PROCESS TO BUILD AN EFFICIENT DECISION SUPPORT SYSTEM
–IDENTIFYING IMPORTANT ASPECTS OF A DSS

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Abstract

Decision support systems will be an asset dealing with the complexity involved in many decision situations for companies, organizations and societies by integrating different aspects into a holistic pattern. That creates a close relationship to systems science since systems thinking promote holism as a profitable way to handle complexity. The ideal decision support system should not be used to make automatic decisions but to assist a human being in the decision process. That process is sometimes described as a model consisting of the phases, intelligence, design and choice. Intelligence is needed to understand the situation and find the information that is needed to continue the process. Design means designing different alternatives and in the last phase, choice, the alternatives are evaluated and the best alternative is chosen. A good decision support system should give the user assistance through the whole process. The main purpose of our research is identifying the process of building an efficient Decision Support System. The target groups are the people who are working with multinational companies that are specialized in constructing and delivering decision support systems to end users. The number of target companies involved in this study is only two and is limited Indian Multinational companies. The theoretical study helps in identifying the basic characteristics of a decision support system, exploring the types of decision support systems used in current organizations, resulting if there is any particular standard for constructing DSS today and signifying approach for constructing a user friendly decision support system by analyzing the existing literature related to DSS. At the same time, empirical study advances the research problem from a practical angle. The conclusion for this research is a comprehensive report in relation to the varieties of Decision Support Systems used in today's organizations, qualities that a decision support system ought to possess and suggested process to be implemented for building an efficient decision support system.

Acknowledgements

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1 Introduction

The introduction gives the plan of research area and describes the research purpose. It also introduces the research questions which are conceptions for the theoretical study and empirical study.

1.1 Background of the Study

Complex Decision making is the difficulty faced by almost all the organizations i.e. small to large organizations, regularly. A process of choice results in decisions. It also needs to be taken into account whether the decisions are for technical or operational. The stakeholder participating in the process makes decision making even more complex and time consuming. A dedicated and efficient decision support system allows us to save time.

Managers have been using computers, business databases and models to take decisions. Use of decision support systems has become a business necessity and also an opportunity to gain competitive advantages."Good decision making means we are informed and have relevant and appropriate information on which to base our choices among alternatives. In some instances we take decisions either using existing or historical data, while some times we collect information. The quality of decision depends on adequacy of the available information, the quality of the information and the number of options and the appropriateness of the modeling effort available at the time of decision". (Vicki Sauter, 2010)

 DSS Resource.com is a resource created and maintained by Dan Power. It mainly contains comprehensive entries about the history of DSS. According to DSS resources.com a decision support system is an interactive PC based system or subsystem intended to help decision makers use data, documents, communication technologies, knowledge and models to identify and solve problems, complete decision process starts and make decisions. Decision support system can be referred as a general term for computer applications that support a person or a group to take decisions. Wide availability of resources and increased DSS users encourage for their advancements in research and development of new tools. (Power, 2007)

The Decision making process is "fundamentally one of both recognizing and solving problems along the way towards the objective of producing a decision" (Holsapple & Whinstone, 1996, pp-73). Structured decisions have proper steps form solving problems and reaching a decision. While unstructured decisions have only few steps. The Modern Decision support systems make use of internal and external sources of data, distributed databases, real-time information, models and intelligent techniques. (Emo & Kim, 2006). In 2002, Shim proposed that intelligent decision support systems and software agents would interact with the user in a distributed environment over the web.

"A Decision Support System is a convenient and compliant PC based information system which makes use of decision regulations, representations and model

foundation united with wide-ranging databases along with the decision maker's personal approach, to carry out definite decisions during problem resolving. Therefore, Decision Support System supports composite decision making and add to its efficiency". (Janakiraman, 1999)

"The thought of decision support systems (DSS) have been accepted by the organizational decision makers as a composite knowledge processor, having multiple human and PC components planned according to roles and relationships that define their individual's contributions in the concern of resolving decision problems faced by the organizations" (Bonczek , 1979). Every component (human or machine) is considered as a knowledge processor which has the capability of solving some kind of problems either on its own or by organizing the efforts of other components either passing or receiving messages from them. The main idea in this early framework are the concepts of distributed problem solving by an individual and machine knowledge processors, interaction among the problem solvers, and bringing together of interconnected problem-solving efforts for providing a solution to decision problem(s). Also noting those DSSs are means for problem solving, communication, and synchronization, Hackathorn and Keen (1981) maintain that organization support concentrates on providing facilities for the multiple participants engaged in a sequence of operations of an organization task.

Consider a simple situation, a decision maker in an organization is working on a decision, but there are chances that many other possibilities may arise. For instance, a decision maker may work on a series or planned and organized collection of minor decisions that leads to a major decision, or the decision maker may be engaged in making multiple parallel decisions that can affect each other or, in their totality, significantly affect organizational performance without being tied to an overall grand decision. Decision support systems can be developed to assist in any of these cases.

As there are many kinds of organizations, in the same way there are also many kinds of DSS. However, every organization decision support system is an instance of a Multi-participant Decision Support Systems (MDSS). It supports a decision maker comprised of multiple participants belonging to one organization – corporate or public, formal or informal, actual or virtual, large or small. These participants are responsible for taking a decision on behalf of that organization. All of the participants or only few of the participants may have authority over the decision. There can be some participants who share authority over the decision. There can be some participants who do not have authority over the decision, but can influence the decision because of the unique knowledge or knowledge processing skills they possess or because of their key position in the network of participants. Thus, organizational decision support systems are Multi-participant Decision Support Systems proposed to support participants organized into relatively complex structures of authority.

1.2 Statement of problem

Decision support systems are vital to any organization in simplifying the decision making process. However, there have been no specific standards for building a

decision support system. Decision Support Systems will be an asset dealing with the complexity involved in many decision situations for companies, organizations and societies by integrating different aspects into a holistic pattern. That creates a close relationship to systems science since systems thinking promote holism as a profitable way to handle complexity. The ideal decision support system should not be used to make automatic decisions but to assist a human being in the decision process. That process is sometimes described as a model consisting of the phases: intelligence, design and choice. Intelligence phase is required to know the state and discover the information which is necessary to maintain the process. Design means scheming diverse alternatives and in the last phase, choice, the options are assessed and the best option is chosen. A good decision support system be supposed to give user assistance in the course of the whole process.

Diverse people have different approach to make their decisions. A decision support system ought to therefore be likely to adjust to the characteristics of a particular user.

1.3 Purpose of the study

Decision support systems are PC based systems intended for interactive utilization by users or decision makers having the capability to handle the progression of interaction as well as the operations executed in an organization. Although, there exists a definite standard for constructing a resourceful decision support system and user responsive till date. This study aspires at discovering the characteristics a decision support system ought to have to assist the decision process for a specific user in addition to propose a systematic process for building an efficient decision support system. The study aims at attaining the following research objectives.

Primary Objectives

This study aims at identifying the important aspects for building an efficient Decision Support System

Secondary Objectives

- To study in detail the architecture of a Decision Support System.

- To identify the types of decision support systems used in today's organizations

- To explore the characteristics to be possessed by an efficient Decision Support System

- To understand the basic concept of Decision support systems

- To suggest the process to be undertaken in order to build an efficient Decision Support System

1.4 Research questions

The research will aim mainly in answering the following question:-

1. How can an efficient decision support system be built?

In order to find the answer for this question, the following sub questions will have to be answered:

a) What is a Decision Support System?

b) What does a decision support system look like?

c) What are the Types of decision support systems used in today's organizations?

d) What are the characteristics to be possessed by an efficient Decision Support System in order to facilitate the decision process?

e) What should be done in order to construct an efficient Decision support system?

1.5 Target group

In this research, the target groups are the people who are working with multinational companies that are specialized in constructing and delivering decision support systems to end users. This thesis is written with the intention of identifying best practices in building DSS and suggests strategies to be adapted by developers in constructing efficient and user-friendly DSS.

1.6 Limitations

- This study is limited to Indian multinational organizations, which restricts the scope of general applicability of the concepts, processes and outcome of the study.
- The number of target companies involved in this study is only two

1.7 Expected outcome

The expected outcome for this research is detailed report about the types of Decision Support Systems used in today's organizations, characteristics that a decision support system must possess and suggest a process to be taken up for building an efficient decision support system.

1.8 The authors' own experience and background

The Authors' own experience and background in Decision Support Systems is limited to relevant books and journals, lectures and internet. Before starting this research the Authors had submitted a paper on Organizational Decision Support Systems for the subject area Human Information and System. The theory is mainly based on theoretical materials and empirical study results but not based on our own experience.

1.9 Structure of the thesis

As the figure shows the thesis is divided into six different chapters, where

1. Chapter 1 comprises of the introduction to the study, containing, research background, aims, objectives, significance and limitations of the study. Besides, this chapter has the research questions and problem statement.

2. Chapter 2 explains in detail the research methodology such as research design, sample design, data collection techniques, data analysis and interpretation techniques.

3. Chapter 3 is the literature review containing the concepts of Decision Support System based on the previous findings of researchers in the past along with the research gap that needs to be filled.

4. Chapter 4 analyzes and interprets the data collected through methodology proposed in chapter 2.

5. Chapter 5 has the presentation of findings as observed from chapter 4.

6. The final chapter 6 consists of the conclusion obtained from connecting the proposed research objectives with facts inferred from findings in chapter 5. This chapter also has strategies and recommendations for future research.

Besides, the research is supported by bibliography, that lists out the sources referred for undertaking this research and appendices that contains tools such as questionnaires, sample responses, etc., collected for this research. The following figure shows the structure of this thesis
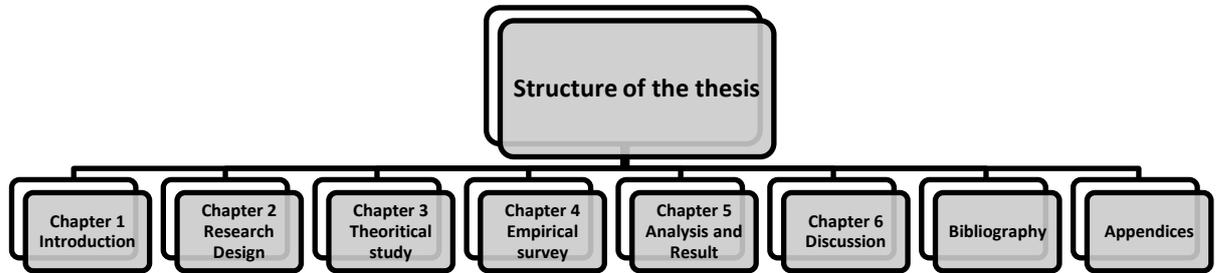
Figure 1: Structure of the thesis

2 Research Methodology

2.1 Research Perspective

Research perspective is the way followed by the researcher in order to carry out the research work. This part shows the research perspective taken up by the researcher. The following segments clarify about the sampling techniques, sampling plan, data collection method, and data analysis and interpretation methods implicated in the research.

every scientific research is carried out by using any of the following two research perspectives. They are (1) Positivism (2) Hermeneutics. Positivism aims to suggest explanations most important to control and predictability. This type of research is carried out all the way through application of statistical tools as well as experiments. Positivism is also well-known as quantitative research. Quantitative Research at primary varies on quantitative data gathering furthermore tracks the further characteristics of quantitative research pattern. Since the center of interest is on hypothesis testing and theory testing (Caputi 2001; Holloway 1997), quantitative research method mainly follows confirmatory scientific technique.

Quantitative research is usually regarded as being exclusively precise, justifiable as well as scientific and exact information is revealed based on data. In the direction of stating one's hypothesis furthermore then testing those hypotheses by means of empirical data to observe if they are supported is a primary importance taken into account by the Quantitative researchers.

Hermeneutics is recognized with the type of textual study as well as is apprehensive with the methodological analysis of diverse forms of text. Hermeneutics is also well-known as qualitative research. Qualitative research is a type of social investigation of which center of attention is on the practice people understand and formulate sense of their knowledge along with the world within which they are living. Numeral methods exist within the wider structure of this kind of research however the majority of these contain the similar intend to realize the social truth of individuals, groups as well as traditions. Researchers exercise qualitative approaches to investigate the manners, perceptions and skills of the citizens they study. The foundation of qualitative research lies within the interpretive method towards social inquiry. Qualitative research is characteristically presented in usual settings furthermore draw on multiple approaches that value the humanity of the contestants in the study. It focuses on the framework, is emergent and evolving and is necessarily interpretive.

Qualitative researchers preserve and incline to view communal worlds as composite as well as complete, employ in organized expression on the behavior of the research. They continue to be sensitive to their personal biographies or social uniqueness and how these outline the research and depend on complex way of thinking that progresses based on logical arguments among conclusion and orientation.

The research strategy adapted in our research is ***hermeneutics***. In this research a qualitative study is done by collecting data from two different multinational companies that are experts in designing decision support systems and interpreting the same.

