Multi Standard Accreditation as Expert System Tool in Jordan University Hospitals

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Abstract— Accreditation is a process of evaluating business activities based upon a set of pre-determined standards. Hospitals and health care centers seek international and local accreditations to win the confidence of patients and increase a competitive edge in the health services. Hospitals and health care centers do great efforts to achieve international accreditation certificate despite the many difficulties and pitfalls awaiting them along the way. Trial and error lead to long time to success meaning escalating costs and late to gain large number of benefits of that certificate. This proposed expert system aim at provide medical professionals and organizations' administrative staff necessary expertise in dealing with complicated information subtleties, tackled with on day to day basis, as to comply with standards in order to achieve this esteemed accreditation in systematic and coherent manner. This methodology is distinguished from other systems in its flexibility of expert system in selecting specific standard (local or international), following up fault points, and analyzing results. The flexibility is provided to make settings for evaluation process adaptable to the selected standard, and also standard itself can be easily changed upon need. Henceforth it is suitable for both direct clients (hospitals) and indirect evaluator organization. The proposed system is built in multiple phases. In first phase the HCAC is considered as a sample for proposed system. Power designer was used to design the proposed system database entities relationships, Oracle database, Developer 6i, Report Builder and Graphics to implement the proposed expert system. All these tools were utilized under Microsoft Windows OS.

Keywords— Accreditation. Health care system, Jordan, medical informatics.

I. INTRODUCTION

Hospital accreditation, is defined as "A self-assessment and external peer assessment process used by health care organizations to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve"[4]. There are many international hospital accreditation schemes; one of the best-known in the USA has been established by Join Commission International (JCI), it was received accreditation by the International Society

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for Quality in Health Care (ISQua) [5] Accreditation by ISQua provides assurance that the standards, training and processes used by JCI to survey the performance of health care organizations meet the highest international benchmarks for accreditation entities [5]. Another prestigious scheme is owned by Accreditation Canada which was known as Canadian Council on Health Services Accreditation (CCHSA). Accreditation Canada is also certified by ISQua[6].

As a Jordanian accreditation standard, HCAC was created in December 2007, having on its Board of Directors the Ministry of Health, Royal Medical Services, Private Hospital Association, university teaching hospitals and the professional healthcare syndicates and associations. In addition to these, there is representation from the communities of academia, law, business and economic sectors [18].

While JCI mission is "to continuously improve the safety and quality of care provided to the public through the provision of health care accreditation and related services that support performance improvement in health care organizations"[17]. The CCHSA mission is "Driving quality in health services through accreditation"[6]. HCAC vision is to promote continuous quality improvement and excellence in healthcare services through the philosophy and process of health care accreditation[8].

In each case the concentration is on continuous improvement of health care services, quality through following accreditation standards, thereby it can be claimed that there is a strong demand to have a methodology or scheme enabling the health care centers to select suitable international accreditation standard. Hospitals seek international accreditation standards to win the confidence of patients, increase a competitive edge in the marketplace, lead to effective and efficient operations by professional advice, clarify the framework for organizational structure and management, and added credibility with government and third-party financiers [11,12]. The systematic approach of hospitals and health care centers to world wide recognized standards of services' quality and performance have been proven very elusive, unless followed up closely by precise and concise automated methodology. Achieving international accreditation standards certification for health care centers opens up a wide door of potentials and opportunities; hence the health care centers are understandably keen to obtain such a Certificate despite the many difficulties and

pitfalls awaiting them along the way. The international Standards are built upon the predefined set of requirements' criteria, inherently complicated by the sheer volume and incomprehensibility unless overtly simplified, which might creates additional problems of subordinate understanding with potential of generating new fault points, inherently aggravated by staff's lack of experience and misunderstanding of the standards themselves. Lack of a professional self evaluation process and dependence on external resources at high expenses proved time and again to be of substandard quality, since the process itself is very time consuming and should be followed up on regular basis.

There is a belief that national accreditation schemes are more practical, culture-specific, better accepted and much less costly. Relating to culture-specific acceptance; JCI and other councils adapt their standards to country-specific needs, legal, religious and cultural values and laws [21]. Since the quality of health services has direct effect on patient's health and public trust, developing and adopting accreditation is important for Jordanian Hospitals in different aspects i.e. positioning Jordan amidst highly developed countries in medical field through obtaining esteemed hospital accreditation certificate, establishment of a regional center for customization of international standards to be in agreement with Arabic and Islamic traditions and culture, & to act as a director for setting a path for neighboring countries to fully adopt those standards. In the other hand, obtaining medical accreditation might give Jordan an opportunity to become a center of attraction for medical tourism. Which might affect the economy directly and indirectly through granting Jordanian hospitals a highly competitive international certification; this might be accompanied by price competitiveness of medical treatment in Jordan versus same quality of treatment in European countries, which would give great advantage to Jordanian hospitals [18, 19].

Adherence to these standards nevertheless is bound to utmost precision of information presented to decision makers so corrective measures might be applied in timely and sustainable manner. It is worth mentioning that reliability of the obtained data and continuous process of its refinement is furthermore reduced by the sheer size, overt complexity, and intractability if traditional techniques of quality assurance are applied as per se.

Considering the hospitals' goal to establish an international Accreditation Certification, might highlight the importance to design and implement user friendly expert system assisting hospitals in order to select particular Accreditation Standard's practices, and enabling them to follow up mistakes by detecting the fault points so as to implement the corrective measures [20]. The choice of Oracle's database and front end development tools as proven enterprise technology provided both robustness and scalability suitable for

different sizes, categories and scopes of medical organizations. Cultural and linguistic differences were tackled by taking special care of Expert system's design in localized manner, and providing bilingual data entry and display (English – Arabic) as to avoid pitfalls of phonetic differences, especially in nominal fields, as well as achieving utmost user friendliness for bilingual users. Variety of options for producing management reports and decision making support simplify greatly the systematic materialization of intangible information; by gaining patients trust, giving professionals expert path to follow, and increasing approval, and confidence of all national and international parties of our medical institutions.

II.   RELATED WORKS

Many methodologies were used to help hospitals prepare to achieve accreditation certificate such as different formats of standards' manuals both printed and electronic [13], Web based education [14, 23, 24] conferences and seminars, training sessions, DVDs, Booklets and CDs [17]. Those methodologies are considered primitive and hard to understand and follow, since they depend on the experience of the user which is not easily quantifiable. As an example we list the flaw found in compliance software JCAHO Net-It. Designed exclusively for JCAHO standard, this software proved to be hardly expandable and modifiable to include other standards[16], baring it inflexible with today's high rate of changeability and updatability in addition to its high cost. However what distinguishes this proposed study from others is the use of expert system in selecting specific standard (local or international), following up fault points, and analyzing results. The flexibility is provided to make settings for evaluation process adaptable to the selected standard, and also standard it self can be easily changed when requested. At the same time it is suitable for both direct clients (hospitals) and indirect evaluator organization. In [22], the authors described the main processes involved in academic accreditation and assessment in Higher Education (A3-HE). They have stressed the issue of heavy and tedious paperwork that characterize actual academic processes. Advances of Internet technologies have offered new opportunities for enhancing traditional decision support systems and expert systems [21]. With the development of Expert Systems (ES) and multimedia, computers are able to mimic many important roles that normally require human actions.

