APPLICATION OF DECISION SUPPORT SYSTEM IN CONSTRUCTION PROJECTS USE IN COST MANGEMENT

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ABSTRACT

This work is concerned with introducing new methods and techniques for the projects management in construction industry. This research suggest that the Iraqi engineering staff, who work in construction sector, have a poor knowledge about the subject of Decision Support System (D.S.S.) in spite of that this subject have a wide uses in construction companies in the world. So the researcher presents this study to introduce and to increase the knowledge about the concept of Decision Support System.

This research consist of the questionnaire process for construction companies, then the research use the questionnaire results in building a proposed Decision Support System, also the questionnaire process indicate the relation between the decision structure and the organizational levels.

The results obtained from the questionnaire process shows that there is a requirement for Decision Support System in cost control decisions support. So the researcher build a Decision Support System for cost control process which can be used by the planner and estimator for different types of projects. The researcher also applies and evaluates the proposed system in some Iraqi construction companies.

The application and evaluation process recommended the needs for applying the Decision Support System for project management in construction companies.

الخلاصة

يتعلق هذا العمل البحثي بتقديم الطرائق والتقنيات الحديثة لإدارة مشاريع للصناعة الإنشائية. يفترض البحــث أن الكادر المهندسي العراقي، الذي يعمل في قطاع الإنشاءات، لديه معرفة قليلة حول موضوع نظــام دعــم القرار بالرغم من أن هذا الموضوع له استخدامات عديدة في شركات الإنشاء في العالم. لذلك يقدم الباحــث هذه الدراسة لإدخال وزيادة المعرفة حول مفهوم نظام دعم للقرار.

يضم البحث عملية استبيان لشركات الإنشاء، يقوم الباحث بعدها باستخدام نتائج الاستبيان في تطبيق نظام دعم قرار مقترح، كما تؤشر عملية الاستبيان العلاقة بين هيكلية للقرار والمستويات الإدارية. لقد بينت نتائج عملية الاستبيان الحاجة إلى نظام دعم للقرار في قرارات السيطرة الكلفوية. لذلك فإن الباحث ببناء نظام دعم قرار للسيطرة الكلفوية والذي يمكن استخدامه من قبل المخططين والمخمنين لمختلف أنواع للمشاريع الإنشائية. كما قام الباحث بتطبيق وتقويم للنظام المقترح في بعض شركات الإنشاء العراقية.

KEY WORDS
Decision support system, Project management, Cost control, Decision structure and Organization level.

INTRODUCTION
When ever a decision is made, one of the proposed alternatives is chosen. Future activity focused on the chosen alternative uses time, money and other resource, and excludes any efforts on the alternatives rejected. Thus, if a poor choice was made and later decided to revise the decision, all the intervening time is lost and expenditure are, for the most parties. Thus all decisions commit the decision makers and other parties related for further efforts to make better decisions.

Successful project management depends on the ability to make good decisions. The ability to make good decisions depends on the availability of timely, accurate, and organized information in the right format at the right time. To handle such task, project managers, should use a proper planning and management system. One of these systems which has received considerable attention in the recent years is the Decision Support System.

In spite of that construction industry founded and developed from thousands of years, but, it is still less organized and controlled as compare with other industries (e.g. Manufacture industries). Also construction industry consists a lot of decision making with uncertainties situations.

To work in such environment and to increase the project organization and control, in construction industry, many researchers working in the construction management field began highlighting new techniques and methods to achieve this target.

From this start point the idea of making this study have been crystallized to show Decision Support System as a modern method used in project planning and control, also, to show its basic concepts, to identify its types, to find areas in project management working with Decision Support System. Then, this study derives results and recommendations that develop and support this method in project management.

DEFINITION OF DECISION SUPPORT SYSTEM
Decision Support System can be defined as "An organized collection of people, procedure, software, database and devices used to provides support in three main categories; data collection, analysis of models and presentation to help in making decisions".(Post and Anderson 2000; Stair and Georgy 1997)

DECISION SUPPORT SYSTEM OBJECTIVES
There are six major objectives of D.S.S. which are (Turban 1988).
1- D.S.S assists managers in their decision processes in semi-structured (or unstructured) tasks.
2- D.S.S support rather than replace managerial judgment.
3- D.S.S improve the effectiveness of the decisions, not the efficiency with which decisions are being made.
4-It incorporates data and models, as well as, other analytical techniques.
5-It focus on features that make them easy to use by non-technical users in interactive mode.
6-It emphasize flexibility and adaptability to make accommodate changes in the environment and decision making approach of the user.

