A survey on Business Intelligence Application to Evaluate the Software Quality From End User Point of view

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Abstract: Information technology supports all major business processes and business functions. Software plays a very important role in the industry and society. So as the role of software in the industry and the society becomes vital, It becomes very crucial to develop high quality and easy to use software. This article deals with the software evaluation and it afford survey contains various models and metrics for measuring the of software from the end users prospective. There are several software quality models that evaluates how easily users can use the software to carry out their required task. the article is also measured in terms of its capability to provide the user satisfaction and ability to fulfill the needs of the users by providing the user friendly interfaces.

Key words : Information system evaluation, Software evaluation, ISO 9216, Business intelligence, Evaluation methodology

1 INTRODUCTION

Information technology is the backbone of any organization today. Practically all major business processes and business functions are supported by information technology. It is inconceivable that a business firm or any other nontrivial organization would not be able to operate without powerful information systems [3].

Software evaluation is important because organizations have invested large amounts of money in their software and are now completely dependent on these software. Their systems are critical business assets and organizations have to invest in system change to maintain the value of these assets. Consequently, large companies spend more on maintaining existing systems than on new systems development [13].

The evaluation of a system can rarely be considered in isolation. Changes to the environment lead to system changes that may then trigger further environmental changes. Of course, the fact that systems have to evolve in a 'systems rich' environment often increases the difficulties and costs of evaluation. As well as understanding and analyzing the impact of a proposed change on the system itself, we may also have to assess how this may affect other systems in the operational environment [15].

Software development and evaluation can be thought of as an integrated, iterative process that can be represented using a spiral model. On the other hand for custom systems, the software maintenance costs usually exceed the software development costs. The process of software evaluation is driven by requests for changes and includes change impact analysis, release planning, and change implementation [17].

2. Information system evaluation

There are several software quality models for evaluating the information system. A quality model is defined as 'the set of characteristics and the relationship between them, which provide the basis for specifying quality requirements and evaluating product quality' [5]. examples of the evaluation model as example McCall, Boehm, FURPS, Dromey, Bayesian and ISO 9216 [6-8].

2.1 McCall Model

McCall defined the quality of a software product through 3 different perspectives namely Product Operations, product Revisions and product Transitions [9]. It consists of 11 quality factors to

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describe the external view of the software (users' view); 23 quality criteria to describe the internal view of the software (developer's view); and a set of metrics that are used for quality evaluation. The fundamental idea of this model is assessing the relationship among external quality factors and product quality criteria. A major contribution of this model is the relationship between quality characteristics and metrics. However, there are criticisms such as not all metrics are objectives [5] and the functionality of software product is not considered in this model [10].

2.2 Boehm Model

Boehm introduced a model for evaluating the quality of software as well as the quality of hardware [11, 12]. It presents a hierarchical structure similar to McCall consisting of High-Level, Intermediate-Level and Low-Level characteristics. Each of these characteristics contributes to the total quality of software product. This model takes into account some considerations of software product with respect to the utility of the program. Boehm also extended characteristics to the McCall model by emphasizing the maintainability factor of a software product, which is one of the advantages of this model. However, it does not suggest any approach to measure its quality characteristics [5].

2.3 Furps Model

Robert Grady and Hewlett Packard proposed the FURPS model that decomposes characteristics into two categories of requirement: functional requirements and non-functional requirements. Functional requirements is mentioned by character are defined by input and expected output while non-functional requirements consist of usability, reliability, performance and supportability is mentioned by (URPS). It is important to note that domain specific attributes and software product portability were not addressed in this model [13].

2.4 Dromey Model

Dromey proposed a working framework for evaluating requirement determination, design and implementation phases [14, 15]. The framework consists of three models namely requirement quality model, design quality model and implementation quality model. Layers are defined as high-level attributes and subordinate attributes. The main idea of this model is to create a framework that is broad enough for different systems; and to understand the relationship(s) between characteristics and sub-characteristics of quality product [10]. different evaluation is proposed for each product. However, the more dynamic modeling of the process is needed since this model lacks the criteria for measuring software quality.

