



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

New Model Based on the Integration of Lean Principle and Information Technology to Enhance Education System at High School in Egypt

Eng .Ahmed Lotfy Dorgham,

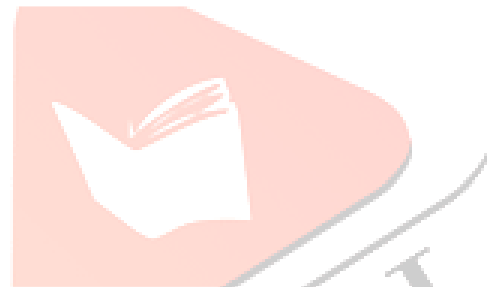
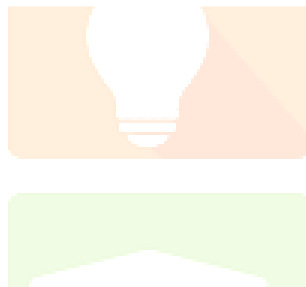
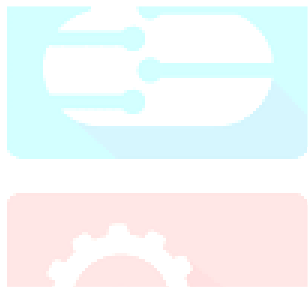
Phd Researcher at Faculty of Graduate Studies for Statistical Research, Cairo University, Egypt

Prof .Abdul Hadi Nabih Ahmed,

Faculty of Graduate Studies for Statistical Research, Cairo University, Egypt.

Prof. Abd El Hakim Al Manhawey

Faculty of Graduate Studies for Statistical Research, Cairo University, Egypt



Abstract

The purpose of this study is to improve the quality system in high schools of education in Egypt. A comparative study between high school education system in Florida state university school (FSUS) and three high schools in Cairo (Egypt) using 10 parameters according to National Authority for Quality Assurance and Accreditation of Education (NAQAAE) is conducted to identify the points of weakness in high school of Egypt. Then, the results were analyzed by using suitable quality tools, lean principles, and Information technology which have different characteristics than the regular methods due to the very specific nature that can be applied to achieve the aforementioned purpose.

Keywords

Education, quality tools, lean principles, and Information technology.

Introduction

Education is very important; it is the main pillar to realize our dreams. It fetches better prospects in career and growth. Today, every employer requires his prospective employees to be well educated moreover requires expertise. So, education becomes an eligibility criterion for employment into any sector of the industry. We are rewarded for exercising the expertise required for the field we venture. The quantum of education, training, skills are necessary for organization to compete and have a reasonable market share. The importance of education in life cannot be doubted. Education opens up our minds and makes us broadminded. Globalization has transformed the world into a big village, intercommunication, virtually has been realized.

In this research, the high schools education system in Florida and Cairo cited varies in terms of the curriculum offered to the students. The core subjects are almost similar which composes of math, science, English and physical education. These high schools offer additional courses and electives that the students may choose from. Similarly, these schools cater to students on grades 9-12 and ages 12-17. These high schools acknowledge the relevance of having competent educators as a key element in the improvement of the students. The level of competence is determined by the ratings from the department of education in the country which they belong.

A comparative study of high school education in Florida (U.S.A) and three high schools education in Cairo (Egypt) is performed to identify the points of strength, the points of weakness and the necessary improvement projects to be done in Egypt.

Quality Tools and Lean Principles

The impact of implementing quality in education requires understanding what the meaning of quality and quality tools is. This chapter gives an overview of quality literature and definition through understanding various meaning of quality and quality tools in addition to lean technique. There are various meaning of quality. It depends on each individual case and the perception of the customer as follows:

- Quality is conformance to requirement: product or service meeting specification, free from deficiencies, and all requirements are accepted by both the supplier and the customer (Russel 2005).
- Quality is not only complying with a specification or being the best, but also quality is to realize customer satisfaction (Tricker 2001).

Quality Control: quality control ranges from the basic inspection activity to sophisticated methods and systems, self-inspection by approved operators, use of information, the tools and techniques.

Quality Assurance: quality Assurance refers to planned and systematic activity directed toward providing customers with products (goods and services) of appropriate quality, along with confidence that products meet consumer's requirements.

Seven Basic Quality Tools.

No	Tool	The reason of using
1	Pareto analysis	To identify the main causes (20% of the total causes) that produces (80% of the problem).
2	Cause and effect diagrams	Determine the causes of the problems.
3	Flow chart	Identify the process and the activities.
4	Check sheets	Collecting data in real-time and at the location where the data is generated.
5	Histograms	To determine the capability (Cp) of the histogram.
6	Scatter charts	Clarify the relationships between factors.
7	Process control charts	Explain how to control the variations (special causes).

Table (1). Seven Basic Quality Tools.

Quality Management Tool

Quality tool is any chart, device, software, strategy, or technique that used in understanding and improving production and services processes, and supports quality management efforts.

A-Tools Working With Ideas

The main tools working with ideas:

- Cause and Effect Diagram.
- Brainstorming.
- Flow Chart.
- Affinity Diagram.
- Relationship Diagram.
- Systematic Diagram.

B-Tools Working with Numbers

The main tools working with numbers are:

- Spider plot.
- Histogram
- Control charts.
- Scatter diagram
- Pareto chart.
- Run chart.

Check sheet.

- Pie charts.
- Bar charts.
- Process capability calculations.

Comparative Study between FSUS and High Schools in Egypt.

Quantitative survey was implemented to make a comparison between FSUS and some of Cairo school then take the mean for three of them with high level to complete the comparison with FSUS. The survey was based on gathering data through questionnaire to determine the parameters of the comparison study and to identify the weakness points in schools of Egypt. The survey was carried out during 6 months. Questionnaire had been submitted to 20 American professional teachers who represent American education system, and 20 Egyptian teachers in each of the three high level schools in Cairo who represent Egyptian education system. The survey focused on the following standard parameters according to National Authority for Quality Assurance and Accreditation of Education (NAQAAE). We used some quality tools like bar chart in phase 1, spider plot used in phase 2 to ensure our practical work.

