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An Application of Electronic Program to Manage the Laboratory Quality Ranking in the University of Mosul

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Abstract

Laboratories are an essential part of the educational process in university faculties because of their importance in delivering scientific and applied material to students. There is great importance to the availability of safety conditions, professional staff, technical capabilities, and other laboratory requirements. Given the importance of quality in educational laboratories, the ranking of its must be done frequently. The evaluation information must be sound and available when needed. The objective of this research is to create an electronic Laboratory Quality Ranking (LabQR) program that simulates the paper evaluation process. The program converts all documents to electronic documentation and extracts the final score of the required conditions. Also, all the attached documents were saved in electronic databases, such as course certificates for employees and administrative orders. The program also provides ease of searching, retrieval, and archiving. The expansion and flexibility features have been considered in the program by adding other colleges, departments, and universities.

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1. Introduction

Laboratories play an important and essential role in the student's career in terms of developing his skills, and scientific thinking[1]. Laboratories are important for all disciplines in line with modern science, how to identify problems, conclusions, and interpretation of the experimental process[2]. Laboratories help in developing the scientific and intellectual trends of the student, and this leads to the opportunity for creativity and invention, as well as improving and developing skills with great scientific diversity[1]. Each laboratory must meet a set of conditions that comply with international quality standards for a good laboratory in specialized educational institutions. The Iraqi Ministry of Higher Education, the supervisory and evaluation body, identified these standards within eleven indicators to measure the quality of laboratories, according to forms prepared for this purpose, called Laboratories Quality Ranking (LQR) forms. The LQR forms explained the method of evaluating laboratories and the details of the indicators with the related values of each condition of the indicators, by publishing a guide to the evaluation process[3].

Database management systems are the most popular tools used for converting traditional systems to digital systems using the Structure Query Language (SQL). The idea of this research is to create an electronic program LabQR to simulate LQR forms using an SQL-server databases management system, which is characterized by its enormous power and capabilities in storing and retrieving information, images, and documents. The program was built after studying and analyzing the data contained in the scientific laboratory's quality forms to create database components and relationships. Supporting that by creating simplified and easy-to-navigate user interfaces. The interfaces are built using C#, which saves less effort in the process of entering and retrieving information at any time. The advantages of programming languages were also exploited in calculating the final score of the quality ranking and making it immediately affected by any modifications in

the values of the indicators. Moreover, the value of the conditions can be modified by the system admin user at the program which make it more flexible for future updates. The remaining parts of the current paper are organized as follows: Second, the research problem. Third, the research objective. Fourth, related studies. Fifth, the importance of digital systems. Sixth, digital database system. Seventh, quality rating of specialized educational laboratories. Eighth, suggested program.

2. The Research Problem

Educational institutions, especially those with scientific specializations, include educational laboratories dedicated to applied sciences, such as physical sciences or chemistry sciences laboratories. These laboratories need continuous follow-up to provide all the necessary supplies for the continuation of the laboratory's work, and the necessity of providing specialized professional staff, in addition to ensuring that the building is prepared for emergencies such as fires and others. To achieve this, these laboratories are subject to periodic follow-up operations by the supervisory and evaluation body through evaluation processes carried out by the relevant committees. The process of protecting laboratories is also considered part of the evaluation process of the educational institutions to which they belong.

The evaluation laboratories process is carried out periodically by the assessment committees in the colleges. This process is done when field visits are made to laboratories, and the information about the laboratory is collected with its documents, certificates, and photos that document the valuation process. This is done within the indicators that were identified in the LQR form. This process is done manually, and the process of documenting information is done in a traditional paper way, which requires effort and the availability of safe storage sites. The forms are also subject to deletion or damage. We also note that the traditional search for LQR forms requires time and effort, especially when the number of laboratories is large or when the LQR report is needed for previous years. This makes converting to a digital system a very important process.

3. The Research Objective

Educational laboratories have a significant impact on the level of educational outcomes. The more these laboratories are appropriately equipped for the specialization in the educational institution, the better performance will be reflected in the learners' reactions. To achieve this, there must be a periodic or annual evaluation process for these laboratories and ways to make the necessary improvements. This evaluation process must be documented and archived for annual follow-up, in addition to being part of the process of evaluating the educational institutions that include these laboratories. The research suggested a computer program to perform the laboratory evaluation process electronically.

The proposed research aims to achieve the following objectives when applied in relevant educational institutions:

- Getting acquainted with the laboratory quality system and the indicators specified by the Ministry.
- Facilitating the work of evaluation committees in colleges by switching to the electronic system instead of the traditional system.
- Converting manual work in filling out forms and collecting images into a simplified electronic method that saves effort and time as it uses interactive user interfaces.
- Providing an electronic storage facility for laboratory evaluation data in an electronic database that is available when needed.
- Archiving the laboratory evaluation process electronically and keeping all documents and images attached to the evaluation process, and the possibility of inquiring about them when needed.

4. Related Studies

At the time when the research was conducted, no previous research was found that dealt with the application of an electronic program to manage laboratory evaluation in Iraqi universities, and because of that, and to activate the current research, previous research was studied that dealt with somewhat similar topics. The research was based on databases as the basic unit for building the program. In addition, designing interactive interfaces to manage user interaction with the database. The studies were selected for review during the research study, as they adopt a similar method for converting the traditional system into an electronic system and are arranged by its years. SALEH et. al. (2020), used Microsoft Access2013 to design a system for managing graduate students' information in Iraqi Universities, which has the possibility of changing and modifying the system according to the specificities of each College[4]. Al-Kubaisi and Kamal (2020), suggested designing an electronic program that allows its users to evaluate the various practices of professional project management according to the (PMBOK) methodology. The system uses the Microsoft SQL database management system[5]. Hussein and Ahmed (2021), presented the design of an electronic system to create a database of taxpayers in tax departments and to facilitate it is electronic archiving using the Microsoft Excel spreadsheet program[6]. AL-ALI and Al-Wattar (2021), presented a paper on the design and implementation of an electronic system to manage Theses of the College of Computer Science using the C# language and SQL Server databases to facilitate the higher administrative authorities to obtain the required results quickly and accurately[7].