2.5 Bayesian belief network Model

The Bayesian Belief Network (BBN) model is represented in hierarchical structure, similar to McCall and Boehm. The structure is graphically illustrated, where nodes represent variables and arrows represent the relationships between nodes [16, 17]. The root of the tree represents the node quality and is connected to quality characteristics nodes. Each quality characteristics node is further connected to corresponding quality sub-characteristics. The advantage of this model is that it can represent and manipulate complex models that could not be implemented using conventional methods as conforming to established practice or accepted standards [10]. However, this model cannot be used for evaluating software quality product due to the lack of characteristics.

2.6 ISO 9126 Model

ISO 9126 is an international standard for the evaluation of software [18]. It is divided into 4 parts which addresses the Quality Model; External Metrics; Internal Metrics; and Quality in Use Metrics. This model is based on previous works by McCall, Boehm, FURPS, etc. The fundamental idea of this model is specifying and evaluating the quality of a software product in terms of internal and external software qualities and their connection(s) to attributes.

Quality attributes are classified into a hierarchical tree structure of characteristics and sub-characteristics. The highest level consists of quality characteristics and the lowest level consists of quality criteria. ISO 9126 specifies 6 characteristics that are further divided into 21

sub-characteristics. These sub-characteristics are manifested externally when the software is used as part of a computer system, and the results of internal attribute. The main advantage of this model is that the characteristics defined are applicable to every kind of software while providing consistent terminology for software product quality.

This section has presented several quality models for evaluating software product shown Table01 illustrates a comparison between the models including advantages and disadvantages. It can be concluded that the ISO 9126, since it is based on previous works and models, is more complete than the other (older) models and suitable to be used in the evaluation of software. ISO 9126 covers all crucial characteristics such as hierarchical structure; criteria for evaluation; comprehensive expression and terms; simple and accurate definitions; and one to many relationships between various layers of model [10]. In addition, work in [19] also concluded that ISO 9126 supports strategic decision-making activities, avoiding costly mistakes.

Comparison of Software Quality Models						
CHARACTERISTICS/ MODEL	**MCCALL**	**BOEHM**	**FURPS**	**DROMEY**	**BBN**	**ISO 9126**
STRUCTURE	Hierarchical	Hierarchical	Hierarchical	Hierarchical	Hierarchical	Hierarchical
NUMBER OF LEVELS	2	3	2	2	n/a	3
RELATIONSHIP	Many-Many	Many-Many	Many-Many	Many-Many	Many-Many	Many-Many
MAIN ADVANTAGE	Evaluation Criteria	Hardware Factors Included	Separation of FR & NFR	Different Systems	Weighted Factors	Evaluation Criteria
MAIN DISADVANTAGE	Components Overlapping	Lack of Criteria	Portability not Considered	Comprehen-siveness	Lack of Criteria	Generality

Table 01**:** International Journal of Control and Automation

3 The evaluation Model ISO 9216

The ISO 9216 has been used to detect design flaws in evaluation the system [20] to evaluate software quality using generic external quality characteristics and sub-characteristics [8] and to analyze technological, managerial and economic factors in systems [21]. The generality of the ISO 9126 means further analysis and mapping of characteristics are required before it can be fully adapted to system. ISO 9126 specifies 6 characteristics namely Functionality, Reliability, Usability, Efficiency, Maintainability and Portability and 21 sub-characteristics. The quality characteristics are briefly discussed below:

3.1 Functionality

Functionality is 'the capability of the software to provide functions which meet the stated and implied needs of users under the specified conditions of usage'. Functionality is divided into 5 sub-characteristics: Suitability, Accuracy, Interoperability, Security, and Functional Compliance.

3.2 Reliability

Reliability is 'the capability of the software product to maintain a specified level of performance when used under specified conditions'. Reliability is divided into 4 sub-characteristics: Maturity, Fault Tolerance, Recoverability and Reliability Compliance.

3.3 Usability

Usability is 'the capability of the software product to be understood learned, used and attractive to the user, when used under specified conditions'. Usability is divided into 5 sub-characteristics: Understandability, Learn-Ability, Operability, Attractiveness and Usability Compliance.

