
# DECISION SUPPORT SYSTEM FOR SUPPLIER EVALUATION FOR HEALTH CARE INSTITUTION

By

Samar Salem El-berns Abd El-motaal

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Systems and Biomedical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

# DECISION SUPPORT SYSTEM FOR SUPPLIER EVALUATION FOR HEALTH CARE INSTITUTION

By

Samar Salem El-berns Abd El-motaal

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Systems and Biomedical Engineering

Under the Supervision of

Prof. Dr. Ahmed Mohamed El-Bialy

Professor
Systems and Biomedical Engineering Department
Faculty of Engineering
Cairo University

Dr. Ahmed Abd El-sameea Mohamed

Doctor
Engineering Mathematics and Physics Department
Faculty of Engineering
Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

# DECISION SUPPORT SYSTEM FOR SUPPLIER EVALUATION FOR HEALTH CARE INSTITUTION

By

Samar Salem El-berns Abd El-motaal

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in

Systems and Biomedical Engineering

Approved by the

Examining Committee

_____

Prof. Dr. Ahmed Mohamed El-Bialy, Thesis Main Advisor

_____

Prof. Dr. Ahmed Hisham Bahey El-Din Kandil, Internal Examiner

_____

Prof. Dr. Ahmed Farag Sedek, External Examiner (Professor, Biomedical Engineering Department, Faculty of Engineering, Helwan University)

_____

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

| | |
|---|---|
| **Engineer's Name:** | Samar Salem El-berns Abd El-motaal |
| **Date of Birth:** | 10/10/1987 |
| **Nationality:** | Egyptian |
| **E-mail:** | Samarsalem21@hotmail. com |
| **Phone:** | 01006208594 |
| **Address:** | Mansoura, hay elgamaaeet |
| **Registration Date:** | 1/10/2009 |
| **Awarding Date:** | 7/9/2016 |
| **Degree:** | Master of Science |
| **Department:** | Systems and Biomedical Engineering |
| **Supervisors:** | Prof. Dr. Ahmed Mohamed El-Bialy<br>Dr. Ahmed Abd El-sameea Mohamd |
| **Examiners:** | Prof. Dr. Ahmed Mohamed El-Bialy (Thesis main advisor)<br>Prof. Dr. Ahmed Hisham Kandil (Internal examiner)<br>Prof. Dr. Ahmed Farag Sedek (Systems and Biomedical Engineering Department, Faculty of Engineering, Helwan University) (External examiner) |
| **Title of Thesis:** | Decision Support System For Supplier Evaluation For Health Care Institution |
| **Key Words:** | Supplier Evaluation, Artificial Neural Network , Discriminant Analysis, Fuzzy Logic. |



**Summary:**

In today competitive world, selecting a good supplier makes a significant difference in an organization's operational costs and the quality of its services. Supplier selection is becoming more significant and more complicated with the variations of purchase methods. Since the organizations are heavily dependent on suppliers, choosing the wrong one may cause problems during both the purchase phase and maintenance phase.

The supplier evaluation systems provide decision makers with real time awareness about the supplier's performance. In a typical supplier evaluation and selection process, suppliers are analyzed due to specific criteria such as quality of product, purchasing cost, after sale service and delivery due date. This multi criteria - qualitative and quantitative- decision problem is a complex process which requires expertise.

The purpose of this study is to develop a decision support system to help decision makers to evaluate and select suppliers that satisfy the needs of hospital from medical equipment based on their performance according to some specific criteria. The developed systems are implemented by two techniques. The first model is developed by using artificial neural network (ANN) combined with discriminant analysis. The second model is developed by using fuzzy logic (FL).

The decision support systems for supplier evaluation and selection were applied in KASR EL Aini hospital as a case study. The developed decision support systems were applied to real data for number of suppliers of large sized medical equipment that have been dealt with for a long period.

