THE USE OF KNOWLEDGE-BASED SYSTEMS FOR STRATEGIC DECISIONS IN ENGINEERING OFFICES IN JORDAN

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Submitted in Partial Fulfillment of the Requirements
for the Degree of Master in Business Administration

Faculty of Graduate Studies
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January 2003

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Dedicated with love to my parents who appear to be the inexhaustible source of energy for me and were the main driving force in the completion of this study

ACKNOWLEDGEMENT

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1.1 Information for Decision Making: An Overview

The utilization of information and knowledge in facilitating organizational activities has been recently of wide interest worldwide. The rationales and value of information utilization in supporting decisions will be highlighted in this section by identifying the importance of managing information and knowledge artifacts, and further by specifying attention to the steps of building a Knowledge-Based System and its benefits.

1.1.1 Knowledge Management

Knowledge Management is the process of *capturing* information and experience of individuals and the organization –which is available in databases, on paper, or even in people's intellect – and *distributing* it to wherever it can produce benefit.

In other words, Knowledge Management is a technique that seeks to improve the performance of individuals and organizations by making use of the present and future value of knowledge assets. It is presumed that the performance will be improved by providing the right knowledge to the right people at the right time.

Knowledge Management identifies the flow of knowledge within an organization as a process of four steps: starting with the entry of knowledge into the system (Knowledge Creation), preserving knowledge by allowing it to remain in the system (Knowledge Retention), the flow of knowledge from one part to another within the systems when needed (Knowledge Transfer) and finally applying knowledge in decision making and different business processes (Knowledge Utilization). (Brian and Kurt, 1999)

Studies have categorized knowledge into three main types: Explicit Knowledge, Implicit Knowledge, and Tacit Knowledge. Explicit Knowledge is presented in a formal tangible way (books, reports, … etc) that can be transferred easily. Implicit Knowledge whose content is not explicitly captured but can be easily transformed to explicit (such as an employee's experience of certain design criteria that is in his mind but can be easily reported explicitly in paper). Tacit Knowledge is knowledge embedded in individuals representing intangible factors (such as beliefs, values, … etc.). Studies identify tacit knowledge as the most important type though it is rarely recorded or shared (Zoltan and Josef, 1999). Moreover, knowledge can be classified according to its source to internal and external (in terms of the organization dimensions).

However, knowledge transform from one type into another through different techniques: Formalization involves conversion from tacit

knowledge to tacit knowledge, Externalization involves conversion from tacit knowledge to explicit knowledge, Combination involves conversion from explicit knowledge to explicit knowledge, and finally Internalization involves conversion from explicit knowledge to tacit knowledge. (Mahe, Rieu, and Beauchene; Gerry and Kevan, 1999)

1.1.2 Importance of Knowledge Management

Knowledge Management is intended to facilitate the production of relevant and timely information for planning, controlling, decision-making, and performance evaluation. Knowledge Management should enable managers to undertake the strategic, tactical and operational activities necessary to achieve the organization's overall objectives. The utilization of knowledge management for different organizational activities is illustrated in figure (1-1) below:

Developed by the researcher
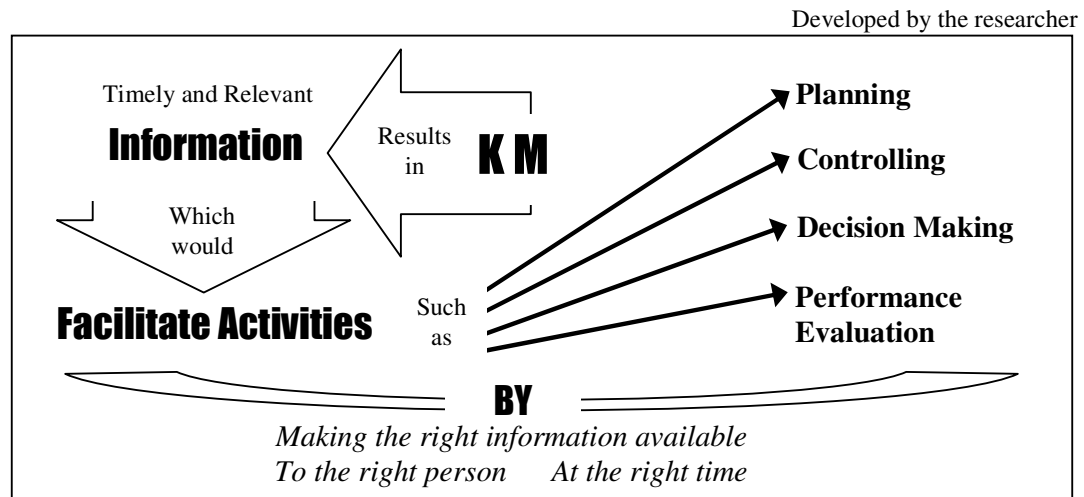
Figure (1-1): Utilizing KM for different organizational activities

However, an organization gains competence and strength not only through the knowledge availability, but also by the means of its representation and management in order to be easily found when needed. Organizing the knowledge that is available through a system, such as the Knowledge-Based System (KBS), plays a significant role in gaining the benefit from the available knowledge. This study will highlight the manner through which KBS can facilitate the search for data in an easy manner by having a user-friendly interface that intelligently interacts with the user. In other words, Knowledge Management is managing our knowledge by achieving the saying "To know what we know". (Sue, 1999)

Knowledge Management is important for organizational improvement, because what worked yesterday may not work tomorrow; by getting updated information into the organization's databases, the organization can

avoid the threat of the fast changing environment these days. A threat that is illustrated by the saying "Today's core competence may become core rigidity of tomorrow"(Malhotra, 1998)

Why do organizations need knowledge management? Generally, knowledge management facilitates managing businesses and prevents the loss of knowledge due to retirements and change of strategy. On the other hand, knowledge management reduces the time required in acquiring information. However, it all leads to achieving effective strategic decisions for the future of the organization.

With the use of knowledge management contribution in operations, every situation is addressed with the sum total of everything anyone in the organization has ever learned in the past about a similar situation (Brian and Kurt, 1999), and that decisions can be built -if possible- to figures rather than just experience of managers. In contrast, without knowledge management, dealing with a particular situation would be based only on what an individual or a group thinks at that specific time. On the other hand, the contribution of employees at different levels of the organization helps in achieving commitment, because individuals would feel that they are contributing in the decision for the future strategy of the organization rather than having it imposed upon them.

1.1.3 Building Knowledge-Based System (KBS) and its Benefits

It should be kept in mind that "Knowledge Management" is the broad science behind Knowledge-Based System. There are different criteria and techniques for the management of knowledge within any organization, of which KBS represents one of the most recent and advanced. KBS is a collection of tools for data retrieval, that employees would depend on at different levels for planning, controlling, decision-making, and performance evaluation as shown in the model developed by the researcher in figure (1-2) below.

What makes KBS receive worldwide interest recently, and makes it more unique than the simple knowledge management or file management techniques, is that it achieves comprehensiveness by resting on both knowledge and information base that would be gathered from every employee in the organization. Second, is the unique interaction between the system and the user in an easier scenario (like a dialogue) rather than a simple data search and/or reporting system. Chapter two of this research will further identify the characteristics of such a system, and the different concepts concerning the use of the system specially as a decision-supporting tool.
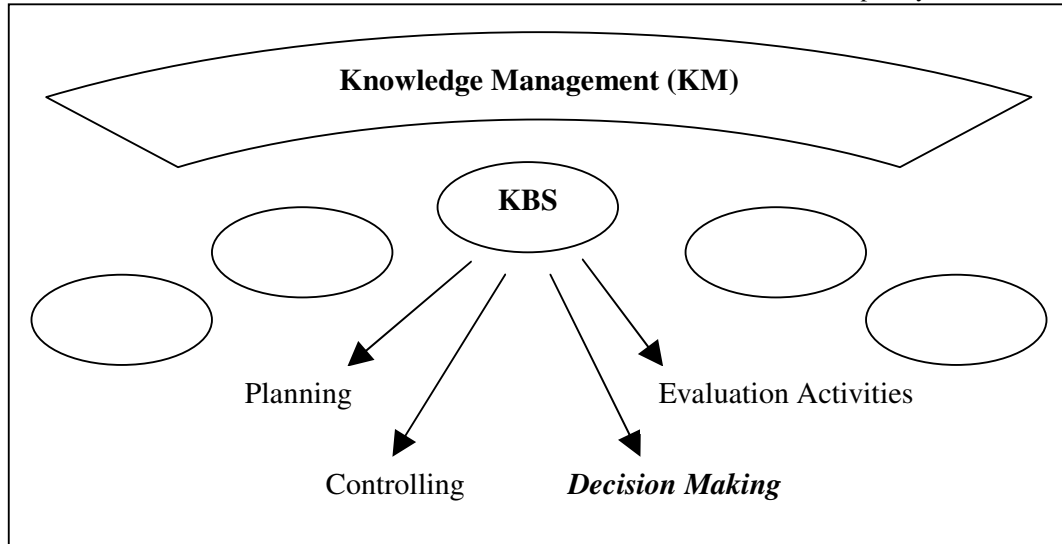
Figure (1-2): KBS as one of KM techniques for improving the organizational performance

The aim of this study is to highlight the importance of such a system particularly as a decision-supporting tool in selected Jordanian organizations.

Summarizing what was said earlier, the researcher has developed a simplified framework for the benefit gaining process of Knowledge-Based Systems as a decision-supporting tool. Figure (1-3) shows these simplified steps, which can be divided into three:

- Starting with information gathering and continuous updating of the available information in the database.
- Achieving system effectiveness: the organization should achieve awareness of the use of the system amongst the users (easily getting information into and out of the system) and amongst decision makers (achieve trust of the higher level managers at the different decision making levels for the truthfulness of the data and thus accepting to depend on it).
- Information Utilization: information should be distributed to the right person at the right time.

However, in order to achieve the effectiveness of the system, additional requirements would be the coordination and contribution of the whole organization and its different departments, as well as the necessary support of the managers.

1 **Capturing** *reliable* information potentially *useful*.

Input

2 **System Effectiveness** by achieving *awareness* (to know what we know and how to get it) and *acceptance* (to believe in what we know) between individual

Throughput

Building KBS

3 **Distributing** information to the *right person* at the *right time*

Output

Gaining KBS Benefit

All should be within a *healthy environment* of *effective communication* and *coordination* between departments that *encourages contingency thinking* and grants individuals' *empowerment* bounded with *leadership respect.*

Main Result

Effective decision making that would guide the organization's future strategy and improve performance

Minor Results

o Achieve Loyalty of individuals feeling that they contributed in decision making
o Reduce cost of acquiring information
o Reduce time for information gathering, which results in having the information at the right time.

Figure (1-3): Simplified 3-Step Process to achieve an effective KBS as a DSS

The previous process represents the basis for a more detailed process that will be discussed in chapter two of this study.

1.1.4 Information as a Core Competence

This subject has been of interest to many researchers worldwide; such interest was the result of managers increased realization for the importance of knowledge and information as a key resource. This was additionally highlighted with recent advances in information technology such as the fast improvement of computers and communication tools. On the other hand, one of the most effective benefits of knowledge management is its support for decision-making processes; this benefit represents one of the most significant positive effects on the performance of the organization and its bottom line.

However, harvesting the benefit of information and Knowledge as a decision supporting tool cannot be excelled without having a system of hardware and software through which information (characterized as correct and reliable) can easily be added or taken off, such a system is often called a *Decision Supporting System (DSS)*. The DSS facilitates the decision-making that would guide the short and long-term direction of the organization.

Accordingly, it should be pointed clearly at this point that the main focus of this study is to evaluate the extent of using Knowledge-Based Systems as DSS's in certain selected Jordanian organizations.

The researcher supposed that a big percentage of the organizations under study would have information technology for keeping data such as designs of previous projects (like AutoCAD files and previous reports). Although such information may sometimes help in decision-making, the research will try to highlight the management of information and knowledge that are directly related to decision making. This will include for example information about certain markets, previous bidding documents, information about other competitors, costing techniques, accounting information, … etc. The research will also identify the effectiveness of documenting and storing such data for later use.

1.2 The Study Problem and Its Importance

This study derives its importance from its subject, which is concerned with knowledge management. The researcher believes that the problem behind this study is the inherent risk facing Jordanian organizations due to globalization. This risk has two perspectives:

1. International organizations are performing an increasing number of projects in Jordan, which reduces Jordanian organization market share.

2. Jordanian organizations are forced to work internationally in order to compensate for the decrease in local share and in order to survive within these changing situations.

Consequently, Jordanian organizations are forced to improve their performance in order to compete internationally and avoid the risk inherent in international operations.

This study deals with the problem more specifically by identifying the importance of having a comprehensive database that would include information (such as instability of certain foreign economies, currency fluctuations, and adverse tax policies and governmental activities) in reducing this risk by providing a powerful base for decision-making.

The question here is: Are Jordanian organizations aware of the importance of knowledge management and of its benefits in preventing the loss of knowledge and facilitating business adaptation to the fast changing turbulent environment?

The researcher anticipates that this study derives its importance due to the presumed value added to readers and Jordanian library; which can be summarized through the following points:

1. The study reveals the link between intangible assets and financial results by demonstrating the benefits of shifting focus from managing tangible assets to managing knowledge and intangible assets.

2. This study characterizes various methods and technologies used in knowledge management. It provides an overview for a number of key terms and concepts, and links them to the methods of building a Knowledge-Based System as a decisions evaluating tool.

3. The study highlights the difficulties associated with applying Knowledge-Based System, and what should be done at each organizational level to achieve the desired benefit.

4. The study importance will be more obvious when addressing the importance of Knowledge-Based Systems in building a corporate future through helping in taking the right strategic decisions.

5. The study will enrich the Jordanian library and motivate future researchers to carryout further studies in this and other related topics.

6. Finally, the importance of this study arises from the scarcity of researches that have examined this subject in the past, and perhaps the first to discuss the subject from this perspective and in the chosen sector.

1.3   The Aim and Objectives of The Study

This study aims to:

1. Explain the importance of applying Knowledge Management in some Jordanian organizations

2. Anticipate the effect it might have on the performance expressed by taking potentially successful strategic decisions.

The study will illustrate the following objectives:

1. Highlighting main ideas concerning what should be expected from Knowledge Management.

2. Outlining the major difficulties associated with implementing Knowledge-Based Systems.

3. Explaining what the organization should do at each organizational level.

4. Explaining the major steps for implementing a Knowledge-Based System.

    (Objectives 1 through 4 will be covered through the secondary sources such as books, literature survey, and through interviews to conduct managers' opinions; these objectives will be mainly highlighted in chapter two of this study)

5. Understanding the benefits of knowledge management system for the organization especially as a decision-supporting tool. (This will be studied through focusing on the effect of having a KBS on the effectiveness of strategic decisions represented in the theoretical model and tested in the presumed hypotheses)

6. Identifying the major factors that must be fulfilled in order to achieve an effective Knowledge-Based System. (This will be studied through focusing on the importance of the chosen independent variables in achieving an effective KBS and on the effectiveness of strategic decisions, as illustrated in the theoretical model and tested through the first hypothesis).

7. Identifying the effect of different aspects on having a KBS and making effective decision. (This will be studied through the effect of categorization of the company and the number of employees on the building of KBS and the making of an effective strategic decision, which is illustrated in the theoretical model and tested in the second hypothesis).

2.1 Organizational Knowledge Management

Within the last few years, the topic of Knowledge Management has gathered a lot of interest; companies, governments, institutions, and organizations are demonstrating an increasing interest in the topic. This topic will be highlighted by identifying the set of processes, events, and activities for determining knowledge type and sources, the flow of knowledge within the organization, types of knowledge, and in the transformation of knowledge from one state to another.

2.1.1 Introduction to Knowledge Management

Although there is no commonly agreed upon definition of Knowledge Management, according to "The Knowledge Management Year Book 1999-2000", knowledge management can be defined as: identification, optimization, and active management of intellectual assets, either in the form of explicit knowledge held in artifacts, or tacit knowledge possessed by individuals or communities[1].

The activities of knowledge management have become important to organizations willing to survive and adapt to the changing environment. The importance of knowledge management within an organization can be seen as providing a repository in which external and internal knowledge would be stored, such system would provide the employee with easier accessibility to required knowledge in less time and effort. Overall, the organization will gain competence by enhancing its knowledge environment, and managing knowledge as an asset to improve its daily activities such as decision making, controlling, planning, and performance evaluation.

"The Knowledge Management Year Book 1999-2000" specified four main factors of success in a knowledge management project:

"
- *Build a Knowledge-Friendly Culture*, where:
    - o People have a positive orientation to knowledge
    - o People are not inhibited in sharing knowledge
    - o The knowledge management project fits with the existing culture
- *State your Clear Purpose and Language*.
    The term - "knowledge", "information", "organizational learning", "data" - are subject to varied use and interpretation. Pay attention to this factor for your organization.

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[1] Quotes from "The Knowledge Management Year Book 1999-2000" are available online at: Knowledge Management Research Group Website   http://kmrg.itb.ac.id/concept/

- *Use Multiple Channels for Knowledge Transfer.*
- *Give Senior Management Support*, in the form of:
  - ○ Sending messages that knowledge management and organizational learning are critical to the organization's success.
  - ○ Providing funding and other resources for infrastructure.
  - ○ Clarifying what types of knowledge are most important to the organization.

"

Today's competitive focus agreed to be in the strategic management of the organization, and the way it perceives and adapts to the changes in its environment. Knowledge management and information technology's role has been in the core of these new developments. KM helps organizations interpret their future and improve their daily activities as will be discussed in this chapter.

2.1.2 Determining Information Type and Sources

The type of information that should be gathered depends on the long-run objectives and strategies of the company; understanding the organization's requirements and forecasts of it's future represents the first step in building a master plan for its information system.

On the other hand, it should be recognized that the scope and benefit of the system would affect more than one department or division of the company, thus the information should assess different decisions that may be made in each department, such information should be related to financial, commercial, strategic, and technical factors. Accordingly, determining the type of information, and the gathering of information should be a comprehensive effort of employees at different departments of the organization.

To The Point →	The scope of the system would affect more than one department of the organization → Should include information that assess different decisions made in each department → Coordination between departments and sharing of knowledge in a healthy atmosphere should be guaranteed in order to achieve system effectiveness.

Generally the KBS would include information gathered from the industry environment, such as news concerning different projects, rumors, budgets,

…etc, as well as information gathered from individuals' standards within departments.[1]

As previously pointed, determining information type and sources would be the first step for an organization attempting to build a KBS. This step would start by identifying the organization's strategies and vision for the future, and then determining the type of information potentially expected to be useful. Next is setting strategies for gathering such information from outside and inside the organization. Taking into account that having an integral system, which includes every single piece of information needed, is a non-achieved goal since environmental variables are a dynamic system.
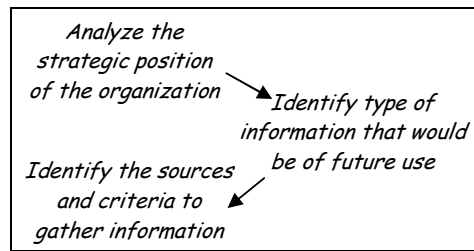
Analyze the strategic position of the organization

Identify type of information that would be of future use

Identify the sources and criteria to gather information

2.1.3 The Flow of Knowledge within the Organization

Knowledge flow comprises the set of processes, events and activities through which data, information, and knowledge are transformed from one state to another. General Knowledge Model organizes knowledge flow into four primary activity areas: knowledge creation, retention, transfer, and utilization.(Brain and Kurt, 1999)

Knowledge Creation: Include activities associated with the entrance of new knowledge to the system; this activity would include knowledge discovery, search, and capture, and should be done from all employees at different organizational levels.

Knowledge Retention: Include activities associated with preserving knowledge into the system and allowing it to be available for later use; this would include feeding the system with the knowledge and saving it in a viable manner. Knowledge retention is usually the second step that follows knowledge creation; however, between both steps, screening activities by selected number of employees should be done. The screening activities would filter the mass of the collected data so that only useful and correct data are to be stored into the system. On the other hand, screening activities would avoid having misleading, irrelevant, unrelated, or wrong data in the system. Finally, saving data into the system should be done in a systematic organized manner to avoid the duplication of data.

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[1] Such information would be gathered and added to the system by employees from different departments and at different organizational level in a systematic and organized manner to avoid duplication of data and to avoid having useless or misleading data.

Knowledge Transfer: Includes activities associated with the flow of knowledge from the system to the target party, or from one party to another within the organization. This includes communication, meetings, memos, data search, translation, conversion, filtering, and rendering of knowledge.

Knowledge Utilization: Includes activities describing the application of knowledge to business processes. It would include using data for different activities within the organization such as planning, organizing, decision-making, and performance evaluation. Moreover, the knowledge utilization activities can be associated with the creation of new knowledge and ideas that may be added to the system as well.

Source: http://www.km-forum.org/KM-Characterization-Framework.pdf
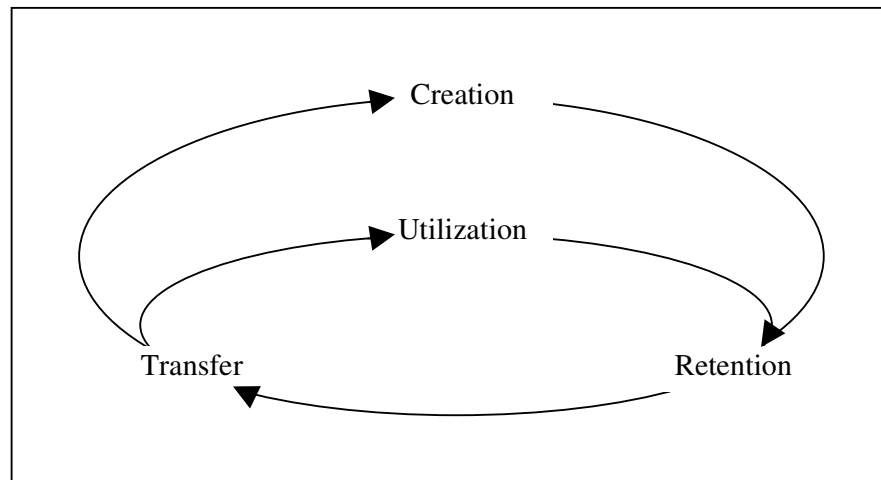
Figure (2-1): The General Knowledge Model

However it should be noted that within each activity phase, there exists other smaller knowledge flows and cycles, the totality of these cycles would cover the whole organizational activities and levels ranging from the broad organizational activities to the individual day to day decisions. (Brian Newman, 1999; Kurt Conrad, 1999)

2.1.4 Types of knowledge

There are different classifications for the type of knowledge within an organization. These classifications are based on its source, location, reason of adopting, and other characteristics. Through this section the research will attempt to briefly identify the basic classification relevant to the study.

