profit, p. 79.

Various techniques are available to enhance the creativity of groups and individuals. Other than the Nominal group technique and the Delphi technique which have already been discussed, other methods such as the following could be used:

- Brainstorming: As previously mentioned, in a brainstorming session, a group of people are encouraged to exchange ideas freely in an atmosphere that is nonjudgmental and non-critical. The quantity, rather than the quality, is emphasized at this stage. Later on, the recorded proposals are refined and evaluated.
- Grid Analysis: With this technique, ideas or materials of possible relevance to the problem in hand are listed on the sides of two-dimensional grid. Each possible combination of ideas is created and examined for its usefulness as a solution.

Other techniques are suggested that would increase the creativity of individuals. These include being unafraid of failure, permitting playfulness, identifying creative time periods in each day, and borrowing ideas. Because of the importance of the issue in nowadays' environment of business decision making, advanced aspects in the decision supporting tools have been developed to provide managers with facilities that would add to their creativity and to the quality of the decisions they make.

1.7. Enhanced Creativity DSS

The regular DSS, that have already been discussed in the previous sections can be successfully used for support of certain aspects in the functional

organizational areas. However, decision support can be provided in more complex settings potentially yielding large benefits such as better enhanced creativity and more effective decision making task. An enhanced DSS can be equipped with intelligent components.[27] These components can be used for various purposes, such as making it economically feasible to accomplish generic process tasks (e.g. problem formulation) and to perform repetitive decision making procedures made by the same DSS. Moreover, a regular DSS plays a passive role in human-machine interaction. The regular DSS will execute computations, present data in a tabular form, and respond to many commands. However, it will not "play the role of an intelligent assistant to the decision maker."[28] Of course, this factor restricts the use of DSS only to well- defined and unambiguous tasks. Nevertheless, certain tasks in problem solving are ambiguous and complex. In such case, the need will be for an enhanced DSS that can play an 'active' role where the interaction between the user and the machine is close and frequently in real time. Still another aspect is that most DSS, are centered around the design and choice phases or stages of the decision making process. The intelligence phase, which includes problem finding, problem representation, and information collection, is neglected by most DSS. Therefore, to make it more effective, it is important to automate as many tasks as possible. A final point is that an enhanced DSS should be equipped with facilities that would help the decision maker generate more ideas and be creative. This aspect can not be

[27] Turban, Decision Support and Expert Systems, pp. 336 - 343.

ignored since creativity for idea generation is an important activity in decision making. *Table IV* shows a summarized comparison between the features of the regular DSS and those of the enhanced one.

Table IV - Comparison of Features: Regular DSS and Enhanced Creativity DSS

Regular DSS	Enhanced Creativity DSS
- Analytical mode	- Creative and Analytical mode
- Semistructured and Unstructured problems	- Unstructured problems
- Passively or Reactively responding	- Proactively responding
- Less active tools	- More active tools
- Mid-range & long-range perspective	- Longer-range perspective
- Superficial thinking	- Deeper & more creative thinking
- Decision-centered	- Decision-paced
- Less quality in decision making	- More quality in decision making

Source: Turban, Decision Support and Expert Systems, pp. 336-350.

1.8. The Need for The Study

Management Support Systems refers to a collection of computerized technologies designed to support managerial work and especially decision making. These computerized applications for management support are on the rise. Most organizations, private and public, use computerized anlysis in their decision making. The cost of hardware and software is declining, whereas the capabilities and compatibility of information systems and networks continue to increase.

[28] Ibid., p. 337.

Various information systems are being developed and integrated with each other and/or with other automated systems to enable easy accessibility to data stored in multiple locations. Thus managers can make better decisions because they have more accurate information within reach. However, despite all these technological advancements, many managers running the organizations operating in the Lebanese market are not using computers at all, or are using them primarly to support simple decisions.[29] Decision support systems (DSSs), along with the other decision support technologies, are being designed to change this situation.

Moreover, 'creativity' and 'innovation' are two terms so popular and important that they can be considered as a required characteristic of the managerial job. The notion that creative and/ or innovative organizations are more likely to attain excellence and be at a better competitive edge than those who are not is universally accepted. However, in practice, not many organizations, if any, know how to develop or enhance the 'creative mode' in the way managers and employees carry out their tasks. One might find senior managers encouraging their subordinates to be more creative. Yet, there is a wide gap between what is required and what is really applied.

The need for the study thus stems from three basic reasons. First, managers operating in the Lebanese organizations are not fully aware of the great supportive advantages that computer technologies can provide them with. Computers are still majorly used to handle transactional processing operations

[29] In fact, interviews were conducted with managers of 60 organizations operating in different Lebanese industries. Almost all these managers confirmed their use of computers mainly

rather than more managerially serious tasks concerned with situation analysis and decision making. Second the concept of creativity is not well adopted, developed nor practiced in the Lebanese organizations. There should be more awareness about the importance of this concept in providing organization with the reward of success and excellence. Finally, no previous research work was conducted to study the effect of developing and using enhanced decision support systems upon the managerial creativity and work effectiveness in organizations working in the Lebanese national market.

1.9. Research Questions

1. What are the major characteristics of the decision making function practised in Lebanese organizations?
2. What are the creativity aspects of the managers operating in the Lebanese organizations?
3. What are the factors that are most likely to be associated to the use of creativity enhancing DSS (CEDSS) and to creativity?
4. Is there any kind of relationship between using a CEDSS and creativity?

1.10. Statements of Hypothesis

1. A user of CEDSS will adopt a multiple step decision process, whereas a user of no software will adopt a single step decision process.

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for transactional processing, and a few of them needed it to support simple decision making.

2. The use of CEDSS has a direct and positive effect upon creative managerial decision making.
3. Factors such as Playfulness, change effect, organizational and personal aspects and DSS features are related to the creativity aspects in decision making and to the decision making process carried out by individuals.
4. Users of a CEDSS will outperform the nonusers in the quality and creativity of decisions made and solutions provided.

1.11. The Statement of Purpose

Today's organizations are operating in an environment which is quite paradoxical. On the one hand, the challenges are high, the pace of change is large, the competition is fierce, and the power of claimants (environment, social, governmental, and others) is potent. On the other hand, technological resources are providing organizations with the benefits of better access to information, time saving, accuracy and effectiveness in work. In addition, computer software applications are available that would provide managers with the privilege of carrying out the managerial tasks - especially decision making - in a more efficient, effective and creative way.

Based on this, the study will shed light on the decision making practices in the Lebanese organizations and the extent to which they use decision support systems to carry out this task. Moreover, the factor *creativity* will be investigated as being applied to the decision making process carried out by the CEDSS user. Besides, based on an experimental design that will be conducted in this study, the factors related to and the outcomes resulting from the use of a CEDSS will be

identified. Such factors include personal attributes, perception, and computer knowledge, and such outcomes include creativity, playfulness, productivity and effectiveness. Finally, the factors that are most likely to be associated to creativity along with the relationship among the various variables will be investigated. The model to be followed in this study is presented in *Figure 1.5*.

As an outline for the research:

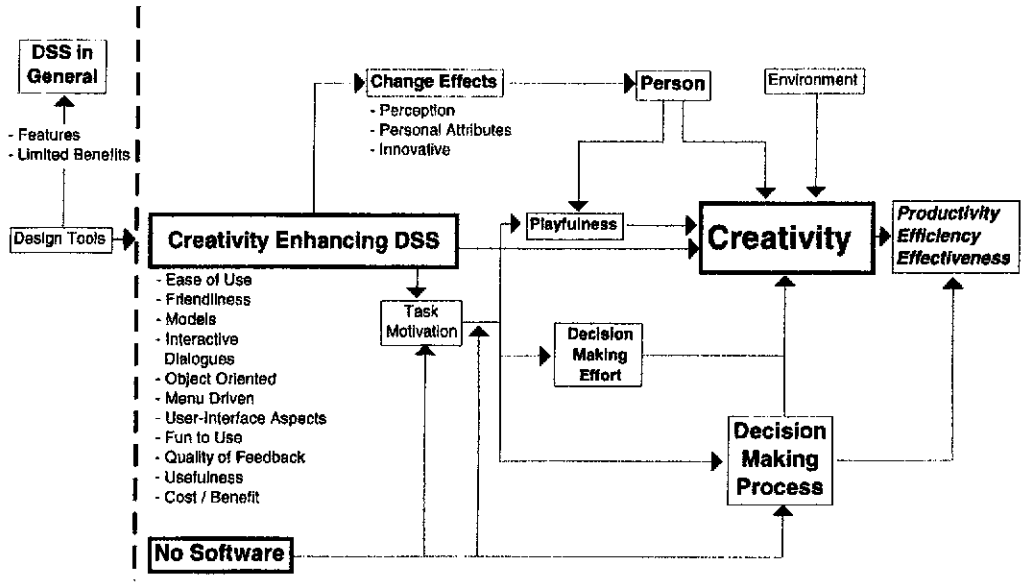
⇒ Chapter II will be a review of the literature and the research work that was conducted within the field of *Creativity Enhancing DSS and Creativity*,

⇒ Chapter III will be a presentation for the design and methodology to be followed in conducting the study and analyzing the findings,

⇒ Chapter IV will encompass the results of the findings and their analysis, and

⇒ Chapter V will summarize the findings and present the limitations and recommendations of this study.

Figure 1.5 - The Model of The Study



CHAPTER II

Review of Literature

2.1. Overview

The crucial role played by information systems in handling the daily operations, supporting the managerial decision making, and determining the success of organizations can never be underestimated. That marvelous set of information technology tools is no more looked at as a cost or as a luxury, but rather as an asset and as a necessity if the competitive edge is to be reached. The excellence of firms can be achieved by the quality of information being used and the quality of decisions being made. The factors of time, accuracy, and relevance are critical. Thanks to the technological advancements which gave birth to the end-user computing, the computer technology was and is still being developed in a way so as to be put within the hands of managers. Managers, who are in general viewed as nonprofessional computer users, are provided with easy-to-use, easy-to-learn software that would provide them with a great support in carrying out their managerial tasks, especially that of decision making.

The decisions made by managers are various, ranging from the structured simple ones where previously set guidelines can be followed and applied to the

more complicated ones where judgment, intuition and creativity are vital ingredients to a successful process of decision making and problem solving. In the latter type, the manager is in need for supportive tools that would enhance his/ her creative thinking in searching for alternative solutions to a particular problem. Such supportive tools that the information technology could provide managers with were introduced under various names, one of which is the decision support systems (DSS). Certain questions might come to mind in this stage including:

- What features should DSS have to efficiently help in the managerial decision making task?
- If creativity is an essential factor in determining the excellency of organizations, how can a DSS be designed and modeled to include more advanced features so as to develop and enhance this creativity?
- How can the manager's creativity be enhanced by using such creativity enhancing DSS (CEDSS)?

In fact, an extensive body of research was developed concerning the areas of MIS and DSS. However, the research work directed to study the concept of creativity in the MIS field is limited.

This chapter will be a review of the literature that addresses the subject of CEDSS and its relationship to the creativity of managers in the work environment.

2.2. Can Individuals Be Helped to Be More Creative?

People are assumed to have a creativity base since it is an essential part of being human. Humans constantly generate flows of ideas, words and images, and combinations of these things. They always invent new systems - organizational, social, cultural, ... and others; they invent new methods and new technologies. Humans cannot stop creativity, and it is not a true statement to consider some people creative and others uncreative. This is because every person is at least a little bit creative. "Some - the Rachmaninoffs and Einsteins and Picassos and Stephen Kings - are very creative. Some seem just creative enough to decorate a cake. Most fall somewhere between the two extremes."[1] There are many careers in various fields that open the way to those who are creative to be top performers and get rewarded. For such a thing to be achieved, individuals, even the most creative among them, should be trained in the specific field of work they are handling. "Given a body of knowledge and the skills to use that knowledge, the creative individual can then produce wonders."[2]

The aspect that should be investigated now is that can "uncreative" or less creative people learn to generate ideas entirely automatically in the same way as the creative ones? In fact, "the mental looseness that makes creative ideas is

[1] Thomas A. Easten, Think Thunder! And Unleash Your Creativity, (CA: West Consulting, Inc., 1989), p. 17.

[2] Ibid., p. 20.

something a few people have from birth or retain from childhood."[3] A research conducted by Roger Sperry showed that both hemispheres (right and left) of the brain are capable of complex modes of thinking. Two major conclusions were reached through this research and through other more recent researches:[4]

1. The brain is capable of infinitely more complex tasks than has been thought,
2. When people are encouraged to develop the weaker functions of their mental process, rather than depending merely on their supposedly strong areas, they produce a strengthening of all areas of their mind's performance.

These two conclusions convey a very important message that is creativity is not monopolized by anybody. Although activities associated with creativity come more naturally to people who are more creative than others, even those who are less creative are capable of undergoing the '*lateral shift*' from being less to more creative through increased awareness of one's own mind and its working.

In a research that was conducted about the influence of software upon creativity[5], Elam and Mead started their experiment work with the basic assumption that individuals can be helped to be more creative. According to

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[3] S. Weisburd, "The Spark: Personal Testimonies of Creativity," Science News, (Nov. 7, 1987), pp. 293-300.

[4] Simon Majoro, Managing Ideas for Profit, (London: McGraw-Hill Book Company, 1992), pp. 62-63.

[5] Joyce J. Elam & Melissa Mead, "Can Software Influence Creativity?", Information Systems Research, (Vol. 1, No. 1, 1990), pp. 1-22.

them, being creative is not an easy task. This is because when faced with a problem, a person, according to the natural tendency, is apt to choose the first solution that comes to mind. To think of a wide range of alternatives and evaluate them in terms of their pros and cons requires a considerable amount of time and mental effort. This was based upon the review of literature they made concerning this issue. According to this review, individuals often develop what could be called mental blocks that inhibit their creativity. Now, if it is universally agreed upon by psychologists and others who study creativity that childhood is the time of raw creativity, why does it fade out in adulthood? A possible answer is that the flow of creativity is blocked by certain family and social factors that will cause the individuals to get brainwashed against new ideas through discouragement, disapproval, and ridiculing. Four kinds of mental blocks were identified including fear of ridicule, failure, success and self-destruction. Following will be an explanation for each as presented by Thomas Easten.[6]

- Fear of ridicule: This is the fear that people will not only reject the idea, but also laugh at the person generating it for being so silly as to think of it.
- Fear of failure: A failure in having a new idea be accepted might lead a person to avoid taking other risks. This is because in most times, such a failure will be associated with people's ridicule, pity, or sympathy.

[6] Easton, Think Thunder! And Unleash Your Creativity, pp. 36-44.

- Fear of success: It is the fear that the individual will fail to be up to the expectations and challenges created by success.
- Fear of self - destruction - ego: It is the fear of having external improvements to one's idea that may not seem beneficial to the idea generator. Individuals here fear having their ideas discarded, criticized, or revised.

Despite the existence of such blocks, Elam and Mead's review of creativity literature shows that there is evidence that explicit creativity training can help and individual overcome such mental blocks, and can thus learn to think more creatively.[7] Moreover, Couger, Higgins and Mcintyre,[8] in dealing with structured and unstructured creativity, proceeded their views with the understanding that creativity exists and is part of the human cognitive activity; thus, by use of specific techniques and methodologies, individuals and teams can improve their creative process. They contended that in order for organizations to develop more creative and innovative solutions to their problems, they must "first be sure that certain preconditions and organizational components be in place to help individuals and teams become more creative." [8] This is important since in today's environment of increasing competition, on the national and the

[7] Elam & Mead, "Can Software Influence Creativity?", p. 2.

[8] J. Daniel Couger, Lexis Higgins, and Scott Mcintyre, "(Un)Structured Creativity in Information Systems Organizations", MIS Quarterly, (Vol. 17, No. 4, December 1993), p. 375.

international level, the need for creative solutions is becoming more and more essential.

In order to understand how various techniques can be employed to enhance the creativity of individuals in organizations, it is intended now to discuss various aspects related to creativity including its origin, conditions and models.

2.3. Origins of Creativity

What can the origin of creative production be attributed to? Can it be entirely attributed to a collection of personal traits possessed by the creative person? Or are there other factors equally important to this process? A research conducted by Hennessey and Amabile demonstrated that social and environmental factors play a major role in determining creative performance.[9] They found that there is a strong and positive relationship between the motivational state of a person, i.e., "motivational orientation," and the person's creative performance. They contend that certain aspects of the social environment would determine this motivational orientation, which has been termed as the "intrinsic motivation principle of creativity." It states:[10]

> People will be most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself - not by external pressures.

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[9] Beth A. Hennessey & Teresa M. Amabile, "The Conditions of Creativity", in The Nature of Creativity, ed. Sternberg, Robert J., (Cambridge: Cambridge University Press, 1991), pp. 11-35.

[10] Ibid., p. 11.

An examination of the literature showed Hennessey and Amabile that the principle they stated, i.e., the creativity will most likely result from an intrinsically motivated state; it is supported by the work of other psychological theorists.[11] For example R. Crutchfield[12] proposes that "task-involved" intrinsic motivation will lead to higher creativity levels than "ego-involved" extrinsic motivation. Based on the analysis of certain personality data, he concluded that the work of notably creative persons is accompanied by high levels of intrinsic motivation. Furthermore, K. McGraw[13] suggests that increases in extrinsic motivation should have an adverse effect upon the performance on heuristic tasks (creativity tasks) and an enhancing effect upon performance on algorithmic tasks (procedural or structured). Also, in an attempt to explain the relationship between the motivational state and creativity of performance, Leeper and Greene[13] suggest that the intrinsically motivated person should feel freer than the extrinsically motivated person to take risks because those risks carry virtually no liability. Finally, Deci and Ryan,[14] state that when people are intrinsically motivated, they will search for situations that interest them and that require the use of their creativity.

[11] Ibid., pp. 12-14.

[12] Ibid., pp. 12.

[13] Ibid., pp. 13.

[14] Ibid., pp. 14.

Also Couger, Higgins and Mcintyre[15] found that the contradictions available in the existing theories related to the origin of creativity led to the availability of two opposing possibilities or views: the origin-oriented and the process-oriented. *Table V* summarizes these two views. The origin-oriented view asserts that creativity originates from the characteristics of the individual and the characteristics of his/her environment. Creativity here is described by some as the natural ability of the individual. Others, however, describe it as a result of the presence or absence of conflict in the individual's external environment, mental environment or both. On the other hand, the process-oriented view sees creativity more as a process than as a natural characteristic. Here, individuals are assumed to have the ability to explore things and direct cognitive processes toward specific creative goals.

Finally, Elam and Mead,[16] stated that the theoretical framework of creativity includes (1) a focus on distinctive personality and individual characteristics, and (2) a focus on the various social and environmental conditions. These various characteristics and conditions can hinder or enhance the individual's creativity since they are expected to control, determine, and enter into his/her cognitive processes.

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[15] Couger, Higgins & Mcintyre, "(Un)Structured Creativity in Information Systems Organizations," pp. 376-377.

[16] Elam and Mead, "Can Software Influence Creativity", pp. 3-4.

Table V - Summary of Views on the Nature of Creativity (Adapted from Ackoff and Vergara)

Origin - Oriented Approaches	Process - Oriented Approaches
Psychoanalysts Creativity arises from conflicts within an individual. The creative process involves externalizing the internal products of imagination through the interaction of primitive and more mature types of thinking (Freud, 1970).	**The Associationists** An individual's creativity is a function of his or her ability to invoke and explore remote associations in selecting a response to a problem (Mednick, 1962).
Humanistic Psychologists Creativity arises when there is no conflict within an individual. The creative process involves the release of natural creative potential through the removal of inhibitions from the individual and obstructions from his or her environment (Fromm, 1959).	**Gestalt Psychologists** Creative thinking proceeds neither by piecemeal logical operations nor by disconnected associations but by more determinate restructuring of the whole situation (Wertheimer, 1959). Creativity lies in the ability to redirect a line of thought taken in solving a problem (Maier, 1970).
Psychometricians Each individual's natural creative potential is limited by his or her genetic endowment and can be measured by standard tests. The creative process involves the interaction of two contrasting types of thinking: "divergent," which converts information into a variety of unconventional alternatives, and "convergent," which aims at unique or conventional outcomes (Guilford, 1977).	**Cognitive Science Theorists** The human thinking process can be simulated as the process of information processing in computer programs. Creative activity is a special class of problem-solving activity characterized by novelty, unconventionality, persistence, and difficulty in formulation (Newell and Shaw, 1972).

Source: J. D. Couger, L. F. Higgins, & S. C. Mcintyre, "(Un)Structured Creativity in Information Systems Organizations", MIS Quarterly, December 1993, p. 377.

2.4. Conditions for Creativity

If all individuals have a creativity base that they retain from childhood, then why don't they, although equally competent, perform equally? According to Couger, Higgins and Mcintyre, a primary reason for such performance inequality is that "certain preconditions must be met and certain organizational components

must be marshaled to help individuals and teams become more creative."[17] The preconditions were identified and determined by T. M. Amabile and discussed by Elam and Mead and by Couger et al. The organizational components -origin and process oriented- are determined by (1) Ross Mooney[18] in his four major approaches to creativity which are discussed in the review of literature presented by Calvin Taylor, and by (2) Rhodes' 4-Ps model of creativity.[19]

2.4.1. Preconditions for Creativity: The Amabile Framework

In this model, Amabile proposes that creativity be viewed as a set of components that are "necessary and sufficient for producing creative responses in any domain."[20] These components are considered as factors determining and controlling the cognitive process rather than representing it. The components of Amabile's model are:

- Domain - relevant skills,
- Creativity - relevant skills, and
- Task Motivation.

These components are shown in *Figure 2.1* and are discussed in the following sections along with the respective relevant literature.

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[17] Couger, Higgins and Mcintyre, "(Un)Structured Creativity in Information Systems Organizations", p. 377.

[18] Calvin W. Taylor, "Various Approaches to and Definitions of Creativity", in The Nature of Creativity, ed., Robert Sternberg, (Cambridge: Cambridge University Press, 1991), pp. 99-113.

[19] Couger, Higgins and Mcintyre, "(Un)Structured Creativity in Information Systems Organizations", p. 377.

Figure 2.1 - Amabile's Componential Model of Creativity.

Domain - Relevant Skills Includes:	Creativity - Relevant Skills Includes:	Task Motivation Includes:
- Knowledge about the domain - Technical Skills required - Special domain - relevant "talent"	- Appropriate Cognitive Style - Implicit or explicit knowledge of heuristics for generating novel ideas	- Attitudes towards the task - Perceptions of own motivation for undertaking the task
Depends on:	Depends on:	Depends on:
- Innate cognitive abilities. - Innate perceptual and motor skills. - Formal and informal education.	- Training - Experience in data generation - Personality - Characteristics	- Initial level of intrinsic motivation towards the past - Presence or absence of salient extrinsic constraints in the social environment - Individual ability to cognitively minimize extrinsic constraints

Source: Elam and Mead, "Can Software Influence Creativity?", p. 4.

2.4.1.1. Domain - Relevant Skills

The specific knowledge base that an individual has about a certain domain is critical to creative performance. The link here is direct; in other words, a higher level of domain relevant knowledge would contribute to higher levels of creativity: "there is a high correlation between creativity and proficiency in the... domain - relevant tasks."[21] In this part of the model, creativity involves combining what is already known in terms of unrelated facts and ideas in a way that would lead to the emerging of new ones. To do this, one must have the needed components. Moreover, trait-based attributes could be thought of as

[20] Elam and Mead, "Can Software Influence Creativity?", p. 4.

domain-relevant skills influencing creativity and associated with highly creative individuals. J. P. Guilford identified several traits that are associated to creativity including "a general sensitivity to problems, originality and an ability or tendency to redefine problems."[22] He also suggested that the trait of curiosity would help people build a large memory base from which they can recall facts, ideas, and strategies in the future. Other traits were identified by other researchers such as D. W. Mackinnon who stated that creative individuals have the following traits: "inventiveness, independence, individuality, enthusiasm, determination, industry, self-acceptance, openness to new experiences, and tolerance of increasing tension when striving for solutions."[23]

The importance of task-relevant prior knowledge is also emphasized by Robert Weisberg[24] who concentrates on what could be viewed as a major type of creativity, namely insight. His research shows, at minimum, that insights are not likely to happen nor truly efficient problem solving is likely to come about if the individual has not acquired a deep knowledge of the domain in question. If the problem is novel, then it is reasonable, according to the researcher, to consider all problem solving as creative. As a consequence, it could be speculated that

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[21] Couger et al., "(Un)Structured Creativity in Information Systems Organizations", p. 378.

[22] Elam and Mead, "Can Software Influence Creativity?", p. 4.

[23] Ibid., p. 4-5.

[24] Robert W. Weisberg, Problem Solving and Creativity" in The Nature of Creativity, ed., Robert Sternberg, (Cambridge: Cambridge University Press, 1991), pp. 148-174.

"creative thinking in other domains, such as science and the arts, may also depend on extensive knowledge in those domains."[25]

2.4.1.2. Creativity - Relevant Skills

As put by Elam and Mead and by Couger et al., these skills aid creative thinking and problem solving, thus enabling the individual to be creative through the use of innate creativity or creativity-generating processes. These skills include "cognitive style, application of heuristics for the exploration of new cognitive pathways, and working style."[26] They also include "facility with breaking out of a set way of viewing a problem (perceptual set breaking) and of solving a problem (cognitive set breaking), divergent thinking and delayed judgement."[27] The general understanding, and based upon the review of literature, is that breaking out of established perceptual and cognitive patterns will result in having a broader range of solutions - probably creative ones to be developed.[27]

Divergent thinking refers to the ability of thinking of a wide variety of alternative solutions. Torrance considers certain criteria for recognizing creative performance.[28] Skills such as fluency, flexibility, originality, elaboration, and so forth are regarded as good predictors for criteria such as quality and quantity of creative performance. Moreover, Torrance discusses the Mental abilities approach

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[25] Ibid., p. 155.

[26] Couger et al., "(Un)Structured Creativity in Information Systems Organizations", p. 378.

[27] Elam and Mead, "Can Software Influence Creativity?", p. 5.

as a way identified by J. P. Guilford to conceptualize creativity. In his structure of intellect, Guilford sees creative thinking as clearly involving what he terms as divergent production which is "the generation of information from given information, where the emphasis is on variety of output from the same source (innovation, originality, unusual synthesis or perspective)."[29] Guilford, however, concludes that creative thinking can not be equated only to divergent thinking. Other factors such as sensitivity to problems and redefinition of abilities are also important in creativity. The redefinition abilities involve basically the freedom from functional fixedness in deriving unique solutions, and sensitivity to problems is important since it gets the creative thinking process in motion. Elam and Mead also state that divergent thinking requires perceptual and cognitive set breaking as has just been mentioned. According to them, "availability of time, ease of producing solutions and the decision maker's willingness to persevere"[30] have a direct influence on the number of alternatives considered.

As to the practice of delaying judgement, it means suspending "critical evaluation of ideas until a great deal of 'free' thinking has been done."[30] This, based upon the idea that creative solutions are later solutions, has been suggested as a factor contributing to creativity. Opposite to this would take place when the focus of thinking shifts to critical evaluation because in this case, convergent thinking would prevail. It is important to mention here that " while convergence

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[28] E. Paul Torrance, "The Nature of Creativity as Manifest in its Testing", in The Nature of Creativity, ed. Robert Sternberg, (Cambridge: Cambridge University Press, 1991), pp. 43-73.

[29] Ibid., p. 46.

to a final solution is necessary, premature selection of a solution may preclude the conception and consideration of more creative alternatives."[30]

2.4.1.3. Task Motivation

Task motivation is considered as the most important factor in explaining the difference between what an individual is capable of doing and what he/she will really do. This precondition includes motivational variables that determine an individual's willingness to carry out tasks associated with creative thinking. As it is stated by Elam and Mead, Amabile suggests that task motivation "is a combination of an individual's baseline attitude towars a task (a trait) and their perception of the reasons for undertaking the task (a state)."[30] This implies that an individual's task motivation ranges from an entirely intrinsic motivation to do the task he/she likes to an entirely extrinsic motivation to perform the task that he/she does not like. A review of the related literature shows that there is a negative relationship between extrinsic constraints and intrinsic motivation, and that freedom from extrinsic constraints will add to creativity enhancement.

In fact, the impact of social-environmental constraints on motivation and the impact of intrinsic motivation on creativity have been the subject of a substantial body of research. Hennessey and Amabile showed the negative effects environmental pressures have upon performance and creativity.[31] Carl Rogers, for example, talked about the "conditions for creativity" and explained why it is

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[30] Elam and Mead, "Can Software Influence Creativity?", p. 5.

[31] Hennessey and Amabile, "The Conditions of Creativity", in The Nature of Creativity, pp. 11-35.

important to set up situations where individuals feel psychologically safe and free and where external evaluation is absent. In fact, it was Roger's statement that creativity "can fluorish only in a climate in which the motivation to produce comes from within, and an examination of creative individuals' first - person accounts of their work supports this viewpoint."[32] This freedom "nurtures the deep involvement and playfulness that many theorists believe is critical to creativity."[33]

Moreover, according to their cognitive evaluation theory, Deci and Ryan[34] stated that external events can be viewed as informational, controlling, or amotivating. If an environmental event is perceived as controlling, then it will be interpreted by the individual as pressure to attain a given behavioral outcome - pressure that is interpreted as an inducer or a coercer for the individual to perform in a specific manner. Furthermore, the theory states that an environmental event is perceived as informational if it provides the individual with relevant information to attain a particular outcome in the absence of pressure. Finally, according to this theory, it is also sometimes possible to classify some events as "internally amotivating". These would be events occuring within an individual such as the feeling of hopelessness and self-depreciation, that signify one's ability to master certain situations.

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[32] Ibid., p. 12.

[33] Elam and Mead, "Can Software Influence Creativity?", p. 6.

[34] Hennessey and Amabile, "The Conditions of Creativity", in The Nature of Creativity, pp. 29-31.

Couger et al. attributed the widespread acceptance of Amibile's model to her development of a framework for how the three components interact. According to them, and in information processing terms, "task motivation is responsible for initiating and sustaining the process." This will determine whether a search for the problem will begin and whether it will continue or not. Based upon prior knowledge, domain-relevant skills determine what pathways should be followed to search for responses and what criteria will be used to assess the various alternative responses to be generated. Creativity-relevant skills play the role of "executive controllers" during response generation, thus influencing the way in which the search for responses will take place.

2.4.2. The 4-Ps Model: Four Major Approaches to Creativity.

Couger et al. considered the 4-Ps model as a useful structure for understanding creativity and its application in information systems (IS). The 4-Ps model of creativity was developed by M. Rhodes in his "An Analysis of Creativity."[35] The model includes four major components: person, process, product and press (the work environment).[35] Similarly, Ross Mooney considered that there are "four significantly different approaches to the problem of creativity, depending on which four aspects of the problem a person uses to gain his initial hold."[36] Mooney's four approaches are: (1) the creative environment or place, (2)

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[35] Couge et al., "(Un)Structured Creativity in Information Systems Organizations", p. 377.

[36] Taylor, "Various Approaches to and Definitions of Creativity", in The Nature of Creativity, ed., Robert Sternberg, pp. 100-101.

the creative product, (3) the creative process, and (4) the creative person. The following sections will deal with each of these four components as they were presented by Rhodes and Mooney.

2.4.2.1. The Creative Environment (Place or Press):

The creative environment is that situation which stimulates the creative processes and sustains them through to completion. This environment can either be a natural environment or one where deliberate attempts have been made to design an atmosphere to spark and maintain creative processes in an individual or a group of individuals. As it is mentioned by Taylor, several articles contributing to the environmental approach point out that existing knowledge may be an enhancer or a deterrent to creativity; moreover, the past knowledge a person may have accumulated provides no assurance that such a person will be capable of producing new knowledge more than what is known. These studies, along with Taylor's research, show that some persons putting a great effort to learn and keep past knowledge might not step out beyond that knowledge towards the unknown or towards producing a type of knowledge that has not yet been produced. Other persons, nevertheless, can rise from past knowledge and produce new one in a creative way. An important step here is to have the existing knowledge presented in a way that would stimulate the individual to process it in a creative way. It is important to state here that "the stimulus nature of the input knowledge and the

method used in its presentation can be important in whether such knowledge is an asset or a liability in activitating creative processes in a person."[37]

Based on this, and according to Couger et al., the importance of the work environment for encouraging or discouraging creativity in individuals has made it necessary to tackle the subject of the relationship between human being and their environment in the creativity research. Their review of literature shows that in reference to some researches in the field of scientific achievement, climate variables have a significant effect on the creative output or performance in organizations.[38] Such variables include reward and recognition of superior or creative performance especially in the first stages where the individual is in need to be recognized and supported.

2.4.2.2. The Creative Product

The product of creativity could be performance, behavior, idea or any other kind of output.[39] Some researchers believe that if people are informed about their creativity capabilities that they retain from childhood, are provided with the proper processes to facilitate creativity, and are supported with a positive creative environment, then it is expected that creative output will result.[40] Couger et al. believe that it would be helpful to provide employees with ways to measure their

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[37] Ibid., p. 104.

[38] Couger et al., "(Un)Structured Creativity in Information Systems Organizations", p. 379.

[39] Taylor, "Various Approaches to and Definitions of Creativity" in The Nature of Creativity, p. 104.

creativity; for example, Couger and Dengate (1992) developed a framework for measuring the creativity of IS products and services.[40]

2.4.2.3. The Creative Process

The creative process was the subject of a considerable body of research. As it is mentioned by Couger et al., people can enhance their creative abilities and output by using approaches that facilitate the creative process. It is also mentioned that five major studies of creativity show "significant positive results when creative abilities are deliberately nurtured."[40] The conclusions for all these researches are the same; creative abilities can be enhanced by utilizing proper programs and procedures. The work of Couger et al. supported these findings. Creativity improvement programs were introduced in the IS organizations of two companies and they resulted in an ROI factor of two in the first company and a factor of six in the second company. This means that these programs and techniques provide the "heuristics for exploration of new cognitive pathways,"[40] the aspect that was emphasized in Amabile's model of creativity.

2.4.2.4. The Creative Person

As presented by Couger et al., much of the early research work emphasized on the study of creativity in individuals that were considered as either geniuses or professionals. Some researchers tended to believe that creativity is

[40] Couger et al., " (Un)Structured Creativity in Information Systems Organizations", p. 379.

inherited and that people either possess it or not. Others believed that it is a heavenly gift given to some people and deprived from others.[41]

Research nowadays demonstrates that individuals are innately creative; however, most people use less and less of this ability as they mature. "Nationwide studies of American School children reveal progressively low scores on creativity tests as they move through the school system."[41]

Based on this, and according to Couger et al., IS organizations can enhance their employees' creativity if they reinforce the fact that all people are creative, and that creativity is available within everyone. This enhancement can take place: - through encouraging employees to use certain techniques that will restore their curiosity and originality in thinking; and - through motivation (external and internal) that was stressed by Amabile.[42]

2.5. Application of Techniques for Creative Problem Solving and Idea Generation

A large number of useful techniques are available for individuals engaged in generating ideas. One of the earliest and most frequently used methods is 'brainstorming' which was first introduced by Alex Osborne. In the following sections, the main techniques that can be used during the 'idea generation' phase will be described briefly. This will be followed by a description of the structure

[41] Ibid., p. 378.

[42] Ibid., pp. 378-379.

and techniques presented in Couger et al.'s review of literature, the analytical techniques and the intuition techniques.

2.5.1. The Main Techniques for Creative Problem Solving

The following are the techniques that can be used to generate ideas in response to well-defined problems:[43]

a - Brainstorming

Alex Osborn defined brainstorming as "a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously contributed by its members."[44] The modern brainstorming session is basically a creative conference to produce a checklist of ideas that can lead to problem-solving. The important point here is that the main purpose of brainstorming is to generate ideas and not to evaluate these ideas. Based on this, there are main rules pertinent to an effective brainstorming session:

- Judgment must be suspended.
- 'Freewheeling'- i.e., having ideas flowing smoothly from each other in an associative way - is encouraged.
- Quantity of ideas generated is important. Here, the probability of having good ideas to include in the list becomes greater.
- Combining and improving others' ideas to yield yet another new idea should be encouraged.

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[43] Simon Majaro, Managing Ideas for Profit, the Creative Gap, (London: McGraw-Hill Book Company, 1992), pp. 140-149.

b - Metaphorical Analogy

Introduced and developed by the research work of William Gordon and George Prince, and known today as 'synectics', this technique involves conducting a number of proprietary programs aimed at developing creative solutions to problems. Synectics, which means "joining together of differently and apparently irrelevant elements", seeks to integrate diverse individuals with diverse disciplines into a problem-definition and problem-solving group.[45]

The idea of Metaphorical analogy is to attempt to draw an analogy between a problem for which no solution exists at the moment and a comparable problem from a completely different field for which a solution does exist.

c - Trigger Sessions

Unlike brainstorming, a trigger session proceeds with every member of the group being asked to generate a number of ideas independently of each other. Each member is given a card on which he/she is asked to write down ideas as to how the stated problem could be solved. Following the individual work, members here will not benefit from the stimulation resulting from the freewheeling interplay among participants in a brainstorming session. This means that participants have to produce ideas in as much as each member of the team is under some internal kind of pressure to generate 'good ideas'.[46]

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[44] Ibid., p. 141.

[45] Ibid., p. 143.

