Developing a Computerized Quality Control Management Information System in Higher Education

Conference Paper · April 2010

Dr. Saad Talib Hasson Aljebori
University of Babylon

Developing a Computerized Quality Control Management Information System in Higher Education

Dr. saad Talib Hasson (Assist . Prof.) ***Nada Jasim (MSc. student)***
Computer Science Department – College of Science- University of Babylon.

Abstract

This study discusses Quality Control Management Information System (QCMIS) to assist organizations in decisions regarding Quality control and its corrective process. Management Information System (MIS) is basically concerned with the process of collecting, processing, storing and transmitting relevant information to support the management operations in any organizations and provides the required right information for the feasible possible decisions. The study used (MIS) in decision-making to review and analyses of long term planning and short-term planning in the Iraqi Universities. Data collected were analyzed using statistical quality control (SQL) techniques. The computer system is used Quality Control Tools for continuous improvement. It includes three modules (Oracle Database, Quality Control Charts and analyses Reports).

Introduction

Information systems play a main role in improving quality management. It can be used to collect data about quality measures. If quality measures come directly from the tested units (production machines), there can be an overwhelming amount of data. In other cases, quality measures might be collected electronically from suppliers. Collecting data seems like an obvious idea, but the huge amount of data complicates the process. In many cases, manufacturers have trouble identifying the original source when a component fails. Failure data can be used by the supplier to pinpoint the source of problems. Since 1992, nations in the European Union (EU) have been requiring firms to improve quality by complying with the statements in the ISO 9000 (International Organization of Standards) directive. ISO 9000 requires companies to measure quality at all stages of the production, and the education process seems like a production process to produce educated students and researches as products. Any firm that wishes to sell products or parts to firms in EU must build an information system to monitor quality and provides information to customers. [Gerald & David, 2003]. Statistical process Control (SPC) is an important tool for improving quality.

Management Information System (MIS)

MIS- is a part of information system and it means the development and use of information systems that help businesses to achieve their goals and objectives. This definition has three key elements: development and use, information system, and business goals and objectives. [Kroenke, 2007]

Information Systems components

An information system is an organized combination of people, hardware, software, communications, and data resources that collects, transforms, with certain procedures and disseminates information in an organization, [O'Brien, 1996].

Organizations develop and use information systems to gain competitive advantage, to solve problems, and to assist in decision making. Some information systems accomplish two or more of these goals. [Kroenke, 2007]

Database Management System

Database Management System (DBMS) are one of the most important tools in business and Management Information System (MIS). They have changed the way that computer applications are developed, and they are changing the way that companies are managed. The Database approach begins with the premise that the most important aspect of the computer system is the data that it stores. The purposes of a Database Management System is to provide shared access to the data, answer questions, and create reports from the data, [Gerald & David, 2003]

Quality

The word Quality has different means, the most important are:

- Those features of products which meet customer needs and thereby provide customer satisfaction. In this sense, the meaning of quality is oriented to income. The purpose of such higher quality is to provide greater customer satisfaction and to increase income. However, providing more and/or better quality features usually requires an investment and hence usually involves increases in costs.
- It may means freedom from deficiencies-freedom from errors that require doing work over again (rework) or that result in field failures, customer dissatisfaction, customer claims, and so on. In this sense, the meaning of quality is oriented to costs, [Juran,1999] .

Quality control

Quality Control (QC) refers to the use of specification, tolerances and inspection of completed parts, subassemblies, and products to design, and improve the quality of the product or service. Quality Assurance (QA) is defined as the overall program that ensures that the final results reported are correct, [Summers, 2006]. The aim of quality control is simply to ensure that the results generated by the test are correct.

Control Charts

Control chart is a chart with upper and lower limits on which values of some statistical measure for samples or subgroups are plotted. To continue reduce the variation, control charts should be used to help search for and to eliminate variation. [Ronnestrand, 2009]

Types of control charts

- Control Charts for Variables

For $\overline{X}$ charts:	$UCL = \overline{\overline{X}} + A_2\overline{R}$ $LCL = \overline{\overline{X}} - A_2\overline{R}$	*Where $\overline{\overline{X}}$ is average of sample averages & $\overline{R}$ is average of ranges*
For R charts:	$UCL = D_4\overline{R}$ $LCL = D_3\overline{R}$	*Where D_3, D_4 and A_2 are constants*

1. **X-Bar Chart** (x -Chart): uses average of a sample. The X-bar chart monitors the process location over time, based on the average of a series of observations, called a subgroup.

2. **Range chart** (R-Chart): uses amount of dispersion in a sample. The Range chart monitors the variation between observations in the subgroup over time.

3. **Standard deviation chart** (S or δ): A statistic that measures the amount of data dispersion around the mean.

σ = standard deviation of a sample
$\overline{x}$ = the mean
x_i = observation i, $i = 1, \ldots, n$
n = the number of observations in the sample

S chart: Takes into account the standard deviation of a subgroup. The equations for computing control limits are:

Center line= $\overline{S}$, LCL= $B_3\overline{S}$, UCL= $B_4\overline{S}$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}}$$

Where $\overline{s}$ is the average standard deviation σ

B3 & B_4 are constants (calculated from tables, depending on each sample size)

- Control Charts for Attributes: which depends on the qualitative approach in controlling the product attributes ….. Such as; P chart and C chart.

