Application of Native XML Database in Hospital Marketing Decision Support Systems

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Abstract- *In knowledge economy era, with the fast growth on WWW, the emerging web services and customer relationship management (CRM) issues are being widely concerned. Many hospitals are eager to establish their own CRM system to provide quality service and discover some metadata that new customers may have. Once the amount of service is increased, huge data will be accompanied. In the light of the extracted information from medical database, it can be used to hold the relationship between the medical personnel and the customers. Thus, how to find and exploit useful knowledge from the database is critical to survive for the hospitals to consolidate customer faithfulness and raise their competence. This study is to develop a hospital marketing decision support system utilizing the essence of knowledge sharing and related technique to explore XML-formatted data from the so-called native XML database. With the help of a case-based model, the result will assist hospital marketing decision-makers in making their decisions to meet customers' requirements and cater for the marketing strategy tendency. This paper will contribute not only to the hospital marketing decision support but also to any related applications where the knowledge issue and native XML database are concerned.*

Keywords: Decision Support Systems, Hospital Marketing, Native XML Database, Case-based.

1. Introduction

Decision Support Systems (DSS) are usually applied to comprehend all trades and professions, especially in military, law, healthcare and enterprise domains as helpful auxiliaries for decision making. With the increased number of new business model and knowledge application, many information technologists were interested in finding out how DSS has been changed and what DSS might look like in the next decade.

The adoption of use-case in producing decisions is one of the fundamental factors to achieve a successful modern decision support event [2]. According to the fact we hope decision makers can be provided the very constructive suggestion that produce in accordance with rules and experience; and furthermore, people who make use of DSS can record and share their precious decision cases. Speaking generally, this can be treated as a "knowledge-sharing model". The important aspects of this model include the decision gestating process against the data retrieving and the knowledge sharing among those decision makers incubated.

In this study we will adopt both the pith and marrow of DSS and the core component as our basic foundation to provide a means of specifying a knowledge model called knowledge-based system and provide a formal representation of our recommendable decision in a knowledge-spreading manner. The insight granted by Sprague's framework [10] we adopt is that it characterizes how knowledge-based component can be utilized at the moment in which decision makers affect as if a tugging action had been applied in a simple way.

On the other hand, extensible markup language (XML) has become a famous tool to not only facilitate DSS decision brewing between each component in the system but also assist in the decision reciprocal processing. XML is a universal language for describing and exchanging data on the sphere of action due to its standardization ability and flexibility.

Besides, to the part of data management, why users store information in XML rather than relational format is often a question, with a great majority of having an RDBMS system in place that can store relational data, program objects and multimedia content. An XML server can store XML data natively, which means without further conversion into other formats, and it can query and transform that data using the Web and XML specifications and interfaces. In addition, it integrates cleanly with Web servers and application servers in existing infrastructures. This provides clear benefits in time to market and total cost of ownership when an organization is challenged to deal with increasing volumes of XML data.

From this point of view, the goal of this study is to develop an integrated knowledge based hospital marketing DSS modeling and decision service sharing environment which utilizes the knowledge

model approach and technique to store and retrieve XML-formatted data from the so-called native XML database. Contrast to some application studies of DSS [1, 7, 8], we will describe the decision case in XML format for knowledge interaction and attempt to improve the decision data storage environment. With the help of our trial system, decision makers will be provided with decisions produced either in direct process or in particular knowledge repositories retrieval. Furthermore, the system should allow users to make use of conceptual application of the native XML database to exchange and share their experienced case of decision opinions with others on the Web. Accordingly, the following sub-goals should be achieved:

(1) To design a data operation process in accordance with the XML format to file source data and cases, presenting not only the data repository but describing also the used case.
(2) Decision makers at different situations can add their experiential opinions and comments after case reference. People's lesson learned earlier is valuable. Users interacting with similar scenario immediately helps accomplish the specific task.
(3) To assist system users (decision makers) in meeting the effective business strategy of hospital marketing. According to the CSF (Critical Success Factors) established, users are guided to find out the similar cases for references and can have some decision reforms at their own will.