[46] Ibid., p. 145.

d - Wildest Ideas Session

This is a systematic attempt at thinking more broadly and, if necessary, in an unconventional way. The important point here is to train people's brain cells to generate and cope with what might seem impossible. People then will bring these ideas closer to the real facts of the problem under discussion. With such a method, members of a creative group who have not had much experience with group idea-generation activities and thus tend to have an inhibited mental posture in the ideas they usually produce will be capable of moving out of this frame and be encouraged to produce better ideas.

e - Morphological analysis

This is a very useful technique used in generating a wide variety of ideas in a very short time period. This method is used for enhancing 'exploratory creativity' rather than ideas for 'normative innovation' [47], yet it is also useful for generating ideas for problem-solving activities in certain circumstances as well.

In order to know what this method involves, it is important to state that the word 'Morphology' as being stated by Majaro, means the study of the structure and form of things. The technique, thus, aims at identifying the most important dimensions of a specific problem and then examining all the relationships among them.

[47] Ibid., p. 146.

f - Scenario Writing or Scenario Daydreaming

This technique involves the recording of future events taking into consideration both timing and correlations in relation to a company, an industry, or a specific problem. It is a systematic attempt at writing a forecast for the future with a certain level of probability associated with it using a number extrapolation methods of proven value and validity. Conducting surveys in certain companies, as reported by Majaro, shows that this technique is an excellent exercise in:

a) helping companies become more proactive rather than reactive about the future environment in which they expect to operate,

b) stimulating a more creative climate, and

c) providing a superb training ground for promising and bright employees who have recently joined the company.

As for scenario daydreaming, it is similar to scenario writing except that the latter is collated into a written document whereas the former is done verbally, in an open group meeting, and without a record of the discussion being kept. This is believed to provide the team with a less inhibited environment in which they are believed to think freely and more creatively.

g - Suggestion Schemes

This technique has become highly popular in many organizations. It provides a channel of communication through which every member of the organization can transmit his/her ideas or suggestions. These ideas will be screened, evaluated, and, if effective, implemented. Moreover, such a technique is

believed to establish an environment which stimulates people to become more creative and more productive.

As reported by Majaro, some companies use suggestion schemes in order to obtain a company-wide participation in generating ideas in response to specific and well-defined problems. The problem statement is circulated in the company calling for ideas as to how it can be solved, and awards are offered to the most satisfactory and feasible idea. This way, one can benefit from the contribution of the whole organization in thinking about the problem and generating ideas in response to it.

2.5.2. Analytical versus Intuitive Techniques

Although some believe that structuring the creative problem-solving process inhibits creativity, others believe that such a process can be enhanced and facilitated. In the past thirty years, a number of techniques have been developed to help in unlocking an individual's innate creativity in order to stimulate creative ideas.[48] The aim of these techniques is to help people consider a wider range of alternatives and, thus, move away from the frame of their normal inhibiting mode of thinking. As it is stated by Arnold, "When applied conscientiously and repeatedly", creativity techniques, "will help awaken and strengthen.... creative potential."[48] Moreover, Davis states that the use of creativity techniques "demystifies creativity and helps convince new innovators that they can build upon, modify, and combine existing ideas..."[48]

As was previously mentioned, five major studies have shown that creativity can be improved through creativity generation techniques.[48] According

to Couger et al., these techniques can best be classified on a continuum ranging from analytically dominant to intuitively dominant.

2.5.2.1. Analytical Techniques for Creativity

The analytically oriented techniques use a structure to form a logical pattern of thinking. Couger et al. reported that analytical techniques "take advantage of different ways of organizing known information to help you approach problems from new angles... and tend to follow a linear pattern or sequence of steps."[48] The analytical techniques to be discussed below are the following:

- Progressive abstraction
- Interrogatories (5 Ws/ H)
- Force field analysis

A description of these techniques will be based upon the review of literature presented and analysis provided by Couger et al. [49]

a - Progressive Abstraction Technique

The progressive abstraction technique was developed by Geschka, et al. This technique generates alternative problem definitions by moving in a progressive form through higher levels of problem details until an acceptable or a satisfactory definition is reached. Systematically enlarging a problem this way will lead to the emergence of new definitions that will be evaluated for their

[48] Couger et al., "(Un)Structured Creativity in Information Systems Organizations", p. 380.

practicality, usefulness and feasibility. When a satisfactory level of detail in problem definition is reached, possible solutions will be more easily identified. The major advantage of this technique is that it provides the problem solver with a high degree of structure for examining the problem aspects and connections, thus increasing the solution space.

b - Interrogatories: 5 Ws and the H Technique

This technique includes 5 Ws: Who, What, Where, When, Why, and one H: How. These questions help in broadening an individual's or group's perspective of a problem or opportunity. The framework provided by this technique is simple and easy to remember, thus, aiding the problem solver to systematically take a more complete and comprehensive approach to both problem identification and solving. This is because by going through several cycles of the 5 Ws/ H, one can broadly explore various alternatives related to the problem or opportunity being considered.

c - Force Field Analysis Technique

Force field analysis is frequently used by creative groups in trying to determine what effect a proposed solution is likely to have during its implementation. The technique is based upon the concept that any attempt at implementing a solution to a problem is subject to two kinds of forces - some helpful and some unhelpful. Of course, it is very important to identify and evaluate the impact of all these forces. Helpful and supportive forces are termed as "driving forces", whereas unhelpful and unsupportive forces are termed as

[49] Ibid., pp. 381-385.

"restraining forces".[50] The technique can stimulate thinking through (1) defining direction (perception or vision), (2) identifying strengths that can be enhanced, and (3) identifying weaknesses that can be minimized.

2.5.2.2. Intuitive Techniques

As for the intuitive techniques, Couger et al. state that these techniques tend to skip steps in a sequence. They "rely on a single image or symbol to provide a whole answer... to arrive at solutions by a leap." [51]

The intuitive techniques to be discussed in the following sections are:

- Associations / Images
- Wishful Thinking
- Analogy / Metaphor

a - Associations / Images Technique

This technique is based upon the natural tendency of human beings to associate. In fact, this linking or combining process is another way of expanding the solution space. The procedure for use of this technique is as follows:[52]

1. The leader helps the group in identifying the problem or opportunity.
2. Participants asked to select a solution set in the form of a goal.
3. A key concept central to the goal statements is picked by the leader.

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[50] Majaro, Managing Ideas for Profit: The Creative Gap, p. 150.

[51] Couger et al., "(Un)Structured Creativity in Information Systems Organizations", p. 380.

[52] Ibid., p. 385.

4. The leader asks the group to think of a world away from the world of the problem.
5. The participants are asked to list images that characterize the remote world they thought of.
6. Participants are asked to relate these images of the remote world to the world of the problem.
7. The group will be directed to develop other associations from those listed in step 6. This will be used by the leader to extract key principles and apply them in a more realistic way.
8. Appealing ideas will be selected and implemented.

b - Wishful Thinking Technique

According to Couger et al., this approach could prove useful to people who follow an analytical approach to problem solving.[53] Since wishful thinking involves a lot of fantasy, this will loosen the analytical framework of thinkers, thus widening the area of the solution alternatives they might take into consideration. Another procedure was suggested by Van Gundy to help in the use of this technique. It goes as follows:[53]

1. Define the problem statement
2. Make the solution area open to all possibilities
3. State the alternative solutions in terms of a wish or a kind of fantasy

[53] Ibid., p. 387.

4. Convert each "wish" statement into a practical one
5. Use an analytical problem-solving approach (previously discussed) to develop a solution.

c - Analogy / Metaphor Technique

This technique was developed by de Bono. However, the concept of the metaphor value was talked about "almost 2,200 years ago" by Aristotle: "Ordinary words convey only what we know already; it is from metaphor that we can best get hold of something fresh."[54] Also Miller stated that: "An analogy is a similarity between two things otherwise dissimilar."[54] This means that an analogy can widen the area of alternative solutions to be considered in solving a certain established problem.

A procedure to be followed for developing an analogy for the creative problem solving was originated by Van Gundy as follows:[54]

1. Generate a list of objects, people, situations, or actions that are similar but unrelated to the problem.
2. Without relating to the original problem, select one of the analogies and describe it in detail.
3. Translate the items generated into a statement that applies to the problem or opportunity being analyzed.

[54] Ibid., p. 388

4. Examine the list of statements and evaluate their application to the problem or opportunity.

In fact by using both techniques, analytical and intuitive, a wider range of solution possibilities can be developed. Both types of techniques aid in retaining possible options, "forcing divergence toward many alternatives before convergence on an acceptable solution."[55]

2.5.3. Creativity Improvement Programs

In an organizational setting, individuals and teams should be helped to be more creative if the organization is aiming to reach and maintain the competitive edge. Organizations, thus, can use several creativity improvement techniques that have proved successful in other disciplines - the techniques that were discussed above.

Alan Farnham[56] stated that whereas nobody manages creativity, people are what gets managed. To do this, organizations should avoid using "the techniques that are so instructable so as to be almost inexpressible."[57] These and other variables might prevail leading to certain kinds of blocks inhibiting creativity. The effect of such variables could be diminished if organizations provide its people with:

a) Accommodation: As it is set by Farnham, "creatives may be high maintenance, but they repay the effort ." Organizations are highly

[55] Ibid., p. 380.

[56] Alan Farnham, "How to Nurture Creative Sparks", Fortune, (January 10, 1994), pp. 52-56.

recommended to adjust their ways to suit the creatives' way of expressing their talent. It is also important to remember that creatives can not always choose the time in which they will create. Another thing is that organizations should let creatives give full play to their temperament. Finally, because creativity imposes a very high human cost (measured in exhaustion, unrest, and tension), good management should be restrained from punishing the failure of the creatives, especially the "failure is so conspicuous a byproduct of their work."[57]

b) Stimulation: This means that there should be certain programs that would stimulate the creativity aspect of the creative persons in the organization. For example, at Hallmark, "whose more than 600 artists, writers, and designers constitute what they claim is the largest creative staff in the world, management brings in some 30 speakers a year to scatter intellectual pollen. Writers and artists also get sent on what seem like vacations to soak up atmosphere and inspiration."[57] Such programs, employees of Hallmark report, lead them to suggest new ideas and new products.

c) Recognition and Rewarding - the right way: In fact, the best reward for creative people, according to Farnham, is to give them greater autonomy. This is important since they are "self-starters" and hate others to take credit for what they did in terms of work and achievement.

[57] Ibid., p. 54.

d) Directing (lightly) and Giving Feedback: An important thing for a manager of creatives to learn is how to achieve a balance between preserving the creatives' sense of autonomy and giving them directions as to what should be done. Moreover, as it is stated by managers with whom the survey was conducted and reported by Farnham, resource deprivation, i.e. giving creatives less resources, can stimulate creativity.[58]

e) Protection: Creative people should be protected from people who do not get their way of work or understand their behavior. At the same time, managers should prevent the formation of a privileged class by defusing the organizational problems, such as envy or hostility,....., and so on.

f) Creative Managers: This is a "fundamental rub between creatives and managers... They have never walked in others' shoes."[58] Farnham points out that at Hallmark, this problem is addressed by inviting managers "to change shoes." A creative leadership course is prepared so that Hallmark's executives can yearly go through and benefit from.

Moreover, based on what has been previously mentioned, following Amabile's and the 4-Ps model, organizations can develop and implement a creativity improvement program. The approach recommended by Couger et al. follows the 4-Ps structure:

1) improve the atmosphere for creativity (environment),

2) define for employees the factors constituting a creative product or service,

[58] Ibid., p. 56

3) make employees aware of their retained creative abilities (person), and

4) provide employees with techniques and procedures that will help them improve their idea generation and evaluation.

Of course, a proper climate for creativity will show employees that management appreciates and cares for their creative ideas, and that the ideas will be fairly and timely assessed. Managerial support for creativity is highly important. One way to demonstrate it is to provide employees with training on the techniques that can enhance their idea generation and evaluation aspects. According to Couger et al., both analytical and intuitive techniques are needed to support qualitative and quantitative approaches to idea generation. While it is natural to find that there are procedures in analytical techniques, it could be surprising to find that there are procedures to follow in intuitive techniques. The procedure "help 'unstructure' the normal thought processes, enabling..." problem solvers to step away from the normal framework of established standards. As a result, a wider range of choices and alternatives could be considered.

This section concentrated on describing the various creativity techniques along with the procedures follow to use them. The succeeding sections will cast the light on the use of certain creativity techniques provided by computer-based systems, as presented by the work of other researches. In fact, the emphasis will be on CBISs providing problem solvers and decision makers with the needed support to define the problem more efficiently and effectively, and generate a broader range of possible and creative solutions. The focus, thus, will be on the DSS, and more specifically, on the CEDSS.

2.6. Decision Support Systems: Capabilities and Values

As has been mentioned in chapter I, the semi-structured problem is the domain of decision support systems (DSS) research and development. This domain, however, encompasses many different decision types which could be defined through the following attributes:[59]

- Recurring versus nonrecurring decisions.
- Stable versus dynamic environments.
- Reliable versus unreliable information on current position.
- Reliable versus unreliable information on future states of the environment.
- Clear versus ambiguous goals.

A critical factor to developing DSS for any of the above mentioned classes of decision tasks is to identify how such decisions are made. In other words, do decision makers intend to achieve maximization or satisficing given such a task? What heuristic procedures do decision makers apply? And finally, what DSS capabilities or tools can support heuristic decision making? Concerning semi-structured recurring decisions, Remus and Kottemann[59] reported an experiment through which they studied various decision making models and made some suggestions for developing a DSS. They dealt with one class of relatively semi-structured problems characterized by recurring decisions in a dynamic environment with reliable data on current position but less reliable

[59] William Remus and Jeffrey Kottemann, "Semi-Structured Recurring Decisions: An Experimental Study of Decision Making Models and Some Suggestions for DSS", MIS Quarterly, (Vol. 11, No.2, June 1987), pp. 233-241.

data concerning future projections of future states of the environment, and finally clear objectives for performance. To achieve the objective of the study, a production scheduling decision was used to assess various models of decision making. The models experimented were:

(1) the regression rules derived from actual decisions, (2) the tracking model, and (3) the optimal rules.[60]

The production scheduling decision task used in the experiment allows the determination of optimal solutions which can be compared with actual solutions and with decisions made using other decision models. Moreover, in the production scheduling problem, the decision maker can also be viewed as tracking customer demand in a way that demand fluctuations are absorbed in order to minimize cost. The concept of tracking is based upon the idea that instead of trying to achieve "discrete optimal hits each time, the ..." decision maker "uses various strategies to follow the target", and it corresponds to the notion of continuous decisions.[61] According to Remus and Kottemann, if this characterization is right, then the DSS should provide the decision maker with appropriate supportive aids. While tackling the concept of tracking, it is important to distinguish between two types of tracking: the pursuit tracking, where both the position of the target and the control of the movement are known; and the compensatory tracking, where the tracker does not recognize the location of the target and only an error signal is provided to aid in it.

[60] Ibid., p. 234.

The purpose of the experiment conducted was to examine the decision making behavior when making a production scheduling decision. This was done taking into consideration two factors: (1) Tracking skills generally increase with experience, and that is why subjects were selected to be equally naive when in the experiment, and (2) tracking experience can transfer from one problem to another; thus, subjects were selected with no experience in related problem.

The conclusion of Remus and Kottemann comes to be that while it is important for the DSS model base to have optimizing models, tracking support systems would also be helpful.

The questions that need to be addressed are how variable DSS are? And are they cost justified? This is what the following section will discuss.

2.6.1. Value of a Decision Support System

Justifying DSS projects used to take place through traditional cost-benefit analysis. Alternative, more recent methods, such as the value-based techniques are proposed by other authors. Still other authors have an extreme view and consider that DSSs have no justification to exist if it does not match with the user's ability and desire to use them. These various views concerning DSS evaluation were presented by Pieptea and Anderson.[62] Their paper analyzes the main factors that differentiate the valuation of DSS from other MISs, and shows that DSS evaluation techniques are context dependent. Moreover, it asserts that

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[61] Ibid., p. 235.

[62] Dan Pieptea and Evan Anderson, "Price and Value of Decision Support Systems", MIS Quarterly, (Vol. 11, No. 4, December 1987), pp. 515-525.

the adequacy of a valuation method can be assessed only by taking into consideration the attributes of the system.

Following the price and value analysis is considered better than the traditional cost-benefit analysis since cost and benefits are often compared in quantitative terms, whereas benefits provided by a DSS are more qualitative than quantitative. A necessary condition to select the DSS is that the value exceeds the price. However, the value of a DSS is often subjective leading to a difficult assessment of the value-price relationship. Focusing on the attributes might fill the gap between value and price of DSS. Still, it is important to mention that this gap becomes larger for systems aiding highly unstructured decisions in the choice phase of the decision making model.[63]

To evaluate the relationship between value and price of DSS, Pieptea and Anderson adopted as a reference structure a two-dimensional space in which DSS can be represented: One represents the phase of the decision making process supported by the system, and the other introduces a scale on which distinctive qualities of the supported decision are measured. Such qualities include degree of structure, managerial level, level of uncertainty, and source of information.

2.6.1.1. Dimension I: the Supported Phase of the Decision Making Process

In developing the first dimension, the researches applied to DSS the decision making model proposed by Simon, who depicted the human decision making as a three-stage process: intelligence, design, and choice. Of course, the phase of the decision making process in which a DSS intervenes can be considered as an important system attribute.

In the intelligence phase, which corresponds to identification of problems or any kind of conditions calling for decisions, the DSS "provides the decision maker with integrated, well-analyzed and formatted data."[63] As an example on this are expert systems, such as MYCIN- a medical expert system, which help identify the nature of a problem and thus aid the decision making process in its intelligence phase.[64] Identifying the problem is an important step and is referred to as problem-finding process.[65] As Einstein puts it:[66]

> The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old questions from a new angle, requires creative imagination and marks real advance in science.

In the design phase, alternative solutions to the problem are set. Quantitative techniques and design tools are frequently used in this phase. Each solution is examined and evaluated, and DSS will incorporate planning and forecasting models. "Artificial intelligence applications and optimization techniques, such as linear, large scale and dynamic programming, and networks and statistical models, are used to aid this phase of the decision making process."[67] Moreover, expert systems are being developed to form a better computer support for this phase. These "avoid blind search by using rules to reason that make use of expert

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[63] Ibid., p. 516.

[64] Robert J. Thierauf, User-Oriented Decision Support Systems: Accent on Problem Finding, (London: Prentice-Hall, Inc., 1988), p. 365.

[65] Ibid., p.60.

knowledge stored in the computer, and by constructing inference paths from this reasoning to generate problem solutions."[67] Finally, as to the choice phase it involves the selection of a course of action. This phase is considered as more complex due to uncertainty, conflict of interest, control, and variety of preferences. DSS, in supporting the decision maker in this stage, provides three types of information: [67] (1) highlights of the various alternative solutions, (2) possible scenarios of outcomes- 'what-if' analysis, and (3) feedback information that will help in the implementation of the adopted alternative.

2.6.1.2. Dimension II: Decision Classes

Classification criteria for the decision making process are majorly defined by:[68] (1) degree of decision structure, (2) level managerial activity, (3) degree of uncertainty, and (4) source of information used. According to Pieptea and Anderson,[69] the degree of decision structure as defined by Simon, ranges from programmed or structured decisions which can be described by the steps of a highly quantitative procedure to unprogrammed decisions which are based upon heuristic methods - experience and intuition. As to the level of managerial activity, it includes strategic planning, management control, and organizational control corresponding to top, middle, and operational management levels respectively. Concerning the degree of uncertainty, three relevant categories are

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[66] Albert Einstein, Ideas and Opinions, (NY: Bonanza Books, 1954), p.35.

[67] Pieptea and Anderson, "Price and Value of Decision Support Systems", p. 517.

[68] Ibid., p. 516.

[69] Ibid., pp. 516-7

found: deterministic (or structured), probabilistic (or unstructured), and random (or highly unstructured) decisions. Finally, regarding the source of information used, it could either be internal or external. According to Pieptea and Anderson, the information source is an important item in DSS analysis and design and has a great effect in the valuation and pricing of DSS.

After developing the framework to be followed, Pieptea and Anderson proceeded to study DSS valuation and pricing.

2.6.1.3. DSS Specific Valuation and Cost Factors

The factors considered by the two researchers are the tangible and intangible benefits.

A. *Tangible Benefits*

With the conflicting views of previous researches, Pieptea and Anderson maintained that "there is no common recipe for valuation, and the appropriate approach depends on the attributes of the DSS in question."[70] According to them, traditional cost-benefit analysis can be performed successfully for DSSs that have a high degree of structure, aim at supporting decisions that are made in a certain environment, and primarily address the intelligence phase.

B. *Intangible Benefits*

These play an important role in the evaluation and justification of a DSS. The main intangible benefits that are perceived by managers using a DSS tend to be: "facilitation of thoughts, improvement of communication, and a sense of

[70] Ibid., p. 519.

success and capability to perform sensitivity analysis."[71] The assessment of such benefits is highly affected by subjective factors, and according to Pieptea and Anderson, the more the weight attributed to these benefits is, the wider the price-value gap of the system would be.

As it is stated by the two researches, "while it is hard to objectively estimate a priori the intangible benefits, the a posteriori benefit estimation is even more difficult." This is because it is almost impossible to know what the managers decision would have been without a DSS. Moreover, the effect of the DSS is hard to test experimentally, since "by using the system, management gain knowledge that makes the experiment irreproducible."[72]

Regarding the DSS specific cost factors, the two major aspects that make the cost side of the cost benefit analysis of DSS different from that of the traditional MIS are the system life cycle (including the phases of need recognition, systems development, installation, system operation, and system obsolesence and termination) and the personnel structure.

In studying the effect of DSS diversity on valuation, the two researches found that as one moves from non-structured to highly structured decisions and from intelligence to choice, the intangible benefits become the more important motivating factor for system selection.[72] Furthermore, while the price is set by tangible and measurable costs, the value is a subjective matter, and thus there will be a potential gap between value and price of DSS. Therefore, this gap is

[71] Ibid., pp. 519-20.

conditioned by the subjectivity of value perception and is related to the intangibility of benefits which increases as the direction moves towards the choice decision making phase for highly unstructured decisions made in an environment of uncertainty.

2.6.2. Capabilities of a DSS

The traditional assumption in the decision support systems (DSSs) literature is that if decision makers are provided with expanded processing capabilities, then they will use them to analyze problems taking a wider range of alternatives into consideration and, as a result, make better decisions. Pearson and Shim[73] had the following objectives while investigating DSS capabilities: (1) to determine if specific combinations of DSS capabilities could be identified, (2) to propose a taxonomy based on the identified capabilities, and (3) to determine if a relationship exists between the proposed taxonomy and that suggested by other researches.

Pearson and Shim showed that the DSS research tackled three areas. The first focused on whether DSS could improve decision quality and decision performance. Moreover, Sharda, Barr, and McDonnell found that most of the studies proved that DSS actually improve decision quality and/or decision

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[72] Ibid., p. 521.

[73] J. Michael Pearson and J. P. Shim, "An Empirical Investigation into DSS Capabilities: A Proposed Taxonomy", Information and Management, (Vol. 27 , No. 1, 1994), pp. 45-57.

effectiveness.[74] The second has been directed towards identifying specific design characteristics and the impact they have on DSS development. They included presentation formats, the use of color, graphic capabilities, and user interfaces. Results concerning the impact of these topics on DSS development had been mixed. The third area of research addressed the role of the decision maker and taking into consideration individual differences in influencing the effectiveness of DSS. Individual differences were based on characteristics such as the cognitive process. Results showed that these factors are important; however, different studies showed different directions of their significance.

Moreover, Pearson and Shim showed that very little empirical research was developed concerning the various types of DSS being formed. In a study of 56 DSS, Pearson and Shim reported seven distinct types of DSS. The categorization was done based on the operations the DSS performed only. The seven categories developed by Alter, along with the operations performed, are as follows:[75]

DSS Category	Operations Allowed
(1) File Drawer System	Simple data inquiries.
(2) Data Analysis Systems	Data manipulation by means of task-tailored or general commands.
(3) Analysis Information Systems	Access to a series of databases and small models.

[74] R. Sharda, S. H. Barr and J. C. McDonnell, "Decision Support System Effectiveness: A Review and an Empirical Test", Management Science (Vol. 34, No. 2, February, 1988), pp. 139-159.

[75] Pearson and Shim, "An Empirical Investigation into DSS Capabilities", p. 46.

DSS Category	Operations Allowed
(4) Accounting Models	Calculation of the consequences of planned actions according to accounting definitions.
(5) Representation Models	Estimation of the consequences of action according to models not based on accounting definitions.
(6) Optimization Models	Generation of optimal solutions consistent with a series of constraints.
(7) Suggested Models	Performing mechanical work leading to a specific suggested decision for a fairly structured work.

Moreover, according to Pearson and Shim, current research shows that DSS is composed of three interrelated components, each providing the decision maker with specific capabilities and, thus, improving the effectiveness with which he/she works. The three components are: (1) data management, (2) model management, and (3) dialogue management. [76]

The data management component provides the user with the following capabilities:

- the capture of data into a DSS database
- the storage, retrieval, and control of data through a database management system.
- the interaction with data from several queries.
- the ability to perform ad-hoc queries.
- the tracking of the use of data within DSS.

[76] Ibid., p. 47

– the management of data through a data dictionary.

As to the capabilities provided by the model management, they include the following:

– the use of multiple models to support various problems.
– the support of semi-structured and unstructured problems.
– the ability to build models easily and quickly.
– the ability to track models through a model directory.
– the integration of models within the DSS.
– the creation, storage, and retrieval of models through a model base management system.

Finally the dialogue management component facilitates that type of interaction process between the user and the computer. The dialogue management component has the following capabilities:

– the support of multiple dialogue styles.
– the capture, storage and analysis of dialogue usage through a dialogue management system.
– the tracking of dialogue usage by DSS users.
– the interaction with the data and model components of the DSS.
– the support of multiple methods of presenting output.

Method of Study

Pearson and Shim used a questionnaire developed from previous surveys and DSS literature. It was divided into three parts. The first part was designed to identify the operating environment in which the DSS exists and to classify the respondent's DSS into one of the categories proposed by Alter (as mentioned

above). The second part solicited information about the specific capabilities of the DSS used by the respondent. The third part contained questions concerning the demographics of the respondent. Moreover, the questionnaire was checked for validity and reliability, and the results showed that the questions factored as anticipated and that inter-item correlations performed as expected. Concerning the second part of the questionnaire which included the three factors (database, model, and dialogue management components), an overall alpha of 0.8463 was obtained.

A DSS Taxonomy

Pearson and Shim used a correlation-based clustering procedure to classify the respondents' DSS according to capabilities provided by the database, model, and dialogue management components. The internal validity of the cluster solution was verified based on a sample replication test, and external validity was checked through the use of multiple discriminant solution. The results presented on the following page indicate that the clusters differed significantly on items such as the level of management supported, types of decisions support, degree of structure within problem(s) supported, respondent's usage pattern, number of users supported, and integration with other computer systems. These significant differences provide evidence of external validity.

Analysis indicated that a five-cluster solution was the most appropriate:[77]

A. A model oriented DSS

B. A data oriented DSS

C. A generic DSS

D. A data/model oriented DSS

E. A fully developed DSS

Significant Cluster Differences Along Environmental Factors Using Wilk's Lambda and Univariate F-ratio(s) (d.f. = 4 and 153; n = 158).

Variable	Wilk's Lambada	F-Ratio	Significance	
Management Level Supported	0.92	3.42	0.0104	*
Decision Phase Supported	0.93	2.95	0.0221	*
Degree of Task Structure	0.92	3.32	0.0123	*
Usage Pattern	0.93	2.86	0.0255	*
Number of Problems Supported	0.98	0.79	0.5334	
Computer Skill of User	0.96	1.37	0.2473	
Number of Users Supported	0.83	7.61	0.0000	*
Interaction with Other Computer Systems	0.88	5.12	0.0007	*

* Significance at 0.05

Source: Pearson and Shim, "An Empirical Investigation into DSS Capabilities", p. 50.

A - A Model Oriented DSS

The model oriented DSS generally supports mid-level managers who use the DSS to evaluate and choose among relatively structured alternative solutions. As a result, the model oriented DSS provides the user with strong modeling capabilities but limited database and dialogue management capabilities. It provides access to multiple models through a well-developed model management

[77] Ibid., pp. 50-52.

system. Results reported by Pearson and Shim show that users of this type of DSS indicated that the models provided supported operational, tactical and strategic decisions.

Regarding the database component of the model oriented DSS, it typically provides access to limited databases. In addition, there is no formal database management system to control the database activities (such as queries, storage, retrieval, data dictionary, so on).

As to the dialogue capabilities provided by this DSS, they are very limited. Although it has access to a dialogue management system, it does not provide capabilities such as tracking dialogue as age, multiple dialogue styles, and easy access to other components of the DSS. Pearson and Shim reported that users of this DSS consider the dialogue component to be inflexible.

B - A Data Oriented DSS

This support mid and upper levels of management in relatively unstructured decisions. The support is basically for identifying possible problems and/or opportunities. This type of DSS provides strong database management capabilities. The dialogue support it provides is moderate, i.e., the capabilities are limited since the dialogue system does not support advanced dialogue capabilities such as tracking dialogue usage and others. As to the model management system, it is not well developed, and therefore offers limited modeling capabilities to its users.

C - A Generic DSS

This is the least developed type of the five DSS categories. As reported by the two researchers, the users of this DSS were not satisfied and could not identify what type of task is being supported. Thus, the generic DSS provides weak modeling, database, and dialogue capabilities to the DSS user.

D - A Data/ Model Oriented DSS

The data/ model oriented DSS generally supports mid-level managers in the identification of problems and opportunities. It also supports them in the analysis and selection among different alternatives. This type of DSS provides its users with strong database and modeling capabilities and with moderate dialogue capabilities.

E - A Fully Developed DSS

This fully developed DSS supports lower and mid-level managers in semi-structured tasks involving problem/opportunity definition and the evaluation of different alternatives. All three components, database, modeling, and dialogue, are fully developed and provide the user with many of the capabilities associated with DSS. *Table VI* shows the DSS taxonomy proposed by Pearson and Shim.

Finally, a comparison between the proposed taxonomy to Alter's DSS taxonomy showed that the five DSS categories mapped easily onto Alter's taxonomy. The taxonomy proposed in the study is based on DSS capabilities and Alter's taxonomy is based on the task performed. Hence, "it is not surprising that

a specific category of the capabilities based DSS could be developed in response to more than one type of task oriented problem."[78] As a result, by clearly identifying the operations that are to be supported and categorizing these into Alter's taxonomy, the DSS developer would be capable of determining the type of capabilities that should be included in each component of the DSS.

Table VI - A Taxonomy of DSS *

	General Capabilities		
DSS categories	Database	Model	Dialogue
Model Oriented DSS	Moderate	Strong	Moderate
Data Oriented DSS	Strong	Weak	Moderate
Generic DSS	Weak	Weak	Weak
Data/Model Oriented DSS	Strong	Strong	Moderate
Fully Developed DSS	Strong	Strong	Strong

* Strong = exhibits most or all of the capabilities frequently associated with DSS.
Moderate = exhibits some or a limited level of capabilities frequently associated with DSS.
Weak = exhibits very few or none of the capabilities frequently associated with DSS.

Source: Pearson and Shim, "An Empirical Investigation into DSS Capabilities", p. 52.

2.6.3. Factors Affecting Successful Implementation of DSS

As it has been previously emphasized, information systems are becoming increasingly important to the daily operations and success of various organizations. This, combined with increasing investments in design and development of and reliance upon these information systems, make the issue of implementation a critical one.

[78] Ibid., p. 53.

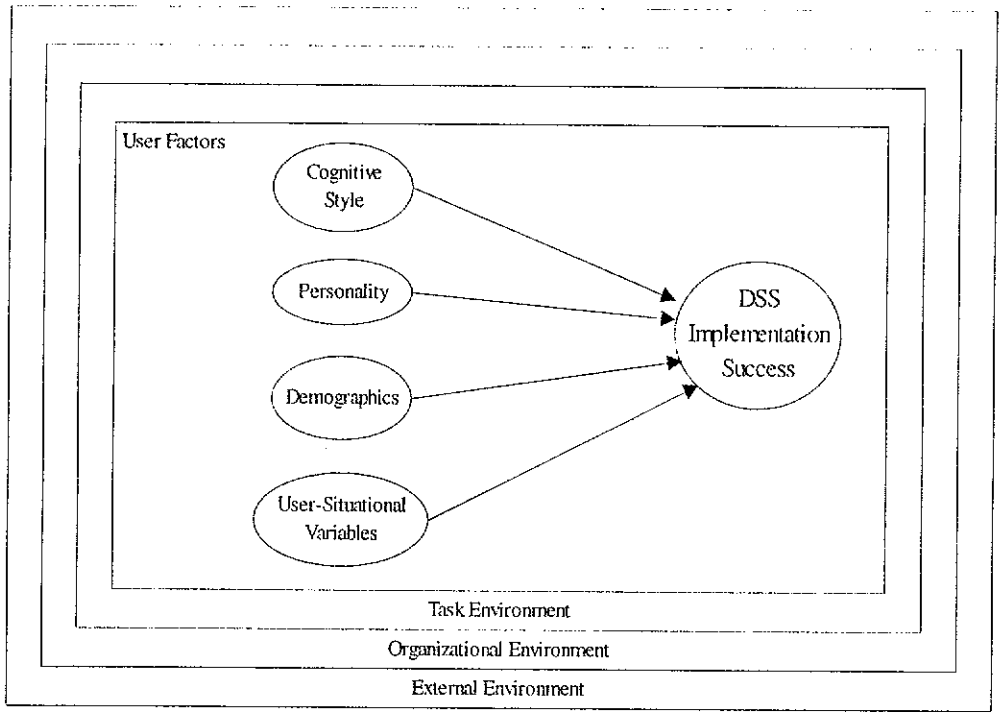
Alavi and Joachimsthaler[79] used meta-analysis to study the effect of certain variables - user-situational, personality, and others upon the DSS implementation success. Meta-analysis refers to "a set of procedures for the quantitative accumulation and analysis of descriptive statistics across studies without requiring access to original study data."[80] In other words, the findings of studies are treated as the unit of analysis. Because the findings of the studies were based on different statistical tests (e.g., F-test or T-test), they were converted to a common metric which represents the effect of an independent variable. The meta-analysis findings were related to DSS performance and user attitudes towards DSS. The two researchers found that most of DSS implementation studies have investigated the relationship between user-related factors and implementation success. The core of the relationship consists of four sets of user-related factors, cognitive style, personality, demographics, and user-situational variables. The relationships among these factors and DSS implementation are believed to be "influenced by a number of contextual variables consisting of decision making tasks (e.g., task type or task complexity), organizational factors (e.g., top management support), and external factors (e.g., competitive considerations)."[81] This framework is presented in *Figure 2.2.* Alavi and Joachimsthaler's meta-

[79] Maryam Alavi and Erich Joachimsthaler, "Revisiting DSS Implementation Research: A Meta-Analysis of the Literature and Suggestions for Researchers", MIS Quarterly, (Vol. 16, No.1, March 1992), pp. 95-113.

[80] Ibid., p. 99.

[81] Ibid., p. 96

Figure 2.2 - User Factors / DSS Implementation Research Framework.



Source: Alavi and Joachimsthaler, "Revisiting DSS Implementation Research: A Meta-Analysis", p. 97.

analysis study was organized around the core relationships between user factors and DSS implementation success.

The construct of implementation success has been represented in terms of a variety of different variables, such as system use, decision making performance (cost or profit), decision making time, user satisfaction with the system, user confidence in the decisions, and user attitudes toward DSS. The following will be a description of the method applied and the findings of the analysis.

A - DSS Performance Along the User-Related Factors

1. *Cognitive Style*:

The consensus among theorists is that cognitive style relates to the habitual ways individuals process and utilize information - that is, how they solve problems and make decisions.[82] Most DSS research tends to focus on the analytic/ heuristic dimension, which reflects the individual's preference to use abstract models and systematic processes or to rely upon experience, common sense, and pragmatic approaches. Another conceptualization of cognitive style highly emphasized in DSS literature is based on the Jurgian problem-solving style. This could be measured along a four-scale indicator: Extroversion - Introversion (EI); Judging - Perceiving (JP); Sensing - Intuition (SI); and Thinking - Feeling (TF).[83]

The results of the analysis showed that of all cognitive style dimensions, the analytic/ heuristic is the best predictor of the DSS performance. However, although this finding implies that "analytic decision makers tend to exhibit higher DSS performance, the relatively large credibility interval suggests great variation in this performance."[84] Moreover, the effects of the problem-solving style dimensions on DSS performance are smaller relative to the analytic/ heuristic

[82] Ibid., p. 97.

[83] Ibid., p. 98.

[84] Ibid., p.101.

dimension, yet more consistent. Overall, these results suggest that the relationship between cognitive style and DSS performance is small.

2. *Personality*:

Personality traits that are believed to have an impact upon DSS implementation success include: need for achievement; degree of defensiveness, locus of control, dogmatism; and risk-taking propensity.[85] Meta-analysis results reported suggest that the relationship between risk-taking propensity and DSS performance is higher than the relationship between other personality traits and DSS performance.[86]

3. *Demographic Variables*:

These include a range of personal characteristics of users, such as age, sex, and education. The two researchers showed that these variables influence DSS implementation success in terms of system use, decision performance, and decision making time.[87] Because of the small number of findings involving a relationship between basic demographic variables and DSS performance, the results could not be meaningfully integrated, thus, demographic variables were not considered further in the meta-analysis.[88]

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[85] Ibid., p. 98.