3.4 Efficiency

Efficiency is 'the capability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions'. Efficiency is divided into 3 sub-characteristics: Time Behavior, Resource Behavior and Efficiency Compliance.

3.5 Maintainability

Maintainability is 'the capability of the software product to be modified'. Modifications include correction, improvements or adaptation to changes in the environment, in requirements; and functional specifications. Maintainability is divided into 5 sub- characteristics: Analyzability, Changeability, Stability, Testability and Maintainability Compliance.

3.6 Portability

Portability is 'the capability of the software product to be transferred from one environment to another'. The environment includes organizational, hardware, and software. Reliability is divided into 4 sub-characteristics: Adaptability, Install-Ability, Co-Existence, Replace-Ability and Portability Compliance.

4. Case Study: Business Intelligence Application

In order to have a real case study to apply the BI application, we have chosen a data mart of the monitor noise measurement for developing an application of environment affair- Egypt

The evaluation of the noise value is a difficult task with respect to a business one. The major difference is that in the business environment are hard to evaluated in metrics, such as price or amount. Such hard metrics are not applicable to the environment affair for the most activities. It is fundamental to develop an application that enables environment Ministry - Egypt to measure the success or failure of environment affair activities [12].

In particular, data mart contains data about noise measurement enrolled to the environment affair. This data mart has been designed through the integration of the logical schemas of two transactional databases: (a) (Noise record per each major area including the entry places), that is the current database that supports all the administrative processes and services to the requesters and users in accordance with the environment affair; and (b) secondary database that stores noise residual historical.

The database (a) and the database (b) represent also the repository of data used to feed the data mart, after the *Extraction Transformation Loading* (ETL) process. The data mart's logical model can be thought of as a set of data cubes, whose main dimensions are: noise record , noise level , major areas study; these are the base dimensions, because they represent the minimum information to express what , *where* and *when* aggregation levels for business analysis. According to these coordinates, it is possible to find data; a single datum is stored in a cell of the cube and it represents the value of a measure; a measure is the quantitative description of a fact; and, in a business context, a fact is a meaningful event to be analyzed.

The dashboard is a collection of different visual elements usually charts arranged on a single web page, providing a summary of the most important results or findings related to a particular subject.

Dashboards can be connected to live data that is automatically updated in real time, or based on a completed survey project or other finite datasets which it can come from multiple datasets [4].

Dashboards should be accessible on any internet capable device anytime and anywhere, providing a significant advantage over traditional static reports. we can create free dashboards that are accessible only by specific people. You simply create a user ID for each person who should have access and then set the appropriate permissions.

The dashboard may also contain interactive charts, which allow the viewer to make changes to the chart to show different data, different breakdowns, and different filters, enabling them to run multiple scenarios and uncover new insights on the fly .

The examples below shows a dashboard containing four charts relating to a particular noise records data, showing noise stander level and several other metrics. This single dashboard provides an instant view of all the key performance indicators.

Being able to see these results graphically and control how the information is displayed is a major advantage of dashboards over static charts and reports. Dashboards bring the data to life and enable a level of analysis that can be performed by anyone, While viewing the different charts in this sample dashboard, a user may want to see the data in a different way:

- Sliced by Major Areas or place of measurement.
- Showing Noise levels permitted.
- Showing more than one year of data.
- Showing the thirds breakdown instead of day

By using an interactive chart in this dashboard, you can provide the user with those options, as shown below.