Three main classifications will be discussed in this section of the study: First, is classifying of knowledge according to its source; this classification states that knowledge is either from within the organization or from outside sources. Second, is classifying the knowledge according to the motivating

need whether it was gathered in response to a problem or not. Third, is classifying knowledge according to its tangibility, which states to what limit the knowledge could be explicitly reported. These classifications are illustrated in table (2-1) below:

Table (2-1): Classification of Knowledge into different types

According to	Source		Motivating Need		Tangibility		
Types	Internal	External	Primary	Secondary	Explicit	Implicit	Tacit
Reference criteria	Organization dimensions		Reason to gather knowledge		Representation of the data		

According to source knowledge that would feed the system can be divided into internal or external. *Internal* knowledge represents data that would be gathered from within the organization employees and from there own previous experience (such as previous bids results, design criteria, …etc) However, the totality of the system cant be guaranteed only from these sources and most strategic decisions would require information about markets, industry, and competitors. Such information would be gathered from *external* sources including magazines, reports, external specialists, experimental studies, surveys, rumors, …etc. It should be noted at this point that the source of the data should be identified in the system for its importance in estimating to what limit the decision may depend on it.

According to motivating need two types of information would feed the system simultaneously; primary and secondary as follows (Willain, 1971):

- *Primary Information*: which include information that would be gathered as a response to a certain problem. However to determine what information is required for the solution of a business management problem, the totality of the problem must be defined with all its integral and interrelated parts as well as the environmental variables which influence the problem. Such information should be added to the system for later use in similar situations.

- *Secondary Information*: which represent information gathered and added to the system in continuous basis and not as a response to a certain problem. For a certain problem, this type will also include

information that was previously gathered and added to the system in response to previous problems.[1]

According to tangibility, knowledge can be divided into three main types explicit, implicit, and tacit (Zoltan and Josef, 1999). The classification criteria and characteristics of each are as follows:

- *Explicit Knowledge* is presented in formal tangible way (books, reports, ... etc) and accordingly can be transferred easily. This type of knowledge is expressed in a way that allows it to be easily and completely transferred from one person to another. Most probably this knowledge is expressed in a materialistic way easy to touch, feel, and manipulate (e.g. books, reports, data files, newspapers, audio cassettes, and other physical forms). The optimization of explicit knowledge is achieved by consolidation and availability

- *Implicit Knowledge* whose content is not explicitly captured but can be easily transformed to explicit (such as an employee experience of certain design criteria, which is in his mind but can be easily reported explicitly on paper). In other words these include data of which the codification process is incomplete.

  Interpreting of implicit knowledge must rely on previously retained knowledge. Even though implicit knowledge is not explicitly apparent, this knowledge usually represents an important asset that would effectively constrain activities, and should be added explicitly if possible into the system.

  > "*The explicit knowledge as we find everyday is like a top of an iceberg where the tacit knowledge reside under the surface. Managing the tacit knowledge becomes very important and strategic for organizations*" (The Knowledge Management Year Book 1999-2000)

- *Tacit Knowledge* which represents knowledge embedded in individuals involving intangible factors (such as beliefs, values, … etc) which is rarely recordable or shared although it may be the most insidious and powerful of the three. Michael Planyi, 1966 referred to tacit knowledge as "knowing more than we can say" (Mahe, Rieu, and Beauchene). The importance of this type of knowledge can be seen by imagining what would happen if each person would stop and think of how to walk!! Holding and sharing such knowledge achieve the optimization of the benefit of tacit knowledge.

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[1] Notice that the same piece of information can be classified primary to certain problem at certain time, and secondary to other in the future or at that same time.

2.1.5 Transforming of Knowledge Type

Generally, distinction can be made between two types of knowledge; on the first hand is the explicit knowledge (formalized in books or by words...) and on the other hand is implicit knowledge (non-formalized) (Mahe, Rieu, and Beauchene; Gerry and Kevan, 1999). The aim within an organization (or a managerial system) is to capitalize on the available knowledge and to create new knowledge.

Nonaka (1994) has studied the dynamics of knowledge with regards to implicit/explicit distinction resulting in four possible evolutions (from one to same or from one to another). Nonaka states that not only the two static knowledge dimensions presented earlier should be taken into account, but also the four dynamic knowledge dimensions (Mahe, Rieu, and Beauchene). The four possible evolutions are shown in the figure (2-2) below:

Source: http://ksi.cpsc.ucalgary.ca/KAW/KAW96/mahe/maherieu.html
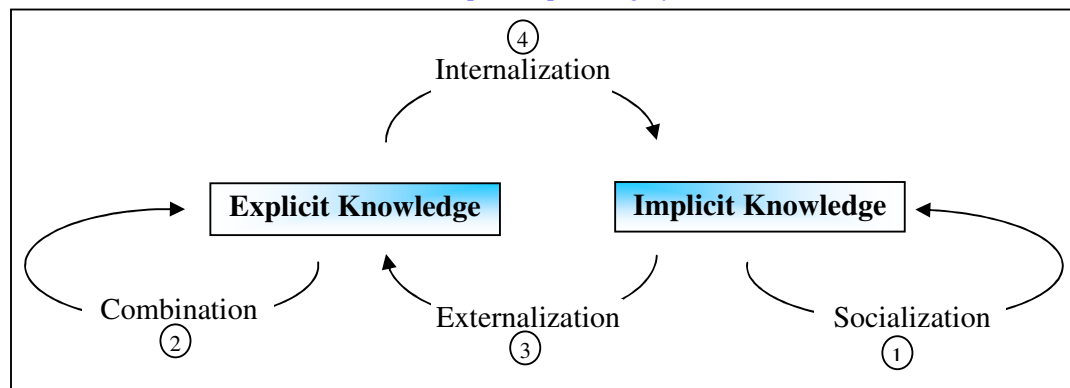
Figure (2-٢): Dynamic of Knowledge Creation in the Enterprise

Socialization (From Tacit to Tacit): The tacit knowledge of a person can become the knowledge of another. This can be seen as the result of strong interaction between employees. This process is not associated with the help of a language but with observation, imitation and practice.

Combination (from Explicit to Explicit): This represents the easiest transforming mechanism. Usually done by the aid of languages and communication mechanisms where people can gather the knowledge of others and combine them with their own, and thus obtain new knowledge.

Externalization / Formalization (from Tacit to Explicit): Practices sometimes can be expressed in formalized manner. This mechanism is considered the hardest operation to implement in real world, but may also be considered the most important due to the importance of tacit knowledge as previously discussed in earlier sections.

Internalization (from Explicit to Tacit): by repetition we root the explicit knowledge in sequence that can reach the reflex level, by adapting the explicit diagram to specific conditions of the execution (Mahe, Rieu, and Beauchene)

2.2 Decision Making

The study of decision-making and problem solving has attracted much attention through most of this century. This section will highlight the major concepts concerning decision-making processes and activities. The discussion will include (but not limited to) decision-making influences, management decision hierarchy, and main characteristics of strategic decisions.

2.2.1 Problem Solving Concept

Decision-making can be defined as the process of choosing among different alternatives that are presumed for problem solution. Problems occur as a result of change in the environment, objectives of the organization, functioning of the business, personality and demographical roles of key employees, and change in their way of running the business. These changes are examples of those that lead to deviation between reality and the organization overall objectives (what ought to be) <a problem>.

However, problems vary in their importance according to the criticality of the subject under study and according to the degree of deviation. Therefore some problems are more complex than others, but all problems need a certain level of attention.

In order to understand the problem, there are a group of elements that should be studied; starting with identifying the organization's overall objectives (the desired state), then comparing such a state to the organization's present state. The resulting gap between both identifies the degree of complexity of the problem the organization is facing.

After identifying the problem, a set of criteria(s) (alternatives) should be identified for solving it (reducing the gap between the current and the desired state), in the mean while constraints that

may affect the implementation of each solving criteria should be identified. Finally, is the step of choosing among those alternatives and implementing the change under continuous controlling and evaluating scheme.
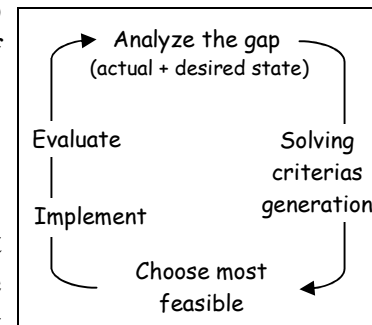
A scenario of problem occurrence and its solution is shown in figure (2-3). However, a real problem situation is more detailed and can be more complex in practice than the previous scenario presented in the figure.

To The Point	→	A KBS is a high-tech tool that helps managers in their daily activities, one of its functions that will be highlighted through this study is its use as a decision support system (DSS) which helps decision makers evaluate problems, and test assumptions with corporate data which would result in choosing the most effective solution criteria.

Decisions within an organization vary in the degree of risk associated, at the first extreme of the scale are decisions taken within a situation where abundant sources of information limits and minimizes the degree of uncertainty. The degree of information scarcity determines

Decisions are taken in three different states scale representing the scarcity of information available

Certainty   Risk   Uncertainty Ambiguity

the degree by which risk is associated with the decision in hand, and accordingly intuition would be the basis of choice (أحمد جمعه و رفعت جاب الله،

3-Dimensional Model

Stable
Abundant

Simple → Complex

Scarce
Dynamic

Arrows indicate direction toward higher uncertainty

١٩٨٦). The degree of uncertainty in the decision making state, is a reflection to the degree of uncertainty in the environment and industry, the uncertainty of an environment can be scaled according to three factors proposed by the three dimensional model. The model states that environment uncertainty depends on volatility (degree of instability: stable vs. dynamic environment), complexity (degree of heterogeneity: simple vs. complex), and capacity (degree by which it can support growth in resources and information: abundant vs. scarce) (Stephan, 2001).
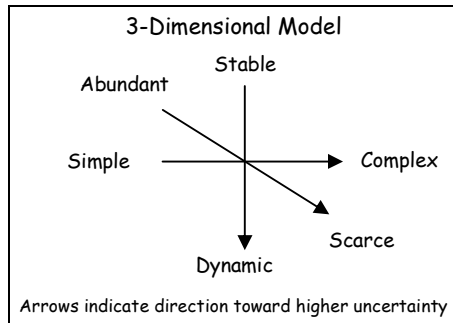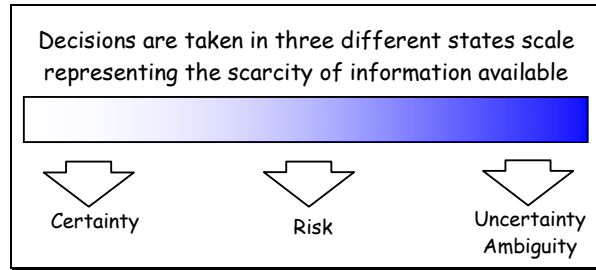
To The Point	→	The role of KBS in the decision making process can be seen in the stages of generating alternatives, evaluating these alternatives, and choosing the most feasible. However, such a system would push the decision making process into states of higher certainty by having abundant sources of information in the hands of decision makers.

Finally, it should be noted that a set of implicit decisions are made in every situation about the decision itself: Whether to decide → What to decide → Who will decide → How to decide.
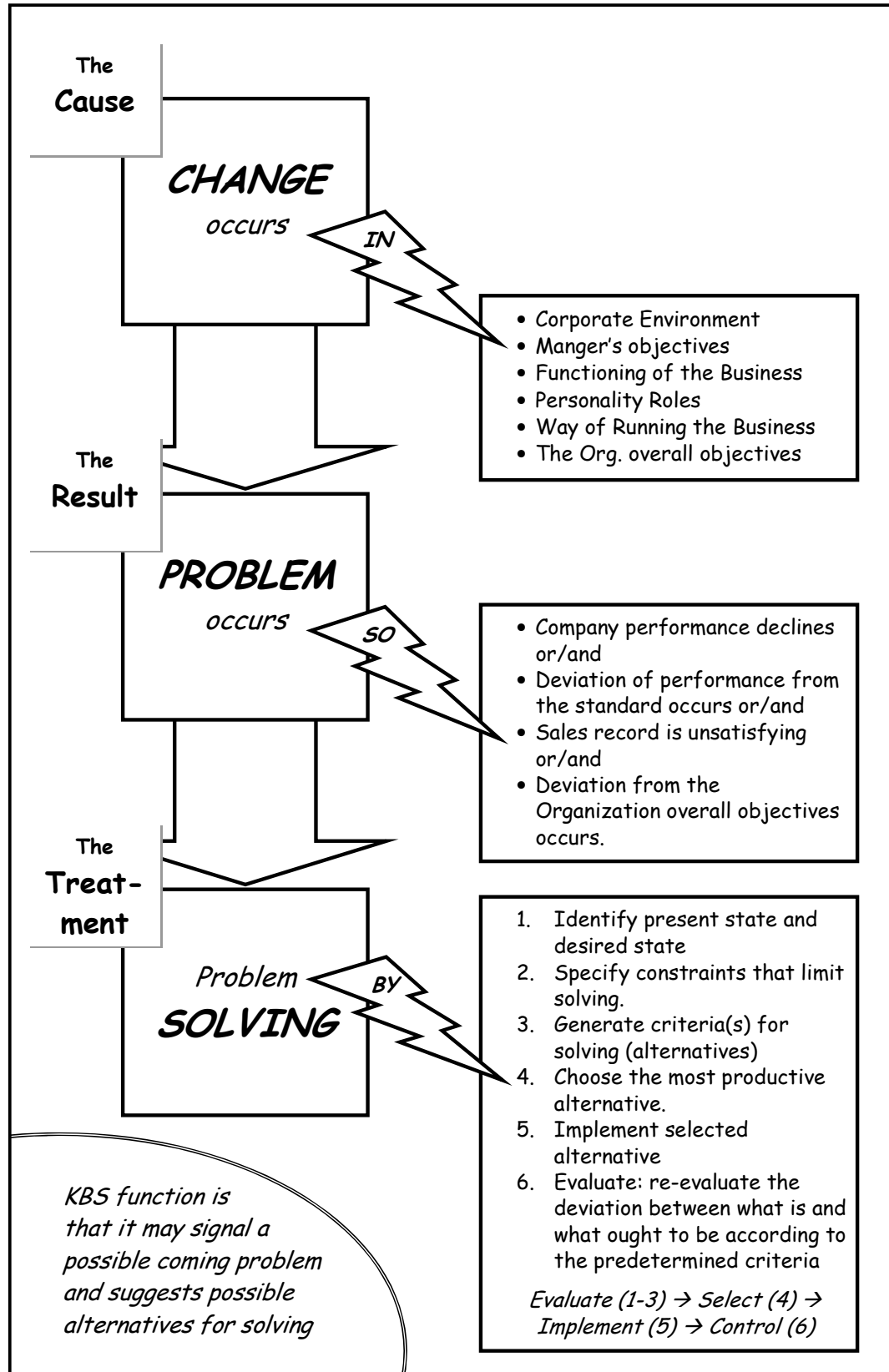
Figure (2-3): Problem Formulation and Solving Process

2.2.2 Decision Making Influences

The information used to analyze the problem may be considered the basic influence on the effectiveness of the taken decision. Emotions, values, and principles of the decision maker also have an influence and a role. However, it is important for decision makers to first be aware of all influences (by determining how decisions operate and the environment in which decisions are made), and secondly to consider how to handle the influences to make the better decisions.

Generally, decision makers are bounded by several influences that limit their alternatives and choice. Such influences can be related to three major organizational dimensions: Personal, organizational, and environmental dimension.

Decision-making occurs as a reaction to a problem. However, the awareness that a problem exists and that a decision has to be made is a perceptual issue, which differs from one person to another. Two managers within the same industry and market may perceive a certain event differently and thus react or not react differently. The difference in personal perception results from difference in education, emotional state, position within the hierarchy, economical situations, interest, past experiences, and expectations.

Most of the times organizational influences posses a challenging limitation for employees and managers in their daily decision-making processes. Pressures to avoid errors or complete tasks in a limited time period, work overload, and unpleasant co-workers are a few examples of pressures that may influence the decision-making process. These factors have been classified around task, role, and interpersonal demands, organizational structure, organizational leadership, and the organization's life stage. (Stephan, 2001)

Finally, environmental factors influence the decision making process. Economic, political, social, and technological uncertainties are only examples of such influences. Moreover, due to globalization, organizations should adjust to the international cultures and their reappraisal of the home culture as one of the key components during the decision making process (Riki, 2001), organizations must consider the implication of a dualistic adjustment perspective that takes the impact of these two dimensions (international and home culture) on decisions.

2.2.3 Management Decision Hierarchy

Decisions within each department and within the organization as a whole tend to be organized in a sequential descending hierarchical order according to its importance and scope. The order is based on the fact that decisions of broader scope tend to affect subsequent decisions. Therefore, decisions should be made in a descending order so that no decision is given priority in preceding another decision of broader scope. (William, 1971)

Controversially, and incase when decisions are made without accordance with the rationale of this sequence, subsequent decisions may require revision after a broader decision has been made; this would accordingly influence the operations of the firm and become a time consuming process.

2.2.4 Quantitative Decision Making in Business

Quantitative models in decision problems have been widely used for evaluating alternatives and choosing from them. Especially in cases when the complexity of the problem result in the fact that finding the appropriate decision becomes difficult by general studying.

In such cases, when the complexity of the problem makes it difficult to make decisions, constructing an accurate model and using the techniques of quantitative decision-making can be useful. Examples of such techniques where real decision problems are handled using quantitative methods include linear programming, inventory control, queuing, and project scheduling techniques.

Moreover, computer software have been widely used for solving such models for real world problems which would insure the speed, accuracy, and flexibility compared to the time-consuming and difficulty of carrying them out by hand.

2.2.5 The Nature of Strategic Decisions

The study at hand focuses attention to strategic decisions as being one of the most challenging yet important decisions made in the organization. The strategic decisions represent a challenging and complex process because it involves an unstructured process with a wide variety of conflicting and equivocal considerations and inputs.

Managers at strategic positions are being usually asked to form their own understanding (interpretation) of the external and internal variables in which their organization is operating, and to extend this understanding into

an intuitive feel of what should be done to improve the organization future position. (Robert, 1998)

Due to the increased level of uncertainty in a complex environment that most industries face nowadays, little precedents and knowledge are accompanied with the problems where decisions should be made. Therefore, reliance on intuition becomes a must for managers. Intuition does not represent the alternate of formal analysis rather than it represents a complimentary tactic that strategic managers should have. Robert (1998) argues referring to Mintzberg (1976) that planners utilize two kinds of analysis: formal analysis as well as their own intuition. Mintzberg argues that both styles are needed; it is the dilemma of achieving an optimal mix of both that remains.

This leads to understanding the importance of knowledge -and tacit knowledge in specific- in guiding an individual's thinking and intuition, and in limiting the factors which are considered important in a decision as will be discussed in later sections of this chapter.

2.2.6 Main Characteristics of Strategic Decisions

Generally speaking, operations within an organization articulate decisions at the strategic, tactical, and operational level (Willem, 2000). Strategic decisions represent characteristics that are somehow different from those performed on a daily basis within other levels of the organization; the difference can be seen from this simple example: inventory decisions at a store represents a structured formal process through which a DSS programmed to signal an alert whenever the inventory of a certain item is below a certain level would guide the logistic manager to furnish an order. The previous scenario is of no existence in strategic decision where it would rely mainly on intuition. Willem (2000) confirms on the importance of strategic decision compared to the other types saying: "these strategic implications then filter through the organization or network of organizations to the tactical and operational decision-making processes".

The major characteristics of strategic decisions that Robert (1998) pointed out in a study concerning the importance of tacit knowledge in strategic deliberations and decisions, can be identified as follows:
- o Use intuition decision ability that would depend on gut feeling.
- o Not easy modeled or analyzed.
- o Complex, unstructured, nonlinear, fragmented process.
- o Often have no precedence or guide.

o Inputs are highly qualitative and equivocal in nature.

So far strategic decisions can be seen as the managers combination of his own interpretations of the internal and external environments with the tacit knowledge that he/she or others have according to previous experience to suggest a future action.

		The role of KBS can be seen as providing a platform of knowledge that would guide the decision maker's thinking and limit the possibilities taken into consideration. Thus forcing managers to combine the effort of formal analysis and intuition into an optimal combination that would lead to a better understanding and decisions, rather than depending on intuition only.
To The Point	→	

2.3 Knowledge-Based System for Decision Making

The ability and skills of the decision maker, that would determine the quality of the decision and problem solution, are highly influenced by the availability of information and its relevance. The following section will highlight the use of KBS for decision making; the section will generally identify the basic concepts of KBS such as evolving key roles, difficulties associated with building a KBS, benefits associated with KBS, …etc and links it to its use in decision-making processes and activities.

2.3.1 Introduction to System Theory and Management

Organization is a composition of subsystems that interact and work simultaneously to achieve certain goals. A system can be defined as the structure that contains several integrating units working together to achieve the common goal.

A System's role can be viewed as changing of inputs into outputs; the outputs of one system would be the inputs of another complementary system. This emphasizes the importance of healthy communication and information flow between different systems within the organization at different departments[1]. Naturally, this will be associated with conflict in opinion; which can be positive-constructive or negative demolishing.

Organization systems are classified as major and minor, the communication and holistic work of these systems sum up to a total system -integrated system- that takes into account social, cultural, environmental,

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[1] Sciences have been concerned in the problems associated with communication and control between different systems; example is (Cybernetics) which is the science of communication and control.

organizational, …etc systems. Such system attempts to help manager's role in understanding the complexity of the dynamic environment in which the organization operates, which would facilitate managerial activities such as decision making.

To The Point →	The role of the KBS can be seen so far as the tool that would facilitate the flow of knowledge between different systems within the organization, however the focus of this study is to understand such a role in the gathering of knowledge that everyone has and to allow it to be accessible for decision makers whenever needed.

Three major systems should be understood in organizational environments (محمد شهيب، ١٩٨٠):

- *Environmental System* identifying the major economical, political, social, and cultural factors of the environment through which the organization is operating.

- *Competitive System* identifying the industrial norms within which the organization is operating including the competitive relations.

- The *Internal Organization System* identifying the organizational structure, aims, strategies, and different relations within the organization dimension.

To The Point →	The researcher through the last section has started his study of KBS by generally studying the basic principles of the managerial system for the fact that a KBS should coincide with these principles

2.3.2 Introduction to Knowledge-Based System

The major role of the KBS in supporting the Decision-Making System is through facilitating the knowledge flow reaching the decision makers. This would improve manages decisions by taking into account as much as possible all aspects that influence the decision to be made.