2.2 Research Strategy

A research strategy gives a reason, or else collection of measures for responding to research questions mainly 'what' and 'why' queries (Blaikie N 2010). A variety of methods for performing this task have emerged due to growth in social sciences. The selection of research approach or a mixture of them forms the subsequent most significant design decision

A research design must contain a short explanation of the research plan or plans that have been elected and validation for choosing in conditions of its/their correctness for the duty of responding to the research questions. It is pleasing to formulate clearly the epistemological and ontological theories required in the selection of research plan or plans as they have a behavior on how to employ the process of investigation and information gathering will be understood. According to Wolcott H F (1990) a research design behaves as a map, construction and approach to investigate to get responses to research queries or troubles. The preparation is the fulfill plan or agenda of the research. It comprises a sketch out of what the researcher will do from writing the theories and their prepared inference to the last investigation of data. A conventional research plan is a design or complete plan for how a research lessons is to be done, set variables so that they can be designed, selecting a test of interest to study assembling information to be used as a basis for testing theory and investigating the outcome. A research plan is a technical sketch that is assumed by the researcher to give response for questions genuinely, impartially, correctly and reasonably. According to Festinger D (2010) research plan has two major roles. The primary one speak about to the recognition and/or growth of actions and logistical planning necessary to commence a learning and the secondary one highlights the meaning of quality in these actions to make sure their strength, impartiality and correctness.

To classify solutions to the research queries, ***descriptive research*** is used in this learning. This learning uses descriptive research because a complete investigation of type of decision support systems used in current organizations and their distinctiveness is to be prepared as an element of this research. Besides, this research suggested an organized way of constructing an efficient decision support system and transporting it to the consumers. Descriptive research engages challenge to identify or calculate a specific occurrence regularly by challenging to calculate approximately the power or strength of an actions or the bond among two (Dane F C., 2011). Rather than evaluating whether or not something is obtainable on descriptive strategies absorb review accurately what is taking place.

The research consists of theoretical study as well as an empirical study. The theoretical study is done using book/text analysis and the empirical study involves qualitative method. In this research theoretical study assist in recognizing the basic characteristics of a decision support system, searching the types of decision support systems used in today's organizations, discovery if there is any particular standard for

constructing DSS currently and telling plans for constructing an user responsive decision support system by investigating the existing literature associated to DSS. At the same time, empirical study draws near the research problem from a practical perspective. In this research, theoretical study is used to find the answers related to constructing a user responsive decision support system from a theoretical point of view. In addition, empirical study finds answers for the questions by gathering observations of public who are in fact drawn in constructing DSS as well as delivering to consumers. Empirical study gives an overview of practical challenges involved in constructing DSS that is user-responsive.

2.3 Data collection procedures

Data collection plays a vital role in carrying out any technical research. In every study, the two necessary categories of data drawn in are the primary data and secondary data. The data collection techniques vary for both theoretical and empirical studies involved in this research. The next part makes clear the same:

2.3.1 Primary Data

Primary data are produced by the researchers or a researcher who is/are liable for the plan of the learning and the gathering, investigation and exposure of the data (Ketchen, 2005).   New information is used for responding particular research queries. The researcher can illustrate how and why they were collected. Primary data is collected from various sources and they are illustrating by the truth that they are the outcome of straight contact among the researcher with the source. Primary data are produced by the request of particular methods and as researchers have power over the manufacturing and investigation they are in a situation to assess their quality.

2.3.2 Secondary Data:

Secondary data are unrefined data that have previously been cumulated by someone else either for some common in sequence purpose such as administrative survey or new officer statistics or for an explicit research project. In both of these possessions the actual point of gathering such information might not be similar to secondary customer mostly in the folder of an earlier research project. According to Lancaster G (2005), the utilization of secondary information is frequently referred to secondary investigation. Now it is common for information sets to gather and make obtainable for investigation by new researchers.

Theoretical study: Text analysis

The theoretical study utilizes the data composed from a technique known as book investigation. Travers M (2001) says that comfortable investigation is the basic given name for book investigations that includes balancing, complementary and classifying an amount of information in organizes to test theories. It is also the procedure of arranging and combining description qualitative information according to topic and model. It is a method for examining in print or spoken message in an organized and objective style.

The researcher has assumed the similar method. The researcher has composed primary data connected to Decision Support Systems and their custom by the builders who constructed the same. The secondary data for text interpreting is composed from journal and books that converse about "Decision Support System" have many connotations, based on Steven Alter's (1980) pioneering research. We can recognize the following three major characteristics. (1) DSS are planned particularly to help decision procedure (2) DSS must support relatively than make routine decision making, and (3) DSS must be able to react fast to the varying necessities of decision makers. (Janakiraman, V. S. 1999. Decision support systems; Kulkarni, U. 2007Decision Support Systems, Prentice Hall, New Delhi,; Decision Support for global enterprises, Springer, New Delhi), their design, implementation and usage. We must also contain a basic knowledge on Organizational Decision Support System George, J.F., "The conceptualization and Development of Organizational Decision Support Systems, "Journal of Management Information Systems", 1991. The journals and books are chosen after reading, which are linked to decision support systems published by a range of writers and researchers and also the course books.

Empirical study: Questionnaires

The empirical research largely makes use of primary data and the data collection method concerned in this learning is survey. According to Blessing L T M (2009) survey is used to gather feelings, attitude, view, reason, etc from group about history, current or upcoming details and actions by putting questions. A particular center is on data that cannot be taken into supervision using surveillance or synchronized expression and on data about the past that was not captured. Surveys have been used for gather two major principles kind of data that respondents are set to supply details and view.

Primary data in this research for empirical study is composed from six experts working in two different Indian companies respectively that are specialized in building and delivering decision support systems to organizations. The data is collected by distributing questionnaire to them through e-mails. Since this is a qualitative study, open-ended questionnaires are used. Secondary data for theoretical study is collected from research papers, books and journals related to decision support systems that have been published by various authors and researchers.

2.4 Sampling selection

The data for qualitative research is collected from two companies located in Karnataka, India and pioneers in delivering information system solutions to end users. The primary data is collected from employees designated as project managers in the following two companies.

- Aalpha Information Systems (India) Pvt. Ltd
- Sunquest Information Systems (India) Pvt. Ltd.

The sample size for the survey is 6, 3 belonging to each organization.

The type of sample design used for this study is ***convenience sampling*** (explained in section 4.2).

2.5 Data analysis procedures

Hermeneutics research is used to offer good narrative descriptions of happening that improves understanding with words. Qualitative research can produce helpful and useful information. Qualitative research concentrates on in detail considerate of public and human behavior and the causes at the back such actions. Qualitative research accomplishes no differentiation among minor distinctions as well as big level quantitative research. Qualitative researchers fascinated in comprehending, investigating latest thoughts, along with determining model and conduct. Qualitative investigation is seldom better in identifying small troubles so as to get away without been observed in quantitative study. Data analysis within a qualitative research starts almost immediately succeeding to data compilation as the researcher verifies operational assumption, unexpected consequences as well as the resembling (Lindlof T R 2010; William W, 2009). In reality, within a qualitative research, data compilation along with data analysis generally run mutually in addition to a lesser amount of data is collected; further investigation is created, as the research advances. Data analysis engages arranging, summarizing, incorporating as well as producing. Analytical description behaves as the base for qualitative research. In this research, empirical study is done by conducting a qualitative analysis of responses collected from two topmost companies in India, that are experts in building and delivering decision support systems to end-users. The data collected from companies that build and deliver decision support systems are examined by interpreting the statements and opinions specified by them.

The primary data derived in the research will be tested for their uniformity and accurateness by comparing several similar works of researchers. The secondary data collected using questionnaire will be analyzed to find out if there are any specific standards for building organizational decision support systems.

2.6 Strategies for validating findings

Reliability and validity be two essential constraints with the purpose of shaping the value of the research carried out. Though, reliability as well as validity is primary concern within quantitative research furthermore do not cling to a significant position within qualitative research. Relatively the four factors that are of most significance in estimating the value of qualitative research are credibility, transferability, dependability and conformability (Guba and Lincoln, 1994, pp 234).

2.6.1 Credibility:

"Credibility depends more on the richness of the information gathered and on the analytical abilities of the researcher rather than on sample size" (Patton, 1990). Credibility is a way of ascertaining with the aim of making the results of the

[11]

qualitative research believable. Data has been collected by the researcher only from organizations that have a good reputation and expertise in building and delivering decision support systems to end users in order to establish the credibility of the research. The methods that concentrate on credibility comprise section of the unprocessed data accessible for others to examine, in addition to the employ of "member checks" during which respondents will be requested to substantiate the results (Lincoln and Guba 1985, pp 313, 316).

2.6.2 Transferability:

"Transferability denotes the degree to which the results of the qualitative research can be generalized or transferred to other contexts and settings" (Trochim and Donnelly 2007, pp 149). The researcher establishes transferability in the research by simplifying the conclusions to construct decision support systems which can be utilized by all kinds of organizations, irrespective of their size, structure and core competency.

2.6.3 Dependability:

Dependability is quite similar concept to the concept of reliability in quantitative research. Dependability is mainly concerned whether the repeated use of the research will give in the identical results the same as it was while the research was carried out for the first time. As qualitative research permits flexibility and liberty of the respondents it is hard to foresee the point of dependability. Nevertheless, the researcher has tried to establish dependability by maintaining the record as well as additional data obtained in a data storage system. "Since there can be no validity without reliability (and thus no credibility without dependability), a demonstration of the former is sufficient to establish the latter" (Lincoln and Guba 1985, pp 316)

2.6.4 Conformability:

"Conformability requires the researcher to show the way in which interpretations have been arrived at" (Koch 1994, pp 978). In this research the researcher presents the raw data collected from the survey respondents to ensure conformability.

2.7 Result presentation method

Representing the data gathered is as obligatory as collecting them, to make a research meaningful. The key method of presenting results in this research is writing. All results are put in writing in order to enhance readability and all significant theories and definitions are accompanied by appropriate references. Besides text, this research work has also contains tables, charts and figures wherever necessary. The researcher has adopted Harvard referencing style in order to reference contents of this research report.

3 Theoretical study

3.1 Key concepts

The key concepts in this paper are the following definitions.

Decision Support System (DSS)
A Decision Support System is a computer based system which helps Decision makers in taking decisions in order to get better quality of decision.

Decision Making
Decision making can be regarded as the cognitive process resulting in the selection of a course of action among several alternative scenarios. (Wikipedia 2011)

Business Intelligence
Business Intelligence is to describe a set of concepts and methods to improve business decision making by extracting and analyzing data from database. (Howard Dresner)

Expert Systems
It is an Artificial Intelligence system with specialized problem-solving expertise. The expertise consists of knowledge about a particular domain, understanding of problems within that domain, and skill at resolving a specific problem. Expert system technologies are commonly used to build knowledge driven DSS. (Daniel Power)

Information Technology
Information Technology can be defined as a collection of computer hardware, software, database, networking and telecommunication devices that helps the organization to manage the business process more effectively and efficiently (Bhel, 2009).

Organizational Decision support systems
Organizational Decision support systems are new of decision support system (DSS) they focus on the organization rather than the individual or group.

3.2 Subject areas relevant for the research

The theoretical study is the chapter that explains answers to research questions by exploring existing literature and interpreting it. The figure given below illustrates the relationship between the sections present in this chapter and the research questions. The diagram also represents the relationship between different subject areas.
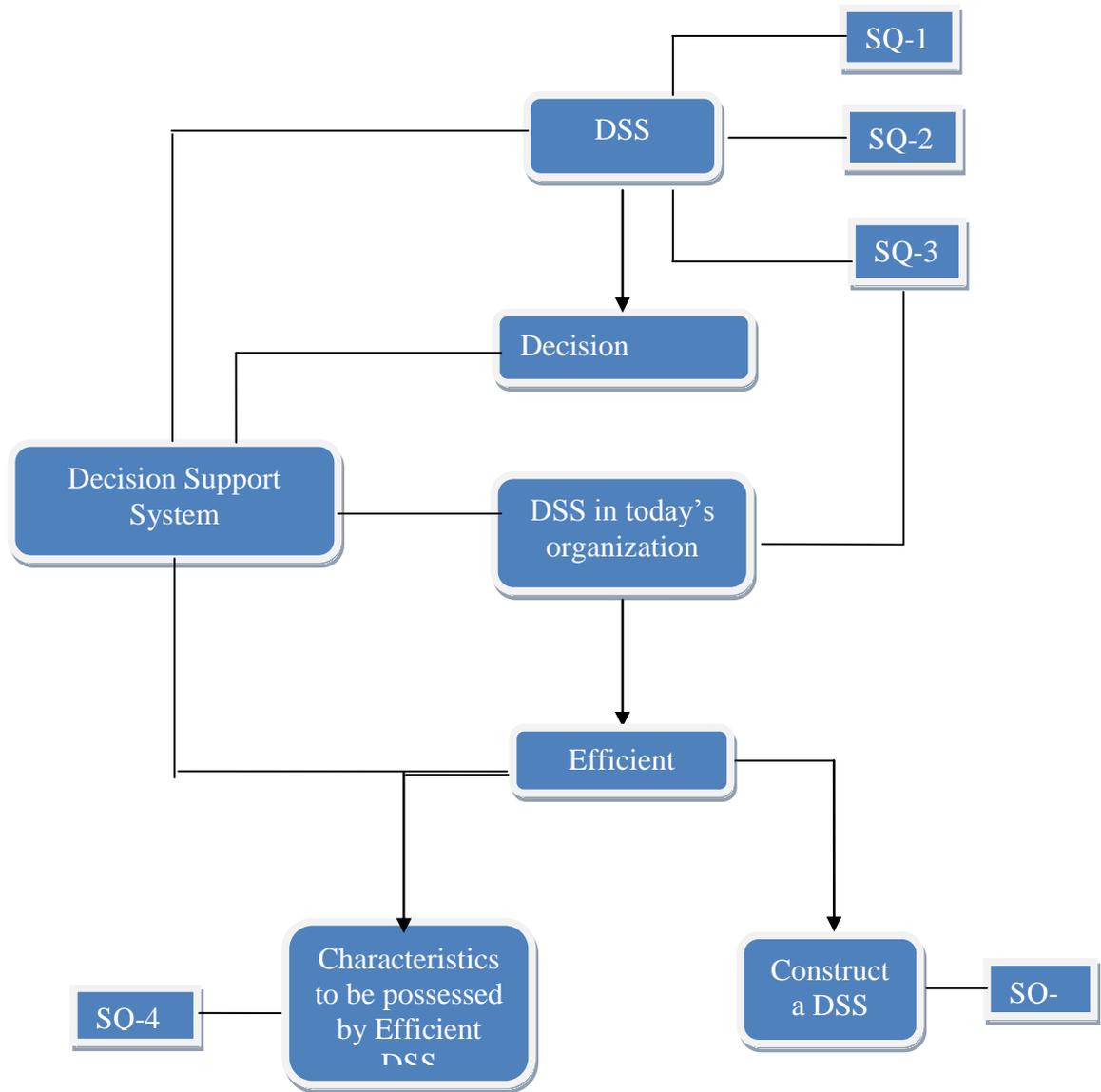
Figure 2: Relevant research areas