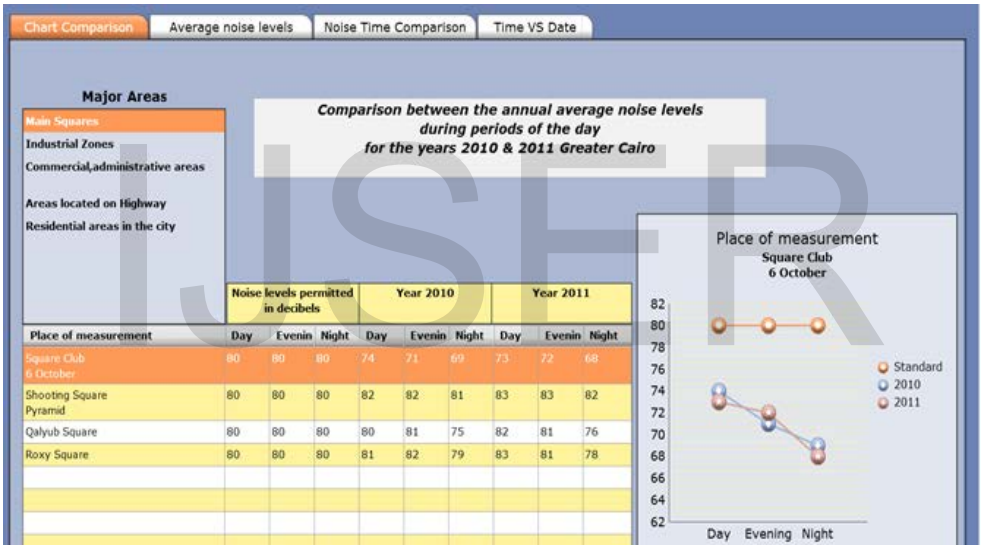


Figure 1. The Monitor Noise Chart Comparison Report (Proposed BI application)

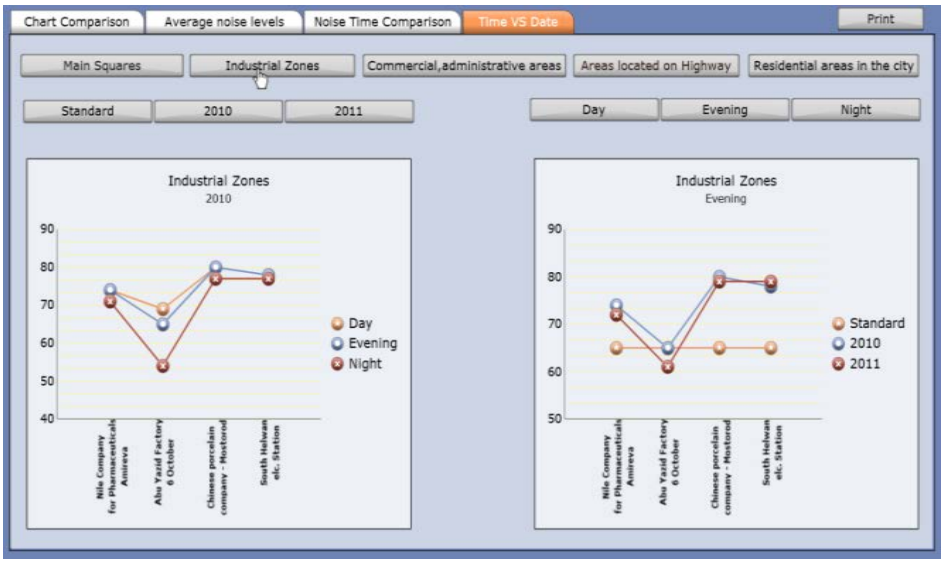


Figure 2. The Monitor Noise Time VS Date Report (Proposed BI application)

Summary analysis for the proposed reports and inquires

- **Control size of report results:** Control the size of report results by not displaying detailed data.
- **Change the contents of the report:** Use the PivotTable feature to add and remove dimensions and measures from the report results, specify filters, and expand or collapse dimension levels..
- **Export report results to Microsoft Excel**: can export the results of a dynamic report to Microsoft Excel or platform.
- **Create new report definitions**: can modify existing dynamic reports or create new ones based on a SQL Server query or an OLAP cube. .
- **Delete report definitions:** can delete custom dynamic report definitions. You cannot delete default dynamic report definitions.
- **View report results as a chart:** can view completed dynamic reports as Pivot Charts.
- **Use the drill through feature to view additional report data for selected reports:** For dynamic OLAP reports you can double-click a cell in the PivotTable data area to retrieve the detailed data for that cell.