A-The Comparison between the Educational Parameters in FSUS (USA) and the Mean Value of Cairo Schools.

No	Point of Comparison	FSUS	Mean of Cairo schools	Gap
1	Courses for instructor (Qualification).	8	3	5
2	No of hours for each lab	8	3	5
3	No of hours for hobbies	8	4	4
4	Students research	7	4	3
5	Instructor-parent communication	8	4	4
6	No of students per class (spc)	8	2	6
7	Main and electives courses	9	5	4
8	Total number of study days/year	8	3	5
9	No of hours for each main & elective subject and the time consumption to prepare the exams	8	3	5
10	Instructor students ratio	7	3	4

Table (1). The Comparison between the Educational Parameters in FSUS (USA) and the Mean Value of Cairo Schools.

B -Bar Chart for the Comparison between the Educational Parameters in FSUS and the Mean Value of Cairo Schools.

Bar chart was used to clarify the gap between the educational parameters of FSUS and the mean value of Cairo schools as shown in figure (1):

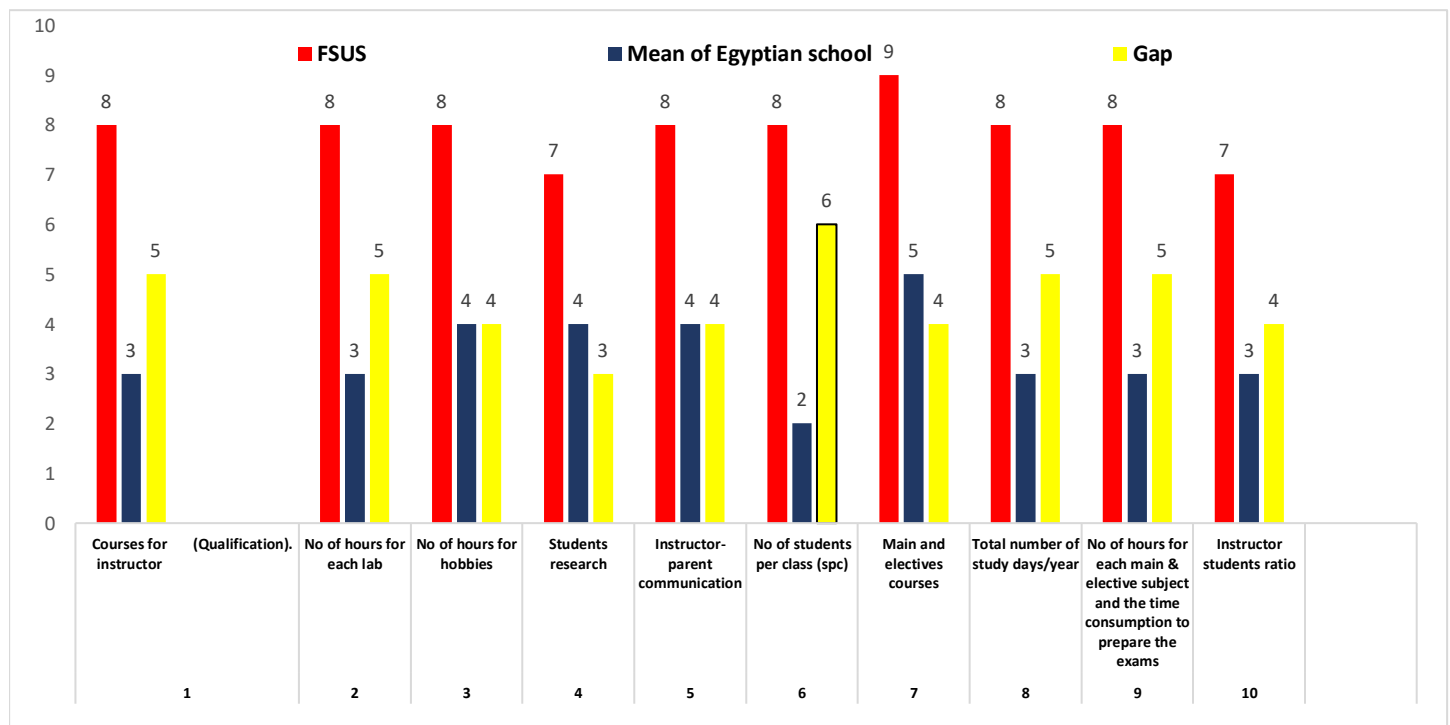


Figure (1): The Gap between FSUS and the Mean Value of Cairo Schools

Bar chart was used to clarify the gap between the educational parameters of FSUS and the mean value of Cairo schools as shown in figure (1).

By analyzing the previous table we come to the conclusion that the high gap between the educational parameters in FSUS and the mean value of Cairo schools were in no of students per class ,courses for instructor (qualification), main and elective courses,, no of hours for each lab, instructor-parent communication, student's research, and. The parameters need to be improved to obtain high quality of education in the three Cairo schools.

C -Spider Plot for the Actual Performance (the Mean Value of Cairo Schools), the Best Performance (FSUS), and the Ideal Performance.

Spider plot used to evaluate the actual organizational performance for the mean value of Cairo schools and the best performance for FSUS as shown in figure (2).

The gaps between actual performances (the mean value of Cairo schools) and the best practice (FSUS). Also the gaps between the ideal performances and the best practice (FSUS). The gap area between the actual situations (the mean value of Cairo schools) and the best practice (FSUS) as shown in table (2).