5. The Importance Of Digital Systems

The rapid development in the fields of science and information technologies has affected the development of societies, and thus the need to use new digital technologies for the existing traditional systems has increased. The use of digital technologies, including databases for data storage and archiving, brings several advantages as it provides high reliability and flexibility, in addition to providing faster services to the beneficiary, keeping data secure from damage, and providing space for storage[8]. With the increasing volume of this data and the expansion of systems, digital transformation has become one of the necessities that cannot be ignored.

Information and communication technologies using computers and software have helped facilitate access to data and make the necessary modifications to it, to keep pace with developments at work. This encouraged organizations to keep pace with technical developments and shift towards digital systems by making the necessary changes to adapt to the new work environment and improve work efficiency to be more accurate and fast[9].

6. Digital Database System

Digital data in information technology refers to the database, which is a logically linked group of data elements. The way of data organization is the major goal of digital databases and this makes it not focus on special applications[10]. Any successful database application is bounded by a better design of the database to provide high performance and a high level of security[11]. The database is described as a collection of associated data that records facts. The applications package developed to deploy and drive a computerized database is called Data Base Management System (DBMS). A database system consists of both the database and the applications together [12]. A Relational Database Structure can be constructed by specifying the entities and relations that connect among entities involved in the database system. The entity is a subject that can be specified clearly in the environment of the system[13]. Furthermore, the entity has characteristics that explain it which are called attributes. The attribute value can be represented as a character string, number, date, sound, image, or other data types. Data types must be described for each attribute before starting. In Relational Databases, Data are stored in tables as rows and columns. Columns describe attributes and rows point to records[14].

SQL Server with a Structured Query Language is an execution engine, that performs the plan to retrieve the data from the physical storage and produces the output effectively. SQL Server creates and stores the databases, while the standard query language manipulates the data in databases using insert/update/delete and select statements[11].

7. Quality Rating Of Specialized Educational Laboratories

To improve the education process and raise the performance of scientific institutions, attention must be paid to quality standards, especially in educational laboratories. The laboratories have a significant impact on the level of student performance and the educational process as a whole[15]. For this, quality standards for a good laboratory are applied to achieve quality assurance of educational programs and to encourage legitimate competition between colleges. This leads to raising the level of the educational process, emphasizing the efficiency of educational outcomes, and increasing the community's confidence in educational institutions. Quality is one of the common terms in public life, but it is a vague term, as studies differ in finding a unified definition for it. Quality can be defined from the premise that the product or service provided conforms with the specifications set for it and that any shortcoming in specifications is an indication of inefficient performance. It is "the degree of excellence of something, often a high degree of it"[16]. Quality also means conformity with the needs of the beneficiary and then requires that errors do not occur and the prevention of making mistakes, not just discovering them, and then the standard of quality is free from defects[17].

Consequently, quality assurance is a method for raising the level of institutions' performance, ensuring that mistakes do not occur, and finding ways to prevent risks before they occur[17]. At present, there are positive trends to apply educational laboratory quality standards for colleges, and this is in line with the specifications set by the Ministry of Higher Education, providing all requirements, and providing human and material capabilities to achieve this. The Ministry of Higher Education / Quality Assurance and University Performance has prepared educational LQR forms to evaluate laboratories and raise the level of educational performance in colleges. These forms are circulated annually and the information is collected by the evaluation committees and the Quality Assurance Division in the faculties. LQR forms are based on international standards[3], and they include eleven indicators shown in Table 1.

Table 1. LQR form description

Ind.	Indicator	Description		Grade	Upper grade limit
1	Leadership and management	a. Laboratory Supervisor	Assistant Professor	3	
			Teacher	2	
			assistant teacher	1	
		b. Technical Officer	At least a technical diploma	2	15
		The number of employees working in the laboratory	more than 4	10	
			3	6	
			2	4	
2	Insurance For collective Protection systems	- Early warning system		3	
		- Ventilation system		3	9
		- Fire brigade according to the laboratory specialization		3	
3	Civil design for lab	- lab room		7	
		- Form preparation room		2	10
		- Administration room		1	
4	Program of training courses for laboratory personnel	- An internal auditor or chief auditor course.		Passing course certificate : 3marks	
		- A course in the requirements of quality documentation or quality manual.			
		- Specialized courses in laboratory specialization.			
		- A course in the international standard ISO (18915 and 17025).			15
		- A course in GLP or GCLP, according to the laboratory's specialization		Participation in the course certificate : 1mark	
5	Maintenance program for devices and equipment	- Unified coding program for laboratory equipment and materials.		5	
		- Regular maintenance program.		3	15
		- Calibration plan program.		3	
		- Employee training program		4	
6	Special titles For laboratories and declared documents	- There are titles for rooms and laboratories		2	
		- Definition of laboratory personnel and their specializations.		3	
		- Laboratory objectives.		3	10
		- The layout of the laboratory within the building and identifying emergency exits.		2	
7	Appreciation certificates and letters of thanks to laboratory workers throughout the evaluation year	- International Certificate of Appreciation		3	
		- Local Certificate of Appreciation		2	
		- letters of thanks.		1	5
8	Personal protective equipment and visual media	- Smartboard, display screen, or video conferencing (video chat)		4	
		- The business vest or business suit		2	
		- Paws and masks		2	10

		- Goggles or a mask	2	
9	Insurance for laboratory safety supplies.	- Guidance signs. - Warning signs. - Detergents and disinfectants. - First aid kit - Waste containers.	Two marks for each fulfilled condition	10
10	The number of students in the laboratory	- 25students. - More than 25 students.	7 3	10
11	Procedural modalities	- Procedures for implementing the procedural modalities prepared by our Ministry	3 marks for each method	15

8. Suggested Program

Based on the principle of converting from traditional systems to digital systems in educational institutions, and developing application research, an electronic LabQR program was proposed to manage the evaluation of educational laboratories, which is the first application program designed for this purpose. To build the proposed electronic program model, we followed the stages that are adopted in the transformation from traditional systems to digital systems (electronic programs), which is called the System Development Life Cycle (SDLC). SDLC is a conceptual model that includes rules and procedures for developing or changing old systems throughout their life cycles. SDLC is a systematic procedure that obviously breaks down the work into phases. These phases are required to implement either a new designed system or modify the old Information system. The following sub-paragraphs explain the SDLC for developing the LabQR program , and these phases are shown in Figure 1.