The above diagram mainly shows that the decision support systems play vital role in decision making. To design an efficient DSS it is important to study DSS in today's organizations. The characteristics that the DSS ought to acquire will be illustrated subsequent to the interviews as well as survey which help to construct an efficient DSS.

3.3 Previous research on decision support systems

According to Mallach, E G (2002)" in any organization one of the main activities of the management is taking decisions. The decisions a manager is called upon to take could range from quite simple matters like the date on which the bonus will be declared to very complex matters like going in for diversification, expansion of certain facilities or the takeover of another business unit". Therefore, manager is a decision maker. Managers are rated especially high in the competence level for taking timely and successful decisions.

Decision making was considered more of an art than a talent that could be acquired till 1970's. Decision making depended on factors like conclusion, skill, innovative capability, information and sense. Order based on mathematical and logical reasoning, the evaluation and analysis of data gathered from various sources and the evolution of actions were not evidently clear throughout this time for deriving conclusions. The main aspects which prejudiced managerial decisions were technique of job and person's background.

The state has been altering very fast all through the last thirty years. Organizations are becoming more and more complex as they are emerging. It is not just the business enterprises that are enduring these changes; more or less the entire hospitals, universities, institutions, supermarkets, hotels and these phenomena of complexity and expansion in size are clearly exhibited by the departments of the government (Kersten G E, 2000; Ravindranath B, 2003). Managers and administrators are recognizing that the usual procedures are not up to the requirements of speedily altering circumstances. Decision making is becoming difficult in current times. The difficulties that the managers face for taking decisions are:

- The result of a fault in taking a decision may be far accomplishment.
- To convene the challenges of international contest decisions have to be made extremely fast.
- Latest tools as well as ideas have resulted in a number of varying solutions from which it is not trouble-free to choose the finest solution.
- The job of extracting valuable information is becoming hard because the existing data at present is a lot compared to what it was some years previously.
- Even in emerging countries, latest trends are forming like the safety of the consumer.
- Government limitations and policies are upsetting the company trends.
- In decision making International situation has a part to play.
- New materials and new technologies are making tried and tested processes out of date.

Stair R (2011) states so as to the above list furnish a scheme on the diversity of factors that must be considered before taking a decision. The execution and development of decision support systems needs understanding and awareness of managerial decision making levels of problem solving as well as reasoning and manager's role within organizations. The requisites to make use of automated decision support comprise a test within, to the persons who are studying the applications of information technology intended for development which can sustain longer.

3.4 Relevant Literature Sources

Even though the term "Decision Support System" has numerous implications, based on Steven Alter's (1980) pioneering research, we are be able to recognize the subsequent three main characteristics. (1) Explicitly to facilitate decision processes DSS are intended (2) DSS must support but not automate decision making, and (3) To the altering wants of decision makers DSS ought to be able to react fast. DSS contains many types of analytical information systems. DSS give managers access to analytical tools, extra power on their data and capabilities for interacting and consulting with a dispersed collection of staff (Power, 1997). According to Sprague and Carlson (1982), "DSS comprise a class of information system that draws on transaction processing system and interacts with the other parts of the overall information system to support the decision-making activities of managers and other knowledge workers in organizations". Bonczek, Holsapple and Whinston (1981) argue that the "system must possess an interactive query facility, with a query language that is easy to learn and use" various types of DSS help decision makers manipulate and use huge amount of databases; some facilitate managers apply rules and checklists; mathematical models are broadly used by others. Similarly, Holsapple and Whinston (1996) indicates that the ability for selecting a desired compartment of stored knowledge for either deriving new knowledge or for presentation, a record-keeping capability that can present knowledge in distinct customized ways as well as in standardized reports on an adhoc basis, indicate that a DSS must have a body of knowledge, and must be designed to communicate directly with a decision maker in such a way that the user has a flexible sequence and choice of knowledge-management activities. "Decision Support System is not developed to make a single recommendation but rather to provide decision makers and choices. Decision Support Systems should be seen as sources of valuable tactical information" points National Research Council.

For a DSS development and research today a number of academic disciplines provide the substantive foundations. The primary objective of this research is to propose a standard for building a decision support system and analyze the key concepts of decision support system.

3.5 Decision Support System

Sprague (1982) defines "Decision support system as an interactive computer based system which supports managers in making unstructured decision".

Keen and Scott-Morton (1978) define DSS as "Decision support system couple the intellectual resources of individual with the capabilities of the computer to improve the quality of decisions. It is a computer based support system fir management decision makers who deal with semi structure problems".

The main objective for which Decision support system are being built today are

- To give assistance to Decision makers.
- Discover potential act to resolve problems.
- Rank along with the solution identified; provide a list of variable selection and those which can be implemented.

3.5.1 Subsystems in DSS

A Decision support system has following subsystems.

1. *The Data Management Subsystem*
    The data which is used in decision making comes from database management system. The data or information in decision making is important. The data is of two types one is within the organization i.e. internal source and the other is outside the organization i.e. is external source. Decisions will be proper unless the data we acquired from these sources are correctly retrieved and organized.

    The data can be stored, organized and queried in database management system. A computer purpose that helps in this purpose is the Database Management subsystem (DBMS) software.

    DBMS software provides different   facilities for
    -   Database creation can be Modified and deleted ,
    -   the data present in the database can be manipulated,
    -   the data in the database can be queried, and
    -   Enforce standard and ensure reliability.

2. *The Model Management Subsystem*
    Relationships between different parameters of the system are obtainable by model. Models can be formulated by analyzing the actions in an organization.

    A model management subsystem of Decision support system provides facilities for effective execution, management and creation of models. General management science models are classified into statistical, mathematical and operational research models.

    The Model management Subsystem provides the following
    -   Creation of models and maintenance of the models can be done by model management subsystem.
    -   An external interface which permits user to select a model to be executed and provides facilities for entering data.
    -   Unless an interface is provided, data from the database cannot be accessed. In an interface to the database sometimes the user might create a user specific model and try to execute the same from the data available from the database

3. *Dialogue Management Subsystem*
    For the user to communicate with the Decision support system, Dialogue Management Subsystem acts as a gateway.

    The major activities of Dialogue Management Subsystem are
    -   For the user to communicate successfully with the system, it provides icons and menus
    -   Necessary on-line context sensitive help is provided to different kinds of users.

- Queries given by the users are converted into forms which the other subsystem can recognize and execute, and
- Activities being performed are tracked.

3.6 Decision Making

Decision making can be regarded as the cognitive process resulting in the choice of a course of action among several alternative scenarios. Every decision making process produces a final choice. (En.wikipedia.org/wiki/Decision-making.)

Decisions making is of three types:

- *Structured decision:* Decision taken in the case of certainty.
  A decision in which all the steps are properly planned is called a Structured Decision. It is easy to build and design a computer program for structured decision. Decision taken under certainty is always the best one. However there is an element of risk attached to future events in several managerial decisions because the uncontrollable variables are not known completely or with certainty.

- *Semi-structured structured:* Decision taken in the case of risk.
   A decision, in which some steps are structured and some are unstructured
  Decision under risk can have more than one outcome. It is assumed that decision makers will know the probability of events occurring i.e. decision makers will have some knowledge of how matters will turn out. By taking the probabilities associated with the uncontrollable input into account, decision makers try to take a good decision which will result in good outcome.
  Simulation is a model building tool which is used to analyze problems containing uncontrollable variables represented by probability distribution. The advantage of simulation model is that by using random numbers uncertainties can be handled. Statistical techniques, involving probabilities and probability distribution, are the main tools used in solving problems which have an element of risk attached to them.

- *Unstructured decision:* Decision taken under the case of uncertainty.
  A decision, in which none of the steps are structured, is called an unstructured decision. To provide support for structure scientist and researchers are trying to adopt artificial intelligence.
  Decision making under uncertainty is nothing but a guess work. Because of the levels of uncertainty probabilities cannot be assigned to uncontrollable inputs.

Characteristics of Decision-making

Characteristics	Certainty	Risk	Uncertainty
Controllable variables	Known	Known	Known
Uncontrollable variables	Known	Probabilistic	Unknown
Types of model	Deterministic	Probabilistic	Non- probabilistic
Types of decision	Best	Informed	Uncertain
Information type	Quantitative	Quantitative and Qualitative	Quantitative
Mathematical tools	Linear programming	Statistical methods; Simulation	Decision analysis; Simulation

Table 1: Characteristics of Decision-making (Behl, 2009).

3.6.1 The Decision Making Process:

There are number of paradigms to describe the human decision making. Among them the paradigm proposed by Simon is widely tested and used. It consists of three phases, intelligence, design and choice. Later implementation phase is added. (Lakhmi C. Jain)

The process begins with the **Intelligence phase**. In this phase a decision maker establishes an understanding of the associated opportunities and the problem domain by observing the reality a. In the **Design phase**, using a specific model the decision criteria and alternatives are developed, with the relevant uncontrollable events identified. The relationships between the alternatives, events and decisions have to be clearly specified and measured. This enables the decision events and alternative to be evaluated logically in the next phase i.e. **Choice phase**. In the **Implementation phase**, the decision makers need to reconsider the decision evaluation and analyses, as well as to weigh the consequences of the recommendation

INTELLIGENCE
- Observe reality
- Gain problem/opportunity understanding
- Acquire needed information

DESIGN
- Develop decision criteria
- Develop decision alternatives
- Identify relevant uncontrollable events
- Specify the relationship between criteria, alternatives and events

CHOICE
- Logically evaluate the decision alternatives.
- Develop the recommended actions that best meet the decision criteria.

