

Application of “Matrix Diagrams Tools” for Quality Improvement in High Education

* Layla Lateef Alwan

Manager of Quality Assurance Dep.

Abstract:

Academic quality assurance process is a central to achieving and maintaining universities excellence and advancement. Academic staff and scientific research are strongly involved in this process.

Scientific research is the major significant indicator of academic staff's quality and the determinant of development and advancement.

In this research the relationships of the related indicators of the academic staff categories, and scientific research fields, are studied based on the quality indexes. The case study application, included (academic staff & scientific research of four engineering departments). The “Matrix Diagram Tool”, which is one of seven new quality tools ,is used to analyze the collection data of the

* Manager of Quality Assurance Dep.

University of Technology

Baghdad/ Iraq



above two fields and their indicators, , it is beneficial for problem solving process.

Many “Matrix Diagrams Tools” are used to analyze the data collected for this research purpose, such as; L- type matrix, which is a two- dimensional table, T- type matrix, which is a three dimensional table and Y- type matrix, which is a three dimensional.

The results signified the relationships of academic staff categories and subcategories, the strength and weakness points, and also the comparison of the four departments of all indicators.

According to the results, many recommendations are suggested to strengthen the weak points and many corrective actions are mentioned, to improve quality in the engineering departments.

Key words: quality assurance ,matrix diagram , new” quality tools, higher education, academic staff

١- Introduction

Challenges of globalization and internationalization have to be faced. The globalization of education markets has resulted in international competition of higher potential [١][٢].

Education is an important part of society, and both affects as well as is affected by society at large. Higher education is supposed to deal with teaching, research and transfer of knowledge [٣].



There is an increasing interest in quality and standards, reflecting both the rapid growth of higher education [٤]

There is currently a strong move throughout developed countries towards having rigorous, internationally recognized higher education quality assurance processes. Many countries have taken steps to establish mechanisms for quality assurance in higher education [٥]

Quality assurance has been defined as” systematic management and assessment procedures adopted by higher education institution and systems in order to monitor performance against objectives, and to ensure achievement of quality output and quality improvement[٦]

the Quality assurance system comprises the main elements , the general academic statute and its associated regulation, policies and procedures reflect how the university’s standards for educational programs are met and enhanced [٧]

Higher education is preparation of qualified scientists and researchers. Quality within this viewpoint is more about research publications and transmission of to do quality research [٨].

Quality assurance of teaching staff, Institutions should have ways of satisfying themselves, that staff involved with the teaching of students are qualified and competent to do so [٩]

Research publication in the university is a major or most significant indicator of academic staff productivity. It may be pointed out that research publication in any field of specialization provide current information, progress, development and an improved society [٩].



The agency should have a strong, highly qualified staff with experience in quality assurance and with knowledge of the higher education system. The professional staff of the agency should carry a major obligation for the consistency of operational processes and reporting.[٣]they have a professional responsibility for the quality and the relevance of their curriculum design and delivery [١٠].

٢- Research problem:

There is an increasing interest in quality and standards, reflecting both the rapid growth of higher education

Quality assurance in higher education is very important for the competition of universities. Academic staff and scientific research are the important elements in the quality assurance system . Research publication in the university is a major significant indicator of academic staff productivity.

These elements need to be studied periodically by using activated quality tools,

٣- The goal of the research:

The goal of this research is to study the capability of application of the matrix diagram to show the relationship between two, three or four agency of highly qualified academic staff with scientific research, in quality assurance system in the high education.

٤- The matrix diagram:

The matrix diagram is one of seven “new” quality tools, The seven tools include [١١] [١٢]:



١. Affinity Diagram
٢. Interrelationship Diagram (ID)
٣. Tree Diagram
٤. Prioritization Matrix
٥. Matrix Diagram
٦. Process Decision Program Chart (PDPC)
٧. Activity Network Diagram

The matrix diagram shows the relationship between two, three or four groups of information. It also can give information about the relationship, such as its strength, the roles played by various individuals or measurements.

Six differently shaped matrices are possible: L, T, Y, X, C and roof-shaped, depending on how many groups must be compared [١٣] [١٤],

Table (١), summarizes when to use each type of matrix.