Decision-Making System includes the following six major elements:

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- Information	- Alternatives
- Objectives	- Probabilities
- Strategies	- Consequences

Decision-making is usually based on two types of information: Information gathered at the time of the problem and in response to that specific situation. (Primary), and Information previously gathered in earlier similar problems. (Secondary)

From this perspective the role of a KBS would be seen as reducing the time required for decision-making by reducing the time required for data collection. On the other hand, it would insure a more comprehensive set of data that would achieve effective decisions especially in critical situations.

Knowledge-Based System is not quite of a new practice as it is an integrated practice. The difference between a Decision Supporting System (DSS), Management Information System (MIS), Accounting Information System (AIS), …etc and a Knowledge-Based System (KBS) can be seen as a functional difference. While previous practices where much oriented to record keeping, transaction processing, or report generation, and DSS was decision oriented, the KBS was more into an integration of these systems (that would generally speaking support each individual in the organization rather than being oriented to certain benefit only). Another difference can be seen as expanding the interest to implicit knowledge as much as to explicitly represented information, while previous systems emphasized on systematic explicit knowledge only. KBS expanded the interest to intangible assets and the benefits that can be harvested from them.

The benefits harvested from a Knowledge-Based System are emphasized in facilitating dealing with problems; the study at hand highlights the role of such a system in decision-making processes. Examples of decisions that may be handled through such a system include: the business acquisition

decisions, the joint venture decision, market choosing and entry decision, as well as other daily decisions.

Finally, KBS should be characterized as flexible and dynamic. Being able to adapt to the changing organization industry and environment is one of the major factors for its success. New data that reflect the changes in the organization environment should be continuously fed into the system to achieve more effective predictions of the future. Moreover, the system should achieve a human-machine interaction that ensures taking feedback of the type of data potentially useful as previously discussed.

2.3.3 DSS classification

In order to give a more general understanding of the subject, the different classifications of DSSs would be identified to highlight the comprehensiveness of KBS compared to previous practices.

DSSs are classified to seven main types, the classification can be generally identified as data oriented or model oriented systems. Data oriented systems include

Data Oriented Systems		Model Oriented Systems
- File Drawer Systems	DSS	- Accounting Models
- Data Analysis Systems		- Representation Models
- Analysis Information systems		- Optimization Models
		- Suggestion Models

file drawer systems, data analysis systems, and analysis information systems. While model oriented systems include accounting models, representation models, and optimization models.

(أحمد جمعه ورفعت

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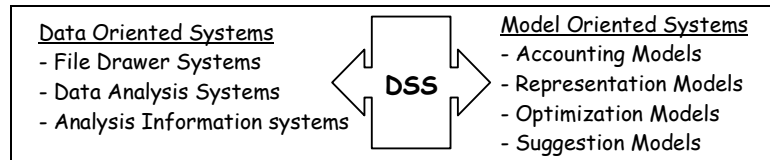
جاب الله، ١٩٨٦)

 The difference between the seven types of DSS can be seen from their functionality perspective; File Drawer Systems represent online/quick data retrieval systems, which speeds the retrieval of data. Data Analysis Systems represent ability to retrieve and perform analysis of data. Analysis Information Systems, which is differentiated by its ability to stimulate the current strategies and predict future events (such as marketing systems). Accounting Models represent systems that are built based on an accounting equation and used to develop financial statements and analysis ratios. Representation Models are simulation models, which present the cause-result relation; such models -usually called risk analysis models- performs analysis on different random variables at the same time. Optimization Models are based on the idea of mathematical programming of which activities are presented in the form of equations and matrixes; such models mainly used in transportation and mining industries. Finally Suggestion Models are more structurally oriented to generating suggestions for solving certain problem.

2.3.4 The Need for A Holistic Approach

There has been a growing amount of interest and research in the area of knowledge management and using it as a vehicle for supporting managers in their activities of decision-making.

However, decision-making usually involves evaluating and judging problems in many diverse application areas, thus the Knowledge-Based System as stated by Charles McClure (1980) should assess a number of factors such as financial, commercial, strategic, and technical factors, the focus of each factor is listed in table (2-2).

Table (2-2): Factors that should be associated in a holistic KBS

Factor	Focus	Example
1 Financial	The economic evaluation of alternative proposals	• Financial risk systems • New product development funding. • R&D projects selection.
2 Commercial	Support the alignment between an organization, its product and the market place in which products are sold.	• Industry Analysis • R&D projects selection. • Product mix studies. • Product positioning.
3 Strategic	Support strategic decision-making regarding proposed investments	• Strategy formulation. • Planning mergers and acquisition • Evaluating strategy • Studying whether to enter new markets • Market assessment reports.
4 Technical	Identifying the optimal of alternative technical investment options.	• Material studies. • New inventions

The use of knowledge and information to solve problems in an optimal manner requires that the gathered information be available and easily accessible in a continuous manner. This requires that the information should be organized in a systematic, scientific process that can be mainly achieved through a computerized system. But more importantly is that the gathered data should be applicable for a large number of problems and decisions that would fit requirements at different managerial aspects of the management decision hierarchy as will be discussed more thoroughly in later sections.

One other important condition for the success of the KBS in supporting decision-making is the relevance of information, which states its suitability for the decision under study. Information relevant to the activities of an organization should satisfy three conditions (أحمد جمعه و رفعت جاب الله، ١٩٨٦):

1. Effectively predicting future.
2. Takes feedback into account.
3. Right timing.

2.3.5 A Roadmap to Building a Knowledge-Based System

This section will identify -from the researcher's own perspective- the major steps that should be taken in order to build a Knowledge-Based System within an organization. Depending on readings, interviews with CEOs and

his own field experience[1], a detailed cycle process was suggested in figure (2-4) below[2].

The process was structured within four major steps as follows:

Step One: **Building the basic foundation of the KBS**

This step aims at having the necessary computer base as well as understanding the system. To achieve such a goal, the following steps would be done simultaneously:

- Achieve awareness between the employees and managers of what the system is and what it will serve; this would be done through brochures, manuals, and seminars.

- Building the required computer base including hardware and software dimensions: technically this step would result in a computer network and a friendly interface through which adding and searching for information are made easy.

- The following step is training the employees of direct contact with the system on how to use it to add/find a piece of information.

- One of the major steps would be determining the type of information that the system should contain. Information would be modified with time to cope with changes that may occur in the organization, its strategies, and its environment. However, as a first time the information type would be determined according to the organization's current strategies and future aim.

Step Two: **Building the KBS**

This step aims at having the system already in use, it should be noted that this step is a continuous process. This step would involve the following major sub-steps:

- Gathering information and knowledge.

- Feeding the system with this information.

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[1] The researcher had the chance to actually use the system while being a member in the strategic planning team in one of the top ten international engineering firms worldwide (a more than $1.3 billion in annual revenue firm).

[2] Notice that figure (2-4) is a detailed sequence for the major steps shown earlier in figure (1-3) developed by the researcher and shown in chapter one of this research.

Gathered information would be according to a predetermined systematic manner to avoid getting un-useful or misleading data. While gathering information would be done almost by every employee in the organization, the information should involve screening activity before being added to the databases where only approved information would be added.

<u>Step Three</u>: **Utilizing Benefits of the KBS**

This step aims at harvesting the benefits of the KBS by distributing the right knowledge to the right person at the right time.

<u>Step Four</u>: **Updating the KBS**

In order for the system to achieve its intended goals there should be continuous updating to keep it in track of the changes that may occur in its environment or in the organization itself. Feedback for the performance of the system would be obtained from three main sources:

- Individuals dealing with the system at different organizational levels.

- Applying modifications according to changes in the environment and the technologies.

- Continuously examining the compatibility of the system with the organization requirements and future strategies.

The update would affect different activities within the organization and would result in a cycle process for building the KBS. The previous changes may affect one or more of the following steps:

- New technologies may require a rebuilding of the system computer base.

- Changes in the organization scope and strategies may require a different type of information to be gathered and added to the system.

- Changes in the environment and the organization may involve different ways of gathering information and thus require additional training; examples of such change are the introduction of new departments or SBUs to the organization structure.

The researcher perceives the previously mentioned process as his own general understanding of how the system should be built. However a more detailed and precise process would depend upon the particular factors and influences within each organization.

| To The Point | → | The previous process of building a KBS would lead readers to anticipate what each employee should do to achieve the final goal. This section as well as the next section (what should be done at each organizational level) would build the basic requirements of having an effective KBS and would therefore form the basis of the study theoretical model. |
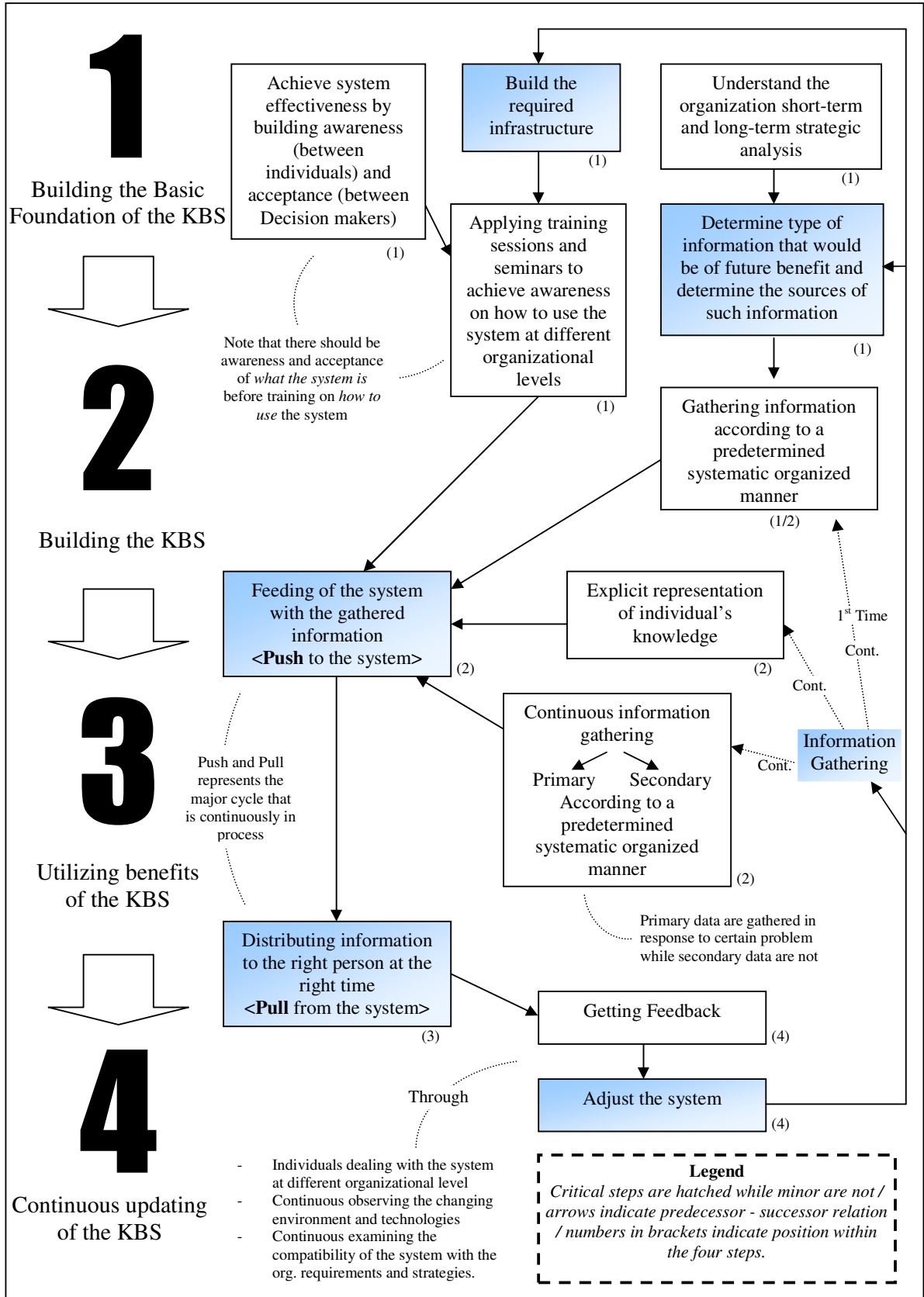
Figure (2-4): A Roadmap to Building a Knowledge-Based System

2.3.6 The Evolving Key Roles of a KBS

Different techniques and specialties would be involved in building and using a KBS. Four responding role holders are involved as shown in figure (2-5); the four levels are organizational support, KBS user, KBS builder, and KBS programmer.

Developed by the researcher

KBS User
Which would include managers at different organizational levels who attempt to use the system to support their business activities.

KBS Builder
Data Collector
Data Screening
Data Entry
Represents the collective approach of almost all of the organization employees in building the system, which would include collecting, screening and entry of data to the system. As well as continuous studying of the organization industry and the environment through which it operates.

KBS

Note that KBS users have duplicated role sometimes of builders as well.

KBS Programmer
Which would include the employees responsible for building the system technical requirements at the first place, as well as updating such techniques after the system is implemented to adjust to the users feedback and changes in the environment.

Organizational Support
Which would include getting approval of the expenditures, having budgets allocated for the system building and improvements,

Figure (2-5): Evolving Key Roles of a Knowledge-Based System

One of the major roles that clearly contribute in achieving the effectiveness of the overall system is the data screening, through which data would be entered into the system in a selective manner to achieve efficiency and to insure that the system includes only the proper data. The data-screening role (which the researcher calls *system gate-keeper*) would be predetermined and would include employees at managerial levels who are aware of the organization's future strategies and needs. Such a role would also contribute in guiding the data collectors of what, where, and how data is to be collected.

Note that the roles discussed do not necessarily align with persons on one-to-one basis, for example; a manager may have a shared role as users and builders, that is to say that one individual may be partly user and partly builder simultaneously.

2.3.7 Difficulties Associated with Building a KBS

Many factors influence the success of a KBS installation. These factors are related to the different evolving key roles of such a system. The difficulties are illustrated in the following figure.

Developed by the researcher

Organizational
➢ No team relationship among members of the support staff.
➢ Leadership style may eliminate innovative ideas and un-approve time spent on building or updating the system.
➢ Unhealthy organizational environment or culture which reduce the cooperative effort to achieve organization overall goal.
➢ Unhealthy communication between employees at different departments and/or levels.

Technical Support
➢ Technical difficulties of building required base of software and hardware.
➢ Applicability of the system to all levels of management.
➢ Achieving an individualized, user-friendly, and interactive interface.
➢ To be easy to create, easy to understand, and easy to use.

➢ Cost justifying for all managerial level and B.O.D. is not easy because of the subjectivity of determining the resulting benefits.

Users
➢ Decision makers' inherent resistance to change.
➢ Decision makers' acceptance and trust of the data in the system
➢ Decision makers' preference to use their own intuition.
➢ Personal influences while using the system.

Builders
➢ Individuals who control certain info may not want to relinquish that control to a new system for the fear of losing their job.
➢ Unqualified to use the system.
➢ Unclear understanding of the system benefits that may result in misleading or un-useful data entry.
➢ The need for a continuous updating of the system information to adapt to the changing environment.

Difficulties associated with a KBS at each level

Evaluating Difficulty
➢ No self-evident impacts (intangibility of outcome).
➢ Evolutionary over long time process.
➢ Post implementation evaluation mainly.

Figure (2-6): Difficulties Associated with building a Knowledge-Based System

The previously mentioned forces that influence the building of the KBS and the effectiveness of its performance should be taken into consideration by identifying what should be done at each organizational level to achieve the intended benefits. A cooperative organizational environment and supportive top management help excel the benefits of such system.

One of the major difficulties associated with KBS is the difficulty of evaluating the system performance because the system results in intangible outcomes such as improving communication, managing data more effectively, better understanding of the problem, and improving the effectiveness of decisions. Another reason that evaluating such a system is a challenge is that the system is evolutionary over a long period of time that

it sometimes takes years to get into full operation. The third reason is that evaluation cannot be done prior to the point where the system is fully designed and is working.

2.3.8 What should be done at Each Organizational Level

All managerial levels participate in building a KBS, though it can be seen that the KBS is directed toward middle and upper management, but low level (operational control) mangers also contribute in building and benefiting from it. The following figure identifies the basic responsibilities of employees at different organizational level in a road towards a KBS.

Developed by the researcher
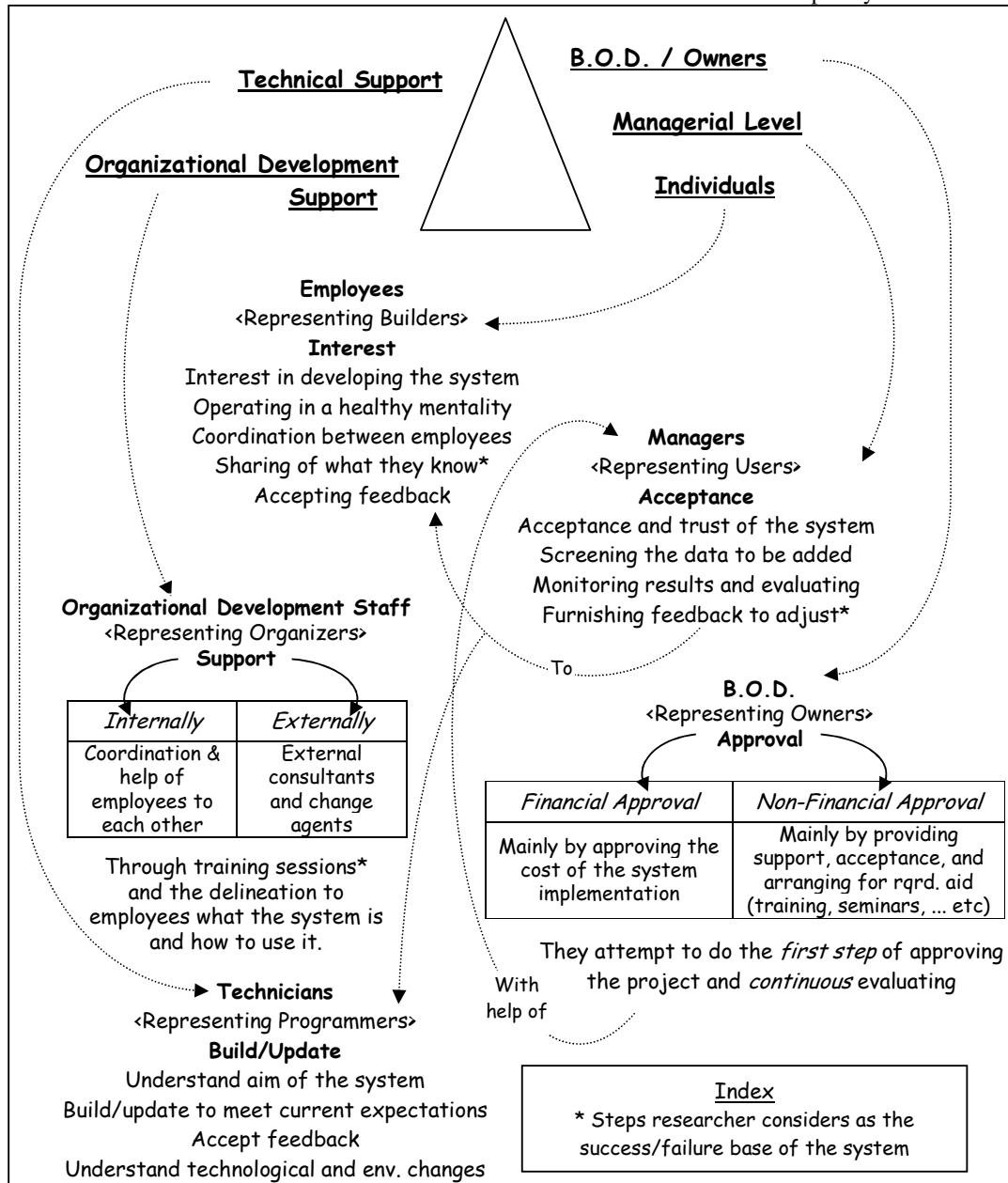
Figure (2-7): What Should Be Done To Achieve An Effective KBS

2.3.9 Getting Employees to share what They Know

Individuals who control certain information may not want to relinquish that control to a new system for the fear of losing their job. That was highlighted as one of the major difficulties associated with building a KBS in any organization. Getting employees to share what they know is no longer a technology challenge, it's a corporate culture challenge (Justin Hibbard and Karen Carrillo, 1997). The

> " *These days, it's not who you know, but what you know and who you share it with"*
> (Justin and Karen, 1997)

researcher perceives this subject as one of the major challenges, and most difficult "what should be done". Thus it was given interest in this separate section. Figure (2-8) below illustrates the problem from different perspectives and suggests ideas to solve.

Developed by the researcher

Understanding the Problem

Why Not Share ?
(employee side of the story)

Fear to loose their job (job security), staying unique through the knowledge they have, which would result in gaining self-confidence and results in higher

Why To Share ?
(employer side of the story)

Declared Benefits

Easing job by providing more information to understand the problem in hand, sharing opinions and responsibilities, and reducing time and cost of job performance.

Denied Benefits

The organization would not be affected by the resignation or leave of an employee (employees easily switch positions), no certain task would be dependent on an employee to perform, reducing employees bargaining power, and may be associated with reducing # of employees.