[86] Ibid., p. 103.

[87] Ibid., p. 98.

[88] Ibid., p. 103.

4. *User-Situational Variables*:

User-situational variables include training, experience and user-involvement.[89] Training refers to the provision of hardware and software skills sufficient to enable effective interaction with the DSS used. Experience refers to prior exposure to DSS as well as to individual's work history. User involvement, according to Swanson, corresponds to the "entanglement" of the user in DSS-related activities.[90] Meta-analysis results reported by the two researchers show that DSS experience is more closely related to DSS performance than work experience.[91] The relationships between user-situational variables and DSS implementation success were string. This reinforces the "conventional wisdom" that user-involvement and training lead to improved chances of successful system implementation.[92]

B - Attitudes Towards DSS

The results of the analysis conducted reveal that the effects of cognitive style, personality, and user-situational variables on attitudes towards DSS are similar to the impact of these variables on DSS performance. The relative ordering of the magnitudes of effect sizes suggests that user-situational variables

[89] Ibid., p. 98.

[90] E. B. Swanson, "Management Information Systems: Appreciation and Involvement", Management Science, (Vol. 21, No. 2, October 1974), pp. 178-188.

[91] Alavi and Joachimsthaler, "Revisiting DSS Implementation Research: A Meta-Analysis of the Literature and Suggestions for Researchers", MIS Quarterly, p. 104.

have the strongest association with attitudes towards DSS. The association strength of cognitive style variables with DSS attitudes is less than half that of user-situational variables, and personality variables show only small effects.[93]

The overall conclusion of the study is that user factors do impact DSS performance, that user-situational variables are more important than individual differences, and that by working upon user-situational variables (training, experience, and involvement) can significantly improve the implementation success rate.

2.7. Advanced DSS: Attributes and Importance

Decision support systems (DSS) are considered as an important direction in computerized information systems. As has been mentioned above, user involvement is an important factor in determining DSS performance. Since the emphasis here is upon users, it is, then, important to state that the emphasis should be on user-oriented DSS. The concept of the user-oriented DSS originates not only from the need of having a DSS that provides users with the capability of solving problems in a traditional manner by using the problem-solving process, but also by enabling them to get engaged in problem-finding. This means the capability of looking into the future and identifying problems that should be solved now.

[92] Ibid., p. 108.

[93] Ibid., p. 104.

In fact, the three most important characteristics of user-oriented DSS can be summarized as:[94] (1) focus on problem finding and problem solving, (2) use of an interactive processing mode, and (3) a comprehensive systems approach.

(1) Problem Finding and Problem Solving

The feature of a DSS to go beyond problem solving and focus upon problem finding paves the way to certain important characteristics to emerge:[95]

1. a broad approach to support decision making, with an emphasis upon "management by perception." Here, managers are assisted in perceiving important future trends and in adopting the organization to upcoming conditions.

2. a user-machine interface that permits the user to retain control throughout the problem-finding and problem-solving processes. Through a human-machine dialogue provided to the user, he/she will have a high level of control over all stages of problem-finding or problem-solving.

3. a user support in solving well-structured, semi-structured and unstructured problems, the focus, however, being on the semi-structured and unstructured decisions. DSS recognizes the need for bringing together human judgment and computerized information for improving the quality of the final decision in either problem finding or problem solving.

4. a use of quantitative models. This means that mathematical and/or statistical models can be employed to assist the user in evaluating alternative

[94] Thierauf, User-Oriented Decision Support Systems, pp. 40-48.

[95] Ibid., p. 41.

solutions. The quantitative models will, thus, be integrated into the DSS as decision tools.

5. a use of financial planning languages and statistical packages. These are modeling languages or DSS generators used to solve a wide range of pressing or organizational problems in an interactive mode.

(2) Interactive Processing Mode

To be effective, DSS must take place in an interactive mode with the following characteristics:[96]

1. query capabilities to obtain information by request. Query capabilities include not only interactive computation, but also responsiveness which implies using the system as an extension of the individual's reasoning process throughout the decision making process.

2. use of the management work stations. These allow users to perform a wide range of computer functions in an interactive processing mode. The more sophisticated management work stations provide users with data processing, color graphics, modeling languages, and word processing capabilities.

3. convenient and easy-to-use approach. The most important sign of effective DSS is that it is easy to use. This is demonstrated in allowing users to follow their own natural tendencies to problem finding and problem solving. The

[96] Ibid., p. 44.

individual thus feels comfortable and at ease with the system rather than intimidated by it.

4. adaptive system over time. The user is able to face changing conditions and adapt the system to meet these changes.

(3) Comprehensive Systems Approach

This approach allows the user not only to focus on problem finding and problem solving, but also to operate in an interactive processing mode. This approach includes the following characteristics:[97]

1. integrated systems of functional areas. Data for use by all systems are processed along broad, functional lines rather than the traditional, narrow departmental lines. This allows managers and their personnel to retrieve and process data of concern to them for supporting decisions.

2. enlarged database, with integration of external and internal data element. The DSS database should not only contain data pertinent to current and past operations, but it must also contain appropriate external information which is compatible to the internal data provided by the database. Thus, a database management system should be available to assist in a user-machine dialogue.

3. output directed to organization personnel at all levels. DSS does not only have the capability to supply top and middle management with important short- to long-range planning information, but it can also provide lower management and operating personnel with the necessary output for supporting

[97] Ibid., p. 46.

decision in controlling output operations. Thus, a comprehensive DSS approach assist in supporting all organizational members in decision making.

2.7.1. The Need for and Characteristics of More Advanced DSS

After presenting the major characteristics of a DSS, and taking into consideration the evolving maturity of these systems, it is important to talk about the broader and more developed features of an advanced DSS. Of course, these advanced DSSs are an extension of current DSS. This new kind of DSS is needed by organizations to help in handling difficult and complex conditions. A basic element in this DSS is to have internal and external data interaction taking place in countless ways. Moreover, this DSS will allow users, particularly those at the top management level, to use a highly integrated, total corporate planning model that interacts with all the major systems and subsystems of the organizations. This broader approach to DSS will support top management not only in problem solving, but also, more important, in problem finding.[98] Following will be a presentation of the major characteristics of an advanced DSS.[99]

2.7.1.1. A Broader-Based Approach to Support Decision Making

A very important distinguishing characteristic of advanced DSS is that more emphasis will be placed upon problem finding than on problem solving. The detection and solution of these problems will make it necessary for management to accommodate corporate integration. Thus, planning, actual performance, and plan changes must be appraised continuously across the

[98] Ibid., pp. 354-56.

organization. Such an environment requires management by perception which was previously mentioned. Because users will be able to project the effect of strategic plans on the organization, such an approach is highly important in a complex and dynamic environment, where top management must be able to understand and react quickly and decisively.

2.7.1.2. Tendency to Solve More Unstructured Problems

Advanced DSSs tend to solve problems of a very long range nature. These are expected to be more unstructured, including, for example, "planning and evaluating new products over their life cycles, allocating factory capacity in the most effective way, and setting long-range organizational plans and objectives."[100] What add to the complexity of such situations are the time dimension and globalization factors. Because these situations include a large number of unstructured variables and undefined parameters, the problems here are considered unstructured rather than semi-structured.

2.7.1.3. Use of More Complex Quantitative Models

Advanced DSSs include more developed and complex models that encompass several or all of the organization's systems and subsystems. Such a trend is moving ahead based on two factors: (1) many of the standard quantitative models are being combined into more sophisticated ones, and (2) problems that are difficult to structure are getting increased attention in the field of management science.[100]

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[99] Ibid., pp. 357-68.

More complex quantitative models are oriented toward the higher levels of management, that is, the strategic and the tactical levels. Strategic models tend to be corporate wide (macro-oriented) and subjective in nature, whereas tactical models tend to assist in allocating and controlling the use of the organization's resources.[100] Such models include: (1) corporate planning models which are capable of viewing the overall operations or a specific area and are concerned with the company's finances and rely on some form of simulation; (2) goal programming which is capable of handling goals and subgoals to determine how resources should be allocated to reach the goals; (3) venture analysis, which is useful to analyze a company's investment opportunities; and (4) heuristic simulation which is capable of providing users with intuitive rules and guidelines to explore the probable paths and to make good guesses in arriving at a solution.[101]

An important point to mention here is that certain semistructured and unstructured problems do not lend themselves to mathematical modeling. Examples include determining objectives; selecting, developing, and motivating employees; humanizing the work environment; and facilitating company-government relationships. With the assistance of advanced quantitative tools, the manager can reformulate these problem type to the computing capabilities of the DSS.

[100] Ibid., p. 358.

[101] Ibid., p. 359.

2.7.1.4. Expanded Capabilities of Modeling Languages

Along with the characteristics of an advanced DSS, many modeling languages (DSS generators) should have advanced quantitative models built as subroutines. In addition to the standard mathematical techniques (linear programming, PERT analysis,...) and statistical models (regression and correlation analysis), there is an emphasis upon more advanced techniques or models such as models for corporate planning, goal programming, venture analysis, and heuristic simulation.

2.7.1.5. Enlargement of Data Capabilities Using the "Moving Database" Concept

The database structure of advanced DSSs supplies important data to meet the needs of all management and operational levels. Such a database procures more environmental or external information that is compatible with internal information than that procured in the past. This includes information about the industry, competitive factors, the relative strengths of competing firms, economic conditions, and demographic data.

2.7.1.6. Total Systems Concept

More advanced DSSs are expected to be approximating the total systems concept. Highly sophisticated quantitative models that cut across the entire organization should be incorporated. Moreover, this should be accompanied with the ability of extracting desired information from the multilevel distributed databases available in the organization.

The above mentioned characteristics, as compared to the characteristics of the traditional DSS, are presented below.

Traditional DSS Characteristics as Compared to More Advanced DSS Characteristics.

Traditional DSS Characteristics	More Advanced DSS Characteristics
* Problem-Solving Support.	* Problem-Solving Support, but more emphasis on Problem-finding support.
* Supporting Structured, Semi-Structured, and Unstructured Problem Solving.	* Tendency to solve more Unstructured Problems.
* Standard Quantitative Models (linear Programming, PERT, regression and correlation analyses).	* More advanced quantitative models (corporate planning models, goal programming, venture analysis and heuristic simulation).
* Database including internal information and limited external information.	* "Moving Database" including more environmental and external information compatible with the internal information.

2.7.2. DSS for Recurring, Semi-Structured Decisions

Remus and Kottmann reported that judgment decision making situations should not be considered as discrete processes but rather as relatively continuous.[102] A manager can not make one judgment followed by one decision. Rather, he/she tracks the environment, making many decisions over time and making many more judgments. The decision strategies he/she uses change over time depending on the change of conditions and the feedback obtained. His/her performance in terms of success or failure is a factor of (a) the information used

for judgment, (b) the weights given to the information, (c) how various information is combined, or (d) the level of environmental uncertainty.

Taking the factors of uncertainty and the prevalence of recurring decisions into consideration, existing DSS provides decision maker with the "what-if" facility and the "multi-period" modeling. However, if decision makers are applying the tracking model, then existing decision aids "fall short on one critical front-direct support for perfecting decision strategies over time."[102] More comments about current DSS and needed DSS features were also presented by Remus and Kottemann.

To start with, current DSS support queries on data values within a model; however, "they do not readily support queries on structural elements of models themselves."[102] Moreover, DSS do not provide a maintenance of the decision making history which is necessary for tracking and which includes past actual situations and past forecast, the past decision alternatives that were chosen and those not chosen, and past decision strategies that were used.

Suggested by the two researchers, several DSSs are stated: DSS that include graphics packages which can be used to plot planned versus actual levels of variables; DSS that are packaged with statistical analysis routine; DSS that plot decisions generated using certain rules against actual decisions. Such capabilities may help decision makers formulate more effective tracking strategies. In fact, if

[102] Remus and Kottemann, "Semi-Structured Recurring Decisions: An Experimental Study of Decision Making Models and Some Suggestions for DSS", p. 240.

the basic notion of DSS is extended, decision makers may[103] "(1) generate alternative models using various scenarios of past and future values of decision variables, and (2) directly manipulate terms in the models to assess changes in decision outcomes."[104] Such capabilities support both the inductive and deductive forms of learning, which will help improve the decision making strategies over time.

As was mentioned earlier, the concept of creativity in decision making is highly crucial if the organization aims at reacting and maintaining a competitive edge in this highly complex, dynamic and rapidly changing environment. Because of this, advanced DSSs, should be designed, developed, and implemented in a way so as to enhance the creativity of its users. The following section will present the literature pertinent to the major features of a CEDSS as compared to traditional DSS.

2.7.3. Creativity Enhancing DSS versus Traditional DSS

Elam and Mead emphasized the use of a creativity enhancing DSS and drew a comparison between the attributes of a traditional DSS and those unique to an enhanced creativity one.[105]

To start with, a CEDSS is "process-oriented". It provides the problem solver with an environment that facilitates the use of a number of creativity-enhancing skills. Furthermore, it is generic in nature. This means that it is capable of providing support to the decision maker in any problem context. In contrast to

[103] Ibid., p. 241.

this, a traditional DSS is "Structure-oriented". This means that it provides a structure through its database and model base to represent and support the solution of a particular problem.

In addition to that, creativity-enhancing DSS places more emphasis on "problem conceptualization" than traditional DSS. Current DSS design practices recommend that "a model describing the decision making situation be identified, and either implicitly through a data-based DSS or explicitly through a model-based DSS, made available to the user as an aid to exploring alternative decisions."[105] In fact, this implies that such a type of DSS can support creativity only through providing users with the ability to explore and generate alternative solutions. Such an approach comes in conflict with the literature pertinent to creativity where the emphasis is on divergent rather than convergent types of thinking. The generation of alternatives is convergent in nature since the overall problem structure is predetermined. "Convergent thinking at an early stage may inhibit creativity by bounding the set of solutions that will be considered." [105] On the contrary, creativity-enhancing DSS supports the decision maker in defining and formulating, first, the problem and, then, selecting the models and databases to be used.

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[104] Ibid., p. 242.

[105] Elam and Mead, "Can Software Influence Creativity?", p. 6.

2.8. The Link Between Creativity Research and DSS

In referring to the social and environmental factors (represented by creativity-relevant skills and task motivation components) in Amabile's componential model of creativity,[106] one can say that these factors offer "a new promising avenue for DSS researchers interested in developing creativity-enhancing DSS when a DSS is viewed as a special type of social environment."[106] Comparing social and environmental factors to personal factors, it could be stated that social environments influencing creativity can be changed easily, and this change may have an immediate observable influence on performance. Personality characteristics and innate abilities cannot be changed the same way. Domain-relevant skills which represent the individual's abilities and traits can only be supported by providing users with the ability to have an access to specific knowledge bases relevant to the problem within consideration.

Since, as it was mentioned in the previous section, creativity enhancing DSSs are different from traditional DSSs, then a new perspective is needed for designing them. According to Elam and Mead, this perspective views the creativity-enhancing DSS as a special type of environmental factor that can raise the level of task motivation and support or enhance the creativity-relevant skills. It should be taken into consideration that "while a generic creativity-enhancing DSS does not directly augment the domain-relevant knowledge of its user through databases or knowledge-bases, the creativity-enhancing DSS through the process

[106] Ibid., p. 4.

it provides may help the user reorganize and better utilize the existing domain knowledge that he or she has."[107]

Using this perspective, a set of five guidelines for designing creativity-enhancing DSS has been developed by the authors.[108] The first three guidelines are pertinent to general capabilities of a DSS. The remaining two involve providing these capabilities to the DSS user.

A - Design Guideline 1:

The DSS will allow users to stop, store work sessions in process, then resume work later.

This means that a DSS should be characterized with features that do not necessitate a user to complete all work on a task in a single session. Completing a task in a single session was used to be done by users in order to avoid incurring startup costs in later sessions. According to Elam and Mead, such features give the user control and choice over when, and to some extent how, to get involved in the decision making task. Furthermore, the ability to expand the time factor facilitates the task of delayed judgment, which is one of the characteristics of creative persons.

B - Design Guideline 2:

A DSS should provide depth and positive tenor in its feedback.

As it is stated by Elam and Mead, A DSS should identify imperfections, search for causes to account for these imperfections, present new ways for

[107] Ibid., p. 6.

identifying the problem, or present it to the user in a different way. This way, a DSS can assist the user in breaking the bounded framework of the cognitive and perceptual sets surrounding decision making tasks. Positive tenor involves providing users with helpful, meaningful, and encouraging responses that would increase task motivation. Again these effects facilitate a wide range of alternative solutions generation and facilitate delayed judgment.

C - Design Guideline 3:

The DSS will make available to the user a full range of qualitative as well as quantitative decision aids.

Most DSS rely heavily on quantitative tools that allow for the generation for alternative solutions and scenarios based on predetermined models. This capability provides users with the required support in the choice phase of decision making. Such a capability, however, does not support creativity in an adequate way. This is because the generation of alternatives is convergent in nature due to the fact that the overall structure of the problem is predetermined, which does not allow a decision maker to freely conceptualize a problem and formulate a decision making task. Qualitative tools, on the other hand, are believed to support creativity since they expand the way a user views a task as well as allows a wider space for evaluation of alternatives.

Elam and Mead reported many qualitative aids. Examples include, Weber's "rehearsal tools, sketching tools, and decomposition tools"; El Sawy's "relevance trees, morphological analysis, and heuristics of lateral thinking in a

[108] Ibid., pp. 7-8.

system intended to support divergent thinking"; and Young's suggestion that "idea processing capabilities support problem conceptualization by incorporating and manipulating verbal data in a combinational fashion". Such qualitative aids are believed to support the user in employing creativity relevant skills.[109]

Although frequently tools are only provided for alternative generation and validation stages, a range of both qualitative and quantitative techniques should be provided to the user to support his/her creativity in each stage of the Amabile model.

D - Design Guideline 4:

A DSS will be technically easy to use and conceptually challenging.

Ease of use is a factor highly emphasized in most of the MIS and DSS literature. It is believed to result in positive user attitudes toward an information system (and more specifically DSS) use. Elam and Mead emphasized on technical ease of use intending by this to draw a distinction "between systems that are functionally straight forward and those that are conceptually easy to use."[109] Thus, maintaining broad conceptualizing capabilities as suggested with the above mentioned third design guideline may make a DSS conceptually more difficult to use. In other words, these DSS require the user to do more abstract thinking than traditional DSS. This, of course, supports the finding of creative solutions. However, the system does not need to introduce technical difficulties that distract

[109] Ibid., p. 5.

the user. "DSS should assist the user in focusing on the primary task of decision making rather than on the intricacies of operating the software."[110]

E - DSS Guideline 5:

The DSS will provide an enjoyable or "fun" computing environment.

As it is stated by Elam and Mead, "Fun" has a connotation from gaming that includes enjoyment and becoming highly absorbed in a certain activity. Thus, an enjoyable environment offers a kind of motivation for the user to spend more time in generating alternatives for the decision making task. This provides the user with the advantage to examine a larger number of solutions and to delay judgment. In addition to that, an enjoyable environment will reduce the stress the user may feel. Finally, "fun" is associated with play rather than work. Such a fact is expected to positively affect creativity.

After presenting the literature pertinent to the link between creativity research and DSS, and before conveying the literature covering the influence of creativity-enhancing DSS upon users' creativity, it is important at this stage to tackle the subject of creativity assessment. Being a thinking process that helps an individual in generating ideas, its assessment could abide by certain quantitative as well as qualitative measures (to a great extent). It is important to mention that the literature concerning the assessment of creativity is very limited. Typically, the problems used to study creative thinking allow a variety of solutions, thereby

[110] Ibid., p. 8.

requiring that the solutions be judged for acceptability or adequacy on one or more criteria. The following section will present the literature pertinent to criteria of creative behavior and predictors of creativity.

2.9. Creativity Assessment

A valid way of learning about the nature of creativity is through testing creative behavior. Torrance[111] presented a description of two longitudinal studies used to assess creativity: one involving high school students tested in 1959 and followed up 7 and 12 years later, and the other involved elementary students tested in 1958 and followed up 22 years later.

The criteria of creative behavior used by Torrance consisted of the following factors:[112]

1. Quantity of publicly recognized creative accomplishments.
2. Quality of creative accomplishments. Here, subjects were asked to identify what they considered their three most creative achievements. These were judged by three judges.
3. Quality of creative achievement as implied by future career image. This was also judged by three judges assessing the subjects' responses to questions related to their career ambitions; position, responsibility, or reward wished to be attained; and what they would like to do or be in the next 10 years.

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[111] E. Paul Torrance, "The Nature of Creativity as Manifest in its Testing", The Nature of Creativity, ed. Robert Sternberg, (Cambridge: Cambridge University Press, 1991) p. 58.

[112] Ibid., p. 59.

4. Quantity of high school creative achievements. This was used only in elementary school study and limited to achievements during the high school years.
5. Quantity of creative life achievements, not publicly recognized. This was used only in elementary school study and included activities such as designing a house, designing a garden, composing a musical passage, etc.

The correlation of these criteria with the predictors of creativity was studied. The predictors included variables such as fluency, flexibility, originality, elaboration, inventiveness, intelligence, and achievement. *List I* (page 113) shows the results obtained from the follow-up data of the seniors in the high school study in 1966 and 1971 (N = 46 in 1966; N = 52 in 1971). Torrance's creativity test predictors successfully predicted the criterion measures (judged quality of three most creative achievements, number of publicly recognized creative achievements, and judged quality of creative achievements projected for the future) in 1966 and 1971.

The predictive validity for the entire high school sample (N = 254) supplying follow-up data is shown in *List II* (page 114). Again, it is seen that all of the creativity test predictors are statistically significant at the 0.01 level. The basic conclusion of the study was that "young people identified as creative on the basis of creativity tests during the high school years tend to become productive, creative adults."[112]

List I - Correlation Coefficients between Creativity Predictors Established in 1959 and the Criterion measures established in 1966 and 1971.

	Criterion Variables					
Predictions	Quality 1966 N = 46	Quality 1971 N = 52	Quantity 1966 N = 46	Quantity 1971 N = 52	Aspiration 1966 N = 46	Aspiration 1971 N = 52
Fluency (TTCT)[a]	0.39 *	0.53 *	0.44 *	0.54 *	0.34 *	0.49 *
Flexibility (TTCT)	0.48 *	0.59 *	0.44 *	0.58 *	0.46 *	0.54 *
Originality (TTCT)	0.43 *	0.49 *	0.40 *	0.54 *	0.42 *	0.51 *
Elaboration (TTCT)	0.32	0.40 *	0.37 *	0.43 *	0.25 *	0.41 *

[a]. Torrance Tests of Creative Thinking
*. Coefficient of correlation is significant at the 0.01 level.

Source: Torrance, "The Nature of Creativity as Manifest in its Testing", in The Nature of Creativity, p. 59.

For the 22-years follow-up of the elementary school students first pretested in 1958, the predictive validity is shown in *List III* (page 114). Here also; all the creativity test predictors correlate with all of the creativity achievement criteria at the 0.001 level or higher.

Based on these results, the conclusion derived by Torrance is that "the predictive validity is as good as we have any right to expect for almost any kind of predictor of adult achievements."[113]

2.9.1. Skills Involved in Creative Thinking

Torrance reported that thinking could be viewed as a skill like reading, writing, swimming, playing tennis, or cooking. As it is the case with these skills,

[113] Ibid., p. 60.

List II - Product-moment coefficient of correlation between predictor and criterion measures of total high school sample.

Predictors	Number	Quantity *	Quality *	Aspiration *
Fluency	254	0.30	0.30	0.27
Flexibility	254	0.28	0.29	0.24
Inventiveness	254	0.36	0.41	0.35
Total (1959)	254	0.32	0.36	0.32
Originality	254	0.40	0.43	0.39
Intelligence	254	0.21	0.38	0.39
Achievement	254	0.27	0.47	0.43

*. r is significant at better than the 0.01 level.

Source: Torrance, "The Nature of Creativity as Manifest in its Testing", in The Nature of Creativity, p. 59.

List III - Predictive validity of the Torrance Tests of Creative Thinking for males, females, and total sample for five criteria of creative achievement in 22-year follow-up.

Criteria of Creative Achievement	Males (N = 95)	Females (N = 116)	Total (N = 211)
- Number of High School Creative Achievements	0.33	0.44	0.38
- Number of Post-High-School Creative Achievements.	0.58	0.42	0.46
- Number of Creative Style-of-Living Achievements.	0.42	0.48	0.47
- Quality of Highest Creative Achievements (ratings).	0.59	0.57	0.58
- Quality of Future Career images.	0.62	0.54	0.57

Note: All coefficients of correlation are significant at 0.001 level

Source: Torrance, "The Nature of Creativity as Manifest in its Testing", in The Nature of Creativity, p. 60.

improvement in thinking skills requires practice with the right tools and in the right environment.[113] This requires the identification of the component skills that underlie creative thinking.

On the Torrance Tests of Creative Thinking (TTCT), a variety of skills that are considered to be important in producing creative responses were identified. "The responses to both the Verbal and Figural tests, Sounds and Images, and other creativity tests give evidence of these abilities, which can be scored."[114] Moreover, tests and experiments conducted by Torrance show that they are valid predictors of creative achievement since they correlated significantly with the two creativity criteria: judged quality of creative achievements and number of publicly recognized and acknowledged creative achievements.[115]

The following abilities were identified in the figural forms of the TTCT:[116]

1. Fluency, number of responses.
2. Flexibility.
3. Originality.
4. Elaboration.
5. Abstraction.
6. Resistance to closure.
7. Emotional expressiveness of the response.
8. Articulating.
9. Movement or action shown in the response.
10. Expressiveness.
11. Synthesis or combination.

[114] Ibid., p. 66.

[115] Ibid., p. 67.

[116] Ibid., pp. 66-7.

12. Unusual visualization.
13. Internal visualization.
14. Extending or breaking the boundaries, getting outside the expected.
15. Humor, juxtaposition of two or more incongruities.
16. Richness of imagery, showing variety, vividness, liveliness and intensity.
17. Colorfulness of imagery.
18. Fantasy, unreal figures.

2.9.2. Baseline Creativity Measurement

In recent years, several tests have been developed to measure creative behavior and abilities. According to Vecchio,[117] while these tests are certainly useful, they do not adequately tackle all the aspects of a complex network of behaviors. Such behaviors include personality traits, attitudes, motivations, values, interests, and other variables. These variables predispose a person to think creatively.

In an attempt to arrive at creativity assessment measures that have the feature of covering a broader range of creativity attributes, Vecchio reported an inventory type of test that was developed by one organization. The subject is provided with a list of statements for which he/she should present his/her attitude using a 5-Likert type scale. Each statement is given a certain weight based on which the calculation of the subject's score will take place. A sample of the instrument is presented in *Appendix A* and will be adopted in this research.

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[117] Robert P. Vecchio, Organizational Behavior, (London: The Dryden Press, 1991), p. 370.

2.10. The Role of Creativity-Enhancing DSS Upon Creativity

Based upon the advanced features that an enhanced DSS has, basically regarding problem definition and problem solving, and based upon the basic assumption that was presented earlier in this chapter that an individual can be helped to be more creative, the basic question that poses itself now is what role can a DSS with advanced features play in enhancing the creativity of its users?

In their study, Elam and Mead drew a set of guidelines for designing DSS and proposed two hypotheses involving the use of a DSS which is developed in accordance with these guidelines. The two hypotheses are:[118]

1. A user of a creativity-enhancing DSS will adopt a multiple step decision process, whereas a user of no-software will adopt a single step decision.
2. The use of a creativity-enhancing DSS will result in higher levels of creative responses than the use of no-software.

The hypotheses are set this way because, according to the researchers, in order to begin to understand how a creativity-enhancing DSS might have an impact upon creativity, it is first important to determine if such a DSS can actually influence the user to adopt a systematic, stage by stage approach to addressing a task. Implicit in their research is the belief that DSS can, indeed be instrumental in providing an environment that encourages creative decision making. This was based upon Amabile's componential model which hypothesizes that creativity in any given task will be directly influenced by an individual's

[118] Elam and Mead, "Can Software Influence Creativity?", p. 8.

domain-relevant skills, creativity-relevant skills, and task motivation. The relationship here is that, as the researchers believe, a DSS designed according to the prementioned guidelines may be employed to support and extend an individual's creativity-relevant skills.

In order to test these hypotheses, a laboratory experiment was designed.

2.10.1. Software Used in Experiment

For the purpose of the experiment, the researchers chose an existing software package that represented one possible implementation of the design guidelines. From the various available packages, the Ods / CONSULTANT was selected. This was produced by Organization Development Software, Inc., and was ran on a MacIntosh computer.

This software was selected for several reasons:

1. It was designed from a creativity-enhancing perspective.
2. It supports the problem conceptualization phase of problem solving.
3. It encourages the user to think about options, alternatives, comparisons,... etc. The package does not gather data, analyze information, make judgments or solve problems directly.
4. Ods / CONSULTANT matched closely the creativity-relevant skills contained in the Amabile's Componential Model of Creativity. Quantitative thinking aids designed to encourage idea generation were included as well as routines to facilitate brainstorming, provoke questions and produce components of idea fragments. Quantitative thinking aids included utilities for grading ideas and evaluation and rating of ideas based on two or more criteria.

5. It is easy to learn and use. This minimized the time and effort required of each subject in training and in completing the experimental tasks. Also, there were no commands to remember. Rather, context-sensitive help was available at all times.
6. Two versions of the software were used. Version 1 encourages the user to look for underlying causes for the decision situation at hand. The user then is helped to move from causes to explanations then to solutions. Version 2, however, is found on practical solutions at every step. This version asks the user to identify a desired outcome, consider resources and constraints and finally generate solutions and a decision.[119]

2.10.2. Experimental Design, Subjects, and Tasks

The experiment included one independent variable - software treatment at three levels: no software, version 1, and version 2 of Ods / CONSULTANT. The no software was preferred to a traditional DSS, since a traditional DSS and a creativity-enhancing DSS such as the one selected do not share the same functionality. The two dependent variables that are included in this experiment are: the decision making process employed and creativity of response.

An independent creativity measurement was also used to yield a baseline creativity score for each subject. This was done to ascertain that subsequent differences in measured creativity of responses was due to the independent variables included in the experiment rather than due to individual differences in

[119] Ibid., pp. 9-11.

creative aptitude. Moreover, measures of the users' perceptions of the quality of feedback, ease of use, and fun to use were also taken into consideration.

The sample size for the experiment was 12 junior members of the auditing group of a "big eight" accounting firm. Each subject addressed two tasks, thus, yielding 24 observations. Furthermore, to control the domain knowledge that the subjects brought to the experiment and their motivation for performing the task, a group of professionals with similar education and experience backgrounds and with the same work environment were selected.[120]

Also, two tasks were developed for this experiment, one involved business application while the other involved a public policy. The characteristics of these tasks were as follows. First scenarios were needed that required the making of important decisions. Second, a level of complexity had to be associated to the task so that a broad range of possible solutions could be trapped. Third, the tasks had to be ill-structured.

2.10.3. Results of the Experiment

As for hypothesis 1, it was tested for two groups - those using either version of the creativity-enhancing DSS and those using no software. This hypothesis was confirmed using a Chi-square test ($X^2 = 9.1263$, $p = 0.0025$, d.f. = 1).

Further tests (Fisher's Exact Test) showed significant differences in the decision processes of subjects using version 1 and subjects using no-software (p =

[120] Ibid., p.11.

0.0128) as well as significant differences in the decision processes of subjects using version 2 and subjects using no software ($p = 0.0128$). The results strongly indicate that the DSS will influence a user to follow the underlying multi-step decision process in a systematic way.

Concerning hypothesis 2, the mean creativity rank shows that the group using version 1 produced more creative responses than the group using no-software. The group using version 2 actually produced less creative responses than the no-software group. This was a surprising result since what was expected were more creative responses resulting in both software versions than in no software.

The difference in the results for the two software treatments could be attributed to differences in the users' perceptions of design features. Version 1, according to reported results, is perceived as being more fun to use and more helpful than in version 2, but more difficult to use than version 2. The factors that were considered here then were: ease-of-use, playfulness, cognitive effort, and help provided for task.

It is important to note that the methodology applied in this experiment will be followed in this study, except for certain adjustments that should be done to make it suitable for the sample to be worked with and the setting selected.

The above presented literature was an elaborate review of the research pertinent to creativity and supportive DSS. The following chapter will be a

description of the design and methodology to be applied in gathering and analyzing data in this study.

CHAPTER III

Research Design and Methodology

3.1. The Basic Approach

The purpose of this study is to understand the link between creativity and DSS. Features characterizing DSS and their relationships with the user's perceptions about computer use along with the effect they have in enhancing creativity were investigated. Moreover, the study intends to examine the various factors that are most likely to be associated to creativity. These include playfulness, ease-of-use, usefulness, and DSS usage. In addition to this, the relationship between computer use, software use, training and experience on one hand, and individual variables on the other will be studied. Finally, factors such as computer experience and training were "investigated" in accordance to their relationship to DSS usage and attitude towards the creativity enhancing DSS (CEDSS) used in the experiment. The variables used and the type of analysis applied will be presented in the following sections.

3.2. Sources of Information

In order to test the hypotheses stated and answer the questions addressed in Chapter I, two sources of information were used, a field survey and an experimental design conducted on employees working in one of the top five leading banks in the Lebanese banking industry. The various branches of this bank were considered as the sample frame of this study. The reason that one bank was selected is to keep the consistency of certain individual and organizational factors, which would help in achieving the aim of the research.

The field survey intended to collect data regarding certain basic creativity aspects of the respondents. At a later stage, the survey was used to collect demographic as well as computer and DSS related information.

The experiment was designed to provide information regarding the effect of using CEDSS upon users' creativity. This, in reference to the literature review presented in Chapter II, it was based upon the assumption that creativity exists and an individual can be helped to be more creative.

The methodology followed in conducting the survey and the design applied in carrying out the experiment used the approach that was adopted by Elam and Mead.[1]

3.3. Survey Design

The complex nature of the variables included in the study, namely

[1] Joyce Elam and Melissa Mead, "Can Software Influence Creativity?", Information Systems Research, (Vol. 1, No. 1, March 1993), pp. 1-22.

creativity and cognitive aspects, and the wide variety of these factors among various individuals made it necessary to design two different questionnaires to be filled by the same respondents, one before and the other after the experiment conducted.

3.3.1. Questionnaire I - Creativity Baseline Measurement

The first questionnaire was a creativity baseline measurement. It was distributed to the participants and answered in a controlled environment. The permissions and support of all the concerned branch managers were taken in order to ensure prompt responses and effective cooperation. Also, respondents were asked to fill out the questionnaire individually and give it back as soon as they finished. Group discussions were not allowed so that one respondent will not affect the opinions and answers of the others. The reason that the questionnaires were collected immediately after finishing was to assure that respondents were not giving statements resulting from a long time of thinking or to avoid them reconsidering their answers. The immediate response was the most important. The respondents were not left alone in order to answer their questions if they had any and to ensure that the statements in the questionnaire were clearly understood by them.

The questionnaire was designed to assess, in general, the individual's creativity as a way of perceiving and thinking about various matters. This questionnaire included statements pertinent to feelings, behavioral conducts, and attitudes toward specific life situations. Fifty statements were given to which the respondent was asked to rate his/her attitude based on a five Likert type scale

ranging from 1 (Strongly Agree) to 5 (Strongly Disagree). Weights from -2 to +2 were given to the answers ranging from noncreative to creative, and the score for each individual was computed over 100 by adding all the scores that were given to the various statements. It is worth mentioning that the respondents were not told that the questionnaire was intended to measure their creativity. The cover story informed them that the statements aim for assessing the process they apply in solving problems and making decisions. They were also informed that their responses will be used as an aid and as a guide to identify the facilities that should be provided by a computer software developed to support the decision making and problem solving process.

This questionnaire was adopted from the creativity test presented by Robert Vecchio in the discussion he made about creativity measurement.[2] This measurement tool could be referred to in *Appendix A*.

3.3.2. Questionnaire II - Survey About The Creativity Enhancing DSS

The second questionnaire was used as a tool to measure factors that are most likely to be associated to creativity in generating ideas and selecting a solution to a problem. This instrument included ten sections. The first section consisted of ten questions on demographic characteristics, followed by a section on computer use consisting of questions related to computer type, extent of use, and frequency of computer use. This was proceeded by a section covering software use, and consisting of two parts, one related to the software packages

[2] Robert Vecchio, Organizational Behavior, (London: The Dryden Press, 1991), pp. 370-373.

being used by respondents and the extent of their use, and the other related to the various tasks in which the software packages are used. Then, the sections coming next included four questions on the kind and level of computer training, six questions on computer knowledge and experience, and eight on aspects related to DSS usage in general. These questionnaire parts were followed by sections that assess the respondent's attitudes and perceptions about certain aspects related to the DSS software used in the experiment. It is worth noting that these sections were skipped by participants who did not use this software. These included ten questions on the DSS's ease of use, twenty two items describing the extent of system's playfulness, and seventeen questions assessing the respondents' attitudes and perceptions about the DSS software used. Again here, and as in the first questionnaire, nothing was mentioned to respondents about creativity, and the term "playfulness" was substituted by the word "friendliness". This was basically done in order to avoid bias in evaluating the CEDSS or in expressing attitudes.