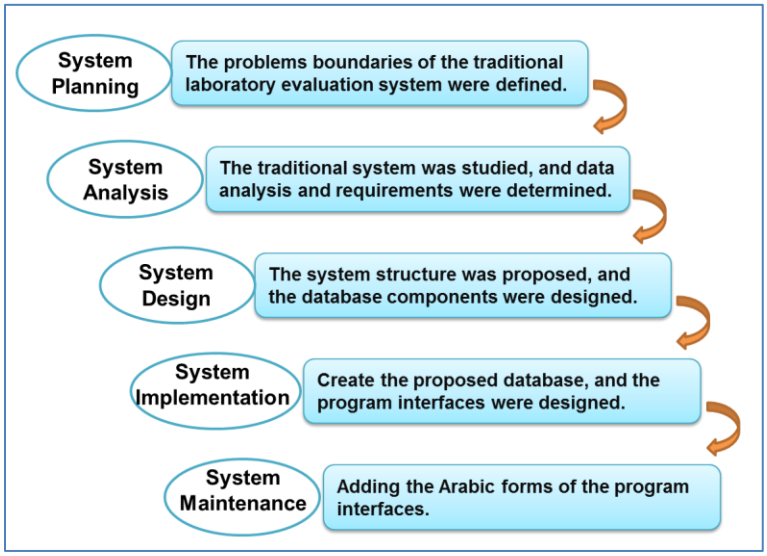


Figure 1. SDLC for developing the LabQR program

8.1 System Planning

At this phase, the boundaries of the problems of the traditional laboratory evaluation system were defined in terms of manual calculations of evaluation result values and maintaining paper copies of documents attached to each evaluation process. The goals required for the new digital system were also determined (programmatically performing calculations, electronic archiving, ease of inquiry, and issuing reports). This was followed by studying the possibility of switching to an electronic system in terms of building the database and determining the way the application program interacts with users (interfaces and methods of displaying results).

8.2 System Analysis

This phase defined the needs of the system and the needs of the system users (evaluation committee) were identified. In order to build the application program, the traditional system was studied, and data analysis and requirements were determined. In this step, the LQR forms proposed by the Ministry of Higher Education, and the Supervisory and Evaluation Authority, were collected, and the detailed information available in the guide attached to these forms was studied. The LQR

forms include eleven indicators, each of which includes several conditions, which were previously detailed in Table 1. To identify the needs of the program and know the mechanism of its use, we clarified that by drawing a diagram of the use case to analyze the data and identify the users of the program and the capabilities available to each of them, as shown in Figure 2. The user at the top level (System Admin) can perform all operations of the program, as he can control the database server and manage all operations related to the database. The user at the next level (Manager Level) has fewer powers than the previous level, depending on the position of responsibility he has. The user at the lower level (Employee level) has the authority to enter and retrieve data in searches and print reports only.

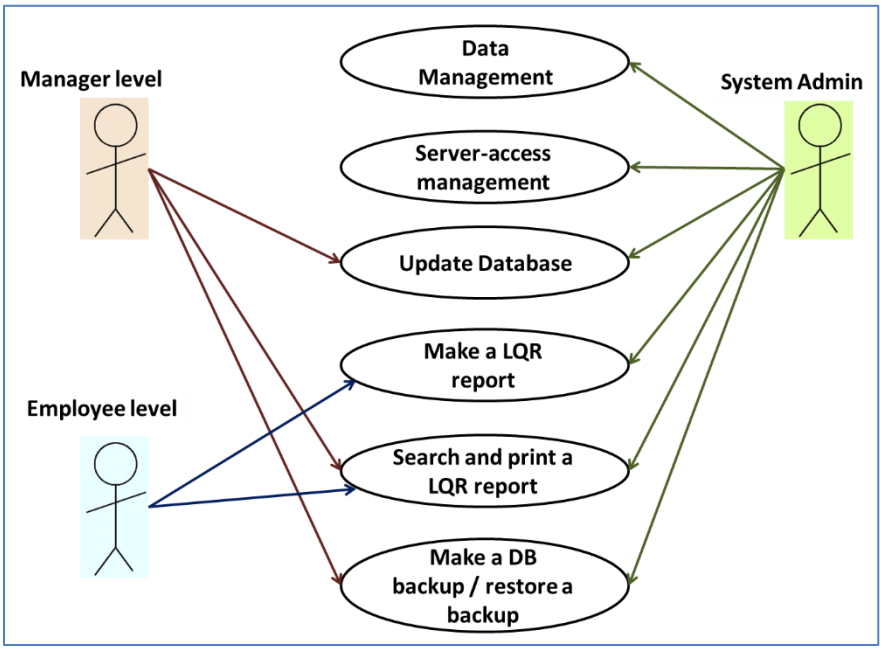


Figure 2. Program Use Case Diagram.

8.3 System Design

The system structure was proposed at this phase, the proposing based on the analysis of the requirements and objectives that were defined previously. The first step includes creating components of the database. This phase includes converting the previously mentioned information into database units (tables and relationships) and specifying the fields for each table and data type to build the proposed database for the program. A set of main tables has been suggested to store information about Laboratories, LQR forms, Departments, Colleges, and Universities. A set of secondary tables was also recommended that store default values for the conditions, indicators, and degrees related to each of them, for example, the laboratory official's degree (The first condition in the first indicator) in the Lab_supervisor table shown in Table 2. These values are used to compare with the user's entries to calculate the total marks of the final score of the quality ranking. If the user chooses Assistant Professor then three degrees are added to the value of the total mark, if chooses a teacher then two degrees are added to the value of the total mark, or if the user chooses an assistant teacher then only one degree is added.

Table 2. Lab_supervisor

The scientific title	Grade
Assistant Professor	**3**
Teacher	**2**
Assistant teacher	**1**

8.4 System Implementation

The SQL server database system was used to create the proposed database. Figure 3 shows the relationship of the database components to the program implementation steps. A set of queries was created to link the information in the tables to be used when performing searches and retrieving information.