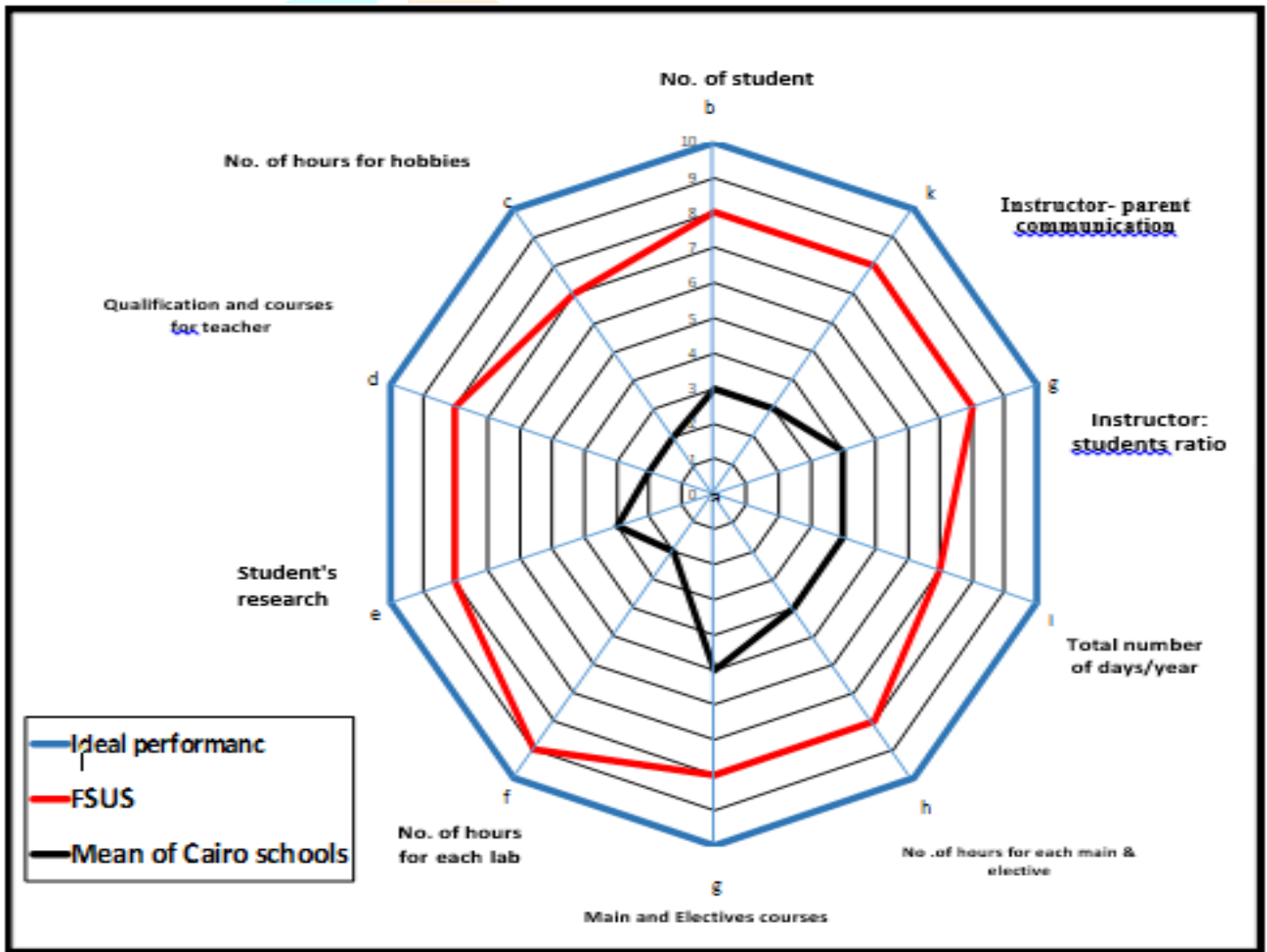


Figure (2): Spider Plot for the Actual Performance (the Mean of Cairo Schools), the best performance (FSUS), and the ideal performance.

No	Point of comparison areas	FSUS areas (cm ²)	The mean of Cairo schools areas(cm ²)	Gap cm ²
1	The area between courses for instructor (Qualification) and no. of hours for hobbies. (adc)	16.43	1.17	15.23
2	The area between main and electives courses and no. of hours for each lab. (agf)	21.13	2.93	18.2
3	The area between no. of hours for hobbies and no. of Students in class. (acb)	16.43	1.76	14.67
4	The area between no. of hours for each lab and Students research. (afe)	21.13	1.76	19.36
5	The area between students research and Courses for instructor (Qualification). (aed)	18.78	1.76	17.02
6	The area between the no.of Students in class and instructor-parent communication. (abk)	18.78	2.64	16.13
7	The area between no. of hours for each main and elective subject and main and electives courses. (ahg)	18.78	5.87	12.91
8	The area between total number study of days/year and no. of hours for each main and elective subject.(aih)	16.43	4.69	11.73
9	The area between instructor-parent communication and instructor students ratio.(akg)	18.78	3.52	15.22
10	The area between instructor students ratio and total no. of days/year.(agi)	16.43	4.69	11.73
The ideal performance Areas for schools = 294 cm ²		183.10 cm ²	30.90 cm ²	152.20 cm ²

Table (2). The Gap Area between the Actual Situations (the Mean Value of Cairo Schools) and the Best Practice (FSUS).

The total ideal performance areas was 294 cm², the total performance areas for FSUS was 183.10 cm² and the total performance areas for the mean values of Cairo schools are 30.9 cm², the gap between the actual performance of the mean values of Cairo schools (30.9 cm²) and the best practice FSUS (183.1 cm²) is represented by an area of (152.2 cm²).

D- Causes and Effect Diagram for the Cairo Schools.

The cause and effect diagram identifies the causes of the weakness points in Cairo schools as follow:

Materials

- The defects in the courses that need to be developed.
- The shortage of professional instructors who have the experiences to develop the courses.