Table ١: The use differently-shaped matrices[١٣]

L-shaped	٢ groups	$A \leftrightarrow B$ (or $A \leftrightarrow A$)
T-shaped	٣ groups	$B \leftrightarrow A \leftrightarrow C$ but not $B \leftrightarrow C$
Y-shaped	٣ groups	$A \leftrightarrow B \leftrightarrow C \leftrightarrow A$
C-shaped	٣ groups	All three simultaneously (٣-D)
X-shaped	٤ groups	$A \leftrightarrow B \leftrightarrow C \leftrightarrow D \leftrightarrow A$ but not $A \leftrightarrow C$ or $B \leftrightarrow D$
Roof-shaped	١ group	$A \leftrightarrow A$ when also $A \leftrightarrow B$ in L or T



The use of Matrix Diagram tool are the following [١٥]:

- Identifies the relationship between pairs of lists
- Shows the relationship between issues or ideas
- Helps in prioritizing resources and processes
- Help to facilitate the improvement process
- Brainstorming tool
- Can be shown in two, three, or four dimensions
- Simple to use
- Useful way to organize the data collected

Steps in Creating a Matrix Diagram:

١. Select type of matrix
٢. Select the symbols for relationships
٣. Fill in the matrix
٤. Analyze and make conclusions
٥. Select factors

٥- **Research Methodology & practical application:**



In this research the relationships of the related indicators of the academic staff categories, and scientific research fields, are studied based on the quality indexes. The case study application, included (academic staff & scientific research of four engineering departments).

L- type matrix, which is a two- dimensional table; T- type matrix, which is a three dimensional table and Y- type matrix, which is a three dimensional, are used to analyze the collection data of the above two fields and their indicators, ,the data collected for the (٤ departments) included the difference information which are analyzed as follow:

- ١- **The collected data are analyzed by application (L- type matrix)as shown in the figure (١),(٢),(٣),(٤) and(٥).**
- ٢- **Figure(١),represents the percentage of academic staff in each department.**
- ٣- **Figure (٢), represents the percentage of the age categories of academic staff in each department.**
- ٤- **Figure (٣), represents the percentage of the university job years categories of academic staff in each department.**
- ٥- **Figure (٤), represents the percentage of the scientific researches of academic staff in each department.**
- ٦- **Figure (٥), represents the percentage of the research tasks of academic staff in each department.**
- ٧- **According to the data analyzed by L- type matrix , then T- type matrix, applied, which show the relationship of ٣ groups, by using the following symbols:**



- strong relationship
- Moderate relationship
- △ Weak or potential relationship no relationship

department academic staff	Department Of building & construction	Department Of lazar	Department Of control &system engineering	Department of material
Prof.	6.9%	5.5%	2.9%	3.5%
Ass. Prof.	10.6%	2.7%	5.7%	11.8%
Lect.	30.5%	25%	28.9%	25.5%
Ass. Lect.	52.5%	66.8%	62.5%	62.7%

Fig (1): application of L-matrix diagram [department & academic staff]

department age	Department Of building & construction	Department Of lazar	D Department Of control &system engineering	Department of material
More than 60 year	6%	Zero	1.5%	6.7%
50-60	18.5%	22.9%	10.45%	11.8%
40-50	24.0%	12.5%	23.88%	20.3%
Less than 40 year	51.5%	64.6%	65.7%	61.2%

Fig (2): application of L-matrix diagram [department & age-faction]

department year academic job	Department Of building & construction	Department Of lazar	D Department Of control &system engineering	Department of material
More than 30 year	5.5%	3%	1.45%	13.5%
20-30	17%	8.5%	10.14%	4.8%
10-20	18%	38.5%	13.04%	8.5%
Less than 10 year	59.5%	50%	75.36%	66.2%

Fig (3): application of L-matrix diagram [department & year academic job]



research of academic staff	Department Of building & construction	Department Of lazar	Department Of control & system engineering	Department of material
Prof.	١٢.٩%	١٦.٢%	٥.٩%	٨.٨%
Ass. Prof.	٣٨.٧%	٤٠.٥%	٥.٩%	٦٧.٦%
Lect.	١٩.٣%	٣٣%	٥٢.٩%	٢٧.٥%
Ass. Lect.	٢٩%	١٠.٣%	٣٥.٣%	zero