5. Evaluation methodology

The methodology is designed to evaluate software application provided by proper Business intelligent (BI) tools, we established a set of tasks on which to perform the comparison of the software tools investigated. The function point analysis measures the features which an application is composed by listing all the real elements that are enumerable by the end user. on the other hand here are some key features a good BI should have:

A) Supports custom design
B) No knowledge of code required
C) Ease of use
D) Ability to preview the work in time manner
E) Navigation/page management
F) Modular and extensible
G) Permission based user management
H) Minimal server requirements

5.1. Field work

Firstly, the selected individual were contacted and given information about the objectives and methodology of the study. The agenda of site visits consisted of a brief explanation of scope and objectives of the study, followed by information about the contents of the questionnaire. Then, the system project (Average Level Noise) and the questionnaire was left to be filled in and sent back. Return of the questionnaires took about 20 days on the average. Initial analysis of the results has provided the basis for the development of another questionnaire to be employed in the structured interviews to follow.

5.2. Candidate group

Ministry : 33% (40 contacted, 27 responses.)
NGOs : 29% (35 contacted, 22 responses.)
Academics: 21% (25 contacted, 16 responses.)
Others : 17% (20 contacted, 13 responses.)

5.3. System evaluation

For practical use, the questions have been divided into the following groupings:

- Usability
- Effectiveness
- Efficiency
- Learnability
- Satisfaction

- For each applicable criterion, rate the program:

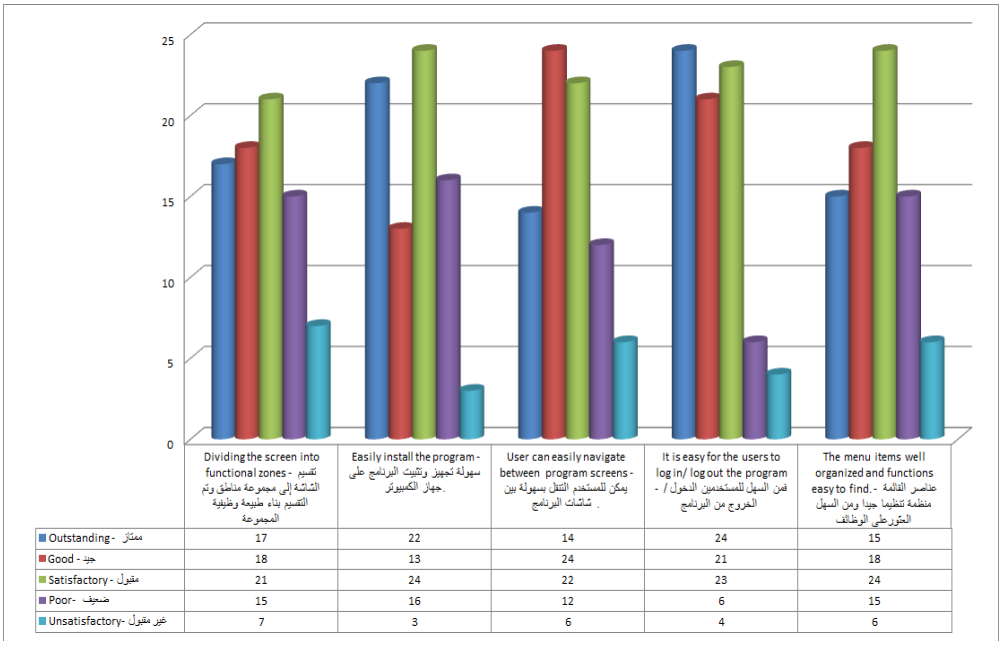
5 = Outstanding, 4 = Good, 3 = Satisfactory, 2 = Poor, 1 = Unsatisfactory

- For each applicable criterion, weight the program:

5 = Very important, 4 = Important, 3 = moderatel important, 2 = somewhat unimportant, 1 = Not at all important