III.   THE PROPOSED SYSTEM FOR HOSPITALS' MULTI STANDARD ACCREDITATION (ESHMSA)

The proposed (ESHMSA) system aims to guide medical users towards achieving and maintaining accreditation in a productive, efficient, and user friendly manner. Providing medical professionals and organizations' administrative staff with the necessary expertise in dealing with complicated information subtleties, tackled with on day to day basis, as to comply with standards and achieve this esteemed accreditation

in systematic and coherent manner. Its distinctive set of complimentary features work in unity to provide statistics, reports and data analysis for medical organizations management giving instantaneous perspective on points of strength as well as weakness together with recommendations that may expedite achieving selected accreditation standard. Another issue is the ability of the system to analysis result related to survivor themselves especially in measurement the intersection between their evaluation of the same sample of question, which may lead to misunderstanding some points of standard itself between survivor and point to necessary modification on that standard or the need for training of

survivor .

A. ESHMSA Overview

The ESHMSA (as shown in Figure 1) consists of a set of components grouped into three major categories; interface component, logic component and database component. Each of them has its own functions and responsibilities yet they are all seamlessly integrated with each other. Detailed clarification for these components will be presented in this section.
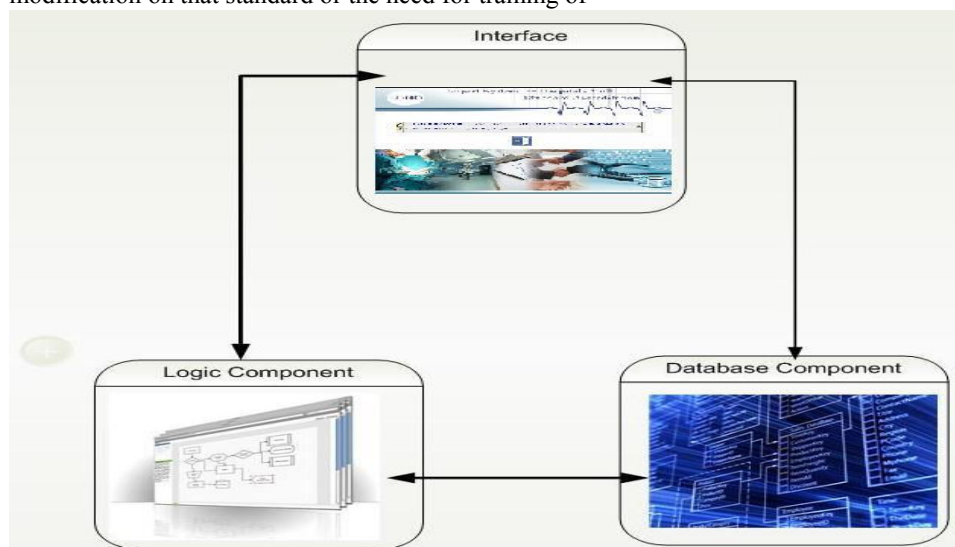

Fig. 1 : An overview of ESHMSA major components.

B. Interface Component

1) Start in Screen
This screen serves as the first step to user navigation to ESHMSA (Figure 2). From this start in screen end user can select specific Hospital Accreditation Standard (HAS). ESHMSA will decide the language base of this standard according to user choice and all following displayed screens will use the language and direction of selected HAS.

Driven Menu

It is one of the interface major component; the menu items and sub menus are enabled or disabled according to predefined privileges and rights given to users by system administrator. User friendliness is enforced by implementation of interface clearness, self evident logical flow, online help and quick tips to assist users and clarify different concepts and functionalities as and when. Granulation and fine tuning of responsibilities granted to users is clearly shown in the scope of menu items available to users according to working needs.

2) The Administration and Security Component
Taking into account security and authorization issues are of primary concerns for system administrators in mature and responsible environment so special priority has been given to facilitate this task in detailed and atomic manner. The main objective of this component is to provide administrators a user friendly means to manage users, control and monitor access to different components of expert system. Any breach of security would negatively impact the reliability and prove disastrous on validity and correctness of gathered data compromising the objectivity and jeopardizing the whole accreditation standards compliance. This component can be further divided into three parts equally important toward prioritizing security and providing easily manageable interfaces.

3) Settings and Configurations Component
As a basic building block for the whole ESHMSA this component is used to code different categories of hospital accreditation standards, along with specific processes used in different stages of survey building, scoring, reports generation, statistics gathering, analysis studies and decision support graphical output. Generally this task is performed prior to any later stages by system administrator and is

considered as a cornerstone upon which all other components are based.

It is crucial for system administrator to understand fully the functionality needed by different users and components so as to provide efficient usability of system through employment of proven and successful software engineering design concepts of functional interface building. Configuration can be subdivided into several dependent steps for easier management and gradual building so as to simplify the work and reduce mistakes in this essential and preliminary task.

[1] Institutions Categorization: categorization of institutions where different health care establishments are categorized into groups of relevance in order for specific standards to be applied correctly and any ambiguity of relevant activities cleared or removed.

[2] Job Title categorization: Job categorization so as to pinpoint their applicable scopes of questionnaire and survey details following the principle of asking the right person the right question and reducing the points of irrelevancy and non-applicability related to jobs.

[3] Qualification categorization: Qualifications categorization which clarifies academic qualifications held by ESHMSA customer employees, or survivor in order to approve their suitability for assigned jobs& to. select the right and suitable related in survey during which is question to this category of qualification.

[4] Sites Categorization: Sites coding where a specific institution is bound to predefined categories of institutions reflecting applicable sets of standards. It helps in selecting the institution's requested accreditation standard and imposing the limits of scope to its historical transactions which has to be included in building of any future survey.

[5] Employees interface component: This component represent an integration point between employee record in HR system and ESHMSA ,also it enable ESHMSA to select sample of employees' files to ask different types of questions in accordance with selected standard & in addition to selection of suitable employees to participate in self assessment survey or invoking external consultant .Also it is used by the following interface component in case of fault point that might happened during survey, in the other hand using these historical fault in future for learning purposes. Other issues, the capability of ESHMSA is to use this component as stand alone in case of trail or testing environment .this component is clarified in Figure 18, Figure 19.

[6] Patient Interface Component: This component also represent an integration point between patient record in medical organization system and ESHMSA, also it enable ESHMSA to select sample of patient files to ask different types of questions in accordance with selected standard and patient check in check out and diagnosis or procedure in selected check in .also it is used by the following interface component in case of fault point that occurred during survey and it is used in learn lessons. Other issues the capability of ESHMSA to use this component as stand alone in case of trail or testing environment.

[7] Consultant Interface Component: This component is responsible for keeps records of consultants in different fields who are candidates to participate in specific survey transactions. Additionally it produces historical transactions and notes on particular consultant. Engagement of external consultants provides a great range of expertise to improve the objectivity and validity of assessments. ESHMSA invest this component to analyses survivors' evaluation which gives important indicators to standard and in many cases result based decision has to be taken by standard owner management.