# Acknowledgments

***In the name of Allah, the Most Gracious and the Most Merciful Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this thesis.***

***Special appreciation goes to my supervisor, Prof. Ahmed Elbialy Professor in the Systems and Biomedical Engineering department, Faculty of Engineering, Cairo University for his valuable contributions. ***

***I am deeply grateful to prof. Ahmed Hesham kandil Professor in the Systems and Biomedical Engineering department, Faculty of Engineering, Cairo University, for his detailed and constructive comments, whose letters gave me important guidance during my first steps in technical work and for his important support throughout this work. ***

# Dedication

*Special thanks go to my husband Eng. Ahmed el-sherbeny for his continuous help; I would like to tell him that; his gratitude will never be forgotten*

*NO word thanks my mother for her endless support and loves not in this part of my life only but in all my life stages and always kept my spirits high.*

*I would like to express my deep and sincere gratitude to my father Mr. salem El_Brins for his support.*

# Table of Contents

# List of Tables

# List of Figures

# Nomenclature

| | |
|---|---|
| MCDM | Multi-criteria decision making |
| ANN | Artificial neural network |
| NN | Neural network |
| SO | Supply order |
| QS | Quality certificates |
| COO | Country of origin |
| TOC | Type of company |
| AMC | Authorized maintenance center |
| QOT | Quality of training |
| WP | Warranty period |
| RT | Response time |
| DT | Down time |
| VMC | Value of maintenance contract |
| MH | Matched high pattern |
| ML | Matched low pattern |
| OUTH | Value of matched high pattern |
| OUT L | Value of matched low pattern |
| FL | Fuzzy Logic |

# Abstract

In today competitive world, selecting a good supplier makes a significant difference in an organization's operational costs and the quality of its services. Supplier selection is becoming more significant and more complicated with the variations of purchase methods. Since the organizations are heavily dependent on suppliers, choosing the wrong one may cause problems during both the purchase phase and maintenance phase.

The supplier evaluation systems provide decision makers with real time awareness about the supplier's performance. In a typical supplier evaluation and selection process, suppliers are analyzed due to specific criteria such as quality of product, purchasing cost, after sale service and delivery due date. This multi criteria - qualitative and quantitative- decision problem is a complex process which requires expertise so it is very difficult mission to be done manually.

The purpose of this study is to develop a decision support system to help decision makers to evaluate and select suppliers that satisfy the needs of hospital from medical equipment and consumers based on their performance according to some specific criteria that are Supply orders, Quality certificates, Country of origin, Type of company, Authorized maintenance center, Quality of training, Warranty periods, Preventive maintenance, and Corrective maintenance, down time, Warranty period and the value of maintenance contract.

The developed systems are implemented by two techniques. The first model is developed by using artificial neural network (ANN) combined with discriminant analysis. The second model is developed by fuzzy logic (FL).

The decision support systems for supplier evaluation and selection were applied in KASR EL Aini hospital as a case study. The developed decision support systems were applied to real data for number of suppliers of large sized medical equipment that have been dealt with for a long period.

Artificial Neural Network combined with discriminant analysis were used to implement the first model in 2 stages, first building NN and verify all its parameter as number of input nodes, number of hidden layer, number of hidden nodes, number of output nodes, training algorithm, architecture of the network, maximum error and number of iteration, in the second stage discriminate analysis was used to calculate final score of the supplier. Feedforward backpropagation network based on pattern recognition theory was used to build the network. In the NN, the training phase of network is done by using training set of data that contains information about 12 patterns and its desired scores as the training process is supervised training, the test phase of network is done by apply test set of data that contain information about 4 patterns and its desired output.

Results of the first model showed that presence of authorized maintenance center, Preventive maintenance, and Corrective maintenance (response time, quality of maintenance), Country of origin, down time are the main factors which have great impact in the performances of the suppliers. With a total error 1.07.

Fuzzy logic was used to implement the second model in 2 stages, first building fuzzy inference system and defined all its parameter as fuzzification interface, rule base, database, decision-making unit, and finally defuzzification interface, the second stage is apply inputs and test the model to test the output of fuzzy inference system. Mamdani's Method was use to implement the fuzzy inference system and center of

gravity method was used as defuzzification. The data of 6 suppliers were used as input to fuzzy model and the output from defuzzification was the score of the 4 suppliers.

Results of the second model showed that presence of Preventive maintenance, and Corrective maintenance (response time, quality of maintenance), Country of origin, down time are the main factors which have great impact in the performances of the suppliers. With a total error 1.9.