Quality assurance in higher education

The philosophy of **quality assurance (QA)** is derived from industrial and commercial practice. To achieve the quality objectives, the highest level of management should establish a quality system with a structure for effective control, evaluation and improvement of service quality. [Zbigniew, 1997]

The basic purpose of quality education is to improve students' learning and their experiences in higher education. This can be achieved through:

• changing the method of teaching and learning as well as assessment methods
• renewing the curriculum continually
• updating and upgrading professional knowledge and skills, and
• improving the broader educational, administrative, and resource environments in which teaching and learning take place. [Salahuddin M., 2009]

The QA technique should be used to predict, monitor and verify efficiency of any investments or enhancements into educational processes. [Zbigniew, 1997]

The aim of the quality assurance in higher education is to guarantee the improvement of standards and quality in higher education in order to make higher education meet the needs of students, employers and financiers. [Lomas, 2002]

Research problem & objectives

This research aims to develop software for control chart and histogram analysis that designed specifically to previously mentioned process by using Visual Basic and Oracle Database. This software helps users to construct and analyze control chart and calculate process capability. The software also provide warning if the process is out of control. The question is about the quality of outcome in term of academic standard of student:

What is the quality and excellence level of our educational system?

In this study, we tries to present the status of quality and excellence with the help of conceptual framework developed by using Quality Control Management Information System (QCMIS) to quantify the quality and excellence of the universities and colleges in higher education.

Proposed system

QCMIS model: In (figure 1) shows the designed system of quality management information system (QCMIS).Control chart is one of the seven tools of Quality control.

There is significant potential for error in long education process that consist of sequential stages, each of which is heavily dependent on the previous stage; Quality control procedures are required in order to monitor this process and to reduce the number of mistakes to a minimum.

A process is considered out of control if a point falls outside the control limits or a series of points exhibit an unnatural pattern (also known as nonrandom variation). Analysis of unnatural patterns is an important aspect of control charting. These unnatural patterns provide valuable information regarding potentialities for process improvement. Figure 2 displays examples of the types of unnatural pattern. The typical unnatural patterns on control charts are defined as follows.

1. **Trends**. A trend can be defined as a continuous movement in one direction (either upward or downward).
2. **Sudden shifts**. A shift may be defined as a sudden or abrupt change in the average of the process.
3. **Systematic variation**. One of the characteristics of a natural pattern is that the point-to-point fluctuations are unsystematic or unpredictable. In systematic variations a low point is always followed by a high one or vice versa.
4. **Cycles**. Cyclic behavior of the process mean can be recognized by a series of high portions or peaks interspersed with low portions or troughs.

5. **Mixtures**. In a mixture the points tend to fall near the high and low edge of the pattern with an absence of normal fluctuations near the middle. A mixture is actually a combination of data from separate distributions. [Ping & Sheng, 2009]