[8] Diagnosis Categorization: This component enable ESHMSA to select suitable question that related to patient check in diagnosis during survey, also it helps in extracting statistics and report during survey result analysis stage.

4) Standard Core Interface Component

This component is one of the main important interface sub-components where ESHMSA leads the standard owner or standard designer through friendly user interface to deal with dynamic structure model. It has many functions which facilitate work of HAS user, specify general information about target standard, attach different type of media materials video, sound, different format of files to open standard document that could be saved in selected location, and referenced later by clicking button that link end user to these documentation or media materials which could be used for clarification, explanation and training end user on standard totally or partially as it is available. In the other hand link end user to HAS website keep track end user with new events & made modification news of that HAS.

A (HAS) owner or designer can use this component and keep track the following information in the following structure .first level of information is function or cluster for each function or cluster user can keep or update Acronym, statement of function or cluster, for each function or cluster user may add or update (function or cluster) intent(s) and requirement(s).each HAS can consist off 999 main function or cluster while practically available HAS not more than 20 main functions. each function could have up to 999 intents,999 requirements and 999 requirement documents which are very large comparing with founded HAS which means that their is no problems in size enlargement of any of these part in standard.

The second level of this component is standard within function or cluster, user may add up to

999 main standard within each function or cluster drill down up to four level with the same size . Now at each standard level there are five substructures, Standard Intent structure up to 999 intents, Requirements Structure up to 999 requirements, Measurable Elements Structure up to 999 elements, Survey Structure up to 999 survey points and Scoring Result Structure also up to 999 scoring result points. Navigation to any structure easily executed by clicking specific function button.

5) *Survey Setting*

This component is strongly integrated with Standard core interface component; it enables the user

to design about 999 questions on each measurable element of survey.

During this stage, question can be designed according to different criteria ,first, question relation Where user can select employee, patient or other, the aim of this criteria is to enable ESHMSA to select right questions for surveyed person, for instance when user select employee new information is requested Figure 2 clarify this criteria.

Fig. 2 : Survey Questinair Setting Defualt Criteria.

When the user select patient, new information is requested from ESHMSA which is related to diagnosis of patient checked in base. Evaluation method criteria enable user select points or Conformity, selecting conformity means ESHMSA will allow surviour evaluate answer according the maximum points allocated to this question. While selecting conformity will allow evaluator (surviour) select met, partially met or not met to evaluate this question. Answer method criteria, multiple choice, Essay and speech. Multiple choice option refer that suggested answers have to be entered , Essay option will require the surveyed person to write answer in the designate area, while speech option will require talking answer, taking into consideration answer limitation time, and preventing user from navigate with recording interface, no stopping no re-repeat recording.

Clarification criteria, selecting Allowed means that ESHMSA will allow surveyed person to clarify his answer by writing in particularize area, this type of clarified question may lead surviour to increase or decrease points given by ESHMSA   to selected answer, option not allowed will take selected answer and system evaluation for this answer as a final result of evaluation of this question.

Answer person Criteria, Employee option means that the target of this question is employee and another information will requested by ESHMSA   the job title of this target employee to be sure that the question is suitable for this employee with this job, patient selection also require additional information related to diagnosis of check in patient also to select right question for specific diagnosis, both option means that ESHMSA may ask this question in both cases employee or patient.

Answer requirement criteria has four selection, No option means the system will not ask surveyed person to produce any evidence ,Video selection means that ESHMSA will ask video evidence for particular questions for instance operation rooms, hospital location, entrances ..etc, selection three, Scanned document ESHMSA   gives the user the ability to produce scanned document for instance forms, patient or employee file document., option four ESHMSA will give surveyed person the opportunity to produce two types of evidences video and scanned document , it should be noticed that there is no limitation on number of evidences .

Number of survivors enable ESHMSA   requires three survivors to evaluate answer of the same question; detailed explanation will be hidden in extracting survey

result. Max point criteria enable ESHMSA work this type of dynamic survey setting and validate that this question in this survey transaction may be give specific weight that could not be more than allocated.

Recording criteria enable ESHMSA to ask question audio, enabled question designer to save this recorded question on selected path, in addition to that it enables to verify and hear the recorded question.

Multiple choice answer components which enable ESHMSA save suggested answers that will be displayed to surveyed, and decide the deserved point.

1) *Survey questionnaire Component*
It is one of the major interface component that consist of three sub-components, Initiating a survey questionnaire transaction, survey questionnaire transaction target setting and survey questionnaire transaction process, these sub-components have to run in sequence .

Initiating a survey questionnaire transaction:
This sub-component is necessary for initiating transaction and feed ESHMSA with basic information such as transaction id, initiative date ,reference no ,reference date ,survey type where (there are two selections self and consultant), selecting self type gives medical organization the capability to make self assessment and to select the survivors from hospital employees. Selecting consultant indicates that transaction is real and surviors are from external organizations. In both cases this component keep information about surviors or evaluating committee members, these information include id, name, organization and qualification of participant. Farther more an important part of this component is Assessment Transaction, which keeps track of transaction status, & changed as a result of survey questionnaire process .Status are Initiative , Setting, Process and Close. Initiative means only basic information and management decision is taken to make questions survey, Setting means that the target of questioner is defined, detailed clarification about in next sub-component section Process means that the survey is running , not all questions answered and time to answer is opened.

Survey Questionnaire Target setting: This sub-component gives the ability to specify the target of survey questionnaire, by displaying two options, complete standard and specific function(s),in which complete standard option will generate bank of questions for all functions of selected standard, while selecting specific function ESHMSA will generate bank of questions according to the selected target and criteria defined in Survey Setting section 3.2.5, this feature gives the flexibility to brake self assessment into narrower objective to be focused and treat the fault points that may appear during survey process then move to other function and so on. Selecting complete

standard may used in real survey or simulating it. Different types of Validations executed before enabling the target setting to assure that this user has the authority to execute this task, the main validations are no pervious setting occurred on the same transaction and no of tries not exceeded three tries only then message "Sorry I have to log you out your tries exceeded Permitted No".

Survey Questionnaire Running: This component enable Target Survey questionnaires clients to start answer their related question(s) according the predefined criteria, Type, Answer Method..Etc, previously mentioned in Standard core interface component 4, clicking Start Survey button fire different type off validations, user target validations, ESHMSA validates that user account is specified for employee, patient or visitors. As it is clarified in Figure-48 despite system administrator try to start Survey ESHMSA prevents him and such as "You Are System Administrator but You Are Not Authorized to Answer Survey Question(s)" message is displayed. when validation result success randomly, ESHMSA begin survey with login in user and select only questions that is predefined for this type of user and not answered before from this user, ESHMSA asks the same question to different users of the same category .In addition, it is possible to ask the same question in different design and take answer in different methods, this diversity to be sure that answer is not fabricated and evaluation is right up to the maximum .It is possible to pause survey questionnaire by user to take rest, but after answer the current question , process of user survey questionnaire is clarified in the algorithms in Figures 3,4,5,6, and Figure 7.

```
            Begin
While there is question specified for this user class and
not answered from this user do
  Question is selected randomly from generated survey
bank question;
           If question criteria is essay then
               Question is displayed in designated area;
              Designated answer area is displayed;
             User write answer;
            User confirms answer;
         if evidence(s) is required then
           While there is evidence do
            Evidence_Block;
          End do;
        Elsif criteria is audio then
            Phonetic_Block;
        Elsif Question criteria is multiple choice then
         Mul_ans_block ;
      End if;
     End Do;
    End;
```

Fig. 3: User survey questionnaire algorithm.