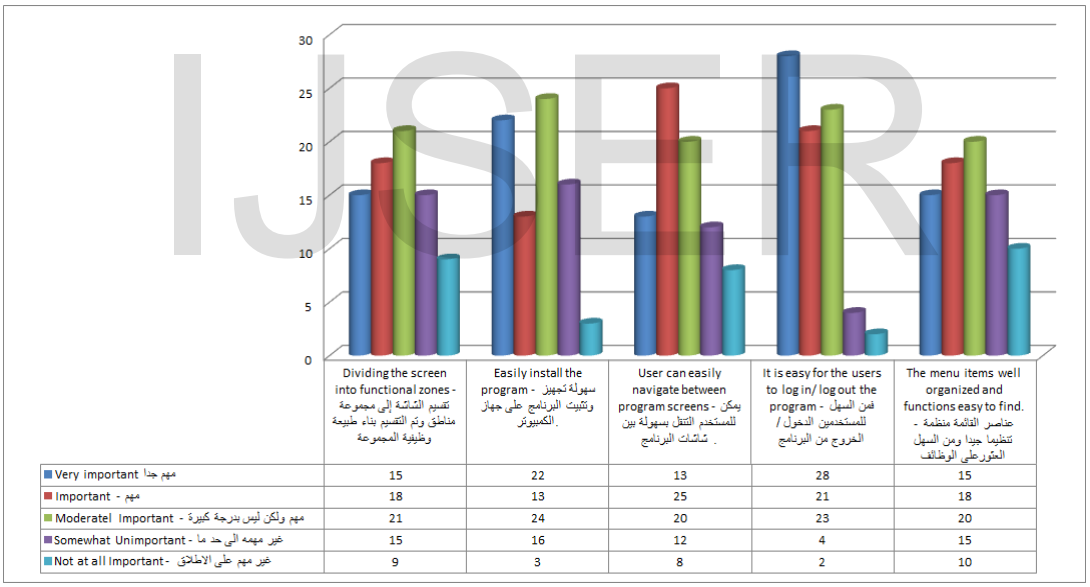
		Rate - system evaluation					Weight - System Importance				
Function	Applicable criterion	Outstanding	Good	Satisfactory	Poor	Unsatisfactory	Very important	Important	Moderatel Important	Somewhat Unimportant	Not at all Important
Usability	Dividing the screen into functional zones	17	18	21	15	7	15	18	21	15	9
	Easily install the program	22	13	24	16	3	22	13	24	16	3
	User can easily navigate between program screens	14	24	22	12	6	13	25	20	12	8
	It is easy for the users to log in/ log out the program	24	21	23	6	4	28	21	23	4	2
	The menu items well organized and functions easy to find	15	18	24	15	6	15	18	20	15	10
Effectiveness	Software adequately meets its objectives	28	21	23	4	2	15	18	21	15	9
	Software would make my job more effective	21	18	21	15	3	22	13	24	16	3
	Use the program not Linked to previous experiences	12	18	23	12	13	13	25	20	12	8
	Use the prompt time when need information	25	13	24	13	3	28	21	23	4	2
	The use of color and the backgrounds for a particular purpose	13	25	20	12	8	15	18	20	15	10
Efficiency	Equilibrium and distribution elements within the screen	28	21	23	4	2	15	18	21	15	9
	The program layout automatically branching based on the stockholder response	21	18	21	15	3	22	13	24	16	3
	Font size and color screen fits the target group	12	18	23	12	13	13	25	20	12	8
	Simplicity of the display components	25	13	24	13	3	28	21	23	4	2
	Exciting graphics more attractive	13	25	20	12	8	15	18	20	15	10
	Protection of the amendment update	21	18	21	15	3	22	13	24	16	3
Learnability	General Guidness of use and easy to read and understand	12	18	23	12	13	13	25	20	12	8
	Search for certain items is simple and complex search may be done also	13	25	20	12	8	15	18	20	15	10
	All of the functions I expected to find in the menus were present	14	24	22	12	6	13	25	20	12	8
	Can be used for skill building	24	21	23	6	4	28	21	23	4	2
	Encourages higher levels of thinking/ Critical thinking	15	18	24	15	6	15	18	20	15	10
Satisfaction	Software is usable without reference manual or user help	12	18	23	12	13	15	20	21	15	7
	User can navigate through program without difficulty	13	25	20	12	8	22	13	24	16	3
	Software performs management tasks satisfactorily	14	24	22	12	6	23	21	20	11	3
	Completed all the tasks on prefect time	24	21	23	6	4	28	21	23	4	2
	Menus and other features make the program user friendly	15	18	24	15	6	21	18	20	15	4

