



# **A CONFLICT RESOLUTION MODEL USING LOGIC SCORING OF PREFERENCE FOR EXPERT SYSTEMS**

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**ABSTRACT:** An Expert System is a type of system that usually has a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular solution. It is an Artificial Intelligence Based System that performs task that otherwise is performed by a human expert. A problem with these systems is that it may output several Possible Causes for a set of Symptoms. In return, the user will still have a coarse time in doing diagnostic procedures. A solution to this problem is to apply a Conflict Resolution model. This paper presents a Conflict Resolution model using Logic Scoring of Preference (LSP) to be used in an Expert System for Information System Communication Networks. This can aide the user in diagnostic procedures and reduce trial and error.

**Keywords:** Conflict Resolution, Data Management, Expert Systems, Information Systems.

## I. INTRODUCTION

Artificial intelligence is maybe the most important technical contributor in the future [1]. Systems that can make jobs or processes faster are advantageous.

An example of an Artificial Based System is an Expert System. This type of system simulates the judgment and behaviour of a human or an organization that has expert knowledge and experience in a particular field or intends to embody the ability and knowledge of an expert in a specific domain [2].

In this era of fast growing Technology and Communication systems, it is very important for corporations and industries to develop Support Division environment technologies to facilitate and diagnose its own Information System Communication Network. The integration of a Helpdesk Contact Center in the organizations structure is of vital importance to a large corporation. Employees of the company are the customers of the division. They facilitate the technical concerns of the employees and diagnose them at the soonest possible time to minimize the delay in operations.

For this research Information System Communication Networks refers to the internal technical backbone of an organization solving problems that relate to Information and Communications Technology (ICT), computers and their networking, hardware, firmware, and software applications. The Conflict Resolution Model that was developed will be applied in an Information System Communications Network division of a telecommunications company.

## II. EXAMPLE OF DEVELOPED EXPERT SYSTEMS

One of the earliest developed Expert Systems which were developed in the early 1970 at Stanford University was the MYCIN [3]. It was the Doctoral Dissertation of Dr. Edward Shortliffe and was written in LISP. This Expert System was programmed to identify the bacteria that can cause severe infections and to recommend antibiotics. This expert system uses an Interference Engine that is composed of six hundred rules. The system will query the physician running the program with a long series of text questions. The result will be a list of possible bacteria that is responsible for the disease. The system will also give a recommended method of treatment. A research conducted by Stanford Medical School found that MYCIN gives a correct diagnosis percentage of 65% which was beneficial to most physicians who



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are not specialists in that field. This Expert System was never used in practice not because of its weakness in performance but due to its ethical and legal issues on the use of Expert Systems in Medical Diagnosis.

Another example of developed Expert Systems is the Caduceus [4]. It was an Expert System developed by Harry Pople in the University of Pittsburg. It started in the early 1970's. It took a long time to finish and was based on his interviews with Dr. Jack Meyers, one of the top internal medicine diagnosticians. Their intent was to improve the MYCIN Expert System. Instead of focusing on internal medicine, this Expert System can possibly diagnose 1000 diseases.

Another Expert System that was created is the MEXSES [5]. This program is a prototype for environmental screening. This software draws a number of Environmental Impact Assessment Techniques in an attempt to combine the most appropriate elements into one intelligent, comprehensive and knowledge-driven. This Expert System manages a database of project assessments and a geographical database of maps and geo-referenced data. This system provides potential environmental impacts in an early stage. The Expert System draws on broad knowledge and databases on project characteristics based on a hierarchical classification scheme and generic profiles. The system's knowledge base is limited to a few examples of checklists and rules for one problem class.

An additional example of a developed Expert System is IMPACT. It is an Expert System used for environmental analysis screening tool that was developed by the US Department of Energy [6]. This software uses a simplified approach to assess the different kinds of impacts like proximity effects, groundwater effects and water pollution. The software gives its results by giving a tabular written report.