IMPLEMENTATION
- Ponder the decision analyses and evaluations
- Weigh the consequences of the recommendations
- Gain confidence in the decision
- Develop an implementation plan
- Secure needed resources
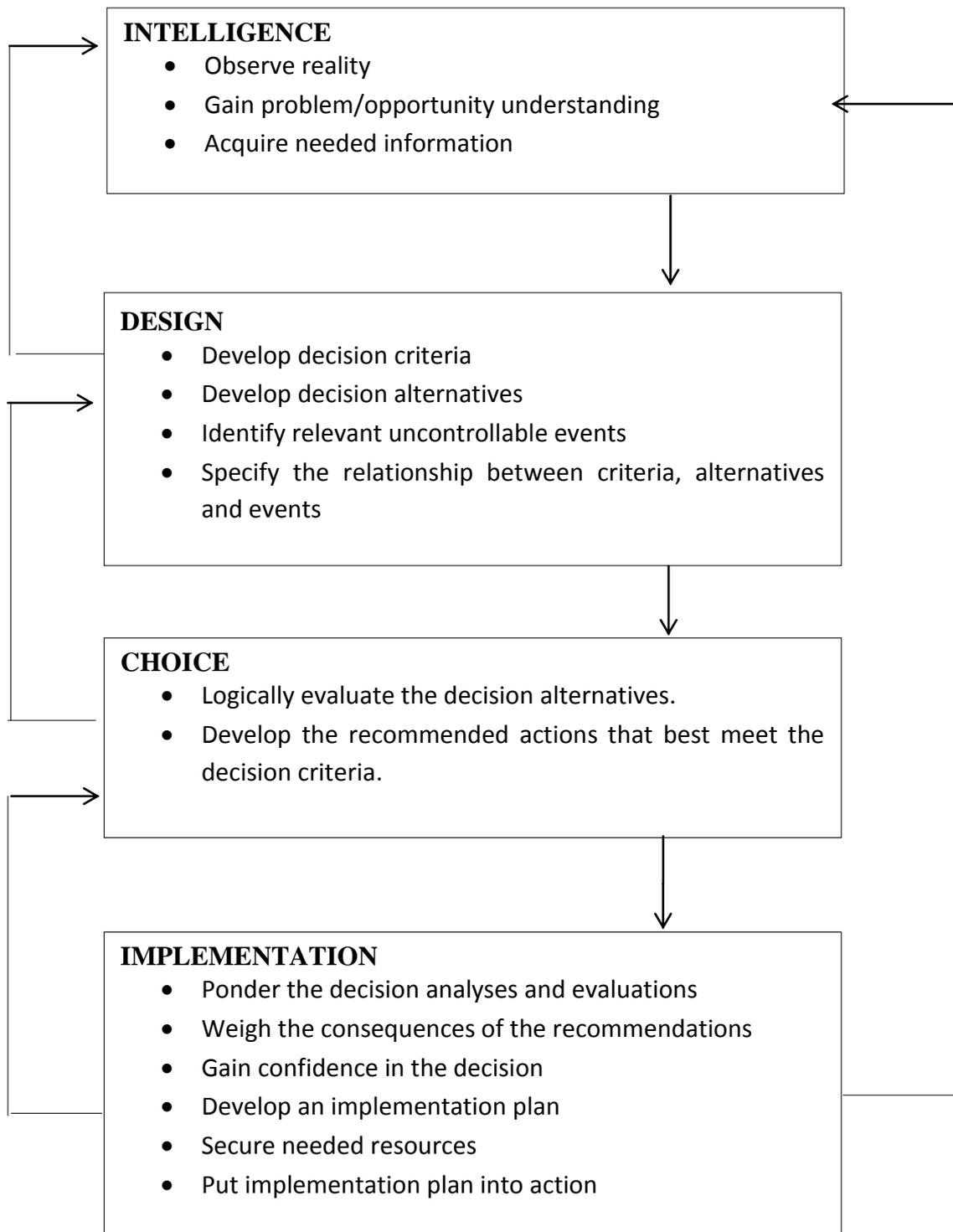- Put implementation plan into action

Figure 3: The Decision Making Process (Lakhmi Jain)

3.7 What does a Decision Support System look like?

On hearing the term "architecture", many people visualize it as a science related to designing of buildings. Conversely the meaning of the expression architecture comprises the added common idea intended for generating a plan for every structured item, simultaneously by means of a computer system. Among the opinions allied to the plan of building, a dialogue meant for computer system design is able to originate. Buildings are often explained using artistic terms like holistic, abstract, organic, soaring, natural, geometric, and continuous (Smith C L, 1998; Wierzbicki A, 2000; Chandra C, 2007). The clients will be able to explain the preferred new house necessities through usage of such artistic words. It is the case of Kaufman House recognized as Falling Water that Frank Lloyd Wright explained and constructed in 1936. This nonrepresentational approach cannot be suitable in support of a composite and outsized client-server system. It in addition needs several architects along with client details. Yet building structural design motto possibly will be as "form follows function" however someone may as well affix so as to "function follows need."

About 2000 years ago Roman architect Vitruvius first published the notion from the world of building architecture, and suggested a holistic approach for creating architecture (Burstein.F, 2000). He classified a set of constraints needed for constructing a building structural design are variables which are drawn in employing the building i.e. the consumer necessities or things disturbing the consumer and architects of building i.e. the system necessities. Likewise at present while someone designs client-server system planning, an essential condition is to recognize and describe the variables which surely can encompass a vital consequence to the clients along with the system itself. Subsequently extend the system structural design considering the variables.

In the case of scheming a client-server system, a structural design is an explanation of the clients i.e. the client's PCs as well as the servers i.e. the service supplier of storage, database administration as well as network actions must be created. It must operate as a guide for engineers and programmers in their work to build a system as preferred by the consumer. Therefore the structural design must replicate the system necessities as articulated by the clients. Consequently, client-server structural design must include an explanation of building a client-server system.

Present IS architecture of client-server systems are commonly distributed, open-system surroundings in which the hardware along with software possibly be heterogeneous while the subsystems be interoperable i.e. subsystems will be able to interface with each other, portable i.e. applications are able to be placed on diverse computers, and scalable i.e. subsystems be capable of extended devoid of disruption of service (Turban, 2008; Hoffmann F, 2001). Client-server model offers a logical means of systematize the network-computing surroundings intended for sharing the resources. A single computer system may be considered as a client, a server or both. Within the client-server model, whenever a local client application needs data from the database on an isolated machine, the client-software asks the server to contact the database to provide the data. The network offers the connectivity among clients and servers in an understandable way to the consumer.

According to Radadieh M A (2007) organizations more often than not desire four things from a client-server network so as to present communications connectivity intended for a set of DSS. The network ought to be:

- Open so consumers are able to attain the guarantee of convenient systems.
- Distributed, so that consumers can set the data and also their users anywhere it would best suit.
- Interoperable, so that consumers will be able to assertively include relevant new technologies once they happen to be available and
- Considering the standards, so as to the consumers can buy various software as well as hardware systems with the purpose of attaining advantageous characteristics like cost and performance.

Client-server computing can be described as a process representation in which a lone application is divided to a number of processors (front-end client interface and back-end server activities) and all the processors work together to finish the processing as a sole incorporated job. Client-server relationship software products bind the processors as one to offer a sole system representation (illusion). The resources that can be shared are placed as servers contributing solitary or added services. Applications or requesters are placed as clients, who can use approved services. The complete structural design is continually recursive i.e. the servers will be able to transform as clients and access services from further servers placed in the network (Berkley D, 1998; Power D J, 2002; Sobh T K, 2006).

There are various DSS applications offered in a client-server surroundings since this type of systems fulfill the requirements of consumers who desire to include admission to huge quantity of data similar to which can be accessed through the internet. The designer will be able to attain a robust design as a result by means of an extensible design, which can be designed by means of a prototype of the DSS.

3.7.1 Extensible design

A suggested way for designing decision support system architecture is by using an extensible design. Madura J (2006) states that an extensible design should be where client must be able to include supplementary abilities when required to reach the present system necessities, that are dynamic as well as always altering. It needs an approach that is based upon the important necessities so as to construct core architecture. The core architecture must be fashioned in an approach so as to let the client to effortlessly include other abilities as they are desired.

A model meant for an extensible architecture is revealed in the below figure:
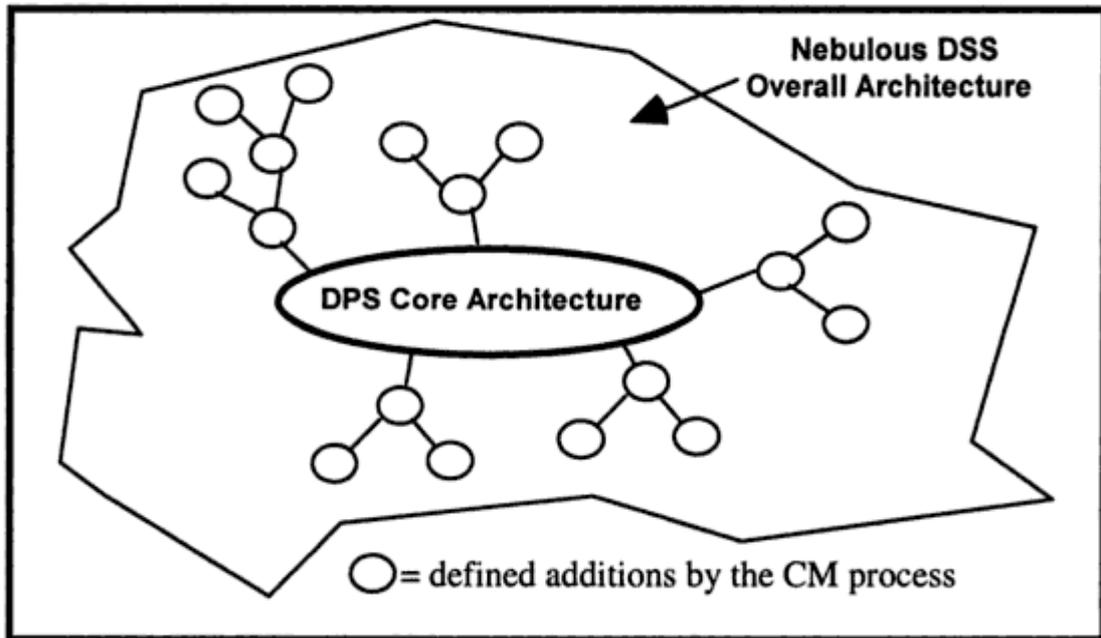
Figure 4: Extensible Architecture
Source: (Marcomini, 2009) Decision Support System for risk based management, Springer, New York

"The extensible concept is based on identifying a set of basic or core requirements which are used to create core element architecture" (Yeung A K W, 2007; Fong J, 2001). The core architecture is planned so as to effortlessly extend to add other identified requirements as well as lately derived necessities when they occur at some point in the life of system. A method for building an extensible architecture is shown in the figure below along with the description of the steps below:
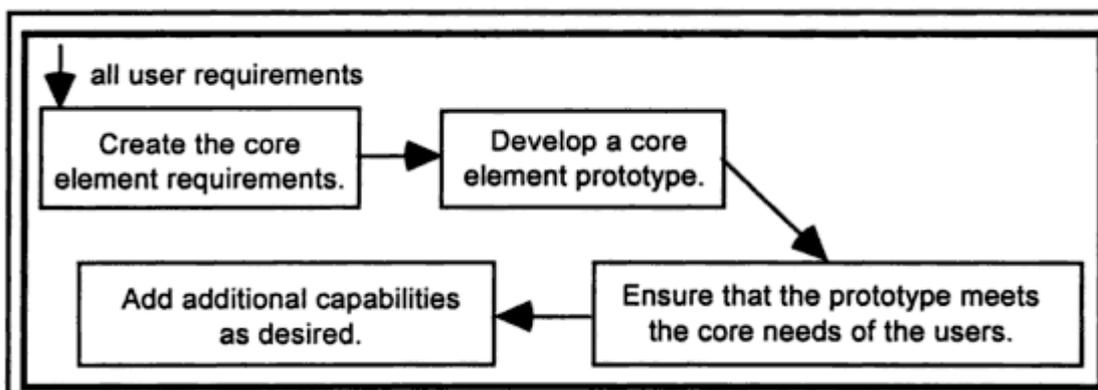
Figure 5: Creating an Extensible Architecture
Source: (Hall, 2007), Spatial Database System, Springer, New York

Singh H (1998) says that a core element of the DSS must be illustrated in such a way that the element be relatively simple and be able to be constructed quickly and effortlessly. The core element ought to be distinct to facilitate the essence of the DSS needs are fulfilled i.e. it is a fundamental construction block. Subsequently additions

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are able to be defined and added to ultimately transport the core element up towards the completely preferred ability.

The method begins with an approximately recognized set of decision support system requirements. Still the method works if one ought to have extremely defined decision support system requirements. Specified all the DSS necessities, choose those necessities that show to be the essential. It is expected to be as a slanted process although must be at the same time as objective as possible. Make use of a consensual method by means of a set of knowledge developer (Wang Y, 2010; Nakamtsu K, 2009).

A core element in a complex information system like a DSS consists of the basic abilities of a system like assumed as of the recognized client requirements, which is shown in the figure below:

Figure 6: Defining the core element requirements
Source: (Wren, 2010), Advances in Intelligent Decision systems, Springer, New York

Though the DSS necessities are dynamic, core necessities must be sensibly static (Diappi L 2004). It is the main reason of illustrating the core architecture. The method of recognizing these fundamental necessities is more going on art rather than a science furthermore depends upon the designer's skills. The designer should comprehend those necessities that amount to the fundamental requirements of the DSS.

Formerly after the core necessities are recognized after that sample of core element system is able to be created. Check the core structural design and alter it based on the requirements of the client. Include new abilities waiting on the whole user needs are met. This method is not different the Lockheed, Kelly Johnson; skunk works method of grasping essential requirements and rapidly constructing a system so as to meet these requirements (Holsapple C W, 1993; Papadopoulos G A, 2009; Sloot P, 1999). The subsequent proposals are suggested to aid in make certain that the expansion of software is attained in a satisfactory way:

- Apply profitable off the shelf architectural solutions, once viable, well-organized and useful.
- Contain a familiar thought on the whole concept of the DSS.
- Contain an exceptionally good idea of the extension of the core element.
- Contain an extremely good and comprehensive idea of the core element of the DSS.

- Make use of a client server architectural design.
- Make use of object oriented programming methods.

Khosrowpour M (1992) says that illustrating and constructing a restricted core element keeps the DSS architecture uncomplicated and easy-to-do in small time. This method has the subsequent advantages:

- It lets an organization to contain a thorough understanding of the DSS development, technically as well as organizationally, consequently be appropriately controlled.
- It lets an organization to extend the fundamental DSS part devoid of understanding on the whole architecture.
- It lets the designer to undoubtedly recognize what desires to be done to act upon proficiently and successfully.
- It permits for a fast planning, programming, testing and execution of the entire system (hardware and software).
- It lets for later on alterations to be defined in relation to dynamic DSS necessities, swiftly altering information technologies along with improved understanding of progress of the on the whole DSS necessities and structural design.