How to let them Share ?
(essential ingredients for sharing knowledge)

*Knowledge management's main challenge nowadays is no longer technology, it has a lot to do with corporate culture; it's more about changing business processes than about upgrading software. Workers must be reassured that they will still be valued after they give up their know-how. Five main ingredients for sharing knowledge were introduced by studies: companies must learn to look beyond their formal OBS to recognize **communities** and encourage the existence of such groups as an easier way to express their ideas and knowledge. Moreover, groups should be free to select their own members to achieve consensus and cohesiveness. Achieving an atmosphere of **collaboration** by building consensus and commitment. There should be the ability to listen between employees and the understanding of **concepts** behind someone's idea, which might alter his own perception of the subject before being added to the system. Conflict and **critique** must be understood as positive-functional factor within an organization encouraging the development of new ideas. Finally, dialog remains the oldest and most powerful tool for correcting and suggesting ideas, **conversation** and keeping the story alive is the road to new knowledge (Denham, 1996; Justin and Keven, 1997)*
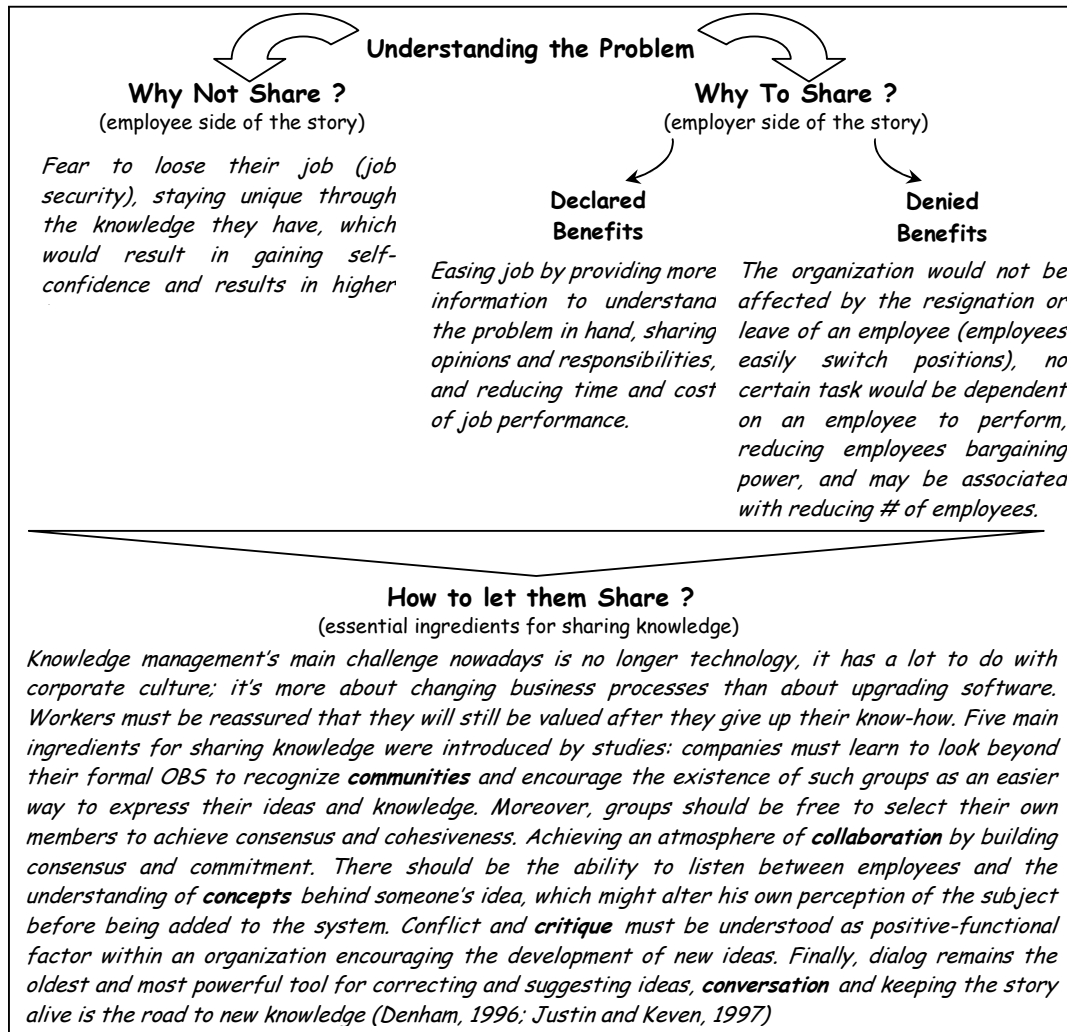
Figure (2-8): Sharing of Knowledge Challenge

This subject has been of interest through this study for two reasons; first reason is what it would have of great impact in affecting the success / failure of the system, and second is for its unique productive influence and effect in Jordan and Arab countries due to cultural aspects.

Cultural influences, values, and beliefs would influence an employee's attitudes and behavior. The employee's fear of sharing knowledge with others or relinquishing it for a system would negatively influence the effectiveness of the system. Research director at Delphi Consulting Group Inc. in Boston, 1997 says: "in our research, users clearly identify cultural issues as the largest obstacle to implementing knowledge management" (Justin and Karen, 1997)

2.3.10 Benefits Associated with a KBS

Generally, without a KBS each problem would be dealt with separately at each location, with the use of KBS all problems would be considered at once with the help of everything everyone knows in the organization. The system further insures that explicit and implicit knowledge would not be lost.

> "The abilities and skills that determine the quality of our decisions and problem solutions are stored not only in more than 200 million human heads, but also in tools and machines, and especially today in those machines we call computers"
> (Simon, 1986)

It should be noted that although a KBS might replace or compete with other systems in some cases, generally, it supports other systems by actually extracting knowledge and information (from systems) and retaining it for later use. Thus benefits of such a system would not be excelled without achieving efficiency of other organizational systems.

> A KBS role as decision supporting tool helps a manager reach: "this is the best I can do, given what I have"

According to "The Knowledge Management Year Book 1999-2000", objectives of a knowledge management project are listed as follows:
"

- *Create knowledge repositories*
  Three basic types of repositories:
    1. External knowledge, such as competitive intelligent
    2. Structured internal knowledge, such as research reports, product-oriented marketing materials, techniques and methods
    3. Informal internal knowledge, like discussion databases full of know-how.

- *Improve knowledge access*
  Provide access to knowledge or facilitating its transfer among individuals. "Get at the knowledge we know we have" and "share our knowledge".

- *Enhance knowledge environment*
  Establish an environment conducive to more effective knowledge creation, transfer, and use. Build awareness and cultural receptivity to knowledge, initiatives attempting to change behavior relating to knowledge, and improve the knowledge management process.

- *Manage knowledge as an assets*
  Treat knowledge like any other asset on organization's balance sheet to improve return.

”

Generally, knowledge management can be seen as a strategy that turns an organization's assets into greater productivity through utilizing the benefits of knowledge. However, the introduction of such practice in an organization should be considered with caution for the fact that it might be associated with a group of disadvantages if not effectively managed; the competing of KBS with other existing organizational systems represent one of the major disadvantages that should be taken into consideration.

2.3.11 Industrial Dynamics Effect on the KBS

A more complex factor that affects the KBS is the interrelation between the organization's internal operation with its dynamic ever-changing economic, social, political, technological, and ethical environments. KBS provide not only the information for decision-making processes, but also systems by which complex operational processes can be controlled for departmental and organization-wide operations. However, most organizations' wide operations are affected by an interrelation with its dynamic environment.

The system and the use of its information would be highly affected by the economic, social, cultural, political, technological, and ethical factors in which the company operates, thus for such a system to operate effectively there should be continuous monitoring of the company's environment and the changes that may occur in the industry norms, accordingly the system should be correctively changed and data within the system should be updated to adapt to such changes.

communication and the effectiveness of decision-making)

- Evolution of such a system takes time, years sometimes, and before the system is under full operation there is no way to evaluate it.

But what are the indicators of a successful Knowledge-Based System? How can managers identify if there is a problem in their system and locate it? Studies have shown that there are different indicators of a successful Knowledge management project, the indicators according to "The Knowledge Management Year Book 1999-2000" are:

- Growth in the resources related to the project, including money income of the company's activities benefiting from the system.

- Growth in volume of knowledge content and usage.

- Successful projects should be an organizational initiative that is to say that its survival depends on the organization and not on certain individual. In other words, the system would still survive with the resignation of certain employees within the organization.

- Financial return evidence at the organization overall dimension or at the knowledge management activity itself.

Accordingly the difficulties associated with evaluating a Knowledge Management project or a KBS, highlights the fear of most the CEOs to implement such a system in their organization for the fact that there are still no clear understanding of such practice and of its intended benefits specially in Jordan.

3.1 Jordanian Studies

o <u>Mh'd Abdel Rahman Al-Nathere</u>, 1990, *Information System and it's Effect on the effectiveness of Decisions in Jordanian Banking Sector*, M.Sc. Thesis, University of Jordan, Amman, Jordan

The aim of this research is to identify the importance of information systems in decision-making processes. The study, which focused on the banking sector in Jordan, discussed the effect of such a system on the effectiveness of decisions.

The following conclusions were established:
- There is effect for Information Systems on the effectiveness of decision-making.
- There is no effect of Information Systems on the profitability.
- 20% of the companies have a separate department for information systems.
- Summation result for the degree of the effectiveness of Information systems is 69%.

o <u>Hareth Hasan Abed El-Razek</u>, 1993, *The Extent of Use of Accounting Information in Planning and Control – A Field Study of Listed Industrial Companies in Jordan*, M.Sc. Thesis, University of Jordan, Amman, Jordan.

The research aimed to identify the importance of accounting information to achieving the organization's aims through planning its actions and activities, and the analysis of any variance between the actual and planned results. The purpose of this study was to determine the extent of the use of accounting information in planning and control decisions.

The following conclusions were made:
- The top management (decision makers) of listed industrial companies used accounting information for planning purposes (80% of the sample).
- Top management (decision makers) of listed industrial companies used accounting information for control purposes (85% of the sample).

- In general (83.27%) of the companies used accounting information for both planning and control purposes. This reflected the importance of financial statements in decision-making.

o <u>Rifat O. Shannak</u>, 1994, *The effect of Managerial Information Systems on the performance of the public shareholder companies in Jordan*, M.Sc. Thesis, University of Jordan, Amman, Jordan

The research aimed to identify the information systems' degree of availability in public shareholding companies in Jordan, the degree of utilizing Information Systems, and its effect on the performance of the company.

The research arrived at the following conclusions:
- 24.53% of the companies had a department concerned with Information Systems, but this had no effect on the performance of the company.
- 83.02% of the companies under study used computers but with no effect of its use, number of experts, nor years of using it on the performance of the company.
- Little attention was paid to Information Systems, most considered the existence of computers as if to have a separate specialized department with information systems.
- No effect of neither environmental nor organizational factors on the performance of the organization.

o <u>Mh'd Al-Shahari</u>, 1996, *Managerial structuring and it's effect on performance*, Institute of Public Administration, Amman, Jordan.

This research aimed to identify the effect of unhealthy managerial structure on the performance.

The research reached to the following conclusions:
- Most organizations were built on no specific strategy and thus had no positive contribution to economic and social development plans.
- Insufficient number of well-qualified employees.
- Tasks were divided between number of employees and departments, which affected the performance and resulted in coordination problems.

- The existence of unqualified employees within the organization, which resulted in weak structure.

o <u>Majd Ma'ita</u>, 1997, *Managerial Coordination and it's effect on employees performance in Public Management Library Department*, Institute of Public Administration, Amman, Jordan.

This study aimed to identify the existence of managerial coordination and types of coordination between employees.

The research reached the following conclusions:
- (67.66) % of the employees accepted the existing managerial coordination within the department and (32.334%) did not.
- The study showed that there was a flaw in delivering the information to the employees at the right time, which affected the performance.
- The study also showed that this flaw was due to different reasons such as managerial structure, personal factors, and weakness in employees' personality, and/or not giving the subject enough attention.

3.2 Foreign Studies

o <u>Robert H. Bennett,</u> 1998, *The Importance of Tacit Knowledge in Strategic Deliberations and Decisions,* Management Decision Journal, 36/9 , pp. 589-597

The study represents an attempt to draw together the research that has been written on the topic of strategic decision-making, focusing on the use of tacit knowledge and intuition in such domains. The study attempted to develop better practical understanding at this subject to increase managers understanding of tacit knowledge's nature, use, and value to decision making in organizations.

The study concludes that there should be an optimal balance of both formal analysis and intuitive decision processes, emphasizing the importance of tacit knowledge in guiding the individual on how to navigate through certain situation by learning which factors are most important on one hand, and by limiting the factors which mangers consider to be important in a decision.

The researcher recommends and emphasizes on: first, the necessity for managers to communicate their knowledge. Second, to learn more

about how to stimulate and utilize both types of group interactions knowledge. Third, the needs for innovative ways to teach people how to be intuitive and how to open up their tacit store of knowledge.

o <u>Vincent K. Chong, Lan R. Eggleton</u>, 1999, *Management Accounting Systems Design and its Interaction with Task Uncertainty and Locus of Contorl on Managerial Performance: Further Empirical Evidence*, Vincent K. Chong School of Accounting, Western Australia, Australia.

The purpose of this study was to investigate the effects of control, task uncertainty and the use of Management Accounting System (MAS) on managerial performance in terms of two dimensions: task uncertainty and for both internal and external managers.

Findings suggest that under low task uncertainty conditions, internal managers performance deteriorate dramatically when provided with broad scope MAS information whilst external managers performance remained virtually unaffected. Under high task uncertainty, both internal and external managers improve their performance when they increase their use of broad scope MAS information. With respect to timely MAS information and managerial performance, also results suggested that under low task uncertainty conditions, both internal and external managers perform similar when provided with less timely MAS information. However, when more timely MAS information is provided, internal managers performance declines dramatically whilst external managers performance remained virtually unaffected. Under high task uncertainty, both internal and external managers improve their performance when they increase their use of timely scope MAS information. However, these results are consistent with their expectation and provide support for hypothesis.

o <u>Malhotra Yogesh</u>, 2000, *Knowledge Management for e-Business Performance Advancing Information Strategy to 'internet time',* The Executive's Journal

The study proposes a new perspective on knowledge management and suggests how managers can effectively apply it in the new world of e-business.

The study estimated information technology, creativity, and innovation as dependent variables for achieving knowledge management.

The study has concluded that there is a need for developing better and more accurate understanding of knowledge strategy in the e-world of business. The study presented a new conceptualization of knowledge management based on the need for synergy between the capabilities of advanced information technologies, human creativity, and innovation to realize agility demanded by emerging business environment.

o Hemant K. Bhargava, Daniel J. Power, 2001, *Decision Support Systems and Web Technologies: A Status Report,* United States.

The study highlights the effect of World Wide Web technologies and information on designing, developing, and implementing Decision Support Systems.

The study has reached the following conclusions:
- The availability of web technologies and information can be of great benefit in the practice of building DSS. These technologies provide a platform for the distribution of calculations and the exchange of complex information.
- The practice of building DSSs have benefited from World Wide Web technologies, but much remains to be done (in researchers' point of view), there is a need to resolve technological, behavioral, and social challenges to realize the benefit of the web as a platform for building DSS.
- DSS are of great interest to a broad resources of stakeholders and enormous resources have been and will be committed to building systems for the improvement of the quality, speed, and effectiveness of specific decisions.

o Alexandre Gachet, June 2001, *A Framework for Developing Distributed Cooperative Decision Support Systems-Inception Phase,* University of Fribourg, Switzerland.

The study describes the development process of framework of a cooperative Decision Support System (DSS). It analyses the reasons why the broad use of DSSs have not yet occurred.

The study states the major problems for which the field of DSSs creates low interest in practice. The various factors of the problem were divided into three main categories: Human factors, conceptual factors, and technical factors.

Human factors cover the reason why the people involved (users and decision-makers) subjectively oppose the computerized decision-

making systems. This is based mainly on the personal feelings of the actors towards the proposed system.

Conceptual factors cover the problem encountered by DSSs because of wrong or incomplete choices carried out during the design of the systems. These factors concern a lower level than the human (and subjective) factors, but also relate to the pure technical consideration of the system.

Technical factors cover the problems encountered by DSSs related to pure software or hardware considerations. Thus these factors are not directly connected to the high level concepts concerning decision-making, but rather with constraints that data processing structures impose on the implementation of these high level concepts.

o <u>Rimvydas Skyrius</u>, June 2001, *Business Decision Making, Managerial Learning and Information,* University of Vilnius, Luthuania.

The study has highlighted the decision maker's attitude towards different factors influencing the quality of business decisions. The study included the role of information sources, analytical tools, factors influencing creativity, and the role of information technology.

The findings have shown that in the decision making process, available knowledge is used and new knowledge is created, and these processes preferred to be supported by simple yet efficient support tools.

o <u>Meliha Handzic</u>, June 2001, *Does More Information Lead to Better Informing,* The University of New South Wales, Australia.

The study investigates the impact of increased information availability on people's ability to process and use information in a judgmental decision-making task context.

The findings of the study indicate that increased availability of information had an effect on both processing efficiency and decision accuracy of individual decision makers.

The study emphasizes the danger of dramatic increases in information supply enabled by new technology. The study also indicates the importance of improving people's ability to make sense of the available information in turning it into useful knowledge.

4.1 The Nature of the Study

This research is related to organizational knowledge handling and decision-making; the research will describe and quantify factual knowledge sources that may be used in organizational decision-making. Moreover, the research will emphasize on strategic decisions that evolve through a complex, non-linear, and fragmented process. The study will further analyze the effect of using such information and knowledge in improving the effectiveness of strategic decisions being made. Based on research findings, the researcher predicts that strategies may be suggested to improve organizational knowledge management in the engineering offices.

A group of factors representing the effectiveness of the knowledge-based system within the organization will be studied. These factors that cover all organizational levels include:

- The individual's capabilities and awareness of the system and information handling.
- The availability of required technologies (software and hardware).
- The coordination between employees at different levels within different departments and their sharing of information.
- Acceptance and trust of decision makers at different managerial levels of the system and the information it contains.

The effect of classification of the office and number of employees working within the office will also be studied as moderating factors influencing the effectiveness of the strategic decisions made.

Although it is recognized that certain knowledge sources may have more or less impact on the resolution of a given decision situation, the degree of this effect (difference between knowledge sources) will not be at this stage determined. Therefore, this study assumes that all sources of knowledge have the same degree of value for a given decision situation[1].

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[1] In other word the study will not measure the quality of knowledge the sample offices have in their system as much as it will measure the fact of having a system that gathers and distributes the knowledge to aid the managerial activities (this represents one of the study limitations as will be discussed in later sections).

Moreover, this study will not identify or describe personal demographical characteristics of employees or decision makers, although it can be assumed that such factors may affect the information acquisition and utilization during the decision-making process.

Also, it is recognized that both employees and the decision makers may be affected by the organizational structure and his/her relative position within that structure in terms of information acquisition and decision-making. However, although the relationship of status or organizational title and informational-handling ability will be discussed, the degree to which the formal structure affects the decision-making process and the individuals contact with information will not be formally measured.

The study identifies and studies four major factors for the success of a KBS, the factors represent the basic organizational levels and what should be done at each as previously mentioned in chapter two. Furthermore, the study identifies the effect of company's classification and number of employees as moderating factors, while it only mentions and comments on other demographical aspects of the company (like years of experience, ownership type, paid up capital, …etc). In addition, the study identifies the role of such a system on the effectiveness of strategic decisions.

Finally, the findings that will be presented in this study are based on data collected from engineering offices from different categories regardless of their geographical locations in Jordan; the findings may be generalized to a number of other similar organizations meeting certain criteria. Additionally, the results will allow CEOs of engineering offices to compare their situation to that presented in the study and assess strategies to improve themselves. Nonetheless, the combination of these results and related research may provide a catalyst for future research and for organizational decision makers to carefully examine their knowledge-handling activities in the decision making process.

4.2 Theoretical Model

Figure (4-1) below, shows the theoretical model that will be the basis for the study to accomplish its objectives:

It should be pointed that there are several other factors that affect the Knowledge-Based System and its use in decision-making processes, such as commitment of the employees, empowerment granted to individuals, leadership respect, characteristics of the environment, consistency of information, encouraging innovation and contingency thinking, suitability of information to the organization business and to the decision under study. On the other hand, this would also be moderated by several other factors such as demographical factors of users and decision makers (gender, degree of education, age …etc). However, the researcher estimates that the chosen factors in figure (4-1) represent the most effective and further future studies may help in enhancing this study's findings by studying other factors.

4.3 Study Hypotheses

First Hypothesis:

(Ho) : No significant statistical relationship between independent variables and the effectiveness of strategic decisions.

Minor hypotheses:

(1-1) : (Ho) No significant statistical relationship between capabilities of individuals and the effectiveness of strategic decisions.

(1-2) : (Ho) No significant statistical relationship between availability of required technology and the effectiveness of strategic decisions.

(1-3) : (Ho) No significant statistical relationship between departments coordination and the effectiveness of strategic decisions.

(1-4) : (Ho) No significant statistical relationship between acceptance and trust of decision makers and the effectiveness of strategic decisions.

(1-5) : (Ho) No significant statistical relationship between independent variables as a whole and the effectiveness of strategic decisions.

Second Hypothesis:

(Ho) : The demographical variables have no significant statistical effect on the relation between independent variables and the effectiveness of strategic decisions.

Minor hypotheses:

(4-1) : (Ho) The office classification has no significant statistical effect on the relation between capability of individuals and the effectiveness of strategic decisions.

(4-2) : (Ho) The office classification has no significant statistical effect on the relation between availability of required technology and the effectiveness of strategic decisions.

(4-3) : (Ho) The office classification has no significant statistical effect on the relation between departments coordination and the effectiveness of strategic decisions.

(4-4) : (Ho) The office classification has no significant statistical effect on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions.

(4-5) : (Ho) The office classification has no significant statistical effect on the relation between independent variables as a whole and the effectiveness of strategic decisions.

(4-6) : (Ho) The number of employees has no significant statistical effect on the relation between capability of individuals and the effectiveness of strategic decisions.

(4-7) : (Ho) The number of employees has no significant statistical effect on the relation between availability of required technology and the effectiveness of strategic decisions.

(4-8) : (Ho) The number of employees has no significant statistical effect on the relation between departments coordination and the effectiveness of strategic decisions.

(4-9) : (Ho) The number of employees has no significant statistical effect on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions.

(4-10): (Ho) The number of employees has no significant statistical effect on the relation between independent variables as a whole and the effectiveness of strategic decisions.

Third Hypothesis:

(Ho) : There is no significant statistical relation between the independent variables.