This second questionnaire, was distributed to respondents after the experiment for two major reasons that support the basic purpose of the study. The two reasons are:

1. To investigate their attitudes about the DSS used, and whether they perceive it as an effective helping tool for problem solving and decision making.
2. To study the effect that such a CEDSS might have upon the respondent's creativity, taking factors such as usefulness, ease of use and playfulness along with others into major consideration.

lateral thinking. It also provides the user with the ability to think about certain qualitative matters away from subjectivity and close uniqueness.

Of all these available CEDSS, the IdeaFisher produced by Fisher Idea System, Inc. was selected. This software "is unique in that it has an associative lexicon of the English language that cross-references words and phrases. These associative links make it easy for the user to be fed words related on some level to be given theme based on analogies and metaphors." Moreover, using its large database the program generates lists of related words or phrases related to a topic. Although many of these words make little sense, yet users can then eliminate them. This is similar to what takes place in brainstorming. Any selected word can then be used as a subject to further associations by the program.[3]

This IdeaFisher was selected for many reasons. First of all, it was designed according to creativity enhancing measures. The user here is encouraged to think about options and alternatives. This is done through idea associations which stimulate the memory and help generate new ideas. Second, it has a Qbank which is a storehouse of questions organized into sets and categories designed to help the user define, clarify, modify, and evaluate problems, solutions, and ideas. The user can directly answer the chosen Qbank questions, and these answers will be recorded to be referred to and evaluated later on. Third, other than the qualitative aids which help in generating ideas, quantitative thinking aids are available in the form of filtering which generates key concepts from the user's

[3] Efraim Turban, Decision Support and Expert Systems, (NY: Macmillan Publishing Company, 1993), p. 341.

answers to the Qbank questions. Such a qualitative aid provides the user with the utility of prioritizing a set of ideas according to the key concepts or words most mentioned by the user in his/her solution.

Still another feature is that the IdeaFisher is easy to use and learn. The type of help provided minimizes the time required to train the subject and help him/her to proceed with and complete the experimental task requirements. Also, there are no commands and syntax to remember in IdeaFisher; rather, the users are provided with an icon-and-mouse driven environment as well as simple pull-down menus.

A final feature to be mentioned here is the ability to customize several tools, specifically the Qbank questions, so as to provide the user with several sets and categories for idea generation. Of these categories, various questions were selected to form a process model similar to the one provided by version 2 of Ods-CONSULTANT used in Elam and Mead's experiment.[4] The process model applied in the experiment is clearly presented in *Appendix C*.

3.4.2. Experimental Dependent and Independent Variables

The only independent variable used in this experiment is software treatment at two levels: no software and version 5.0 of IdeaFisher. A no software treatment rather than a traditional DSS was used since a traditional DSS and a CEDSS, as reasoned by Elam and Mead, "...do not share the same functionality...a traditional DSS is not an appropriate tool used for task designed

[4] Elam and Mead, "Can Software Influence Creativity?", p. 10.

to employ the unique features of a creativity-enhancing DSS."[5] Two dependent variables are included in the experiment: (1) decision making process employed, and (2) creativity of response.

The results of the experiment are compared to the scores of creativity-baseline measurement. This is done to ascertain that differences in measured creativity are due to software/ no software use rather than due to individual differences in creative aptitude. For the software treatment group, measures of the users attitudes and perceptions regarding usefulness, ease of use, and playfulness were also taken into consideration through questionnaire II described above.

3.4.3. Subjects

The subjects of the experiment were those that participated in the first, and of course, in the second surveys. The subjects were selected as employees all working in one of the top five leading banks in Lebanon. Thirty employees participated in the experiment, which determined the size of the sample. The sample was selected taking into consideration that certain factors should be controlled to attain and keep the validity of the study findings. Because of this, the thirty subjects were selected from the various branches of the same bank to ensure the consistency of the working conditions to which the various subjects are exposed. Also, the users were selected with either a BS or an MS degree to ensure consistency in the educational level factor. Finally, the subjects working experience in the banking sector along with the fact that they are business graduates provided consistency in the domain of knowledge factor.

[5] Ibid., p. 11.

Another aspect that was considered important to the conduct of the experiment was to select people who are or have the potential to become managers involved in the decision making process. This is why it was important to select subjects having the common characteristics mentioned above.

3.4.4. Experimental Task

After filling the baseline questionnaire which measures the creativity of the subjects, they were either given an appointment for the experimental task (sometimes upon their request), or were directly asked to sit for the experiment. The participants were all from the same working environment and accordingly they were given a case problem related to the banking sector. *Appendix D* shows a full description of the problem.

The control group solved this problem manually without referring to the CEDSS facilities. The experimental group used these facilities after getting used to the various aspects of the software through a simple and a short user's manual that trained them on how to go along and use the system.

The task required certain significant characteristics for the reliability of the experiment:

1. Scenarios were needed that required the making of essential, consequential and relevant decisions.
2. The task had to be complex in a way that a capacious range of possible solutions could be addressed.
3. The task had to be ill-structured enough that an obviously "right" or "wrong" solution was excluded.

4. Since the same task was approached by the two treatment groups (software and no software), it had to be addressed in a reasonable as well as flexible time without automated assistance.

3.5. Experimental Procedures

Subjects were assigned randomly to software treatment before filling the creativity baseline questionnaire. As mentioned before, half of them used the CEDSS to solve the case problem and the other half dealt with the problem manually with no reference to the computer. Each session included one or two subjects conducting the experiment, separately, and one or two solving the problem manually. The researcher and other persons who assisted in running the experiment were always available to provide the subjects with all the necessary instructions help during the warm-up exercise and training sessions. Subjects were informed that the task they would be addressing is an open-ended case that had no right or wrong solution and that they were free to handle the problem the way they found most convenient.

The warm up exercise was given for both software and no software treatment groups. This was important in order to help subjects try out instructions and ask clarifying questions about the case and the software for the software treatment group, and about the case for the no software group.

The software treatment group was given a training session where they read a manual and applied its instructions. This manual was prepared in a way so as to cover some of the tools provided by the system (IdeaFisher), specifically the

Qbank and filtering functions. The participants were not trained on the various tools for two main reasons:

1. The experimental task (training and problem solving) should be accomplished in two consecutive sessions with a maximum of five minutes rest period in between. Thus, due to the time constraint, only the main functions of the system were to be well known by the participants. They were given as much time as they felt was needed to get used to the functions.
2. It was intended to save the participants a lot of effort and possible confusion in grasping more than what was needed for the conduct of the experiment.

Finally, the subjects using software were introduced to the software's basic menus, format, and icons, as well as help facilities.

When the experimental task began, no additional guidance or assistance was offered to the subjects. They were just told they had approximately thirty minutes for the non software group and one hour for the software group planned for the task completion. However, they were notified that the timing was flexible, and they should work comfortably untill they finished. This was important in order to have a uniform time frame for subjects while maintaining a minimum external control. Subjects using software were assured, before starting problem solving, that they had the freedom in using the software the way that best suited them. They were told they could skip any step or cue suggested by the software that they felt irrelevant for the task on hand. It is worth noting that IdeaFisher supports this flexible usage, i.e., while the software suggests certain cues, it operates effectively even when the cues are used in any order or when certain

steps are omitted.

Upon task completion, subjects were asked to fill out the second questionnaire concerning the software used and other categories that were mentioned in a previous section (3.3.2).

3.6. Variables of the Study: Measurement Procedures

Several measurement procedures were adopted from the literature review and previous works in the same field area. These were applied to measure baseline creativity of the participants (discussed in section 3.3.1), their decision making process, the creativity of their responses, and users' perceptions of software features.

3.6.1. Experiment Variables.

Four major variables were included in the experimental design. These are: (1) Decision Making Processes used by the subjects; (2) Creativity of responses; (3) Time needed to complete the task; and (4) Software treatment at two levels. The latter two were discussed in previous sections.

Decision Making Processes

This variable measures the number of steps the subject took in the decision making process to reach a solution. These steps taken by each subject were recorded and saved under a separate file that was referred to later on for analysis purposes. These were easily measured with people who used the CEDSS. This is because the software provides a customized list of questions that matches the 5-steps of Amabile's model used as a reference. *Appendix E* shows the list of

questions provided by the software and the matching with the corresponding steps of Amabile's model.

On the other hand, for the no software treatment group, two independent coders matched the subjects' written statements to the steps of Amabile's model. The coders agreed on 80% (24 cases) of the matches. Fortunately, disagreements were discussed, referred to a third independent coder, and revolved by consensus.

Hence, the decision process employed by each subject was characterized as either (1) multiple step, or (2) single step. A multiple step decision process includes at least two steps of the Amabile model in any order, whereas single step decision process is when the process employed by the subject included one immediate decision. It was expected that subjects using software would be influenced to use multiple steps while the non users would approach a single-step process.

Creativity of Responses

This is the basic and the most important dependent variable in this study. Measuring such a variable with all the complex differences among the various human beings is a difficult task. That's why evaluating this variable was done according to the assessment technique used by Elam and Mead. This technique developed by Amabile is based upon this definition of creativity:

> "A product or response will be judged as creative to the extent that it is both novel and appropriate, useful, correct, or valuable response to the task at hand." [6]

[6] Elam and Mead, "Can Software Influence Creativity?", p. 13.

Furthermore, it is a subjective technique that needs the assessment of qualified judges to creativity. For this reason, five independent judges were chosen and told to use their own subjective definitions of creativity in making the evaluation for each response. Amabile states "that such measures must be accepted as not only consistent, but valid as well. That is, if experts... agree that a product is creative then we must accept the validity of their judgment."[6] To maintain the consistency of measurement among judges and in accordance to the baseline measures, a 5-Likert scale was provided with each response to the judges. Each judge received a set of all responses for the task. These responses were represented in an identical manner in a way that the two different treatments could not be identified. (Refer to *Appendix F* for information about the judges).

3.6.2. Survey Variables:

Other than the creativity baseline variable which was discussed earlier, different variables that are believed to have an effect upon the creativity of the individual's responses and their attitudes towards the CEDSS used were also included in this research because of their perceived importance.

3.6.2.1. Computer Use

Based on previous research on MIS usage, end-user computing, and user satisfaction, the dimensions of computer usage included in this study are the following:

1. *Actual Daily Use of Computers*: This dimension was considered as an important one in determining computer use, and, thus, was widely used in

MIS studies. In this study, the scale used by Igbaria[7] will be applied. The extent of use was measured on a six point scale ranging from "almost never" to "more than 3 hours per day".

2. *Frequency of Use*: This dimension was also used by Igbaria and first suggested by Raymond. According to Raymond, this provides a slightly different perspective than duration of use.[8] This dimension was measured on a six-point scale ranging from "less than once a month" to "several times a day."
3. *Software Use*: This variable was included in the study to determine the number of software the subject is familiar with and the extent of his/her knowledge in using the software mentioned. Ten software packages were included which are, Spreadsheets, Word processing, Data management packages, Modeling systems, Statistical packages, Graphical packages, Communications or E-Mail packages, 4th Generation Languages, 3rd Generation Languages, and other software. The scale built ranges from "Not at all" to "To a great extent". This measure was developed and adopted by Igbaria.
4. *Inclusion of Computer Analysis in User Tasks*: The emphasis would be on the inclusion of computer facilities and analysis in the bank-related activities. A good indication of the overall inclusion of computer analysis in the bank tasks

[7] Magid Igbaria et al., "Microcomputer Applications", Information Management, (Vol. 16, No. 3, 1989), pp. 187-196.

and the variety of tasks performed on the computer was analyzed using a scale that was developed for measuring thirteen tasks: Looking for Trend, Finding Problems/ Alternatives, Planning, Budgeting, Taking Actions, Communicating with Others, Controlling and Guiding Activities, Making Decisions, Historical Reference, Keeping users Up-to-Date on Activities/ Performance, Aiding in Adequately Reporting to Superiors, Aiding in Increasing Productivity, and Aiding in Cutting Cost. As developed by Igbaria, ordinal scaling was used to measure each task category. Five ordinal answers were listed ranging from "Not at all" to "To a great extent". The number of these tasks was used as an index for this measure.

3.6.2.2. Computer Experience and Training

Computer experience was assessed by asking subjects to indicate whether they had knowledge and experience in using computers, information systems, computer use, involvement in analysis and design of information systems, and use of various kinds of models. Responses were coded 0 for no experience, and 1 for some or more experience. The total that the respondents reported was used as a measure. Computer training was measured by individuals' response to a question which asked them to report the extent of training they have received from four sources: College or University Courses, Vendor Training, In-house Training, and

[8] L. Raymond, "Organizational Characteristics and MIS Success in the Context of the Small Business", MIS Quarterly, (Vol. 9, No. 1, March 1985), pp. 37-52.

Self Study. This scale was developed by Nelson and Chenney[9] and used by Igbaria et al. The mean of the responses to these four questions was used as an indicator of computer training. The validity of the scale was proved by Igbaria since it has an internal consistency reliability of 0.86.

3.6.2.3. Beliefs and Attitudes About Computer Usage

This measure reflects the general attitude of subjects about using computers in their jobs. This was used by Igbaria in terms of computer anxiety, and it had an internal consistency reliability (coefficient alpha) of 0.94. The instrument asked the participants to indicate their agreement and disagreement with 12 statements reflecting the beliefs of users about the advantages and disadvantages of using computers. The response options in this scale range from 1 (Strongly Agree) to 5 (Strongly Disagree). The mean of the responses was used as a measure for this variable.

3.6.2.4. DSS Usage

This part of the survey was adopted from previous surveys and DSS literature, specifically the study conducted by Pearson and Shim.[10] 8 item questions were listed to measure the extent to which the participant is familiar with DSSs - concept and usage. These questions intended to investigate the participants' level of DSS usage

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[9] R. Nelson and P. Chenney, "Training End Users: An Exploratory Study", MIS Quarterly, (Vol. 11, No. 4, December 1987), pp. 547-559.

[10] J. Michael Pearson and J. P. Shim, "An Empirical Investigation into DSS Capabilities: A Proposed Taxonomy", Information and Management, (Vol. 27, No. 1, 1994), pp. 45-57.

(if any), whether he/she was involved in any of a DSS development stages, the level of satisfaction reached with the results of the DSS usually used (if any), and whether the effectiveness of decisions made could be attributed to the DSS being used (if it is used).

3.6.2.5. Ease of Use

The ease of use construct, developed by Davis[11], was used in this study as an instrument to measure whether the CEDSS being used by experiments in the experimental group was seen as an easy system to use. The instrument included items pertinent to confusion, understanding, mental effort needed, type of system on-line help provided, ease of remembering, flexibility, and others. To verify the construct validity of the ease of use questions, an oblique rotational factor analysis was performed, and an internal consistency reliability of 0.93 was reported.

3.6.2.6. System Playfulness

Computer playfulness was considered by a lot of MIS research work as a factor affecting the users' attitudes towards computer's usage and their perceptions about its usefulness. Elam and Mead considered it as a factor influencing the users' attitudes towards the CEDSS and the level of creativity in their decision making processes. Based on this, and in an attempt to study the effect of this variable upon users' attitudes towards IdeaFisher and upon the creativity of their responses, computer playfulness was included in this study. The

[11] Fred Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly, (Vol. 13, No. 3, September 1989), pp. 319-340.

computer playfulness scale was adopted from Webster and Martocchio.[12] The instrument includes 22 adjectives for which the subjects would indicate their level of agreement using a 5-Likert type scale ranging from 1 (Strongly Agree) to 5 (Strongly Disagree). The validity of the scale was validated by Webster et al. since it has internal consistency reliability ranging from 0.86 to 0.90, which demonstrates good distribution properties.

3.6.2.7. Attitudes Towards IdeaFisher

This variable was used to assess the attitudes and perceptions of the experimental group subjects of the experimental group subjects about the CEDSS selected for them in order to deal with the task case they were given. The scale was used by Pearson and Shim[13], and was adopted for this research. This instrument included 17 items for which the subjects indicated their agreement or disagreement using a 5-Likert type scale. The items intended to get the opinions of the respondents regarding the usefulness of the system for decision making and problem solving for various problem areas faced by the various management levels. The scale had an overall Cronbach's coefficient alpha = 0.8463, and was, thus, considered as a reliable measure.

3.6.2.8. Demographic Variables

Single item questions were used to get information about respondents' gender, age, educational level, years of employment, number of subordinates, and

[12] Jane Webster and Joseph Martocchio, "Microcomputer Playfulness: Development of a measure with workplace implications", MIS Quarterly, (Vol. 16, No. 2, June 1992), pp. 201-219.

organizational level, position, and tasks performed. The levels in the organization hierarchy consisted of four categories: professional staff, first level supervisor, middle management, and strategic management. As to the functional division, 15 categories were used: accounting, finance, marketing, general management, personnel and HRD, MIS/ computer, letter of credit, letter of guarantee, transfer, foreign relations, mailing, telex, foreign exchange, checks and collections, and others. The list of tasks performed in the bank by the participants included 12 items: deposits, proceeds of loans, savings, stock & bonds, mortgage, bank checks, foreign exchange, collections, commercial related tasks, auditing, miscellaneous, and others.

A list of the variables used along with a description (label, formula, or link) of each could be referred to in *Appendix G*.

3.7. Data Analysis

The data gathered from the creativity-baseline measurement survey, the judges' evaluation of the participants' responses for the task case they were given to solve (manually or through the CEDSS), and from the questionnaires they filled out after completing the experimental task were all analyzed by means of the statistical package STATISTICA version 4.5. The facilities used and the type of analysis performed were as follows:

[13] Pearson and Shim, "An Empirical Investigation into DSS Capabilities: A Proposed Taxonomy", Information and Management, pp. 45-57.

1. A descriptive analysis was performed to study the characteristics of respondents, investigate their responses, and study the various aspects related to computer use and beliefs about computer use in general. To do this, the frequency, correlation, crosstabulation, and ANOVA tools were used.
2. Item and Reliability analysis was performed on the judges' responses and on the question items forming up variables such as Beliefs about Computer Usage, Ease of Use, Playfulness, and Attitude Towards IdeaFisher. This was used to validate the reliability of the questionnaires used as a measure in this sample for the variables included.
3. A Pearson correlation analysis, one way ANOVA, and MANOVA were used to confirm the inter-rater reliability among the evaluations given by the various judges regarding the subjects' responses for the case task given.
4. A regression analysis was conducted to build models for creativity and to establish equations that would help identify the variables that are most likely to be associated with the measure of creativity and attitudes towards a CEDSS such as IdeaFisher.

Having identified the design and methodology of this research, the variables included, and the analysis tools used, it is important to list the findings and the implications of the study and to evaluate them in the light of the hypotheses to be tested. This what the following chapter will present.

CHAPTER IV

Research Findings and Analysis

In almost any survey looking into what constitutes good management, it is likely to find a factor highly emphasized and prominently mentioned, which is the ability to make clear-cut decisions when needed, well made decisions in terms of quality, effectiveness, and promptness. Computer-based information systems (CBISs) have had an impact on the manager's job. This impact was, however, majorly felt at the lower and middle management levels. Nowadays, such support systems could have an impact on the top manager's job, with the most important task which is decision making. But decision making, especially at top management levels, is a thinking process with which a way will be paved towards solving a problem or seizing an opportunity. Improving the quality of the thinking process will, thus, improve the quality of the decision made, especially that the quality of the decision, and its implementation efficiency and effectiveness form the corner stone for achieving organizational success and attaining competitive edge. The assumption upon which the study is based is that a person can be helped to be more creative. Keeping this assumption in mind and recognizing the availability of creativity enhancing DSS (CEDSS), how would such a system provide its users with new

facilities and processes to plan, design, and determine the right purposes to be accomplished, generate a large number of imaginative and unique alternatives, and develop the systems needed to implement effective solutions. Addressing such a question is in fact the major objective of this study, and the answer will be formulated based on analyzing the data, and the gathering and analysis methodology of which was presented in Chapter III.

To start with, Chapter I presented the hypotheses to be tested in this research. They were listed as follows:

1. A user of CEDSS will adopt a multiple step decision process whereas a user of no software will adopt a single step decision process.
2. The use of CEDSS has a direct and positive effect upon creative managerial decision making.
3. Factors such as Playfulness, change effect, organizational and personal aspects and DSS features are related to the creativity aspects in decision making and to the decision making process carried out by individuals.
4. Users of a CEDSS will outperform the nonusers in the quality and creativity of decisions made and solutions provided.

The main intent of this chapter is to test these hypotheses in light of the findings obtained from data analysis and interpretations. Following will be a presentation of these findings and their implications to the study and its objectives.

4.1. Profile of Respondents.

As mentioned in Chapter III, the sample of the study constituted of 30 employees working in the various branches of one of the top 5 leading banks in the country. These belong to certain organizational levels: professional staff (36.6%), first level supervisor (10%), middle management (16.6%), and employees of the first degree level (36.6%). No participants working at the strategic level were available within the sample. The participants had an age category average of 1.6, i.e. within the range of 25-34. Another feature is that the participants' educational level ranged from those having a Bachelor degree (53.3%) to those with some graduate study (13.3%) and finally to those with graduate study (33.3%). Moreover, these participants work in various functional areas in the bank, such as accounting (6.67%), finance (3.34%), marketing (10%), general management (23.34%), personnel and HRD (6.67%), MIS/Computer (13.34%) letter of credit (16.67%), transfer department (33.34%), foreign relations and mailing department (6.67%), and telex department (13.34%). The highest percentage is for those working in the foreign exchange (53.34%) and Checks and Collections (50%). Those working in other functional areas make up 6.67% of the whole sample. These and other characteristics are presented in *Table VII.*

Table VII - Demographic Characteristics of Respondents (N = 30).

Variable	Value	Frequency	Percentage	Cumulative Percentage
A- Individual Variables				
- Age	1 (< 25)	14	46.67%	46.67%
	2 (25 - 34)	14	46.67%	93.34%
	3 (35 - 44)	2	6.66%	100.00%
- Sex				
	1 (Male)	13	43.34%	43.34%
	2 (Female)	17	56.66%	100.00%
- Education				
	1 (Some High School or Less)	0	0%	0.00%
	2 (High School)	0	0%	0.00%
	3 (Some College)	0	0%	0.00%
	4 (Bachelor's Degree)	16	53.34%	53.34%
	5 (Some Graduate or Professional Study)	4	13.34%	66.67%
	6 (Graduate or Professional Degree)	10	33.34%	100.00%
B- Organizational Characteristics				
- Functional Area				
	1 (Accounting)	2	6.667%	
	2 (Finance)	1	3.334%	
	3 (Marketing)	3	10.000%	
	4 (General Management)	7	23.333%	
	5 (Personnel & HRD)	2	6.667%	
	6 (MIS/Computer)	4	13.334%	
	7 (Letter of Credit)	10	33.33%	
	8 (Letter of Garantee)	5	16.667%	
	9 (Transfer Department)	10	33.334%	
	10 (Foreign Relatives)	2	6.667%	
	11 (Mailing Dep't)	2	6.667%	
	12 (Telex Dep't)	4	13.334%	
	13 (Foreign Exhange)	16	53.334%	
	14 (Checks & Collections)	15	50.000%	
	15 (Other)	2	6.667%	
- Organizational Hierarchy				
	1 (Professional Staff)	11	36.667%	36.667%
	2 (First Level Supervisor)	3	10.000%	46.667%
	3 (Middle Management)	5	16.667%	63.333%
	4 (Strategic Management)	0	0.000%	63.333%
	5 (Other: Employee First Degree)	11	36.667%	100.000%
C- Job Characteristics				
- Task Performance				
	1 (Deposits)	15	50.000%	
	2 (Proceeds of Loans)	2	6.667%	
	3 (Savings)	12	40.000%	
	4 (Stocks & Bonds)	3	10.000%	
	5 (Mortgage)	1	3.334%	
	6 (Bank Checks)	13	43.334%	
	7 (Foreign Exchange)	15	50.000%	
	8 (Collection)	14	46.667%	
	9 (Commercial Related Tasks)	4	13.334%	
	10 (Auditing)	5	16.667%	
	11 (Miscellaneous)	4	13.334%	
	12 (Other)	8	26.667%	

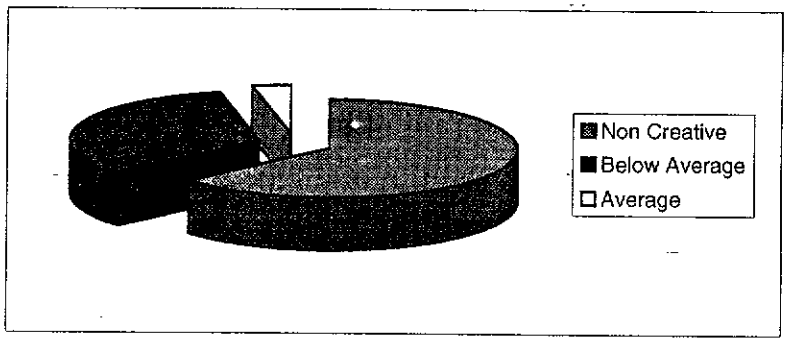
4.2. Creativity Baseline Measurement Results.

This type of measurement was used to assess individual creativity. Each subject recorded his/her agreement or disagreement with 50 statements items describing him/her. *Table VIII* and *Figure 4.1* shows the results of the frequency distribution analysis listing the distribution of scores among the 30 subjects that participated in the sample. As noticed, 63.3% got scores that gave them the description of being non creative, 33.3% were below average, and 3.33% were average.

Table VIII - Frequency Distribution: Creativity Baseline Measurement Results.

Value	Frequency	Percentage (%)	Cumulative Frequency (%)
Non Creative	19	63.33	63.33
Below Average	10	33.33	96.67
Average	1	3.33	100.00
Total	30	100.00	

Figure 4.1 - Creativity Baseline Measurement Results Distribution



The individual's creativity was assessed at a stage preceding the conduct of the experiment in order to study the effect of using a CEDSS upon enhancing the creativity of the subject. In order to test for statistically significant difference in the baseline creativity scores of the two treatment groups (software and no software), a one-way ANOVA was conducted. The results of this test are shown in *Table IX*. As could be deduced from these results, there is no significant difference in the baseline creativity scores of the two treatment groups. This is because at a significance level of $\propto = 0.05$, the p-level for this test is = 1.000, thus denying any kind of difference between the two treatment scores. This implies that any differences in the measured creativity of responses can not be attributed to individual differences in creative ability, but rather to software treatment applied in the experiment.

Table IX - One-way ANOVA: Baseline Creativity Measurement Scores by Software Treatment.

Design: One-way ANOVA
Dependent: BASECRTV
Between: SOFTRMN (Yes No)
Within: None

Summary of all Effects						
Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	1	0.000000	28	0.328571	0.000000	1.000000

4.3. Computer Use.

This variable was studied along four dimensions: (1) extent of use, (2) frequency of use, (3) software use, and (4) task inclusion in computer use. A descriptive analysis was used to study the computer system use along these four dimensions, and to investigate its relationship to the other study variables. Following will be a presentation of the descriptive analysis results of these computer system use dimensions.

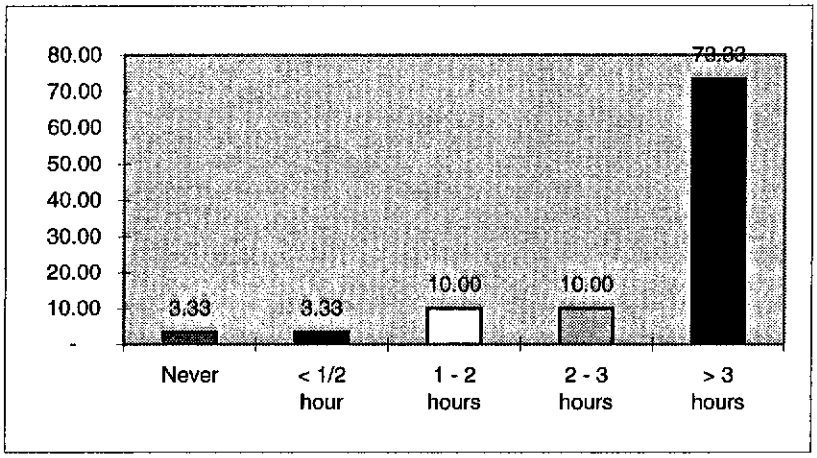
4.3.1. Extent of use.

The frequency distribution of this dimension is shown in *Table X* and *Figure 4.2*. As noticed, respondents spend a significant time using the computer system available at the bank. Most of the respondents (73.3%) reported using the computer for more than 3 hours daily and 20% reported using it for 1 to 3 hours. This "heavy" use of computers could be attributed to the fact that the major part, (if not all) of the work of these participants involves using the computer.

Table X - Frequency Distribution: Extent of Computer Use.

Value	Frequency	Percentage (%)	Cumulative Percentage (%)
Never	1	3.33	3.33
< 1/2 hour	1	3.33	6.66
1 - 2 hours	3	10.00	16.66
2 - 3 hours	3	10.00	26.66
> 3 hours	22	73.33	100.00
Total	30	100.00	

Figure 4.2 - Extent of Computer Use Distribution



4.3.2. Frequency of Use.

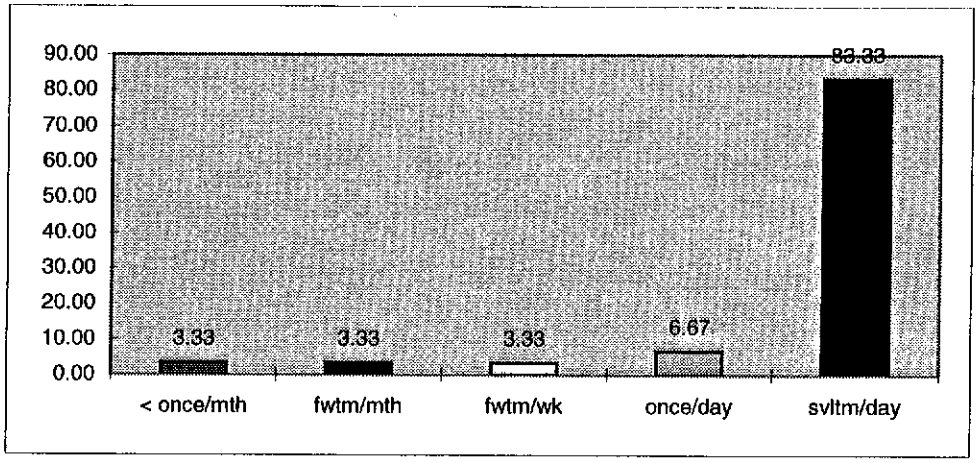
This is the second dimension of the computer system use. *Table XI* and *Figure 4.3* present the distribution of this variable results among the various subjects who participated in the study. These results show that 83.34% of the subjects reported using the computer several times a day. Only 6.67% reported using it once a day, 3.33% few times a week, 3.33% few times a month, and 3.33% less than once a month. This again implies a "heavy" use of computers among respondents. Moreover, to study the variability of this dimension along other individual variables, (such as organizational level, age, sex, and others), a Chi-square analysis and one-way ANOVA was used.

To start with, a Chi-square analysis was performed to test the variability of the frequency of use dimension along the organizational level to which the respondents belong. The results are shown in *Table XII* at a level of significance

Table XI - Frequency Distribution: Frequency of Computer Use.

Value	Frequency	Percentage (%)	Cumulative Percentage (%)
< once/mth	1	3.33	3.33
fwtm/mth	1	3.33	6.66
fwtm/wk	1	3.33	9.99
once/day	2	6.67	16.66
svltm/day	25	83.33	100.00
Total	30	100.00	

Figure 4.3 - Frequency of Computer Use Distribution



$\propto$ = 0.05, the Chi-square ratio is = 27.3964 and the P-level = 0.00679. This implies that there are significant differences in the frequency of use dimension along the various organizational levels. Based on the subjects' responses, all those belonging to the professional staff level (100%; i.e., 36.67% of the whole sample) reported using the computer several times a day. These were followed by those working as employees of first degree level, with 90.91% (33.33% of the whole sample) of them reporting using the computer several times a day. At a

lower rate where those working as first level supervisors followed by those at the middle level management with percentages reporting using the computer for several times a day of 66.67% (6.67% of the sample size) respectively. These results imply that subjects working at lower level ranks use the computer more frequently than those at higher level ranks. This could lead to the conclusion that the computer technology is still adopted by organizations to help in processing transactions and monitoring activities- structured functions taking place at the lower organizational levels- rather than in problem analysis, solution finding, and decision making processes taking place at higher levels.

A supporting and interesting result was also obtained from another Chi-square analysis run to study the variability of the frequency of computer use along the age of respondents. As shown in *Table XIII*, statistically significant differences were observed in the results of this analysis. Again, at a level of significance $\propto = 0.05$, the Chi-square ratio is = 24.6857 and the p-level = 0.001762, thus indicating statistically significant variability in this computer use dimension along the individual variable age. Such a result is indicative for two things:

1- In conformity with previous MIS research (e.g., Igbaria, 1989), as people become older, they will become more resistant to change, including technological change, thus preferring to do the job the way they got used to.

2- In support to the aforementioned result- i.e., the variability of this dimension along the organizational level-, it is expected, generally speaking, to find older

people at higher organizational levels. Since these levels use the computer facilities (as previously explained) with a lower frequency rate than those at lower levels, it is natural to observe variability in frequency of use along the various age group.

Table XII - Crosstabulation Analysis: Frequency of Use by Organizational Level

Summary Frequency Table Table: FREQUSE(5) x ORGLEVEL(4)					
FREQUSE	ORGLEVEL Prof_stf	ORGLEVEL 1st_lvel	ORGLEVEL Midd_mgt	ORGLEVEL Other	Row Totals
<oncemth	0	1	0	0	1
Column %	0.00%	33.33%	0.00%	0.00%	
Total %	0.00%	3.33%	0.00%	0.00%	3.33%
fwtm/mth	0	0	0	1	1
Column %	0.00%	0.00%	0.00%	9.09%	
Total %	0.00%	0.00%	0.00%	3.33%	3.33%
fwtm/wk	0	0	1	0	1
Column %	0.00%	0.00%	20.00%	0.00%	
Total %	0.00%	0.00%	3.33%	0.00%	3.33%
once/dy	0	0	2	0	2
Column %	0.00%	0.00%	40.00%	0.00%	
Total %	0.00%	0.00%	6.67%	0.00%	6.67%
Svltm/dy	11	2	2	10	25
Column %	100.00%	66.67%	40.00%	90.91%	
Total %	36.67%	6.67%	6.67%	33.33%	83.33%
All Grps Total %	11 36.67%	3 10.00%	5 16.67%	11 36.67%	30

Expected Frequencies Pearson Chi-square: 27.3964, df=12, p=.006790					
FREQUSE	ORGLEVEL Prof_stf	ORGLEVEL 1st_lvel	ORGLEVEL Midd_mgt	ORGLEVEL Other	Row Totals
<oncemth	0.366666667	0.1	0.166666667	0.366666667	1
fwtm/mth	0.366666667	0.1	0.166666667	0.366666667	1
fwtm/wk	0.366666667	0.1	0.166666667	0.366666667	1
once/dy	0.733333333	0.2	0.333333333	0.733333333	2
Svltm/dy	9.166666667	2.5	4.166666667	9.166666667	25
All Grps	11	3	5	11	30

Table XIII - Crosstabulation Analysis: Frequency of Use by Age

Summary Frequency Table
Table: FREQUSE(5) x AGE(3)

FREQUSE	AGE Under25	AGE 25-34	AGE 35-44	Row Totals
<oncemth	1	0	0	1
Column %	7.14%	0.00%	0.00%	
Total %	3.33%	0.00%	0.00%	3.33%
fwtm/mth	1	0	0	1
Column %	7.14%	0.00%	0.00%	
Total %	3.33%	0.00%	0.00%	3.33%
fwtm/wk	0	0	1	1
Column %	0.00%	0.00%	50.00%	
Total %	0.00%	0.00%	3.33%	3.33%
once/dy	0	1	1	2
Column %	0.00%	7.14%	50.00%	
Total %	0.00%	3.33%	3.33%	6.67%
Svltm/dy	12	13	0	25
Column %	85.71%	92.86%	0.00%	
Total %	40.00%	43.33%	0.00%	83.33%
All Grps Total %	14 46.67%	14 46.67%	2 6.67%	30

Expected Frequencies
Pearson Chi-square: 24.6857, df=8, p=.001762

FREQUSE	AGE Under25	AGE 25-34	AGE 35-44	Row Totals
<oncemth	0.466666667	0.466666667	0.066666667	1
fwtm/mth	0.466666667	0.466666667	0.066666667	1
fwtm/wk	0.466666667	0.466666667	0.066666667	1
once/dy	0.933333333	0.933333333	0.133333333	2
Svltm/dy	11.66666667	11.66666667	1.666666667	25
All Grps	14	14	2	30

Also, a one-way ANOVA was performed, and the same result was obtained regarding the variability of the frequency of use dimension (variance in means) along the various age groups. At a level of significance $\propto = 0.05$, the F-ratio =

4.1357 and the p-level is = 0.01046, thus indicating significant mean variances along the age groups. These results are shown in *Table XIV*.

Table XIV - One-way ANOVA: Frequency of Use by Age.