- The short time of lectures.

Personal

- No training courses for instructors.
- The increase number of student in the classes.
- The lacking of the communication between the teachers and the parents.

Methods

- The methods of teaching in the class.
- Inadequate exercises work for the students.
- The carelessness of the student's follow-up.

Machines

- The consumable availability in the school not enough.
- Inadequate of the measurements tools in the lab.
- The lacking of the computers lab and availability of the maintenance in the school.

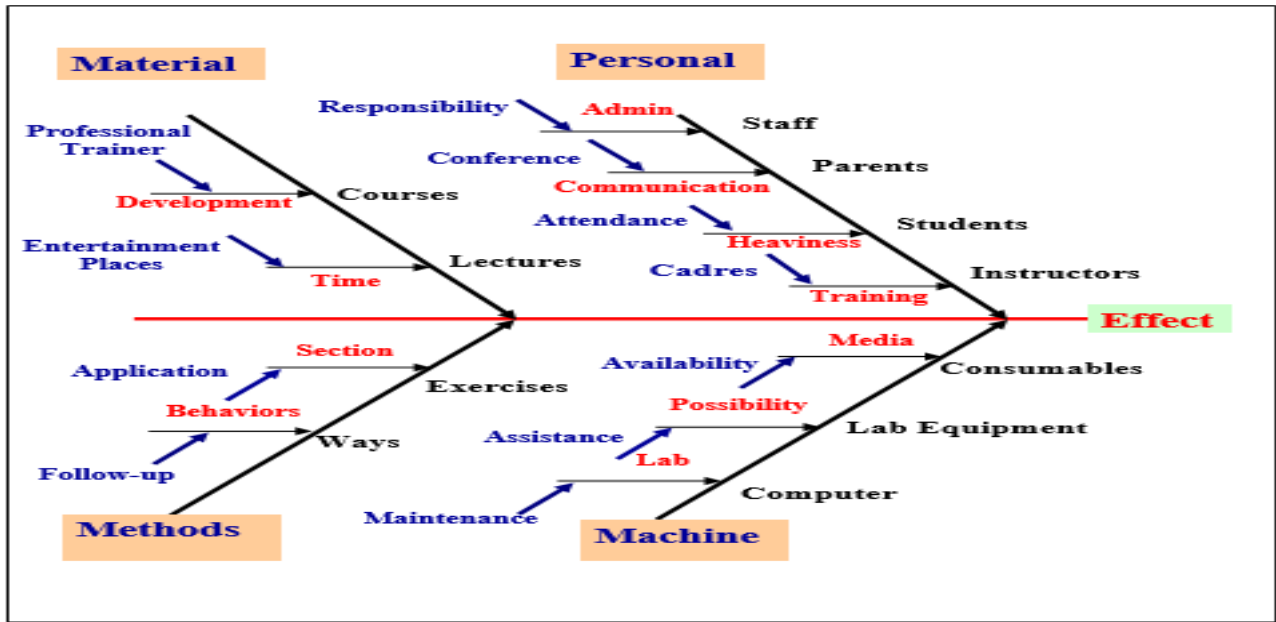


Figure (3): The Causes and Effect Diagram for Cairo Schools.

The Processes Improvement.

The Integration of Lean Principle and Information technology is the relevant method to improve the total performance areas in Cairo schools. The expected improvement in three parameters; courses for instructors (instructor's qualification), no. of spc, and no. of lab hours for each subjects (physics, chemistry... etc) can reach (50 -60 %) improvement through (3-6) months. The further improvement is continued through Total Quality Management (TQM) to an increase of approximately (10-15 %) in one year.

Lean Manufacturing Principles

The five-step thought process guiding for the implementation of lean techniques are:

- Define value from customer perspective.
- Identify the value stream mapping.
- Reduce waste and improve flow.
- Pull from the customer.
- Peruse perfections.

The process shown in figure (4).

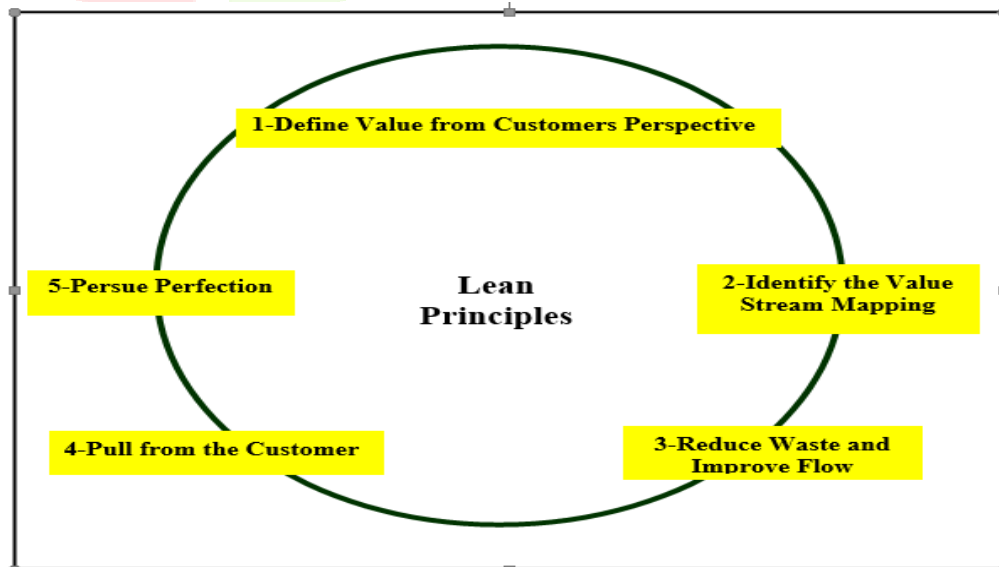


Figure (4): Lean Principles

Benefits of Lean:

- Remove non value-added activity.
- Reduces waste.
- Cuts lead times.
- Improve cash flow.
- Lower cycle time.
- Minimize downtime.
- Lower production costs.
- More efficient use of personnel.
- Higher quality.
- Higher profitability and flexibility.