4.4 Operational Definition

o *Individual Capabilities:* Identifies the technical capabilities of individuals to use computers and software as well as other techniques within the KBS. This would be measured through the

educational level of users, their awareness of the system as well as their interest in the success of such a system. [The degree of individual capability in an office will be measured by questions 5 through 11 in the questionnaire]

o *System Technologies:* Represents the availability of required technologies for the operation of the system, this will include hardware (computers, servers, and local network) and software (the interface that links individuals into the database to add and take off the required information). [The level of system technology in an office will be measured by questions 1 through 4 in the questionnaire]

o *Department Coordination:* The interaction between individuals, groups, and systems in organizations by which each would be pursuing his/her specific task and objective and at the same time contribute to the objectives of the organization as a whole. This will be measured by the degree through which all departments contribute in building and adding information to the system and negotiating opinions at different levels to reach the required information. [The degree of Coordination between departments in an office will be measured by questions 12 through 19 in the questionnaire]

o *Acceptance of the System:* Measures the degree by which decision makers accept the data available in the system and believe it is reliable for making decisions. This can be measured by different factors including the degree by which managers understand and believe in such a system and its benefits. [The degree of decision-makers acceptance of the system and its information in an office will be measured by questions 20 through 24 in the questionnaire]

o *Classification of the office:* Engineering offices in Jordan can be divided into four main categories according to Jordan Engineering Association; the classification include specialized office, Engineering Office, Engineering Consultancy Office, and Consultation Office. These categories are given to offices according to experience and specialty[1]. [The classification of offices will be identified from a question within the first part of the questionnaire which concerns the company's demographical data]

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[1] According to Jordan Engineering Association:

   Specialized Office: An office that is specialized in one field.
   Engineering Office: An office tat has two or more specialties.
   Engineering Consultancy Office: At least eleven years of experience from which four are in design.
   Consultation Office: Provides consulting services, and is related to neither design nor supervision.

o *KBS: A*n easily accessible knowledge base through an artificially intelligent interface. The system represents a collection of tools, data, and techniques that employees would depend on at different levels for planning, controlling, decision-making, and performance evaluation. KBS includes the result of the contribution of all previously mentioned factors. It also includes the whole system of hardware and software and knowledge within it.

o *Strategic Decisions*: decisions likely to be concerned with or affect the long-term direction of an organization that try to achieve advantage for the organization, and are likely to be concerned with the scope of an organization's activities. Strategic decision can be seen as the matching of the activities of an organization to the environment in which it operates.(Gerry and Kevan, 1999)

The contribution of KBS in making strategic decisions would be measured by the opinion of manager at different managerial levels (respondents of the questionnaire) about the system importance and benefit [the use of KBS in decision making would be measured by question 25 through 32 of the questionnaire]

4.5 Research Population

The researcher has chosen the engineering offices sector in Jordan as a research population for it's importance and effective participation in the development of the country, with over half a decade in providing services and contributing to the development of Jordan's economy and industry respectively. On the other hand, this sector has a regional recognition and presence.

The research population includes engineering offices in Jordan that can be divided into four main categories, according to the Jordan Engineering Association, the classification criteria is shown in the following table:

Table (4-1): Engineering Offices Classification Criteria

Category		*Description*
Specialized Office	مكتب مهندس	An office that is specialized in one field
Engineering Office	مكتب هندسي	An office that has two or more specialties
Engineering Consultancy Office	مكتب استشاري	An office that has at least 11 years of experience from which four are in design
Consultation Office	مكتب رأي	An office that provides consulting services, and is related to neither design nor supervision

The number of working offices by the end of 2001 was 517 specialized offices, 363 Engineering offices, 144 Engineering Consultancy Offices, and 11 Consultation Offices. Summing up to a total population of 1035 offices[1]

4.6 Data Collection Method

Required data will be collected using two main sources: Primary Source, and Secondary Source. Data will be gathered from books, magazines, and the World Wide Web representing primary source of data, in addition to data gathered from previous studies of similar and related subjects, representing the secondary data.

Required information for the statistical analysis of the study and for evaluating the hypotheses will be collected using a questionnaire that will be distributed among a representative sample of the companies. The sample will include the four categories of the companies (Specialized Office, Engineering Office, Engineering Consultancy Office, and Consultation Office) in proportion equivalent to their actual ratio in the population.

The questionnaire will consist of two parts:

o The first part will consist of questions about the company's demographical factors (including the category of the company, number of employees, and others) as well as the availability and type of IT in the office.
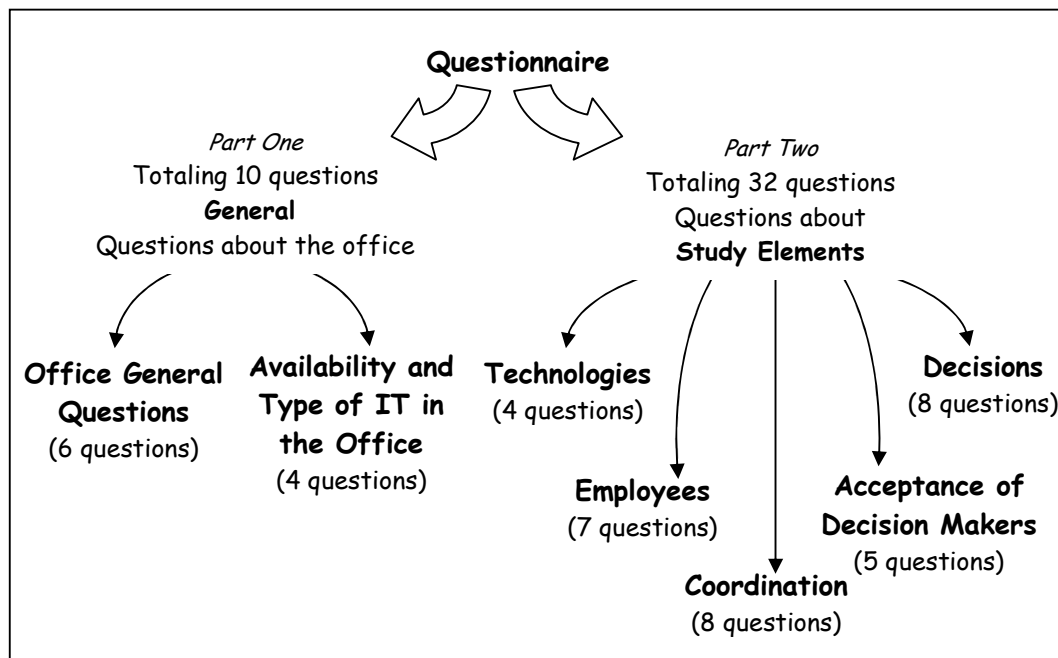

Figure (4-2): The Structure of the Study Questionnaire

[1] According to: index of Engineering Offices in Jordan, 2001, published by Jordan Engineering Association / Order of Engineering Offices and Companies.

o The second part will consist of thirty-two questions measuring the importance of different aspects in achieving an effective decision-making.

The data will be gathered from employees at the managerial level of each office and as much as possible from the CEO of the office. Personal structured interviews were the basis for filling the questionnaire and were mainly done with the CEO of the office. On the other hand, personal interviews will be held when possible with representatives at both Jordan Engineering Association (JEA) and Order of Engineering Offices (OEO)[1].

4.7 Sampling Procedure

According to the index of engineering offices in Jordan (دليل المكاتب والشركات الهندسية) published from Jordan Engineering Association (نقابة المهندسين الأردنيين) / Order of Engineering Offices and Companies (هيئة المكاتب والشركات الهندسية) in 2001 (the latest), a total of 1035 engineering offices in Jordan represent the population of the research. These offices are divided into four main categories (Specialized Office, Engineering Office, Engineering Consultancy Office, and Consultation Office). Furthermore, Specialized Offices are divided to three main categories (A, B, and C), while Engineering Offices are divided to two main categories. The break down of the study population according to the offices' classification is shown in the following table:

Table (4-2): Study Population Break Down According to Offices' Classification

Specialized Office			Engineering Office		Engineering Consultancy Office	Consultation Office
A	B	C	First category	Second category		
264	167	86	38	325	144	11

Equation (4-1) below will be used to estimate sample size:

$$n = \frac{Z^2 * p * q}{E^2} \quad \text{------------------------ (4-1)}$$

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[1] Data revealed by JEA and OEO represent mainly (but not limited to) the list of working offices in Jordan and the classification criteria.

(William, 2000)

Where:
n : number of items in the sample
Z^2 : square root of the confidence level in standard error units
P : estimated proportion of successes
Q : (1-p) estimated proportion of failure
E^2 : square of the maximum allowance for error between the
true proportion and sample proportion

⇨ Assuming 95% of confidence level for the estimation (z =1.96)
⇨ Estimating proportion of companies effectively using a Knowledge Management technique for their strategic decision is 30%

Thus, p = 0.3 (estimated proportion of success)
q = 0.7 (estimated proportion of failure)

⇨ The researcher wishes that the allowance for sampling error would not be greater than 12 percent.

Thus, E = 0.12

Accordingly, using equation (4-1) yields

➜ n = 56

Since the sample size is more than 5% of the population (56 > .05*1035=51.75), the above procedure may have over estimated the sample size (the sample size is large relative to the population).

Thus, there is a need to reduce the sample size using the finite population correction factor shown in equation (4-2) below:

$$\text{Finite population correction factor} = [(N-n)/(N-1)]^{0.5} \quad \text{-------------(4-2)}$$

(William, 2000)

Where:
N : population size
n : sample size

$$\text{Finite population correction factor} = ((1035-56)/(1035-1))^{0.5} = \mathbf{0.973}$$

Thus the reduced sample size would be

$$\text{Reduced sample size} = 56 * 0.973 = \boxed{\mathbf{54}}$$

Checks:
n = 54 > 30   O.K.
np = 54*0.3 = 16.2 ≥ 5   O.K.
n(1-p) = 54*0.7 = 37.8 ≥ 5   O.K.

➔ **Sample Size = 54** ⬅

Since the population is divided into four main stratas (Specialized Office, Engineering Office, Engineering Consultancy Office, and Consultancy Office), the researcher will use a *stratified complex random sample*.

Number of observations from each strata will be determined according to the stratas percentage of the whole population. Table (4-3) shows the number of offices from each classification in the study sample:

Table (4-3): Study Sample Break Down According to offices' Classification

Classification		*Number of offices in population*	*Percentage of the population*	*Number of observations to be taken from it*
Specialized Office	**A**	264	0.25507	**14**
	B	167	0.16135	**9**
	C	86	0.08309	**4**
Engineering Office	**First category**	38	0.03671	**2**
	Second category	325	0.31401	**17**
Engineering Consultancy Office		144	0.13913	**7**
Consultation Office		11	0.01063	**1**
Total		**1035**		**54**

Moreover, choosing from each stratum will be done randomly according to the offices serial number (taken from Jordan Engineering Association). "Random Clock# Generator" Software[1] was used, the software selects randomly as much numbers required from a list of given numbers. The resulting sample of the study is shown in appendix B.

[1] Originally written for employers to randomly select employees for drug testing by clock number. Can be used for many things, will randomly select numbers, names, or most anything from a text file created from notepad, Excel, ...etc / NathanHunt Software - Downloaded for free at http://www.nhuntsoftware.com

4.8 Time Horizon

To achieve the research objectives, the primary data will be collected during year 2002 and for only one time. Therefore, this research is considered a *cross-sectional research*.

4.9 Analysis of Data[1]

Statistical tests will be used to verify whether the hypothesis aught to be accepted or rejected. The statistical methods that will be used are:

o Descriptive statistics (such as ratios, mean, standard deviation, …etc).
o Simple Regression.
o Multiple Regression.
o Cronbach's Alpha to check reliability of measuring tool.
o 2-way Anova

4.10 Study Limitations and Challenges

The findings that will be presented in this study are based on data collected from engineering offices in Jordan. Although results can be tentatively generalized to a number of other organizations or sectors meeting certain criteria, the results did not formally measure or take into account the generalization to other sectors, thus limiting findings of being generalized to include all sectors in Jordan.

The study assumes that decisions made in the engineering offices are based to some degree on information (regardless of the source) with which organizational members have contacted and accordingly measured the effect of information management on achieving effective decisions. However, the research ignores the number of strategic decisions that would be based on managers' intuition rather than specific knowledge, where the effectiveness of such decision will not be clearly affected by having a knowledge management system.

The research assumes that decision makers may obtain information useful for strategic decision making from different sources. However the researcher conducts that much of the necessary information would be hard to obtain.

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[1] The criteria for using the appropriate test for each of the study hypothesis will be discussed thoroughly in chapter five of this study.

This study will not identify or describe personality characteristics or personal intelligence of the system users and decision makers. Although it can be assumed that both factors may affect to some degree the information acquisition and utilization during the decision making process and during the Knowledge-Based System building process.

The study questionnaire had to be filled by the office CEO or owner to achieve the highest possible overall rationality in answers (for being the most familiar with strategic decision-making processes and requirements). However, some of the questions which were related to the decision maker's actual practice might have achieved higher rationality if was to be answered by other employees at lower managerial levels.

Moreover, the focus of this study is on a number of factors assumed to be of the most influence to the effectiveness of knowledge-Based management, such as individual capabilities and awareness, availability of required technologies (software and hardware), departments coordination, and acceptance and trust of decision makers. However, several other factors could affect the Knowledge-Based system and its use in decision making processes such as commitment of the employees, empowerment granted to individuals, leadership respect, characteristics of the environment, consistency of information, encouraging innovation and contingency thinking, suitability of information to the organization business and to the decision under study.

Finally, some of sample offices CEOs lack of a clear understanding of the organizational information handling and Knowledge-Based System, which has forced the questionnaire to be based on simple language and not to use specific scientific methodology to avoid confusion, and forced the sampling procedure to be based mainly on personal interviews, which was a time consuming process.

5.1 Note on the Reliability and Validity of the Data[1]

The first criterion to ensure the validity of the measuring tool was having it thankfully reviewed by different professors at the faculty of Business Administration in University of Jordan. Their opinion and suggested corrections were taken into consideration prior to data collection stage.

On the other hand, different criteria have been conducted to insure the reliability of the measurement tool. The first criterion to insure reliable measurement is the accurate scoring and coding of responses by the researcher. Three actions were taken to increase the consistency of scoring: First, respondents were encouraged to ask for clarification of any terms or questions that seemed unclear. Second, interviews and survey administration were all done by one person (the researcher). Finally, a written set of definitions / descriptions of variables was maintained throughout the data collection process.

A second criterion that was used as an indicator of the reliability is the computing of a coefficient of reliability. Cronbach Alpha was calculated for this study equal to **79.38%**, a ratio that indicates a reliable measure (accepting limit of 60%). Moreover the Cronbach Alpha test was performed for each of the study variables, the alpha coefficients were all above the accepting limit as indicated in table (5-1) below:

Table (5-1): Cronbach Alpha calculation for the study variables

Variable	α
Individuals Capabilities and Awareness	66.39 %
Availability of required technologies	65.18 %
Departments Coordination	75.48 %
Acceptance and Trust of decision makers at different managerial levels	70.35 %
Study as a whole	**79.38 %**

One more criterion related to validity is the degree to which the results can be generalized to the population as a whole. Generalizability is largely dependent on the sampling procedure; through this study, the selection of the study sample -as discussed in the previous chapter- was conducted to ensure a good presentation of the population as much as possible. In short it is believed that the results of this study may be generalized to the examined population but with caution.

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[1] Reliability implies stability and consistency of measurement, while the validity of the instrument is the extent to which it accurately measures what it purports to measure. A measure may be reliable and still be invalid.

5.2 Study Sample Descriptive Analysis

The first part of the questionnaire (consisting of ten questions) aimed to give a general idea about the demographical factors of the office; this part is further divided into two main groups; the first group consists of questions regarding general information about the office while the second group consists of questions identifying the availability and type of IT in the office (refer to figure 4-2).

The following section of this chapter will highlight the major characteristics of the study sample in terms of these selected descriptive factors. The fifty-four offices representing the study sample were categorized in response to these factors as follows:

5.2.1 Office Classification

The questionnaire started by identifying the category of the office in congruence to the classifications identified by the Jordan Engineering Association (specialized office, engineering office, engineering consultancy office, or consultation office). The resulting distribution of the study sample reflects the real percentage for working offices in the population at end of year 2001 (refer to section 4.7 Table (4-3)). The distribution of the study sample went as follows:

Table (5-2): Study Sample Descriptive Distribution According to Category

Category	Frequency	Percentage
Specialized Office	27	50.00 %
Engineering Office	19	35.19 %
Eng. Consultancy Office	7	12.96 %
Consultation Office	1	1.85 %
Total	54	100.00 %

This shows that the majority of the sample representing 50% was specialized offices, while 35% of the study sample were engineering offices, 13% were engineering consultancy office, while only 1 office representing 2% of the sample was a consultation office. The distribution exactly mirrors the break down of offices in the population. (According to the index of Engineering Offices 2001 published by the EOA).

Study Sample Distribution According to Classification
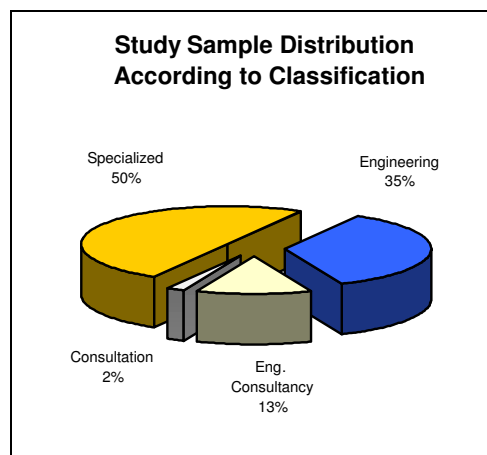
5.2.2 Number of Employees in the Office

Number of employees working within the office was studied as a moderating factor. The number of employees was assumed to influence the effectiveness of the KBS and strategic decisions within an office. The researcher had further assumed that companies with a higher number of employees would be in more need of such a system and would achieve a more comprehensive system in terms of integration in information type and sources. This factor was divided to five main categories; less than five employees, more than five and up to thirty, more than thirty and up to fifty, more than fifty and up to a hundred, or more than a hundred employee. The distribution of the study sample was as follows:

Table (5-3): Study Sample Descriptive Distribution According to
Number of Employees

Category	*Frequency*	*Percentage*
< 5	34	63.00 %
5 – 30	19	35.20 %
31 – 50	0	0.00 %
51 – 100	0	0.00 %
> 100	1	1.90 %
Total	54	100.00 %

This shows that the majority of the sample were offices with a number of

Study Sample Distribution According to # of Employees

employees less than five, this majority represents 63.0% of the sample, while the rest representing 35.2% are offices with number of employees between 5-30. Finally, only one office had more than a hundred employees.
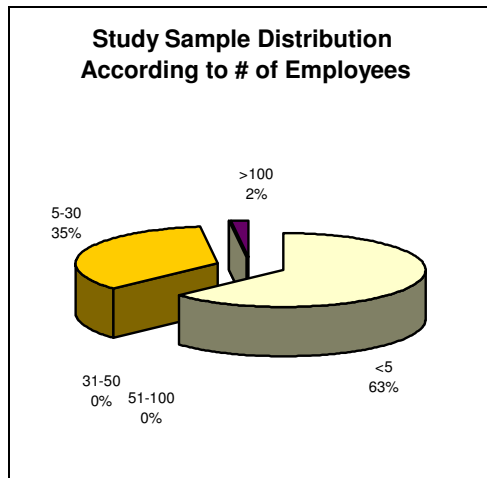
This signifies that the majority of the engineering offices in Jordan are relatively small-sized; that might be one of the reasons why an organized structured investment in knowledge management was not clearly noticed through the study although there has been a great interest from CEOs in such a system as will be discussed further through this analysis.

5.2.3 Years of Experience (since established)

The "office's years of experience" factor was the next aspect that the researcher conducted to describe the study sample. This factor was studied as one of four categories; companies with less than five years of

experience, five to ten years, eleven to fifteen years, or more than fifteen years of experience. This factor was studied to identify whether newly formed companies would be more interested in new technology such as a KBS or vise versa.

Table (5-4): Study Sample Descriptive Distribution According to
Years of Experience

Category	Frequency	Percentage
< 5	7	13.00 %
5 – 10	12	22.20 %
11 – 15	19	35.20 %
> 15	16	29.60 %
Total	54	100.00 %

The previous table shows that the sample represented a fair distribution in according to years of experience, through which one third of the offices had less than ten years of experience, one third had 10 to 15 years of experience and the last third had more than 15 years of experience.

Study Sample Distribution According to Years of Experience

The effect of years of experience on the effectiveness of knowledge management technique and/or effectiveness of the strategic decisions in the office was not exactly measured, but generally speaking and from the personal interviews with offices' CEOs, the researcher conducted that there is no clear trend showing that the interest in KBS or the effectiveness of strategic thinking and decisions differs between offices in terms of the years of experience. It actually depends on several other influencing factors as described earlier in chapter two (section 2.3).
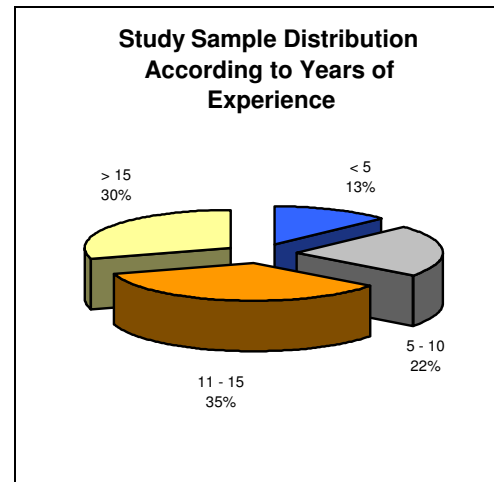
5.2.4 Locality of Projects

It has been presumed that offices performing projects abroad (outside Jordan), may be forced to have a system for managing their information and knowledge as a result of the variety of information and knowledge being imposed to. Again this factor was studied by classifying offices into three main categories: offices performing projects only in Jordan, offices performing both local projects in Jordan and projects abroad, or offices

located in Jordan and registered as Jordanian engineering office but mainly depend on projects and markets abroad[1].

Table (5-5): Study Sample Descriptive Distribution According to
Locality of Projects

Category	Frequency	Percentage
Local Projects	37	68.50 %
Local + International Projects	16	29.60 %
International Projects	1	1.90 %
Total	54	100.00 %

This shows that the majority of the sample representing 68% are offices performing local projects only, while the rest of the sample representing 30% had some projects performed for clients abroad as well as those performed inside Jordan. Moreover, only one office indicated depending on projects abroad, which represents only 2% of the study sample.

Study Sample Distribution According to Projets Locality

Local 68%
Local+Int 30%
Intr. 2%
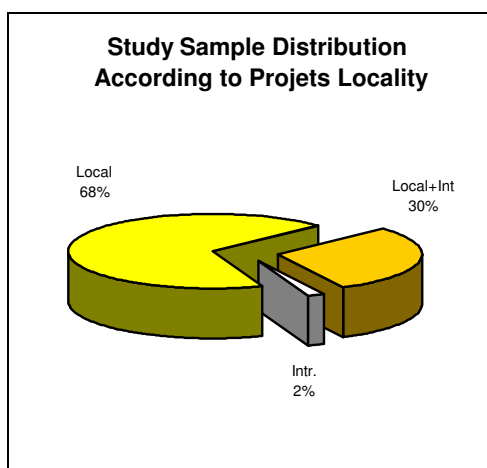
No effect for locality of the projects performed by engineering offices was studied on the interest or availability of a knowledge management project. However, the research interviews with offices CEOs had conducted that the intent for knowledge management activities and a KBS are more likely to occur in companies performing projects abroad and in different markets.

5.2.5 Location of Headquarter

The location of the office headquarter was studied as either in Jordan/Amman or somewhere else. The location of the head quarter was assumed to have effect on the company's interest in new knowledge management technologies as being more exposed to such new techniques. However, the researcher has concluded that the location of the main office had a minor effect, which was concluded from the personal interviews; CEOs of offices located in Amman had more interest and knowledge about the subject than those who are working in small range cities outside Amman. However, this effect was of no significance or obvious difference and thus will not be taken into consideration in this study.