3.8 Types of decision support systems used in today's organizations

Decision Support systems are more different and more common today than when Alter carried out his research and estimated his framework, so current DSS need a latest wider typology of construction. A few types of decision support systems can be still classified by the 1980 typology. Typically practitioners as well as intellectuals have argued constructing decision support system in terms of four main components:

- The user interface,
- The database,
- The models and analytical tools and
- The DSS architecture and network (Sprague & Carlson, 1982; Power D, 2009).

These four components are valuable because it can help out mangers as well as analyst construct a fresh decision support system by finding out the kinds of decision support system or similarities and dissimilarities between categories. When systems are in fact created the following extended DSS framework is initially on the basis of diverse emphases positioned on DSS components. This quality, the significance of elements of a DSS was recognized as a main discriminating variable. Initially from one core element several DSS appear to obtain their functionality. To maintain the numeral categories in a latest framework convenient, Alters' 1980 typology was cut down into three kinds of decision support systems. They are Data Driven, Model Driven and Knowledge Driven.

According to Morley D (2009) the extended structures primarily focus on single key dimension by means of five types along with three secondary dimensions. The main characteristics in the structure are the principal technologies that drive or else provide decision support functionality. Five basic types depending upon the prevailing elements are argued below. They are Communication Driven, Data driven, Document driven, Knowledge driven and Model driven decision support systems. A few DSS are hybrid driven by additional than one key DSS element. The subsequent extended DSS structure facilitates to classify the majority of commonly used DSS today.

3.8.1 Communication driven DSS:

The communication driven DSS consist of structures constructed by decision support expertise and communication alliance. These structures were primarily built in the mid-1980 and they are different compared to DSS types recognized by Alter. That accentuates on Shared decision making support, interaction as well as alliance. A communication driven decision support systems encourages group decision tasks, permit interaction between groups of people, and supports management and alliance among people as well as conveniences sharing of information. An uncomplicated threaded or report board electronic mail is the mainly necessary stage of functionality (Behl, 2009; Yao J T, 2010; Kulkarni U, 2007). By means of diverse software tools a set of people work collectively. Electronic mails, interactive videos Video conferencing, audio conferencing, file sharing and report boards are paradigms of group support tools. Advisors, sellers, consumers as well as researchers refer to them as groupware. It allows the group associates to study, arrange and produce information in a controlled way. For the development of influential groupware systems internet infrastructure plays a significant role. Newsgroup is excellent at allowing people to produce data but they don't have the capability to arrange the data. Newsgroup allows the group to collect, organize, rewrite and erase information that is simple to examine and can change gradually as latest updates are added. This type of groupware are utilized in extra ordinary meeting rooms, and to allow groups to assemble from distinct geographic places.

Mora M (2003) states that the virtual workplace is one more section of shared computing surroundings intended to maintain geographically and momentarily isolated work teams. This is a structure for incorporating the varied collaborative abilities. To encourage communication driven decision supports systems Stack of software packages are existing. The software developed to encourage the effort of expert groups for the operation of difficult projects are web based. An immense importance is given by research people to Communication driven decision support systems. The major study consists of *impact* of group procedure and group consciousness, multi customer boundary, concurrency management, interaction and synchronization inside the group. A communication driven decision support system is repeatedly classified based on time or location matrix by the means of difference between the similar time and similar place or dissimilar time and dissimilar place.

3.8.2 Data driven DSS:

The data driven DSS comprises of spatial decision support systems (SDSS) and executive information systems (EIS), management reporting systems and file drawer, analysis systems and data warehousing. Some of the example of data driven DSS are Business intelligence systems associated with data warehouse. Data driven DSS accentuate reach to and management of huge records of planned data and particularly a time sequence of internal business data. The majority of the basic level functionality is supplied from Easy and understandable file systems entered by recovery and query tools (Chatterjee, 2010; Schuff D, 2011; Laudon, 2008). Data warehouse systems that permit the management of data by automated tools customized for a precise job and background or by additional common tools and operators offer extra functionality. Data driven DSS in addition with online analytical processing (OLAP) gives the main stage of functionality as well as decision support which is associated to study of huge set of earlier data. The unusual data driven decision support systems are the Executive Information System (EIS) and the Geographic Information Systems (GIS). A data management component reaches the information and offers a choice to DSS to choose information based on different measure: data driven decision support systems are apprehensive by past data than transactional data. A data driven decision support system might make use of a database designed for the structure but generally it is associated to additional databases.

3.8.3 Document driven DSS:

The document driven DSS are widely used and are pointed at extensive support of client groups. Such types of DSS are used to explore internet and based on definite set of key words and explore expressions get papers. The standard expertises used to associate such DSSs are through client server system or web. To offer total file recovery and study the document driven DSS put together a combination of processing and storage technologies. A search tool to facilitate text abstract as well as assesses document bearing offers decision support functionality, other than the main element is document base. Examples of documents which may be added into the database comprise guidelines as well as actions, result conditions, brochures and business past data including proceedings of gathering, company accounts also significant communications(Muntermann J, 2007; Eom S B, 2005).
A most important decision supported instrument connected with a document driven DSS is explore engine. These structures are also called as text oriented DSS. Text and document management materialized as a significant and extensively utilized automated way intended for presenting and developing parts of text. The World Wide Web technology considerably improved the ease of use of credentials as well as assisted the growth of Document-driven DSS.

3.8.4 Knowledge driven DSS:

According to Mathur P (2005) the knowledge driven DSS are the similar Suggestion DSS, phrased by Alter, which be able to advise or urge measures to managers. There is a particular problem solving skill for these kinds of decision support systems. The proficiency consists of information regarding a specific field understanding the

difficulties surrounded within the domain and talent of resolving few problems. These systems are described as suggestion DSS and knowledge based DSS.

These structures are supported on artificial intelligence technology. Artificial intelligence systems are constructed to discover scam and speed up financial transactions. A lot of added medical diagnostic systems are built on the basis of AI and expert systems, they are also used for setting up a developed operation and network based consultative systems. In recent times knowledge drive DSS are broadly used because of the connecting expert systems technologies to relational databases with web based front ends

3.8.5 Model driven DSS:

According to Reynolds G (2008) the model driven DSS are tough systems that assist examine decisions or select among various options. These systems are used by, administrator, employees of industry or business people who communicate with in the organization for many reasons rely upon how the form is group scheduling, decision analysis, etc. The model driven DSS consists of systems that utilize financial along with accounting models, optimization models and demonstration models. Model driven DSS directs and highlights admission to a model. A plain systematic and arithmetical tool gives the majority basic functionality level. In model driven DSS the choice makers offer partial constraint and information to assist the decision makers to investigate the present circumstances however in common huge databases is not preferred for model driven DSS. Premature edition of computationally oriented DSS or model driven DSS or at times worksheet tilting and solver leaning DSS.

The primary business tool used for constructing model driven DSS by quantitative and financial model was called IFPS, a short form for interactive financial planning system. A new DSS created for construction of definite systems based on the Analytic Hierarchy Process called Expert Choice was liberated in 1983. Individual and group decision making is encouraged by Expert Choice. As automated representation developed abundantly, research improved on model management as well as developing additional varied sort of designs to utilize in DSS For example, optimization and simulation models. The thought of model driven spatial decision support systems (SDSS) grew in the late 1980s. Data driven spatial DSS are also ordinary (Lindiwig O, 2005; Piattini M, 2003; Seese D, 2008).

Data driven, document driven and knowledge driven DSS require particular database elements. The model driven module offers the leading functionality in a model driven DSS. Lastly the communication and networking modules is the main driver of communications driven DSS.

3.9 Characteristics to be possessed by an efficient Decision Support System:

According to Khan.A (2003) there is no particular view of what a decision support system is. Along with the administrative authority even the customers offer distinct views concerning a DSS. The list below gives the standard design of characteristics to be possessed by efficient decision support systems.

It must offer encouragement for decision making highlighting on semi structured and unstructured position. By conveying jointly individual decision and automated information decision makers are encouraged essentially in semi-structured and unstructured condition. Such troubles cannot be answered through automated systems or in the course of regular quantitative methods or apparatus. Usually these dilemmas add construction because the DSS is built-up. DSS have been capable to solve a few structured problems

It must offer decision making encouragement to director in each and every stage starting from topmost managers to supervisors plus must help in combining different levels of management. It must carry each and every phase of Decision Making method and moreover should not completely lie on individual model but encourage a range of Decision Making models. It must encourage both independent and interdependent methods and moreover it must not be extremely difficult and confusing. It should encourage crowds as well as individuals. Few structured problems regularly need the participation of people from unrelated section and managerial levels or from unusual groups (Howlett R J, 2009; Agrawal B, 2009; Laube D R, 2003). DSS encourages effective groups through mutual web tools. DSS are manufactured to maintain personal or group task and as well to maintain personal decision making and community of decision makers functioning a bit separately. It should encourage for chronological decisions and/or interdependent. The choices are made once, various times or continuously. It should be encouraged in every stage of decision making process: intelligence, design, choice and implementation and it should besides encourage a mixture of decision making processes and methods.

According to Mehta (2003) the decision maker must be fast, capable to meet varying situation rapidly and capable to settle within the DSS to reach up these modifications. DSS are adjustable so the customers can change, rearrange, combine, add, or delete necessary basics. DSS are also adaptable in that they can be voluntarily customized to answer additional alike difficulties.

User friendliness, powerful graphical abilities and a normal words interactive human machine boundary can significantly enlarge the efficiency of DSS. Nearly all latest DSS appliance bring into play net based boundary. It must contemplate on growth of usefulness of decision making than on its competence. Even after the DSS are installed properly decision making usually take long time however the decisions are better.

The decision maker has total control over all steps of the decision making process in answering a problem. A DSS particularly intends to maintain and not to change the decision maker.

End users are capable to build up and adjust easy structures by their own. Bigger systems can be constructed by aid from Information system (IS) experts. Worksheet correspondence has been exploited in rising simpler systems. Online analytical processing (OLAP) and data mining software in combination with data warehouses permit users to construct reasonably huge difficult DSS (Lefranc G, 2005; Janakiraman V S, 1999, Bidgoli H, 1998).

Models are normally used the most to explore decision making positions. The modeling ability makes possible testing with various approaches under various configurations. Actually the models tend a DSS contradictory from MIS and the admission is given to a variety of information sources, configures and types including GIS, object oriented and multimedia.

It can be in use as a separate device used by an individual decision maker in single spot or spread all over business and in various groups with the delivery chain. It can be incorporated with additional DSS and/or request and it can be spread internally or externally using systems and network technologies.

Lamb C W (2009) says that no decision support systems can show all the personality. It must consequently make an effort of designing a decision support systems to integrate a lot of these as possible. There may be circumstance when the potential user may be particular. In this stance the user's main concern must be specified as elevated weightage. The above main individuality allows the decision makers to make improved, more reliable decisions in a sensible manner and they are given by the most important DSS elements.

3.10 Constructing an efficient Decision support system:

The subsequent segment talks about in detail, the stages drawn in collecting necessities, designing, constructing in addition to testing an efficient organizational decision support system.

3.10.1 Requirements for the DSS:

DSS customer usually have three basic options : "Buy a DSS commercial off the shelf (COTS) package and use it as is, buy a COTS package and modify it or build the DSS to one's desires"(Charles, 1998). For clients wishing a behaviorally oriented Decision Support Systems, the COTS packages might not be available. The necessities intended for the DSS can be recognized and developed by relating the client or organizational users. After the designer has acceptably recognized the user necessities and transform these into system qualifications, the Decision Support System modeling process can begin (Ariav G, 1986; Bennett J L, 1983).

In constructing a Decision Support System, a system which isn't associated at all with other computer system in a official network however which possibly will be linked to the internet or else further database services. This system shall consist the subsequent five things:

- A personal computer with a floppy disk;
- A monitor, keyboard and mouse;
- A printer;
- A modem; and
- Appropriate software.

Wrembel R (2007) says that the fundamental system permits a user to accept an illustration or auditory presentation from the computer and to enter from whichever the mouse otherwise keyboard to computer. Some of the latest PCs also agree to voice input, but these systems are generally restricted in their terminology and also possibly will have difficulty understanding a few of the client's verbiage. The PC may also get inputs through a compact disk or else a floppy disk however these might not be instant inputs from the decision maker which/what is of concentration here.

The modem permits the client to gain data from resources like web or other electronic records. The software must contain an operating system, internet accessibility, a RDBMS, a spreadsheet, a word processor, a compiler in addition to a prototyping language. These are essential tools one desires to run a computer system, to construct a Decision Support Systems that is able to be used for distinctive decision making operations. As discussed earlier the construction of a Decision Support System design ought to regard as that the Decision Support System will possibly be extended to contain supplementary means as time goes by.