Lean Office

Lean office is a streamline and eliminates waste from administrative processes and adding value. One of the ways to eliminate or reduce waste and improve flow is a Documentation Management System (DMS). DMS is one of the technology method in widespread use in lean office, especially in the education sector to help the organization to reduce the 8ws and improve the performance as shown in figure (5):



Figure (5): DMS

The Benefits of DMS

- Paperless (using computers instead of paper to record or Exchange information)
- Flexible Retrieval (Waiting).
- Flexible Indexing (Waiting - Inventory).
- Improved, Faster and More Flexible Search.
- Improved Document Distribution (Movement).
- Improved Security (Waiting – Defects).
- Disaster Recovery (Defects- Over-Production).
- No Lost Files (Defects - Waiting).
- Digital Archiving (Waiting - Movement).
- Improved Cash Flow (Waiting - Transporting).
- Improved Internal Operations (Waiting - Movement).
- Competitive Edge (Movement).
- Improve the schools service and customers satisfaction (Defects - Waiting).

Applying Lean Principles to Improve the Education System in Cairo Schools.

1 -Define Value from the Schools Perspectives.

Waste time and high cost are big problems in any school. Schools need effective ways to enhance education system as well as to eliminate the waste of time and the waste of money.

2-Identify and Map Value Stream Mapping (VSM).

The main problems in the Cairo schools are the waste of time during the preparation of exams, writing teacher's reports, and edition of the final results. The previous activities have a high rate of papers consumption. The mean consumption rate in one school can be 1000 packs per year which represents 500000 papers according to the mean value of the owners of three schools. The mean distribution of the papers consumption in the school of Cairo can be shown in the next table.

The Mean Distribution of the Papers Consumed in One School of Cairo.

No	Reason of Consumption	Quantity of Consumed Papers	% of Consumed Papers
1	Exams (monthly, midterm, and final)	350000	70 %
2	Internal operation, reports.	80000	16 %
3	Homework sheets.	50000	10 %
4	Others	20000	4 %

Table (3): Mean Distribution of the Papers Consumed in One School of Cairo.

Pareto chart was used to clarify the most important reasons of consumption of papers in one school of Cairo as shown figure (6):

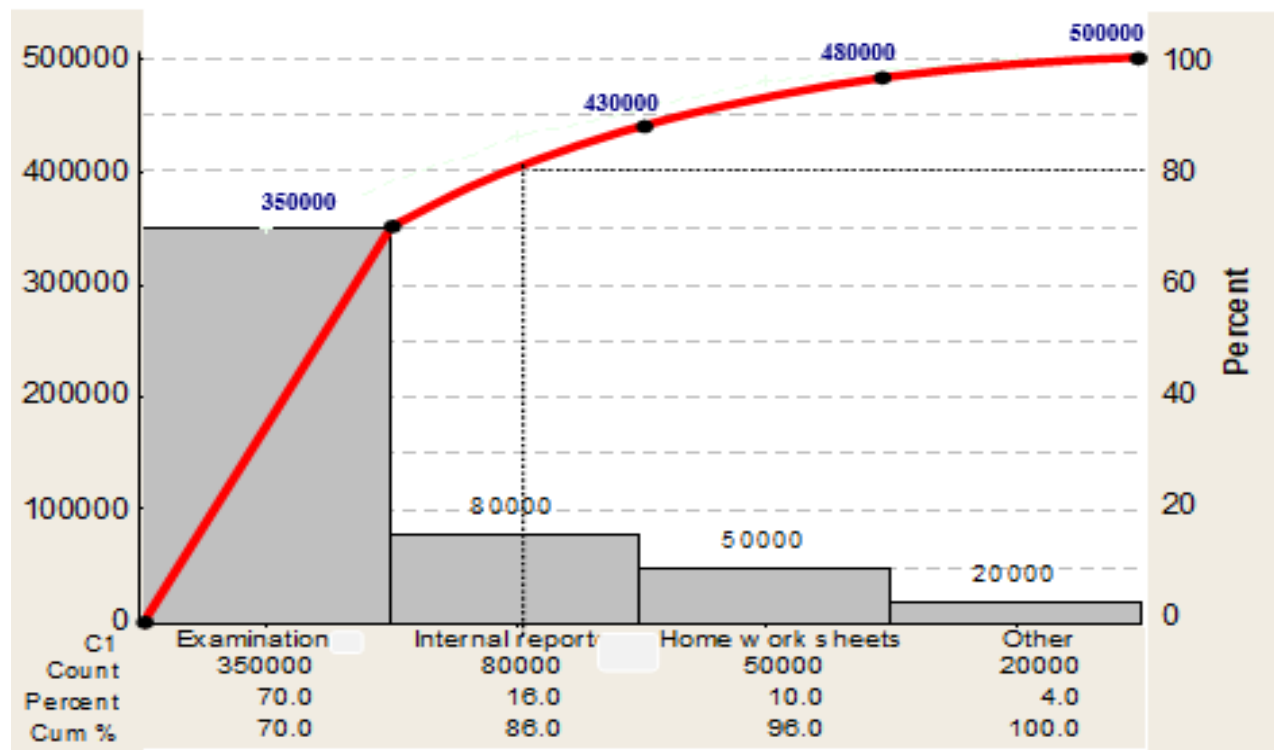


Figure (6): Pareto Chart for Papers Consumption Rate in One School of Cairo.

-Pareto chart and applying the rule of (80–20) we can determine that the exams and internal reports are responsible of 80% of the consumption of papers.