TYPES OF DECISION SUPPORT SYSTEM
There are seven type of D.S.S as follows (Mallach 2000).
1-File drawer systems: -
   Allow immediate access to data items.
2-Data analysis systems: -

Allow the manipulation of data by means of operators tailored to the task and setting or operates of

general nature.

3-Analysis information systems: -
Provide access to a series of database and small models.

4-Accounting models: -
Calculate the consequences of planned actions on the basis of accounting definitions.

5-Representational models: -
Estimate the consequences of action on the basis of models that are partially non definitional.

6-Optimization systems: -
Provide guidelines for action by generating the optimal solution consistent with a set of constraints.

7-Suggestion systems: -
Perform mechanical work leading to a specific suggested decision for a fairly structured task..

The first three types are data-oriented while the remaining four types are model- oriented as shown in Fig. (1).
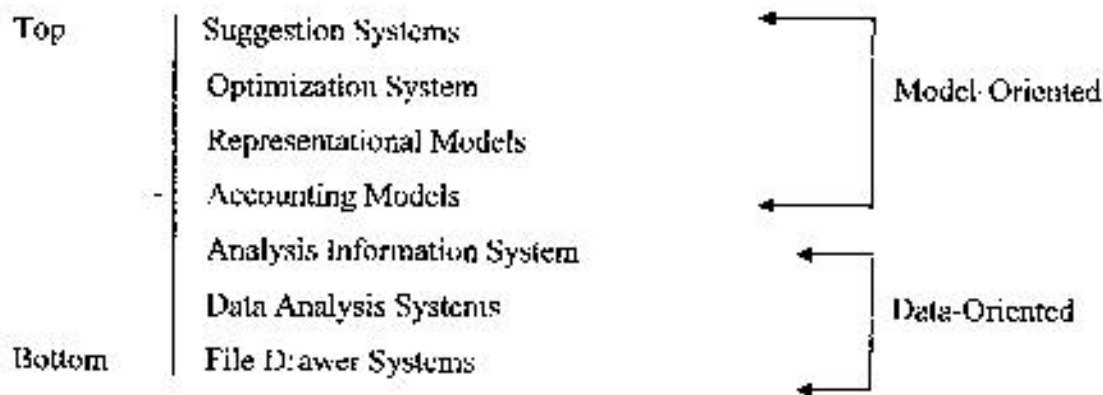
Top	Suggestion Systems	
	Optimization System	Model Oriented
	Representational Models	
	Accounting Models	
	Analysis Information System	
	Data Analysis Systems	Data-Oriented
Bottom	File Drawer Systems	

Fig (1) The seven types of decision support system (Mallach 2000).

THE QUESTIONNAIRE PROCESS

The questionnaire form is designed for the processes in project management and to achieve this goal the researcher employed the processes included in the Specification of the International Organization of Standardization (ISO 10006) down the title "Quality management -Guideline to quality in project management", because this specification involves all the processes and activities in project management.

There main two targets of the questionnaire process is to investigate the process in project management that requires a D.S.S to help in dealing with its decision. and indicate the relation between the decision structure and the organizational level.

THE RESEARCH SAMPLE

The research sample represents the major factor that the questionnaire success depends on the success of selecting them. The research sample represents the tool that tells us the information we need from the field of engineering work. The research sample consists of individuals working in four engineering fields (planning and scheduling, estimating and pricing, designing and construction), because many decision appear in these field in construction projects.

The research sample involves (25) individuals who working in construction companies and have experience in the engineering fields listing above. The results of the questionnaire process are as shown in **Table (1)** through **Table (11)** below.

Table (1)

Process	Importance	Top management	Middle management	Operational management
Strategic	4/25=16%	25/25=100%		
Interdependency management			24/25=965	1/25=4%
Scope related		18/25·72%	7/25=28%	
Time related		5/25 20%	20/25··80%	
Cost related	18/25=72%	6/25=24%	19/25=76%	
Resource related	2/25 8%	1/25··4%	24/25=96%	
Personal related			2/25··8%	23/25 92%
Communication related operational			3/25=12%	22/25=88%
Risk related	1/25=4%	2/25=6%	22/25··88%	1/25 4%
Purchasing related			23/25=92%	2/25=8%

Table (2) The Strategic Process

Process	Structured	Semi-structured	Un-structured
Strategic		5/25=20%	20/25=80%

Table (3) The Interdependency Process.