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[1] The last category may represent foreign owned offices located in Jordan as a strategic approach to benefit of the low salaries and gain a maximized margin of profit.

Table (5-6): Study Sample Descriptive Distribution According to
Location of Headquarter

Category	Frequency	Percentage
Amman	43	79.6.00 %
Outside	11	20.40 %
Total	54	100.00 %

This shows that the majority of the sample (representing 80%) are offices managing their projects from headquarters located in Amman. However 11 offices (representing 20%) had their head quarters located in cities outside Amman.

This coincide with the fact that there is an unequal geographical distribution of the engineering offices in Jordan, a distribution by which most of the offices are located in Amman as the capital city and are performing projects mainly in other regions in

Study Sample Distribution According to Headquarter Location

others 20%

Amman 80%

Jordan. This actually represents a weakness in this sector and in the mentality by which owners expect to gain better market margin if located in Amman. Moreover the above percentages coincide with the percentages developed by the Association of Engineering Offices in their annual reports stating that 77% of offices had been located in Amman by end of year 1999 (Jordan Engineering Association, Order of Engineering offices, 1999).
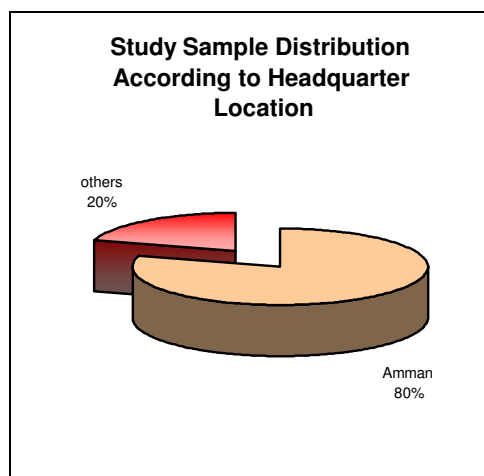
5.2.6 Ownership Type

The questionnaire further identified offices within the sample in terms of ownership type as one of four categories; sole proprietorship, partnership, corporation, or division of a parent company. The distribution is as follows:

Table (5-7): Study Sample Descriptive Distribution According to
Ownership Type

Category	Frequency	Percentage
Sole Proprietorship	43	79.60 %
Partnership	9	16.70 %
Corporation	1	1.90 %
Part of a Parent Company	1	1.90 %
Total	54	100.00 %

This shows that the majority of the study sample representing 79% were sole proprietorship, while the second majority of the study sample

Study Sample Distribution According to Owndership Type

representing 17% where partnership owned, the remaining 4% where either corporation or a division of a parent company of which each represented a percentage of 2%. These percentages of ownership type for the sample offices represent a logical distribution for the fact that the majority of offices and companies in Jordan generally either sole proprietorship or partnership.
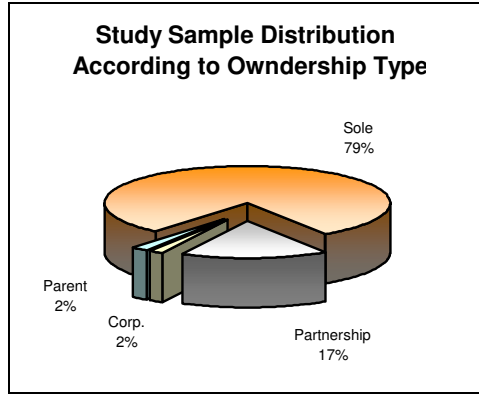
5.2.7 Computing Approach in the Offices

The "Computing Approach" used in the office was further conducted to describe the study sample. This factor was studied as one of four categories; offices with stand alone workstations, one computer (server) connecting a group of terminals, distributed computer systems in different locations of the office, or a network that connects all locations of the office together. The study sample distribution corresponding to this factor is shown in the following table:

Table (5-8): Study Sample Descriptive Distribution According to Computing Approach

Category	Frequency	Percentage
Stand alone computers	45	83.30 %
Server connected network	8	14.80 %
Distributed into different locations	0	0.00 %
Network connecting locations	1	1.90 %
Total	54	100.00 %

The previous table shows that the great majority of the study sample depends on stand-alone computers (representing 83%), while 15% of the study sample had a server connecting the workstations within the location into a one network. Finally, only one office of the study sample had their workstations connected to those of the office other locations and/or parent company.

Study Sample Distribution According to computing approach
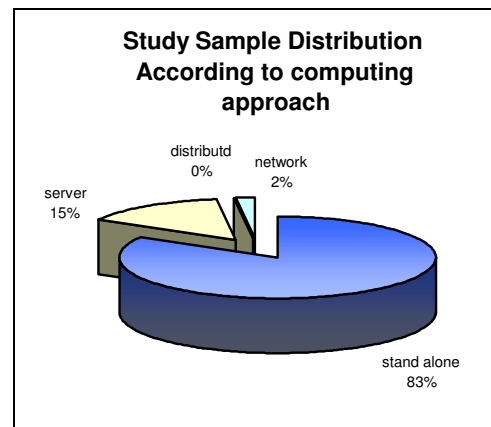
The researcher perceives the effect of the computing approach as facilitating the building and improving of a KBS. The ability of different employees to log into the system to perform changes through adding information, or to utilize and search for certain data would maximize the benefits anticipated to be associated with such a system. However, the majority of the study sample in the selected populations had a lack of a sufficient computing approach that is required in supporting a KBS; this would for sure affect the benefits associated with the system if it was to exist.

5.2.8 Availability of KM Software

At this point the study identifies clearly whether the office has a certain software for managing knowledge in a systematic manner, this question will identify the offices within the sample as either having a software which is internally developed, developed by Jordanian software house, or purchased from foreign source on the one hand, or as having no such software at all on the other hand, the breakdown of the study sample in terms of this factor went as follows:

Table (5-9): Study Sample Descriptive Distribution According to Availability of KM Software

Category	Frequency	Percentage
No software	53	98.10 %
Internally developed	1	1.90 %
Jordanian software house	0	0.00 %
Foreign source	0	0.00 %
Total	54	100.00 %

This shows that the majority of the sample representing 98.1% did not have any special software for managing their knowledge and data in a systematic
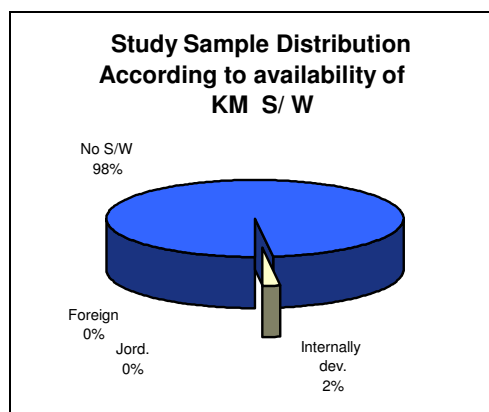
manner, only one office had specified the availability of certain software to store and retrieve required information.

The results associated with this variable will be further clarified in the following two variables discussing the availability of a KBS and the way of managing records in the office. The results of this question will be analyzed and discussed more thoroughly after building a clearer understanding of the case through the next two variables.

5.2.9 Availability of a KBS

The study further identifies specifically the availability of a KBS in the office, the question identifies the offices as being in one of the following stages: already having a KBS, in the stage of applying the system, in the stage of studying the system and gathering information about it, interested in such a system (heard about it from sources other than the questionnaire of this study), or unaware of the idea and concept of such a system. The distribution of the study sample were surprisingly far from the researcher expectations in the early stages of conducting the study for the fact that no office had a clear system to be considered a KBS except for one which stated that the system exists at their parent company offices. The break down of the study sample was as follows:

Table (5-10): Study Sample Descriptive Distribution According to availability of KBS

Category	Frequency	Percentage
Already has a KBS	1	1.90 %
Applying a system	2	3.70 %
Studying a system	2	3.70 %
Interested in the system	8	14.80 %
Unaware of such a system	41	75.90 %
Total	54	100.00 %

This shows that the majority of the sample was offices within which CEOs are unaware of such a system before reading this study questionnaire; this majority represented 76% of the study sample. While only 15% of the study sample had been aware and interested of such a system before. However, the remaining 10% of the study sample had been either an office in the stage of studying such a system, applying such a system, or has a KBS. One office only (which is a leg of a parent

company) had stated the availability of such a system in the offices of their parent company, and that they are using the data stored in such a system at some points whenever they feel it is needed.
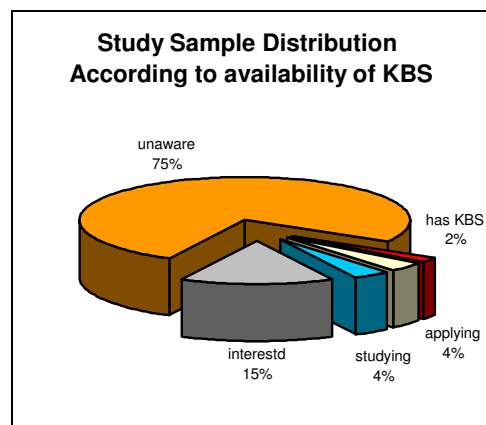
The interviews with CEOs of the offices showed a clear misunderstanding of such technique and idea. There has been a clear misunderstanding of such a system even in offices that stated that they are interested, studying, or even applying the system. The researcher further believes that even the

group of CEOs who stated their interest, studying, or applying of a KBS might have stated so in bragging about their offices.

Although the researcher had expected before starting the study that the majority of the offices will not have such a system in their office[1], the researcher had assumed there would be more understanding in knowledge management and such a system than what was surprisingly later discovered about what actually exists.

5.2.10 Techniques used for managing the office records

As a final stage in the first part of the questionnaire and in the process of identifying the availability and type of IT in the office, a final question will be identifying the techniques of managing the records in the office. This variable will be identified as one of four cases; on papers, on computers with simple file management techniques, in databases with proper search technique, or using a KBS. The breakdown of the study sample concerning this variable went as follows:

Table (5-11): Study Sample Descriptive Distribution According to record managing technique

Category	Frequency	Percentage
On papers	16	29.60 %
Simple file management techniques	37	68.50 %
Databases	1	1.90 %
KBS	0	0.00 %
Total	54	100.00 %

This shows that the majority of the sample representing 68.5% did not have
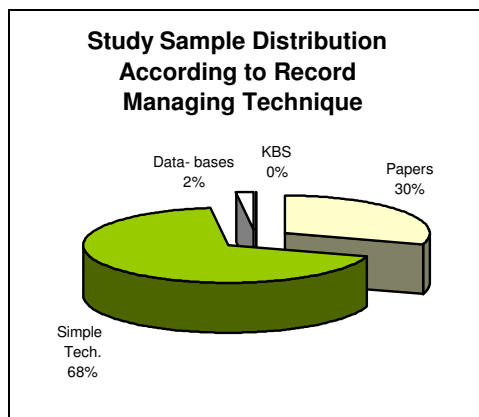
any special software for managing their knowledge and data, and depended only on simple file management technique using windows explorer (arranging data in folders and subfolders to facilitate the search process). However, a surprisingly big percentage representing 30% of the study sample are still depending on papers to manage their records; this percentage of the study sample stated

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[1] Which was the motive to measure its effect indirectly in the questionnaire through measuring the effect of the major variables associated with having such a system. (Refer to the Research Methodology in Chapter Four)

that the majority of their records are still on papers and computers have recently been used in their office. Moreover, no offices of the sample have stated KBS as their major record management technique.

5.3 Study Results Description

The mean and standard deviation for the results of each question in the second part of the questionnaire were derived and compared to the measuring tool mean in order to give a general idea about the tendency of the answers of the questionnaire.

It should be noted though, that the questions of the second part of the questionnaire, totaling thirty-two questions, were answered on a five-interval scale of absolutely disagree, disagree, neutral, agree, and absolutely agree. The scoring criterion is shown in figure (5-1) below:

Figure (5-1): The Measuring Tool Scale
(for questions in part two)

Interval →	Absolutely Disagree	Disagree	Neutral	Agree	Absolutely Agree
Score →	1	2	3	4	5

$$\text{Measuring Tool Mean} = \frac{1 + 2 + 3 + 4 + 5}{5} = 3$$
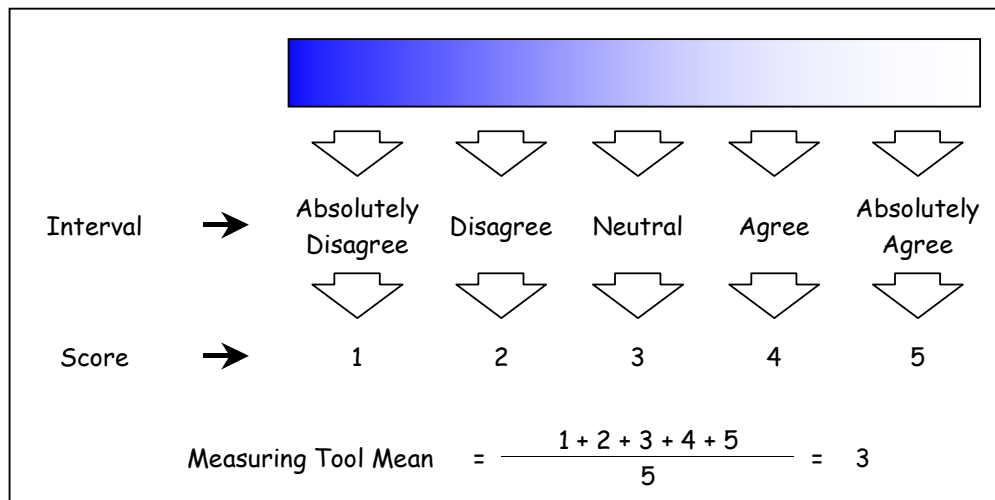
The mean and standard deviation of the questions were derived and summarized in the following table, note that some of the questionnaire questions where composed in a negative statement (to ensure that the questionnaire is not leading respondents to an all agree results), such questions will be marked with a star in the following table, and of which scores will be converted before any statistical analysis is to be done[1].

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[1] Answer scores of negative questions will be converted such as (5 becomes 1 and 4 becomes 2) and vise versa.

Table (5-12): Study Results Tendency Description

Q. #	Mean	Measuring Tool Mean	Standard Deviation	Q. #	Mean	Measuring Tool Mean	Standard Deviation
Q01	4.13	3.00	0.70	Q17	4.56	3.00	0.84
Q02	3.63	3.00	0.90	Q18*	3.65	3.00	1.29
Q03	3.76	3.00	1.01	Q19	4.81	3.00	0.48
Q04	4.61	3.00	0.76	Q20	4.56	3.00	0.63
Q05	4.15	3.00	0.86	Q21	4.30	3.00	0.82
Q06	1.69	3.00	0.93	Q22*	2.63	3.00	0.92
Q07	4.24	3.00	0.75	Q23	4.41	3.00	0.81
Q08	3.37	3.00	1.12	Q24	4.67	3.00	0.61
Q09	3.48	3.00	1.18	Q25	4.65	3.00	0.52
Q10	4.20	3.00	0.76	Q26	4.22	3.00	1.04
Q11*	3.33	3.00	1.33	Q27	4.63	3.00	0.65
Q12	4.54	3.00	0.69	Q28*	2.37	3.00	0.96
Q13	4.41	3.00	0.81	Q29	4.54	3.00	0.72
Q14	4.54	3.00	0.61	Q30	4.26	3.00	0.85
Q15	4.26	3.00	0.96	Q31	4.67	3.00	0.51
Q16	3.98	3.00	0.84	Q32	4.65	3.00	0.52

* Indicating questions formed as a negative statement

It can be noticed that the majority of the study questions had tendency to the agreement, as the results mean had been above the measuring tool mean except for questions number (6 + 22 + 28).

The tendency of the previous questions to a non agreement can be explained in consensus with the study overall results and conclusions so far as follows:

✓ The negative tendency in answers of question number six (which is concerned with the employees understanding for the concept of KBS and its effect on future decisions) represent the general misunderstanding for such concept between CEOs and owners of offices (questionnaire respondents) in the selected population.

✓ The negative tendency in answers of questions number twenty-two and twenty eight (which are concerned with the dependency of decision-makers on intuition and experience in strategic decisions) coincide with the study overall conclusion that decision-makers actually depend on intuition in such decisions; this dependency can be partly explained by their misunderstanding of the system under study and its benefits, and by the unavailability of such a system in the selected sample.

Further the tendency of the study results were derived in response to each of the study variables, tables (5-13) through (5-16) show this tendency in comparison to the measuring tool mean.

Table (5-13): "Individual Capabilities and Awareness" Results Tendency

Q. #	Mean	Measuring Tool Mean	Standard Deviation
Q05	4.15	3.00	0.86
Q06	1.69	3.00	0.93
Q07	4.24	3.00	0.75
Q08	3.37	3.00	1.12
Q09	3.48	3.00	1.18
Q10	4.20	3.00	0.76
Q11*	3.33	3.00	1.33

* Indicating questions formed as a negative statement

The previous table shows that the overall tendency for "Individual Capability and Awareness" is slightly above the measuring tool mean, which represents the CEOs negative perception for their subordinates' knowledge, experience, and capability.

Table (5-14): "Availability of Required Technologies" Results Tendency

Q. #	Mean	Measuring Tool Mean	Standard Deviation
Q01	4.13	3.00	0.70
Q02	3.63	3.00	0.90
Q03	3.76	3.00	1.01
Q04	4.61	3.00	0.76

The previous table shows that the overall tendency for "Availability of Required Technologies" represent an all to the agreement upon the CEO's own understanding. However, the researcher perceives that the actually available technologies in most offices have not reached to the required level for the support of operational activities and/or the support of KBS.

Table (5-15): "Department Coordination" Results Tendency

Q. #	Mean	Measuring Tool Mean	Standard Deviation
Q12	4.54	3.00	0.69
Q13	4.41	3.00	0.81
Q14	4.54	3.00	0.61
Q15	4.26	3.00	0.96
Q16	3.98	3.00	0.84
Q17	4.56	3.00	0.84
Q18*	3.65	3.00	1.29
Q19	4.81	3.00	0.48

* Indicating questions formed as a negative statement

The previous table shows that the overall tendency for the "Departments Coordination" had shown the highest among the chosen variables; this can be explained by the importance of this factor for the nature of business in an engineering office.

Table (5-16): "Acceptance and Trust of Decision Makers" Results Tendency

Q. #	Mean	Measuring Tool Mean	Standard Deviation
Q20	4.56	3.00	0.63
Q21	4.30	3.00	0.82
Q22*	2.63	3.00	0.92
Q23	4.41	3.00	0.81
Q24	4.67	3.00	0.61

* Indicating questions formed as a negative statement

The previous table shows that the overall tendency for the "Acceptance and Trust of Decision Makers" had been to the agreement. However, the researcher perceives that the fact that CEOs and decision makers represented the questionnaire respondents in this study had shifted answers to a more agreement than what actually might exist. This represents one of the study limitations as previously explained in chapter four.

It can be noticed roughly at this point that the tendency of the questions specified to measure the departments coordination are more into agreement than other factors, this can be explained by the importance of this variable in the CEOs own perception specially in engineering offices. In such offices, coordination should be assured in the design of a project between all departments of the office; mechanical, civil, architectural, and electrical. However, the importance of this factor and other factors in terms of their effect on the effectiveness of a KBS and the effectiveness of strategic decision will be further measured and identified in the following sections of this chapter.

5.4 Normal Distribution Test (Kolmogorov-Smirnov)

Kolmogorov-Smirnov test (Goodness of Fit test) was used to measure the degree upon which the data represent a normal distribution; 2-tailed P-value was calculated (using SPSS) less than 0.05 for all the statements in the questionnaire stating that the data represent a normal distribution (Mark Berenson and David Levine, 1992). The 2-tailed P-value for each of the questionnaire statements is shown in the following table:

Table (5-17): Kolmogorov-Smirnov 2-Tailed P-Value

Q. #	2-Tailed P-value	Q. #	2-Tailed P-value	Q. #	2-Tailed P-value
Q01	0.0000	Q12	0.0000	Q23	0.0000
Q02	0.0001	Q13	0.0000	Q24	0.0000
Q03	0.0004	Q14	0.0000	Q25	0.0000
Q04	0.0000	Q15	0.0001	Q26	0.0000
Q05	0.0029	Q16	0.0000	Q27	0.0000
Q06	0.0000	Q17	0.0000	Q28	0.0012
Q07	0.0022	Q18	0.0094	Q29	0.0000
Q08	0.0150	Q19	0.0000	Q30	0.0002
Q09	0.0082	Q20	0.0000	Q31	0.0000
Q10	0.0038	Q21	0.0010	Q32	0.0000
Q11	0.0156	Q22	0.0003		

5.5 Study Hypotheses Testing[1]

Through the research, the symbol H_o was assigned to the null hypothesis and the symbol H_a to the alternative hypothesis. The purpose of the hypothesis testing presented in this section is to determine which of the two hypotheses is correct.

Generally, the hypothesis testing will identify whether the actual sample mean (or other appropriate statistic) has deviated substantially from the mean of the hypothesized sampling distribution by a large enough value to conclude that the statistical hypothesis is wrong. (William, 2000)

However, there should be a decision criterion upon which this deviation is to be compared. This decision criterion is defined as the *significance level*[2]. "On the assumption that the hypothesis being tested is true, if the probability of occurrence of the observed data is smaller than the level of significance, then the data suggest the null hypothesis should be rejected. In other words, there is evidence to support contradiction of the null hypothesis, which is equivalent to supporting the alternative hypothesis" (William, 2000). This significance level was referred in this study by choosing a *confidence level* of 95% <z=1.96> (as discussed in part 4.7 of this research).

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[1] The questionnaire was distributed to 54 respondents in 54 offices (chosen randomly as previously discussed) and results were analyzed using SPSS software.

[2] Significance Level represents the critical probability in choosing between the null hypothesis and the alternative hypothesis. (William, 2000)

The appropriate statistical tests were used through this section to determine which of the two hypotheses is correct, the criteria for choosing tests is shown in the following table:

Table (5-18): Statistical tests used

Hypothesis		Test Used
Hypothesis One	(1-1) Through (1-4)	Simple Regression T-test
	(1-5)	Multiple Regression F-test
Hypothesis Two	(2-1) Through (2-10)	2-Way Anova
Hypothesis Three		Correlation Matrix

5.5.1 First Hypothesis Testing

Simple regression was used to test the first minor hypothesis; the analysis and result are shown in the following table:

Table (5-19): Hypothesis (1-1) Testing

The Hypothesis	(Ho) No significant statistical relation between capabilities of individuals and the effectiveness of strategic decisions.
	(Ha) There is significant statistical relation between capabilities of individuals and the effectiveness of strategic decisions.