2. IT Applications in Health Care

The medical domain increasingly views IT (information technology) as a fundamental asset in providing health-related information services and decision support on demand. Accordingly, it is an arduous challenge to support health-related decision making in a strategic and innovative manner for IT practicing through the health care organization and IT developers [9]. Over the past decades, questioning the desirability of data growing is almost consequential outcome. But for a modern corporation, it has promoted to a higher level that the data quality is more value-added in the process of data gathering. There are two significant issues that almost all companies will experience:

- Dirty data — the quality of data can influence the company's strategy decision making. Besides, data incompatibility also affects the quality of decision making.
- Data aging — It is only natural that circumstances change with the passage of time. The older data will lose their significance and meaning.

It is well known that too much data available will be hard to absorb it all. The key to solving this situation is to roast the related information as knowledge. It is helpful to give a granting access to data full of patient-care and insurance records, as well as critical medical information for decision producing that agrees with business logic [6].

As a whole, the situation between the medical industries and application of IT has changed ever since. The combination of health care and IT application must consider how to progress health care records with appropriate IT tools. In other words, the innovative and valuable information extracting is becoming a futurism. For this reason, an IT facilitator has to focus on the design and development of applications to capture, retrieve, store, standardize, and enrich the information in new trial using famous IT tools or standards. In addition, it is also very important to convince or entice the expert to share their valuable experience and knowledge.

3. Research Method and Consideration

Based on DSS aspect, the solicitude of our study includes two main parts:

(1) Data operation: As mentioned above, poor data quality leads to poor decision-making. With the marvelous data growing, data gaps are constantly understood entirely in terms of incomplete or inaccurate data. Some researches have extended this notion by formulating dimensions of data quality that range over intrinsic, accessible, contextual and representational issues. Data processing about warehousing is not adequately served by data gathered to underpin the core functions of the system destination.
(2) Decision re-knowledge: Viewing an issue from a knowledge reuse perspective, how to raise the treasure of priceless added worth in decision case is very important. In other words, the solution which records user's operation processing of a problem is constantly generated by the knowledge acquired from past rule and experience and its extension to fit new situation for knowledge reusing.

Thus, the following are taken into account:

- On one hand, the raw data will be classified and stored effectively to provide initial decision; and on the other hand, we will formularize each used case in XML format to increase the efficiency.
- We should display the applicable idiosyncrasy for decision making in the light of well-regulated data and certain suitable CSF.
- To accomplish knowledge sharing, typically, a case repository is to be constructed in which cases are collected for references. Besides we should allow specific users to provide their precious experiences in that repository.

Figure 1 shows the problem-solving flow, where in substance, we added the case cleansing event to the standard process of case-based approach. The case cleansing process is composed of three modules: case extraction, case transformation and case loading.

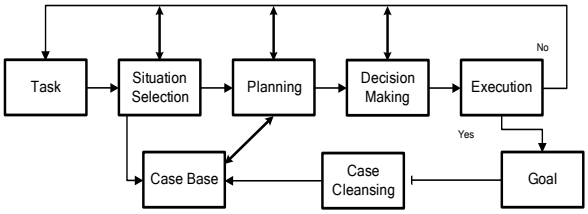

Figure 1. The problem-solving flow

This study combines the prototyping and CSF (critical success factors) as our development foundation stone [5]. The prototyping involves exhibition of planning, design and implementation phases concurrently time and again. In this way the system can be quickly practiced and modified. More precisely, the prototyping method is able to aim at constructing our DSS in a series of short steps with immediate feedback from users to ensure that development is proceeding correctly. On the other hand, it is very appropriate to implant the CSF to our system incubating. In order to fulfill our study goal, we set a few useful CSFs for examining the relationship between patients and hospitals. We will observe the causality through the patient's behavior by setting underlying directions and finding out its implication for hospital marketing:

- Who—it means "who" comes to the hospital; in this study, patient's sex is the target we monitoring; we can find the sex occupation for medical marketing.
- What—it means "what" department patient registers; it implies the objects the marketing provides; we will watch the trend of hospital department.
- When—it means "when" the patient visits the hospital; it symbols the occasion patient chooses; we will focus on the trend of each month.
- Where—it means "where" is the hospital section patient goes; it is able to expect the patient's regional relations and hospital's outlets; we will monitor the patient's address zip code and hospital's branches.
- Which—it means "which" about patient's objects; it helps us to trace the patient's illness; we will monitor the patient's drug for days in this aspect.