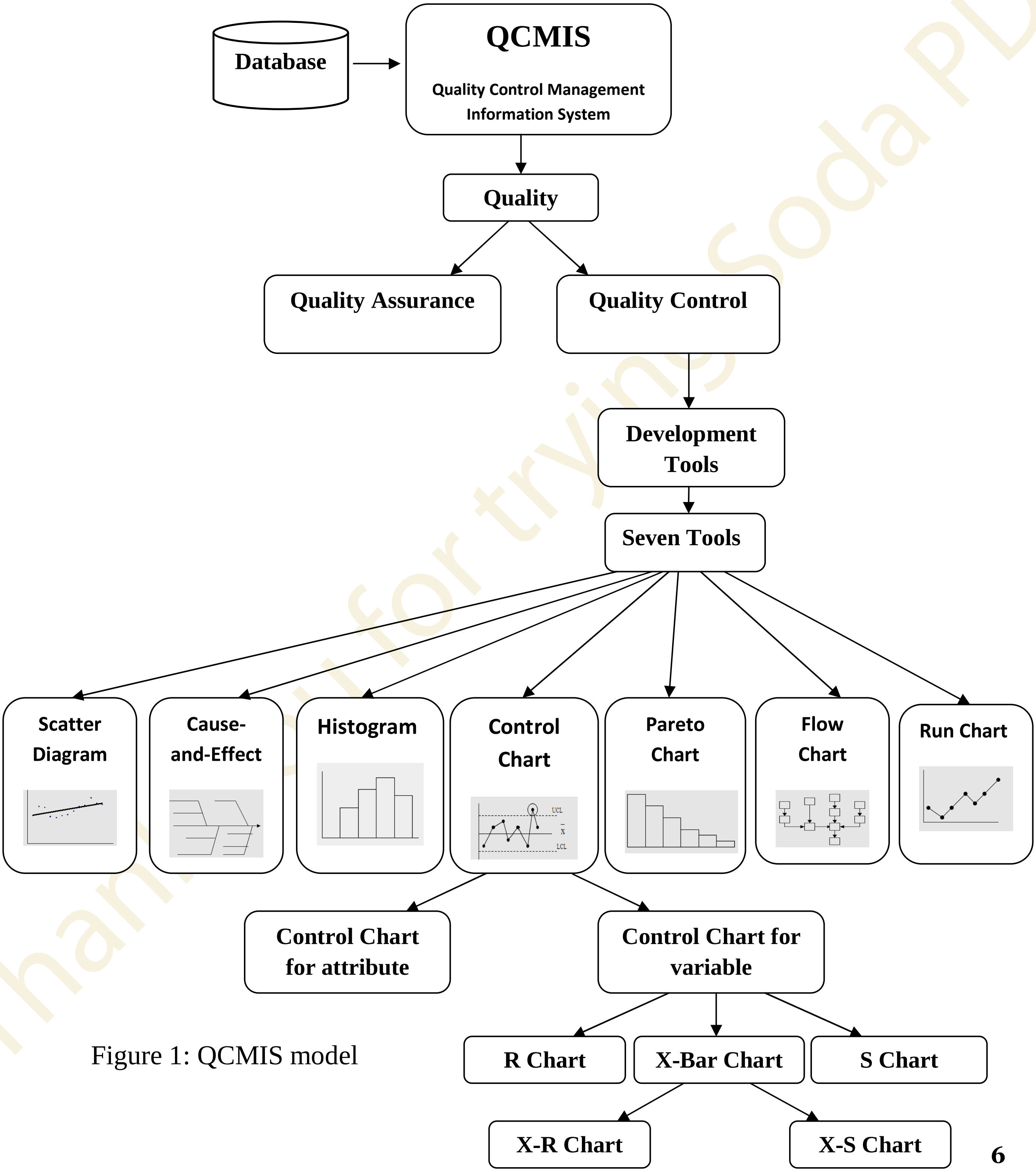

Figure 1: QCMIS model

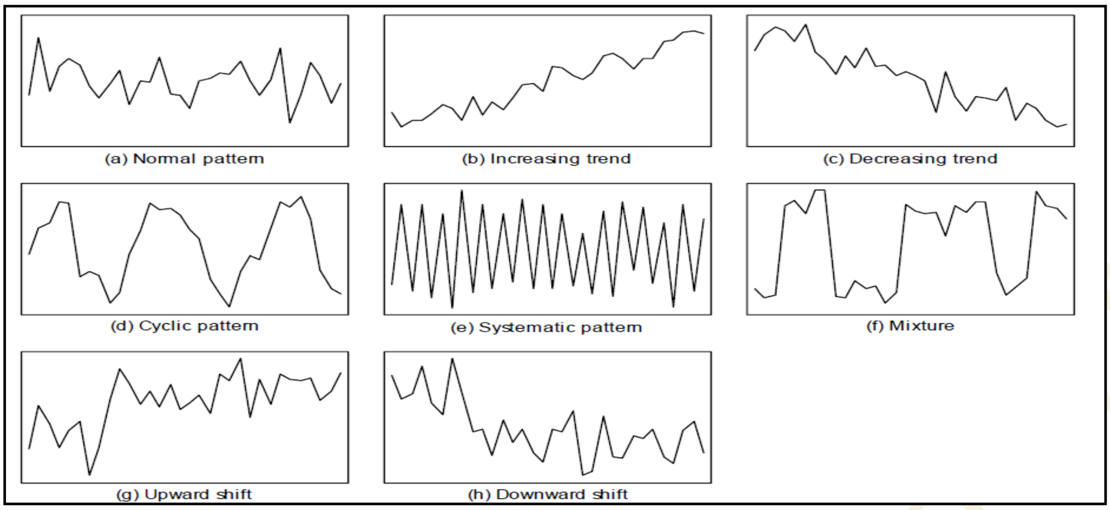

Figure 2: examples of control charts

Rule of Seven Tests

These tests are often taught initially to employees as the method for interpreting control charts (along with points beyond the limits). The tests state that an out of control situation is present if one of the following conditions is true: 1) Seven points in a row above the average, 2) Seven points in a row below the average, 3) Seven points in a row trending up, or 4) Seven points in a row trending down. These four conditions are shown in the figure 3.

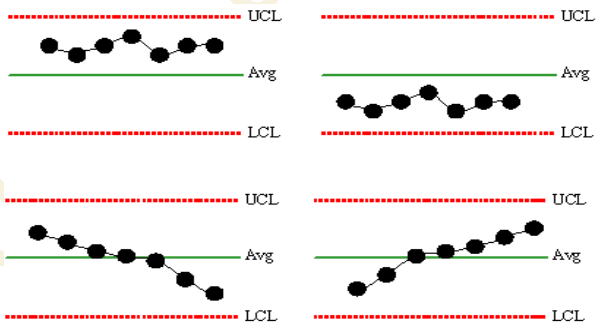

Figure 3: Rule of Seven Tests

Implementation of the proposed system is used raw Students data of departments of Babylon University. The data entered into database management information system (DBMIS) through Oracle Database as tables. The system draws control charts for the entered data to classify a set of patterns collected from education process. Three characteristics of a process that is in control are:

- Most points are near the average
- A few points are near the control limits
- No points are beyond the control limits

If a control chart does not look similar to the one above, there is probably a special cause present.

System Requirements

The database. The structure of the database should be completely clear to the end-user. The system should be capable of storing simultaneously separately, all data and information introduced into database.

Data Input. It should be possible to input data in two different ways-automatically or manually for automatic transmission into the database, no user intervention is necessary.

Report graph output. The output generator will consist of two parts: a configuration and an interpreter. The former provides the user with output reports and graphs, through screen instructions and menus, while the latter generates the desired output. Reports, tables, figures, graphs etc. should be obtainable on a regular basis or by simply demand. The graphical reports most likely include control charts (mean range and, standard deviation) and other control charts like line chart, bar chart and area chart.

Methodology of QCMIS

Figure 4 is the flow chart of SPC of QCMIS software first; users input data into Oracle database automatically or manually from excel or access tables. Then, this data will be retrieved from the database.