Questionnaire question #s to test   :   (5-11) & (25-32)

Test Used   :   Simple Regression Test

Calculated T	*Table T*	*Sig. T*	*Testing Result*
1.103	2.0057	0.2752	Accept

Analysis	The simple regression test was used; SPSS output shown in the previous table indicates that T calculated (1.103) is *less* than the tabulated T (2.0057). Since the decision principle is to accept the null hypothesis when T calculated is less than T in tables, and reject the null hypothesis when T calculated is more than T from tables, the result would be to ***Accept*** the null hypothesis (Ho) and reject the (Ha) hypothesis → There is <u>no relation</u> between capabilities of individuals and the effectiveness of strategic decisions.

Simple regression was used to test the second minor hypothesis; the analysis and result are shown in the following table:

Table (5-20): Hypothesis (1-2) Testing

The Hypothesis	(Ho) No significant statistical relation between availability of required technology and the effectiveness of strategic decisions. (Ha) There is significant statistical relation bet. availability of required technology and the effectiveness of strategic decisions.

Questionnaire question #s to test   :   (1-4) & (25-32)

Test Used   :   Simple Regression

Calculated T	Table T	Sig. T	Testing Result
0.0900	2.0057	0.9286	Accept

Analysis	The simple regression test was used; SPSS output shown in the previous table indicates that T calculated (0.0900) is *Less* than the tabulated T (2.0057). Since the decision principle is to accept the null hypothesis when T calculated is less than T in tables, and reject the null hypothesis when T calculated is more than T from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no relation between availability of required technologies and the effectiveness of strategic decisions.

Simple regression was used to test the third minor hypothesis; the analysis and result are shown in the following table:

Table (5-21): Hypothesis (1-3) Testing

The Hypothesis	(Ho) No significant statistical relation between department coordination and the effectiveness of strategic decisions. (Ha) There is significant statistical relation between department coordination and the effectiveness of strategic decisions.

Questionnaire question #s to test   :   (12-19) & (25-32)

Test Used   :   Simple Regression

Calculated T	Table T	Sig. T	Testing Result
0.1800	2.0057	0.8577	Accept

Analysis	The simple regression test was used; SPSS output shown in the previous table indicates that T calculated (0.1800) is *Less* than the tabulated T (2.0057). Since the decision principle is to accept the null hypothesis when T calculated is less than T in tables, and reject the null hypothesis when T calculated is more than T from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → There is no relation between department coordination and the effectiveness of strategic decisions.

Simple regression was used to test the fourth minor hypothesis; the analysis and result are shown in the following table:

Table (5-22): Hypothesis (1-4) Testing

| The Hypothesis | (Ho) No significant statistical relation between acceptance and trust of decision makers and the effectiveness of strategic decisions. |
| | (Ha) There is significant statistical relation between acceptance and trust of decision makers and the effectiveness of strategic decisions. |

Questionnaire question #s to test : (20-24) & (25-32)

Test Used : Simple Regression

Calculated T	*Table T*	*Sig. T*	*Testing Result*
3.3070	2.0057	0.0017	Reject

| Analysis | The simple regression test was used; SPSS output shown in the previous table indicates that T calculated (3.3070) is *bigger* than the tabulated T (2.0057). Since the decision principle is to accept the null hypothesis when T calculated is less than T in tables, and reject the null hypothesis when T calculated is more than T from tables, the result would be to *Reject* the null hypothesis (Ho) and accept the (Ha) hypothesis → There is relation between acceptance and trust of decision makers and the effectiveness of strategic decisions. |

Multiple regression test was used to test the fifth minor hypothesis; the analysis and result are shown in the following table:

Table (5-23): Hypothesis (1-5) Testing

| The Hypothesis | (Ho) No significant statistical relation between independent variables as a whole and the effectiveness of strategic decisions. |
| | (Ha) There is significant statistical relation between independent variables as a whole and the effectiveness of strategic decisions. |

Questionnaire question #s to test : (1-24) & (25-32)

Test Used : Multiple Regression

Calculated F	*Table F*	*Sig. F*	*Testing Result*
3.8418	2.58	0.0086	Reject

| Analysis | The multiple regression test was used; SPSS output shown in the previous table indicates that F calculated (3.8418) is *bigger* than the tabulated F (2.58). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Reject* the null hypothesis (Ho) and accept the (Ha) hypothesis → There is relation between independent variables as a whole and the effectiveness of strategic decisions. |

5.5.2 Second Hypothesis Testing

Two Way Anova was used to test the first minor hypothesis; the analysis and result are shown in the following table:

Table (5-24): Hypothesis (2-1) Testing

| The Hypothesis | (Ho) The office classification has no significant statistical effect on the relation between individual capabilities and awareness and the effectiveness of strategic decisions. |
| | (Ho) The office classification has significant statistical effect on the relation between individual capabilities and awareness and the effectiveness of strategic decisions. |

Questionnaire question #s to test	:	(5-11) & (25-32) & Mod(1)
Test Used	:	Two Way Anova Test

Calculated F	*Table F*	*Sig. F*	*Testing Result*
1.015	2.1400	0.438	Accept

| Analysis | Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (1.015) is *less* than the tabulated F (2.1400). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the office classification on the relation between individual capabilities and awareness and the effectiveness of strategic decisions. |

Two Way Anova was used to test the second minor hypothesis; the analysis and result are shown in the following table:

Table (5-25): Hypothesis (2-2) Testing

| The Hypothesis | (Ho) The office classification has no significant statistical effect on the relation between the availability of required technologies and the effectiveness of strategic decisions. |
| | (Ho) The office classification has no significant statistical effect on the relation between the availability of required technologies and the effectiveness of strategic decisions. |

Questionnaire questions # to test	:	(1-4) & (25-32) & Mod(1)
Test Used	:	Two Way Anova Test

Calculated F	*Table F*	*Sig. F*	*Testing Result*
1.335	2.0600	0.243	Accept

| Analysis | Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (1.335) is *less* than the tabulated F (2.0600). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the office classification on the relation between availability of required technologies and the effectiveness of strategic decisions. |

Two Way Anova test was used to test the third minor hypothesis; the analysis and result are shown in the following table:

Table (5-26): Hypothesis (2-3) Testing

The Hypothesis	(Ho) The office classification has no significant statistical effect on the relation between departments' coordination and the effectiveness of strategic decisions. (Ho) The office classification has no significant statistical effect on the relation between departments' coordination and the effectiveness of strategic decisions.

Questionnaire questions # to test   :   (12-19) & (25-32) & Mod(1)

Test Used   :   Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
0.9820	2.1000	0.4680	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (0.9820) is *less* than the tabulated F (2.1000). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the office classification on the relation between departments' coordination and the effectiveness of strategic decisions.

Two Way Anova was used to test the fourth minor hypothesis; the analysis and result are shown in the following table:

Table (5-27): Hypothesis (2-4) Testing

The Hypothesis	(Ho) The office classification has no statistical significant effect on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions. (Ho) The office classification has statistical significant effect on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions.

Questionnaire questions # to test   :   (20-24) & (25-32) & Mod(1)

Test Used   :   Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
2.418	2.2000	0.034	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (2.418) is *bigger* than the tabulated F (2.200). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Reject* the null hypothesis (Ho) and accept the (Ha) hypothesis → there is effect for the office classification on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions.

Two Way Anova was used to test the fifth minor hypothesis; the analysis and result are shown in the following table:

Table (5-28): Hypothesis (2.5) Testing

The Hypothesis	(Ho) The office classification has no significant statistical effect on the relation between independent variables as whole and the effectiveness of strategic decisions. (Ho) The office classification has no significant statistical effect on the relation between independent variables as a whole and the effectiveness of strategic decisions.

Questionnaire questions # to test   :   (1-25) & (25-32) & Mod(1)

Test Used   :   Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
1.245	2.2000	0.299	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (1.2545) is *less* than the tabulated F (2.2000). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the office classification on the relation between independent variables as a whole and the effectiveness of strategic decisions.

Two Way Anova was used to test the sixth minor hypothesis; the analysis and result are shown in the following table:

Table (5-29): Hypothesis (2.6) Testing

The Hypothesis	(Ho) The number of employees has no significant statistical effect on the relation between individual capabilities and the effectiveness of strategic decisions. (Ho) The number of employees has significant statistical effect on the relation between individual capabilities and the effectiveness of strategic decisions.

Questionnaire questions # to test   :   (5-11) & (25-32) & Mod(1)

Test Used   :   Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
1.047	2.300	0.407	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (1.047) is *less* than the tabulated F (2.300). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the number of employees on the relation between individual capabilities and awareness and the effectiveness of strategic decisions.

Two Way Anova was used to test the seventh minor hypothesis; the analysis and result are shown in the following table:

Table (5-30): Hypothesis (2.7) Testing

The Hypothesis	(Ho) The number of employees has no significant statistical effect on the relation between availability of required technology and the effectiveness of strategic decisions. (Ho) The number of employees has significant statistical effect on the relation between availability of required technology and the effectiveness of strategic decisions.

Questionnaire questions # to test   : (1-4) & (25-32) & Mod(2)

Test Used   :   Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
0.607	2.200	0.747	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (0.607) is *less* than the tabulated F (2.200). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the number of employees on the relation between availability of required technology and the effectiveness of strategic decisions.

Two Way Anova test was used to test the eighth minor hypothesis; the analysis and result are shown in the following table:

Table (5-31): Hypothesis (2.8) Testing

The Hypothesis	(Ho) The number of employees has no significant statistical effect on the relation between departments' coordination and the effectiveness of strategic decisions. (Ho) The number of employees has no significant statistical effect on the relation between departments' coordination and the effectiveness of strategic decisions.

Questionnaire questions # to test   :   (12-19) & (25-32) & Mod(2)

Test Used   :   Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
0.964	2.200	0.469	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (0.964) is *less* than the tabulated F (2.200). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the number of employees on the relation between departments' coordination and the effectiveness of strategic decisions.

Two Way Anova test was used to test the ninth minor hypothesis; the analysis and result are shown in the following table:

Table (5-32): Hypothesis (2.9) Testing

The Hypothesis	(Ho) The number of employees has no significant statistical effect on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions. (Ho) The number of employees has significant statistical effect on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions.

Questionnaire questions # to test : (20-24) & (25-32) & Mod(2)

Test Used : Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
2.591	2.410	0.0370	Reject

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (2.591) is *bigger* than the tabulated F (2.410). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Reject* the null hypothesis (Ho) and accept the (Ha) hypothesis → there is effect for the number of employees on the relation between acceptance and trust of decision makers and the effectiveness of strategic decisions.

Two Way Anova test was used to test the tenth minor hypothesis; the analysis and result are shown in the following table:

Table (5-33): Hypothesis (2.10) Testing

The Hypothesis	(Ho) The number of employees has no significant statistical effect on the relation between independent variables as whole and the effectiveness of strategic decisions. (Ho) The number of employees has significant statistical effect on the relation between independent variables as a whole and the effectiveness of strategic decisions.

Questionnaire questions # to test : (1-24) & (25-32) & Mod(2)

Test Used : Two Way Anova Test

Calculated F	Table F	Sig. F	Testing Result
0.818	2.400	0.543	Accept

Analysis	Two Way Anova test was used; SPSS output shown in the previous table indicates that F calculated (0.818) is *less* than the tabulated F (2.400). Since the decision principle is to accept the null hypothesis when F calculated is less than F in tables, and reject the null hypothesis when F calculated is more than F from tables, the result would be to *Accept* the null hypothesis (Ho) and reject the (Ha) hypothesis → there is no effect for the number of employees on the relation between independent variables as a whole and the effectiveness of strategic decisions.

5.5.3 Third Hypothesis Testing

The relation between the independent variables was studied by conducting a correlation matrix shown below:

Table (5-34): Hypothesis (3) Testing – Correlation Matrix

	Ind. (1)	Ind. (2)	Ind. (3)	Ind. (4)
Ind. (1)	r = 1.0000 (54) P = *	r = 0.2940 (54) P = 0.031	r = 0.4089 (54) P = 0.002	r = 0.3397 (54) P = 0.012
Ind. (2)	r = 0.2940 (54) P = 0.031	r = 1.0000 (54) P = *	r = 0.4267 (54) P = 0.001	r = 0.3668 (54) P = 0.006
Ind. (3)	r = 0.4089 (54) P = 0.002	r = 0.4267 (54) P = 0.001	r = 1.0000 (54) P = *	r = 0.4228 (54) P = 0.001
Ind. (4)	r = 0.3397 (54) P = 0.12	r = 0.3668 (54) P = 0.006	r = 0.4228 (54) P = 0.001	r = 1.0000 (54) P = *

* Coefficient cannot be computed   (cases processed)
Ind. (1) : Capabilities of individuals   Ind. (3) : Departments coordination
Ind. (2) : Availability of required technology   Ind. (4) : Acceptance and trust of decision makers

The previous correlation matrix shows for each pair of independent variables the r-coefficient, number of cases processed, and two tailed significance. According to Mark Berenson and David Levine, 1992, the maximum calculated coefficient (42.67%) between "departments coordination" and "availability of required technology"[1][Ind(3) & Ind(2)] will be used to calculate the variance of Inflationary factor (VIF):

$$VIF = 1 / (1-r^2)$$
$$= 1 / (1-(0.4267)^2)$$
$$= 1.223$$

Since VIF is less than 5 $\rightarrow$ There is no multicolleniarity.

$\rightarrow$ There is no relation between the independent variables of the study, which states the strength of the theoretical model used.

Note that all correlation coefficients (r) and coefficients of determination (r^2) in this study were up to moderate values (40%) only, which also indicates no relation between independent variables. (William, 2000)

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[1] It is important to point that correlation does not mean causation. For example, no matter how highly correlated "department coordination" is to "availability of required technology" the department coordination does not cause the availability of required technology to rise or vise versa.

5.6 Hypotheses Testing Summary

The following table is a summary of the hypotheses testing results for simplification purposes.

Table (5-35): Hypotheses Testing Summary

Hypothesis		Test Used									Result
		Simple Reg			Multiple Reg			2-Way Anova			
		Calc T	Table T	Sig.	Calc F	Table F	Sig.	Calc F	Table F	Sig.	
1-1	Ind(1) - dep	1.1030	2.0057	0.2752	-	-	-	-	-	-	No relation
1-2	Ind(2) - dep	0.0900	2.0057	0.9286	-	-	-	-	-	-	No relation
1-3	Ind(3) - dep	0.1800	2.0057	0.8577	-	-	-	-	-	-	No relation
1-4	Ind(4) - dep	3.3070	2.0057	0.0017	-	-	-	-	-	-	There is Relation
1-5	Ind - dep	-	-	-	3.8418	2.5800	0.0085	-	-	-	There is Relation
2-1	Ind(1) - mod(1) - dep	-	-	-	-	-	-	1.0150	2.1400	0.4380	No effect
2-2	Ind(2) - mod(1) - dep	-	-	-	-	-	-	1.3350	2.0600	0.2430	No effect
2-3	Ind(3) - mod(1) - dep	-	-	-	-	-	-	0.9820	2.1000	0.4680	No effect
2-4	Ind(4) - mod(1) - dep	-	-	-	-	-	-	2.4180	2.2000	0.0340	There is effect
2-5	Ind - mod(1) - dep	-	-	-	-	-	-	1.2450	2.2000	0.2990	No effect
2-6	Ind(1) - mod(2) - dep	-	-	-	-	-	-	1.0470	2.3000	0.4070	No effect
2-7	Ind(2) - mod(2) - dep	-	-	-	-	-	-	0.6070	2.2000	0.7470	No effect
2-8	Ind(3) - mod(2) - dep	-	-	-	-	-	-	0.9040	2.2000	0.4690	No effect
2-9	Ind(4) - mod(2) - dep	-	-	-	-	-	-	2.5910	2.4100	0.0370	There is effect
2-10	Ind - mod(1) - dep	-	-	-	-	-	-	0.8180	2.4000	0.5430	No effect
3	Ind(x) - Ind(y)	Correlation Matrix									No relation

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Ind(1) : Capabilities of individuals	Ind(3) : Departments coordination
Ind(2) : Availability of required technology	Ind(4) : Acceptance and trust of decision makers
Ind : independent variables as a whole	Mod(1) : Office Classification
Dep : Effectiveness of strategic decisions	Mod(2) : Number of employees

6.1 Study Results Analysis

Analyzing the data of the desk research along with the practical perception gained through the field research, the researcher has reached to several general understandings regarding Knowledge Management practices in engineering offices in Jordan. These understandings are:

1. There has been a clear misunderstanding regarding the subject of knowledge management from the CEOs of engineering offices in Jordan.
2. Engineering offices in Jordan had shown a very diminutive percentage of spending over information technology projects, MIS, and knowledge management projects.
3. CEOs would rather depend on their own knowledge, intuition, and experience in deciding the future strategy of the organization, and prefer not to share such matters with other employees.
4. There has been surprisingly small interest in a system through which knowledge and work experience may be retrieved.
5. There has been a significant interest in a system that includes information with easy retrieval process. This interest has clearly exceeded the interest and understanding for the importance of managing knowledge.
6. The lack of interest and investment in Knowledge Management can be partly explained as a result of the small size offices in Jordan, and the lack of enough projects to produce excess revenue to be invested in such a system.

The hypothesis testing has arrived to the following results and conclusions that coincide with the previously mentioned observations and general understandings:

1. No significant statistical relation between capabilities of individuals, availability of required technologies, or departments' coordination within an organization on the effectiveness of strategic decisions.
2. Acceptance and trust of decision makers in their subordinates' knowledge had a statistical significant effect on the effectiveness of strategic decisions.
3. The number of employees and office classification had only a significant statistical moderating effect when studying the effect of acceptance and trust from CEOs in their subordinates' knowledge provided on the effectiveness of decisions.

The researcher believes that the reasons behind this majority of null findings in this study are[1]:

1. Cultural aspects through which CEOs and owners of enterprises limit the sharing of managerial and strategical concerns regarding the firms future to themselves or few others at the top managerial level.
2. A resulting lack of trust and acceptance from CEOs to opinions and knowledge provided by subordinates and lower leveled employees, and narrowing their contribution to technical sides only.
3. The misunderstanding of such a system had made it hard to visualize what benefits might be associated with it and thus heaved the results into a null majority of findings.

6.2 A Note on the Study Objectives

The researcher perceives that the study has arrived to all its intended objectives through the integrity of information that has been presented and analyzed. Certain objectives were achieved through the theoretical background presented in the first three chapters, while the rest of the objectives had to be covered through a more formal manner of statistical analysis and measurements (as previously discussed in section 1.3).

6.3 Coinciding the Study Results with Those of Earlier Studies

Jordanian studies had mainly discussed the importance and use of information technology on the operations of the organization; this study represents the first that extended the interest to knowledge and its management as well as information. Generally, earlier studies had harmonized in the importance of information on the effectiveness of decisions, and similar findings had been reached through the study in hand.

A study by Moh'd Al-Nathere stated that 20% of the banking sector in 1990 in Jordan had a separate department for information systems, and a study by Dr, Rifat O. Shannak stated that 25% of shareholder companies in Jordan in 1994 had a department concerned with information systems. The results of the study at hand has shown almost the same percentage for offices having certain employees concerned with information systems, but surprisingly, a much less percentage of those offices had a system from

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[1] The findings presented in this and other sections may not certainly coincide with the situation in all of the offices under study, as some offices had presented a contrary case, and as some other sectors might show contrary results. Thus generalizability should be considered with caution.

which data can be quickly and efficiently retrieved, and almost no office had system for knowledge management.

Generally, foreign studies have pointed out the importance of information systems and DSS in improving the effectiveness of decision-making. The studies discussion implies on the great recent interest that this subject is being awarded in foreign countries. Although, Jordan has recently stepped a great deal in the road of IT under the support of his majesty King Abdullah the second, enormous achievements in this field are still expected in the coming few years.

Studies concerned with knowledge management have stressed on the importance of developing a better and more accurate understanding of knowledge strategy within organizations. This has coincided with the results of this study; the study at hand reached to the fact that lack of understanding for the concept of knowledge management was the main driver undermining its importance. The researcher believes that further seminars and studies should be done and published to increase the understanding of this concept between owners and CEOs of organizations in Jordan.

Finally, the researcher perceives great anticipation in this field in the coming few years in Jordan, hoping that this study will take part in assessing this development through the information it provides.

6.4 How can the Study Results Serve in Reducing the Problem

This study represents part of a comprehensive program being adopted in Jordan in the KM and IT fields. Such a study helps in increasing the awareness and trust between individuals at different levels in the organization for the importance of Knowledge Management. Moreover, it is presumed that such increase in awareness would reduce the expanding dramatic danger of globalization and aggressive competition.

On the other hand, the study emphasizes on introducing a new system technology presented worldwide in improving the ability of turning knowledge and experience that people hold into a more tangible, useful, and retrievable state.

Moreover, the study highlights the major steps in building a KBS, and the challenges that should be avoided, what should be done at each organizational level, and the benefits that should be harvested from having

such a system, all in the process of increasing the understanding of such a new concept.

Finally, the study is intended to motivate a group of other researchers into building a cycle of related studies that would drive the concept into a more and more mature understanding.

6.5 Study Conclusions and Recommendations

The study has arrived to the following conclusions:

1. A significant degree of misunderstanding for the concept of knowledge management and the benefits that can be achieved by applying its techniques has been clearly noticed within the study sample.

2. Nearly all of the study sample had no technique for managing their records and had depended on simple file management for keeping their records.

3. The availability of Knowledge management technique can be of great benefit in the practice of organization development through improving the efficiency of different operating activities.

4. Employees at high managerial levels within the sample of the study prefer to depend on their own intuition in deciding the strategy of the organization's future, and prefer not to share the knowledge they have with others. Changing these beliefs can only be done by continuous education about knowledge management benefits.

5. Engineering offices in Jordan had shown a very diminutive percentage of spending over information technology projects, MIS, and knowledge management projects.

6. There has been surprisingly less interest in a system through which knowledge and work experience may be retrieved.

7. There has been a significant interest in a system that includes information with easy retrieval process. This interest has clearly exceeded the interest and understanding for the importance of managing knowledge.

8. The lack of interest and investment in Knowledge Management can be partly explained as a result of the small size offices in Jordan, and the lack of enough projects to produce excess revenue to be invested in such a system.

9. Acceptance and trust of decision makers in their subordinates and the knowledge, information, and opinion they provide represent a major aspect in the success of KBS.

10. The success of a KBS and the benefits associated with having it can be achieved in almost any org. and in any office regardless of the classification in the chosen population

According to the previously presented results and conclusions, the researcher recommends the following:

1. A continuous educating of organizations' CEOs and owners of the importance of Knowledge Management and the benefits associated with applying systems for managing knowledge.