Fig (٤): application of L-matrix diagram [department & research of academic staff]

research task of academic staff	Department Of building & construction	Department Of lazar	Department Of control & system engineering	Department of material
Prof.	٣٣.٣%	Zero	١٤.٣١%	١١.١%
Ass. Prof.	٤٤.٤%	٢٠%	٤.٧%	١٦.٧%
Lect.	٢٢.٣%	٨٠%	٥٧.٢%	٧٢.٢%
Ass. Lect.	zero	zero	٢٣.٨%	zero

Fig (٥): application of L-matrix diagram [department & research task of academic staff]

٨- Figure (٦), represents the relationship of each department to the scientific researches research tasks of academic staff in.

٩-Figure (٧), represents the relationship of each department with the age categories & years on job of academic staff.

١٠-Figure (٨), represents the relationship of each department with the scientific researches & their published site



academic staff	Prof.	△	○	△	△
	Ass.	●	●	△	●
	Prof.				
	Lect.	○	●	●	○
	Ass.	○	△	○	△
	Lect.				
Department		Department Of building & construction	Department Of lazar	Department Of control & system engineering	Department of material
research task	Prof.	●		△	△
	Ass.	●	△	△	○
	Prof.				
	Lect.	○	●	●	●
	Ass.			○	
	Lect.				

● strong relationship

○ Moderate relationship

△ Weak or potential relationship no relationship

Fig (*): application of T-matrix diagram [department & research task academic staff]



Age categories	>60	△		△	△
	50-	○	○	○	○
	40-	○	△	○	○
	30-	○	△	○	○
	<20	●	●	●	●
Department		Department Of building & construction	Department Of lazar	Department Of control &system engineering	Department of material
Years academic _service	>30	△	△	△	○
	20-30	○	△	△	△
	10-20	○	●	○	△
	<10	●	●	●	●

Fig (٧): application of T-matrix diagram [departments with age categories & years of academic job of academic staff]



academic staff	Prof.	△	△	△	
	Ass. Prof.	△	○	△	
	Lect.	○	○	○	
	Ass. Lect.	●	●	●	
Department		Department Of building & construction	Department Of lazar	Department Of control &system engineering	Department of material
Published research	Local	●	●	●	●
	Arabic	△		△	
	international	○	△	○	△

● strong relationship

○ Moderate relationship

△ Weak or potential relationship no relationship

Fig (^): application of T-matrix diagram [department with research of academic staff & site of publishing]

١١- Figure (٩), represents the relationship of ٤ groups , each department to the scientific researches& their published sites and research tasks of academic staff .



academic staff	research	Prof.	△	○	△	△
		Ass. Prof.	●	●	△	●
		Lect.	○	●	●	○
		Ass. Lect.	○	△	○	△
research task		Prof.	●		△	△
		Ass. Prof.	●	△	△	○
		Lect.	○	●	●	●
		Ass. Lect.			○	
Department		Department Of building & construction	Department Of lazar	Department Of control & system engineering	Department of material	
Published research	Local	●	●	●	●	
	Arabic	△		△		
	international	○	△	○	△	

● strong relationship
○ moderate relationship
△ weak or potential relationship no relationship

Fig (٩): application of T-matrix diagram [department & research task academic staff]



١٢- Application Y- type matrix in this research, many calculations must be done for many factors, in order to achieve the relationships of quality indicators, as following;

١- Calculate the percentage of research task for each department:

$$\text{research task for each department\%} = \sum \frac{\text{research tasks}}{\text{academic staff}} \times 100\%$$

$$= \sum \frac{RT}{AS} \times 100\%$$

$$\text{For } D^1 = \frac{45}{188} \times 100\% = 23.9\%$$

$$\text{For } D^2 = \frac{30}{76} \times 100\% = 34.4\%$$

$$\text{for } D^3 = \frac{42}{69} \times 100\% = 60.9\%$$

$$\text{for } D^4 = \frac{36}{61} \times 100\% = 59\% \quad \text{where } D = \text{Department}$$