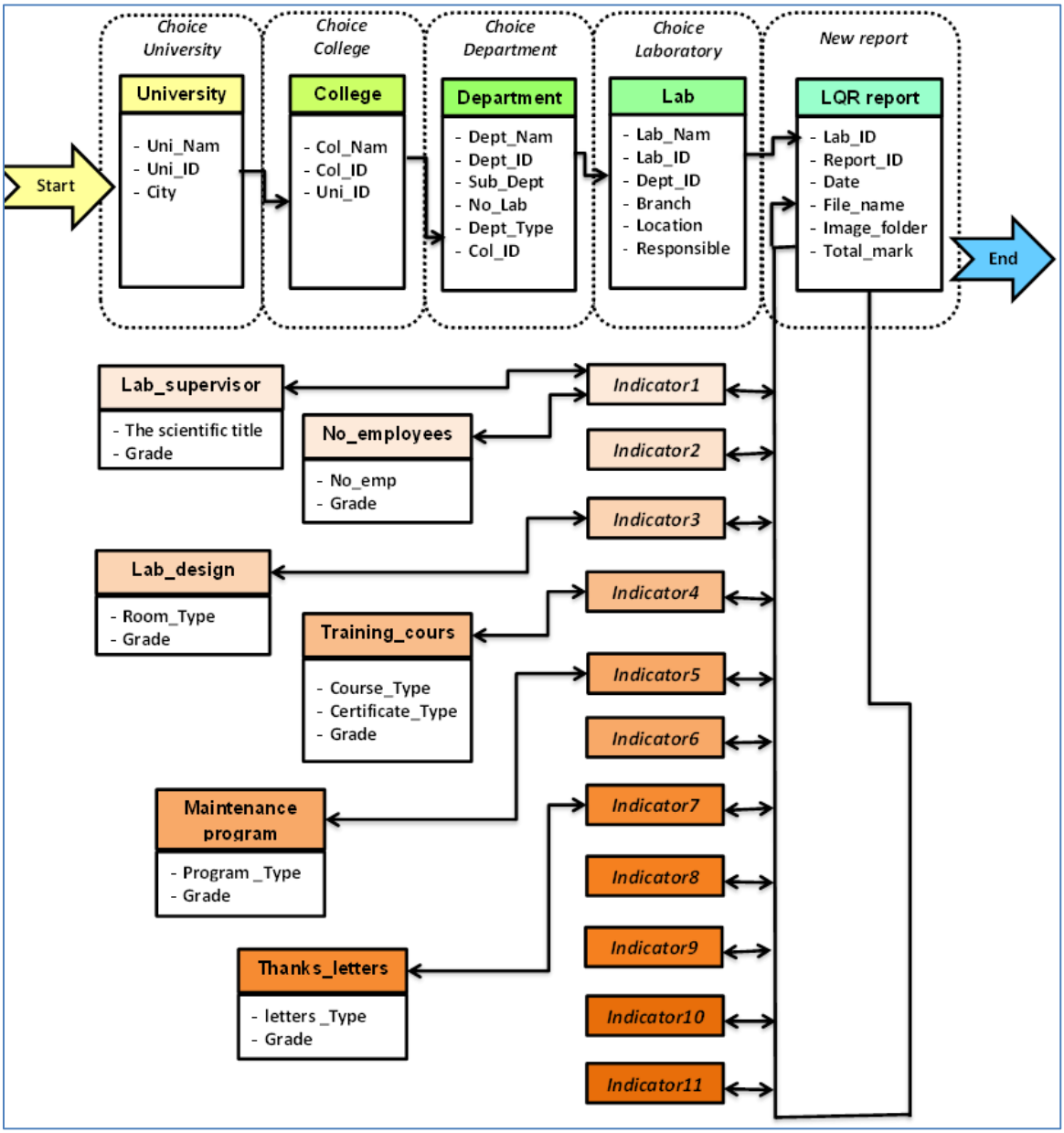


Figure 3. The relationship of the database components to the program implementation steps.

The program interfaces were designed to be a simplified way to interact with the user using C#, and Restore report2015 was used to build the reports of the program. The main interface options are activated after the login process, through which the options that will be active are determined according to the user level. Figure 4 shows the main interface which consists of a set of options, each one opens a sub-interface that performs a specific function. The sub-interfaces are described as flowing:

Figure 4. The main interface

- The Server connection setting: it is activated when the user login as the System admin. When opening this interface, the process of connecting to the SQL server is controlled, and the access method and settings for linking to the database are determined.
- The Data management interface: it is activated after the user login as System admin. This interface manipulates program settings, indicators, and scores for each indicator for future modification.
- Adding a University, Adding a College, and Adding a Department: All these interfaces are activated after login as System admin or Manager level. The user can expand the ability of the program to add a new university, a new college, and a new department or update the information of the database according to the future needs when using the program, Figure 5 shows the interface of Adding a University.
-

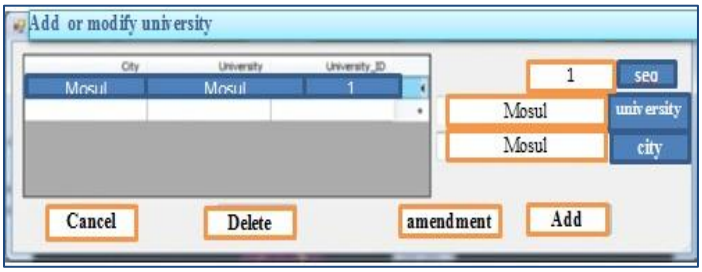


Figure 5. Adding a University

- The Creating Backup copy and Restoring saved copy interfaces: these interfaces are activated after login as System admin or Manager level. The Creating Backup copy interface makes a copy of the database and saves it in a secondary storage device for archiving usage. The restoring saved copy interface is used to restore the saved copies in the event of any problem with the current database or when there is a need to obtain previous years' reports. Figure 6 shows the Creating backup copy and Restoring saved copy interfaces.