By year 2001, NASA's Artificial Intelligence Group Information Systems Technology Section created the Spacecraft Health Inference Engine (SHINE). This system was designed to operate in a non-simulated environment and to be utilized using C and C++ programming languages [7]. Its knowledge base systems include automatic task planning, diagnosis and other applications which require different software modules based on artificial intelligence concepts and advanced programming techniques. This knowledge base can also be customized to meet the user's own problem-solving representations and techniques.

A publicly available Expert System was developed in 2006 by the Expert Health Data Programming called the STD Wizard [8]. It is used for determining which vaccinations, screening tests and evaluations are recommended which are related to sexually transmitted diseases. The information included in this Expert System is based on the Centers for Disease Control and Prevention "Sexually Transmitted Diseases Treatment Guidelines – 2006". This Expert System is web-based and asks a series of questions to the user. There could be 100 questions but the Expert System usually asks about 20.

A challenge in these Expert Systems is Conflict Resolution. If two or more rules in the Interference engine gave a high output, which one will you fire. Few techniques were attempted to solve this problem [9]. One of them was the Means End Analysis (MEA). It was first introduced in General Problem Solver [10]. This search process over the problem space aims to combine aspects both forward and backward reasoning. This approach focused problem-solving on the actual differences between the current state and that goal or calculate the difference between each available option and the goal state. A disadvantage of this is if used in an Expert System is the definition of a goal state. The rules were that goal state that was defined will be fired without consideration to the unfired rules which still have a chance to be the Possible Cause (PC). This paper will present a new Conflict Resolution Model for Expert Systems. It will be applied in Information System Communication Networks.



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## III. CONFLICT RESOLUTION MODEL

The Logic Scoring of Preference (LSP) model is basically used for evaluating complex hardware and software systems like websites. This model was re-engineered by the author to be used as a Conflict Resolution model. This is the first time that it was used in an Expert System. It was used to give a weight to the ones an Expert System has suggested to what the most probable cause.

This model was used on the rules an Expert System. The algorithm on how to incorporate it from website ranking to Quandary weighting for expert systems was originally developed by the author Different input parameters may give different probable causes of problems. As in real applications, given different symptoms, a human expert may have different suggestions to a problem and give percent sureness to might have caused the problem [11]. The Conflict Resolution Model algorithm will give the weight. This algorithm can be used in formulating the relationships of the symptoms of the problems, in which symptoms have sub symptoms with different credence relationships.

**Table I**  
**Symbols and Parameters of the ANDOR Function [12]**

Operation	Symbol	d
Disjunction	D	1.0000
Strong QD(+)	D++	0.9375
Strong QD	D+	0.8750
Strong QD(-)	D+-	0.8125
Medium QD	DA	0.7500
Weak QD(+)	D-+	0.6875
Weak QD	D-	0.6250
Square Mean	SQU	0.6232
Weak QD(-)	D--	0.5625
Arithmetic Mean	A	0.5000
Weak QC(-)	C--	0.4375
Weak QC	C-	0.3750
Geometric Mean	GEO	0.3333
Weak QC(+)	C-+	0.3125
Medium QC	CA	0.2500



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Harmonic Mean	HAR	0.2274
Strong QC(-)	C+-	0.1875
Strong QC	C+	0.1250
Strong QC(+)	C++	0.0625
Conjunction	C	0.0000

The degree of simultaneity  $r$  is represented by this equation:

$$r = \rho(d) = \frac{-0.742 + 3.363d - 4.729d^2 + 3.937d^3}{d(1-d)}$$

An example is when the operation is an Arithmetic Mean, the value of  $d$  is 1 and the value of  $r$  will be 0.5.

The strength of the model over merely additives resides in the power to deal with different logical relationships and operators to reflect the evaluation needs [12]. This strength is advantageous to the Expert Systems which have a Problem and Symptoms relationship. The final products of these systems are Problems with different types of symptoms wherein these symptoms are related with each other. Depending on the number of symptoms, the parameters used for the quandary weight are being selected in the relationship table in the database.