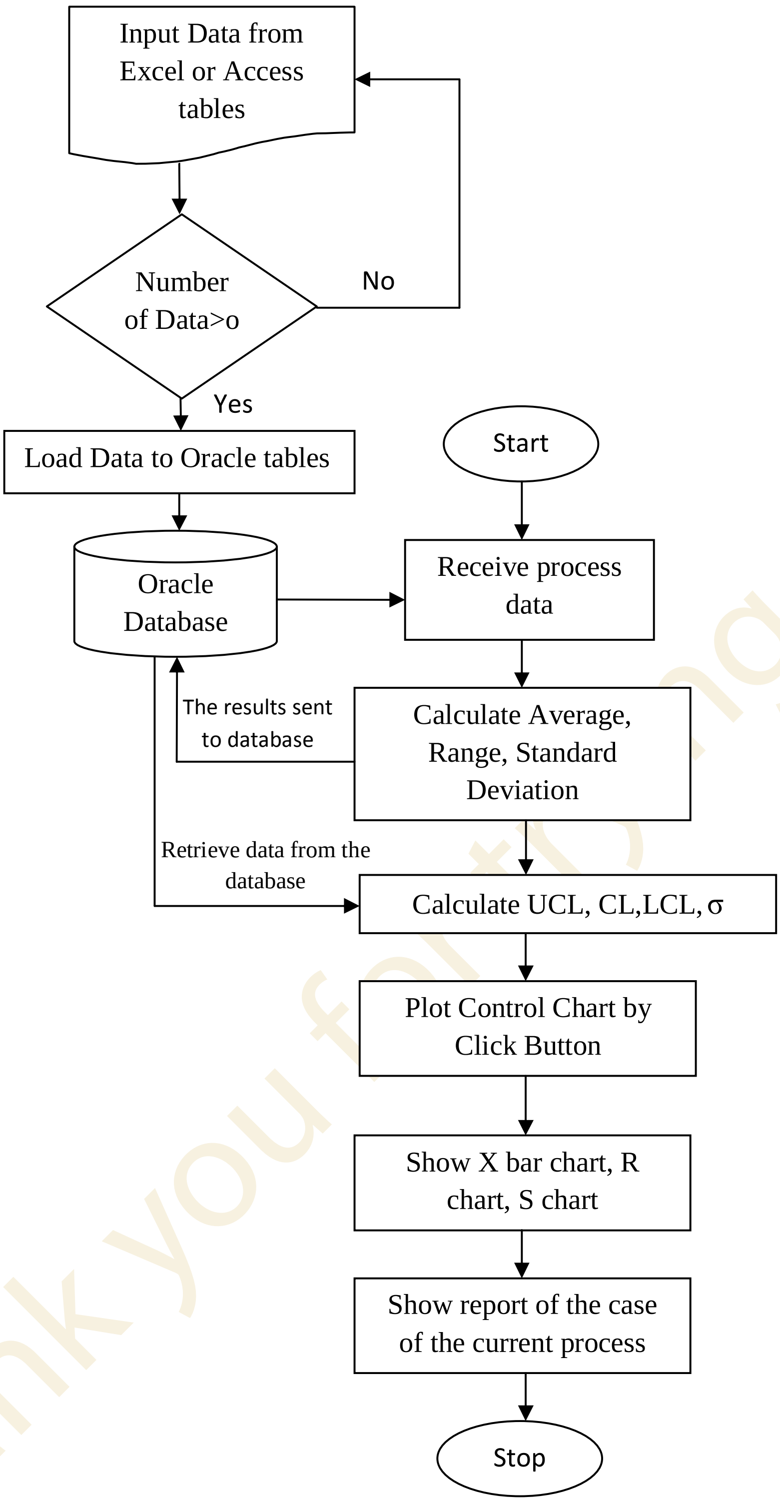

Figure 4: Flow chart of control chart software

The results

In (figure 5) shows user interface which appears the colleges of Babylon University, this system is appropriate for any university in higher education to test its quality and quality assurance.

Figure 5: User interface: Colleges of Babylon University

When user selects one stage, the system will execute another user interface which involves database of student's data and updating buttons (see figures 6, 7)

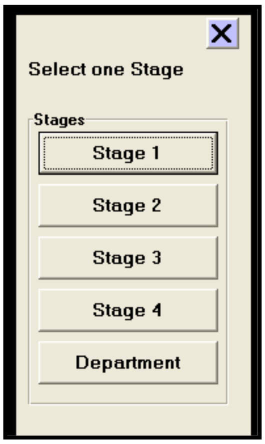

Figure 6: stages of computer's science buttons

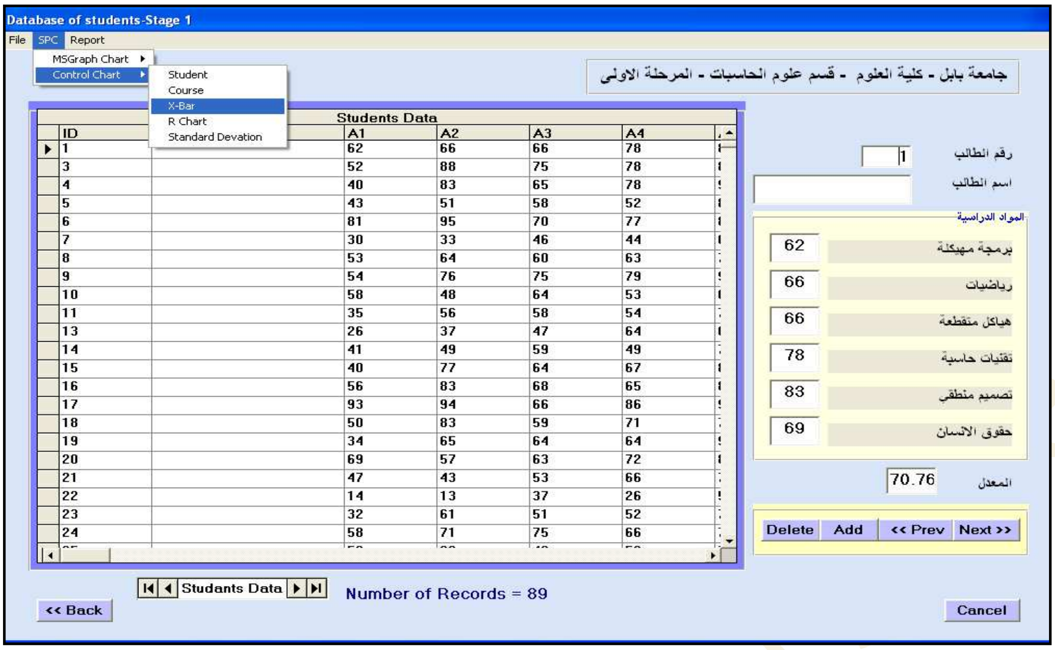

Figure 7: Management Information System for a stage

Figures (8-10) show examples of control charts types of one stage, above each figure shows the results of that figure.

