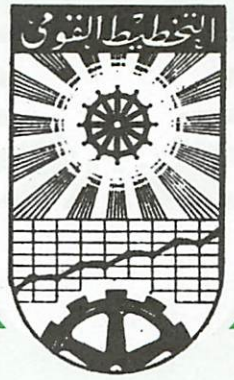
ARAB REPUBLIC OF EGYPT

THE INSTITUTE OF NATIONAL PLANNING



Memo No (1650)

Using Intelligent Decision Support Systems in Selected Aspects of Health Care

Prepared by
Basmah El Haddad, Ph.D.
Computer and Systems Analysis

March 2012

CAIRO
SALAH SALEM St-NASR CITY

Using Intelligent Decision Support Systems in Selected Aspects of Health Care

Researcher

Basmah El Haddad, Ph.D.
Computer and Systems Analysis

Human Development Studies Dep.
Institute of National Panning

Cairo
June 2011

Abstract

Research Title

Using Intelligent Decision Support Systems in Selected Aspects of Health Care

Researcher: Basmah El Haddad

Brief Abstract

The research introduces the need of using agent technologies in assisting and aiding the responsible parties and decision makers during the decision-making process in general and in the Human Organ Transplantation Management "HOTMS" domain in specific. The medical scenario is assumed to be a real application of a decision support system. The research proves that integrating agents with their various types, techniques and interaction abilities in decision support systems generally and HOTM systems especially, can provide a great support to decision makers and help them to make right decisions and solve problems in a highly advanced fashion.

The research also introduces and studies precisely the main definitions and background of all the interdisciplinary related fields, like "Artificial Intelligence", "Agent Technology", "Intelligent Decision Support Systems" as well as the Human Organ Transplantation Management System, in order to point to the significance of using the multi-agent technology during the HOTMS.

From one side, the main contribution was represented by introducing the Human Organ Transplantation Management System Structure for the particular case of Egypt. While from the other side it also contributed by introducing, explaining and presenting the proposed Multi-Agent Human Organ Transplantation Management System architecture with its various proposed agent types and roles integrated in the HOTM System. It is assumed that the system will be of great help on the national level as well on the regional level as the HOTMS is considered now one of the most important services to be provided by the government and which has been recently on the spot for development and establishment.

Table of Contents

List of Figures

List of Tables

Acknowledgment

I would like to thank very much Prof . Dr. Azza Al Fandary, the head of the Human Development Studies Dep. at the Institute of National Planning for her valuable help and fruitful during discussions.

&

I would also like to thank Mr. Muhammad Afifi the researcher at the Institute of National Planning for his assistance for the data & information gathering and for useful discussions.

Using Intelligent Decision Support Systems in Selected Aspects of Health Care

Chapter One

1. Introduction and Overview

Health care is one of the government's major concerns; it has been on the spot recently for improvement, enhancement and development. The health care domain is facing many problems and complications which require efficient planning, decision making, management and problem solving techniques.

The Intelligent Decision Support Systems IDSS in this domain promise to support decision making in the medical industry as a whole. It assists the different parties, health care professionals and providers during the clinical and medical processes as well as the managerial processes. The IDSS have the ability to add main features and facilities that could assist in countless areas of this domain starting from gathering just-in time information, storing and retrieving it, real time processing, online transaction processing, coordinating and communicating, connectivity and global interaction, continuous examining and monitoring, real-time data analysis and diagnosis and many other areas in this domain.

1.1. The Research Problem and Questions

A lot of studies and reports announce that underdeveloped countries and communities are suffering from high birth rates leading up to overpopulation and all associated needs. These needs result in a variety of challenges and problems on different levels and with respect to various dimensions. In Egypt we are estimated to double by the year 2050, i.e. reach a whopping 160 million. So one of the most pressing issues in the Egyptian healthcare domain is the horribly growing number of liver and kidney patients who are in urgent need of organ transplantation surgeries to save their lives. Recently, and according to the ministry of health and population they estimated the liver patients to be around 10 millions, from which one million at least need a new liver through an organ transplantation surgery. As well as a number not to be underestimated of patients who are in need of other organs such as heart or pancreas.