The Algorithm of the Conflict Resolution Model is as follows:

- 1) Obtain the percent sureness inputted by the user.
- 2) Match the corresponding percent sureness to its equivalent Symptom.
- 3) Initialize the value of the initializing variable  $A$  as the feature of the Elementary Preference  $E_i$ . Let  $L$  be the function for evaluating the Elementary Preference  $E_i$ .
- 4) Determine the number of features in the aggregation block as  $N$ . Its value is the number of Conditions necessary to satisfy the Symptoms.
- 5) Obtain  $W$  which is the weight of the specific feature by dividing 100 to the number of features in the aggregation block  $N$ .
- 6) Determine the value of degree of simultaneity  $r$  by matching its and/or functions to  $L$ .
- 7) Substitute the values to  $e_0 = (W_1E_1^r + \dots + W_kE_k^r)^{1/r}$  the result of the equation will be the weight for the Possible Cause.
- 8) Repeat for all the Possible Causes that satisfies the Symptoms.



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## IV. DATA AND RESULTS

### A. Rules of the Expert System from the algorithm

The Algorithm and the Conflict Resolution Model will be tested and validated using actual Data. The Data are the problems encountered by a Network Support Division or Information System Communication Networks of a telecommunications company. For Confidentiality purposes, the actual name of the company will not be disclosed.

**Table II**  
**Table of Symptoms**

ID	Symptom
S1	Conflict with TSR Running Program
S2	Computer Virus Message
S3	Computer Motherboard beeps
S4	Memory Overflow message appears
S5	Error message regarding autoexec.bat or config.sys
S6	USB Virus message
S7	To many programs running on startup
S8	The URL Cannot be accessed through the MDB Portal
S9	Network Connection Error Appears
S10	Mapped Drive Cannot
S11	MOM Alerts on Server: SVREBPPDBS01
S12	MOM Alerts on Server: SVREBPPEBS32
S13	SVR-MDBSPPS-01 Cannot be accessed
S14	SVRMDBADDC12 Cannot be accessed
S15	CPU hangs
S16	Clicking anything can take minutes before computer response
S17	Computer cannot recognize Mc Afee
S18	Video Card Slot is loose
S19	Printer Error Light Blinks
S20	CPU Turns off few minutes after opening
S21	CPU Clock keeps on Changing

**Table III**  
**Table of Possible Causes**

ID	Symptom
PC1	MOM Alerts Critical Error
PC2	MOM Alerts on Application
PC3	Kronos Error
PC4	Domain Server Unavailable
PC5	OS Disk Error config.sys
PC6	File Cannot Be Copied
PC7	Public Folder Cannot Be Accessed
PC8	Cannot Access Application Error MDB Portal



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**Table IV**  
**List Of Symptoms and Possible Cause (PC)**

<b>Possible Cause:</b>	PC1: MOM Alerts Critical Error
<b>Symptoms:</b>	S8: The URL Cannot be accessed through the MDB S9: Network Connection Error Appears S12: MOM Alerts on Server: SVREBPPEBS32
<b>Possible Cause:</b>	PC1: MOM Alerts Critical Error
<b>Symptoms:</b>	S1: Conflict with TSR Running Program S4: Memory Overflow message appears S8: The URL Cannot be accessed through the MDB S10: Mapped Drive Cannot be accessed S11: MOM Alerts on Server: SVREBPPDBS01 S19: Printer Error Light Blinks S21: CPU Clock keeps on Changing
<b>Possible Cause:</b>	PC2: MOM Alerts on Application
<b>Symptoms:</b>	S5: Error message regarding autoexec.bat or S6: USB Virus message S21: CPU Clock keeps on Changing
<b>Possible Cause:</b>	PC2: MOM Alerts on Application
<b>Symptoms:</b>	S13: SVR-MDBSPPS-01 Cannot be accessed S14: SVRMDBADDC12 Cannot be accessed S15: CPU hangs
<b>Possible Cause:</b>	PC3: Kronos Error
<b>Symptoms:</b>	S21: CPU Clock keeps on Changing
<b>Possible Cause:</b>	PC4: Domain Server Unavailable
<b>Symptoms:</b>	S3: Computer Motherboard beeps S10: Mapped Drive Cannot be accessed S12: MOM Alerts on Server: SVREBPPEBS32 S15: CPU hangs S17: Computer cannot recognize Mc Afee
<b>Possible Cause:</b>	PC4: Domain Server Unavailable
<b>Symptoms:</b>	S2: Computer Virus Message S9: Network Connection Error Appears S10: Mapped Drive Cannot be accessed
<b>Possible Cause:</b>	PC5: OS Disk Error
<b>Symptoms:</b>	S6: USB Virus message S8: The URL Cannot be accessed through the MDB S9: Network Connection Error Appears S11: MOM Alerts on Server: SVREBPPDBS01 S13: SVR-MDBSPPS-01 Cannot be accessed S19: Printer Error Light Blinks S21: CPU Clock keeps on Changing