Begin block
 Evidence options are displayed (Video or Scanned document)
  if evidence is video then
    allocated area to accept this video evidence displayed, user friendly interface is given
  to the user to add, check and confirm this evidence.
  Elsif evidence scanned document then
      allocated area to accept this scanned
    evidence displayed, user friendly interface is
  given to the user to add, check and confirm
 this evidence.
 End if;
End block
Fig. 4: Evidence_Block.

Begin block
 Suggested answers are displayed in designated area
   User select answer
   User confirm answer
   If clarification criteria for this question is allowed then
     Clarification allocated area is displayed
     User write his clarification
     User confirm clarification
   End if

End block
Fig. 5 : Mul_ans_block .

Begin block
  Clarification information displayed
Answer Is phonetic
Recording time is limited
Press start when ready to answer
Recording start after Whistle
  User answer
  User confirm answer
End block
Fig. 6 : **Phonetic_Block.**

Begin block
  Clarification information displayed
Answer is phonetic
Recording time is limited
Press start when ready to answer
Recording start after Whistle
  User answer
  User confirm answer
End block
Fig. 7: Phonetic_Block.

2) Scoring Survey Questionnaire
      When Survey Questionnaire transaction is closed by management decision or survey questions target is answered by all required users ESHMSA

enable survivor to evaluate questions that is not evaluated by system or that needed surveyor evaluation according to the predefine criteria for question evaluation method, number of surviours and max point, previously mentioned in survey setting 3.2.5 procedures in this component is executed according to the algorithm in Figure 8.

   Begin

    While there is an answered question in scoring survey transaction not evaluated do
    Begin
      Surviour login with privileged user
       While there is an answered question in
       scoring survey transaction do
        Display question
        Display user(s) answers
      Display user(s) answers evidence(s) and clarification(s)
        Display ESHMSA evaluation for this
        question (in case of multiple choices)
        If evaluation method points then
          Deserved point area enabled
          Else
           Options displayed
           Met
           Partially Met
           Not Met
         End if
      Surviour decide his point of view evaluation
      Surviour evoluation with his Id are saved
    End do
    End block
    End do
    ESHMSA output
    Final results reports, statistics...etc
    End

Fig. 8: Scoring Survey Questionnaire Algorithm.

Following Component: The adherence to standards require usually some corrective actions that requires a process of following to check the compliance and in case that previously obtained answers were not satisfactory to introduce those corrective actions and re-evaluate accordingly.

Following engulfs all tested parties whether they are patients or employees are performed by super user or management with capability to introduce notes on specific dates so all pending issues may be gradually resolved and new evaluation should show better adherence to standards and insure compliance leading to eventual assessment success.

Reports Graphics Component*:* As a culmination of efforts and clarification to scoring and results and obtained from previous components the decision makers use intuitive graphics and other forms of reports in order to obtain a clear view of status of medical center regarding the position of compliance with selected international standards.

C. Database component

It is used by ESHMSA, It is designed to be as flexible as possible, taking into consideration the possible future expansibility of any part of HAS. History tracking of survey transactions, security and user management also covered, to increase performance in extracting statistics it was taken into account on-line base transaction structure.

S_designer was used to implement conceptual and physical design, and using oracle10g database to implement this component. Which gives flexibility to regenerate database structure from oracle database into any well known databases engine like ingress, paradox, Visual Basic Professional…etc and then Complete document in both languages prepared which make future update or development possible without making greater efforts.

IV. DISCUSSION AND EVALUATION OF SYSTEM'S RESULTS

The proposed system produce two classes of results namely the Traditional class results and the Graph analysis class results, the two classes are discussed and clarified in the following sections.

A. Traditional Class Results

The proposed system database has overwhelming capabilities of extracting different types of reports. These reports might be divided into four classes:
- First class is setting categorization that includes but is not limited to Jobs categorization, Qualification categorization, Diagnosis categorization etc. It is generally used to refine the preliminary settings as to produce more accurate results.
- The second class is the standard manual reports, having the capability of printing
standard manual partially or completely, thus providing immediate overlook into more crude information.
- The third class is survey transactions reports, this class of reports include different shapes of reports about history survey transactions.
The major information items are date of transaction, type of transaction (self assessment
or realistic) and the survey committee members' information whether they are local employees or external consultants. Additionally the status of survey transaction information can be included in reports referring to survey transaction status (establishing, setting, process or close). The target of survey transaction reports is to provide the capability of comparing between homogenous targets in different survey transactions. The user survey transaction performance reports are another output of this class, related to users' performance during survey transactions, the major information items are user name, user id, question(s) that are asked, user's answer, and the note of surveyor.

- The fourth class is follow up reports with the major information items are related to survey transaction like date, type etc. Employee information like user id, name, etc. Fault points that occurred during survey transaction and the executed actions that are taken to treat these fault points.

B. Graph Evaluation Class Results

Analyzing data and representing it graphically is of extreme importance for both the evaluator organization as well as evaluated organization, ESHMSA has the merit of being very powerful in producing this type of queries or reports. The instantaneous nature of insight provided is of supreme importance to the management since decision makers can grasp the real situation in a very time efficient manner. The following examples aim to be discussed as instances of graphics and analysis results that can be produced.

1) Systems Environment

The simulated survey transaction consists of 150 questions distributed accordingly to three clusters; these questions are answered by three users, whereas the survey itself is corrected by three surveyors for objectivity maximization purposes.

Questions types are suitably distributed between essay, multiple choice and verbal questions, the relation of these questions are distributed between employees, patients, policies, procedures and others. One of ESHMSA important features is the capability to drill down into levels of analysis study leading to enhance problem diagnosis, therefore helping management to find the optimal solutions.

Example 1:
Table I represents the average points that medical organization gained as a result of simulated survey transaction. These averages are distributed accordingly into three clusters, having the data summarized in Cluster Code, Cluster Abbreviation and Gained Average Point. The content of Table I is represented graphically in Figure 9. It is clear that the gained averages are nearly converging in three clusters, however cluster number three (AOP) could be ranked as the highest average closely followed by cluster number one (ACC) whereas cluster number two is the last. Now it is easy to compare these results with standard threshold pass point, and decide the medical organization location from this threshold for each cluster.

Table I: Gained average according cluster.