Variable	SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	P-level
Age	4.4600*	4*	1.1150*	6.7400*	25*	0.2696*	4.1357*	0.01046*

* = Significant at P <= 0.05

4.3.3. Software Use.

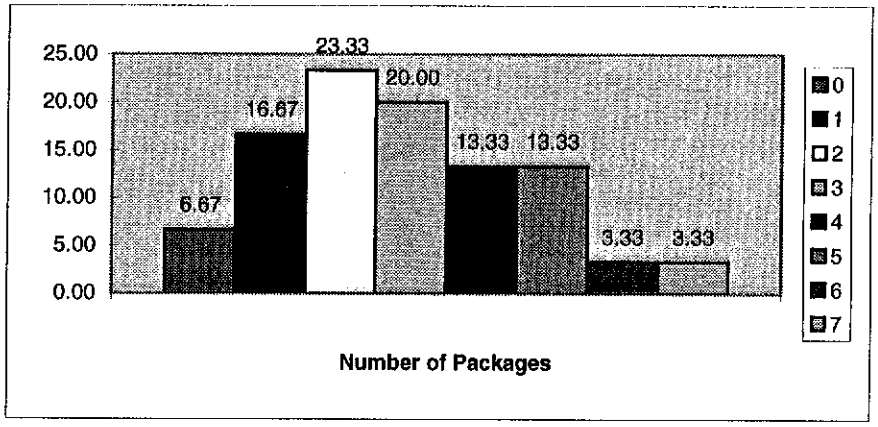
A good indication of the overall computer system use and the tasks performed on the computer can be provided by measuring the number of packages used and the type of software applied by the user. This also was used as an indicator for user sophistication. An "advanced user" as called by Igbaria (1989), can be defined as one who reported using several different applications. Overall, the respondents had an average of 2.88667 (median of 3.0). The number of packages used is shown *in Table XV* and *Figure 4.4*. The results obtained show that less than 7% of the respondents use 6 to 7 software packages. 13.34% reported using 5 packages, and 66.67% reported using 3 packages and less.

As to the extent of software use, the majority of respondents (53.334%) reported using the Word Processing software packages to some extent or to a great extent. This was followed by the other packages category (43.333%), Spreadsheets and Third Generation languages (23.333% each), Data Management

Table XV - Frequency Distribution: Number of Packages Used.

Value	Frequency	Percentage (%)	Cumulative Percentage (%)
0	2	6.67	6.67
1	5	16.67	23.33
2	7	23.33	46.67
3	6	20.00	66.67
4	4	13.33	80.00
5	4	13.33	93.33
6	1	3.33	96.67
7	1	3.33	100.00

Figure 4.4 - Number of Packages Used

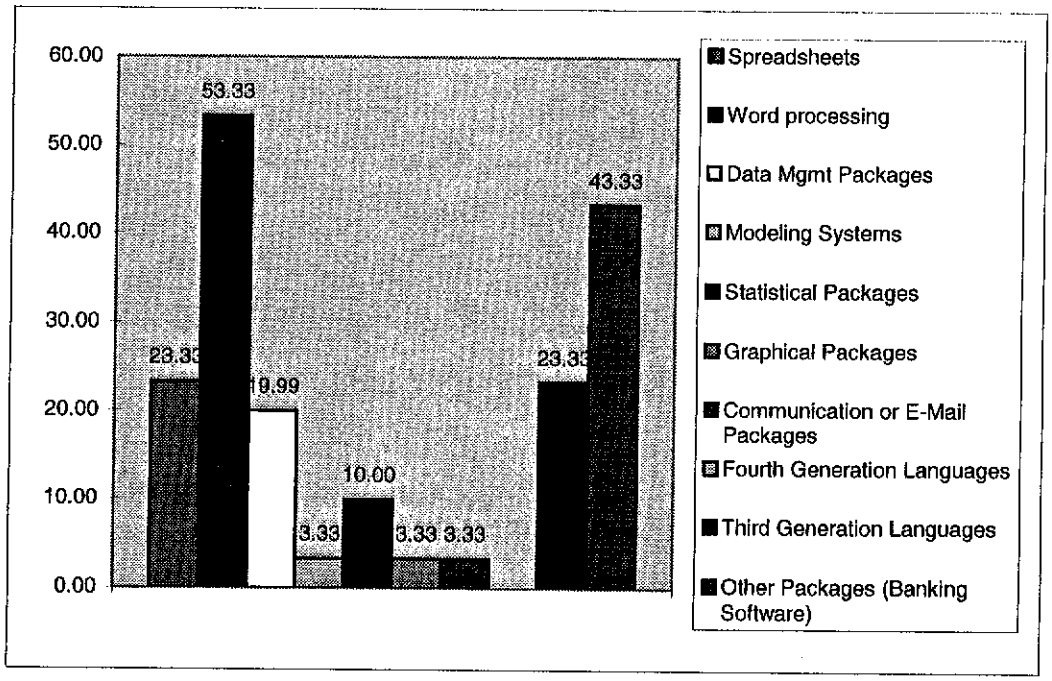


Packages (19.999%), Statistical Packages (10%), Modeling Systems and Graphical Packages and Communication Packages (3.33% each), and finally Fourth Generation languages (0%). These results are shown in *Table XVI* and *Figure 4.5*. In fact, such results show that the respondents are using the computer system on the job majorly either for word processing (typing, documenting,

Table XVI - Frequency Distribution: Software Packages Extent of Use.

Software Package	Frequency	Percentage (%)
Spreadsheets	7	23.33
Word processing	16	53.33
Data Mgmt Packages	6	19.99
Modeling Systems	1	3.33
Statistical Packages	3	10.00
Graphical Packages	1	3.33
Communication or E-Mail Packages	1	3.33
Fourth Generation Languages	0	0.00
Third Generation Languages	7	23.33
Other Packages (Banking Software)	13	43.33

Figure 4.5 - Software Packages Exent of Use



preparing reports, ...etc.), or for running the daily banking transactions (recording, retrieving, history file references, and others) which takes place through a banking software that the majority of respondents use as part of their job. The results

obtained regarding the type of the software used could be attributed to the type of respondents who participated in the study and who worked at the first level supervisory positions or as employees of first degree level. These have to use the banking software as a job requirement and have to use word processing for documenting and reporting. Most of the respondents reporting using spreadsheets, third generation languages and data management packages stated that they learnt them from courses they had in their university years of study. None or a very low percentage of respondents reported using other packages such as Modeling systems, statistical packages or fourth generation languages. Such packages proved to be highly important for business applications requiring analysis, problem modeling, simulation and sensitivity analysis, forecasting and others. Attention should therefore be paid by organizations to get adapted to such software packages especially at higher management levels for better quality of work and more effective decision making processes.

A Pearson correlation analysis was performed to study the relationship between the type of software used, and the type of training and level of computer knowledge and experience a respondent has. The results are shown in *Table XVII.*

The results of the correlation analysis are interesting. Significant correlations was found between the use of spreadsheets, statistical packages, graphical packages , and third generation languages on one hand and training offered in the form of university courses on the other hand. This is expected, especially for third generation languages that are given in the form of courses. Another significant correlation was observed between the use of spreadsheets and

graphical packages with in-house type of training. If these software applications are used as requirements to accomplish certain job tasks, then it is expected that the bank will offer the employees, concerned with the required training sessions. A statistically significant correlation was observed between word processing and self study. This is expected since the aspects of such a software can better be mastered through self training and practice. Third generation languages also have a significant correlation with self study. This is because other than the

Table XVII - Pearson Correlations: Software Packages Used with Computer Training and Experience.

Computer Training & Experience / *Software Package*	University Courses	Vendor Training	In-home Training	Self Study	# of Computer Courses	# of System Information Courses	Time Using PCs	Time Using Computer	Time Participating in Analysis & Design	Time Using Models
Spreadsheets	0.39*	0.20	0.51*	0.13	0.48*	0.37*	0.37*	0.33	0.45*	0.23
Word Processing	0.28	0.14	0.33	0.65*	0.10	0.08	0.29	0.08	0.19	0.44*
Data Management Packages	0.34	0.01	0.22	0.27	0.35	0.21	0.01	0.24	0.42*	0.23
Modeling Systems	-0.34	-0.09	-0.17	0.20	-0.18	-0.25	-0.18	-0.25	-0.09	-0.01
Statistical Packages	0.40*	-0.25	0.24	0.09	0.25	0.16	0.26	0.33	0.46*	0.43*
Graphical Packages	0.42*	-0.07	0.41*	0.19	0.32	0.54*	0.5*	0.4*	0.59*	0.05
Communication Packages	0.32	0.13	0.35	0.28	0.58*	0.63*	0.5*	0.47*	0.85*	0.07
Fourth Generation Languages	-	-	-	-	-	-	-	-	-	-
Third Generation Languages	0.49*	0.38*	0.10	0.36*	0.62*	0.50*	0.33	0.38*	0.49*	0.09
Other packages (Banking Software)	0.05	0.09	0.11	-0.06	-0.28	-0.14	-0.05	-0.27	-0.21	-0.16

* Correlations are significant at P<= 0.05

courses taken at the college or at the vendor place, one still needs self training to catch up with new programming languages, formats, and structures. Statistically significant and positive correlations were observed between the use of spreadsheets, communication packages, and third generation languages on one hand and the number of computer courses taken. This is self explanatory: the higher the number of computer courses taken, the more one is expected to study or get acquainted with the concept of a spreadsheet. Also, communication

packages are offered in the form of courses especially for those involved in the computer science, engineering or communication field. Also, the higher the number of computer courses taken, are especially during the university years of study, the more will be his/her acquaintance with third generation level programming languages. Moreover, using spreadsheets, graphical packages, communication packages, and third generation languages is significantly correlated to the number of information system courses taken. In the field of information systems, the student gets acquainted with programming languages (such as third generation level languages) along with application packages related to general application software (e.g. spreadsheets, graphical packages for planning, analysis and modeling), and communication packages pertinent to the areas of local and wide area networking and other communication structures. Still another finding is that the longer the time one spends in using personal computers, the more one will become acknowledged and skilled in using personal computer software applications (spreadsheets and graphical packages) or applications pertinent to the area of having connections built among personal computers (communication packages). Graphical packages, communication packages, and third generation languages are also found to be correlated to the length of time spent in using computers in general. Statistically high significant correlations were observed between the use of spreadsheet, data management packages, statistical packages, graphical packages, communication packages and third generation languages on one hand and the length of time spent in participating in systems analysis and design. This is because of the involvement

factor in the area of technology. The higher the involvement or participation level, the higher will be one's acquaintance to various applications. Finally, consistent with expectations, the longer the time one spends in using models (including statistical and financial models), the more skilled he/she will be in using and applying packages such as statistical packages.

4.3.4. Task Inclusion in Computer Use

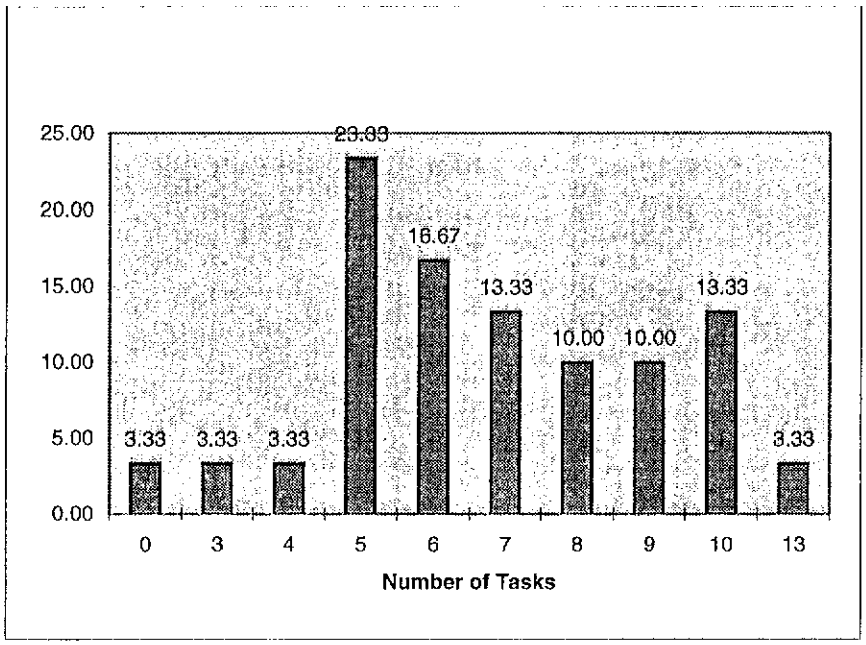
This final dimension of computer use was analyzed, and it showed that the users of computers for task performance are relatively low. Only 3.33 % of the subjects reported that using the computer to perform the 13 tasks, 13.3 % reported performing 10 tasks on the computer, 33.3 % reported performing 7 to 9 tasks on the computer, 39 % reported using the computer for 5 to 6 tasks, and 9.9 % for 4 tasks and less. These results are presented in *Table XVIII* and *Figure 4.6.* The average is 6.800 application types (median = 6.500). This is expected and could be attributed to the nature of the sample itself. Most of the subjects are either first level supervisors or employees at the first degree level who used the computer to accomplish routine transactional processes rather than to aid in completing more advanced tasks.

Concerning the types of tasks performed on the computer, it was found through the descriptive analysis results that the computer is majorly being used for historical reference (76.670 %). This is followed by using the computer to keep the user up-to-date on activities/ performance (73.333 %), to aid in adequately reporting to superiors (63.333 %), to aid in increasing productivity of the area (56.666 %) through cutting cost and reducing labor effort and time, to aid

Table XVIII - Frequency Distribution : Number of Tasks Performed on the Computer

Value	Frequency	Percentage (%)	Cumulative Percentage (%)
0	1	3.33	3.33
3	1	3.33	6.67
4	1	3.33	10.00
5	7	23.33	33.33
6	5	16.67	50.00
7	4	13.33	63.33
8	3	10.00	73.33
9	3	10.00	83.33
10	4	13.33	96.67
13	1	3.33	100.00
Total	30	100.00	

Figure 4.6 - Number of Tasks Performed on the Computer



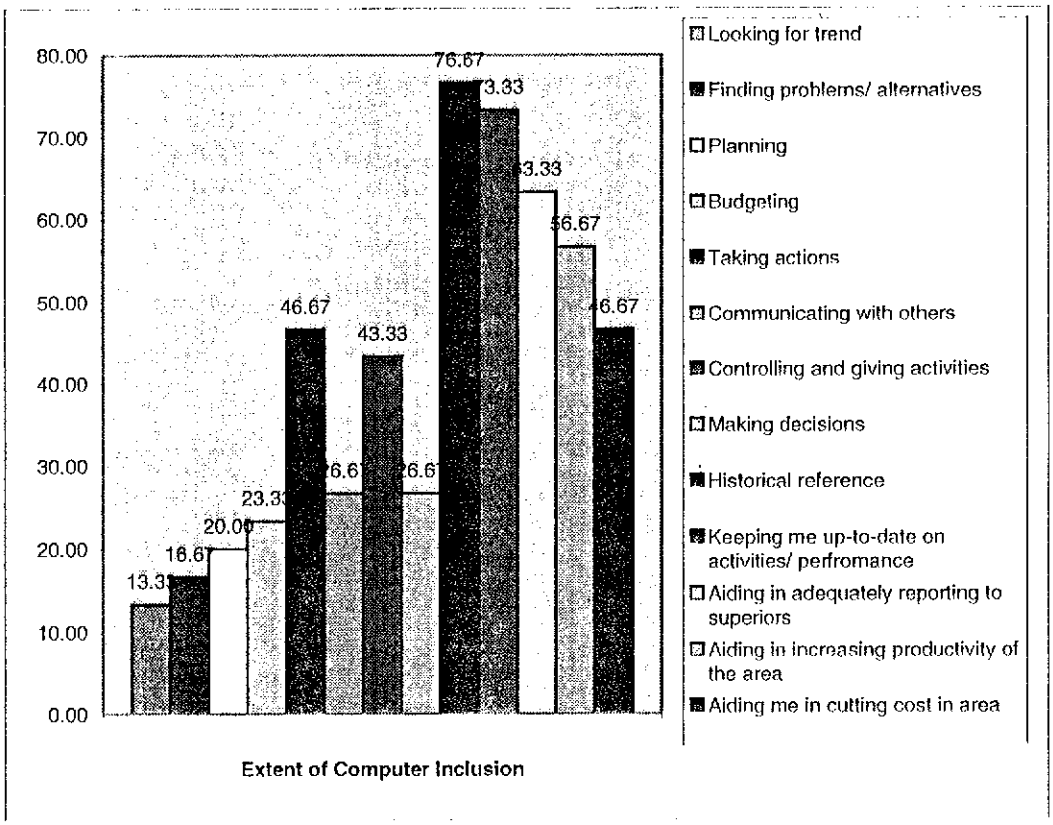
in cutting cost in the work area (46.666 %), to take actions (46.666 %), and to control and guide activities (43.333 %). Lower percentages were reported on

tasks like making decisions (26.667 %), communicating with others (26.667 %), budgeting (23.333 %), planning (19.999 %), finding problems/ alternatives (16.666 %), and finally looking for trend (13.333 %). These results are presented in *Table XIX* and *Figure 4.7*. In fact, such findings support what was previously mentioned regarding the type of software used. The word processing software can well support the task of reporting to superiors, and the banking software being used can provide a major help for historical reference, keeping users up-to-date on activities/ performance, taking actions, and, along with the word processing software, in saving time and automating labor intensive tasks that could be computers, and thus aid in increasing productivity and cutting costs in the area.

Table XIX - Frequency Distribution : Extent of Computer Inclusion in Performing Tasks

Value	Frequency	Percentage (%)
Looking for trend	4	13.33
Finding problems/ alternatives	5	16.67
Planning	6	20.00
Budgeting	7	23.33
Taking actions	14	46.67
Communicating with others	8	26.67
Controlling and giving activities	13	43.33
Making decisions	8	26.67
Historical reference	23	76.67
Keeping me up-to-date on activities/ perfromance	22	73.33
Aiding in adequately reporting to superiors	19	63.33
Aiding in increasing productivity of the area	17	56.67
Aiding me in cutting cost in area	14	46.67

Figure 4.7 - Reported Extent of Computer Inclusion in Performing Tasks



4.3.5. Computer System Usage versus Individual Variables

To study the interrelationship of the four computer system dimensions used with individual variables, a Pearson correlation analysis was performed. The results are shown in *Table XX*. This intercorrelation matrix shows that a significant and a negative correlation exists between the computer system use dimension, extent of use, on one hand and age and years of employment on the other hand. The explanation is straight forward. As for the years of employment, the explanation could be that more years of employment might mean higher

organizational levels, and thus less computer use. A positive and a significant correlation was traced between the extent of use dimension and the number of years the user spent in using the personal computer. This is of course self explanatory since the more time the user is exposed to the microcomputer, the more he/she will be familiar with its operation, use, related software, and other relevant aspects. This, in turn, would probably lead to a heavier computer use. Moreover, although not significant, the negative relationship between the extent of use dimension and age variable is worth mentioning. The negative correlation coefficient means that as one gets older, one will be more reluctant to use the computer. The possibility is that older ages might mean higher organizational levels where computers are not heavily used.

Table XX - Pearson Correlations Between Computer Usage and Individual Variables (N=30)

	EXTNTUSE	FREQUSE	_SFTUSE	_TASKS
YRSEMPLY	-0.39*	-0.01	-0.07	0.13
AGE	-0.32	0.01	-0.15	0.10
SEX	0.34	0.17	-0.03	-0.04
_COMPCRS	0.08	0.15	0.39*	0.31
_INFSCRS	-0.02	0.26	0.44*	0.22
YRPCUSE	0.40*	0.36*	0.43*	-0.03
YRCOMUSE	0.26	0.36	0.42*	0.16
YRPTANDS	0.10	0.17	0.54*	0.20

* Correlations are significant at P<= 0.05

The task use dimension level did not correlate to any of the individual variables listed. The frequency of use dimension level is significantly and positively correlated to how long the user has been using personal computers.

As it is the case with the extent of use dimension, the more time the user has spent in using the personal computer, the more would be his/her familiarity and skills, and the more frequently he/she will be expected to use the computer. The software use dimension was found strongly and positively correlated to the number of computer courses taken, the number of information system courses taken, how long the personal computer system and the computer system in general have been used by the respondent, and the number of years the respondent participated in systems analysis and design. The relationship here is clear. That is, the more each of the four just mentioned aspects take place, the higher would be the number of software packages known and the better would be the user in using and applying them.

4.4. Validity and Reliability of Measurement

The validity and reliability of the measurement scales used in the creativity base-line measurement and in the survey conducted regarding the CEDSS used and including beliefs about computer use, ease of use, playfulness, and attitudes towards IdeaFisher have been demonstrated based on the fact that they were used in numerous previous studies requiring a measure of the individual creativity and of characteristics featuring a DSS or CEDSS. In general terms, and in reference to many statistics books and books dealing with the essentials of behavioral research, reliability refers to consistency or stability (e.g., can what is being measured or observed be confirmed by further competent measurements or observation?), and validity refers to appropriateness or

meaningfulness (e.g., are the measurements or observations used or applied in the study a true representation of reality?).

To investigate the validity and reliability of the measurement scales used in the study, a reliability and item analysis was conducted for the measurement scales related to *beliefs about computer use* (BCUSE), *ease of use* (EU), *beliefs about computer friendliness* (BACF), and *attitude towards IdeaFisher* (ATTDF). This module may be used to construct reliable measurement scales, to improve existing scales, and to evaluate the reliability of scales already in use. Cronbach's Alpha was used as the reliability index. Cronbach's coefficient alpha (α) is "the proportion of true score variance that is captured by the items by comparing the sum of item variances with the variance of the sum scale". Specifically,α is computed as follows:

$$\alpha = \left[k/(k-1)\right] \times \left[1 - \sum (S_i^2)/S_{sum}^2\right]$$

In this formula, the S_i^2's denotes the variance for the K individual items; S_{sum}^2 denotes the variance for the sum of all items. If there is no true score but only error in the items (which is esoteric and unique, and, therefore, uncorrelated across subjects), then, the variance of the sum will be the sum of the individual items. Therefore, coefficient alpha will be equal to zero. If all items are perfectly reliable and measure the same thing (true score), thus coefficient alpha is equal to 1"[1].

[1] Statsoft, STATISTICA, (OK: Statsoft, Inc., 1994), p. 3190.

The results of the reliability analysis are shown in *Tables XXI* through *XXIV*. Also, *Figures 4.8* through *4.11* depict in Box and Whisker Plot the standard deviations, standard errors, and means of the items of each corresponding scale. *Table XXI* shows the reliability and item analysis results for the Beliefs about Computer use scale. Looking at the summary section, the internal consistency reliability (Cronbach's alpha) for the sum is estimated at 0.638. The standardized alpha reported is the reliability that would result if one uses the standardized (Z transformed) values for the items in the computation of Cronbach's alpha. This magnitude of the Cronbach's alpha value is considered satisfactory for a sum scale of 12 items. The value of the Cronbach's alpha can be interpreted as to indicate that about 64% of the variability in the sum score is true score variability, that is true variability between respondents concerning the (BCUSE, beliefs about the computer usage) concepts common in all items. Also, the value of the inter-item correlation (0.14164) shows that the level of correlation between the items is a low one.

As for the ease of use scale, the reliability and item analysis results are shown in *Table XXII*. The summary statistics section shows that the internal consistency reliability (Cronbach's alpha) for the sum is estimated at 0.684, the standardized alpha is equal to 0.799, and the average inter-item correlation is equal to 0.318. The magnitude of the Cronbach's alpha is also satisfactory for a sum scale of 10 items, and it can be interpreted as to indicate that 68.40% of the variability in sum score is true score variability. Again the value of inter-item is considered a low one.

Table XXI - Reliability and Item Analysis: BFCUSE.

Reliability Results			
# of items in scale:	12		
# of valid cases:	30		
Summary Statistics			
Mean:	22.40000	Sum:	672.00000
Standard Deviation:	4.81400	Variance:	23.17300
Skewness:	0.00687	Kurtosis:	0.02396
Minimum:	12.00000	Maximum:	33.00000
Cronbach's Alpha:	**0.63800**	Standardized Alpha:	0.65260
Average Inter-Item Correlation:			0.14164

Figure 4.8 - Reliability and Item Analysis: BFCUSE.

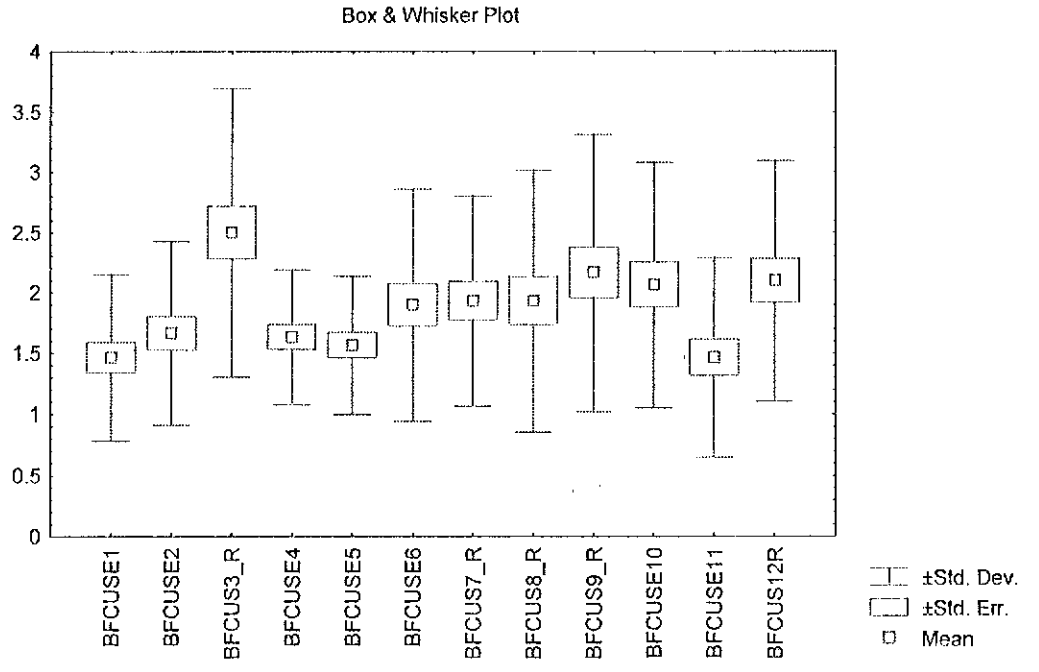
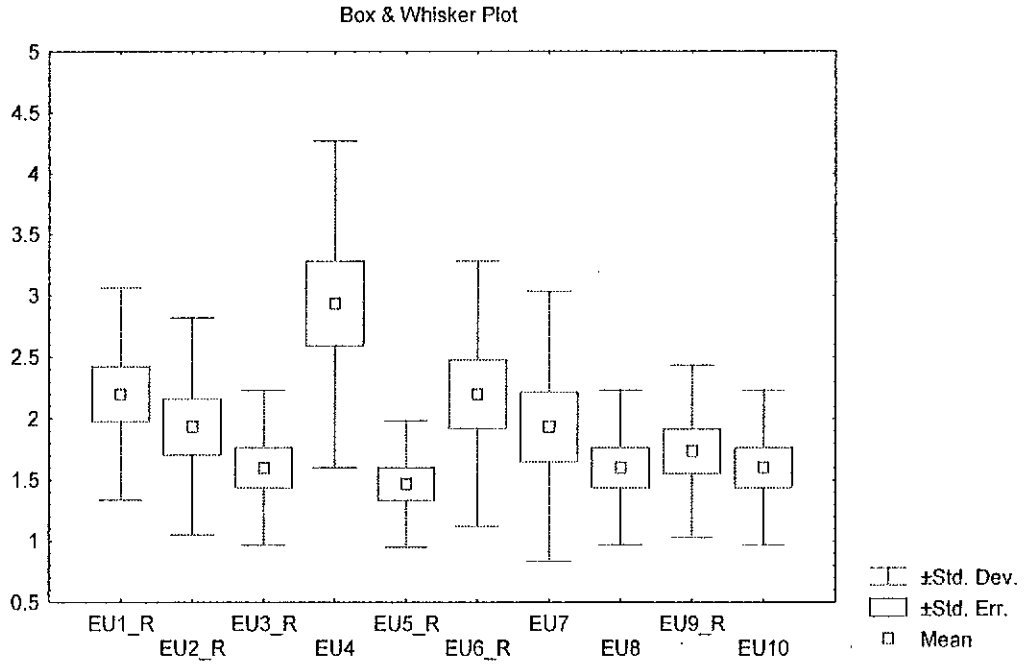


Table XXII - Reliability and Item Analysis: EU

Reliability Results			
# of items in scale:	10		
# of valid cases:	15		
Summary Statistics			
Mean:	19.20000	Sum:	288.00000
Standard Deviation:	4.30813	Variance:	18.56000
Skewness:	-0.32544	Kurtosis:	-1.22144
Minimum:	12.00000	Maximum:	25.00000
Cronbach's alpha:	**0.68380**	Standardized Alpha:	0.79920
Average Inter-Item Correlation:			0.31858

Figure 4.9 - Reliability and Item Analysis: EU.



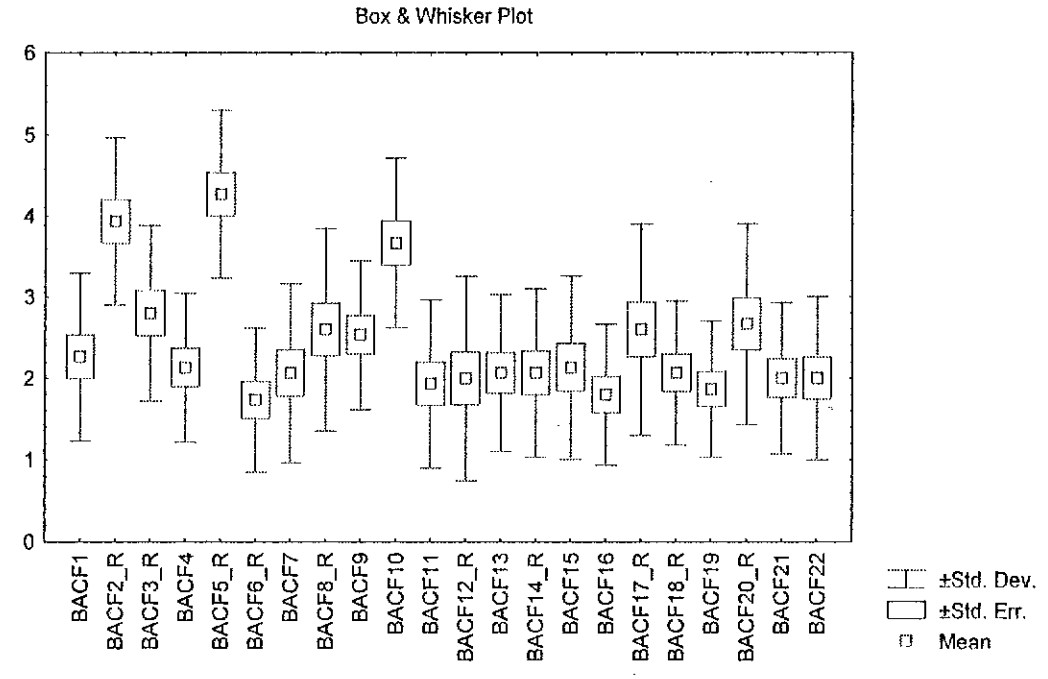
As for beliefs about the computer friendliness, which was used as a scale to measure the playfulness factor, the reliability and item analysis presented in

Table XXIII shows that the scale has a high internal consistency reliability of 0.8705, and the standardized alpha is equal to 0.876. This means that the scale

Table XXIII - Reliability and Item Analysis: BACF

Reliability Results			
# of items in scale:	22		
# of valid cases:	15		
Summary Statistics			
Mean:	53.20000	Sum:	798.00000
Standard Deviation:	11.47868	Variance:	131.76000
Skewness:	0.70044	Kurtosis:	1.14544
Minimum:	35.00000	Maximum:	82.00000
Cronbach's alpha:	**0.87058**	Standardized Alpha:	0.87637
Average Inter-Item Correlation:			0.28380

Figure 4.10 - Reliability and Item Analysis: BACF.



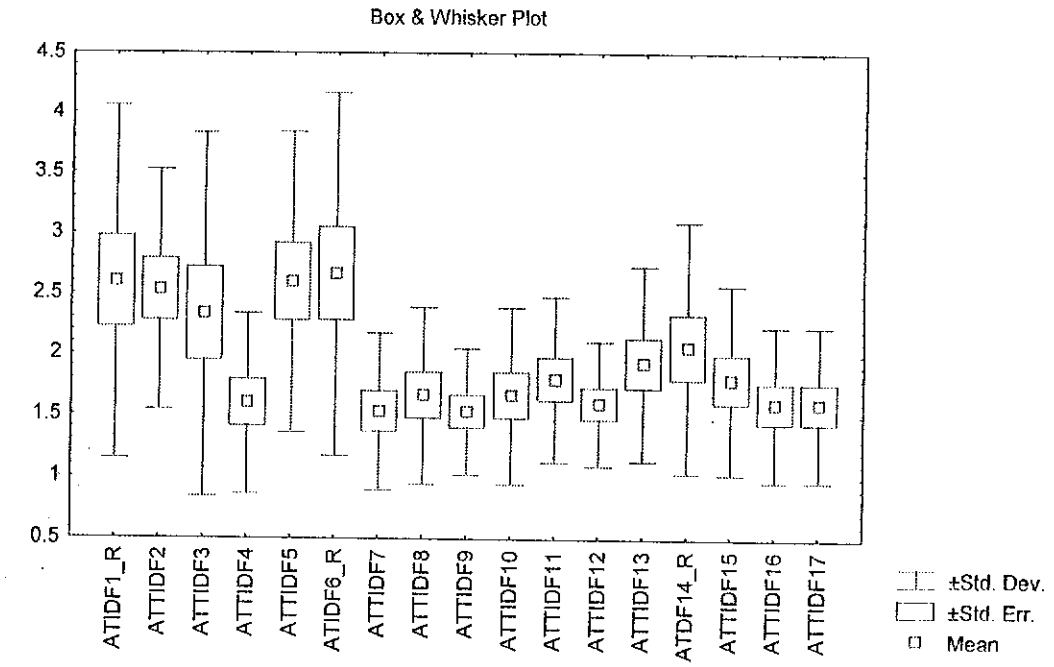
has a high inter-rater reliability where about 87% of the variability in the sum square is a true score. The value of the inter-item correlation is equal to 0.28 which is a low correlation value. These results indicate that BACF measurement tool could be considered reliable.

Finally, *Table XXIV* shows the results of the reliability and item analysis results for the scale measuring attitudes toward IdeaFisher. As noticed, this scale also has a high inter-rater reliability with an internal consistency reliability (Cronbach's alpha) of 0.861. The value of the standardized alpha is equal to 0.9116, and the average inter-item correlation is equal to 0.42 which still can be relatively considered a low one. The value of the Cronbach's alpha indicates that about 86% of the variability of the sum score is a true score. These results indicate that ATTIDF measurement tool could be considered as a reliable scale.

Table XXIV - Reliability and Item Analysis: ATTIDF.

Reliability Results			
# of items in scale:	17		
# of valid cases:	15		
Summary Statistics			
Mean:	33.13333	Sum:	497.00000
Standard Deviation:	8.65538	Variance:	74.91556
Skewness:	-0.20395	Kurtosis:	-1.43944
Minimum:	19.00000	Maximum:	47.00000
Cronbach's alpha:	**0.86130**	Standardized Alpha:	0.91168
Average Inter-Item Correlation:			0.42558

Figure 4.11 - Reliability and Item Analysis: ATTIDF.



4.5. Experiment Results: Software vs. No-software Treatment.

To recall, the experiment in this study was designed to test the hypothesis related to the effect of using creativity-enhancing DSS upon the individual's ability to make better quality and more creative decisions. The effect was studied based on two major dimensions along which the creativity factor was measured. The two major dimensions are: (1) The decision-making process (Single vs. Multiple step decision process), and (2) Creativity of responses as assessed by the selected judges.

In fact, this section will test the first two hypotheses stated at the beginning of this chapter:

1. *A user of Creativity-enhancing DSS will adopt a multiple step decision process whereas a user of no software will adopt a single step decision process.*

2. *The use of CEDSS has a direct and positive effect upon creative managerial decision making.*

A descriptive analysis of the experiment results will first be presented then followed with other types of analysis that would help in assessing the mentioned hypotheses.

4.5.1 Time for Completion: Software vs. No Software Treatment:

Subjects, as previously mentioned, were given a case task to analyze and solve. The average time taken to complete the experimental task by each of the two treatment groups was:

- Software Treatment 60.26 minutes
- No Software Treatment 28.60 minutes

This means that subjects using a software treatment took more time to complete the experiment than the no software treatment. This could be attributed to the fact that the subjects using the software had to customize themselves to its features, ask for on-line help, and analyze the questions posed by the system.

To demonstrate, a one-way ANOVA was conducted to check for the variability in time completion means along the software and the no software treatment groups. The result is depicted in *Table XXV* and graphically verified in *Figures 4.12 and 4.13*. The result shows significant variability in time for completion along the two groups with an F = 27.26163 and P-value = 0.000015.

At a significance in the completion time variability along the software treatment variable.

Table XXV - One-way ANOVA: Time completion by software treatment.

Design: One-way ANOVA
Dependent: TIMECOMP
Between: SOFTRMNT (No/ Yes)
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	1*	7520.833*	28*	275.8762*	27.26163*	.000015*

Figure 4.12 - Categorized Histogram for TIMECOMP by Group SOFTRMNT.