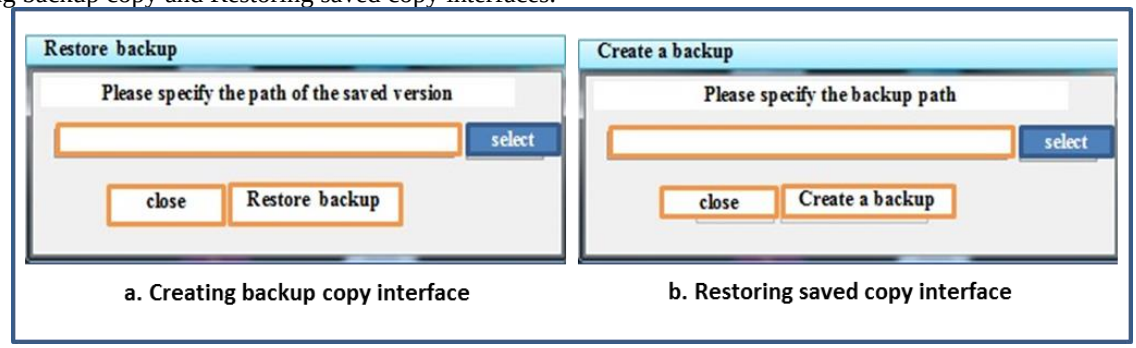


Figure 6. Creating backup copy and Restoring saved copy interfaces

- The new rank report interface: it is activated when the user login as Employee level or any up. The user makes a new LQR report for the relevant laboratory. The current time and date that appear at the top of the screen will be recorded in the assessment report. Figure 7 shows the indicator windows from 1 to 6, and Figure 8 shows the indicator windows from 7 to 11

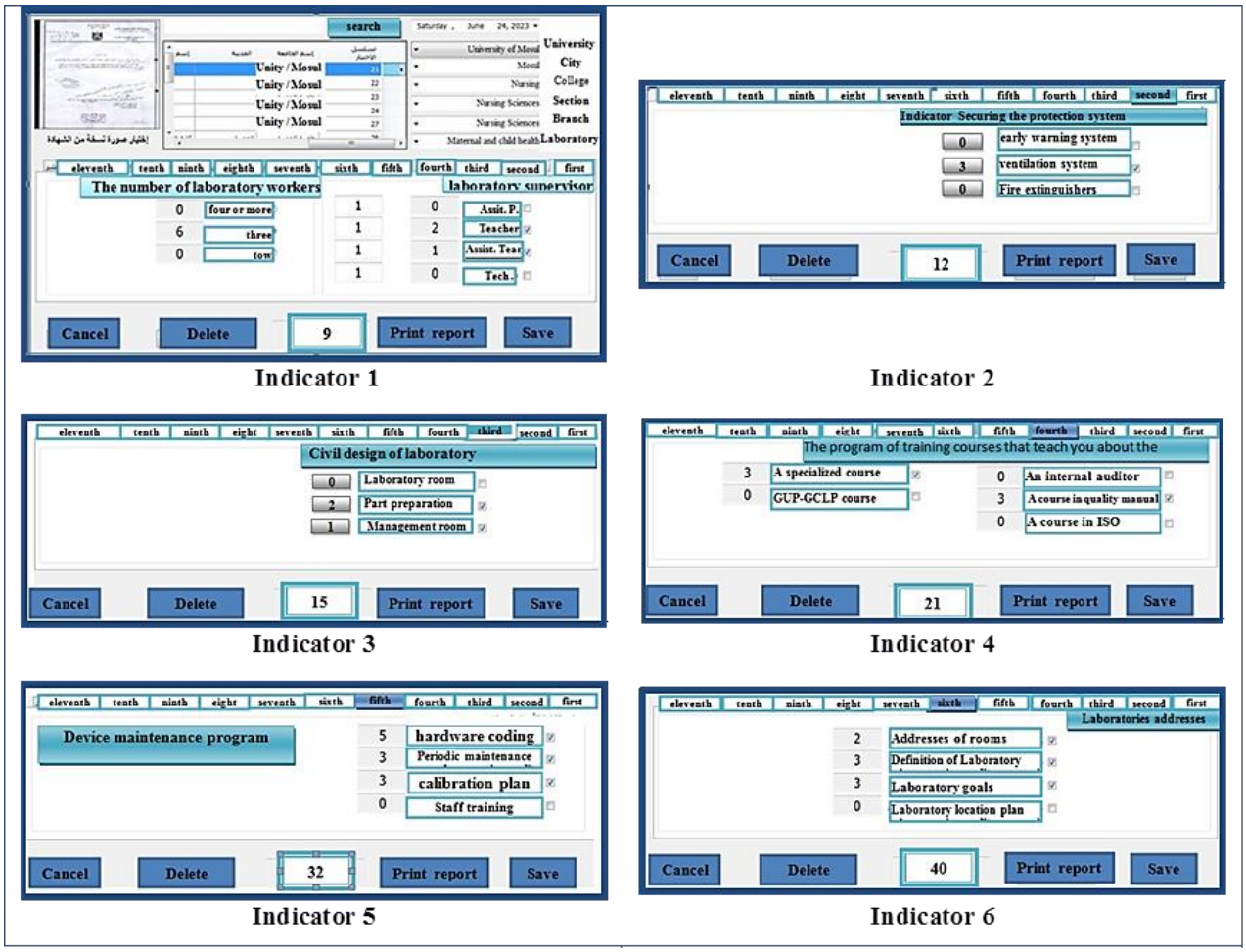


Figure 7. Indicator windows from 1 to 6.

To prepare the LQR report, the name of the University, College, and Department is determined, which is selected using lists that derive their data from the information that was previously entered in the database. Then select the laboratory from the database, or enter the name of the laboratory and its information if it is new. The principle of multiple tabs was used to facilitate the transition between indicators without the need to follow a fixed sequence. Each tab window represents the conditions of one indicator from the eleven indicators. To facilitate interaction with the user, the check box buttons were used to determine the presence or absence of a condition in the indicators for the choices whose values are aggregated. And the use of radio buttons in the values of conditions that require one selection from multiple. The final score of the quality ranking is shown all-time in the window when making an LQR report. The process of calculating grades and the final scores of all indicators is designed to be done automatically when each process of selecting conditions or adjusting any value within the eleven indicators. The grade values are collected from the database column correlated with each condition. Figure 9 explains the database tables used to calculate the final score. The program saves the result of the created LQR report in the database via the Save command.