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<b>Possible Cause:</b>	PC6: File Cannot Be Copied
<b>Symptoms:</b>	S1: Conflict with TSR Running Program S6: USB Virus message S7: To many programs running on startup S8: The URL Cannot be accessed through the MDB S13: SVR-MDBSPPS-01 Cannot be accessed S15: CPU hangs
<b>Possible Cause:</b>	PC7: Public Folder Cannot Be Accessed
<b>Symptoms:</b>	S4: Memory Overflow message appears S19: Printer Error Light Blinks
<b>Possible Cause:</b>	PC8: Cannot Access Application Error
<b>Symptoms:</b>	S1: Conflict with TSR Running Program S10: Mapped Drive Cannot be accessed

**Table V  
Rules of the Expert System**

<b>Rule 1</b>	$(S8 = 1) \& (S9 = 1) \& (S12 = 1) \Rightarrow (PC = 1)$
<b>Rule 2</b>	$(S1 = 1) \& (S4 = 1) \& (S8 = 1) \& (S10 = 1) \& (S11 = 1) \& (S19 = 1) \& (S21 = 1) \Rightarrow (PC = 1)$
<b>Rule 3</b>	$(S5 = 1) \& (S6 = 1) \& (S21 = 1) \Rightarrow (PC = 2)$
<b>Rule 4</b>	$(S13 = 1) \& (S14 = 1) \& (S15 = 1) \Rightarrow (PC = 2)$
<b>Rule 5</b>	$(S21 = 1) \Rightarrow (PC = 3)$
<b>Rule 6</b>	$(S3 = 1) \& (S10 = 1) \& (S12 = 1) \& (S15 = 1) \& (S17 = 1) \Rightarrow (PC = 4)$
<b>Rule 7</b>	$(S2 = 1) \& (S9 = 1) \& (S10 = 1) \Rightarrow (PC = 4)$
<b>Rule 8</b>	$(S6 = 1) \& (S8 = 1) \& (S9 = 1) \& (S11 = 1) \& (S13 = 1) \& (S19 = 1) \& (S21 = 1) \Rightarrow (PC = 5)$
<b>Rule 9</b>	$(S1 = 1) \& (S6 = 1) \& (S7 = 1) \& (S8 = 1) \& (S13 = 1) \& (S15 = 1) \Rightarrow (PC = 6)$
<b>Rule 10</b>	$(S4 = 1) \& (S19 = 1) \Rightarrow (PC = 7)$
<b>Rule 11</b>	$(S1 = 1) \& (S10 = 1) \Rightarrow (PC = 8)$

Tables 2, 3, 4 and 5 shows the Table of Symptoms, Table of Possible Causes, List of Symptoms and Possible Causes and the rules of the Expert System respectively.

### B. Application of the Conflict Resolution Model

The Conflict Resolution Model is applied in the rules in Table 5. There are instances when symptoms are inputted, different set of Possible Causes will appear. Example when we input S1, S10 and S19. A percent sureness of 100% was inputted for all the symptoms as shown in Figure 1.