٢- calculate the percentage of published research to the academic staff:

$$\text{percentage of published research to the academic staff} = \sum \frac{\text{published research}}{\text{academic staff}} \times 100\%$$

$$= \sum \frac{pr}{AS} \times 100\%$$

$$\text{For } D^1 = \frac{31}{188} \times 100\% = 16.4\%$$

$$\text{For } D^2 = \frac{37}{76} \times 100\% = 48\%$$



$$\text{For } D^{\gamma} = \frac{34}{69} \times 100\% = 49.3\%$$

$$\text{For } D^{\xi} = \frac{34}{61} \times 100\% = 53.9\%$$

٣--calculate the percentage of published research for department

As fallow $\sum \text{published research} \frac{\square}{4}$

$$\% \text{ Published research by pro.} = \frac{12.9\% + 16.2\% + 5.9\% + 8.5\%}{4} = 10\%$$

$$\% \text{ Published research by ass.pr} = \frac{38.7\% + 40.5\% + 5.9\% + 63\%}{4} = 36\%$$

$$\% \text{ Published research by lec.} = \frac{19.3\% + 35\% + 52.9\% + 23.5\%}{4} = 43\%$$

$$\% \text{ Published research by ass.lec} = \frac{29.1\% + 10.3\% + 35.5\% + 5.5\%}{4} = 20\%$$

٤--calculate the percentage of research task for department

As fallow $\sum \text{published research} \frac{\square}{4}$

$$\% \text{ research task by Pro.} = \frac{33.3\% + 0\% + 14.3\% + 11.1\%}{4} = 14.5\%$$

$$\% \text{ research task by Ass.Pp.r} = \frac{44.4\% + 20\% + 4.76\% + 16.6\%}{4} = 39.5\%$$

$$\% \text{ research task by Lec.} = \frac{22.3\% + 8.0\% + 57.4\% + 72.2\%}{4} = 39.8\%$$



$$\% \text{ research task by Ass.lec} = \frac{0\% + 23.8\% + 0\% + 0\%}{4} = 6.2\%$$

according to the results achieved, the relationship are putted in the Y-type matrix (department ↔ academic staff ↔ scientific research & scientific tasks ↔ department)

as shown in the figure (١٠):

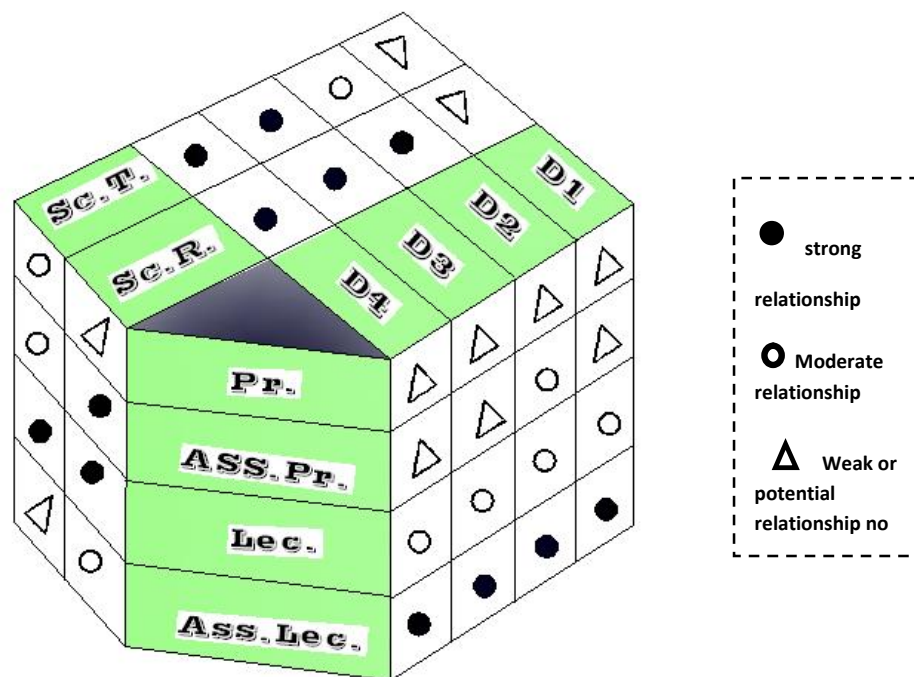


Figure (١٠). Y- type matrix (department ↔ academic staff ↔ scientific research & scientific tasks ↔ department.