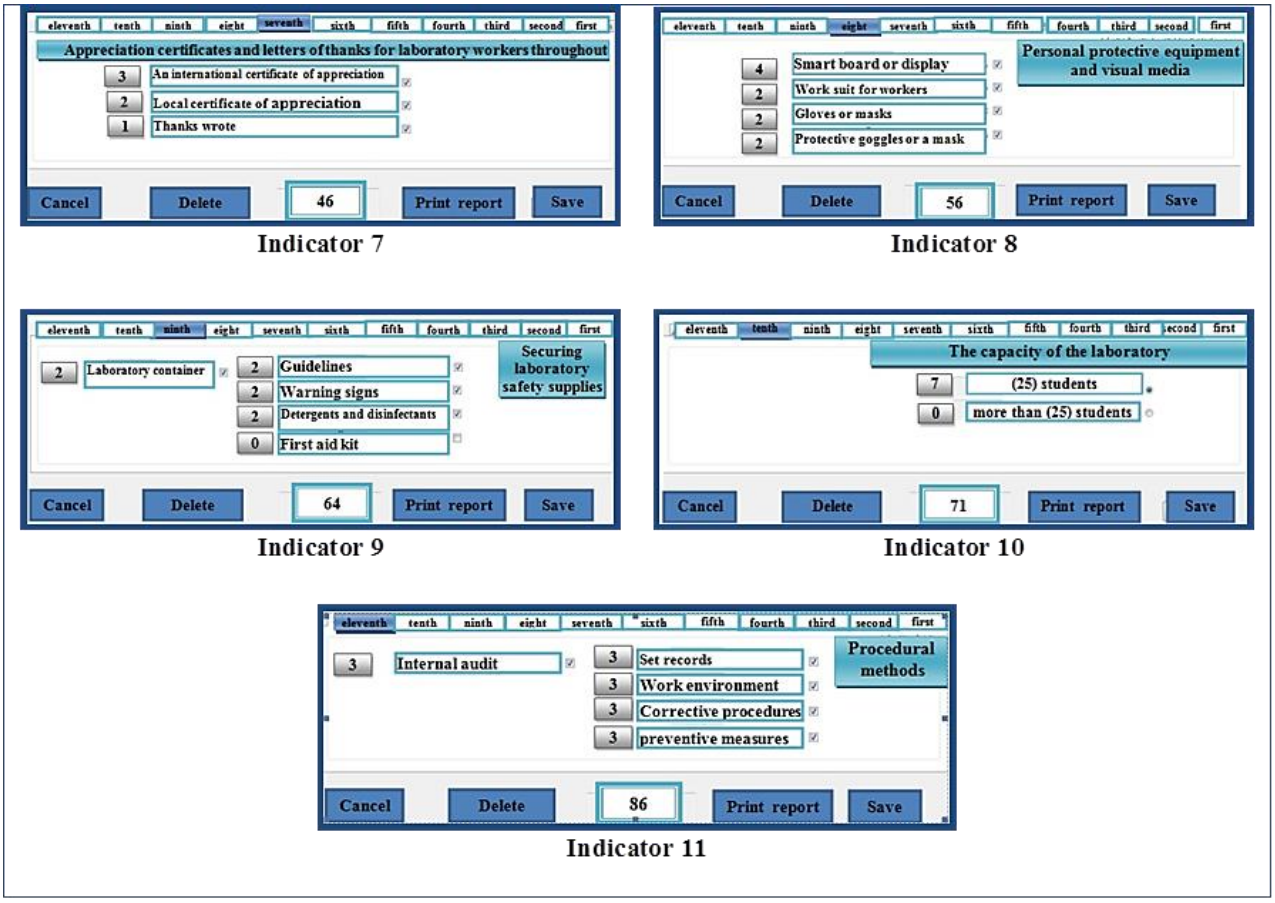


Figure 8. Indicator windows from 7 to 11.

Lab supervisor table

The scientific title	Grade
Assistant Professor	3
Teacher	2
Assistant teacher	1

Thanks letters table

Letters _Type	Grade
International Certificate of Appreciation	3
Local Certificate of Appreciation	2
letters of thanks.	1

No employees table

Number of employs	Grade
More than 4	10
3	6
2	4

Lab design table

Room Type	Grade
Lab. room	7
Form preparation room	2
Administration room	1

Training courses table

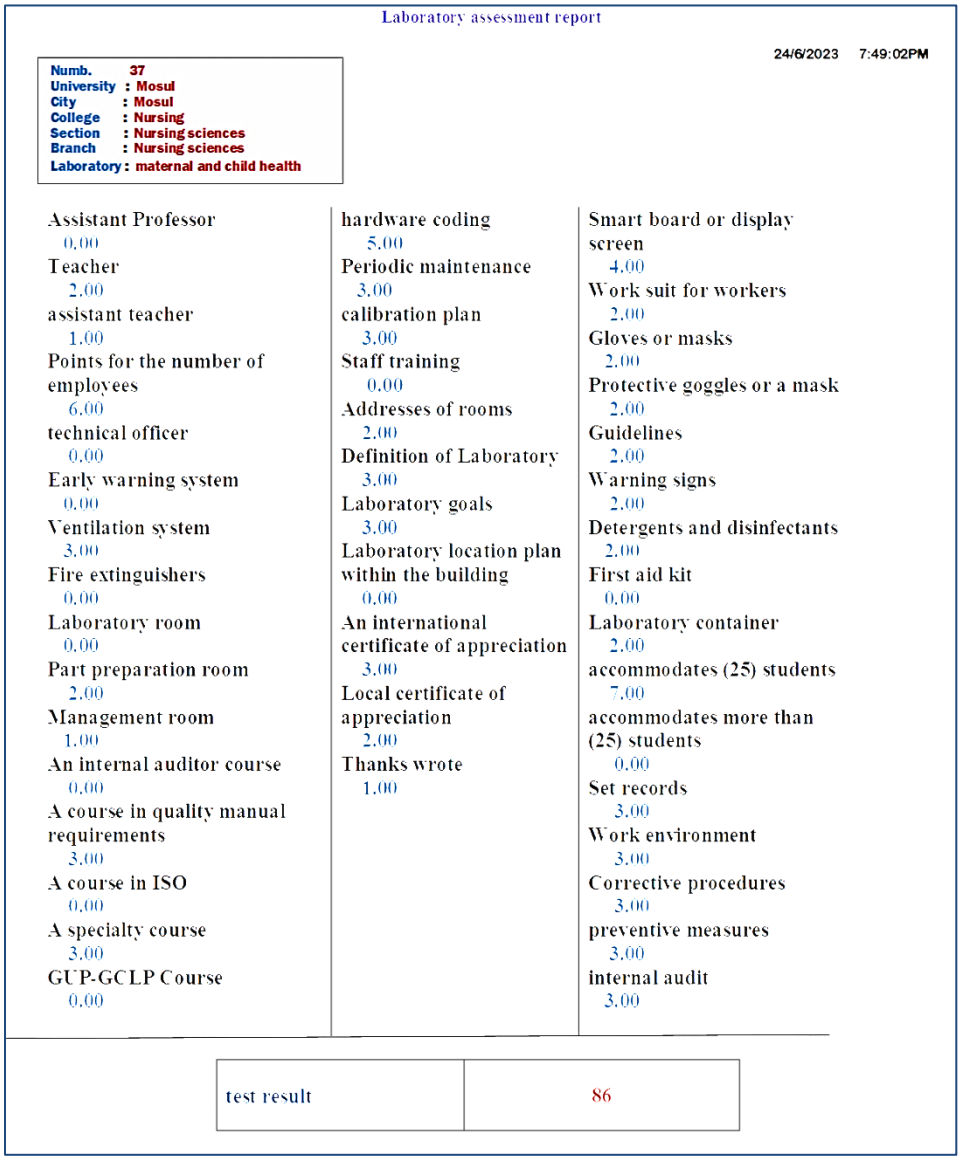
Course Type	Certificate Type	Grade
An internal auditor or chief auditor course	Passing course	3
	Participation in the course	1
A course in the requirements of quality documentation or quality manual	Passing course	3
	Participation in the course	1
Specialized courses in laboratory specialization	Passing course	3
	Participation in the course	1