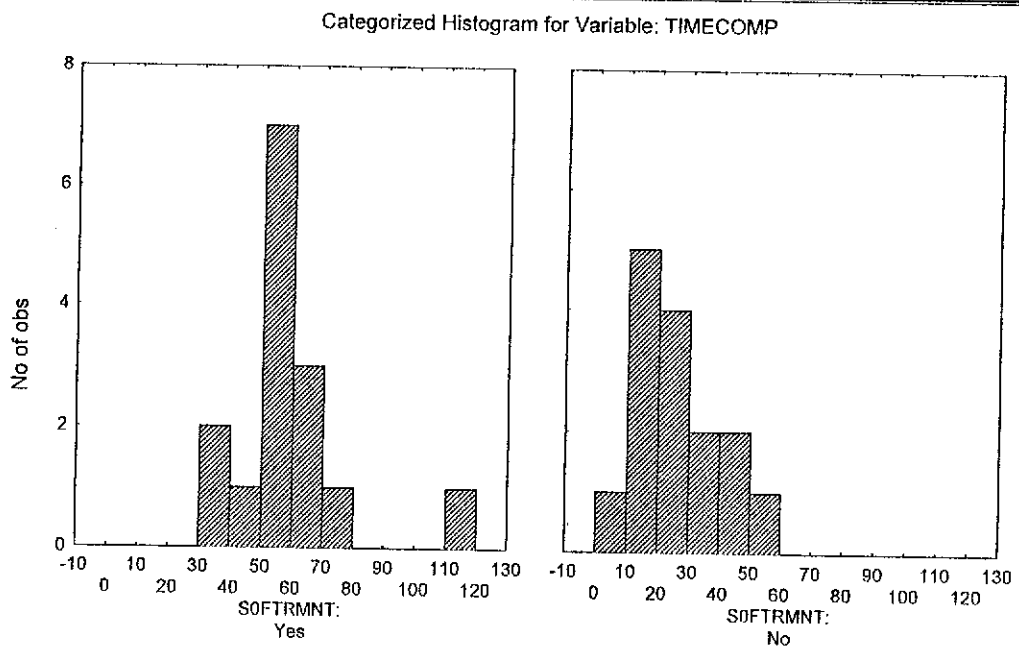
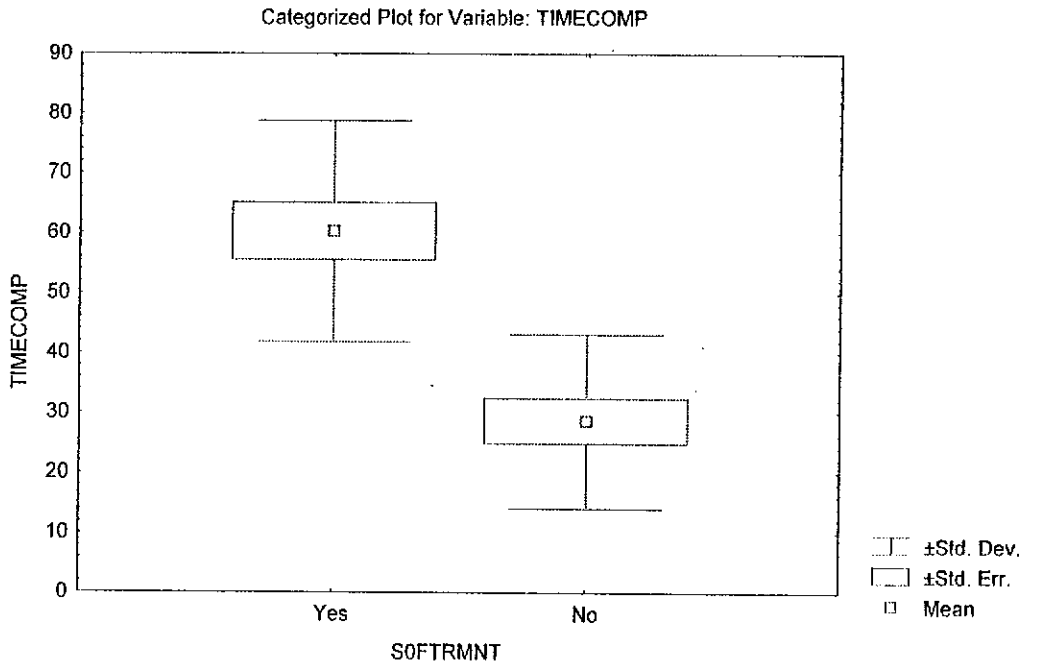


Figure 4.13 - Categorized Box-Whisker Plot for TIMECOMP by SOFTRMNT.



Another one-way ANOVA was conducted to study the variability of the completion time factor along the decision-making process applied. The results are shown in *Table XXVI*. At a level of significance, alpha = 0.05, F = 7.54006, and P-level = 0.010424. This means that there is a significant variability in the time taken for completion along the number of steps followed to solve the problem. It is believed that the larger the number of steps the decision maker uses to solve a problem, the more time he/she will take to complete the task in hand. This is presented in *Figure 4.14* where the average of TIMECOMP in the multiple step for decision making group is higher than that of the single step group.

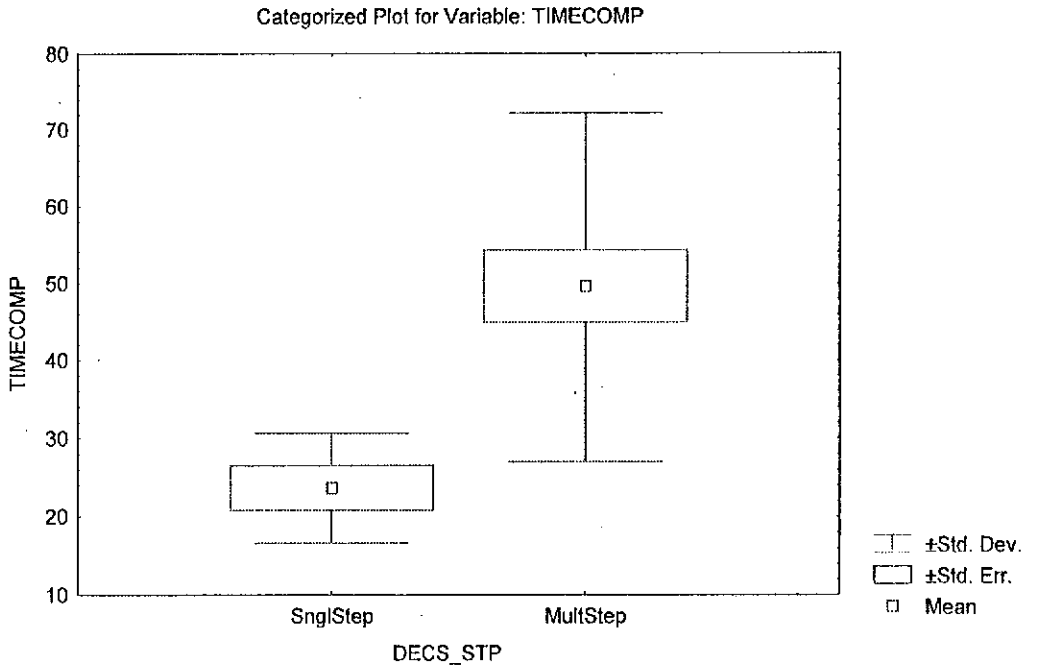
Table XXVI - One-way ANOVA: Time Completion by Decision Steps.

Design: One-way ANOVA
Dependent: TIMECOMP
Between: DECS_STP (Single step/ Multiple step)
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	1*	3234.408*	28*	428.9628*	7.540067*	.010424*

Figure 4.14 - Categorized Box-Whisker Plot for TIMECOMP by DECS_STP.



4.5.2. Decision Making Process Applied

The first hypothesis in this study states that:

A user of CEDSS will adopt a multiple step decision process whereas a user of no software will adopt a single step decision process.

This hypothesis was tested on two groups: Those using the creativity-enhancing, DSS-IdeaFisher and those using no software. To start with, *Table XXVII (A)* and *Table XXVII (B)* show the distribution of the decision process steps for the Software group and the No software group respectively. As reported, the decision process for all subjects using software consisted of multiple steps. However, for subjects not using the software, the decision processes of 40% of the subjects were classified as single step.

Table XXVII (A) - Frequency Distribution of Decision Process Steps for Software Group (N = 15).

Value	Frequency	Percentage (%)
Single Step	0	0
Multiple Step	15	100
Total	15	100

Table XXVII (B) - Frequency Distribution of Decision Process Steps for No Software Group (N= 15).

Value	Frequency	Percentage (%)
Single Step	6	40
Multiple Step	9	60
Total	15	100

Moreover, the hypothesis was confirmed using a Chi-square test. The results of this test along with its cross-tabulation analysis is shown in *Table XXVIII*. As observed, at a level of significance, alpha = 0.05, and with d.f. = 1, the Chi-square ratio = 7.5000 and the P-level = 0.006173. This means that there is a significant variability in the decision making process applied by the user along the software treatment group.

Table XXVIII - Crosstabulation Analysis: Decision Steps by Software Treatment

Summary Frequency Table Table: DECS_STP(2) x S0FTRMNT(2)			
DECS_STP	S0FTRMNT Yes	S0FTRMNT No	Row Totals
SnglStep	0	6	6
Column %	0.00%	40.00%	
Total %	0.00%	20.00%	20.00%
MultStep	15	9	24
Column %	100.00%	60.00%	
Total %	50.00%	30.00%	80.00%
All Grps Total %	15 50.00%	15 50.00%	30

Expected Frequencies Pearson Chi-square: 7.50000, df=1, p=.006173			
DECS_STP	S0FTRMNT Yes	S0FTRMNT No	Row Totals
SnglStep	3	3	6
MultStep	12	12	24
All Grps	15	15	30

Finally, a one-way ANOVA was used to test the availability of mean differences in decision steps along the two software treatment groups. Significant

differences were also observed since at a significance level $\alpha = 0.05$, F = 9.334 and P-level = 0.0049. These results are shown in *Table XXIX*.

Table XXIX - One-way ANOVA: Decision Steps by Software Treatment.

Design: One-way ANOVA
Dependent: DECS_STP
Between: SOFTRMNT (No/ Yes)
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	1*	1.2*	28*	.128571*	9.333333*	.0049*

4.5.3. Creativity of Responses

The second hypothesis of the study states that the use of CEDSS has a direct and positive effect upon creative managerial decision making. In other words, the use of the creativity-enhancing DSS will result in higher levels of creative responses than the use of no software.

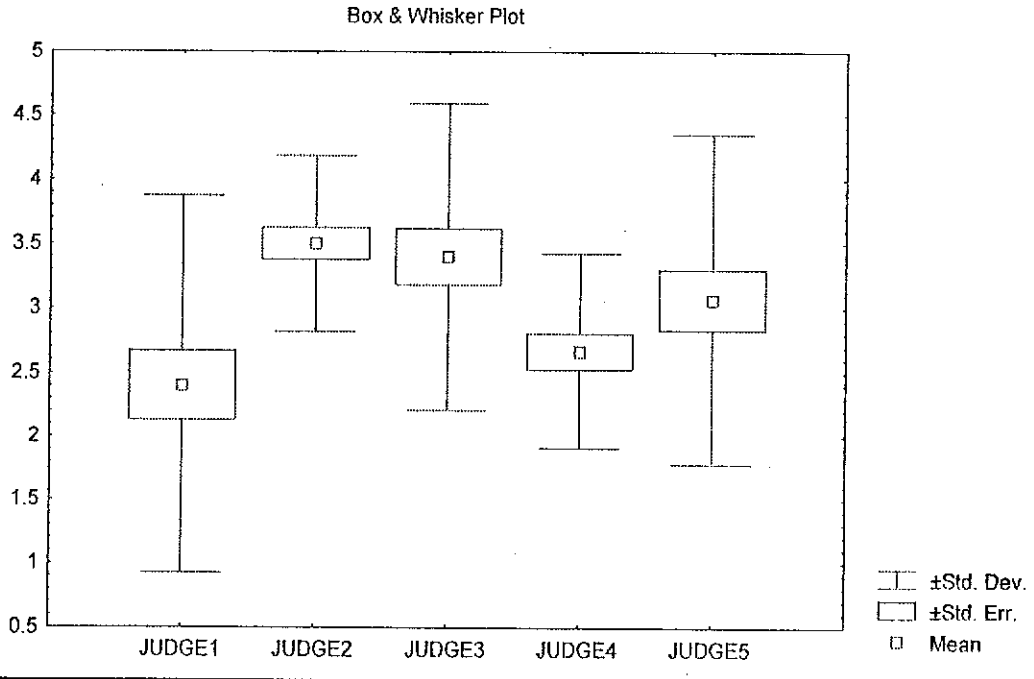
The creativity of responses of subjects using the software and those not using the software was assessed by 5 independent judges. To start with, to ensure consistency and reliability of answers, reliability analysis was conducted. The results are presented in *Table XXX*. Results show that Cronbach's alpha is = 0.8105 which means that the inter-rater reliability among the judges' answers is

high. Besides, *Figure 4.15* pictures the standard deviation, standard error, and mean of the response evaluations for each judge in a Box and Whisker Plot.

Table XXX - Reliability and Item Analysis: Judges' Evaluation of Responses

Reliability Results			
# of items in scale:	5		
# of valid cases:	30		
	Summary Statistics		
Mean:	15.03333	Sum:	451.00000
Standard Deviation:	4.15919	Variance:	17.29889
Skewness:	0.34997	Kurtosis:	-0.87517
Minimum:	8.00000	Maximum:	23.00000
Cronbach's Alpha:	**0.81058**	Standardized Alpha:	0.82128
	Average Inter-Item Correlation:		0.50425

Figure 4.15 - Reliability and Item Analysis: Judges' Evaluation of Responses.



Moreover, a one way MANOVA was conducted, and results showed that there is no variability in judges' scores along the two treatment groups, except for one judge. These results are shown in *Table XXXI*. At a significance level of alpha = 0.05, the P-level for the scores given by judges 1 through 5 were 0.22215, 0.18554, 0.22653, 0.15166, and 0.00272. This means that for four judges, no differences in means between groups were observed. This could probably be attributed to three reasons. First, the five judges were given the scales of measurement to be used in their evaluation, so a standard scale was applied by all of them. Second, each one of the five judges has a high level of experience in a certain professional domain and is involved in tasks requiring quality managerial decision making. Finally, the culture factor might have an influence with certain attitudes or considerations being in common.

Coming back to the hypothesis to be tested, the first thing to be done is to show the frequency distribution of the creativity of response scores along the software and the no software treatment groups. *Table XXXII* shows the results of the frequency distribution analysis. As observed of the 15 subjects who used the CEDSS to handle the task, they were given, the responses of 13.30% were judged, "below average", 46.60% as "average", 33.30% as "above average", and 6.67% as creative. On the other hand, of the 15 subjects who did not use the CEDSS, the responses of 46.60% were rated as "below average", 33.34% as "average", and 20% as "above average". This shows that in general, those who use the software outperformed those who did not.

Table XXXI - One-way MANOVA: Five Judges' Scores along Software Treatment

INDEPENDENT VARIABLES (between-groups factors):

SOFTRMNT Number of Levels: 2 Codes: level 1: 1-Yes
level 2: 2-No

DESIGN: 1 - way MANOVA
DEPENDENT: 5 variables: JUDGE1 JUDGE2 JUDGE3 JUDGE4 JUDGE5
BETWEEN: 1-SOFTRMNT(2): Yes No
WITHIN: none

MAIN EFFECT: SOFTRMNT
1-SOFTRMNT

Dependent variable	Mean sqr Effect	Mean sqr Error	F(df1,2) 1,28	p-level
JUDGE1	3.33333	2.13810	1.55902	0.22215
JUDGE2	0.83333	0.45238	1.84211	0.18554
JUDGE3	2.13333	1.39524	1.52901	0.22653
JUDGE4	1.20000	0.55238	2.17241	0.15166
JUDGE5	13.33333	1.23333	10.81081	0.00272

Table XXXII - Distribution Percentages of Creativity Scores along the Two Treatment Groups

Score	Software (N=15) (%)	No Software (N=15) (%)
Below Average	13.33	46.67
Average	46.67	33.33
Above Average	33.33	20.00
Creative	6.67	0.00
Total	100.00	100.00

In fact, these results imply a very important finding and that is even though all users of the software employed a multi-step decision process, the outcomes of the 2 groups, in conformity with Alam and Mead's findings (1990), were noticeably different. This "emphasizes the fact that encouraging users to

adhere to a standard decision process alone is not enough to ensure favorable outcomes" [2].

Also, a one way ANOVA was conducted to study the variation of RESPCRVT means along software and no software treatment groups. Significant variability in means was observed, since at a significance level, alpha = 0.05, F = 5.1054 and the P-level = 0.031824. The analysis results were as follows:

Table XXXIII - One-way ANOVA: Creativity of Response by Software Treatment.

Design: One-way ANOVA
Dependent: RESPCRVT
Between: SOFTRMNT (No/ Yes)
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	1*	3.20133*	28*	0.62704*	5.10541*	.03182*

Finally, a one-way ANOVA was conducted to study the variability of the responses creativity along the time needed to complete the task and along the number of steps applied in the decision process. Significant variations could be reported in both cases. A conclusion could be assumed from these results that the treatment group who produced the most creative solutions took the most time and applied a higher number of steps. The results of these one-way ANOVA, are

[2] Joyce Elam and Melissa Mead, "Can Software Influence Creativity?", Information

shown in *Tables XXXIV* and *XXXV*. In addition, *Figures 4.16* and *4.17* provide a graphical categorization for RESPCRVT by DECS_STP in two different forms: (1)Histogram and (2)Box-Whisker Plot respectively.

Table XXXIV - One-way ANOVA: Creativity of Response by Time Completion

Design: One-way ANOVA
Dependent: RESPCRVT
Between: TIMECOMP
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	3*	1372.340*	26*	428.0134*	3.2063*	0.03957*

Table XXXV - One-way ANOVA: Creativity of Response by Decision Steps

Design: One-way ANOVA
Dependent: RESPCRVT
Between: DECS_STP (Snglstep / Multstep)
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	1*	3.40033*	28*	0.61994*	5.48493*	0.02652*

Systems Research, (Vol. 1, No. 1, March 1993), p 16.

Figure 4.16 - Categorized Histogram for RESPCRVT by Group DECS_STP.

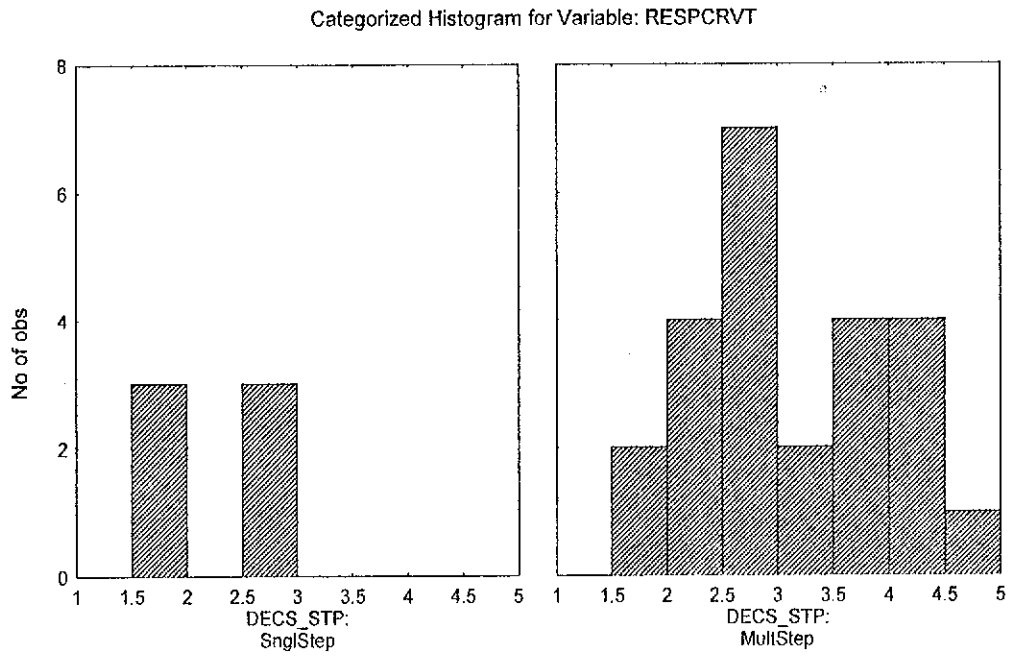
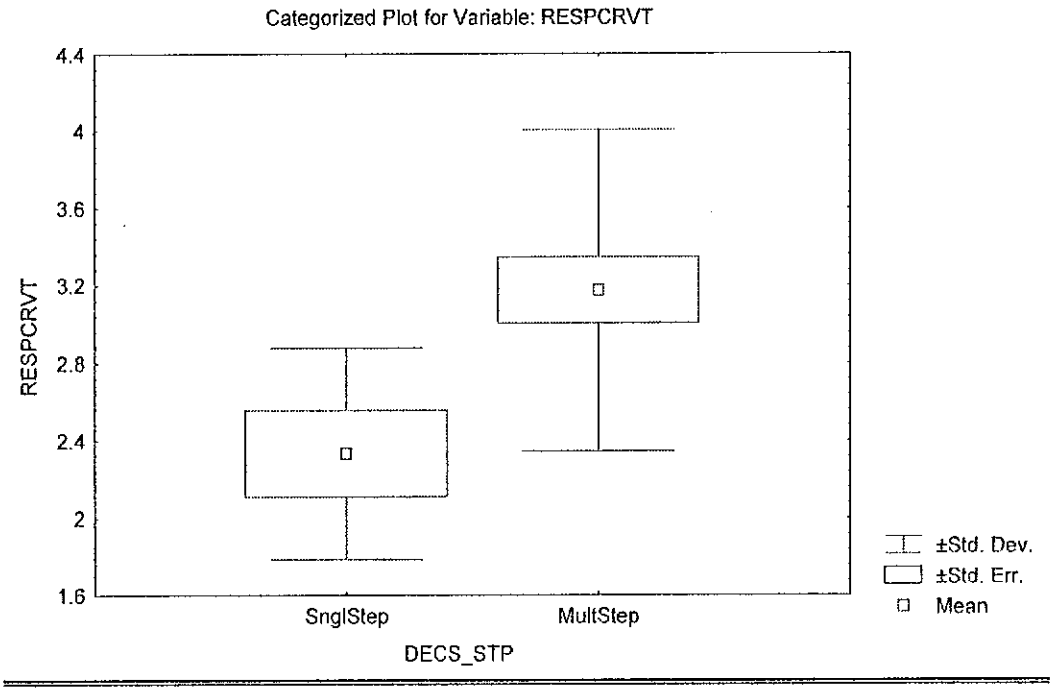


Figure 4.17 - Categorized Box-Whisker Plot for RESPCRVT by DECS_STP.



A correlation analysis was conducted for all the above mentioned variables, and the results are shown in *Table XXXVI*. A negative and a significant correlation was found between Software treatment and DECS-STP, TIMECOMP & RESPCRVT. This means the more one moves towards no software treatment, the less would be the time needed to complete the task, and the less creative the response would be. The positive and significant correlation between Baseline creativity score and the number of decision steps indicates that subjects with a higher creativity aptitude are more likely to apply a multi-step rather than a single step process. The decision making process applied is positively related to TIMECOMP and RESPCRVT. This means that more creative subjects are expected to apply many steps and, thus, take more time thinking of and evaluating many aspects.

Table XXXVI - Correlation Analysis for SOFTRMNT, BASECRTV, DECS_STP, TIMECOMP, and RESPCRVT (N=30)

	SOFTRMNT	BASECRTV	DECS_STP	TIMECOMP	RESPCRVT
SOFTRMNT	1.00	0.00	-0.5*	-0.70*	-0.39*
BASECRTV	0.00	1.00	0.36*	0.08	0.10
DECS_STP	-0.5*	0.36*	1.00	0.46*	0.40*
TIMECOMP	-0.70*	0.08	0.46*	1.00	0.51*
RESPCRVT	-0.39*	0.10	0.40*	0.51*	1.00

* Correlations are significant at P<= 0.05

4.6. Beliefs About Computer Use and DSS Features

Computers nowadays are being highly used by people who are not computer professionals and, thus, need programs that are easy to use or friendly. What is really needed is to develop the skills required to get computers to communicate with users. Ease of use, usefulness, and playfulness as features of the software being used, along with what the user has in terms of beliefs about and attitudes towards the computer system are believed to have an influence upon how the user deals with the system. In this study, these aspects were investigated, and their relationships with each other and with other variables were also examined.

4.6.1. Relationships Between the Factors Beliefs About Computer Use and DSS Features and Other Variables

A user's beliefs about computer use and his/her perception about the features provided by a system could be expected to have relationships with and variations along individual variables such as educational level, type of training, age, and others. In fact, a one-way ANOVA was conducted to test the variability of a user's beliefs about computer use along the individual variables. Results showed that significant variability could be reported in this variable along the training level the user had. As shown in *Table XXXVII*, at a significance level of 0.05, the F-ratio is = 3.5735 and the p-level = 0.01946, implying a significant variability in the user's beliefs about computer use along the training level variable.

Table XXXVII - One-way ANOVA: Beliefs About Computer Use by Training.

Design: One-way ANOVA
Dependent: BFCUSEAV
Between: TRAINAVG
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	4*	0.439053*	25*	0.122863*	3.573526*	0.019464*

Regarding the factor of playfulness (BACFAV), a one-way ANOVA was also used to study the variability of this factor along individual variables. The result of this analysis as depicted in *Table XXXVIII* and graphically categorized in *Figure 4.18* showed that users' view about the playfulness of the computer system has a significant variability along the educational level variable. This could be attributed to the assumption that the higher the educational level, the better will be the understanding level and the analytical ability of the user, the aspects that would lead him/her to understand the various features of the system and thus enjoy using it.

Still another one-way ANOVA was conducted to study the variability of the users' attitudes towards IdeaFisher (ATTIDFAV) along individual variables. Significant variability was reported in ATTIDFAV along the educational level variable as noticed in *Table XXXIX and Figure 4.19*. The same explanation used for playfulness could be applied here. That is, the higher the educational level

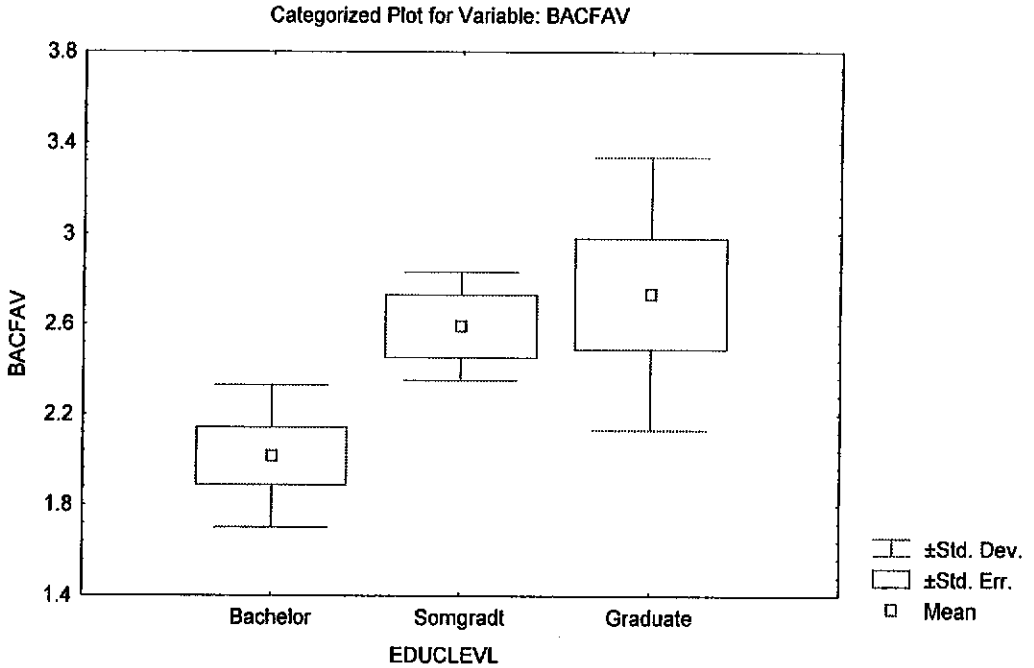
Table XXXVIII - One-way ANOVA: Playfulness by Educational Level.

Design:	One-way ANOVA
Dependent:	BACFAV (Playfulness)
Between:	EDUCLEVL (Bachelor Somgradt Graduate)
Within:	none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	2*	0.832886*	12*	0.201475*	4.133941*	0.043076*

Figure 4.18 - Categorized Box-Whisker Plot for BACFAV by EDUCLEVL.



of the user, the more he/she will be capable of understanding the various aspects of the system used, benefit from them, and thus have better attitudes towards it.

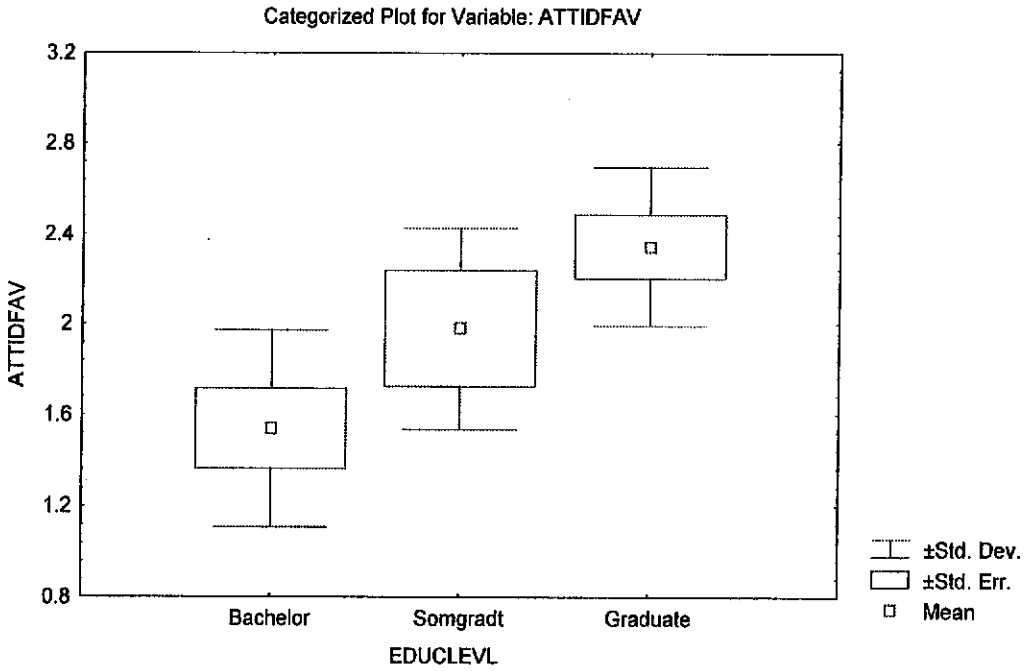
Table XXXIX - One-way ANOVA: Attitudes Towards IdeaFisher by Educational Level.

Design: One-way ANOVA
Dependent: ATTIDFAV
Between: EDUCLEVL (Bachelor Somgradt Graduate)
Within: none

Summary of all Effects

Effect	df Effect	MS Effect	df Error	MS Error	F	P-Level
1	2*	0.97128*	12*	0.162149*	5.990041*	0.015703*

Figure 4.19 - Categorized Box-Whisker Plot for ATTIDFAV by EDUCLEVL.



Finally, a correlation analysis was conducted to study the relationship between beliefs about computer use and DSS features on one hand, and individual variables on the other. As shown in *Table XL*, highly significant and positive correlations were found between each of the factors Beliefs about

Computer Use (BFCUSEAV), Ease of Use (EUAV), Playfulness (BACFAV), and Attitudes towards IdeaFisher (ATTIDFAV) and the Educational level variable. The explanation could be that as the educational level of the user gets higher, his/her tendency or capability to understand the system, explore its features, make proper and efficient use of it to accomplish the work in a productive manner, enjoy it, feel it friendly and easy to use, and in a broader scope have positive attitudes about the system used and the computer in general.

Table XL - Correlation Analysis: BFCUSEAV, EUAV, BACFAV, & ATTIDFAV by Individual Variables. (N=15)

	BFCUSEAV	EUAV	BACFAV	ATTIDFAV
ORGLEVEL	-0.06	-0.01	-0.25	-0.11
EDUCLEVL	0.59*	0.57*	0.62*	0.71*
AGE	-0.16	0.16	-0.15	0.05
SEX	-0.26	-0.01	0.07	0.11
EXTNTUSE	0.00	-0.31	0.18	-0.09
FREQUSE	-0.06	-0.48	-0.01	-0.31
_SFTUSE	-0.21	-0.30	-0.35	-0.22
_TASKS	0.42	0.22	0.57*	0.36

* Correlations are significant at P<= 0.05

Also, a positive and a significant relationship was found between playfulness (BACFAV) and the number of tasks for which the computer system is being used. This could be attributed to the assumption that the higher the number of tasks being accomplished through the use of the computer facilities, the more one will have to learn the system and get familiar with its various features, and thus feel it 'funny' to be used and applied. Finally, another correlation analysis was done to study the relationship between Beliefs about computer use

(BFCUSEAV) and Training level. Surprisingly enough, as shown in *Table XLI*, a negative correlation was found between the two variables. The correlation is that the higher the training level the user could get, the lower would be his/her positive attitude towards the computer. The reason could be that the training offered to the user takes place either in the form of tutorials to be self practiced and studied or in an improper form lacking on-the-job or hands-on training. This might lead to a state of tension experienced by the user which will adversely affect the user's attitude towards the computer system.

Table XLI - Correlation Analysis: BFCUSEAV with Training.

	TRAINAVG	RCODTRAV
BFCUSEAV	-0.37*	-0.34

* Correlations are significant at P<= 0.05

4.6.2. Relationships among The DSS Features and The Beliefs about Computer Use Variables

A correlation analysis was conducted to study the relationships among the variables Beliefs about computer use (BFCUSEAV), Ease of use (EUAV), Playfulness (BACFAV), and Attitudes towards IdeaFisher (ATTIDFAV). The results are shown in *Table XLII*.

As could be noticed from the results, significant and positive correlations were found among mostly all the variables. Beliefs about computer use was found to be significantly correlated to ease of use and attitudes towards IdeaFisher

variable. This could be explained as follows, the more the software is easy to use, the better would be the user's beliefs about the computer use. Also, the more

Table XLII - Correlation Analysis for BFCUSEAV, EUAV, BACFAV, & ATTIDFAV. (N=15)

	BFCUSEAV	EUAV	BACFAV	ATTIDFAV
BFCUSEAV	1.00	0.59*	0.47	0.62*
EUAV	0.59*	1.00	0.53*	0.83*
BACFAV	0.47	0.53*	1.00	0.72*
ATTIDFAV	0.62*	0.83*	0.72*	1.00

* Correlations are significant at P<= 0.05

positive are the user's beliefs about the computer system as a tool that facilitates the work operations and enhances productivity, the better and the more positive would his/her attitudes be about a software designed to enhance the analytical ability and the decision making/problem-solving power of users. The significant and positive correlations between the variable Ease of Use and the variables Playfulness and Attitudes towards IdeaFisher are also expected. The more the system is perceived as being playful and 'Fun' to use, the more it will be viewed as friendly and easy to use. Also, the more the users feel that the system being used is easy to use, the more positive would their attitudes be towards using it.

4.7. Regression Analysis

The last hypothesis in the study was stated as follows:

Factors such as playfulness, change effect, organizational and personal aspects and DSS features are related to the creativity aspects in decision making and to the decision making process carried out by individuals.

In order to test this hypothesis, it was necessary to build regression equations to determine the factors that are most likely to be associated with creativity in the decision making process. To start with, creativity in the decision making process was measured along three dimensions; creativity of responses (RESPCRVT), time taken for task completion (TIMECOMP), and the number of steps involved in the decision making process (DECS_STP). Based on this, three regression equations were built for each factor to determine the variables affecting its variability. The dependent variable is the variable the variation of which is likely to be explained. The independent or predictor variable is the variable used to explain variation in the dependent variable. The regression models that will be analyzed are divided into two sets. The first set consists of the equations representing the whole sample size (n = 30 subjects), whereas the second set consists of regression models based on the 15 subjects who received the software treatment. This separation is due to the fact that some research variables just represent the software treatment experimental group.