Table 02: Survey result



	Dividing the screen into functional zones - تقسيم الشاشة إلى مجموعة مناطق وتم التقسيم بناء طبيعة وظيفية المجموعة	Easily install the program - سهولة تجهيز وتثبيت البرنامج على جهاز الكمبيوتر.	User can easily navigate between program screens - يمكن للمستخدم التنقل بسهولة بين شاشات البرنامج .	It is easy for the users to log in/ log out the program - / سهل للمستخدمين الدخول الخروج من البرنامج	The menu items well organized and functions easy to find. - عناصر القائمة منظمة تنظيما جيدا ومن السهل العثورعلى الوظائف
Outstanding - ممتاز	17	22	14	24	15
Good - جيد	18	13	24	21	18
Satisfactory - مقبول	21	24	22	23	24
Poor- ضعيف	15	16	12	6	15
Unsatisfactory- غير مقبول	7	3	6	4	6

Graph-01 usability rate - capable of being used or how easy to use



	Dividing the screen into functional zones - تقسيم الشاشة إلى مجموعة مناطق وتم التقسيم بناء طبيعة وظيفية المجموعة	Easily install the program - سهولة تجهيز وتثبيت البرنامج على جهاز الكمبيوتر.	User can easily navigate between program screens - يمكن للمستخدم التنقل بسهولة بين شاشات البرنامج .	It is easy for the users to log in/ log out the program - / سهل للمستخدمين الدخول الخروج من البرنامج	The menu items well organized and functions easy to find. - عناصر القائمة منظمة تنظيما جيدا ومن السهل العثورعلى الوظائف
Very important مهم جدا	15	22	13	28	15
Important - مهم	18	13	25	21	18
Moderatel Important - مهم ولكن ليس بدرجة كبيرة	21	24	20	23	20
Somewhat Unimportant - غير مهمه الى حد ما	15	16	12	4	15
Not at all Important - غير مهم على الاطلاق	9	3	8	2	10

Graph-02 usability weight - capable of being used or how easy to use

5.4. General key findings:

Only a small percentage (5%) of candidates who responded have never use any software applications, the majority use some kind of software applications. One area where the software application implemented could use improvement is further training, especially regarding the performance or the ability to accomplish a job.

80% of the responders agreed that the comparison items group are very important or is at least is necessary , 20% not see comparison items group are somewhat unimportant nor not at all important, 78% accepted the comparison items group are outstanding or is at least is good , 22% not see comparison items group are either poor or unsatisfactory.

Over 87% tending that easy for the users to log in/ log out the program Software would make my job more effective, Software adequately meets its objectives , exciting graphics more attractive and

completed all the tasks on prefect time) is very important or is at least is necessary.

Between 75% and 86% from survey result see that screen into functional zones, easily install the program, easily navigate between program screens, the menu items well organized and functions, simplicity of the display components, encourages higher levels of thinking/critical thinking, all of the functions I expected to find in the menus were present is very important or is at least is necessary.

6 Conclusion

Information technology (IT) is the backbone of any organization today. Practically all major business processes and business functions are supported by information technology.

Software development and evaluation can be thought of as an integrated, iterative process that can be represented using a spiral model like ISO 9126 which it is an international standard for the evaluation of software [13,14].

This survey contains the study of various models and metrics for measuring the of software. Factors taken into consideration of various models and standard has been studied, compared and analyzed.

The methodology is designed to evaluate software application provided by proper Business intelligent (BI) tools, it had been established a set of tasks on which to perform the comparison of the software tools investigated. The function point analysis measures the features which an application is composed by listing all the real elements that are enumerable by the end user.

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