Maintenance program table

Program _Type	Grade
Unified coding program for laboratory equipment and materials	5
Regular maintenance program	3
Calibration plan program	3
Employee training program	4

Figure 9. LabQR database tables

The LabQR program also provides the ability to search for the LQR report including the word search on any site of the report. All LQR reports that include the search word are retrieved in the form of a list. In addition, the LabQR program has the possibility of printing a specific report as shown in Figure 10.



Laboratory assessment report

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Numb. 37
University : Mosul
City : Mosul
College : Nursing
Section : Nursing sciences
Branch : Nursing sciences
Laboratory : maternal and child health

Assistant Professor 0,00	hardware coding 5,00	Smart board or display screen 4,00
Teacher 2,00	Periodic maintenance 3,00	Work suit for workers 2,00
assistant teacher 1,00	calibration plan 3,00	Gloves or masks 2,00
Points for the number of employees 6,00	Staff training 0,00	Protective goggles or a mask 2,00
technical officer 0,00	Addresses of rooms 2,00	Guidelines 2,00
Early warning system 0,00	Definition of Laboratory 3,00	Warning signs 2,00
Ventilation system 3,00	Laboratory goals 3,00	Detergents and disinfectants 2,00
Fire extinguishers 0,00	Laboratory location plan within the building 0,00	First aid kit 0,00
Laboratory room 0,00	An international certificate of appreciation 3,00	Laboratory container 2,00
Part preparation room 2,00	Local certificate of appreciation 2,00	accommodates (25) students 7,00
Management room 1,00	Thanks wrote 1,00	accommodates more than (25) students 0,00
An internal auditor course 0,00		Set records 3,00
A course in quality manual requirements 3,00		Work environment 3,00
A course in ISO 0,00		Corrective procedures 3,00
A specialty course 3,00		preventive measures 3,00
GUP-GCLP Course 0,00		internal audit 3,00

test result	86

Figure 10. The LabQR report.

8.5 Test and Maintenance

In order to test LabQR program, the information available to the laboratory (employees and possessions) is first entered sequentially, and the total evaluation values increase automatically with each indicator entry process until the eleventh indicator interface is reached. The final result of the evaluation is displayed in the test result report. Failure to meet any part of the required conditions in the indicators shown in Table 1 leads to a decrease in the laboratory's final evaluation score, as explained previously. The program results were tested on information collected from saved laboratory evaluation information (paper evaluation information) in the form of paper archives. The program results were selected for 20 scientific laboratories. The results of the program were compared against the results recorded previously through paper evaluation, and the results were as shown in Table 3, where the first column represents the identification of a laboratory, the second column and the third column represent the test results of evaluation score and the percentage of evaluation score resulting from the program respectively, while the last column represents the percentage of the laboratory evaluation through the stored paper evaluation.

Table 3. LabQR test results

Lab. Id	Test result	Result percentage	Stored percentage
B202	86	71.07%	71%
B201	116	95.87%	95.5%
B213	115	95.04%	95%
B303	111	91.74%	92%
B305	86	71.07%	71%
C102	108	89.26%	90%
C105	88	72.73%	72.5%
C106	103	85.12%	85%
C107	106	87.60%	87.5%
PH203	111	91.74%	90.5%
PH204	96	79.34%	80%
PH205	73	60.33%	60.5%
B2A	115	95.04%	95%
B3A	78	64.46%	65%
H5A	91	75.21%	75.5%
H6A	106	87.60%	87.5%
H6B	103	85.12%	85%
2A	112	92.56%	93%
3A	82	67.77%	68%
4A	58	47.93%	48%

From Table 3, it is noted that the values of the program results and the stored paper results are very close and that the program gives results with higher accuracy, while manual calculations use rounding and neglecting decimal values most of the time.

The LabQR program was presented to a group of 50 individuals working in scientific laboratory evaluation and testing. A test was conducted to measure the program's performance by members of the previous group. The test consists of four criteria: speed, comprehensiveness, interactivity, and accuracy. Each criterion was given a test grade between 1 to 99. For ease of displaying the results, the values were itemized into intervals with 10 grades. Table 4 shows the test results (values from 1 to 59 were canceled due to the absence of any grades for them). The first column in the table represents the criterion grade out of 100, while the values in the rest columns represent the number from the 50th of individuals who gave those scores for each criterion.