4.7.1. Building a Regression Model for Creativity of Response (RESPCRVT)

Having the creativity of responses being used as the dependent variable, and based upon the correlation analysis results, several independent variables were included. These are the following, number of subordinates (NUMSUBRD), time use (TIMEUSE), number of software applications used (_SFTUSE), number of tasks (_TASKS), number of computer courses (_COMCRS), years spent using computers in general (YRPCUSE), years spent using personal computers (YRPCUSE), when the DSS is used (WHENUSE), beliefs about computer use

(BFCUSEAV), playfulness (BACFAV), and attitudes towards IdeaFisher (ATTIDFAV). These variables, along with their Beta coefficients and T-significance values are shown in *Table XLIII*. The resulting equation therefore was as follows:

$$\underset{}{\textbf{\textit{RESPCRVT}}} = \underset{(0.0001)}{7.5637} - \underset{(0.0025)}{0.1278}\textit{NUMSUBRD} + \underset{(0.0004)}{0.5405}\textit{TIMEUSE}$$

$$- \underset{(0.0052)}{0.2506}\_\textit{SFTUSE} - \underset{(0.0006)}{0.3254}\_\textit{TASKS} + \underset{(0.0009)}{0.1322}\_\textit{COMPCRS}$$

$$+ \underset{(0.0169)}{0.1217}\textit{YRPCUSE} - \underset{(0.0011)}{0.1653}\textit{YRCOMUSE} - \underset{(0.0002)}{1.0104}\textit{WHENUSE}$$

$$+ \underset{(0.0018)}{1.0567}\textit{BFCUSEAV} + \underset{(0.0005)}{1.7870}\textit{BACFAV} - \underset{(0.0002)}{2.0312}\textit{ATTIDFAV}$$

$R^2 = 99.8\%$

$F(11,3) = 98.976 \qquad P \leq 0.00148$

Table XLIII - Regression Analysis with RESPCRVT being the Dependent Variable (n=15).

R =	0.99863	F(11, 3) =	98.976
R^2 =	0.99725	p <	0.00148
Adjusted R^2 =	0.98718	Std. Error of estimate =	0.08882

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_3_	P_LEVEL
Intercpt			7.56366	0.30059	25.16243	0.00014
NUMSUBRD	-0.64013	0.06778	-0.12783	0.01354	-9.44401	0.00252
TIMEUSE	1.32779	0.08111	0.54052	0.03302	16.37056	0.00050
_SFTUSE	-0.50752	0.06882	-0.25058	0.03398	-7.37448	0.00516
_TASKS	-0.97511	0.06583	-0.32543	0.02197	-14.81157	0.00067
_COMPCRS	0.73470	0.05500	0.13221	0.00990	13.35773	0.00091
YRPCUSE	0.31689	0.06562	0.12170	0.02520	4.82952	0.01692
YRCOMUSE	-0.57927	0.04697	-0.16533	0.01340	-12.33372	0.00115
WHENUSE	-1.25709	0.05465	-1.01038	0.04393	-23.00101	0.00018
BFCUSEAV	0.55655	0.05337	1.05679	0.10135	10.42718	0.00188
BACFAV	1.23045	0.07416	1.78704	0.10770	16.59249	0.00048
ATTIDFAV	-1.36477	0.06406	-2.03124	0.09535	-21.30373	0.00023

A- Significance of the Equation

R^2, the coefficient of determination, was reported to be 0.998. This means that 99.8% of the variability in the dependent variable creativity of response could be explained by the independent variables included in the equation. The F-ratio was calculated to be 98.976, and at a significance level of 0.05, the p-value came to be 0.00148, which implies that the equation is highly significant. As for the significance of the variables in determining the variation of the dependent variable RESPCRVT, results show that they are all highly significant. At a level of significance = 0.05, the p-level (t-significance) of the independent variables were found to be much less than 0.05, implying that each independent variable is highly significant in determining the variability of RESPCRVT.

B- Interpretation of the Equation

The first variable to start with in the analysis is the number of subordinates. The correlation coefficient has a negative sign implying an inverse relationship between creativity of response and number of subordinates. In other words, holding other variables constant, as the number of subordinates increases by one, the value of the dependent variable RESPCRVT would decrease by 0.1278. This negative correlation could be attributed to the assumption that as the number of subordinates increases, the responsibility of the manager in controlling and supervising their work would get higher. Having an overload in work, the manager might resort to hasty decision making rather than thinking creatively in the various aspects related to the problem and in the various alternatives available for its solution. Another interpretation could be that as the number of

subordinates increases, the probability would be higher that more authority, and responsibility will be delegated. This in turn means that more time would be spent in issuing policies and controlling performance, which again might lead to less creativity in the decision making process.

As for the length of time, the system has been used by the respondents; the positive correlation coefficient indicates a direct relationship between creativity of response and time use (TIMEUSE). Holding other variables constant, as the length of time spent on using the computer increases by one unit, the creativity of response increases by 0.5405. This could be interpreted as follows, as the time through which the current computer system (available in the workplace) has been used by the respondent gets longer, the respondent would become more familiar with the computer operations and the used software aspects. Also, because the system is used to accomplish job-related tasks, the subject will develop more domain-relevant skills which will be directly reflected onto the creativity of responses.

Coming to the number of software used, a negative relationship was observed. The higher the number of software the subject has been exposed to - taking into consideration that most if not all the software being used are tailor made for specific organization-related tasks (in the study, banking tasks)- the more will his/her thinking be structured and modeled to certain ways of thinking and analyzing. This in general means lower creativity levels in responses.

Concerning the number of tasks variable, the negative correlation coefficient indicates that the higher the number of tasks accomplished using the

computer facilities, the less will be the creativity level of the subjects' responses. Such an association could be attributed to the fact that using the computer for more tasks especially those which are in general considered as routine and less advanced would lead the subject to use the computer facilities as an aid for thinking strategically in issues related to structured or semi-structured tasks.

Furthermore, the positive correlation coefficient that the response creativity variable has with the number of courses taken by the subject indicates a direct and a positive relationship. That is, the more the number of computer courses taken by the subject, the more will be the creativity of responses. The reason for this could be the various systems and models the subject will be exposed to in the various courses he/she had taken. This, would widen the scope of the individual's thinking and mental ability, and thus enhance the level of creativity the individual shows in his responses.

The number of years the respondent has spent in using the personal computer has a direct and positive effect upon creativity of response. The use of the personal computer opens the way before the user to exercise self control, try out various software packages, and have his/her thinking trained to deal with various problem solving models. This, in turn, will most likely contribute in enhancing the user's creativity level.

On the other hand, the number of years the subject has spent in using computers in general has a negative effect upon the creativity of responses. Most of the computer systems applied in the Lebanese banks are minicomputers with task-oriented type of software related to banking. Moreover, these computer

systems -hardware and software- are used to handle routine transactions and keep records of daily repetitive operations. Based on this, the assumption will turn out to be that the thinking process will be confined to certain structured aspects. This, in turn, will have a negative impact upon the way the individual thinks about cases and solves problems.

Moreover, people used to use DSS, applied it either rarely or for handling tasks that do not require the supportive facilities of such a software. Features such as sensitivity analysis, why analysis, problem identification, and alternative solutions generation are rarely -if at all- applied and used. This would probably lead to a narrower scope in thinking and to lower levels of creativity in decision making. This, in fact, could be the reason why a negative relationship exists between when the subject is using the DSS (i.e., daily, weekly, monthly...) and creativity of response.

An interesting relationship was observed between beliefs about computer usage and creativity of the subjects' responses. The relationship is positive and direct. This implies that the more positive the subjects' attitudes towards the computer use in general are, the more he/she will feel motivated to explore the various aspects of the software packages they are applying, and thus make efficient use of them. This might encourage him/her to use probably available modeling facilities, which will enhance their creative thinking ability.

A similar relationship was observed between playfulness and creativity of response. The positive and significant correlation coefficient indicates that, in conformity with Alam and Mead's findings, the more the software package being

used is perceived by users as friendly and 'Fun' to use, the more they will be motivated to explore it and use its features, and thus the better will be their creativity level.

Finally, and surprisingly enough, the more positive the users' attitudes are towards the CEDSS -IdeaFisher- used in the experiment, the less was the level of response creativity that they showed. This could be attributed to the assumption that the subjects, because they were interested in the system, were concerned in knowing what facilities and more steps the software was offering them rather than thinking well about each step and responding to it accordingly.

4.7.2. Building a Regression Model for Time Required for Task Completion (TIMECOMP)

Another regression analysis was done to determine the variables that are most likely to be associated to the time required for task completion. Two independent variables were included in the model, the type of software treatment (SOFTRMNT) and the organizational level (ORGLEVEL). The results are shown in *Table XLIV.*

To start with, and as could be noticed from the results, the coefficient of determination, R^2, is = 0.562, meaning that 56.2% of the variability in the time required to complete the task given to subjects could be explained by these two independent variables. Moreover, at a level of significance = 0.05, F-ratio was calculated to be = 17.383 and the level of significance = 0.00001, implying that the equation is highly significant. As for the significance of the included variables, the p-level of each variable is much less than 0.05, meaning that the

variables are highly significant in determining the variability of the TIMECOMP dependent variable. The regression equation will therefore be as follows:

$$TIMECOMP = \underset{(2.09\times10^{-7})}{77.943} - \underset{(3.4\times10^{-5})}{29.102}SOFTRMNT + \underset{(0.0478)}{3.497}ORGLEVL$$

$R^2 = 56.3\%$

$F(2,27) = 17.383 \qquad P \leq 0.00001$

Table XLIV - Regression Analysis with TIMECOMP being the Dependent Variable (n=30).

R =	0.75024	F(2, 27) =	17.383
R^2 =	0.56287	p <	0.00001
Adjusted R^2 =	0.53049	Std. Error of estimate =	15.711

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_27_	P_LEVEL
Intercept			77.94256	11.30675	6.89346	0.00000
SOFTRMNT	-0.64548	0.13017	-29.10169	5.86869	-4.95880	0.00003
ORGLEVEL	0.26978	0.13017	3.49769	1.68760	2.07259	0.04788

The interpretation of this equation is simple and straightforward. As for the software treatment variable, the correlation coefficient is negative, meaning that it has an inverse relationship with the time required to complete the task. As mentioned earlier, the use of the software was accompanied with a longer time taken by the user for task completion. Subjects who solved the given case using no software, however, took less time. This could be attributed to the fact that using such a CEDSS enhances thinking, thus allowing the user to think of more

alternatives and take many factors into consideration. In addition, the fact that subjects who used the software needed some time to explore the system and get used to its various facilities. The organizational level has a positive and a direct relationship with the TIMECOMP. This means the higher the organizational level of the subject, the more time he/she would need to complete the task required from him/her. This could be reasoned as follows, a higher organizational level means more responsibility, more experience, and more exposition to various situations requiring thinking, analysis and quality decision making. Applying such aspects will of course require more time well reflected in the longer time that these subjects had taken to complete the task they were given.

4.7.3. Building a Regression Model for the Decision Applied

The number of steps involved in the decision making process applied by the subjects was the last measure of creativity. Here, again, a regression analysis was conducted to examine the factors that could be considered as probable determinants for the variability in the decision making process applied.

The results of this regression analysis are shown in *Table XLV*. As noticed, the coefficient of determination, R^2, is = 0.666; i.e., 66.6% of the variability in the dependent variable DECS_STP could be explained by the five independent variables included in the equation: TIMECOMP, YRSEMPLY, EDUCLEVL, _SFTUSE, and _TASKS. Moreover, at a significance level of 0.05, F-ratio is = 9.6053 and $p \leq 0.00004$, which means that the equation is highly significant in determining the variability of the dependent variable. Furthermore, looking at the t-significance or p-value of the independent variables, one can find

out that at a level of significance of 0.05, all the independent variables show a high significance in explaining the variability of DECS_STP.

The resulting regression equation comes as follows:

$$DECS\_STP = \underset{(0.0002)}{1.2122} + \underset{(0.0118)}{0.0059}TIMECOMP - \underset{(0.0015)}{0.0799}YRSEMPLY$$
$$+ \underset{(0.0200)}{0.1345}EDUCLEVL + \underset{(0.0090)}{0.0801}\_SFTUSE - \underset{(0.0158)}{0.0504}\_TASKS$$

$R^2 = 66.7\%$

$F(5,24) = 9.6053$ $P \leq 0.00004$

Table XLV - Regression Analysis with DECS_STP being the Dependent Variable (n=30).

R =	0.81657	F(5, 24) =	9.6053
R^2 =	0.66678	p <	0.00004
Adjusted R^2 =	0.59737	Std. Error of estimate =	0.25815

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_24_	P_LEVEL
Intercpt			1.21222	0.28005	4.32862	0.00023
TIMECOMP	0.335935	0.1233054	0.00596	0.00219	2.72441	0.01182
YRSEMPLY	-0.449714	0.125852	-0.07997	0.02238	-3.57336	0.00154
EDUCLEVL	0.3057732	0.1227432	0.13452	0.05400	2.49116	0.02004
_SFTUSE	0.34600	0.12193	0.08014	0.02824	2.83774	0.00909
_TASKS	-0.31957	0.12309	-0.05042	0.01942	-2.59623	0.01584

The positive correlation coefficient of the independent variable TIMECOMP with DECS_STP indicates a direct relationship. That is, holding other variables constant, an increase in the time required for task completion by

one unit would lead to an increase in the number of steps involved in the decision making process by 0.0059. In conformity with the previously reported findings, the interpretation is straightforward. The more time the subject spends in finishing the task assigned to him/her, the more he/she would be expected to have spent the time analyzing the factors related to the case given to them and thinking of the various alternatives that could lead to the proper solution. These aspects are expected to be reflected in a larger number of steps involved in the decision making process. The negative correlation coefficient with the independent variable YRSEMPLY indicates an inverse relationship between DECS_STP and YRSEMPLY: the higher the number of years the subject has spent as an employee, the less would be the number of steps he/she includes in his/her decision making process. This could be partly due to the fact that getting employed in certain organizations might shape the way an individual thinks and confine it within a certain frame. This, most probably, will structure the individual's thinking ability and narrow down his/her creativity. Such an adverse effect will be reflected in less steps included in the decision making process. As for the educational level, it is generally expected that a higher educational level would result in a wider mental scope and a better analytical ability well reflected in a larger number of steps included in the process of decision making. Another positive relationship exists between DECS_STP and the independent variable _SFTUSE. The higher the number of software applications used by the subject, the higher would be the probability that he/she will get introduced to various software facilities including those that would enhance the user's ability to think

more creatively. Again, this might lead to a larger number of steps in the decision making process applied by the individual. Finally, a negative relationship was reported between the dependent variable DECS_STP and the independent variable _TASKS. The more the subject uses the computer to complete job-related tasks required from him/her at the bank, the less would be his/her creativity level as measured by the number of steps included. This could be attributed to the highly structured tasks the bank employees use the computer for. Moreover, the nature of the banking software applied in the bank is just tailored to the completion of the routine transactions taking place daily there. This, of course, could inhibit the creative ability of the individuals concerned.

4.7.4. Other Regression Models

After building regression models to determine the factors that are most likely to be associated to the variation of the factors used as measures for creativity, it was intended to examine the factors that could have an effect upon computer use and software use related variables. The focus here was upon four variables: BFCUSEAV, EUAV, BACFAV, and ATTIDFAV.

4.7.4.1. Building a Regression Model for Beliefs about Computer Use

The computer technology environment is an environment where change is constant. Having a positive attitude towards the use of the computer is highly believed to play a role in reducing the intensity of the change effect and encouraging the individual to learn new computer systems and use them efficiently. But what are the factors that are most likely to have an influence upon an individual's beliefs about computer use. *Table XLVI* shows the results of the

regression analysis that was conducted for this purpose. As observed from the results, the equation is significant. This is because at a significance level of 0.05, F-ratio is = 2.5404 and $p \leq 0.0415$. In addition, $R^2 = 0.4918$; that is 49.2% of the variation in the dependent variable could be attributed to the variation in the included independent variables. Also, the p-level for each of the independent variables (EDUCLEVL, EXTNTUSE, _SFTUSE, _COMPCRS, and _INFSCRS) indicates its significance in determining the variability of BFCUSEAV.

Table XLVI - Regression Analysis with BFCUSEAV being the Dependent Variable (n=30).

R =	0.70129	F(8, 21) =	2.5404
R^2 =	0.49181	p <	0.04151
Adjusted R^2 =	0.29822	Std. Error of estimate =	0.3418

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_21_	P_LEVEL
Intercpt			0.80541	0.50795	1.58561	0.12777
EDUCLEVL	0.4090137	0.1701978	0.18046	0.07509	2.40317	0.02558
EXTNTUSE	0.6924298	0.3006036	0.22630	0.09824	2.30346	0.03157
FREQUSE	-0.419666	0.2719914	-0.15542	0.10073	-1.54294	0.13778
_SFTUSE	-0.705687	0.2104891	-0.16393	0.04890	-3.35260	0.00302
_COMPCRS	-0.566425	0.2520792	-0.06440	0.02866	-2.24701	0.03552
_INFSCRS	0.9459805	0.296705	0.41269	0.12944	3.18829	0.00442
YRPCUSE	-0.35233	0.22045	-0.06191	0.03874	-1.59819	0.12494
YRCOMUSE	0.32921	0.20776	0.05150	0.03250	1.58456	0.12801

The regression equation will thus look as follows:

$$\underset{}{\textbf{\textit{BFCUSEAV}}} = \underset{}{0.8054} + \underset{(0.1277)}{0.1805}\textit{EDUCLEVL} + \underset{(0.02557)}{0.2263}\textit{EXTNTUSE} + \underset{(0.0315)}{}$$

$$- \underset{(0.0030)}{0.1639}\_\textit{SFTUSE} - \underset{(0.0355)}{0.0644}\_\textit{COMPCRS} + \underset{(0.0044)}{0.4127}\_\textit{INFSCRS}$$

$R^2 = 49.2\%$

$F(8,21) = 2.5404 \qquad P \leq 0.0415$

Coming to the interpretation of the equation and starting with the educational level, the positive sign of the correlation coefficient indicates a direct relationship. This is expected since the higher the educational level of the individual, the wider would be his/her mental scope and knowledge, the more he/she would appreciate the importance of the computer facilities in helping users carry out their operations, and thus the better would his/her beliefs about and attitudes towards the computer system be. The extent of computer use has a positive correlation coefficient, implying that the higher the extent of use, the better would be the user's attitudes towards the computer. A higher extent of use means more exposition to the computer and a better acquaintance and familiarity with its various features and aspects, which in turn could lead to more positive beliefs and attitudes towards the computer use. As for the number of software used, the negative correlation coefficient indicates that the higher the number of software used by the individual, the less would be his/her positive attitudes towards the computer use. This could be due to the fact that the subjects participating in this study reported mostly the use of banking software or other software just to handle routine type of tasks. This most probably will prevent them from forming a positive attitude towards the computer use. Finally, a negative relationship existed between BFCUSEAV and the number of computer courses taken, and a positive relationship between BFCUSEAV and the number of information system courses taken by the user. This could be attributed to the fact that most of the computer courses are related to programming techniques with formats to be memorized and always referred to, which could be considered

difficult for some people. On the other hand, the information system courses include more material about analysis and design of systems and require individuals to become familiar with various types of software applications characterized with their 'easy to use' and "friendliness" features. This is expected to add to the positive attitudes an individual has towards the computer use.

4.7.4.2. Building a Regression Model for Ease of Use

As mentioned earlier, the experimental group was asked to use a CEDSS. Various individuals within this group had various perceptions about its ease of use. What were the factors underlying the individuals' perceptions about the system's ease of use? In order to answer this question, a regression analysis was run, and the results displayed in *Table XLVII* show that 10 variables were included as independent variables for this regression model.

The resulting regression equation is:

$$\begin{aligned} EUAV = {} & \underset{(0.0003)}{3.4418} + \underset{(0.0085)}{0.0067}TIMECOMP + \underset{(0.0036)}{0.3716}EDUCLEVL \\ & - \underset{(0.0005)}{0.7859}AGE + \underset{(0.0006)}{0.1455}TIMEUSE - \underset{(0.0025)}{0.0397}\_COMPCRS \\ & - \underset{(0.0006)}{0.2665}WHENUSE - \underset{(0.0028)}{0.5549}BFCUSEAV - \underset{(0.0019)}{0.6462}BACFAV \\ & + \underset{(0.0001)}{1.0397}ATTIDFAV - \underset{(0.0009)}{0.3710}TRAINAVG \end{aligned}$$

$R^2 = 99.5\%$

$F(10,4) = 74.63 \qquad P \leq 0.00042$

Table XLVII - Regression Analysis with EUAV being the Dependent Variable (n=15).

R =	0.99733	F(10, 4) =	74.636
R^2 =	0.99467	p <	0.00042
Adjusted R^2 =	0.98134	Std. Error of estimate =	0.06091

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_4_	P_LEVEL
Intercpt			3.44181	0.31104	11.06542	0.00038
TIMECOMP	0.2803275	0.058143	0.00677	0.00140	4.82134	0.00851
EDUCLEVL	0.771438	0.1260156	0.37157	0.06070	6.12177	0.00361
AGE	-1.127895	0.1121217	-0.78596	0.07813	-10.05956	0.00055
TIMEUSE	0.6286684	0.0639682	0.14550	0.01480	9.82783	0.00060
_COMPCRS	-0.38829	0.0578447	-0.03972	0.00592	-6.71264	0.00256
WHENUSE	-0.583271	0.0605912	-0.26652	0.02769	-9.62634	0.00065
BFCUSEAV	-0.514087	0.0789972	-0.55497	0.08528	-6.50765	0.00288
BACFAV	-0.782629	0.1076788	-0.64621	0.08891	-7.26818	0.00190
ATTIDFAV	1.22877	0.08296	1.03974	0.07020	14.81193	0.00012
TRAINAVG	-0.77618	0.08864	-0.37104	0.04237	-8.75631	0.00094

As the results show, the equation shows high significance. At a significance level of 0.05, F-ratio is = 74.63 and $p \leq 0.00042$. R^2, the coefficient of determination, is = 0.994. Thus, 99.4% of the EUAV variability could be explained by the independent variables included. Moreover, each of the independent variables is highly significant in determining the variability of the dependent variable EUAV, as could be derived from the t-significance or p-level value of each.

TIMECOMP has a positive correlation coefficient indicating a direct relationship with EUAV. This means the more time the user took to complete the assigned task using the computer, the more he/she was given the opportunity to explore the system more, know its features, get more familiar with it, and perceive it as easy to use. EDUCLEVL also has a positive direct relationship with

EUAV. The higher the educational level of the subject, the better would his/her understanding level of the features provided by the system the more he/she would be capable of applying them, and the more he/she would perceive the system as easy to use. In reference to the negative correlation coefficient of Age, one can say that older subjects are more apt to perceive the system as being less easy to use than younger ones. This could be attributed to the fact that older subjects are more apt to show high resistance to change and to be reluctant in attaching a high level of importance to such systems. This will prevent them from exploring the various system aspects, and will thus impede them from perceiving the system as easy to use.

An interesting relationship is found between EUAV and the length of time the subject has been using the computer system in the workplace (the bank). The positive correlation coefficient shows that the longer the time the current banking system has been used, the more the subject will perceive the CEDSS as being easy to use. This is expected, since as it was reported earlier, the computer system used in the bank is just confined for structured banking operations and routine tasks. Getting acquainted with a friendly, user-oriented software such as the one used in the experiment made them feel the difference and perceive the CEDSS as being easy to use. On the other hand, a negative relationship was found between the number of computer courses taken and the perceived ease of use of the system used in the experiment. This could be attributed to the assumption that the more computer courses (which include a lot of programming) the individual takes, the more would his/her way of thinking be structured within a certain frame

inhibiting him/her from interacting creatively with such enhanced software applications, and thus preventing them from perceiving them as being easy to use. The negative relationship between EUAV and the frequency of using DSS in general can be simply interpreted as follows: the less frequent the subjects have used DSS in general, the more difficult they will perceive the CEDSS.

Surprisingly enough, negative relationships were observed between EUAV on one hand and the two independent variables: BFCUSEAV and BACFAV. The beliefs about computer use that a subject might have were developed from his/her previous general knowledge about or experience with certain computer software applications that could not be considered as CEDSSs. Getting exposed to the features of the CEDSS IdeaFisher for the first time and finding out that they do not match with the structured features they got used to while using other applications (especially that designed just for banking operations), the subjects felt that the system is not really easy to use or understand. As for playfulness, the negative relationship indicates that the more playful the system is, the less easy to use it will be perceived by the user. Such a result could be attributed to the fact that the subjects were given a manual explaining only specific features in the IdeaFisher, features that they were required to use to complete the task they were given. Now, because the system is friendly and easy to use, the subjects started going deep to explore other features all by their own. This led them to encounter certain problems for which they asked for assistance -the fact that contributed to their perceiving the system as being less easy to use, the more playful it is.

ATTIDFAV has a positive correlation coefficient, indicating a direct relationship with EUAV. This is well expected. The more positive are the users' attitudes towards the CEDSS used, the more motivated they would be to use it, and the more they would perceive it as being easy to use.

Finally, a negative relationship was reported between EUAV and TRAINAV. This means the more computer training the user had, the less easy to use he/she would perceive the system. This could be attributed to the reasoning that most training the subject get used to take place in the form of courses or through self study on software applications commonly used. This could impede the users from perceiving the IdeaFisher as easy to use.

4.7.4.3. Building a Regression Model for Playfulness

Based on the results shown in *Table XLVIII*, the regression equation built for playfulness (BACFAV) can be put down as follows:

$$\begin{aligned} BACFAV = {} & \underset{(0.0003)}{6.0342} + \underset{(0.0023)}{0.0112}TIMECOMP + \underset{(0.0003)}{0.6657}EDUCLEVL \\ & - \underset{(0.0002)}{1.269}AGE - \underset{(0.0292)}{0.1297}FREQUSE + \underset{(0.0011)}{0.2263}TIMEUSE \\ & - \underset{(0.0011)}{0.0586}\_COMPCRS - \underset{(0.0009)}{0.3609}WHENUSE - \underset{(0.0004)}{0.9099}BFCUSEAV \\ & - \underset{(0.0006)}{1.7016}EUAV + \underset{(0.0004)}{1.5556}ATTIDFAV - \underset{(0.00032)}{0.6230}TRAINAV \end{aligned}$$

$R^2 = 99.8\%$

$F(11,3) = 207.25 \qquad P \leq 0.00049$

Table XLVIII - Regression Analysis with BACFAV being the Dependent Variable (n=15).

R =	0.99934	F(11, 3) =	207.25
R^2 =	0.99868	p <	0.00049
Adjusted R^2 =	0.99387	Std. Error of estimate =	0.04229

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_3_	P_LEVEL
Intercpt			6.03425	0.33438	18.04620	0.00037
TIMECOMP	0.3846528	0.0393621	0.01125	0.00115	9.77217	0.00228
EDUCLEVL	1.1413394	0.0590482	0.66579	0.03445	19.32894	0.00030
AGE	-1.504006	0.0663803	-1.26929	0.05602	-22.65741	0.00019
FREQUSE	-0.216116	0.054949	-0.12972	0.03298	-3.93303	0.02927
TIMEUSE	0.8072899	0.06455	0.22628	0.01809	12.50642	0.00110
_COMPCRS	-0.473634	0.0374529	-0.05868	0.00464	-12.64614	0.00107
WHENUSE	-0.652306	0.0494305	-0.36099	0.02736	-13.19644	0.00094
BFCUSEAV	-0.695957	0.04042	-0.90991	0.05285	-17.21813	0.00043
EUAV	-1.405031	0.0939943	-1.70163	0.11384	-14.94804	0.00065
ATTIDFAV	1.51799	0.08682	1.55561	0.08897	17.48470	0.00041
TRAINAVG	-1.07615	0.05651	-0.62302	0.03271	-19.04414	0.00032

As for the interpretation of the equation, R^2, the coefficient of determination, is = 99.8%. That is, 99.8% of the variation in BACFAV could be explained by the independent variables included. The equation shows high significance since at a significance level of 0.05, F-ratio = 207.25 and $p \leq 0.00049$. The independent variables also have significance in determining the variability of BACFAV. This is indicated by the p-value (or t-significance) of each of the independent variables.

The positive correlation coefficient of TIMECOMP indicates a direct relationship with BACFAV. The more time the subject takes to finish the task, the more he/she will get acquainted to the system aspects and feel that it is 'fun' to use. As for the educational level, the higher it is, the higher would be the

understanding level of the subject and the broader would be his/her mental scope. This would allow the subject to explore the various features of the system and feel its playfulness and friendliness. Furthermore, the older the subject, the more would his/her resistance to change be, and the less would be his/her ability to examine the capabilities of the system. In this case, the subject's perception of the system's playfulness would be less, which explains the negative relationship between BACFAV and age. Besides, the more frequently the subject uses the system available, the more his/her thinking would get used to structured type of cases and problem solving. This will disable the user from exploring the CEDSS and feel its friendliness and playful features. Nevertheless, the longer the time the subject has been using the system being currently used in the bank, the more he/she would feel the difference when offered an enhanced system such as the IdeaFisher. Unlike the structured banking software, the IdeaFisher includes models, interactive dialogues and other friendly aspects that make it more attractive to users who will feel the difference and perceive its 'fun' aspects.

In addition to this, the less frequently the subject uses a DSS in general, the less would be his/her perception about its usefulness and applications, and thus the less would his/her perception about its 'friendliness' and 'playfulness'. Finally, and as expected, a direct relationship exists between BACFAV and ATTIDFAV. The more positive the subjects' attitudes towards IdeaFisher, the more they will perceive it as a 'fun' to use.

As for the variables _COMPCRS, BFCUSEAV, EUAV, and TRAINAV, the same explanation that was mentioned for the previous equation (dependent variable = EUAV) could be applied for this equation too.

4.7.4.4. Building a Regression Model for Attitudes Towards IdeaFisher

The last regression model was built to examine the factors that are most likely to be associated with the subjects' attitudes towards IdeaFisher. In reference to the data listed in *Table XLIX*, the following regression equation could be built:

$$\begin{aligned} ATTIDFAV = &-3.2587 - \underset{(0.0007)}{0.0065}TIMECOMP - \underset{(0.0047)}{0.351}EDUCLEVL - \underset{(0.0048)}{0.7476}AGE \\ &- \underset{(0.0006)}{0.1382}TIMEUSE + \underset{(0.0008)}{0.0379}\_COMPCRS + \underset{(0.0024)}{0.2537}WHENUSE \\ &+ \underset{(0.0007)}{0.5330}BFCUSEAV + \underset{(0.0019)}{0.9445}EUAV + \underset{(0.0001)}{0.6196}BACFAV \\ &+ \underset{(0.0013)}{0.3502}TRAINAV \end{aligned}$$

$R^2 = 99.6\%$

$F(10,4) = 114.96 \qquad P \leq 0.00018$

The results show that the equation is highly significant. They also show that the independent variables are significant in explaining the variability of the dependent variable ATTIDFAV.

The negative relationship between TIMECOMP and ATTIDFAV indicates that a longer time spent on using the software in order to complete the assigned task might be associated with less positive attitudes towards IdeaFisher.

The subject might get bored and might feel that he/she could have finished the task faster if the software was not used.

Table XLIX - Regression Analysis with ATTIDFAV being the Dependent Variable (n=15).

R =	0.99826	F(10, 4) =	114.96
R^2 =	0.99650	p <	0.00018
Adjusted R^2 =	0.98780	Std. Error of estimate =	0.05806

CASENAME	BETA	ST. ERR.	B	ST. ERR.	T_4_	P_LEVEL
Intercpt			-3.25873	0.35139	-9.27377	0.00075
TIMECOMP	-0.230856	0.040667	-0.00659	0.00116	-5.67675	0.00475
EDUCLEVL	-0.616782	0.1095296	-0.35109	0.06235	-5.63119	0.00489
AGE	0.9079049	0.0947086	0.74769	0.07800	9.58630	0.00066
TIMEUSE	-0.505309	0.0556351	-0.13821	0.01522	-9.08255	0.00081
_COMPCRS	0.3137239	0.0456898	0.03793	0.00552	6.86639	0.00236
WHENUSE	0.469912	0.0500486	0.25376	0.02703	9.38911	0.00072
BFCUSEAV	0.4178417	0.0581978	0.53309	0.07425	7.17969	0.00199
EUAV	0.799249	0.0539598	0.94456	0.06377	14.81193	0.00012
BACFAV	0.6350508	0.0795001	0.61969	0.07758	7.98805	0.00133
TRAINAVG	0.61994	0.08365	0.35023	0.04726	7.41102	0.00177

Surprisingly enough, a higher educational level was associated with less positive attitudes towards the system used. This could be partly due to the assumption that people with higher educational levels might feel that the use of software applications designed to enhance their thinking would be an underestimation for their ability to think effectively and make creative decisions.

Moreover, the older the subject age is, the more he/she will be apt to have a positive attitude towards the system. If an older age implies a higher organizational level, then this means that subjects with higher organizational

levels might like using such a system since they perceive it as a helping tool for their decision making processes.

As for the negative relationship between ATTIDFAV and the length of time the subject has been using the current system available in the bank, the interpretation could simply be as follows. The more the subject uses the current structured system available in the bank, especially if that was the first computer system he/she was trained to use, the more he/she will find it difficult to use another system designed specifically for unstructured tasks. This, of course, would lead to less positive attitudes towards the system.

A higher number of computer courses taken by the subject means in general a better understanding of the computer technology and a better appreciation for the facilities it provides its users with. Thus, a higher number of computer courses taken by the subject will most probably lead to a more positive attitude towards this CEDSS with all its advanced features.

Finally, and as expected, the more positive the subjects' beliefs about the computer use in general, the easier they found the CEDSS that was provided to them in the experiment, also the more they perceive the system as playful and friendly, and the better training they are given, the more positive would their attitudes be towards IdeaFisher.

In fact, this chapter presented a detailed description of all the findings obtained from the study conducted. As noticed, some of the findings were

consistent while others did not conform with other researchers' findings of surveys conducted within the same field.

CHAPTER V

Conclusions and Recommendations

Keep your mind open to change all the time. Welcome it. Court it. It is only by examining and reexamining your opinions and ideas that you can progress.[1]

- DALE CARNEGIE

In the twenty-first century, human ability to think effectively more than any other factor will be of great importance -if not at a premium. The advantage of the quality of thinking will make the big difference in the performance of people and organizations.

The twenty-first century will be an age in need of, demanding and rewarding people who apply creative thinking. The thinking abilities and skills of human beings -more than natural resources, capital, or technology- will determine success and failure of individuals and organizations, and also will determine those who lead and those who follow.

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[1] Dale Carnegie & Associates, Inc., The Leader in You, (NY: Simon and Schuster Inc., 1993), p. 1.

Why? Because the whole world is and will keep on undergoing a process of enormous change and great possibilities. Today, corporate managers strive to increase quality and productivity to remain competitive in an energetic, interdependent world economy. In such a situation, what needs to be done is not merely matching the competition, but surpassing it -a goal that demands creative thinking. Moreover, during the coming year, major areas of emphasis will be the accelerated development of science and technology, computer education and technology, and the need for a comprehensive and effective human resource development program. Of course, the formulation of strategic plans and programs to successfully handle and overcome the challenges and obstacles in these areas require planning, making strategies, and, above all, in-depth thinking.

Yes, no one doubts the need for creativity. It is most useful in good times and essential in turbulent times. It has always been regarded as a magic gift or as a divine type of inspiration that one can do nothing about but await it passively. Such a view has come only because people have not developed the type of thinking that encourages it. The truth is that creativity exists, and making it active requires an understanding of its processes, escaping from attitudes which inhibit these processes, and using methods for encouraging them.

Despite the challenges of the future and the need for creativity, countless people today -employees, executives of major corporations, and leaders of public organizations- especially in the Lebanese market reduce their own potential for success. Their use of technology, in general, is not efficient nor effective. They repeat outmoded problem-solving methods, accumulating voluminous data,

realizing too late their uselessness in finding solutions. Or they might try solutions that someone else found successful for his or her own, basically different situation.

Given these circumstances, and taking the above mentioned factors into consideration, the compelling need for this study was to offer the benefits of creative thinking in the successful solution of personal, social, and most important business organization problems. The study paved its way based on the two assumptions that (1) creativity exists, and that (2) individuals can be helped and encouraged to become more creative. As a tool for encouraging and enhancing the creative problem solving or decision making of individuals, a creativity enhancing DSS, IdeaFisher, was adopted, installed, and used. An experimental design was conducted to study the effect of using such a software upon the creativity of users and the quality of decisions made by managers.

5.1. Major Conclusions

The fundamental questions addressed by this research were whether or not a CEDSS could influence the decision making processes of its users, and whether these systems could affect the creativity of the decisions produced by its users. Two survey designs and an experiment were conducted to answer such questions. The sample used was made up of 30 participants selected as employees all working in one of the top five leading banks in Lebanon. In selecting this sample, certain factors were controlled -namely, educational level, experience, and working conditions- to attain and keep the validity of the study findings.

The major conclusion for the first survey design -creativity baseline measurement- was that there was no variability in the creativity scores along the two software treatment (software/ no software) groups. This implied that any differences in the measured creativity of responses could only be attributed to the software treatment applied in the experiment rather than to individual differences.

Another conclusion was that the frequency of computer use showed variability along the organizational level and age variables. The higher the organizational level and the older the age, the less frequently was the reported use of computers. Moreover, interesting correlations were found between the computer system use dimensions on one hand and individual variables on the other. Extent of computer use was found to be negatively correlated to the number of employment years and positively correlated to how long the personal computer had been used. The number of years the PC had been used was also positively correlated to two other dimensions, the frequency of use and the number of software used. The number of software applied was found to have a positive correlation with number of computer courses taken, number of information system courses, number of years spent in using the computer in general, and the number of years spent in participating in system analysis and design.

Still another major conclusion was that the measurement scales used in the creativity baseline measurement and in the survey conducted proved to be valid and reliable. The value of the Cronbach's alpha (consistency/ reliability) for

each measurement scale was high and the inter-item correlation between the items was reported to be low.