Process	Importance	Structured	Semi-structured	Un-structured
Project initiation and plan development	19/25··76%	20/25··80%	5/25=20%	
Interaction management		6/25··24%	18/20··72%	1/25 ·4%
Change and configuration management	6/25=24%		7/25=28%	18/25=72%
Closure		22/25=88%	3/25=12%	

Table (4) The Resource Related Process.

Process	Importance	Structured	Semi-structured	Un-structured
Resource planning	9/25=36%	4/25=16%	21/25=84%	-
Resource control	16/25=64%	19/25=76%	4/25 16%	2/25 8%

Table (5) The Scope Related Process.

Process	Importance	Structured	Semi-structured	Un-structured
Concept development	4/25=16%		5/25=20%	20/25=80%
Scope development and control			8/35 32%	17/25 68%
Activity definition	4/25 16%	3/25=12%	22/25=88%	
Activity Control	17/25 68%		21/25=84%	4/25=16%

Table (6) The Time Related Process.

Process	Importance	Structured	Semi-structured	Un-structured
Activity dependency planning	6/25 24%		19/25=76%	6/25=24%
Duration estimation	1/25 4%		23/25=92%	2/25 8%
Schedule development		9/25=36%	16/25 64%	
Schedule control	18/25=72%	6/25=24%	18/25=72%	1/25=4%

Table (7) The Cost Related Process

Process	Importance	Structured	Semi-structured	Un-structured
Cost estimation	12/25=48%		21/25=84%	4/25=16%
Budgeting		2/25=8%	23/25=92%	
Cost control	13/25=52%	1/25 4%	22/25=88%	2/25=8%

Table (8) The Personal Related Process.

Process	Importance	Structured	Semi-structured	Un-structured
Organizational structure definition	17/25=68%	25/25=100 %		
Staff allocation process	2/25=8%	3/25=12%	22/25=88%	
Team development	6/25=24%	24/25=96%	1/25=4%	

Table (9) The Communication Related Operation Process.

Process	impotence	structured	Semi-structured	Un-structured
Communication planning	1/25 4%		25/25=100%	-
Information management	23/25=92%	5/25=20%	20/25=80%	
Communication Control	1/25=4%	19/25=76%	6/25=24%	

Table (10) The Risk Related Process.

Process	Importance	Structured	Semi-Structured	Un-structured
Risk identification	3/25=12%		8/25=32%	17/25=68%
Risk estimation	21/25=84%		3/25=12%	22/25=88%
Risk response development	1/25=4%	1/25=4%	18/25=72%	6/25=24%
Risk control		16/25=64%	9/25=36%	

Table (11) The Purchasing Related Process.

Process	Importance	Structured	Semi-structured	Un-structured
Purchasing planning and control			4/25=16%	21/25=84%
Requirement documentation	5/25=20%	22/25=88%	3/25=12%	
Subcontractor evaluation	2/25=8%		1/25=4%	24/25=96%
Subcontracting		23/25=92%	2/25=8%	
Contract control	18/25=72%	10/25=40%	15/25=60%	

THE QUESTIONNAIRE RESULT

1- That regarding the process or activity that needs a D.S.S. to help in solving its problem. The result show that (72%) of the respondents confirmed that the cost-related process need a D.S.S. in dealing with its decisions.

2- that regarding the divisions of the process selected (the cost related). The result shows that a (48%) of the respondents agreed that the cost estimation need a D.S.S., while (52%) of the respondents agreed the cost control need a DSS in dealing with its decisions. So it's recommended developing a D.S.S. to help in making decision for both cost estimation and control.

3- That regarding the organization level and for the project management process and the type of structure for each division in the processes the result is summarized in **Table (12)** below. Most of the results agreed with the theories listed in the review of literature. that's didn't mean (100%) of agreement, but more than (70%) in most cases, because there are many interactions between the processes as well as between the organization levels. But the main goal of this result is to give an indication about the relationship between the organizational levels and type of structure for the processes.