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Input associated Symptoms and corresponding sureness:

Conflict with TSR Running Program (S1) 100%

Mapped Drive Cannot be accessed(S10) 100%

Printer Error Light Blinks (S19) 100%

MOM Alerts on Server: SVREBPPEBS32 (S12)  
SVR-MDBSPP5-01 Cannot be accessed. (S13)  
SVRMDBADDC12 Cannot be accessed. (S14)  
CPU hangs (S15)  
Clicking anything can take minutes before computer response (S16)  
Computer cannot recognize Mc Afee Installed. (S17)  
Video Card Slot is loose (S18)  
**Printer Error Light Blinks (S19)**  
CPU Turns off few minutes after opening (S20)  
CPU Clock keeps on Changing (S21)

Fig. I Inputting the Symptoms of the Expert System

Figure 1 shows the user interface to input the symptoms of the Expert System. It has an autocomplete feature to input the symptoms and a select feature for the percentage sureness.

Do you want to Enter new Symptoms? [click](#)

Do you want to Start Again? [click](#)

Problem Cause	Quandary Weight
PC4: Network IP Address Conflict <a href="#">other symptoms click</a>	14.674703763023
PC7: Printer Fuser Assembly error <a href="#">other symptoms click</a>	32.634981231175
PC8: Internet Email cannot received/sent <a href="#">other symptoms click</a>	100

Fig. II Output of the Expert System

The Possible Cause 4, 7 and 8 will be suggested by the Expert System as shown in Figure 2. Take note that based on the Conflict Resolution model the PC with rules that have the most number of values to the once inputted will have the higher Quandary Weight; therefore based on the data that is most likely the Possible Cause.

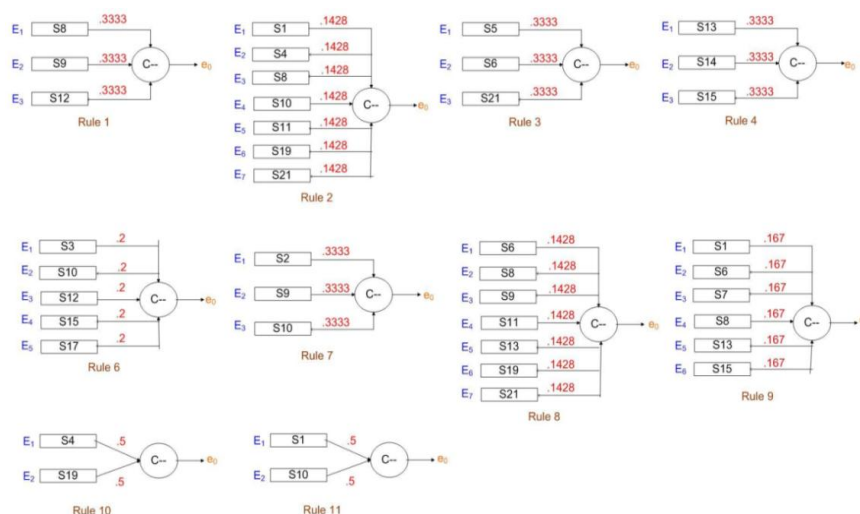


Fig. III Model of the Possible Causes





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Figure 3 shows the model for the Possible Causes for Table 5. These symptoms have a weak relationship that is why an and/or of C-- is defined. Take note that Rule 5 has only one condition. In order to use the Conflict Resolution model there should be at least two or more conditions.

## V. ANALYSIS AND CONCLUSION

Conflict Resolution is important in Expert Systems. The System may suggest different outputs for a set of symptoms. Without Conflict Resolution, the user will have a hard time in its diagnostic activities and may still result in trial and error. This paper solved that predicament by creating a novel Conflict Resolution Model. This Model is used in Information System Communications Networks.

The Conflict Resolution model is used in actual data. It gave quandary weights to the output suggested by the Expert System. The highest weight was outputted by the most likely cause of the Problem based on the Information System. This research created a new Conflict resolution model for Expert Systems by completely re-engineering the LSP that previously can only be used in websites.

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