This, lead the Egyptian government to finally take their decision to allow the organ transplantation surgeries by issuing the **"Human Organ Transplantation Management", HOTM** law after fourteen years of debate, due to the importance of the organ transplantation which stems from the fact that it clearly draws the thin line between life and death. Shortage of such organs raises the mortality and morbidity rates and may as well lead to physical and social complications. They were motivated by the success of organ transplants and the newly developed surgery techniques and medical treatment world wide. One human donor can save one patient, while one human brain-dead donor can save up to eight lives; with his/her eight different organs.

The **HOT** coordination and management is quite a complex process that involves many different organizations, persons, norms and laws. It requires administrative as well as clinical process management. High level of knowledge management, planning/scheduling, coordination and monitoring is also required. The stressing time constraint is a very important aspect due to the nature of the problem. The HOTMS contains two main phases; **Procurement** and **Surgery** phase. Each of them includes many managerial and clinical processes which raise challenges and problems during their execution. In addition, there are many parameters influencing the whole process varying from medical, logistical, managerial ... to ethical. The **Matchmaking** and the **Negotiation** processes during the **Procurement** Phases include some of the main challenges facing the **HOTMS** and the human decision makers and medical experts involved in the system.

In this aspect some **Research Questions** and **Issues** have been raised in an attempt to solve them during the following study as follows:

1- How should the **Human Organ Transplantation Management System's Structure** -in Egypt- look like and why the researcher believes it will be the most fitting for Egypt ?
2- What would be better, an HOTM system relying on centralized or decentralized processes?

3- Is there any chance for negotiations during the procurement phase? And how about using **Intelligent Match Making** and **Negotiation Techniques** !

4- One of the main questions is the ability to rely on techniques and technologies from the AI domain generally and the agent technology specifically as a main contributor of an **IDSS** during the **Human Organ Transplantation Management Processes.**

5- On which techniques should the decision makers relay in specific when building the proposed **Intelligent HOTM System.** And how should the systems architecture look like?

6- Does the proposed intelligent HOT System assure the fairness, effectiveness and efficiency of the allocation process and the whole HOTM Processes?

All these questions have been analyzed, tackled and answered to some extent during the research and in specific in the second part of it during chapter four and five.

1.2. The Research Objectives

The main objectives of the research are to answer and tackle the research questions and try to solve the main problem through proving what follows:

1- The importance of using intelligent systems and technologies from its broad concept, in assisting and aiding the responsible parties and decision makers during the decision-making process in general and in the Human Organ Transplantation Management System, **HOTMS** in specific.

2- Integrating agents with their various types, techniques and interaction abilities in the HOTM domain provide a great support to decision maker and help them to make right decisions and solve problems in a highly advanced fashion. It also assures an improved degree of autonomy, responsiveness, pro-activeness, mobility, social ability and flexibility.

This will be accomplished through providing and achieving specific objectives like follows:

- **Presenting** and **introducing** the literature review and definitions of **"Intelligence", "Artificial Intelligence"** and the **"Intelligent Decision Support Systems"** as well as introducing various **"Intelligent Decision Making"** techniques to encourage decision makers and planners to make use of these different technologies under the umbrella of "Artificial Intelligence" to benefit from its advantages during decision making and planning in the healthcare domain generally and its different topics specifically.
- **Encouraging** researchers from interdisciplinary fields to **apply** and **use** the artificial intelligence technologies and techniques when developing and implementing their intelligent decision support systems
- To **draw** the health care professionals, stockholders, parties and medical specialist's attention to the intelligent systems and techniques used in the health care domain by presenting and defining the intelligent medical and clinical decision making and the classification of the intelligent decision support systems in the health care domain as well as giving some examples and applications in different areas of the domain.
- **Proposing** and **introducing** a **Human Organ Transplantation Management's System Structure** to be considered and adopted while establishing the Egyptian **HOTM** System in the near future.
- As a **proof of concept, proposing and introducing** a **Multi-Agent HOTM System Architecture** to be considered in **Egypt** considering it a real application of decision making systems. Providing it guarantees efficiency, effectiveness and high-quality HOTM services. It also should assure fair and safe resource allocation that saves time, effort and money.

In this Aspect, one will proof that there is an urgent need to develop mechanisms and systems that help to decrease the percentage of losses in each phase and process. Therefore it is worth it to elaborate intelligent systems, efficient information systems and tools to be used as decision supporters during the HOTM. These must have some communicative, informative, cognitive and negotiating functions to guarantee secure distributed communication, maintaining