4- In **Table (12)** below, there is a mismatch some between processes and the organizational level performed it, like in (Scope related and Time related processes). **Table (12)** indicates that these processes performed by Top Management, but actually, these processes performed by Middle Management. This may be related to the interaction between some processes in project management as well as between the persons who performed these processes. More of that there is a misunderstanding may happen for the authority and responsibility for some respondents of the questionnaire, and that may gives a misleading answers that gives incorrect results.

Table (12) The Relationship Between the Organizational Level and Type of Structure for the Project Management Processes.

Levels Type Of structure	Operational Management	Middle Management	Top Management
Structured	*Organizational structure definition *Team development *Communication control	*Project initiation and project plan development *Resource control *Risk control *Requirement documentation *Subcontracting	
Semi-structured	*Staff allocation process *Communication planning *Information management	*Interaction management *Cost estimation *Budgeting *Cost control *Resource planning *Risk response development *Contract control	*Activity definition *Activity control *Activity dependency planning *Duration estimation *Schedule development *schedule control
Un-structured		*Change configuration management *Risk identification *Risk estimation *Purchasing planning and control *Sub contractor evaluation	*Strategic process *Concept development *Scope development and control

BUILDING PROPOSED D.S.S. FOR COST CONTROL PROCESS

According to ISO 10006- Claus (5.6.3) "The information needed to ensure the timely release of funds should be made available and provided as input to the resource control process" after reading this statement, it can be understood that the cost control should provide an information about the amount of money required in every stage of the project, as well as, compare the amount of funds spent on the project in every stage with similar projects implemented in the past. This comparison be available when use the cash flow forecasting for the project. The cash flow will provide regular payments.

represent the expenditure of the project, and by making use of these data which had been documented in the companies for the projects implemented in the past, the estimator or the planner could compare the amount of money expend for constructed project with a similar type of project, accomplished in the past, or he could calculate the required amount of money for the project in the next payment.

OVERVIEW OF THE SYSTEM

The main idea of the system (program) is to collect the data, which represented by the cash flow for completed projects, and then calculate the maximum and the minimum percentage of expenditure for the projects with the same type of the required project, which represented as a percentage from the total cost. For example: if the total cost of a project equal to (10000000 I.D) and the expenditure at (70%) of completion equal to (65000000 I.D) then the percentage of expenditure at (70%) equal to[65000000/10000000=65%]. This percentage represents the result of the data for on project, so the program will repeat this process on the other data of the projects with the same type (for example school projects) and then calculate the maximum and the minimum percentage for all project of the same type in the database. Fig (2) through Fig (6) shows the windows for the proposed system.
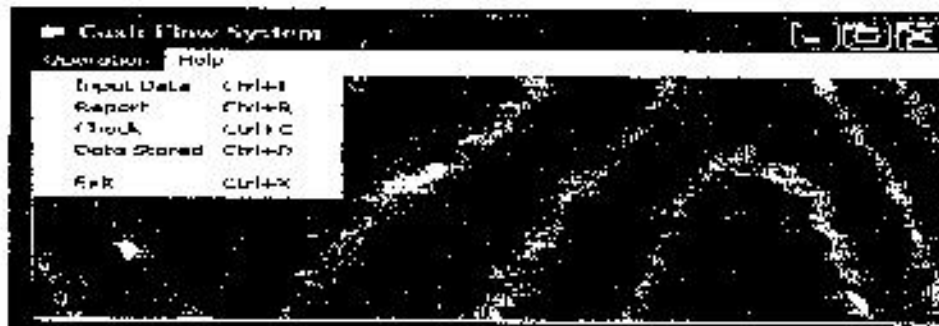

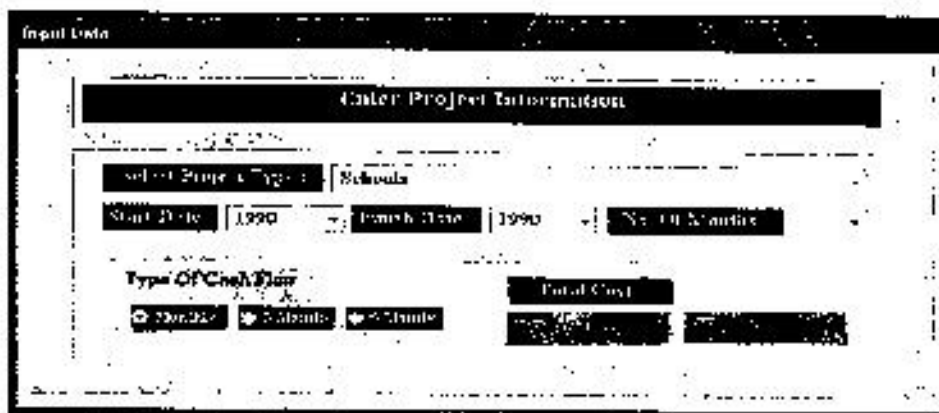Fig (2) The main window for the proposed system.