٤- Results and discussion:

The results of this study clarify the relationships between the factors involved. According to application L- type matrix diagram, it clarify strong involvement of academic staff of age less than ٤٠ years and job less than ١٠ years. But there is a strong relation between assist Prof. and lecturer with scientific research and research tasks. They show weak relationship



with Prof. because of their high job tasks and their number is the lowest .the Ass. L. need to improve them selves .

Application of T- type matrix indicates that this kind can provide a basis for quality improvements, where the strong and weak relationship s clarified for the quality indicators.

Y-type matrix show the strong and weak relationships of many quality indicators which relates to each other, The results show there is weakness in the(Pr.)degree of academic stuff ,where, there is strength in the number of (ASS.L.) .

it is necessary to strengthen the weak points by encourage and support academic staff for scientific research ,for study Ph.D. and other quality indicators.

Also the results show that there are weakness in the scientific research and research tasks in department (١ & ٢). it is necessary to strengthen the weak points by encourage and support academic staff for scientific research ,for study Ph.D. and other quality indicators.

So, the quality matrix tool is very beneficial and effective to show the strengthens and weakness of the quality factors in the university to take the corrective actions to strength the weak points ,and take the right decisions to improve quality in the university.



٥- Conclusion

The application of quality matrix diagram with academic staff and scientific research quality indicators, indicates that this tool can provide a good basis for quality improvements .

and useful in higher education .

Application of L- type matrix ,show the interrelationships between two quality indicators. -

T- type matrix ,show the interrelationships between two different indicators and how it relates to a third indicator..

Y-type matrix show the strong and weak relationships of many quality indicators which relates to each others.

of quality matrix diagram facilitate the improvement process by clarify the problem areas and where they are concentrated. the matrix diagram portray the action required for quality improvement.

References:

[١] Lydia hartwing: “ quality assessment and quality assurance in . higher education institutions in Germany” Germany, ٢٠٠٣

[٢] Mustafa kamal , sherifa norulakmar, &elt “implementation of Quality Assurance in public Higher Education institutions :university of Malaya experience” university of Malaya, ٢٠٠٧

[٣] Robert Lundquist, , "Quality in higher education –approaches to its management and improvement" Luleå University of Technology, Sweden , ٢٠٠١.



- [٤] Pikseri Julkaisupalvelut , "Standards and Guidelines for Quality Assurance in the European Higher Education Area" European Association for Quality Assurance in Higher Education, Helsinki, ٢٠٠٥.
- [٥]" Quality Assurance of Higher Education in Portugal"
- An Assessment of the Existing System and Recommendations for a Future System ٢٠٠٦.
- [٦] Mahmud kandel, ahmed a. Hassan &elt “ UML analysis for quality assurance management system for Higher Education”, Mansur university, Egypt, ٢٠١٠
- [٧] Academic Audit Porfolio “AUT”university, “correlation between performance and quality af academic staff” , ٢٠٠٧
- www.openpraxis.com/files/Aule%٢٠et%٢٠al
- [٨] National assessment and accreditation council, Bangalore, India”
- "quality assurance in higher education “ , ٢٠٠٦
- [http: // www. Naacindia.org](http://www.Naacindia.org),
- [٩] Bassay usage, akuegue basil & elt “Academic staff research productivity : “university of technology, calabar, Nigeria, ٢٠٠٧
- [١٠] Department of Education, Training and Youth Affairs
- "The Australian Higher Education Quality Assurance," Occasional Paper SeriesHigher Education DivisionCommonwealth of Australia ٢٠٠٠



[١١] "Seven Management and Planning Tools", ٢٠١٠

http://en.wikipedia.org/wiki/seven_management_and_planning_tool

[١٢] Laurie A. Cheung "The matrix diagram": mini tutorial, operations management ٣٨٠, due November ٢٧, ٢٠٠١

[١٣] American society for quality (ASQ) "Seven New Management and Planning Tools" Excerpted from Nancy R. Tague's The Quality Toolbox, Second Edition, ASQ

quality Press, ٢٠٠٤, pages ٣٣٨-٣٤٤

[١٤] paper, "Matrix Diagram", ٢٠٠١

<http://www.systema.com/tqmttools/matrix.html>

[١٥] Billy V. Boise, "Matrix Diagram Power Point". Training Presentation by State University

October ٩, ٢٠٠١