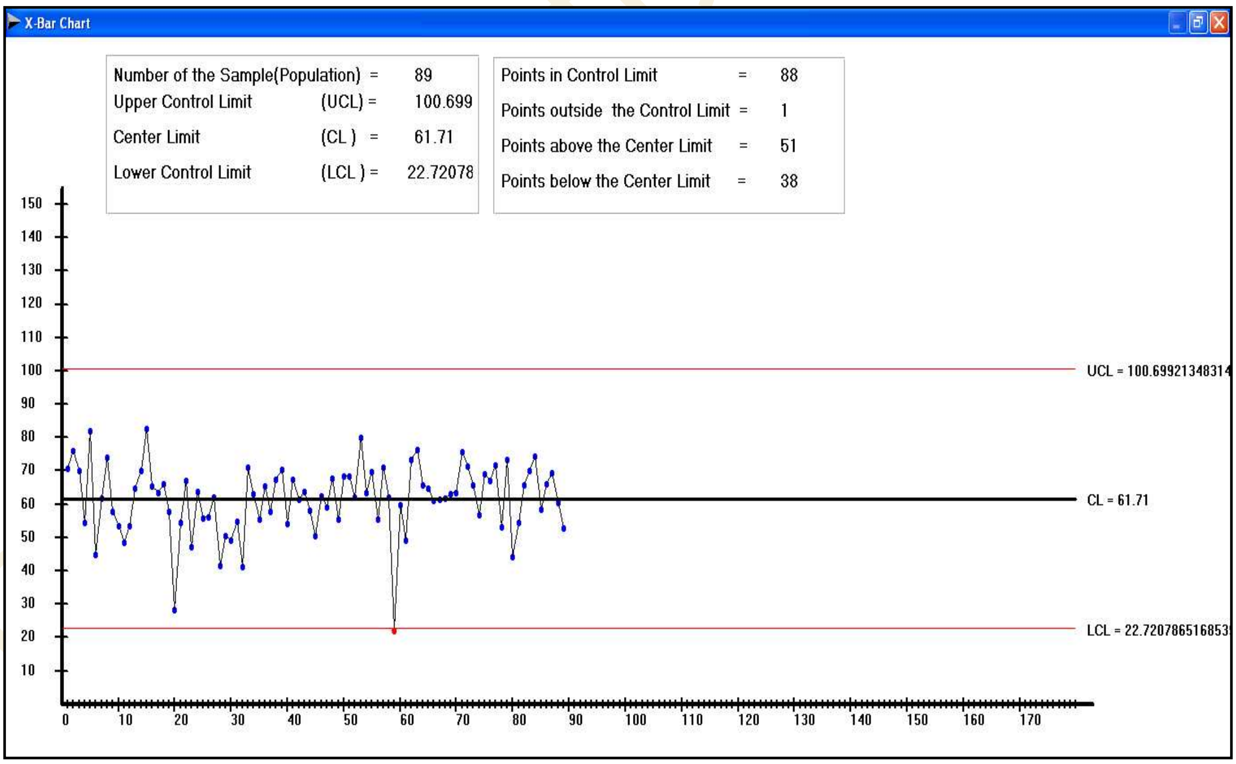

Figure 8: X-bar chart

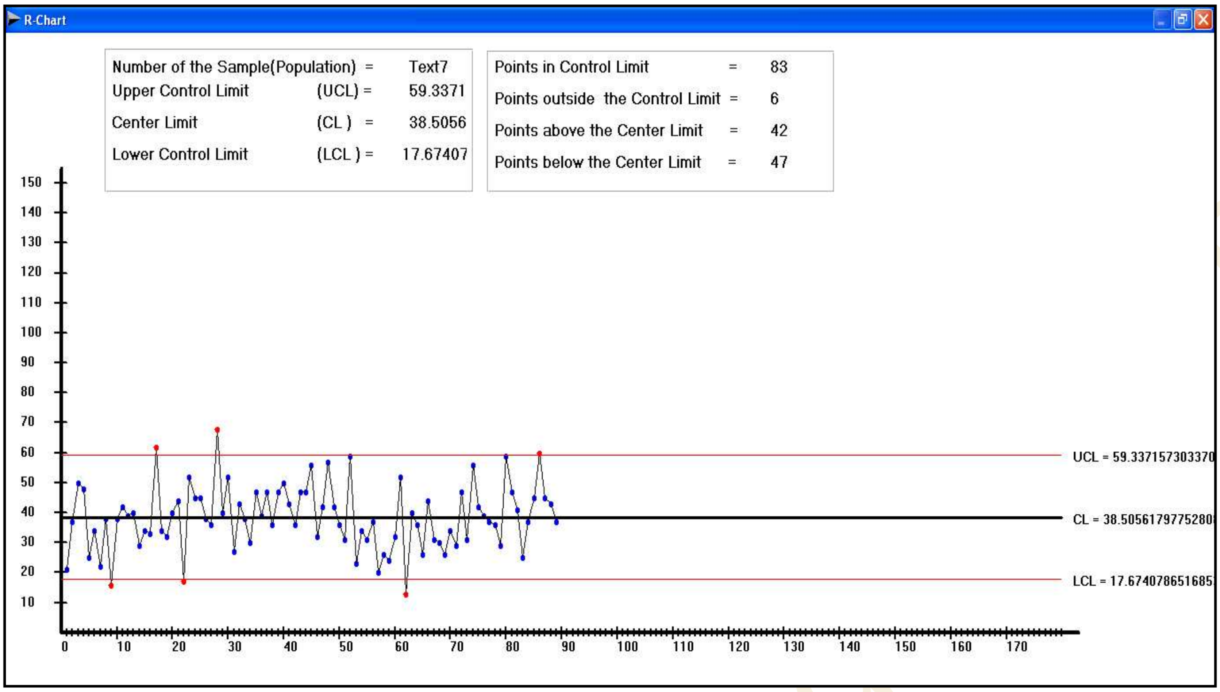

Figure 9: R- chart

Interpretation of Control Charts: In (figure 7) shows the management information system of student's data, one point out of control limit in X-bar chart and existing unnatural process, there is downward shift and mixture in process ,the number of points above center line is 51 and the number of points below center line is 38. A natural process must be normal process (number of points above center line equal number of points below center line). (See figure 8).