-The Examination Process Flow Chart in the Present state

Process	Activity	step	Task	Documents	
Examination Process	Annual Examination plan		<pre> graph TD Start([Planning]) --> T1[Teaching staff for preparation of answer sheets] T1 --> T2[Teaching staff for preparation of setting number] T2 --> T3[Teaching staff for preparation of exam] T3 --> D1{Reviewing and acceptance by consultants} D1 -- No --> T1 D1 -- Yes --> T4[Teaching staff class printing] T4 --> T5[Students execute the exam] T5 --> T6[Replace student's name by labels code] T6 --> C1((1)) C1 --> T7[Teaching staff correct the answer sheets] T7 --> T8[Replace labels code by student's name] T8 --> T9[Final results & marks record] T9 --> T10[Analysis] T10 --> T11[Review by consultants] T11 --> End([Send the final results to the school admin for announcement]) </pre>	Examination Order	
	1-Schools Control	Preparation of exam			
			Exam analysis		Examination release
			Printing		
	2. Exam Execution	Following the exams			List of student's name
	3. Coding				List of code
			Answer sheets correction		List of instructors
	4. Correction				
	5. Decoding				
	6. Final results and analysis	Final results			Student's degree
			Analysis		
			Reviewing		Examination Certificate
		Receiving the results			

Table (4): Present State Examination Process Flow Chart

VSM for the Present State Examination Processes

From project prioritization the first objective to achieve is the process turnaround time. The present state VSM for the examination processes as shown in figure (7):

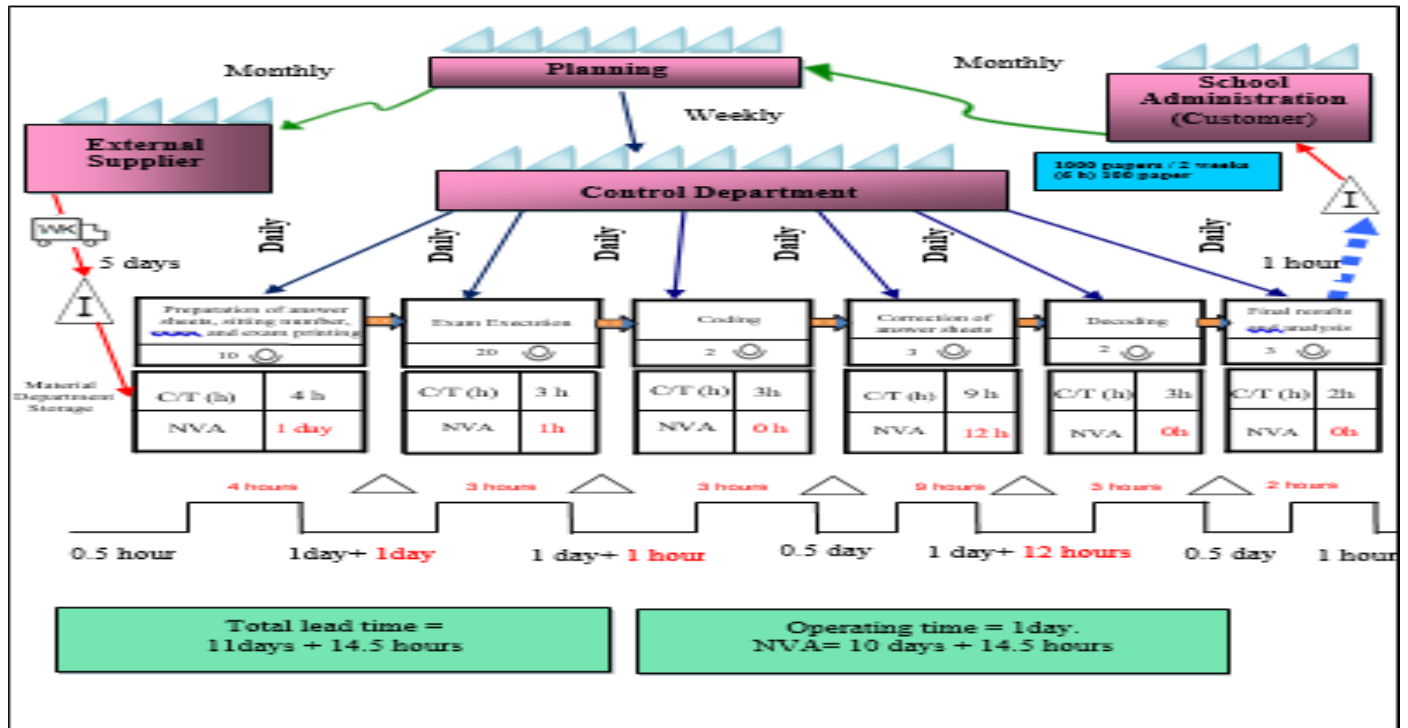


Figure (7)- VSM for Examination Processes in the Present State.

The Examination Processes Improvement

The relevant method to improve the examination processes and enhance the performance of Cairo schools via information technology with Documentation Management System (DMS). It reduces paperwork, and improves work flow, lead times, cycle times, inventories, hence can realize customer satisfaction (internal & external).

DMS Program

DMS program consists of five phases, each phase clarify the activities and the implementation time period as shown in table (5):

No	Phases	Action	Time
1	Phase 1	Select the persons to execute the tasks	1 week
2	Phase 2	Training (each person have to be trained on his role in DMS program)	2 weeks
3	Phase 3	Execution the DMS program	1 month
4	Phase 4	DMS program acceptance test	1 week
5	Phase 5	Popularization of DMS in all departments	1 month

Table (5): DSM Phases

Lean principles via information technology (Zero Client).

A zero client as shown in figure (8) is a type of thiclient device that has a very small factor with little to no processing, storage and memory components. It is a compact client-end PC that is used in a centralized computing infrastructure or virtual desktop infrastructure (VDI).