3.10.2 Designing the DSS

In building a Decision Support System, designer be supposed to regard as so as to Decision Support System shall probably go through a few modifications toward reaching the active requirements of the client. Comparison rules situation can be defined as an instance of how a model can be planned so as to it be capable of easily unmitigated afterwards. Comparison rules are four kinds: "comparison against a standard, comparison across attributes, comparison within attributes and judgmental comparison" (Humphreys P, 1977; Johnson J, 2008; Lucas, 2001). These rules can be placed on a solo screen as shown:
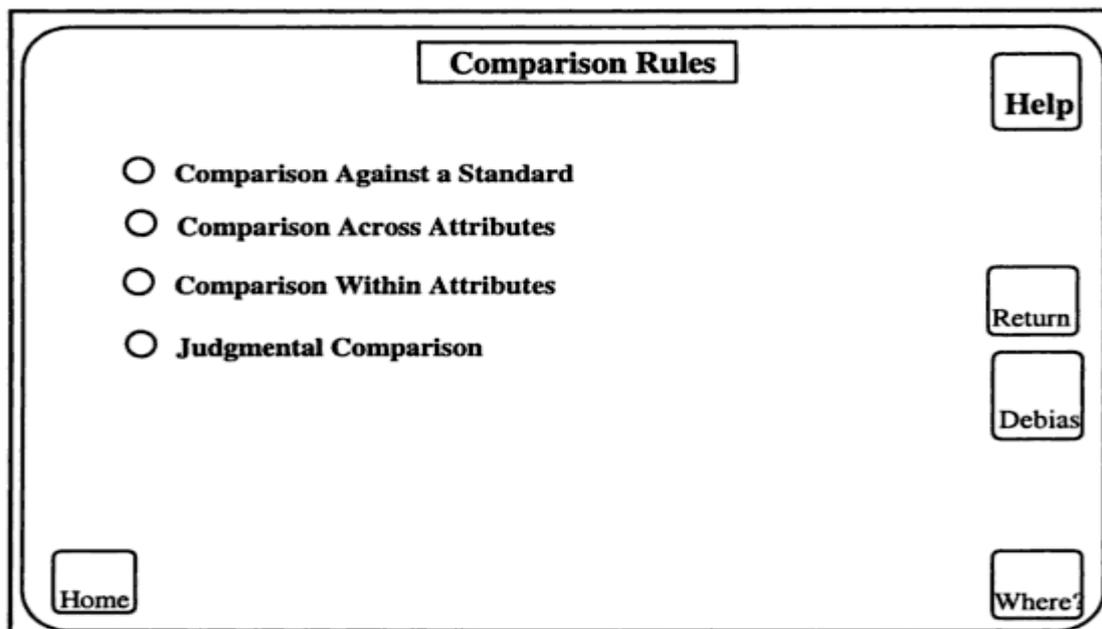

Figure 7: Designing DSS
Source: Kulkarni U (2007), Decision Support for global enterprises, Springer, New Delhi

Zhang P (2006) says so as to the designer may construct a unique design which has just one active rule with the aim of comparison alongside a standard. Nevertheless the system should be planned for whichever of the four options; the user desires to broaden the ability later. The extensible model through the designer accepting the prospective of total set of comparison rules other than the designer need not execute everything.

3.10.3 Prototyping the Decision Support System

The improvement of a prototype of the Decision Support System will start immediately after the Decision Support System necessities are recognized and built. The prototype must be an execution of an easy edition of design so that the user can test the screens of the Decision Support Systems. Consider an example, a designer can build a HyperCard prototype by means of novel screen designs to reach the client necessities although construct the screens attractive to keep the user's concentration on the decision procedure (Salvendy G, 2001; Vercellis C, 2009).

Immediately after a prototype has started the software should be corrected. The technique used at this instance was to build an uncomplicated case study in the company of recognized results. The designer can verify if the prototype is answering properly by applying the required details. Otherwise the system has to be scrutinized to recognize the crisis and repair the prototype when the setback has been recognized. It is a distinctive procedure to facilitate the programmers towards correcting the software.

3.10.4 Implementing the DSS

Kaminsky P (2003) states so as to consumers be able to in fact utilize prototype like an operational system in case they are willing to. At some situations, it might signify loading prototype interpreter for running the system although few prototyping software permit the client to hoard a run-time system without the need of the software. E.g. ToolBook. Therefore prototyped software can be utilized as an operational system. On the other hand, the majority clients desire a resourcefully planned software package intended for the Decision Support Systems. It shall need encoding throw-away prototyped system within an operational programming language like Visual Basic.

3.10.5 Testing and Evaluating the DSS

According to Oishi M K (2010), testing and evaluation method purpose is in the direction of permitting organizational consumer to research on the Decision Support Systems to observe whether it works as they are willing it to and perceive the means to enhance the Decision Support System screens. In case of any errors, the consumer must note down the errors and explain the requirements they are wishing to have.

3.11 Summary of theoretical findings

The Decision Support Systems have three types of subsystems which are data management subsystem, model management subsystem and dialogue management subsystem. DSS deals with data as well as intelligence. Data or information which support for decision making could be from internal, external or personal source. Unless the data acquired from the sources are properly organized and retrieved, decisions will not be correct. The model management will hold the necessary models that are used for analysis. The dialogue management will act as the user-interface to the DSS. The decision makers communicate with the DSS through this subsystem. The theoretical study makes obvious that decision support systems are there in more or less all the organizations; however the kind of the systems utilized differs from organization to organization based upon its extent, construction as well as core proficiency. The reading clarifies that decision support system is a necessity for every organization because it really make things easier in the decision making process through directing managers as well as clients to formulate decisions beneath unsure circumstances. The majority of the decision support systems are built by means of client-server architecture. It has been recognized that present organizations make use of diverse kinds of DSS like communication driven DSS, data driven DSS, document driven DSS, knowledge driven DSS and model driven DSS. Still however there is no exact explanation of how a DSS have got to work; an efficient DSS is that offers support for decision makers in partially structured along with formless situations. Lastly a well-organized DSS be able to be constructed by following a methodical approach which consists of five steps: requirement gathering, design, prototyping, implementation, as well as testing and evaluation. Furthermore, the theoretical study gives explanation on the uniqueness to be possessed by an efficient decision support system subsequent by the steps implicated in constructing an efficient decision support system.

3.11.1 Theoretical framework:

The main research question which is to be answered by this study is

"How can an efficient decision support system be built?"

The answer for this main question is found by dividing the main question into numerous sub questions and finding answers for the sub questions individually. The sub questions are given below:

1. **What is a Decision Support System?**

The first research sub question is answered through section 3.5. This section has revisited the basic concepts of decision support system from the perspective of several researchers.

2. **What does a decision support system look like?**

Section 3.6 answers this sub question. This section has a detailed overview of the architecture of a decision support system explaining how an actual decision support system must really look like.

3. **What are the types of decision support systems used in today's organizations?**

The next section 3.7 answers this sub question. This section describes in detail the types of decision support systems used in organizations at the present age.

4. **What are the characteristics to be possessed by an efficient Decision Support System in order to facilitate the decision process?**

Section 3.8 explains the characteristics to be possessed by an efficient Decision Support System in order to facilitate the decision process which gives an answer for the fourth research sub question.

5. **What should be done in order to construct an efficient Decision support system?**

The final research sub question 5 is answered by Section 3.9. This section has the detail methodology to be adopted in building an efficient, user friendly decision support system.

3.12 Arguments for an empirical study

The theoretical study, thus gives answer to all research question. However, the aims and objectives of the research can be attained only when the theoretical study is accompanied by an empirical study. The empirical study gives the views of people who have experience in developing and using decision support systems in real-time. It answers the questions related to practical problems. Hence empirical study is essential for any research in order to get accurate interpretations. The empirical study in this research is conducted by interviewing people who have expertise in building and delivering decision support systems to end users.

4 Empirical Survey

4.1 Purpose

This empirical survey in intended to collect the practical view of experts involved in building decision support systems about the approach they follow in building a user-friendly decision support system.

4.2 Sampling

This research makes use of convenience sampling. The sample is primarily recognized by convenience. The sampling technique used in convenience sampling is non-probability sampling technique. Elements are included in the sample without known probabilities of being selected or pre-specified. Convenience samples have the benefits of relatively easy data collection and sample selection. In terms of its representatives of the population it is not possible to calculate the goodness of the sample. A convenience sample may or may not provide good results. The procedure that is statistically not justified does not allow inference and probability analysis. Researchers are used as participants in convenience sampling. In convenience sampling people are selected on the basis of their willingness and availability to respond. Convenience sampling is timelier technique and less expensive, easier compare to probability sampling techniques. Probability sampling techniques involve identifying every individual in the population and using a laborious random process to select participants.

Convenience sampling is said to be followed in this research since three employees from the following two organizations in India are randomly chosen to know about the methods followed by them in building efficient decision support systems. The total number of sample respondents is 6, 3 from each of the following two organizations in Karnataka, India.

- Aalpha Information Systems (India) Pvt. Ltd
- Sunquest Information Systems (India) Pvt. Ltd.

4.2.1 Risks using Convenience Sampling

The disadvantage of using convenience sampling is that the sample is not representative of the entire population and sampling bias. Systematic bias results from sampling bias. Sampling bias is the difference between the results from the sample and results from the entire population. Systematic bias leads to obtaining skewed results.

Limitation in generalization and inference making about entire population is another risk in using convenience sampling. This also results to a low external validity.

4.2.2 Argumentation for choosing Convenience sampling

The researcher used convenience sampling as it is not possible to test large groups, because of the limitations on time and access to the subjects. Despite of this major drawback researcher used convenience sampling because it is less expensive and timelier technique than the probability sampling techniques because the probability sampling techniques requires researcher to identify every individual in the population. Although convenience sampling does not guarantee a representative and unbiased sample, it cannot be concluded that this type of sampling is hopelessly flawed.

There are two strategies for solving most of the serious problems in convenience sampling

First strategy is by ensuring that the samples are reasonably representative and not strongly biased. In this research the researcher has selected a sample that consists of people who are working with multinational companies that are specialized in constructing and delivering DSS to end users.

The Second strategy helps in minimizing the potential problems in convenience sampling. It is done by providing a clear description of how the sample was obtained and who the participants are. The researcher has taken a sample of six respondents from two organizations that are pioneers in delivering Decision Support Systems to end users by contacting them and sending e-mails. The researcher has chosen 3 respondents from 2 different organisations that are Alpha Information System (India) Pvt. Ltd. and Sunquest Information Systems (India) Pvt. Ltd. The respondents are designated as Project Managers in those 2 companies.

4.3   Questionnaire

Primary data in this research is mainly collected by mailing questionnaires to the target respondents and receiving their responses. A questionnaire is the medium used to pose the questions that the researcher wants the respondents to answer. Questionnaires are significant essentials in surveys and the five key functions of the questionnaires are:

   i.   They transform the research objectives into particular questions so as to ask the respondents.
   ii.   They homogenize the questions as well as the group of replies so as to each contributor be required to reply to an alike stimulus.
   iii. The courses of questions along with the variety promote the co-operation to maintain the respondents motivated during the interview.
   iv.   They provide as the eternal records of the research.
   v.   Depending on the kind of questions used, a survey can pace up the process of data analysis.

There are two types of questionnaires. They are open ended and closed ended questions. An open ended question is that which allows the participants to respond in

their own words. Since this research is qualitative in nature, the questionnaire is open-ended in nature.

The questionnaire had totally ten questions (Question No 1 to 10) that help the researcher to find answers for the research questions. The first question and third questions require the respondents to define about the purpose of DSS and characteristics of a DSS, respectively from the respondent's viewpoint. The second question enquires on kinds of DSS conveyed by the target organizations. Question 4 collects the characteristics that the end-clients expect a DSS to have. Question 5 gathers information on method implemented by target companies in constructing DSSs. The challenges come across by the target organizations, approaches modified by them to prevail over those problems and methods by which they make certain that a user responsive DSS is conveyed, are collected through questions 6, 7 and 8 respectively. The last two questions maintain the respondents to contribute their company's best practices and suggestion that would be supportive for future DSS developers in constructing an efficient as well as user responsive DSS.

4.4   Challenges encountered in building a delivering a user-friendly decision support system:

The challenges explained by one of the managers of Aalpha Information Systems (India) Pvt. Ltd as met by the organization in building and conveying a user-responsive decision support system is, "*for the reason that of the huge capacity of present organizations, the clients anticipated a standard organizational decision support system to go across organizational gathering or hierarchical levels. Due to this hope it turns into tricky for our company to build an unbeaten organizational decision support system that supports various organization applications*".

The respondents from Sunquest Information Systems (India) Pvt. Ltd said that the current organizations estimated decision support systems to right to use to and influence a large quantity of company information from internal (information within organizational) and external sources (information from other sources). The organizations needed DSSs to support personal as well as group task further help single decision making and decision making by a group of citizens functioning separately. It was truly challenging for them to construct DSSs that would get together all these needs.

4.5   Steps taken by the organizations in order to overcome the challenges   encountered in building an efficient

"*The development method of decision support system have to be distinguished as an iterative and also as a combined set of operations and actions*"-says a manager from Aalpha Information Systems (India) Pvt. Ltd. In order to overcome the challenges encountered in delivering an efficient DSS, this company educate its designers to maintain themselves modernized with the changing requirements of market as well as organizations and design systems accordingly. The organization make sure to deliver

DSSs that rely upon well-timed, valuable and exact information and present an actual time response to changes occurring in the organization.