Cluster Code	Cluster Abbreviation	Average
1	ACC	6.703703703
2	PFR	6.65217391
3	AOP	6.83333333

Fig. 9: Gained average according cluster

EXAMPLE 2 :

Table II represents the average points that medical organization gained as a result of simulated survey transaction. Data is summarized in Cluster code, Cluster Abbreviation, Gained Average Point and drilled down one level into Standard Level One. The content of Table 2 is represented graphically in Figure 10.
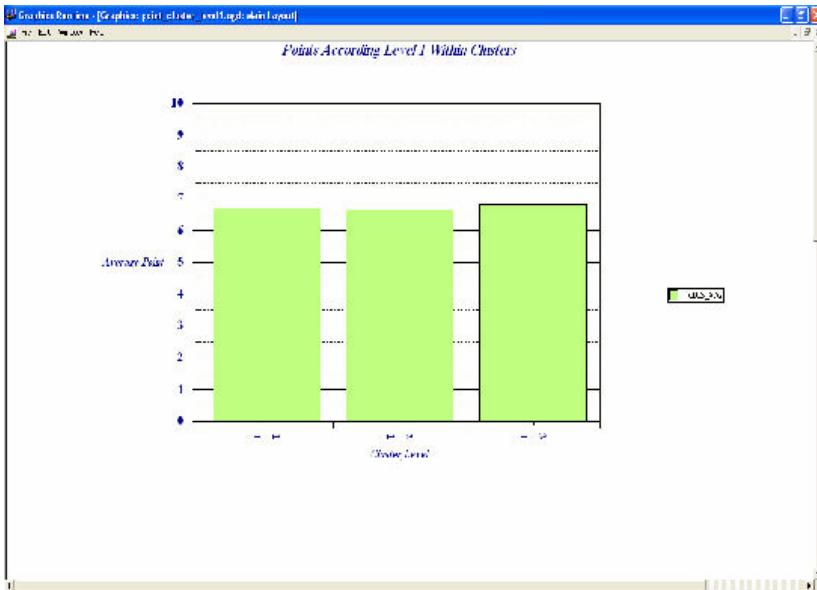
Table II: Gained average according cluster.

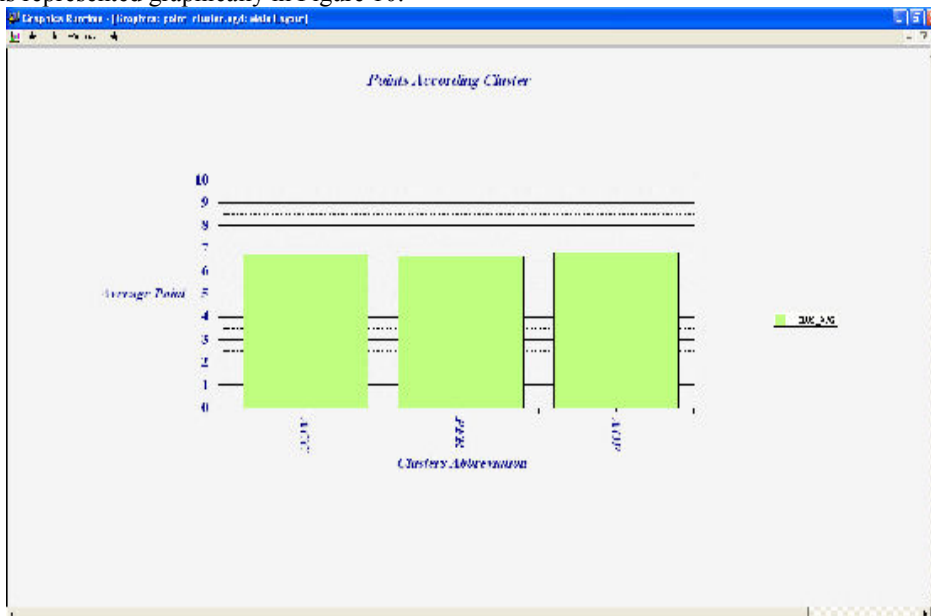| Cluster Code	Cluster Abbreviation	Standard Level	Average
1	ACC	1	6.70370370
2	PFR	1	6.65217391
3	AOP	1	6.83333333

Fig. 10: Gained average according standard rd level 1 within the cluster.

Example 3:
Table III represents the average points that medical organization gained as a result of simulated survey transaction. These averages are distributed across three clusters drilled down two levels. This data is summarized in Cluster code, Cluster Abbreviation, Standard level one, Standard level two, and gained average point. The contents of Table 3 are represented graphically in Figure 11.

Table III: Average points according Standard level 2 within cluster.

Cluster Abbreviation	Standard Level 1	Standard Level 2	Average
ACC	1	2	6.74074074
ACC	1	3	6.5

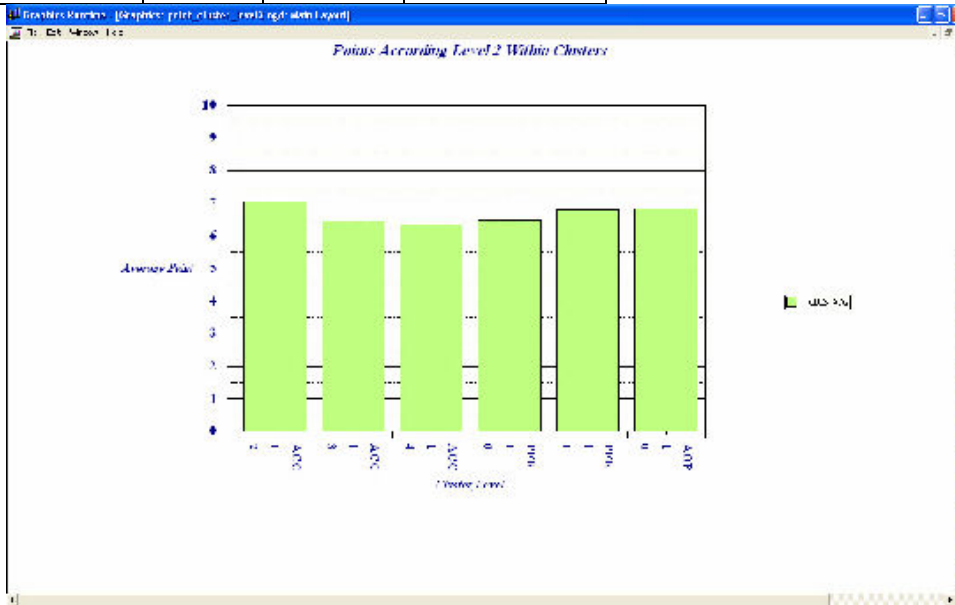| PFR	1	0	6.91666666
AOP	1	0	6.08333333

Fig. 11: Average points according standard level 2 within the cluster.

Example 4:

Table IV represents the average points that medical organization gained as a result of simulated survey transaction. These averages are distributed according to three clusters drilled down three levels. This data is summarized in Cluster code, Cluster Abbreviation, Standard level one, Standard level two, Standard level three and gained average point. The content of Table IV is represented graphically in Figure 12. It is self-evident that hospital gains the highest average in PFR cluster standard level one while the worst average is AOP cluster level one confirming the affirmation of easiness to decide the points of weakness as well as the strength of hospital performance via the survey standard.