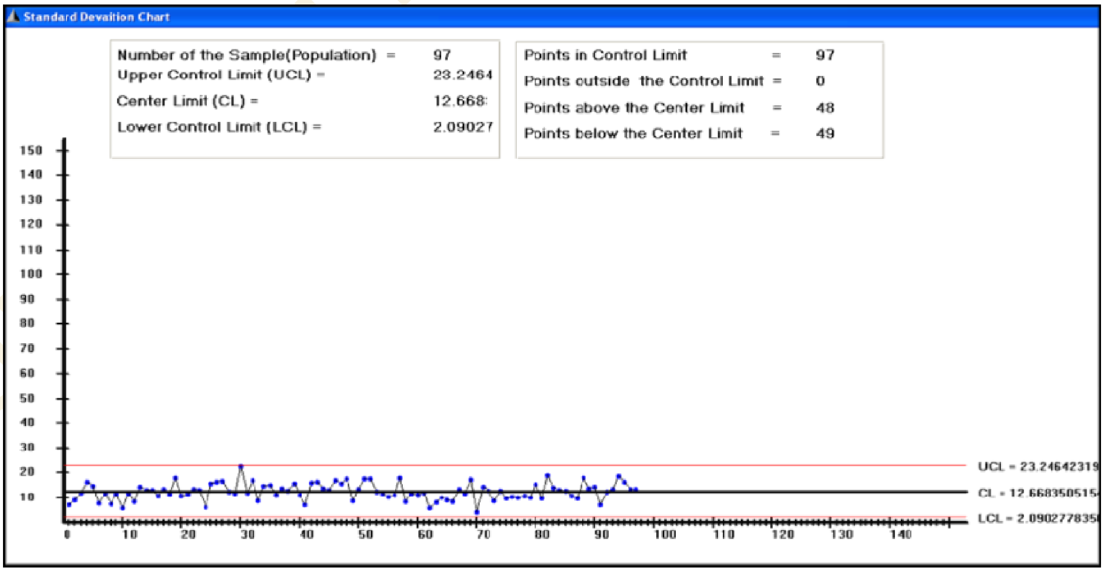

Figure 10: S- chart

In R-chart, existing unnatural process, there are six points outside the control limit (three points above center line & three points below center line),it also appears that there are eight consecutive points below the center line,(see figure 9).

Figure 10 ,S-chart appears Points too close to centre, but there is existing unnatural process, there are seven points outside the control limit (three points above center line & four points below center line),it also appears that there are ten consecutive points above the center line and six points in a row trending down.

Figure 11 shows three control charts, Always look at the Range chart or S chart first. The control limits on the X-bar chart are derived from the average range or from standard deviation σ, so if the Range chart is out of control, then the control limits on the X-bar chart are meaningless

The system also executes Microsoft Graph for each course and student for using it in quality measure, for example selection one subject A1, the system will show line chart, bar chart and area chart, see figures (12, 13 and 14).