In order to overcome the challenges encountered by the company in building an efficient decision support system, it has been identified that, Sunquest Information Systems (India) Pvt. Ltd adopts the new technique in modeling a decision support system. The company adapts a development strategy that encourages the end-users and stakeholders to actively participate in the development process. They are entertained to express their priorities and the organization ensures to deliver the system that meets their specific needs.

4.5.1 Ensuring to deliver a user friendly decision support system:

It has been identified that Alpha Information Systems (India) Pvt. Ltd ensures to deliver a user friendly decision support systems by simplifying all sort of decision making process. The organization attains it as a result of guaranteeing the decision maker has full power above all decision making steps drawn in the process of resolving a crisis. Additionally it sees to it so as to the consumer can delete, add, alter, rearrange or integrate basic essentials of the decision support system conveyed by it. It conveys flexible decision support systems with the intention of helping administrator to witness instant results on giving simple instructions. It helps the managers to maintain the complete decision making process beneath their direct power furthermore modify their decisions at any time desired.

Sunquest Information Systems (India) Private Ltd ensures to deliver a user friendly decision support system by estimating as well as reviewing the necessities of individual end-users along with creating systems so as to meet their individual necessities. Additionally, it makes certain that DSS creates decision implications that are ahead of the capacity of human proficiency. moreover, the organization makes it sure that the decision support systems conveyed by it carry exchange of information among clients since information exchange promotes intelligence growth as well as combination which uphold decisions to be finished on the consent amongst diverse decision makers.

4.5.2 Best practices adopted by target organization in delivering efficient decision support systems:

The survey reveals that Aalpha Information Systems expanded a prototyping of a decision support system and experiment if they assemble their client's necessities as an alternative of rising the whole system especially foremost time. The company modifies the prototype in anticipation of the last necessity is frozen in array to save cost, energy and time. By doing so the company conveys decision support systems that give better earnings, reduce expenditure and better truthfulness in prediction to any organization.

Sunquest Information Systems (India) Private Ltd said that it has a dedicated Quality control team with specialists in quality management, who assist the organization convey premium systems for the first time itself. Besides, it is implicated that the company performs fault analysis meeting after finishing point of each and every phase

of the improvement of the system in order to make sure that the fault rates are either reduced or banned in upcoming developments.

4.5.3 Suggestion for future designers:

The managers from Aalpha Information Systems (India) Pvt. Ltd recommended that the future designers have to recognize the key decision under statement by the decision maker and the similar data needs of a decision support system, to make it a appropriate tool that maintain successful decision making. The designers should have reorganized information on choosing method or the affinity of decision maker. The upcoming decision support designers have to aspire to construct systems that include the ability to modify the decision process.

"*The upcoming decision support system developer ought to construct systems that mainly point on individual choices relatively than pointing on individual variations*", said one of the managers from Sunquest Information Systems (India) Private Ltd. For achieving this he advised that the future designers must enlarge the knowledge of the several roles that decision support system play in an organization and come ahead to build and design such systems. Further, they must be updated with the varying inclinations and requirements of organizations in order to send the best system to their end-users.

4.6 Observation procedures

The researcher conducted this study by mailing the questionnaires to the target respondents to their corresponding workplaces. In order to establish initial trust, the researcher had a telephonic conversation with the target company and explained about the purpose of the survey. The researcher distributed the questionnaire to the organizations after getting an approval from those organizations. Owing to time constraints the researcher chose only six respondents on the whole. Since the questionnaire was open-ended there were so many different types of answers given by the respondents. However, the researcher managed to extract valid points from the various transcripts received, consolidate the same, verify them for accuracy and consistency and finally document them as a single empirical analysis.

4.7 Summary of Empirical Findings

In this section, we discuss the results of the interviews conducted in organization. The interviewees are mainly professionals working with multinational companies that are specialized in constructing and delivering decision support systems to end users. In this summary we will present the results as answers to the research questions.

SQ1: What are decision support systems?

Making a decision process easier is the main job of decision support systems. We have found out that as DSS must be able to aid as well as support definite decision making actions. It ought to also give support headed for decision makers starting

lower level toward higher level within an organization devoid of reinstating decision makers. DSS shall offer ability to carry additional than single chore in decision making process so as to include intellectual and data analysis, recognizing and scheming of options along with choosing among them as well as decision execution. Decision support systems study difficult problems furthermore make possible quicker replies to unpredicted circumstances.

SQ2: What does a decision support systems look like?

We found out that decision support systems must use an extensible design, which permits the client to effortlessly add additional abilities as needed. It must let the organization to encompass a clear thoughtful. The organization should be able to expand essential decision support systems essentials. It should be simple to adjust according to varying information technologies.

SQ3: What are the types of decision support system used in today's organization?

It was found that the both organizations deliver two types of decision support systems they are
- Communication driven decision support systems.
- Data driven decision support systems.

Communication driven decision support systems is an idea which maintains decision making within a group of decision makers by facilitating efficient information exchange i.e. through computerized decision support systems, decision support tools or group internet. Knowledge driven decision support systems assist users make decisions based on human being.
Data driven decision support systems primarily concentrate on admission and influencing huge quantity of information from internal and external sources. Modern driven decision support systems examines different options in decision making while document driven decision support system is utilized for answering web pages and discovery papers using key words or explore conditions.

SQ4. What are the characteristics to be possessed by efficient decision support systems in order to facilitate the decision process?

The decision support systems must put together automated information and human verdict. They ought to support special decision styles as well as processes, multiple as well as sole decision makers. The decision support systems must have the ability to be employed as a self-regulating tool in addition to assist the decision maker to obtain well-timed decisions. It has got to be able to computerize tedious chores. The decision maker ought to be able to look through the difficulty much carefully

SQ5. What should be done in order to construct efficient decision support systems?

It is originate that the customers of the organizations anticipate the decision support systems to hold definite customer specific check level requirement. The decision support systems must be able to maintain essential teams in the course of shared web

tools. It will also answer new questions. The decision support systems should be very familiar and give an opportunity for the users to choose a set or non-payment method of using the system. It must also assist in answering semi structure problems. It must also be able to utilize web based boundary.

5 Analysis and Result

5.1 Analysis

In this part, based on questionnaires collected from 6 respondents belonging to two different organizations located in India who build and deliver DSS to end-users are analyzed to study how efficient DSS can be built.

5.1.1 General purpose of a decision support system:

From the analysis it was initiated that the three respondents from Aalpha Information Systems (India) Pvt. Ltd said that according to them the usual purpose of a decision support system was to present support for wide range of everyday jobs surrounded by a specific purpose area such as production plan or task organization. To make it precise, one of the respondents said that,

"*One way to assist people to turn into more successful decision makers is by helping them grow to be extra efficient in operating data. The decision support gets better personal output*".

New one added that, "*the reason for decision maker is to contract with difficult and huge level problems so as to absorb time consuming information investigation. A decision support system condenses or cuts down the total time required to take a decision*", was the view of the third respondent.

The third one said that decision support systems enlarge the skill of decision maker method the data and study is in detail. In accumulation decision support systems reduce the knowledge required by a worker to achieve agreeably and assist new comers increase knowledge.

The respondents from the second target company, Sunquest Information Systems (India) Pvt. Ltd said that decision support systems study difficult problems and permit quicker responses to unpredicted situations. They combine information basis that can improve communication between business units. They are accomplished of increasing the success of management team as manager spend added time on analysis, planning and implementation and a smaller amount time on data collecting, integration and interpretation.

The third respondent from the same company defined the purpose of DSS as, *decision support systems combines the data from various sources, increase a general understanding of information definitions and rinse data from system with less controls*".

5.1.2 Types of decision support systems delivered by the target organizations:

It was found from the survey that Aalpha Information Systems (India) Pvt. Ltd conveys communication-driven decision support system that encourages decision making inside a set of decision makers all the way through assisting proficient information exchange, web based automated decision support system which are reachable on the web and deliver decision support information or decision support tools to managers or business analysts using thin client web browser such as Netscape navigator or Internet browser that are utilized for entering into the Global internet or else a company intranet and knowledge driven decision support systems that assist clients to take decisions based on human proficiency. Also was found that Sunquest Information Systems (India) Pvt. Ltd conveys data driven decision support system that concentrates on reaching and controlling a huge quantity of business data from internal and external sources, model driven decision support system which utilizes an essential model of an intrinsic particular circumstances to inspect diverse choices in decision making and document driven decision support system that is helpful for questioning web pages and locating documents by means of a precise range of keywords or search conditions.

5.1.3 Characteristics to be mandatorily possessed by an efficient decision support system:

The characteristics to be mandatorily possessed by an efficient decision support system according to the respondents of Aalpha Information Systems (India) Pvt. Ltd is that decision support system ought to offer decision making support to managers of all ranks. Decision support systems must encourage decision makers chiefly in unstructured and partially structured situations by putting together automated information and human verdict. They ought to maintain diverse decision fashion and processes, individual and group of decision makers. Likewise, one of the managers from Sunquest Information Systems (India) Pvt. Ltd alleged that, "*well-organized decision support systems have to reorganize, add, arrange and control the data in diverse types.*" The other two said that decision support systems should have the ability to be restricted as an independent tool and ought to facilitate an individual decision maker to acquire well-timed decisions. Alongside, decision support systems are required to computerize wearisome tasks and assist a decision maker to investigate a problem more carefully and comprehensively.

5.1.4 Basic features to be possessed by a decision support system from client's perspective:

According to the managers of Aalpha Information Systems (India) Pvt. Ltd their clients anticipated decision support systems to acquire certain client specific service level necessities. They support the decision support systems to encourage both

individuals as well as groups. Less structured problems frequently need the participation of people from various branches and managerial levels or also from different groups. Hence they require the decision support systems to maintain elementary teams through mutual web tools. They did not want the decision support systems to be very uncertain and complex and chosen the decision support systems that assist manager's to investigate for trends, remote problems and request fresh queries.

On the other hand it is implicit that the clients of Sunquest Information Systems (India) Pvt. Ltd had chosen decision support systems to be extremely well-informed. Further they required the DSSs to make easy beginner users to choose a usual or default technique of utilizing the system, by providing elective features to work by means of the fundamental system right away and slowly find out its potential in order to keep away from annoyance that was originated in making use of latest systems. Strong graphical means, user responsiveness and an interactive individual interface are some extra features; the customers anticipated a decision support system to have. The customers desired the latest decision support systems to exercise network dependent interfaces because the decisions presented by these systems were superior. Lastly they required the decision support systems to assist them in resolving partially structured problems where fraction of the analysis may possibly be automated although the decision maker's verdict and approach were desired to manage the process.

5.1.5 Process adapted by target organizations in building a decision support system:

One of the managers from Aalpha Information Systems (India) Pvt. Ltd replied for this question that, "*owed to current generation of BI tools and functions similar to OLAP (On Line Analytical Processing), data warehouse or data mining the construction of today's decision support situation has grown to be very composite. In this significance the development procedure of decision support system is not simple at present and also it requires ample structure otherwise methodology that is essential to control a variety of platforms as well as tools to attain the necessities of officials. The most important method followed by our company is SDLC method. Furthermore, the developers of our organization unite and make use of diverse tools as well as technologies depended on business intelligent processes in order to fulfill every decisional necessity of an end-client*".

It was found from the survey that Sunquest Information Systems (India) Pvt. Ltd. which was specialized in delivering, data-driven, document driven and model-driven decision support systems developed DSS through careful planning in the early stages of its implementation. One of the managers added that, "*The method practiced by our organization to construct a DSS is end-user method. Our firm takes into concern at some stage in the design period itself all problems that may be dealt by a single component of a decision support system so as to stay away from doubling of actions. We are capable to attain this as a result of linking the end-users from the early phase of development process*".

5.2 Result summary:

The following are the major results that might be derived from the qualitative study performed by interviewing two organizations that have expertise in building and delivering decision support systems to end-users.

- Even though each respondent interviewed gave their personal observation on the purpose of a decision support system, it can be understood that the general purpose of a decision support system as granted by all is to abridge the process of decision making by giving support to broad range of tasks inside a particular application area in an organization, thereby reducing the overhead of end-users, especially managers.
- Among the two organizations interviewed it can be understood that Aalpha Information Systems (India) Pvt. Ltd delivers three types of decision support systems by name communication driven decision support system, web based and knowledge driven decision support systems. Similarly, Sunquest Information Systems (India) Pvt. Ltd delivers three other types of decision support systems by name data driven, model driven and document driven decision support systems.
- In common all respondents feel that decision support systems must be easy to use and be easily reached by managers elected at all levels of an organization. One additional condition that a decision support system is estimated to have power over is to help users explain unstructured and semi-structured problems i.e., problems that occur under doubtful conditions.
- Another result that was made is that all clients wish for the decision support systems to be user-friendly supporting human computer interaction to a great extent. They have a superior preference towards organization constructed with good-looking interactive and human interface graphical user interface.
- When asked about the process adapted in building an delivering DSS to end-users, Aalpha Information Systems (India) Pvt. Ltd said that it adapted the SDLC approach whereas, Sunquest Information Systems (India) Pvt. Ltd said that it adapted end-user approach.
- No process is free from challenges. Building a user friendly decision support system is not an exception to it. The study exposed that both the organizations faced various defend against constructing and deliver user friendly decision support systems to end-users. The major challenge pointed by both the organizations is the changing needs of the clients owing to today's active business environment.
- It was discovered that both companies followed unlike approaches in order to prevail over the challenges the companies met and guarantee to convey a user responsive decision support systems to their customers and make their decision making process easy.
- Finally, with their knowledge and proficiency both the organizations advise that upcoming decision support designers have to improve the knowledge of the complicated jobs that decision support systems takes part in an organization and come further to plan and construct systems in a way so that they highlight on individual inclination to a certain extent than concentrates on individual dissimilarity.