Table IV: Average according standard level 3 within the cluster.

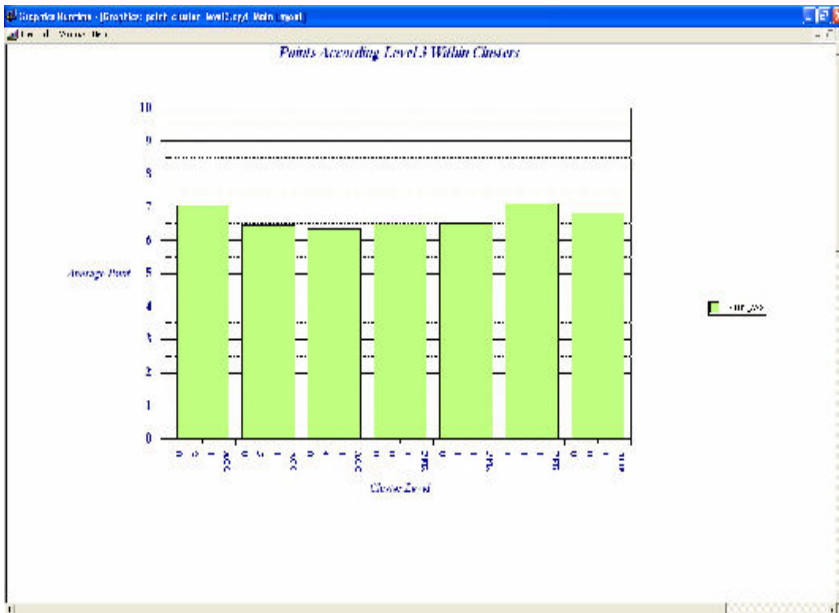| Cluster Abbreviation	Standard Level 1	Standard Level 2	Standard Level 3	Average
ACC	1	2	0	6.740740740
ACC	1	3	0	6.5
PFR	1	0	0	
AOP	1	0	0	6.0833333333

Fig. 12: Average according standard level 3 within the cluster.

Example 5:

Table V represents the average point that medical organization gained as a result of simulated survey transaction. These averages are distributed across three clusters drilled down four levels. This data is summarized in Cluster code, Cluster Abbreviation, Standard level one, Standard level two, Standard level three, Standard level four and gained average point. The contents of Table 5 are represented graphically in Figure 13.

Table V: Average according standard level 3 within the cluster.

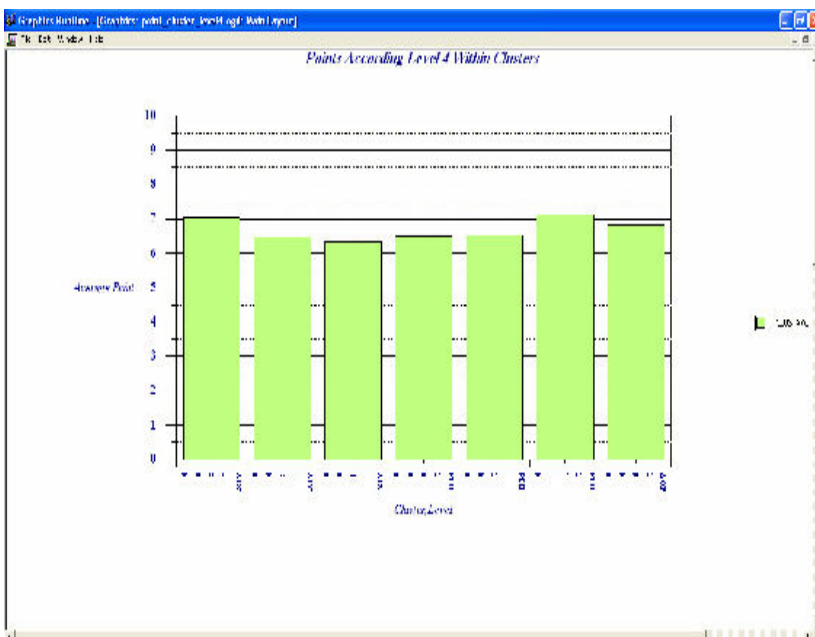| Cluster Abbreviation	Standard Level 1	Standard Level 2	Standard Level 3	Standard Level 4	Average
ACC	1	2	0	0	7.0416
ACC	1	3	0	0	6.45833
ACC	1	4	0	0	6.3333
PFR	1	0	0	0	6.4848
PFR	1	1	0	0	6.5
PFR	1	1	1	0	7.111
AOP	1	0	0	0	6.833

Fig. 13: Average according standard level 3 within the cluster.

Evaluator organization can invest ESHMSA to extract various analysis studies

that lead to developing its own standard or making extensive training course to its surveyors. The questions design method is tightly bound to analysis study that can give suitable indicators to which type of questions is more accurate so as to scale customer on the required standard. Surveyors' performance in specific standard could be easily monitored and controlled as a result of surveyors analysis study, in the following example these points are clarified.

Example 6:

Surveyors' analysis study is of utmost importance for both sides of organizations; evaluator as well as evaluated. Table VI represents the average points that medical organization gained according to three clusters and average points of three surveyors. Data is summarized in Cluster Code, General Average, and Average of Surveyor number one, Average of Surveyor number two and Average of Surveyor number three. The content of Table 6 is represented graphically in Figure 14. A deep study of information in Table 6 and Figure 14 leads to the following notes:

- Surveyor number two and surveyor number three are extremely converged in cluster one while they are nearly close in cluster two.

- Surveyor number one has large gap with surveyors number two and surveyor number three in cluster one and cluster two.
- Surveyor number two has very large gap with all other surveyors in cluster three.
  It can be concluded from this example the following
- Surveyor number three has the highest probability that he really represents this
- standard because he converges with others once, is extremely close once and nearly close once.
- Surveyor number one has the lowest probability of representing of this standard.

Since he is just nearly close once and has large gap with the others.

- Divergence in results refers to the problems existence which indicates:
- Surveyors' standard misunderstanding.
- Sharpness in surveyor's standard adopting.
- Ambiguity in standard evaluation basis.

Table VI: Surveyors' average points within cluster.