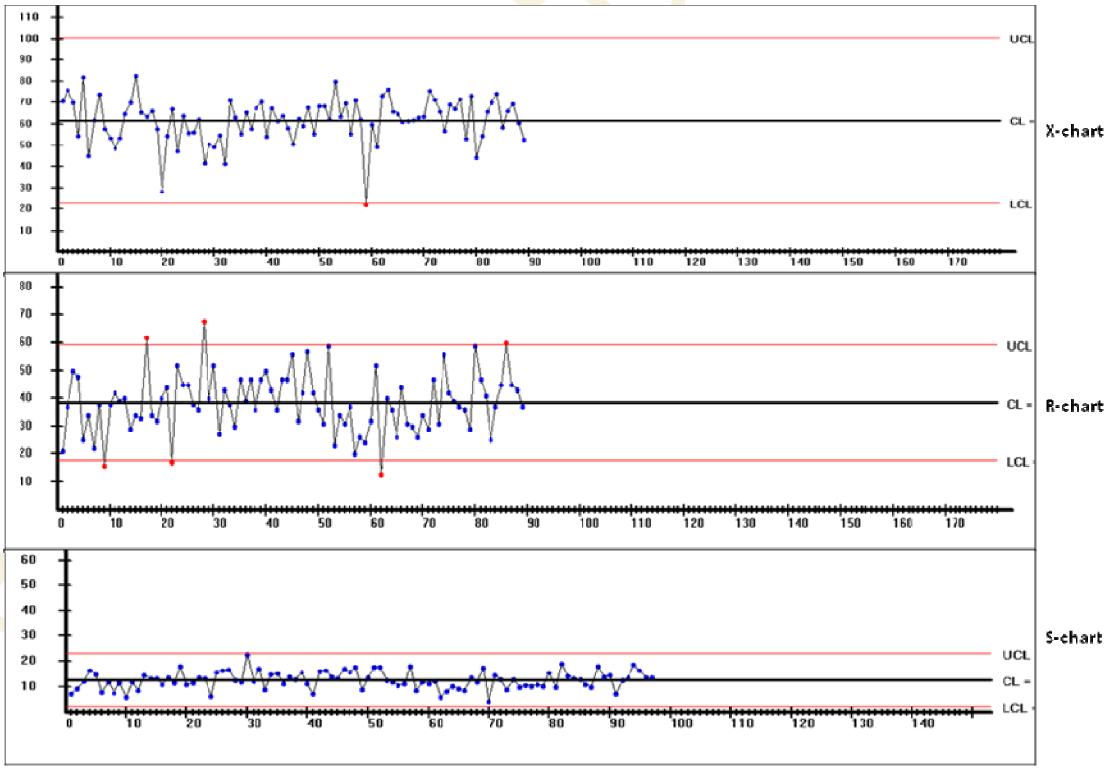

Figure 11: Three control charts (x-bar, R and S charts)