2. Workshops, seminars, training courses, training sessions should be organized and held by JEA and other associations for free or for small amount of money to increase awareness for KM.

3. Retreats and/or meetings should be held annually in organizations to discuss the achievements of each department in the last year and to build the future strategy of the org.

4. A clear mission and vision for the organization should be spread explicitly between employees.

5. More expenditure should be allocated by organizations for the improvement of MIS and KM projects
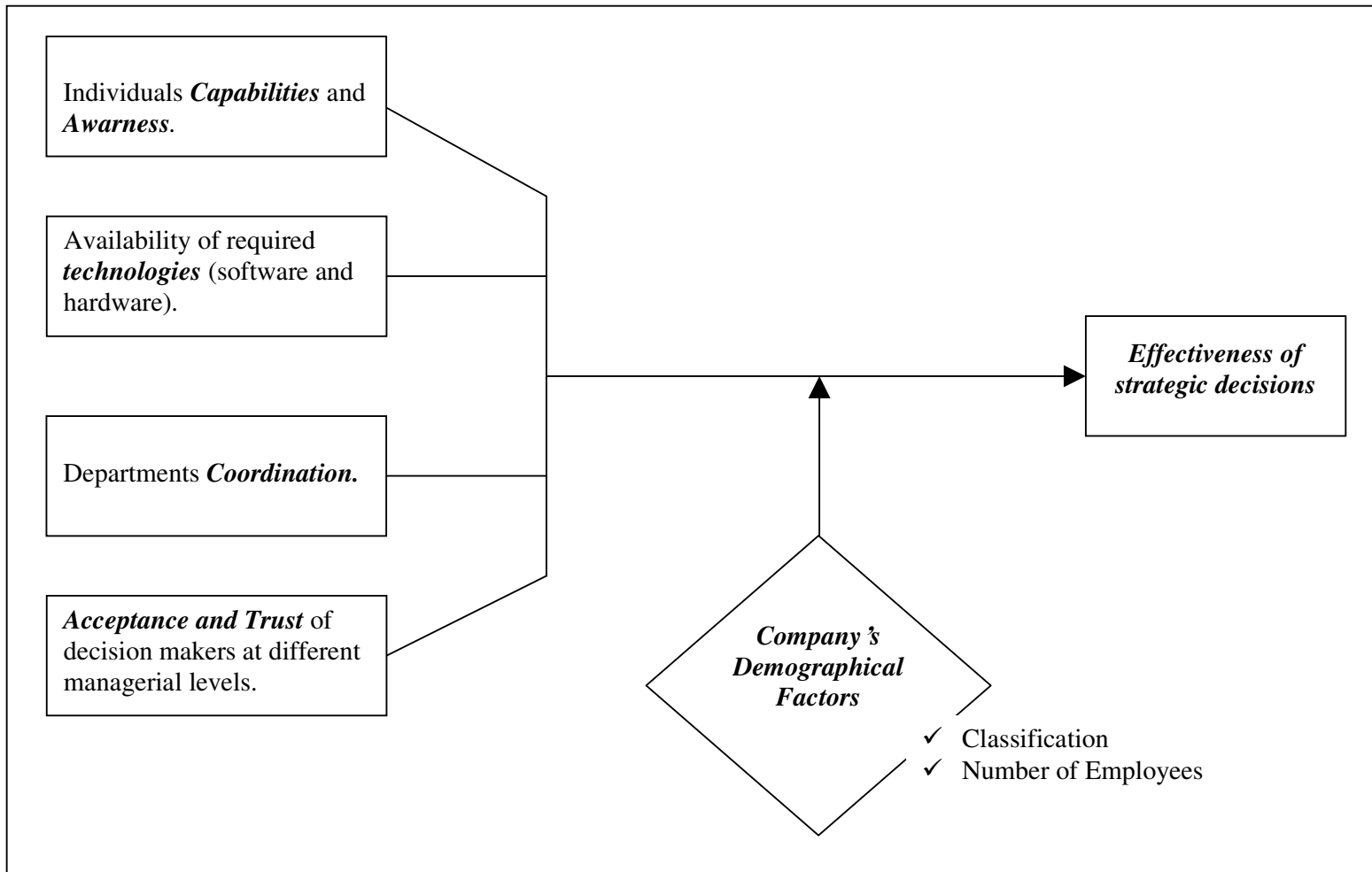
Figure (4-1): Theoretical Model of the study

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STUDY SAMPLE

The number of observations to be taken from each engineering offices category was specified in chapter four of the report. Moreover, choosing from each stratum was done randomly according to the offices serial number taken from Jordan Engineering Association. Random Clock# Generator Software[1] was used, the software selects randomly as much numbers required from a list of given numbers. The resulting sample is:

Specialized Office - A				مكتب مهندس ـ أ
Number of offices in this category 264	Total number of offices representing the population 1035	Percentage of the population 0.25507	Sample size 54	# of observation to be taken from this category 14

١. مكتب المهندس محمد أبو غريبة
٢. مكتب نبراس الهندسي
٣. مكتب المهندس ماهر المعلواني
٤. مكتب يحيى للاستشارات الهندسية
٥. مكتب المهندس سامي الشلّه
٦. مجموعه الحداثه للاستشارات الهندسيه
٧. مكتب المهندس فايز عبيد حسن
٨. مكتب المهندسه سهير دربي
٩. مكتب سوبريم الهندسي
١٠. مكتب المهندس عدنان خضر أبو سعود
١١. مكتب المهندس عبدالله العمايره
١٢. مكتب الكسواني للاستشارات الهندسيه
١٣. مكتب المهندس فوزي خليفه
١٤. مكتب المهندس غالب قعدان

Specialized Office - B				مكتب مهندس ـ ب
Number of offices in this category 167	Total number of offices representing the population 1035	Percentage of the population 0.16135	Sample size 54	# of observation to be taken from this category 9

١. مكتب المهندس جمال دعمس
٢. مكتب المهندس فارس المعشر
٣. مؤسسه عبر الشرق الهندسيه
٤. مكتب المهندس سعد الغرايبه
٥. مكتب سكيما الهندسي
٦. مكتب السنديان الهندسي
٧. مكتب المهندس عيسى نقاع
٨. مكتب المهندس سهيل أبو بكر
٩. مكتب المهندس طلال يوسف مسعود

[1] Originally written for employers to randomly select employees for drug testing by clock number. Can be used for many things, will randomly select numbers, names, or most anything from a text file created from notepad, Excel, ...etc / NathanHunt Software - Downloaded for free at http://www.nhuntsoftware.com

Specialized Office -C			مكتب مهندس - ج	
Number of offices in this category **86**	Total number of offices representing the population **1035**	Percentage of the population **0.08309**	Sample size **54**	# of observation to be taken from this category **4**

١. مكتب المهندس هاني أبو متّه
٢. مكتب المهندسه نسرين كيالي
٣. مكتب المهندس مراد شعبان
٤. مكتب المهندس سميح أبو شرف

Engineering Office – First Category			مكتب هندسي - مرتبه اولى	
Number of offices in this category **38**	Total number of offices representing the population **1035**	Percentage of the population **0.03671**	Sample size **54**	# of observation to be taken from this category **2**

١. مكتب اشتيوي للاستشارات الهندسية
٢. مكتب المهندس عادل شلالده

Engineering Office – Second Category			مكتب هندسي - مرتبه الثانيه	
Number of offices in this category **325**	Total number of offices representing the population **1035**	Percentage of the population **0.31401**	Sample size **54**	# of observation to be taken from this category **17**

١. مكتب المهندس مازن عبد السلام
٢. مكتب المهندس حكم حمدان
٣. شركه أسامه ناجي وشركاه
٤. مؤسسه المناره الأردنيه للدراسات الهندسيه
٥. مكتب المهندس وجيه سماره
٦. شركه هشام القدومي وشركاه (المعماريون العرب)
٧. مكتب المعالي للاستشارات الهندسيه
٨. مكتب المهندس مروان نصار
٩. مكتب الأريزونا الهندسي
١٠. مكتب بناء للاستشارات الهندسيه
١١. مكتب المهندس محمد مشهور مرقه
١٢. مكتب المهندس فهيم أحمد حرب
١٣. مكتب المهندس اياد الكسواني
١٤. مكتب المهندس خليل فضه
١٥. مكتب سماره وشريكه
١٦. مكتب المهندس ابراهيم الحسبان
١٧. مكتب أركان للاستشارات الهندسيه

Engineering Consultancy Office				مكتب استشاري
Number of offices in this category **144**	Total number of offices representing the population **1035**	Percentage of the population **0.13913**	Sample size **54**	# of observation to be taken from this category **7**

١.   مكتب الطبّاع الهندسي
٢.   مكتب المهندس فارس بقاعين
٣.   المختبرات الهندسية الحديثه
٤.   مكتب الثلاثيه للاستشارات الهندسيه
٥.   مكتب المهندس فهمي حزين
٦.   الشرق الأوسط للاداره الهندسية
٧.   ائتلاف ارابتك ــ جردانه مهندسون مستشارون

Consultation Office				مكتب رأي
Number of offices in this category **11**	Total number of offices representing the population **1035**	Percentage of the population **0.01063**	Sample size **54**	# of observation to be taken from this category **1**

١.   مكتب المهندس مازن ريال

مـلـخـص

دراسة تحليلية لمدى استخدام نظم الأساس المعرفي باتخاذ
القرارات الاستراتيجية في المكاتب الهندسية في الأردن

إعداد
سامي إبراهيم "الحاج حامد"

المشرف
الدكتور رفعت الشناق

رغم الاهتمام الواسع الذي حظيت به إدارة المعرفة عالميا، لم تحظ نظم المعلومات الإدارية ونظم الأساس المعرفي إلى القدر الكافي والمرجو من الاهتمام في الأردن. ولقد هدفت هذه الدراسة إلى الكشف عن مدى توافر نظم الأساس المعرفي لدى المنظمات الإدارية والفوائد المرجوة من وجود هذا النظام في زيادة كفاءة اتخاذ القرارات الاستراتيجية. ويقوم هذا النظام على جمع المعرفة والمعلومات لدى الموظفين على اختلاف مراكزهم وتوفيرها كأداة مساعدة لمتخذ القرار. ولقد تم اختيار المكاتب الهندسية في الأردن كعينة للدراسة.

تقوم الرسالة على دراسة أثر أربعة عوامل لمدى فاعلية القرارات الاستراتيجية المتخذة في المكتب ، تتكون هذه العوامل الأربعة والممثلة لنتائج وجود نظام الأساس المعرفي من : قدرة والمام موظفي المكتب بهذا النظام، توفر التكنولوجيا المطلوبة، التعاون والتنسيق بين أقسام المكتب المختلفة بالإضافة إلى القبول والثقة من متخذي القرار لمثل هذا النظام والمعلومات التي قد يحتويها. كما تم دراسة كل من تصنيف المكتب وعدد الموظفين في المكتب كعوامل معدلة لأثر العوامل المستقلة على كفاءة القرارات الاستراتيجية.

لتحقيق الأهداف المرجوة من الرسالة ، قام الباحث بتصميم استبانه لقياس الفرضيات ، قسمت الاستبانة إلى قسمين رئيسيين يقوم القسم الأول منها والذي يتكون من عشرة أسئلة على إدراج أهم العوامل الديموغرافية المتعلقة بالمكتب كما يبين مدى توفر وماهية نظم المعلومات في المكتب. بينما يقوم القسم الثاني من الاستبانة والمكون من اثني وثلاثين سؤالا على قياس فرضيات الرسالة.

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تم إجراء الاختبارات التحليلية اللازمة وخلصت الدراسة إلى النتائج التالية :

- عدم الإلمام والمعرفة الكافية لدى مدراء وأصحاب المكاتب الهندسية فيما يخص نظم المعلومات ونظام الأساس المعرفي مما نتج عنة عدم توفر نظم لخزن واستخراج المعلومات في أغلب هذه المكاتب.

- يعتمد أغلب مدراء المكاتب في العينة المختارة على الحدس والمعلومات الشخصية الناتجة عن الخبرة في اتخاذ القرارات الاستراتيجية بالإضافة إلى الميل الواضح لعدم مشاركة الموظفين بالرأي بما يخص هذا المجال.

- أبدى مدراء المكاتب الهندسية رغبة واهتماماً بهذا النظام وتأييداً للأهداف المرجوة منه بغض النظر عن عدم وجود أثر ذي دلالة إحصائية للمتغيرات المستقلة على كفاءة القرارات الاستراتيجية عدا عن القبول والثقة من متخذي القرار.

- لم يكن لأي من تصنيف المكتب وعدد الموظفين أثرٌ ذو دلالة إحصائية على العلاقة بين أي من العوامل المستقلة وكفاءة القرارات الاستراتيجية المتخذة باستثناء عند دراسة أثر القبول والثقة من المدراء على كفاءة القرارات الاستراتيجية.

وتقدم الدراسة في النهاية عدداً من التوصيات التي تم التوصل إليها والتي تدعو بمجملها إلى مزيد من الاهتمام بموضوع إدارة المعرفة وتوعية أصحاب ومدراء المكاتب والشركات لماهية مثل هذا النظام والأهداف المرجوة من تطبيقه.

ABSTRACT

THE USE OF KNOWLEDGE-BASED SYSTEMS FOR STRATEGIC DECISIONS IN ENGINEERING OFFICES IN JORDAN

BY
Sami Ibrahim Haj-Hamed

SUPERVISOR

Dr. Rifat O. Shannak

Although knowledge management has been of great interest worldwide, IT investment and Knowledge Management have not yet been given enough attention from Jordanian organizations. This study reports on the availability of Knowledge-Based System and the benefit expected by the development of a Knowledge-Based System in increasing the effectiveness of strategic decisions. The study presents the need for an automated tool to support such a complex decision-making process and presents the architecture of such a system. The Knowledge-Based System consolidates the knowledge that every employee holds explicitly or implicitly and utilizes it all for the decision in hand; which would improve its effectiveness. The study sample represents the engineering offices in Jordan.

The effect of four variables representing the use of KBS in the office had been studied on the effectiveness of strategic decisions. The variables are capabilities of individuals, availability of required technologies, coordination between departments, and acceptance and trust of decision makers. To achieve the study objectives, a questionnaire, consisting of two parts and totaling forty-two questions, was developed. The first part consists of ten demographical questions about the office and the availability and type of IT in the office. The second part consists of thirty-two questions, which would study the effect of individuals' capabilities, availability of required technologies, departments' coordination, and the acceptance of decision makers on the effectiveness of a KBS, and accordingly on the effectiveness of strategic decisions. Moreover, the effect of the number of employees, and the classification of the office will be studied as moderating variables.

The appropriate statistical analysis methods were performed with the assistance of SPSS software, leading the study to the following main results:

- A significant misunderstanding for the concept of knowledge management had been clearly noticed in the study sample.

- No technique for managing record had been noticed in the majority of the study sample.

- CEOs and owners would rather depend on their own intuition and knowledge when dealing with strategic decisions, and hardly share opinion of subordinates.

- A great interest had been shown by CEOs in the system and its benefits, although analysis showed that only acceptance and trust of decision makers -of the pre-selected variables- had a significant statistical relation with the effectiveness of strategic decision.

- Office classification and the number of employees had no significant statistical effect on the relation between the selected independent variables and the effectiveness of strategic decisions, except on the relation between the acceptance and trust of decision makers and the effectiveness of strategic decisions.

Finally, the researcher mainly recommends a continuous educating for organization CEOs and owners of the importance of knowledge management and the benefits associated with investments in knowledge management systems.

Subject:
Questionnaire for Studying the Use of Knowledge-Based Systems for Strategic Decisions

Dear Sir,

The enclosed questionnaire will be used in a study about the use of Knowledge Based Systems for strategic decision in Engineering Offices in Jordan.

Your assistance is needed and very much appreciated in filling the questionnaire. Please note that confidentiality is guaranteed as *all provided information would be dealt securely and for academic research purposes only*.

Researcher
Eng. **Sami Haj-Hamed**

Jordan University
Faculty of Business Administration
Department of Management
MBA Program

Prior to filling the questionnaire, I would kindly ask you to note the following explanations:

1. Knowledge Based System (KBS) as a decision supporting tool refers to the availability of techniques (hardware and software) by which different information would be stored <regarding the office's experience, employees knowledge, competitors, markets, previous bids documents and prices, bids that the office lost or won and position of candidates then, actual costs of previous projects done or present ones, and even opinions of employees, their knowledge, experience, and ideas>. The system would include both knowledge and information base, and should be characterized by the ease of retrieving the data in more like a dialogue procedure through a user-friendly software. The data collection would usually involve a comprehensive effort from employees at different levels of the office.

   Such a system that has been recently of great interest worldwide, if available, would be of great role in increasing the effectiveness of different business functions and activities such as controlling, planning, performance evaluation, and decision-making at different managerial levels.

   The system and the data that can be retrieved from it are anticipated through this research to increase the effectiveness of decisions at different levels and mainly in the strategic planning activities; this is for the great role that it plays in helping managers form their own understanding (interpretation) of the external and internal variables in which their organization is operating and helps to extend this understanding into a more effective decision on what should be done to improve its future implementation.

2. This study aims to measure the extent by which few or all elements of such a system is available in your office and the extent to which the system is achieving its goals, as well as measuring the factors that would ensure the effectiveness of such a system.

3. According to Jordan Engineering Association (نقابة المهندسين الأردنين) offices are categorized into four categories as follows:

Specialized Office	مكتب مهندس	An office that is specialized in one field
Engineering Office	مكتب هندسي	An office that has two or more specialties
Engineering Consultancy Office	مكتب استشاري	An office that has at least 11 years of experience from which four are in design
Consultation Office	مكتب رأي	An office that provides consulting services, and is related to neither design nor supervision

Office General Information:

- Office Category:
  - ☐ Specialized Office   (مكتب مهندس)
  - ☐ Engineering Office   (مكتب هندسي)
  - ☐ Engineering Consultancy Office (مكتب استشاري)
  - ☐ Consultation Office   (مكتب رأي)

- No. of Employees in the office:
  - ☐ Less than 5
  - ☐ 5 - 30
  - ☐ 31 - 50
  - ☐ 51 – 100
  - ☐ More than 100

- Years of Experience for the office (years since established):
  - ☐ Less than 5
  - ☐ 5 - 10
  - ☐ 11 - 15
  - ☐ More than 15

- Clients of office projects are mainly:
  - ☐ Local only
  - ☐ Local and international
  - ☐ International only

- Location of main offices:
  - ☐ Amman
  - ☐ Other (specify) _____

- The office is:
  - ☐ Sole Proprietorship (owned by individual)
  - ☐ Partnership
  - ☐ Corporation (public limited company)
  - ☐ Part of a parent company

Availability and Type of IT in the Office:

- Computing approach in the office is:

    - ☐ Stand alone workstations
    - ☐ One computer (server) connected to group of terminals
    - ☐ Distributed computer system (in each of the different office locations)
    - ☐ Network (Connecting all locations of the office together)

- Availability of KM (Knowledge Management) software:

    - ☐ The Office has no such software
    - ☐ The office has a software internally developed (locally developed)
    - ☐ The office has software developed by a Jordanian software house.
    - ☐ The office has software that was purchased from a foreign source.

- The office is considered as:

    - ☐ Already having a KBS
    - ☐ In the stage of applying a system
    - ☐ In the stage of studying the system and gathering information.
    - ☐ Interested in such a system (before today)
    - ☐ Unaware of such system at all (before today).

- The office manages it's records:

    - ☐ On papers
    - ☐ On computers with simple file management techniques (windows explorer; folders and subfolders for example)
    - ☐ In databases with proper search techniques.
    - ☐ A KBS with special software for retrieving data.

Part Two : Different question concerning decision making tools

No.	Question	Absolutely Disagree	Disagree	Neutral	Aagree	Absolutely Agree
Technologies (Software and Hardware)						
1	The office has certain records management technique for keeping information and data.					
2	The office has the adequate computing resources.					
3	The record management system used is efficient enough to retrieve whatever data needed and fast					
4	The data within such a system is being updated continuously.					
Employees						
5	Employees are generally well prepared to run computers.					
6	Employees understand the concept of having a KBS (aware of what it is) and know its effect on future decision making.					
7	Employees have the right to pin point information they come across and believe to be of future use (potentially useful).					
8	There is a special department or group of employees for managing information system in the office.					
9	Periodic seminars and trainings are being made for key employees to ensure they are being updated of the office broad mission and the office system-updating future plans.					
10	Employees are generally well educated to know the importance of managing information for the office.					
11	Managers believe the office broad mission and objectives for the future should not be shared with employees.					
Coordination between departments						
12	Employees are working in the spirit of a team in order to achieve objectives.					

الناره للاستشارات

No.	Question	Absolutely Disagree	Disagree	Neutral	Aagree	Absolutely Agree
	Cont. **Coordination between departments**					
13	Employees generally have good relations with one another inter-department and intra-department.					
14	Employees are granted authority to communicate with each other even across different managerial levels.					
15	Employees contribute with their opinions and knowledge that maybe of importance to other than their department and to the office future strategy.					
16	Employees feel they have an important part in deciding the office future.					
17	The organization encourages teamwork and coordination between departments.					
18	The office managers believe social relationship and communication between departments would decrease the productivity and thus should be avoided.					
19	The organization believes that coordination between departments is essential for its survival.					
	Acceptance and Trust by Decision Makers					
20	Decision makers accept the contribution of employees at different level with their opinion and own experience of similar situations.					
21	Decision makers would trust their staff capabilities and the information that would be gathered within such a system to be correct and reliable.					
22	Decision makers prefer to depend on their own intuition and experience for making strategic decisions than on numbers and available data.					
23	Decision makers agree upon the anticipated benefits of a KBS.					
24	Decision makers are aware of the importance of information available within the office as a core competence.					

No.	Question	Absolutely Disagree	Disagree	Neutral	Aagree	Absolutely Agree
Effectiveness of the system in improving Strategic Decision Making						
25	Strategic decisions become more effective by improving the data collection process through a KBS.					
26	Strategic decisions were more effective when discussed in-group and by having different opinions.					
27	Strategic decisions were more effective when based on information and knowledge of employees.					
28	Deciding the future strategy of the office should be based only on individual's intuition and experience.					
29	Applying a new strategy would be more effective when employees feel they participated in it than being imposed on them.					
30	The effectiveness of a new strategy would be excelled when employees within the office are well educated and aware of the overall objectives and vision of the office.					
31	Having records help building a clear understanding of the external and internal variables and for choosing the appropriate future strategy.					
32	In your own opinion, such a system (KBS) would help in making timely and well-studied decisions for the future strategy of the office.					

Thank You for your time