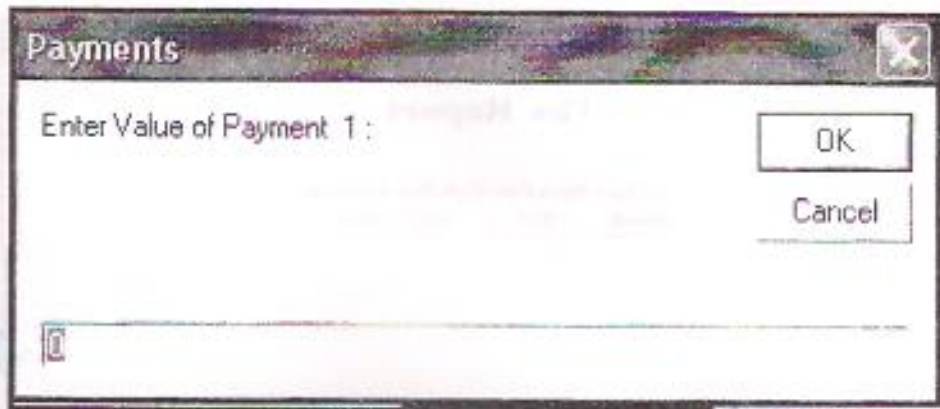Fig (3) Input data window for the proposed system.

Payments

Enter Value of Payment 1 :

OK

Cancel

Fig (4) Entering payments window.

Verify Values

Click On The Value To Change It

O
O
O
O
O
O
O

Accept Change   Exit
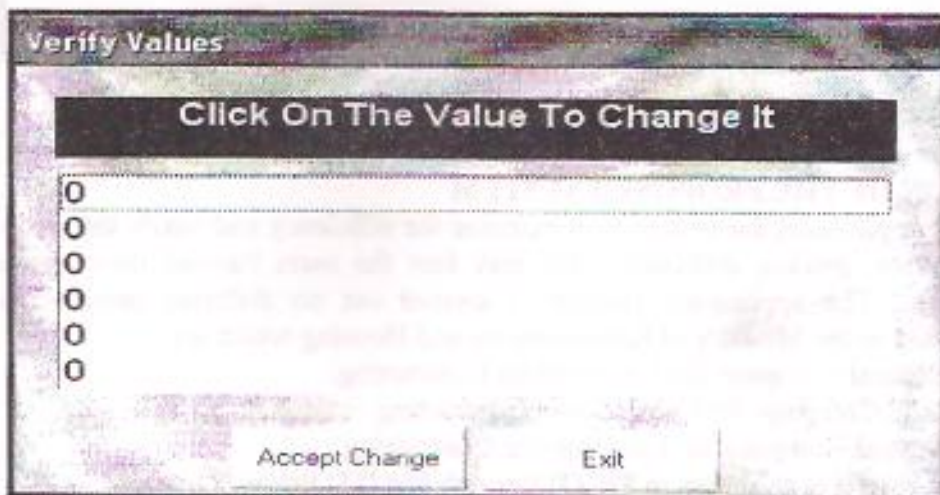
Fig (4) Payments Verifying window

Report

Fill The Following Information To Get A Report

Select Project Type :   Schools

Specify The Finishing Time

● At   1990

● Between   And

● Before

● After

Percent Val : 10

Min Cash Val:

Max Cash Val:

Generate Report

Exit
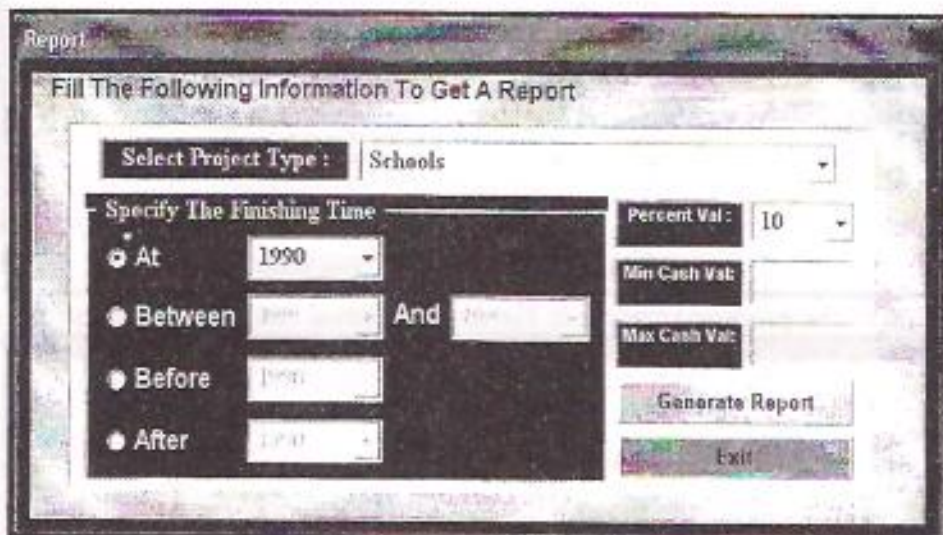
Fig (5) Information entering for the report.

Fig (6) Out put of the proposed system.

APPLICATION OF THE PROPOSED SYSTEM

The purpose of application the system is to examine the efficiency and verify the performance, also to detect any error, defects, difficulties that may face the users through their application of the proposed system. The application process is carried out on different projects in three state companies related to the Ministry of Rehabilitation and Housing which are:

1- Al-Farooq General Company for Construction Contracting.
2- Asuour General Company for Construction Contracting.
3- Hamorabi General Company for Construction Contracting.

The application results is as shown in **Fig (7)** through **Fig (11)** below.

Fig (7) Application of the proposed system in Hamorabi general company (Bridges projects).

Fig (8) Application of the proposed system in Hamorabi general company (Roads projects).

Fig (9) Application of the proposed system in Asuour general company (Bridges projects).

Fig (10) Application of the proposed system in Asuour general company (Roads projects).

Fig (11) Application of the proposed system in Al-Farooq general company (University project).

EVALUATION OF THE PROPOSED SYSTEM

The proposed system evaluation process should take into account operating the system before an open discussion connected with and during the presence of specialized person concerning with this type of work. This process performed in three companies, which the researcher collect the data of application the system from it (Ashour, Hamorabi, and Al-Farooq construction Contract Companies).

The evaluation process consists of ten persons, from the three companies, having experience in planning and cost processes. The evaluation form distributed to the individual to get their opinions, comments and recommendations about the operation and the feasibility of the proposed system. The evolution questions and the answers are summarized in **Table (13)** below.

THE EVALUATION RESULTS

The answer of the evaluation questions shows the following:

A- The proposed DSS is very good in collecting and entering the data and that give an indication of a very good user interface with the system.

B- The proposed DSS provide a very good assistance for the planners and the estimator.

C- The proposed DSS provide excellent information for the user.

D- The proposed DSS have a very good role in cost control process.

E- The answers agreed that the accuracy of the information provided by the system is very good.

F- The proposed DSS have a very good importance for the three companies.

CONCLUSIONS

1- The procedure followed in Iraqi construction companies, by the financial department and planning and follow up department, haven't the ability to play the actual role in cost control

2- Three is a mismatch between the authority, responsibility and the functional position when making managerial decisions.

3- There is lack of documentation process for management activities, especially, that related to the cost control and cost estimation.

4- The evaluation result of the proposed Decision Support System shows that the importance of implementing such system in construction companies.

Table (13) The Evaluation Questions and the Results.

No	The Questions	Excellent 100-90	V. Good 90-80	Good 80-70	Accept 70-60	The Degree	The Evaluation
1	The flexibility of collect and entering the data in the system (user interface).	1	7	2		84	V. Good
2	The assistants that the system provides to the planners and estimators	1	8	1		85	V. Good
3	The type and importance of the information provided by the system	8	2			93	Excellent
4	The role of the proposed system in cost control.	2	8			87	V. Good
5	The accuracy of the information provided by the system.	2	6	2		85	V. Good
6	The important of the proposed system to your company.	3	7			88	V. Good

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