As for the experiment results, major and interesting findings could be reported. To start with, the software treatment group took more time to complete the required task than the no software treatment group. Moreover, the users of the CEDSS adopted a multiple step decision making (or problem solving) process. Furthermore, the scores put by the judges proved to be consistent and reliable. These scores also showed that users of the CEDSS outperformed the non users in the quality and creativity of the decisions made.

Concerning the factors that might have an effect upon an efficient and effective use of such a CEDSS and upon creative decision making, it was found that beliefs about computer use, perceptions about ease of use, playfulness and attitudes towards IdeaFisher are important to be investigated. Beliefs about computer use showed variability along training and educational level variables. Moreover, significant, positive, and direct correlations were found among the four factors: BFCUSEAV, EUAV, BACFAV, and ATTIDFAV.

Finally, regression analysis was conducted and significant models were built to determine the factors that are most likely to be associated to the measures of creativity: RESPCRVT, TIMECOMP, and DECS_STP, and the other related factors: BFCUSEAV, EUAV, BACFAV, and ATTIDFAV. The equations built are the following:

Equation 1

$$\underset{}{RESPCRVT} = \underset{}{7.5637} \underset{(0.0001)}{-0.1278}NUMSUBRD \underset{(0.0025)}{+0.5405}TIMEUSE \underset{(0.0004)}{-0.2506}\_SFTUSE \underset{(0.0052)}{-0.3254}\_TASKS \underset{(0.0006)}{+0.1322}\_COMPCRS \underset{(0.0009)}{+0.1217}YRPCUSE \underset{(0.0169)}{-0.1653}YRCOMUSE \underset{(0.0011)}{-1.0104}WHENUSE \underset{(0.0002)}{+1.0567}BFCUSEAV \underset{(0.0018)}{+1.7870}BACFAV \underset{(0.0005)}{-2.0312}ATTIDFAV \underset{(0.0002)}{}$$

$R^2 = 99.8\%$ $F(11,3) = 98.976$ $P \leq 0.00148$

Equation 2

$$\underset{}{TIMECOMP} = \underset{(2.09\times10^{-7})}{77.943} \underset{(3.4\times10^{-5})}{-29.102}SOFTRMNT \underset{(0.0478)}{+3.497}ORGLEVL$$

$R^2 = 56.3\%$ $F(2,27) = 17.383$ $P \leq 0.00001$

Equation 3

$$\underset{}{DECS\_STP} = \underset{(0.0002)}{1.2122} \underset{(0.0118)}{+0.0059}TIMECOMP \underset{(0.0015)}{-0.0799}YRSEMPLY \underset{(0.0200)}{+0.1345}EDUCLEVL \underset{(0.0090)}{+0.0801}\_SFTUSE \underset{(0.0158)}{-0.0504}\_TASKS$$

$R^2 = 66.7\%$ $F(5,24) = 9.6053$ $P \leq 0.00004$

Equation 4

$$\underset{}{BFCUSEAV} = \underset{(0.1277)}{0.8054} + \underset{(0.02557)}{0.1805}EDUCLEVL + \underset{(0.0315)}{0.2263}EXTNTUSE$$

$$- \underset{(0.0030)}{0.1639}\_SFTUSE - \underset{(0.0355)}{0.0644}\_COMPCRS + \underset{(0.0044)}{0.4127}\_INFSCRS$$

$R^2 = 49.2\%$ $F(8,21) = 2.5404$ $P \leq 0.0415$

Equation 5

$$\underset{}{EUAV} = \underset{(0.0003)}{3.4418} + \underset{(0.0085)}{0.0067}TIMECOMP + \underset{(0.0036)}{0.3716}EDUCLEVL$$

$$- \underset{(0.0005)}{0.7859}AGE + \underset{(0.0006)}{0.1455}TIMEUSE - \underset{(0.0025)}{0.0397}\_COMPCRS$$

$$- \underset{(0.0006)}{0.2665}WHENUSE - \underset{(0.0028)}{0.5549}BFCUSEAV - \underset{(0.0019)}{0.6462}BACFAV$$

$$+ \underset{(0.0001)}{1.0397}ATTIDFAV - \underset{(0.0009)}{0.3710}TRAINAVG$$

$R^2 = 99.5\%$ $F(10,4) = 74.63$ $P \leq 0.00042$

Equation 6

$$\underset{}{BACFAV} = \underset{(0.0003)}{6.0342} + \underset{(0.0023)}{0.0112}TIMECOMP + \underset{(0.0003)}{0.6657}EDUCLEVL$$

$$- \underset{(0.0002)}{1.269}AGE - \underset{(0.0292)}{0.1297}FREQUSE + \underset{(0.0011)}{0.2263}TIMEUSE$$

$$- \underset{(0.0011)}{0.0586}\_COMPCRS - \underset{(0.0009)}{0.3609}WHENUSE - \underset{(0.0004)}{0.9099}BFCUSEAV$$

$$- \underset{(0.0006)}{1.7016}EUAV + \underset{(0.0004)}{1.5556}ATTIDFAV - \underset{(0.00032)}{0.6230}TRAINAV$$

$R^2 = 99.8\%$ $F(11,3) = 207.25$ $P \leq 0.00049$

Equation 7

$$ATTIDFAV = -3.2587 - 0.0065\,TIMECOMP - 0.351\,EDUCLEVL + 0.7476\,AGE - 0.1382\,TIMEUSE + 0.0379\,\_COMPCRS + 0.2537\,WHENUSE + 0.5330\,BFCUSEAV + 0.9445\,EUAV + 0.6196\,BACFAV + 0.3502\,TRAINAV$$

(0.0007) (0.0047) (0.0048) (0.0006) (0.0008) (0.0024) (0.0007) (0.0019) (0.0001) (0.0013) (0.0017)

$R^2 = 99.6\%$ $F(10,4) = 114.96$ $P \leq 0.00018$

5.2. Limitations of the Study

As in any research work, this research study had certain limitations. The first one to be mentioned here is that the sample selected to conduct the experiment represented a homogeneous type of user. All the participants are employees in different branches of one of the leading banks in Lebanon. This means that all of them have an experience within the same work domain. Moreover, they all have either a Bachelor of Science or a Masters degree, thus implying a homogeneity in the educational level too. As it was mentioned earlier, such aspects were controlled for the purpose of not including factors other than those intended to be measured within the frame of the experiment. Had a heterogeneous type of sample been used, the results regarding creativity and various attitudes towards the system used might have been different.

Another limitation is that the time factor was not controlled. Since there was a direct and positive relationship between time taken and creativity scores, it could be assumed that the additional time may have contributed to the higher scores attained by the software treatment group.

Furthermore, the task (Case Problem) that was given to the respondents to solve was not a general one. It was rather confined to the banking sector. Taking certain factors into consideration, such as the applicability of what was mentioned in the case in real life contexts, the attitude of the respondent towards his/her job in the bank, the mental link that he/she established with the problems faced in the bank, along with others, one might say that such factors could have had an influence upon the way each participant perceive the problem.

Finally, subjects were not told about the real purpose of the study. This was done in order to avoid the effect of any external control on how the subject would address and handle the task. The assumption, therefore, is that subjects would have invoked a different decision strategy if they were asked to come up with a creative innovative step.

5.3. Recommendations

Based on the results reported in Chapter IV, and the above mentioned limitations, the following recommendations could be drawn:

To start with, although all the subjects involved in the software treatment group applied multiple steps, variability was observed in the creativity scores of their responses. This means that merely encouraging the users to adopt an explicit

decision making model does not in any way guarantee higher levels of creativity. Managers and employees should, thus, be provided with tools that would help them break down the traditional and structured way of thinking and move towards a broader and innovative problem solution finding.

Moreover, since positive and direct correlations were found between ease of use and playfulness on one hand and creative solutions on the other, this suggests that it is critical to consider the perceptions and requirements of DSS users rather than designers in implementing even general design principles. Also, features that are related to fun and helpfulness may even be of more importance as ways to aid and motivate the user to work through conceptual difficulties. This suggests that understanding the requirements and capabilities of users and making them understand the features of the support systems provided to them would encourage them to make use of and enjoy using the new technologies.

Ultimately, a further research is recommended that would:

- examine the effect of using a CEDSS that would lead users to employ divergent thinking without the imposition of a step wise process upon the users' response creativity.
- study the effect of users' decision making process upon DSS design practice.
- test the hypothesis: A CEDSS that is perceived to have better and more qualitative decision aids than other DSS will lead to higher levels of creative decisions.
- test the hypothesis: A CEDSS that is perceived to be more enjoyable and fun to use than other DSS will lead to higher levels of creative decisions.

As a final word here, designing, developing, and implementing user friendly, easy to use and useful CEDSSs have become a pressing need of today's management and of an uncertain future. This is because creative thinking is highly important, and it should always develop to be up to the level of the changing needs of current and future problem solution finding. Managers and various users should recognize the valuable support made available by new technologies, get properly trained on how to use these support facilities, and make use of them to pave their way towards a better organizational success and a more prosperous tomorrow.

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APPENDICES:

APPENDIX A

CREATIVITY BASELINE MEASUREMENT

SURVEY ABOUT DECISION MAKING AND PROBLEM SOLVING PROCESSES

Dear Respondent,

This questionnaire is designed for you to express the procedure you follow for decision making and problem solving. This information would help us in identifying the facilities that should be provided by a computer software developed to support the decision making making and problem solving processes.

There are no right or wrong answers. Choose the answer that best shows how you feel or think about the matter. Please answer every item, do not skip any. If you are not sure of the meaning of a statement, please ask the person in charge of the survey to explain it to you.

The information you provide us will be treated with complete confidentiality. The answers will be scored by the computer according to each group of respondents. The questionnaires will be destroyed once the scores are completed.

Your answers are an important input to our survey. We highly appreciate your effort and cooperation with us.

Thanking you again for your cooperation,

Yours Sincerely,
Kamal R. Mirza

Student, Master Program
School of Business
L.A.U.

Code Nb:

After each statement, indicate with a letter the degree or extent with which you agree or disagree:

A = Strongly Agree
B = Agree
C = In between or don't know
D = Disagree
E = Strongly Disagree

Mark your answers as accurately and frankly as possible.

1- I always work with a great deal of certainty that I am following the correct procedures for solving a particular problem. ____
2- It would be a waste of time for me to ask questions if I had no hope of obtaining answers. ____
3- I feel that a logical step-by-step method is best for solving problems. ____
4- I occasionally state opinions that seem to turn some people off. ____
5- I spend a great deal of time thinking about what others think of me. ____
6- I feel that I may have a special contribution to give to the world. ____
7- It is more important for me to do what I believe to be right than to try to win the approval of others. ____
8- People who seem unsure and uncertain about things lose my respect. ____
9- I am able to stick with difficult problems over extended periods of time. ____
10- On occasion I get overly enthusiastic about things. ____
11- I often get my best ideas when doing nothing in particular. ____
12- I rely on my intuition and the feeling of "rightness" or "wrongness" when moving toward the solution of a problem. ____
13- When problem solving, I work faster when analyzing the problem and slower when synthesizing(combining) the information I have gathered. ____
14- I like hobbies which involve collecting things. ____
15- Daydreaming has provided the impetus(stimulus) for many of my more important projects. ____
16- If I had to choose from two occupations other than the one I now have, I would prefer to be a physician rather than an explorer. ____
17- I can get along more easily with people if they belong to about the same social and business class as my self. ____
18- I have a high degree of aesthetic(artistic) sensitivity. ____
19- Intuitive hunches are unreliable guides in problem solving. ____
20- I am much more interested in coming up with new ideas than I am in trying to sell them to others. ____
21- I tend to avoid situations in which I might feel inferior. ____
22- In evaluating information, the source of it is more important to me than the content. ____
23- I like people who follow the rule "business before pleasure." ____
24- One's own self-respect is much more important than the respect of others. ____
25- I feel that people who strive for perfection are unwise. ____
26- I like work in which I must influence others. ____
27- It is important for me to have a place for everything and everything in its place. ____
28- People who are willing to admit nut ideas are impractical. ____
29- I rather enjoy fooling around with new ideas, even if there is no practical payoff. ____
30- When a certain approach to a problem doesn't work, I can quickly reorient my thinking. ____
31- I don't like to ask questions that show ignorance. ____
32- I can change my interests to pursue a job or career more easily than I can change a job to pursue my interests. ____

32- I can change my interests to pursue a job or career more easily than I can change a job to pursue my interests. ____

33- Inability to solve a problem is frequently due to asking the wrong questions. ____

34- I can frequently anticipate the solution to my problems. ____

35- It is a waste of time to analyze one's failures. ____

36- Only people with unclear type of thinking resort to metaphors and analogies. ____

37- At times I have so enjoyed the ingenuity(cleverness) of a crook that I hoped he or she would go scot-free (never be arrested). ____

38- I frequently begin work on a problem which I can only sense and not yet express. ____

39- I frequently tend to forget things, such as names of people, streets, highways, small towns, etc. ____

40- I feel that hard work is the basic factor in success. ____

41- To be regarded as a good team member is important to me. ____

42- I know how to keep my inner impulses(inspiration, whim) in check. ____

43- I am a thoroughly dependable and responsible person. ____

44- I resent(dislike) things being uncertain and unpredictable. ____

45- I prefer to work with others in a team effort rather than solo(alone). ____

46- The trouble with many people is that they take things too seriously. ____

47- I am frequently hunted(pursued) by my problems and cannot let go of them. ____

48- I can easily give up immediate gain or comfort to reach the goals I have set. ____

49- If I were a college professor, I would rather teach factual courses than those involving theory. ____

50- I'm attracted to the mystery of life. ____

Thank You for Your Sincere Cooperation

Reminding You That The Results Will Certainly Be

CONFIDENTIAL

...and for Research Purpose.

APPENDIX B

SURVEY DESIGN

SURVEY ABOUT DECISION SUPPORT SYSTEMS (DSS)

Dear Respondent,

This questionnaire is designed for you to express your opinion about computer software developed to improve the decision making and problem solving processes. This information would help us in addressing the points that should be taken into consideration by designers and developers of DSS.

The statements in the questionnaire have been constructed so that your responses will reflect your attitudes and opinions. There are no right or wrong answers. The proper answer for you, therefore, is the one that best shows how you feel or think about the matter.

Please answer every item, do not skip any. If you are not sure of the meaning of a statement, please ask the person in charge of the survey to explain it to you.

The statement express a wide range of perceptions that people might have about computer use, system friendliness and ease of use, and decision support systems. The answers will be scored by the computer according to each group of respondents. It is worth mentionning that no person can be identified in this survey. The questionnaires will be destroyed once the scores are completed.

Your answers are an important input to our survey. We highly appreciate your effort and cooperation with us.

Thanking you again for your cooperation,

Yours Sincerely,
Kamal R. Mirza

Student, Master Program
School of Business
L.A.U.

DEMOGRAPHIC CHARACTERISTICS

This part of the survey is concerned with your background and work experience. This information will help identify trends in the data for different groups of managers or users. Please remember that your responses are completely confidential.

1. What is your functional area?

____ 1. Accounting	____ 6. MIS / Computer	____ 11. Mailing dep't.
____ 2. Finance	____ 7. Letter of Credit	____ 12. Telex dep't.
____ 3. Marketing	____ 8. Letter of Guarantee	____ 13. Foreign Exchange
____ 4. General Management	____ 9. Transfer dep't.	____ 14. Checks & Collections
____ 5. Personnel and HRD	____ 10. Foreign Relations	____ 15. Others(Pls. specify): _____

2. What is your level in the organization hierarchy?

____ 1. Professional staff.
____ 2. First level supervisor.
____ 3. Middle Management (Departmental Head)
____ 4. Strategic Management (Executive)
____ 5. Other (Specify) _____.

3. What is the major task that you perform?

____ 1. Deposits	____ 7. Foreign Exchange
____ 2. Proceeds of loans	____ 8. Collections.
____ 3. Savings	____ 9. Commercial Related Tasks
____ 4. Stock and Bonds	____ 10. Auditing
____ 5. Mortgage.	____ 11. Miscellaneous
____ 6. Bank Checks	____ 12. Other (Specify):_____

4. For how many years have you been employed in this organization? _____ year(s).

5. Number of subordinate(s) reporting to you: _____ subordinate(s).

6. What is the highest level of education you have completed?

____ 1. Some high school or less.	____ 4. Bachelor's degree.
____ 2. High School.	____ 5. Some graduate or professional study.
____ 3. Some College.	____ 6. Graduate or professional degree.

7. Age:

____ Under 25	____ 45-54
____ 25-34	____ 55-64
____ 35-44	____ 65 and over.

8. Gender:

_____1. Male.
_____2. Female.

COMPUTER USE

Please answer the next set of questions with regard to the computer that you are currently using at work.

Part A.

1. Personal Computer Type:
   a. Stand alone
   b. Connected to other computers or networks.

2. Is it your own computer? ____ 1. Yes. ____ 2. No.

3. Do you have free access? ____ 1. Yes. ____ 2. No.

Part B.

Are you using non-PC (Mainframe or minicomputer)?
____ 1. Yes. ____ 2. No.

Part C.

1. On an average working day that you use a computer, how much time do you spend on the system?

   1. Almost never
   2. Less than 1/2 hour
   3. From 1/2 hour to 1 hour
   4. 1-2 hours
   5. 2-3 hours
   6. More than 3 hours.

2. On the average, how frequently do you use a computer?

   1. Less than once a month
   2. Once a month
   3. A few times a month
   4. A few times a week
   5. About once a day
   6. Several times a day.

3. How long have you been using this system?
____ months ____ years.

SOFTWARE USE

Please respond to the next group of questions with regard to software packages and use. Please indicate your extent of usage and your level of expertise in the use of computer packages.

Application Name	Extent of Usage				
	Not at all				To a great Extent
1- Spreadsheets (e.g. Excel, Lotus 123, Quattro Pro...)	1	2	3	4	5
2- Word Processing (e.g. Word Perfect, Winword,...)	1	2	3	4	5
3- Data Management Packages (e.g. DbaseIII+ or IV, Access, Foxpro, Paradox,...)	1	2	3	4	5
4- Modeling Systems (e.g. IFPS)	1	2	3	4	5
5- Statistical Packages (e.g. SPSS, Minitab, Statistica, Edu-Stat, SAS-PC, STATPAK,...)	1	2	3	4	5
6- Graphical Packages (Energraphics, Chartmaster,...)	1	2	3	4	5
7- Communication Packages or Electronic Mail	1	2	3	4	5
8- Fourth Generation Language (e.g. FOCUS)	1	2	3	4	5
9- Third Generation Language (e.g. Pascal, C)	1	2	3	4	5
10- Other (please specify)_____	1	2	3	4	5

With respect to the requirements of your current job, please indicate to what extent do you use the computer to perform the following tasks.

Job Requirements	Extent of Usage				
	Not at all				To a great Extent
1- Looking for trend	1	2	3	4	5
2- Finding problems/ alternatives	1	2	3	4	5
3- Planning	1	2	3	4	5
4- Budgeting	1	2	3	4	5
5- Taking actions	1	2	3	4	5
6- Communicating with others	1	2	3	4	5
7- Controlling and giving activities	1	2	3	4	5
8- Making decisions	1	2	3	4	5
9- Historical reference	1	2	3	4	5
10- Keeping me up-to-date on activities/performance	1	2	3	4	5
11- Aiding me in adequately reporting to superiors	1	2	3	4	5
12- Aiding me in increasing productivity of my area	1	2	3	4	5
13- Aiding me in cutting cost in my area	1	2	3	4	5

COMPUTER TRAINING

Which of the following categories best describes the level of training you have had in the use of computers, both mainframe and/or microcomputers.

	None				Extremely extensive
1- General courses at a college or university	1	2	3	4	5
2- Training provided by vendors	1	2	3	4	5
3- In house company courses	1	2	3	4	5
4- Through self study	1	2	3	4	5

COMPUTER KNOWLEDGE & EXPERIENCE

The next set of questions assesses the actual experience you have working with computers and your knowledge about computers in general.

1. How many courses have you taken in computers? _____.
2. How many courses have taken in information systems? _____.
3. How long have you used Personal computers? _____ years.
4. How long have you used computers in general? _____ years.
5. How long have you participated in technical analysis and design of information systems? _____ years.
6. How long have you used financial, statistical or other models on a microcomputer or mainframe system? _____ years.

BELIEFS ABOUT COMPUTER USAGE

In this section, we would like to find out what you believe are the advantages and disadvantages of your using computers in your job.

1 = Strongly Agree
2 = Agree
3 = Uncertain
4 = Disagree
5 = Strongly Disagree

1- Using a computer could provide me with information that would lead to better decisions.	1	2	3	4	5
2- Using a computer allows me to be more independent in performing my job.	1	2	3	4	5
3- Using a computer exposes me to vulnerability of computer breakdown and loss of data.	1	2	3	4	5
4- Using a computer allows me to be more innovative by providing the opportunities for more creative analysis and outputs.	1	2	3	4	5
5- Using a computer improves my productivity on the job.	1	2	3	4	5
6- Using a computer gives me the opportunity to enhance my image in the company.	1	2	3	4	5
7- I would hesitate to use a computer because of the difficulty of integrating it with existing information systems in my work.	1	2	3	4	5
8- Using a computer can take up too much of my time in performing many tasks.	1	2	3	4	5
9- Using a computer would involve too much time doing mechanical operations to allow sufficient time for managerial analysis.	1	2	3	4	5
10- Using a computer allows me to get exposed to various games -entertainment and educational.	1	2	3	4	
11- Using a computer allows me to access, store and retrieve information easily without difficulties.	1	2	3	4	5
12- I use a computer because my supervisor wants me to use it.	1	2	3	4	5

DSS USAGE

This part of the survey is concerned with identifying the experience of the respondent in DSS usage.

1. I am a current/ past user of DSS.
   ____ Yes. ____ No.

2. I have used a DSS within the past:
   _____ less than 1 year
   _____ 1 to 2 years
   _____ 3 to 4 years
   _____ 5 years or more
   _____ N/A

3. I use the DSS:
   _____ daily
   _____ weekly
   _____ once a month
   _____ never

4. I was involved in the following phases of DSS development:
   _____ design
   _____ development
   _____ implementation
   _____ not involved

5. The results provided by the DSS with which I work are:
   _____ excellent
   _____ satisfactory
   _____ poor
   _____ N/A

6. I am satisfied with the DSS :
   _____ all the time
   _____ most of the time
   _____ some of the time
   _____ rarely
   _____ never
   _____ N/A

7. I make more effective decisions because of the DSS:
   _____ all the time
   _____ most of the time
   _____ some of the time
   _____ never
   _____ N/A

8. The training I receive in how to use the DSS was:
   _____ excellent
   _____ adequate
   _____ poor
   _____ not available.

EASE OF USE

Please answer the following questions regarding the system that you have just used by choosing one of the following answers:

1 = Strongly Agree
2 = Agree
3 = Uncertain
4 = Disagree
5 = Strongly Disagree

1- I felt confused while using the computer system.	1	2	3	4	5
2- I made a lot of errors when I used this computer system.	1	2	3	4	5
3- I think that such information systems are frustrating.	1	2	3	4	5
4- I could often pressed the on-line help and/or consult the user manual while using the computer system.	1	2	3	4	5
5- The system I used is inflexible and rigid to react with.	1	2	3	4	5
6- I believe that the manipulation of such computer systems requires a lot of my mental effort.	1	2	3	4	5
7- The system is designed in a way that made it easy for me to remember how to perform a given task.	1	2	3	4	5
8- The on-line help provides helpful guidance about how to perform a given task.	1	2	3	4	5
9- The system sometimes behaves in unexpected ways.	1	2	3	4	5
10- Overall, I found this information system easy to use.	1	2	3	4	5

BELIEFS ABOUT COMPUTER FRIENDLINESS

The following questions ask you how you would characterize yourself when you used this software. Please respond by using one of the following answers:

1 = Strongly Agree
2 = Agree
3 = Uncertain
4 = Disagree
5 = Strongly Disagree

1- Spontaneous	1	2	3	4	5
2- Conscientious	1	2	3	4	5
3- Unimaginative	1	2	3	4	5
4- Experimenting	1	2	3	4	5
5- Serious	1	2	3	4	5
6- Bored	1	2	3	4	5
7- Flexible	1	2	3	4	5
8- Mechanical	1	2	3	4	5
9- Creative	1	2	3	4	5
10- Inconsistent	1	2	3	4	5
11- Curious	1	2	3	4	5
12- Intellectually inactive	1	2	3	4	5
13- Inquiring	1	2	3	4	5
14- Routine	1	2	3	4	5
15- Playful	1	2	3	4	5
16- Investigative	1	2	3	4	5
17- Constrained	1	2	3	4	5
18- Unoriginal	1	2	3	4	5
19- Examining	1	2	3	4	5
20- Uninventive	1	2	3	4	5
21- Inquisitive	1	2	3	4	5
22- Questioning	1	2	3	4	5

ATTITUDE TOWARDS IDEAFISHER

Please consider the following descriptive statements regarding you and the decision support system (DSS) that you just used. Please circle the number that best matches with your response.

1 = Strongly Agree
2 = Agree
3 = Uncertain
4 = Disagree
5 = Strongly Disagree

1- This DSS majorly supports highly structured decisions.	1	2	3	4	5
2- This DSS majorly supports semi-structured decisions.	1	2	3	4	5
3- This DSS majorly supports unstructured decisions.	1	2	3	4	5
4- This DSS provides support for upper management.	1	2	3	4	5
5- This DSS provides support for middle management.	1	2	3	4	5
6- This DSS provides support for lower management.	1	2	3	4	5
7- This DSS helps in identifying potential problems.	1	2	3	4	5
8- This DSS helps in identifying opportunities.	1	2	3	4	5
9- This DSS is useful for analyzing alternatives.	1	2	3	4	5
10- This DSS is useful for choosing among alternatives.	1	2	3	4	5
11- I think that my usage of DSS is interactive.	1	2	3	4	5
12- This DSS supports the area of decision making.	1	2	3	4	5
13- This DSS provides supports for many diverse problem areas.	1	2	3	4	5
14- This DSS supports only one specific type of problem.	1	2	3	4	5
15- The user interface subsystem provided by this DSS is flexible.	1	2	3	4	5
16- This DSS helps users with findings new directions or strategies for solving a problem.	1	2	3	4	5
17- This DSS provides users with meaningful, helpful and encouraging responses that would increase task motivation.	1	2	3	4	5

APPENDIX C

IDEAFISHER PROCESS MODEL

Problem Solving Questions - Evaluating a New System Establishment.

Content: There are 9 main questions and 25 total questions.

What facts seem pertinent to your assignment?
By solving the problem, what do you stand to gain? To lose?
What is the WORST that can happen if the problem is not solved?

What is now your primary aim/goal/objective?
And What needs to be done?

How will you know when you have achieved your purpose? What are your criteria of success? For example:
How will people feel about their work?
How will your own work be easier or more enjoyable?
What will you no longer be concerned about?

What obstacles must you overcome to reach your objective(s)?

What resources can you use to overcome your obstacles and reach your objectives?
What resources of time, people, information, money, and equipment do you now believe are necessary?

What ideas do you have for using your resources to overcome your obstacles and reach your objectives?

CONCENTRATING ON THE ENVIRONMENT:
How can you alter the environment to make the use of objects and materials more efficient and effective? Consider:
How can efficiency, effectiveness, and morale be improved by changing some activities?
CONCENTRATING ON THE PEOPLE INVOLVED:
How can you get more accomplished with fewer people?
Does this mean increasing the number of people involved, or educating them for the task?
How can you motivate people to increase their moral and productivity?

What will you do? What edited and translated ideas have you chosen to implement?

Have you clearly communicated the results you expect for each person involved?

How will you test your decision?

Does your solution have sufficient potential?
Is the timing right?
Have you taken into account the varied viewpoints of the people involved?
Is your solution cost-effective?

"After answering your selected questions"

Please state a comprehensive summary of your overall solution to the given problem.

THANK YOU FOR YOUR COOPERATION.
A SUMMARY OF THE RESULTS WILL BE SENT TO YOU ONCE THE RESEARCH IS OVER.

APPENDIX D

CASE PROBLEM

Case Problem

The banking sector nowadays is witnessing a state of high complexity. Such a state makes it necessary for banks to think of programs that would insure higher levels of customer satisfaction. Taking this fact into consideration, your bank is on the verge of developing a customer complaint-system. However, employees are quite reluctant to implement the system. The reasons given are the time and inconvenience, as well as concern in principle about altering the way work (including customers' relations, control, responsibilities, and others) is usually being handled. Your boss has asked you to suggest a plan for evaluating the system and dealing with the employees.

* * *

APPENDIX E

MATCHING IDEAFISHER PROCESS MODEL WITH AMABILE'S MODEL

The phrases between brackets are referred to Amabile's Model directly matched to the **bold** phrases which are referred to IdeaFisher Process Model. The questions in *italic* are the main questions asked to participants. (To see all detailed questions, refer to Appendix C, p.252.)

(Task Presentation/Preparation)	
1) **Gather Candidate Facts**	*What facts seem pertinent to your assignment?*
2) **Determine Objectives**	*What do you want to happen?*
3) **Assess Relevance & Validity**	*What is the relevancy and validity of each of your candidate facts?*
4) **Identify Obstacles**	*What hindrances must you overcome to reach your objective(s)?*
5) **Inventory Resources**	*What resources can you use to overcome your obstacles and reach your objectives?*
(Response Generation)	
6) **Generate Ideas**	*What ideas do you have for using your resources to overcome your obstacles and reach your objective(s)?*
(Response Validation)	
7) **Edit and Translate Ideas**	*Edit and translate your ideas into action terms.*
(Outcome)	
8) **Make Decisions**	*What will you do? What edited and translated ideas have you chosen to implement?*
9) **Test decisions**	*How will you test your decision?*

APPENDIX F

PROFILE OF PARTICIPATING JUDGES

Judge	Occupation	Age	Field of Specialization	Years of Experience
Judge 1	University Professor	41-50	International Marketing	25
Judge 2	University Professor	41-50	Marketing Management	20
Judge 3	University Professor	51-60	Management	15
Judge 4	University Professor	30-40	Computer Science	10
Judge 5	Executive	51-60	Human Resource and Development	30

APPENDIX G

SURVEY VARIABLES

NAME	Long Name (label, formula, or link)
S0FTRMNT	Software Treatment
BASECRTV	Creativity Baseline
DECS_STP	Decision Steps
TIMECOMP	Time completion of the problem
JUDGE1	Judge1
JUDGE2	Judge2
JUDGE3	Judge3
JUDGE4	Judge4
JUDGE5	Judge5
RECODRES	Recoded Creativity of Responses
FNCARA1	Accounting
FNCARA2	Finance
FNCARA3	Marketing
FNCARA4	General Management
FNCARA5	Personnel & HRD
FNCARA6	MIS/ Computer
FNCARA7	Letter of credit
FNCARA8	Letter of Guarantee
FNCARA9	Transfer departement
FNCARA10	Foreign relations
FNCARA11	Mailing departement
FNCARA12	Telex departement
FNCARA13	Foreign exchange
FNCARA14	Checks & Collections
FNCARA15	Others
IF15WHAT	
ORGLEVEL	Organizational level
IF5WHAT	
TSKPRF1	Deposits
TSKPRF2	Proceeds of loans
TSKPRF3	Savings
TSKPRF4	Stock and Bonds
TSKPRF5	Mortgage
TSKPRF6	Bank Checks
TSKPRF7	Foreign Exhange
TSKPRF8	Collections
TSKPRF9	Commercial Related Tasks

NAME	Long Name (label, formula, or link)
TSKPRF10	Auditing
TSKPRF11	Miscellaneous
TSKPRF12	Other
IF12WHAT	
YRSEMPLY	Years employed in the organization
NUMSUBRD	Number of subordinates
EDUCLEVL	Highest level of education
AGE	Age
SEX	Gender
PCTYPE	Personal Computer Type
OWN	Computer pocession
FREEACES	Free Access
NONPC	Using Mainframe or minicomputer
EXTNTUSE	Time I spend on the system per average working day
FREQUSE	The frequency of using a computer
TIMEUSE	Time duration of using this system
_SFTUSE	Number of software packages I use
SFTUSE1	Spreadsheets
SFTUSE2	Word Processing
SFTUSE3	Data Management Packages
SFTUSE4	Modeling systems
SFTUSE5	Statistical Packages
SFTUSE6	Graphical Packages
SFTUSE7	Communication or E. Mail Packages
SFTUSE8	Fourth Generation Languages
SFTUSE9	Third Generation Languages
SFTUSE10	Other Packages
IF10WHAT	Other Software or packages
_TASKS	Number of tasks performed by using the computer
TASK1	Looking for trend
TASK2	Finding problems/ alternatives
TASK3	Planning
TASK4	Budgeting
TASK5	Taking actions
TASK6	Communicating with others
TASK7	Controlling and giving activities
TASK8	Making decisions
TASK9	Historical reference
TASK10	Keeping me up-to-date on activities/ perfromance
TASK11	Aiding in adequately reporting to superiors
TASK12	Aiding in increasing productivity of the area
TASK13	Aiding me in cutting cost in area
TRAINING	Provided with training sessions
TRAIN1	General courses at college or university
TRAIN2	Training provided by vendors
TRAIN3	In house company courses
TRAIN4	Through self study
_COMPCRS	Courses taken in computers
_INFSCRS	Courses taken in information systems
YRPCUSE	Years using PC
YRCOMUSE	Years using computers in general
YRPTANDS	Years participating in technical analysis and design of information systems
YRUSMDEL	Years using financial, statistical or other models on a microcomputer or mainframe system

NAME	Long Name (label, formula, or link)
BFCUSE1	Provide information leading to better decisions
BFCUSE2	Be more independent in performing job
BFCUS3_R	Using a computer exposes me to vulnerability of computer breakdown and loss of data. (R)
BFCUSE4	More innovative..., more creative analysis and outputs
BFCUSE5	Improves productivity on the job
BFCUSE6	Gives opportunity to enhance self image in the company
BFCUS7_R	Hesitate because of difficulty of integrating it with existing information systems in work (R)
BFCUS8_R	Using a computer can take up too much of my time in performing many tasks. (R)
BFCUS9_R	Using a computer would involve too much time doing mechanical operations to allow sufficient time for managerial analysis. (R)
BFCUSE10	Using a computer allows me to get exposed to various games -entertainment and educational.
BFCUSE11	Using a computer allows me to access, store and retrieve information easily without difficulties.
BFCUS12R	I use a computer because my supervisor wants me to use it. (R)
DSSCPUSR	Current /past user of DSS
WHENUSE	Time period of using the DSS
FRQDSUSE	Frequency of using a DSS
DSSINVDV	Involvement in phases of DSS
DSSRESLT	Results provided by the DSS with which I work
DSSATISF	Satisfaction with the DSS
DSSEFDEC	Make effective decision because of the DSS
DSSTRAIN	Training received in how to use the DSS
EU1_R	I felt confused while using the computer system. (R)
EU2_R	I made a lot of errors when I used this computer system. (R)
EU3_R	I think that such information systems are frustrating. (R)
EU4	I could often pressed the on-line help and/or consult the user manual while using the computer system.
EU5_R	The system I used is inflexible and rigid to react with. (R)
EU6_R	I believe that the manipulation of such computer systems requires a lot of my mental effort. (R)
EU7	The system is designed in a way that made it easy for me to remember how to perform a given task.
EU8	The on-line help provides helpful guidance about how to perform a given task.
EU9_R	The system sometimes behave in unexpected ways. (R)
EU10	Overall, I found this information system easy to use.
BACF1	Spontaneous
BACF2_R	Conscientious (R)
BACF3_R	Unimaginative (R)
BACF4	Experimenting
BACF5_R	Serious (R)
BACF6_R	Bored (R)
BACF7	Flexible
BACF8_R	Mechanical (R)
BACF9	Creative
BACF10	Inconsistent
BACF11	Curious
BACF12_R	Intellectually inactive (R)
BACF13	Inquiring
BACF14_R	Routine (R)
BACF15	Playful
BACF16	Investigative
BACF17_R	Constrained (R)

NAME	Long Name (label, formula, or link)
BACF18_R	Unoriginal (R)
BACF19	Examining
BACF20_R	Uninventive (R)
BACF21	Inquisitive
BACF22	Questioning
ATIDF1_R	This DSS majorly supports highly structured decisions. (R)
ATTIDF2	This DSS majorly supports semi-structured decisions.
ATTIDF3	This DSS majorly supports unstructured decisions.
ATTIDF4	This DSS provides support for upper management.
ATTIDF5	This DSS provides support for middle management.
ATIDF6_R	This DSS provides support for lower management. (R)
ATTIDF7	This DSS helps in identifying potential problems.
ATTIDF8	This DSS helps in identifying opportunities.
ATTIDF9	This DSS is useful for analyzing alternatives.
ATTIDF10	This DSS is useful for choosing among alternatives.
ATTIDF11	I think that my usage of DSS is interactive.
ATTIDF12	This DSS supports the area of decision making.
ATTIDF13	This DSS provides supports for many diverse problem areas.
ATDF14_R	This DSS supports only one specific type of problem. (R)
ATTIDF15	The user interface subsystem provided by this DSS is flexible.
ATTIDF16	This DSS helps users with findings new directions or strategies for solving a problem.
ATTIDF17	This DSS provides users with meaningful, helpful and encouraging responses that would increase task motivation.
RECOD161	Recode beliefs about computer use average
RECOD163	Recode Ease of use average
RECOD165	Recode Beliefs about computer friendliness Average
RECOD167	Recode Attitude about IdeaFisher Average
RCODTRAV	Recode Training Average