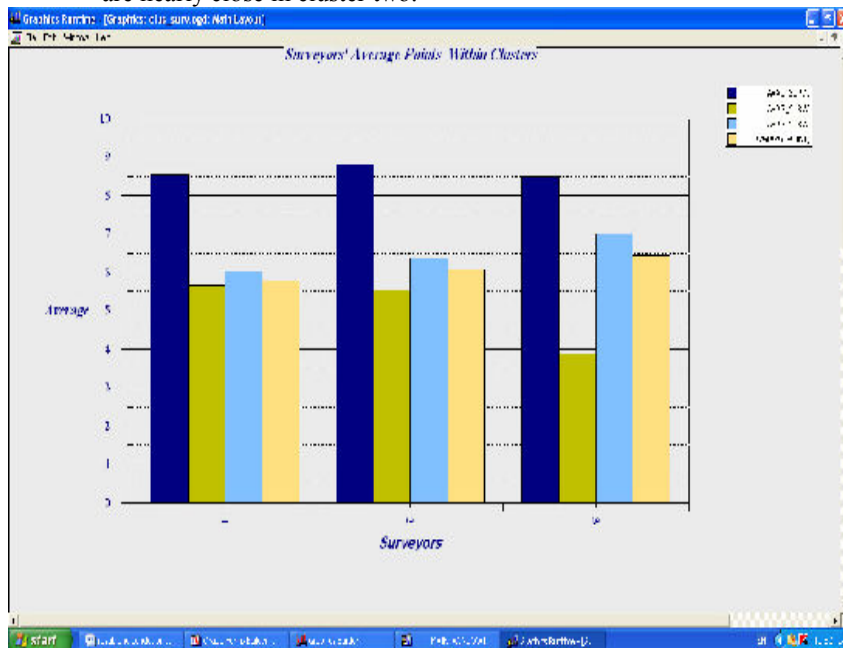| Cluster Code	General Average	Average of Surveyor 1	Average of Surveyor 2	Average of Surveyor 3
1	6.701149	8.586206	5.758620	5.758620
2	6.742857	8.771428	5.5142857	5.9428571
3	6.45833333	8.5	3.875	7

Fig. 14: Surveyors' average points within cluster.

This ESHMSA system can monitor and analyze the performance of surveyors,

the analyzing of this performance is possible to be drilled down up to the smallest unit of measurement element. Standard level one, level two, level three and level four are respectively clarified in tables Table VII, Table VIII ,

Table IX and Table X, data of previous tables is represented in Figures Figure 15, Figure 16, Figure 17 and Figure 18.

Table VII: Surveyors' average points within level 1 in cluster.

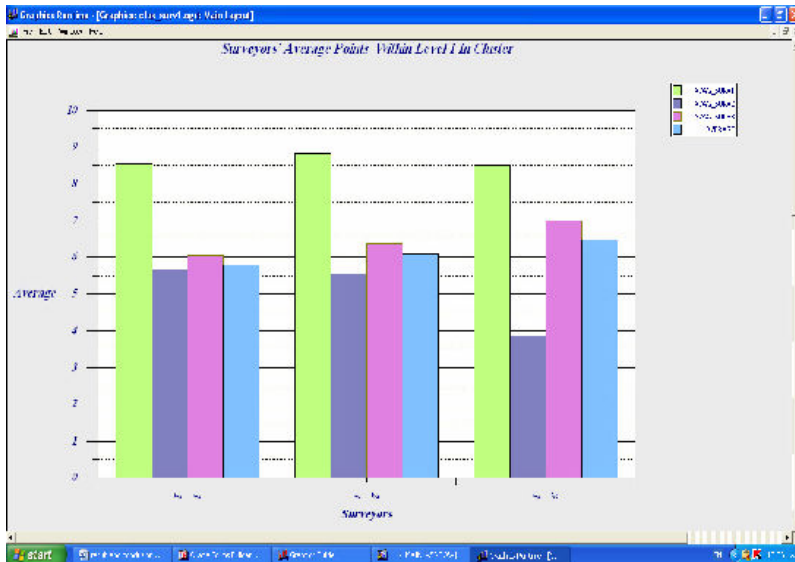| Cluster Code	Standard Level 1	General Average	Average of Surveyor 1	Average of Surveyor 2	Average of Surveyor 3
1	1	6.7011492	8.5862069	5.7586206	5.758620
2	1	6.742857	8.771428	5.514285	5.942857
3	1	6.4583333	8.571	3.875	7

Fig. 15: Surveyors' average points within level 1 in Cluster.

Table VIII: Surveyors' average points within level 2 in cluster.

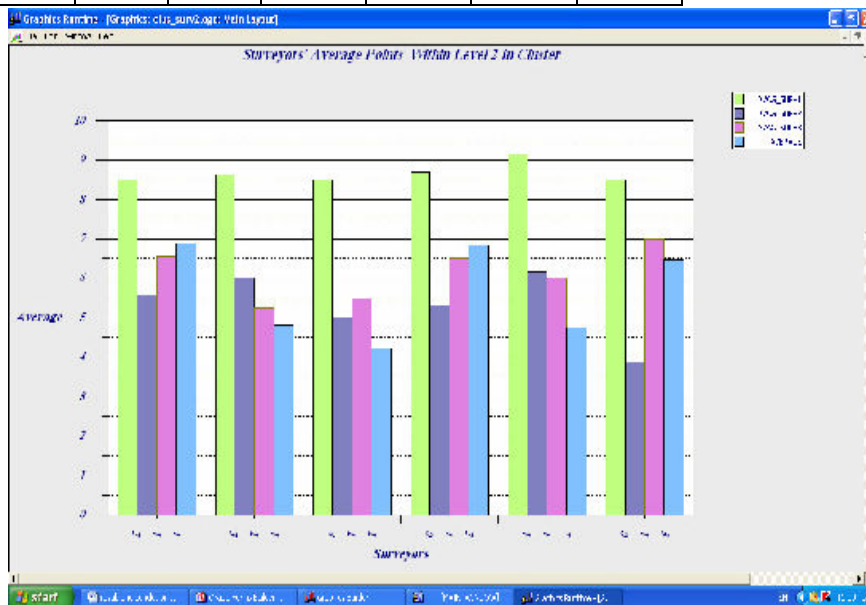| Cluster Code	Standard Level 1	Standard Level 2	General Average	Average of Surveyor 1	Average of Surveyor 2	Average of Surveyor 3
1	1	2	6.8823529	8.5882353	5.7647059	6.2941176
1	1	3	6.4666667	8.6	5.9	4.9
1	1	4	6.3333333	8.5	5	5.5
2	1	0	6.7101449	8.6086957	5.173913	6.3478261
2	1	1	6.8055556	9.0833333	6.1666667	5.1666667
3	1	0	6.4583333	8.5	3.875	7

Fig. 16: Surveyors' average points within level 2 in cluster.

Table IX: Surveyors' average points within level 3 in Cluster.