Table 4. Testing LabQR program

Score %	Speed	Comprehensiveness	Interactivity	Accuracy
90	46	36	41	43
80	2	5	4	6
70	1	4	1	0
60	1	5	4	1

Through the information in Table 4, it is possible to calculate the average rating for each of the four criteria, which is equal to the total sum of (the test grade multiplied by the number of individuals who gave that grade) and divide the result by 50. Thus, we obtain four results, each of which represents the average test grade for one of the criteria, as shown in Figure 11.

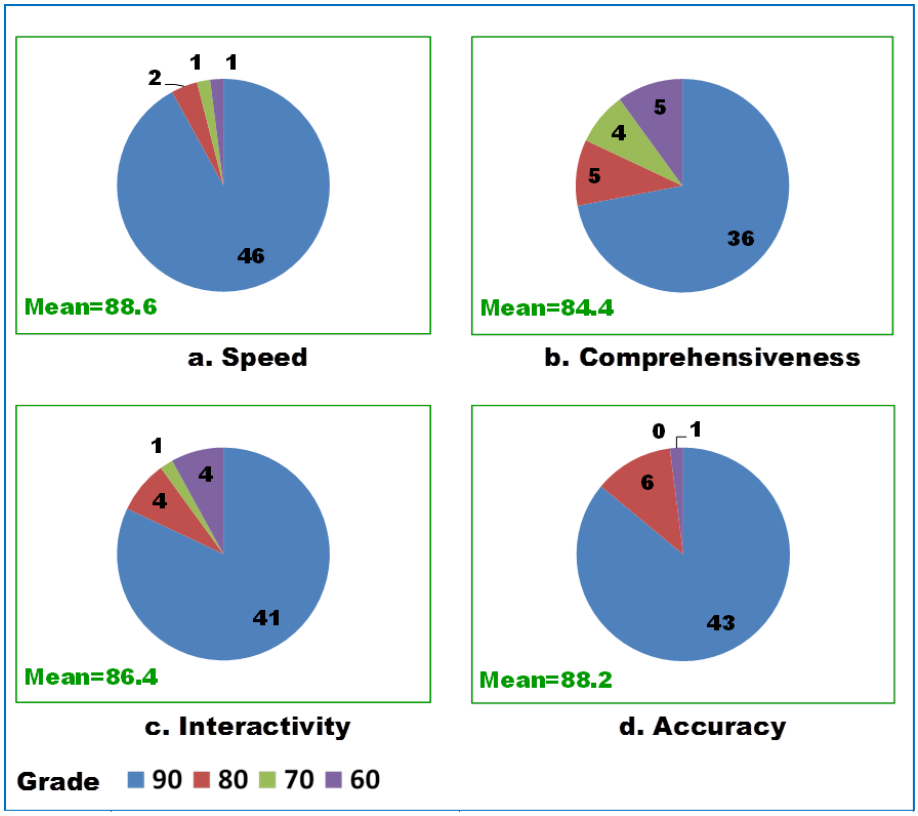

Figure 11. LabQR evaluation means

After the program operates, the maintenance operation add Arabic language form in user interfaces in addition to English, because it was implemented in Arabic university by Arabic employees to make it easy to use.Figure 12 shows the main interface in Arabic form.

Figure 12. LabQR Arabic main interface

9. Conclusions

There is no doubt that the digital transformation of institutions has a significant impact on overall performance results in terms of speed and ease of performance. Digital transformation is extremely necessary when the required operations are carried out periodically and at the same time, many paper output files are produced. This requires permanent storage locations (drawers and shelves) that are immune from damage that may affect paper files. On the other hand, the review and research process is very difficult or sometimes not possible. In order to solve such problems, the LabQR program was designed in a practical way that facilitates the process of entering LQR data within the requirements set by the Ministry in the

eleven indicators required to evaluate specialized scientific laboratories. The program achieves the ability to work over the network because it relies on the SQL Server database, which can be accessed over the network when connecting to the server. The program also made it possible to make a backup copy of the database, which is an annual archive that can be retrieved when needed later.

The LabQR program provides an interactive environment for the user through easy navigation between the program windows and the use of drop-down menus and test buttons to enter user data. The program's capabilities for dealing with images accompanying the evaluation process facilitated verification and review processes by evaluation committees, in addition to saving electronic copies of the files of those images within the database in the relevant fields. Also, the program provides the possibility of expansion and non-restriction, as there is the possibility of adding new departments, colleges, and universities. This is done through the interfaces of adding a university, adding a college, and adding a department. Another possibility of the LabQR program is to provide modification of the score values given to each condition in the indicators through the use of The Data management interface, thus providing high flexibility to deal with expected updates to the LQR models.

Considering the results obtained from implementing the program, future improvements can be considered. The first improvement is adding conditions for evaluating other types of laboratories, such as language laboratories and computer laboratories. On the other hand, work can be done to transform the evaluation process of colleges and universities from a manual system to an electronic system.

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11. References

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تطبيق برنامج الكتروني لإدارة تصنيف جودة المختبرات التعليمية في جامعة الموصل

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المستخلص

تعتبر المختبرات جزءاً أساسياً من العملية التعليمية في كليات الجامعة وذلك لأهميتها في إيصال المادة العلمية والتطبيقية للطلبة. هناك أهمية كبيرة لتوافر شروط السلامة والموظفين المهنيين والقدرات الفنية وغيرها من متطلبات المختبر التعليمي. ونظراً لأهمية الجودة في المختبرات التعليمية يجب اجراء تقييم دوري لها. يجب أن تكون معلومات التقييم سليمة ومتوفرة عند الحاجة. هدف البحث هو إنشاء برنامج إلكتروني لتصنيف جودة المختبرات (LabQR) يحاكي عملية التقييم الورقي. البرنامج يقوم بتحويل كافة المستندات إلى توثيق إلكتروني واستخراج الدرجة النهائية للشروط المطلوبة. كما يتم حفظ جميع المستندات المرفقة في قواعد البيانات الإلكترونية مثل شهادات الدورات للموظفين والأوامر الإدارية. يوفر البرنامج ايضا سهولة البحث والاسترجاع والأرشفة. تم مراعاة خصائص التوسعة والمرونة في البرنامج بإضافة كليات وأقسام وجامعات أخرى .