The Benefits of a Zero Client

- Reducing 60% of the acquisition cost from the regular device price currently in use.
- Reducing 90% of the daily operating costs and daily malfunctions of the devices.
- Not all hardware settings are needed, only the master server is set.
- Few or no problems with the daily operation of programs, as all users work on the main server.
- There are no virus problems and no need to purchase software Antivirus On devices but only on the main server.
- Reducing 90% of of electricity consumption.



Figure (8): Zero Client device

The server connection with zero client as shown in figure (9):

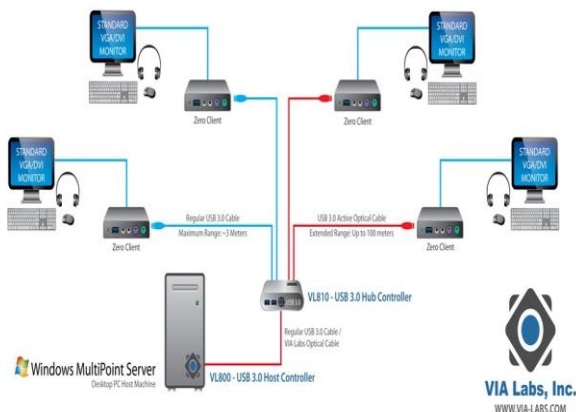


Figure (9): Zero Client device connection sever.

ii- iPad Technology in the Classroom



The iPad, released in 2010, can be a huge boon to the active college student. Providing both educational and social capabilities in a sleek, easy-to-transport and easy-to-use device, the iPad can become a tool for college success. The advantages of using an iPad as a college student stem from the device's usefulness, portability, security and communication capabilities.

The iPad cannot only replace their PCs for these tasks but also offer additional benefits especially in classroom and online learning:

- Variety of programs and courses.
- Lower total costs.
- More comfortable learning environment.
- Convenience and flexibility.
- More interaction and greater ability to concentrate.
- Career advancement.
- Continue in your profession.
- Avoid commuting.
- Improve your technical skills.
- Transfer credits.

The iPad, released in 2010, can be a huge boon to the active college student. Providing both educational Transfer credits. Students in online programs can effectively manage their time, learn the materials, and complete assignments on their own schedules to name just a few benefits of online learning.

Here's a list of 5 smart ways to use the technology in the classroom to get you started on your iPad endeavor.

1-Display Work

- Teacher's work
- Student's work

2- Create Instructional Content

There are tons of really cool apps out there you should take advantage of to create your own content.

3- Interact with Students

Not every student will just throw their hand up in front of the class if they have a question or comments about something. Using iPads in the classroom can fix this.

4 - Personalize Learning

Every student learns at a different pace and through various ways. iPads in the classroom can provide opportunities for students to be able to work and excel at their own level and pace. Teachers can use apps and games to make learning more personalized to fit each students progress.

5-Classroom Management

iPads can make managing a classroom and keeping up with a class full of students much easier.

Examination Process Flow Chart after using DMS:

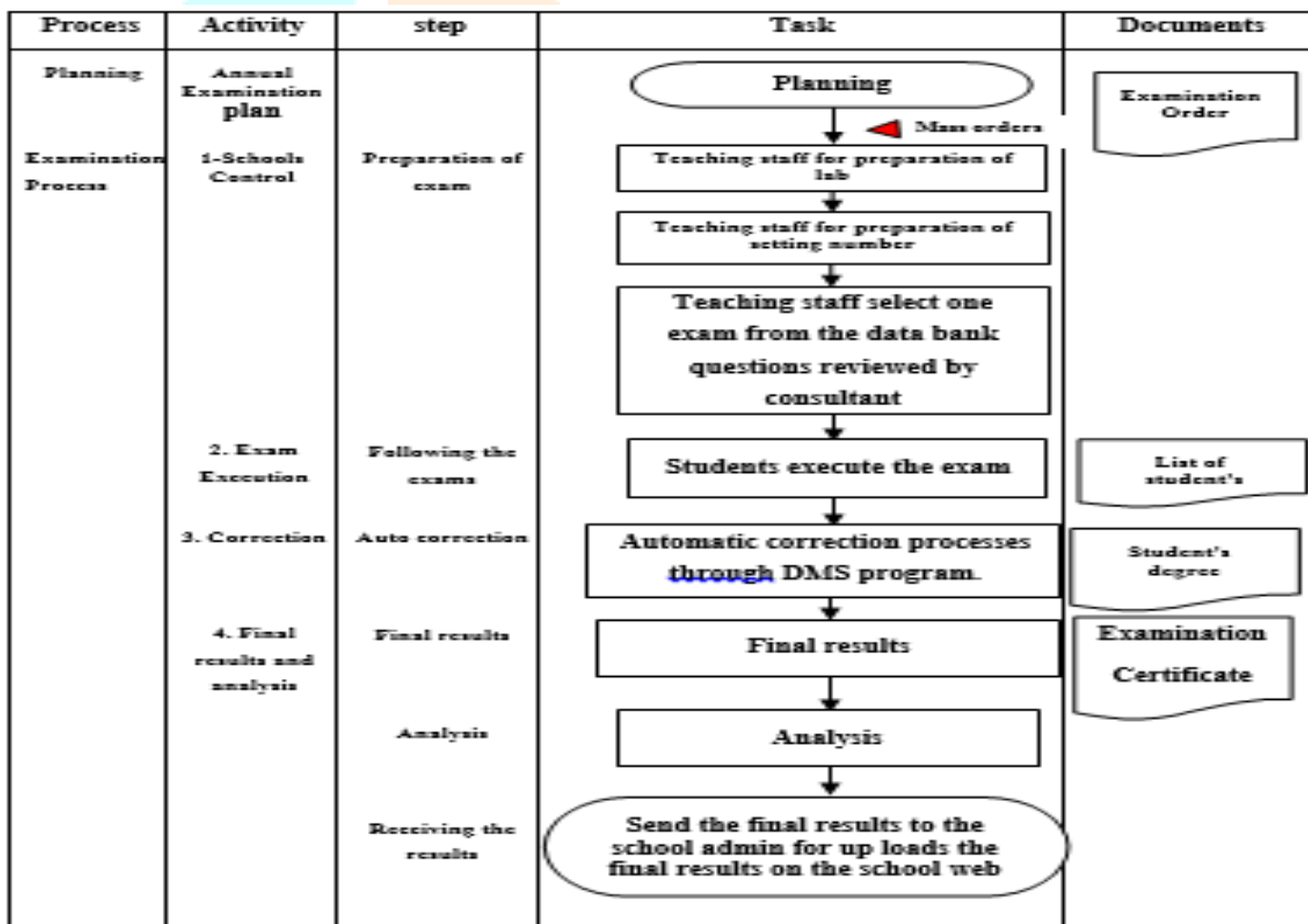


Table (6): Examination Process Flow Chart with DMS

Every student has a different exam from the others that created from DMS data bank questions. After the students finished the exams, the automatic correction processes executed and the final results of the student's exam send to the DMS server. Eventually the administrator up loads the final results on the school web site to the students.

VSM Examination Process using DMS

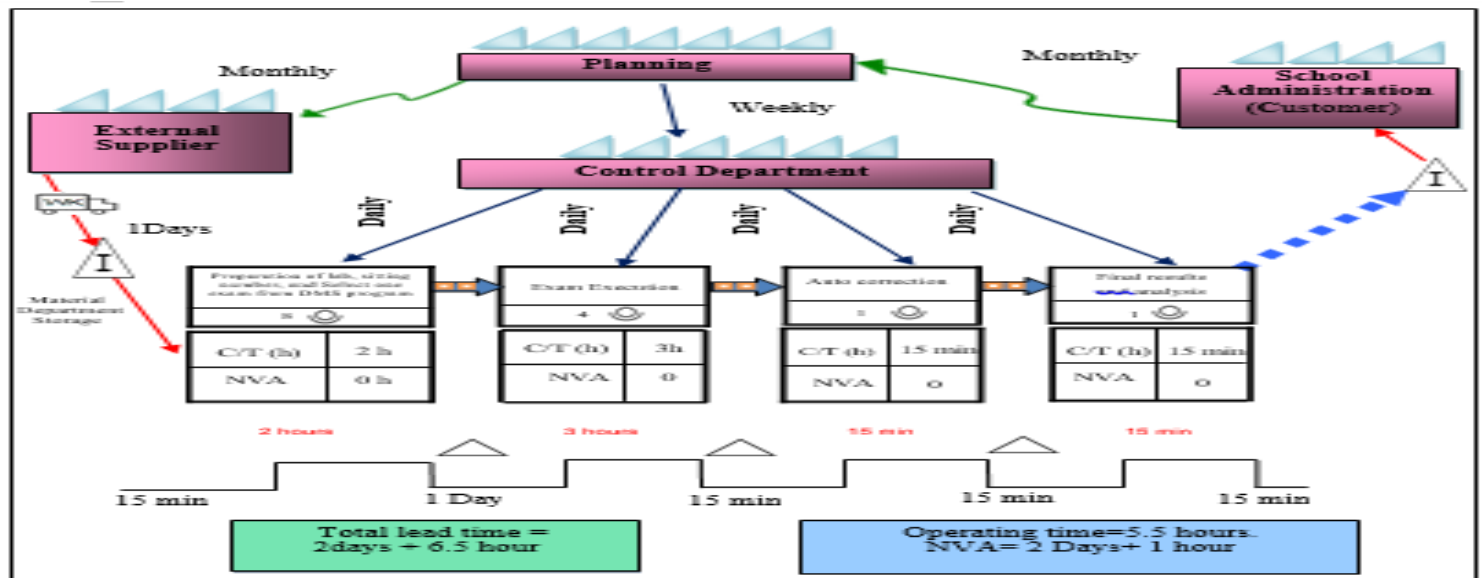


Figure (10): VSM for Examination Processes with DMS

VSM Comparison between the Present State Examination and Future State Examination Processes

No	Point of comparison	Present state before improvement	Future state using DMS	The magnitude of improvement
1	Total lead time	11 days+ 14.5hours	2day+ 6.5 hours	Time decreases to 1/5.
2	The operating time	1day	5.5 hours.	Time decreases to 1/4.
3	Non values added time	10 days + 14.5 hours	2days +1 hours	Time decreases to 1/5.
4	Persons	40	14	Employment decreases to 1/3.

Table (7): VSM Comparison between the Present State Examination Processes and Future State Examination Processes.

3. Reduce Waste and Improve Flow

- Reduce waste and improve flow with DMS program.
- Also VSM using DMS was improved to reach the following results from the present state:
- The total lead time was reduced to the 1/5.
- The operating time was reduced to the 1/4.
- The non values added time was reduced to the 1/5.
- The employment decreases was reduced to the 1/3.

4. Pull from the School

The schools use the kanban system to create " pull" flow of information in the operation. DMS based on the archiving of the data stored; and the system storages have the limit capacity. Signal kanban is the printed card indicating the reorder point has been attained and a particular action need to be replenished. DMS message alert represents the printed card if the storages close to be a full capacity.

Windows Management Instruments (WMI) uses to receive event notifications when the amount of free space on a system disk drops below a certain limit as shown in figure (11).

When the disk storage reached to 85% from its total capacity, the alert message appears to the user. The DMS system performances will be degraded. It indicates that the reorder point has been attained and a particular action needs to be replenished. The DMS admin assists the system to save all the data storage on external hard, tape, or any other media and empty the main hard disk to replenish another data.

5 -Pursue Perfection

As value is specified, value streams are identified, wasted steps are removed, flow and pull are introduced, start the process again and continue it until the schools of perfection is reached.



Figure (11): Pull system (WMI).

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