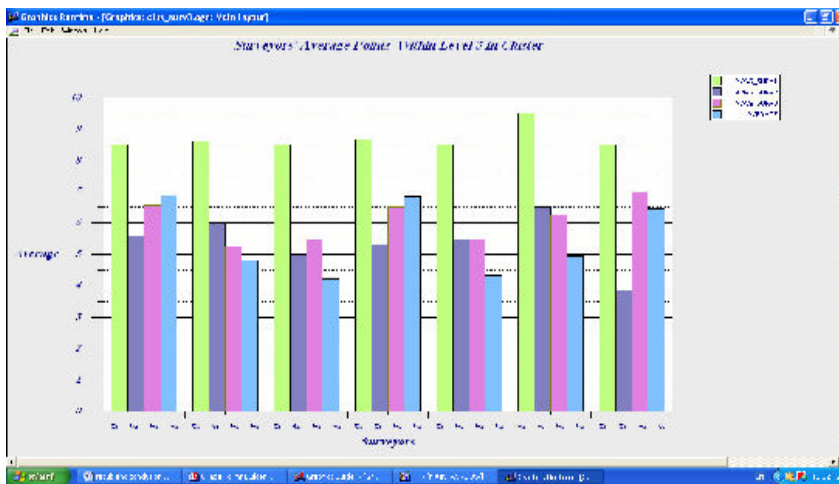| Cluster Code	Standard Level 1	Standard Level 2	Standard level 3	General Average	Average of Surveyor 1	Average of Surveyor 2	Average of Surveyor 3
1	1	2	0	6.8823529	8.5882353	5.7647059	6.2941176
1	1	3	0	6.4666667	8.6	5.9	4.9
1	1	4	0	6.3333333	8.5	5	5.5
2	1	0	0	6.7101449	8.6086957	5.173913	6.3478261
2	1	1	0	6.5	8.666667	6.166667	4.666667
2	1	1	1	7.111111	9.5	6.166667	5.666667
3	1	0	1	6.4583333	8.5	3.875	7

Fig. 17: Surveyors' average points within level 3 in cluster.

Table X: Surveyors' average points within level 4 in Cluster.

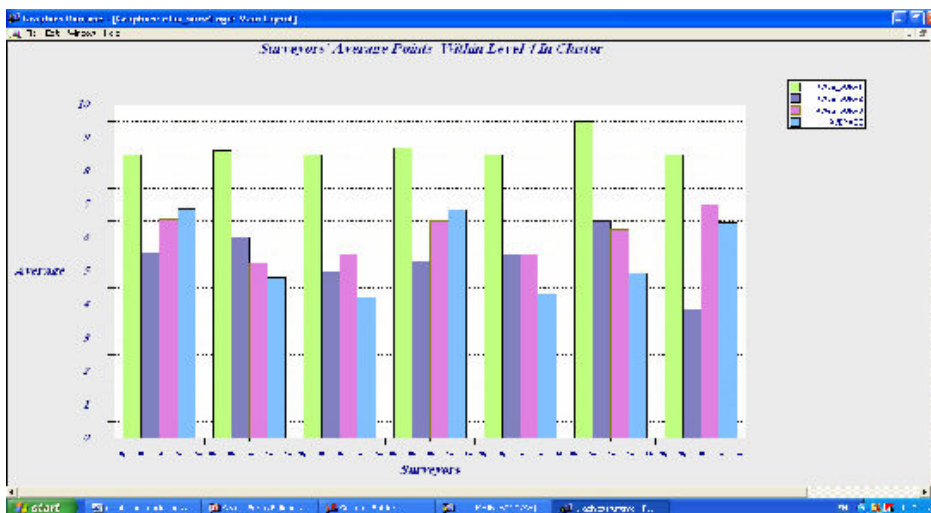| Cluster Code	Standard Level 1	Standard Level 2	Standard level 3	Standard level 4	General Average	Average of Surveyor 1	Average of Surveyor 2	Average of Surveyor 3
1	1	2	0	0	6.88235	8.58823	5.76470	6.29411
1	1	3	0	0	6.46666	8.6	5.9	4.9
1	1	4	0	0	6.33333	8.5	5	5.5
2	1	0	0	0	6.71014	8.60869	5.17391	6.34782
2	1	1	0	0	6.5	8.66666	6.16666	4.66666
2	1	1	1	0	7.11111	9.5	6.16666	5.66666
3	1	0	0	0	6.45833	8.5	3.875	7

Fig. 18: Surveyors' average points within level 4 in Cluster.

Example 7:

Table XI represents the average points that medical organization gained as a result of simulated survey transaction. These averages are distributed according to users who participated in that survey transaction. Data is summarized in Cluster Code, User and gained average. The content of Table X is represented graphically in Figure 104. Medical organization management can have clear picture about performance of employee in survey transaction. In other words it is possible to know every problem inducer partially or completely.

Table XI: Users' average point within cluster.

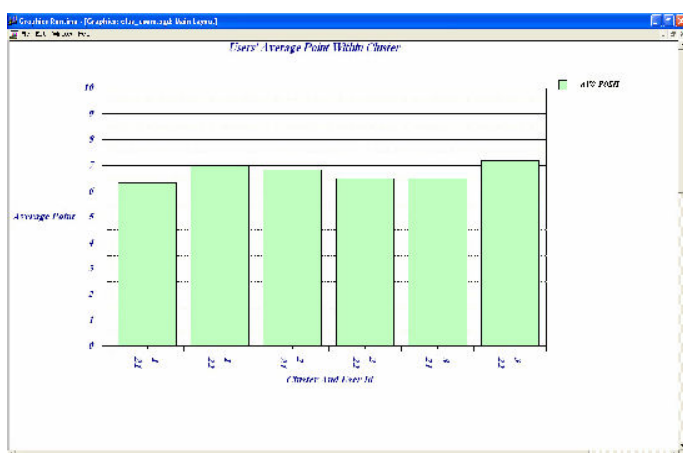| Cluster code	User	Average
1	21	6.3333333
1	22	7.0000000
2	21	6.8181818
2	22	6.5000000
3	21	6.5000000
3	22	7.1666667

Fig. 19: Users' average point within cluster.

C. Hardware and Software

Proposed ESHMSA is implementing using Oracle10g database, Oracle form6i, oracle report6i, Graphic Builder, S_designer. The choice of Oracle's database front end development tools as proven enterprise technology provided both robustness and scalability suitable for different sizes, categories and scopes of medical organizations.

Implementation and extracting results were carried on 2 GHz, 1GB of RAM laptop running under Microsoft Windows XP Professional, Service Pack 2.

V. CONCLUSIONS AND FUTURE WORKS

In this study, we proposed the ESHMSA in order to guide hospitals management to get certificate for well-known accreditation standard as friendly as possible in addition to following of their fault points to prevent repletion, decrease time and cost to win certificate.

ESHMSA was design and feed it with two accreditation standards, JCI as well-known international standard and HCAC local one.

The results refer that ESHMSA can be used for evaluator organization as well as evaluated one.

One of the main advantage for evaluator organization is comparing between their survivors' evaluation and measure their evaluation distribution from average point and intersections between there question evaluation which gives indicators to exaggerated of surveyor or misunderstanding which refer to standard owner organization to necessary action it may be trained, or modified.

Hospitals build historical learn lessons that can be invested build capacity of managements as well as employees.

Winning accreditation standard(s) certificate is the significant goal of most world hospitals, local and regional hospitals is a large target that can benefit from advantages of ESHMSA. To achieve these remarkable requests we recommend the following for future works:

- Develop ESHMSA to work in web based environment which is receptivity by ESHMSA design.
- Solve copyright matter and feed ESHMSA with popular local and international accreditation standards.
- Encourage local and regional hospitals to take advantage of ESHMSA that friendly and easily guide them to gain an accreditation standard certificate.
- Invest the ESHMSA receptivity to work with not only hospital accreditations standards but also other medical accreditation standard fields like laboratory, pharmaceuticals, nursing...etc

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