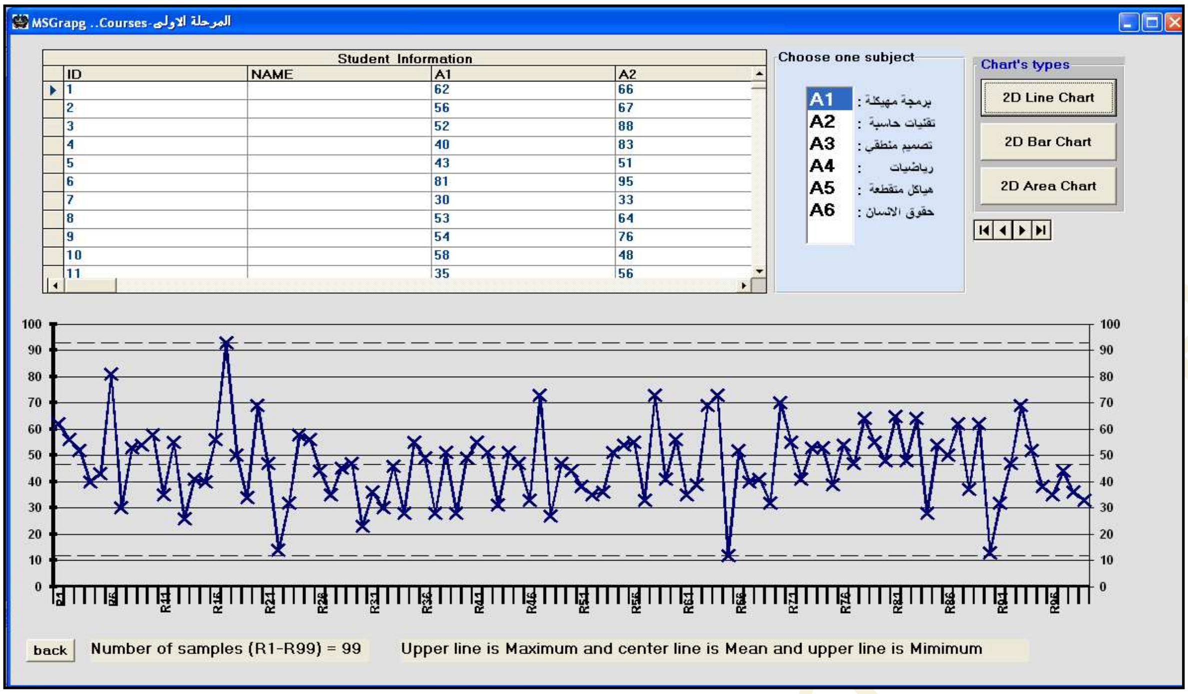

Figure 12: Line Chart

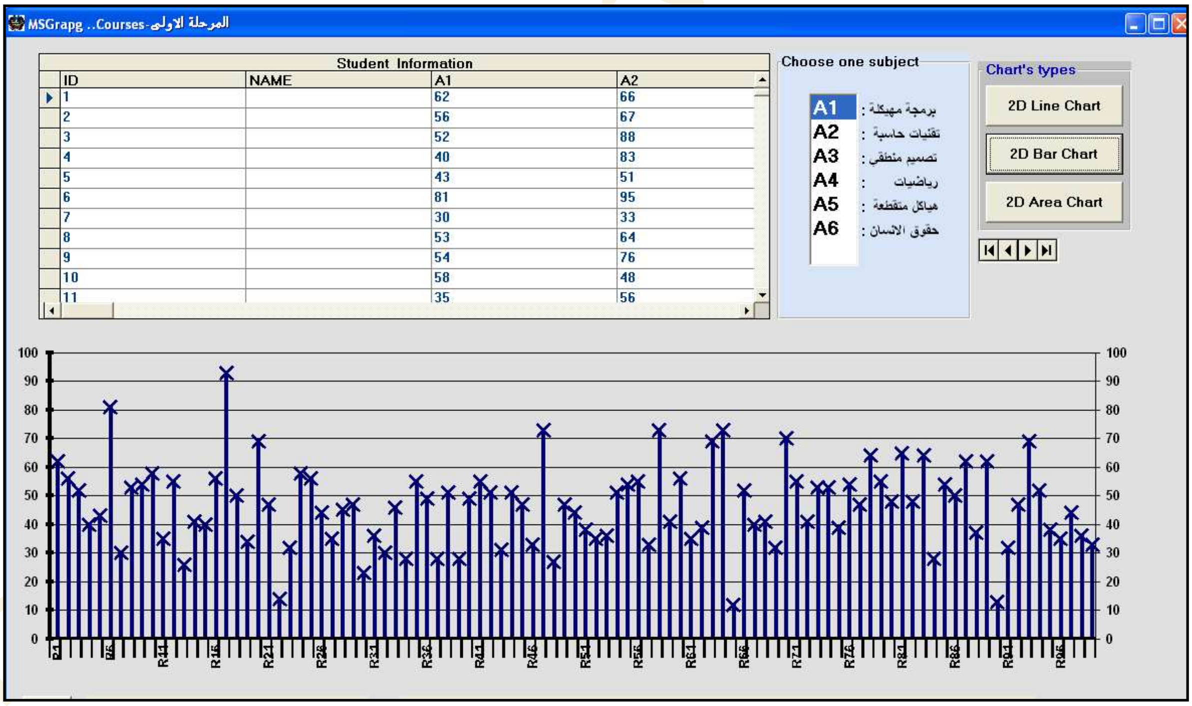

Figure 13: Bar Chart

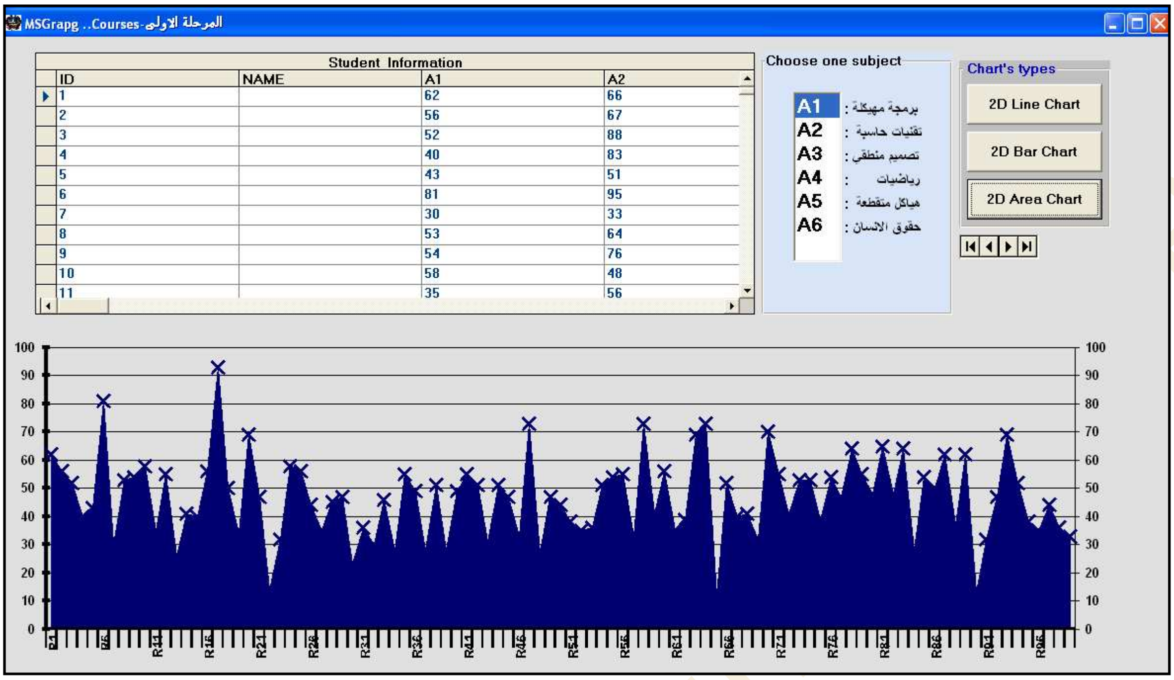

Figure 14: Area Chart

Conclusion and future work

Statistical Process Control (SPC) makes use of control charts to determine whether a process is functioning correctly. A control chart may exhibit many unnatural patterns indicating that the process is out-of-control. Correct recognition of these patterns is important to achieving early detection of potential problems and maintaining the quality of the process. The system developed helps achieve a measurable student progress monitoring process that gives results quickly and meets a larger educational goal benefiting stakeholders in the educational system. The system provides more reliable quality control as porosity data could be checked automatically comparing to through operator's eyesight. The application of the proposed system has been analyzed by means of real data collected from education process. The author believes that this system promotes efficient educational processes which in turn facilitate better education for customers (i.e. students and their sponsors).

References

[Lomas, 2002]: Laurie Lomas," Does the Development of Mass Education Necessarily Mean the End of Quality?" 2002, Quality in Higher Education, Vol 8, No 1.

[Kroenke, 2007]: David Kroenke,"*Using MIS*", 2007, Pearson Education.

[Gerald & David,2003]: Gerald V. Post & David L. Anderson," *Management Information Systems: solving Business Problems with Information Technology*", 3rd Ed, 2003 by the McGraw-Hill companies.

[O'Brien, 1996]: James A. O'Brien, *Management Information Systems: Managing Information Technology in the Networked Enterprice"*, 3rd Ed, 1996, Richard D. Irwin

[Salahuddin M., 2009]: Salahuddin M. 2009," *Quality Issues of Higher Education in Bangladesh"*, Department of Public Administration University of Dhaka (www.educationdev.net).

[Juran, 1999]: Joseph M. Juran, "*Juran's Quality Handbook*,"5th Ed, 1999, the McGraw-Hill companies.

[Summers, 2006]: Donna C. S. Summers, "*Quality*"-4th Ed, 2006, Pearson Education.

[Zbigniew, 1997]: Zbigniew, *Osei, Ali "QUALITY ASSURANCE IN HIGHER EDUCATION*", 1997 (www.mf-foca.com).

[Ronnestrand, 2009]: Clinton Ronnestrand,"*Using Control chart to determine if the process is in statistical process conerol*", 2009, The Graduate School University of Wisconsin-Stout.

[Ping & Sheng, 2009]: Hui-Ping, Chuen-Sheng "*Control Chart Pattern Recognition Using Wavelet Analysis and Neural Networks"*, Journal of Quality Vol. 16, No. 5, (2009).