6 Discussion

6.1 Conclusion

Making"high-quality" decisions is not an effortless job for individuals or for group of managers. Decision support systems formulate decision process effortless. People have major restrictions which hamper their achievement as decision makers. In spite of those restrictions, a lot of managers take and have taken victorious decisions of foremost worth and weight by using a decision support system. Therefore, the reason of a decision support system must be to develop the regularity of victorious decisions in a business.

Decision making is based upon perceiving and understanding the incorporated information yield by the system. A correctly administered decision support system is an interactive software based system intended to help the decision makers to induce valuable information through the documents, business models, raw data and/or individual understanding to discover and repair the problems as well as craft decisions.

High-quality decision support systems have got to assist the managers to make significant judgments in spite of distinction in the data offered. A DSS must aid manager pact with uncertainty. A DSS be supposed to facilitate a manager carry out proper investigation; however it must not endorse unnecessary examination. A DSS be supposed to improve a decision maker's self-assurance. Self-assured decision makers contract more successfully with chances as well as threats. Managers require utilizing their decision-making expertise to craft the correct decision and after that apply convincing talent to trade the decision. A DSS must not be intended to make managers cut back on decisions, however to take more purposely balanced decisions. Evaluating targets and standards is an vital element of decision making, also DSS must not reduce the significance of standards and the significance of assuming task meant for the choice that are made.DSS must support originality. Results are not evidently recognized within every decision conditions. DSS must not force excessively a lot arrangement in conditions that are formless or uncertain and must encourage design of convention results. Moreover, they ought to be extremely communicative as well as user-responsive. Low valued or unnecessary information in a decision support system might results in information surplus or inclined decision making. Decision creator is able to gain from enhanced, well-timed, information given appropriately, balanced manner. Comprehensible examination and graphical demonstrations are usually superior to complex exhibit and lengthy, composite tablets of records. Current programming languages offer the essential functions to construct a decision support system to do a variety of actions like reporting, graphic presentation of instructions, arithmetical and economical operations, data modeling and data organization. In the present day, organizational decision support systems are essential to process data inside and transversely organizational limits. Communication technology had enhanced immensely although a lot required to be made in order to make certain with the intention of decision support systems be accessible as soon as desired as well as act upon fine, the essential function as well as incorporate among other systems.

Technology is generating fresh decision support abilities; although a lot of studying furthermore debates have to happen to productively use the technological potential. Decision support systems vary in numerous ways from operating systems with the aim of handing out business dealings. Several current decision support systems are planned for the reason that multi participant systems shall be able to be utilized in dispersed and active situations. Such task critical decision support systems necessitate meeting several necessities like encouraging decentralized as well as dispersed structural designs, running with no fault although when network is untrustworthy, encouraging mobility among diverse client systems in addition to providing support to several additional low level as well as high level functions. Such decision support systems consist of varied subsystems which craft it decisive for designers to merge them into a sole useful system. These complexities in uniting them into a single dynamic system confuse the execution of light decision support system. Even if every single one of these challenges is dealt by means of a variety of tools, their instance of development will be exceedingly more if they be constructed from starting stage. Therefore, to decrease time and expenditure drawn in designing an efficient decision support system, they must be correctly developed to reach the entire necessities of clients. It is essential to build decision support system suitably by means of RAD and prototyping techniques through the aid of tools like UML (Unified Modeling Language) and technologies similar to Unified Process (UP) methodology to craft them further flexible and user-responsive.

The Decision support system plan as well as development method to construct Decision support systems meant for the current organizations must depend resting on the quantity of data required also its basis, the figure of placed clients, whichever representation and diagnostic tools utilized, along with the quantity of projected use. A lot of small, dedicated Decision support systems are constructed rapidly by means of end-user expansion or quick prototyping. Large enterprise-wide Decision support systems are designed using refined tools as well as organized and planned system examination and improvement methods. Generating enterprise-wide Decision support system atmosphere remains a compound furthermore evolutionary chore. Enterprise-wide Decision support systems foreseeable develop into a main element of an organization's general information method infrastructure. In spite of the noteworthy growth diversity shaped by the extent as well as intention of a Decision support system, every Decision support system contains alike practical mechanism furthermore contribute to a general use, encouraging decision making.

To conclude, decision support system must improve the procedure of decision making as well as decrease the unhelpful penalty of individual information processing limits. This result is achievable from an additional refined knowledge of decision making theories. Some administrators comprise extremely genuine worry regarding automated decision support which they anticipate to be tackled by decision support designers. To tackle the similar, decision support system analysts require making use of their information of organizational decision making while scheming and assessing decision support system. Additionally, decision support system analysts require being precautious in their DSS design tasks, and they require staying away from strengthening the boundaries of choice makers in a decision support system design.

6.2 Process to be undertaken in order to build an efficient Decision Support System

The following are some simplifications about design and development of decision support systems.

- ➢ First, once a task plan is anticipated, the center of attention must be on explanation and identification of decision making along with an investigation of decision and the actions implicated. This method is known as decision-oriented diagnosis.
- ➢ Second, subsequent to identification, the developers ought to carry out a feasibility study and, in several circumstances, put in order a feasibility report.
- ➢ Third, provided if the task appears feasible, subsequently designer and IS personnel must make a decision to purchase or develop the anticipated Decision support system. In several circumstances, an answer will exist personalizing for the Decision support system.
- ➢ Fourth, designers must keep in mind that, in common, knowledge-driven decision support systems and model-driven decision support systems are constructed by means of rapid prototyping. While document-driven and data-driven decision support systems are constructed by means of either rapid prototyping or by a SDLC method based upon the intricacy and level of the system. The communication-driven Decision support systems are generally obtained by buying and then are installed in business computer systems and become accustomed to the suitable methodologies.
- ➢ Finally developers require extending a broad knowledge on designing and developing different kinds of decision support system. At the end of the day, design architects are accountable to guarantee that Decision support systems support company objectives and provided being beneficial to business. for this reason they have to make certain to aim for suitable planning and development methods united with actions to educate consumers in the process of the latest Decision support system to ensure it to reach the business targets and profit the customer.

This approach when followed can aid every organization to plan, execute and convey well-organized and user-responsive decision support systems to their clients.

6.3 Implications for Informatics

The thesis discusses that Decision Support Systems have a great implications for informatics. The informatics techniques provide a great support to DSS and improve decision making processes. A DSS can offer the range of information you require for the decision making. The services provided by such technology will include a chief impact on individuals as well as organizations. At present information is circulated to the correct person on appropriate time consequently letting a decision maker acquire a knowledgeable decision. Formerly, owed to the low potential of organizations to gather the complete information, a decision maker used to acquire decisions taking into account earlier results in addition to self-experiences (Galliers and Baets 1998).

Information Systems and DSS offer the ability to carry out comparisons and judge your decision even before they are made and check what effects it may cause on your organization. Growth in information system expands the limits for Decision Support Systems in effective and time-saving decision making. DSS make possible the business managers with the options to decide, plan, manufacture, market and deliver innovative and well-managed products and services using information.

6.4 Method Evaluation

In this part, in order to supply theoretical support and systematic environment for empirical research text analysis has been established prior to interviews, discovering if at hand there is any specific pattern for constructing DSS in the present day and suggesting approach for constructing an user responsive decision support system by inspecting the present literature connected to DSS. These plans when personalized will help any institute to devise, put into action and convey efficient and user-responsive decision support systems to end-clients. The research techniques we have selected are associated to the DSS present theories with productive outcomes and research queries; this is established subsequent to the theoretical study, data analysis and empirical findings.

In this research, the major difficulty is nearly all of the Decision Support System developers must exercise a decision oriented method and after that apply either a rapid prototyping or SDLC method. End User Decision support system can be acceptable and economical, and MIS staff must work together to maintain such improvement somehow than disappointing it when it appears suitable. Rapid prototyping is valuable in constructing various kinds of Decision support system, but SDLC have a responsibility in growing complex, network, enterprise-wide, data-driven Decision support system. Decision support system analysts and directors require being well-known with all the practices for constructing Decision support system. This composes use of hermeneutic significance to this research.

 As mentioned in Research Chapter, the reason of the theoretical study in our research is for recognizing the essential characteristics of decision support system, searching the type of decision support system used in today's organization, discovering if there is any specific standard for constructing DSS today and suggesting approaches for constructing an user responsive decision support system by examining the presented literature connected to DSS. On the other hand empirical study discovers answers for the questions by gathering observations of people who are really apprehensive in constructing DSS and conveying them to the clients.

6.5 Result Evaluation

In this session, Result evaluation will follow these criteria: Creditability, Transferability, Dependability and Conformability.

6.5.1 Creditability:

In this part, creditability is assessed from the qualitative research.

While interpreting reality researcher's own point of view is hard to get away. Researcher's own point of view can be accustomed by going all the way through the researcher's own procedures and experience exercised in the research.

In this literature, Credibility plays a vital role in assessing the result. Creditability is nothing but it is the method of ascertaining that the outcomes of the qualitative research are convincing. In chapter2 it is clearly described that the type of research strategy used in our study is hermeneutics. Empirical study involves qualitative research in which empirical study gives an general idea of realistic challenges involved in constructing DSS that is user-responsive. Empirical research generally makes use of primary data and the data collection method. We begin with a concise introduction of decision support system followed by how to construct an efficient DSS.

6.5.2 Transferability:

Transferability is also important in assessing a research. Result can also be assessed from Structure aspect. If it is excellent structure it is easy and obvious for the person who reads to know the point. We divided our thesis into empirical and theoretical result to represent high-quality and easy structure. The theoretical study makes clear that decision support systems are there in about every company; however the kind of the system utilized changes from company to company based on its volume, configuration and center competency. The reading make clear that decision support system is a necessity for any company because it generally makes easy the decision making process by directing the managers as well as clients to acquire decisions in doubtful circumstances. Despite the fact that there is no standard explanation of how a DSS have to work, a well organized DSS is one that offers support for decision makers in practically structured as well as formless conditions.

6.5.3 Dependability:

Dependability is alike to the idea of reliability in quantitative research. Dependability is concerned mainly with when if the research is repeated it shall give similar results when the research was carried out for foremost time. As qualitative study permits flexibility and individuality of the respondents it is hard to guess the state of dependability. However, the researchers have made an effort to set up dependability by maintaining the records and other information gathering in a data storage system. In the theoretical study information is gathered from a technique called as text analysis. It is a process for examining printed or oral communication in a methodical and ideal fashion.

6.5.4 Conformability:

Conformability In this research the researchers give the unrefined information collected from the review respondents to make sure conformability. Secondary data are unrefined data that have been previously gathered by some others for some regular information purpose like government survey or other authorized data or for a definite research development. In both of these essentials the main reason in gathering such information might be dissimilar as of the secondary user mainly in the situation of a previous research project. According to Lancaster G (2005), the use of secondary data is frequently referred to as secondary examination. It is at present ordinary for data position to be archived and made accessible for examination by new researchers.

6.6 Possibilities to generalize

The thesis is majorly text and interview based. The respondents are the people who are working with multinational companies that are specialized in constructing and delivering decision support systems. This makes our research discursive. The thesis is helpful for the researchers and people studying informatics.

6.7 Speculation for further Research

For future research, DSS will become an extravagant application due to the development of knowledge and model base. Research is required on the usefulness of methods for planning and constructing decision support system. DSS grow to be well organized and user responsive due to an communicative user interface, because it is what managers will view when they interact with DSS.

Appendix

This survey is a part of my ongoing study on "Process to Build an Efficient Decision Support System"

1. **Personal Details:**

   - Name:
   - Age
   - Designation:
   - Name of the organization:
   - Year of experience:

2. What according to you is the general purpose of a decision support system?
   _____
   _____
   _____

3. What are all the types of decision support systems that your organization delivers?
   _____
   _____
   _____

4. What do you think as the characteristics to be mandatorily possessed by an efficient decision support system?
   _____
   _____
   _____

5. List out some of the basic features that your clients expect for a decision support system to possess:
   _____
   _____
   _____

6. What process does your organization adapt in building a decision support system?
   _____
   _____
   _____

7. Illustrate the challenges that you encounter in building an delivering a user-friendly decision support system:
   _____
   _____
   _____

8. What are the steps taken by you in order to overcome the challenges encountered in building an efficient decision support system?

_____
_____
_____

9. How do you ensure to deliver a user friendly decision support system?

_____
_____
_____

10. List out some of the best practices adopted by your organization in delivering efficient decision support systems:

_____
_____
_____

11. As an expert in building and delivering decision support systems, what would you suggest for the future designers?

_____
_____
_____

Thanks for your valuable time!

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