In marketing strategy aspect, the realization of patient's behavior can lead to several results as follows [3]:

- We can discover the patient target and its properties.
- The more accurate trend of patient we can control, the more beneficial marketing strategy we are able to decide.
- We can evaluate the marketing goals and potential for service providing.
- The closer we get to the patient, the more accurate demand we can nose out.

4. System Architecture and Development

We now proceed to present our system design and implementation. At first, we have to design the formats of the source data and the used case.

4.1. Data initiation

4.1.1. Source data initiating. We have found that to recognize dirty data in the source data repository is one of the most challenging problems. Generally, data cleansing process can assist in this predicament. Briefly speaking, data cleansing is a strange but useful aspect of the whole data processing that makes us capable of ascertaining the extent of the data pollution.

Accordingly, we pick a famous data classifying format of data cleansing for data extraction, transfer and load. The format is composed of two parts, sociological section and medical section in this study. Since weighing gains and losses in harmony with our purpose, we select several significant fields as the meaningful representation. Figure 2 shows the fields and their corresponding values.

```
Sociological Data:
No:001   ID:W100000001   ID_SEX: M
Age:25
Addzip:233
FUNC_SEC:01

Mmedical Data :
FUNC_TYPE: 01
FUNC_MONTH:8
DRUG_DAY:3
PRSN_ID: Zhao
CARD_SEQ: 6
PART_AMT:50  T_APPL_AMT:250  T_AMT:300
```

Figure 2. An instance of the source data

4.1.2. Case representation. Before embarking on a used case repository initiative, we have to deploy some basic preprocesses. As is known to us, a case is the primary knowledge element in our case-based application, which defines a situation or problem in terms of natural descriptions and answers to questions and associates with each situation a proper business action. Figure 3 shows an example case in XML, which contains the following elements [4]:

- Situation—Describing the scenario the event happened at the moment in general.
- Question—What embarrassed situation it involved.
- Action—The decision user had made and the priority user concerned.
- Experience—What users want to share and annotate in certain case.

```
<?xml version="1.0" encoding="utf-8"?>
<Property Category="Success"  ino:id="2">
   <basic>
      <owner>Johnson</owner>
      <no>12530</no>
      <strategy>marketing</strategy>
        </basic>
   <Description>
      <scenario>Growth in the market for health care information
technology will be subdued in certain segments, predicted R.L.
Johnson, president of R.L. Johnson and Associates,
"If the industry continues as it has the last five years, I see a 5%
growth rate," Johnson said. He expects installations to increase by
about 10% in the next few years, basing his estimates on a survey of
65 to 75 top vendors and their signed and expected contracts.
"Hospitals don't have the capital funds to buy equipment anymore,"
Johnson says. "I think the best way to go will be with a lease." </
Text>
      <marketing4P>Price</Area>
      <PKI>0.111</PKI>
      <Times>1</Times>
   </Description>
   <ContactPerson>
      <Name>garden</Name>
      <Annotate>waiting result</Annotate>
      <Email>garden@naxdb.good</Email>
   </ContactPerson>
   <Price>84750</Price>
</Property>
```

Figure 3. A case instance represented in XML

4.2. System Architecture

The system architecture as shown in Figure 4 contains three main modules.

- Case Base Module—This module is responsible for use case manipulations, including the case delivery, sharing, reform and re-knowledge. It is important to ensure the identification of the pertinent information whenever needed.
- Model Base Module—Model base module is composed of CSF analysis model, scenario suggestion and knowledge sharing model.
- Data Management Module—In a reaffirmed look at this data management component, it is specialized to store the XML documents and is able to handle those kinds of XML documents uniformly and parse them efficiently regardless of their structure.

4.3. Implementation and demonstration

The entry user interface to our system includes three main functions: (1) Data creation: when the situation needs for the raw data, users can create the data in this frame; (2) Case creation: the knowledge providers or experts intend to share their experiences in this frame; (3) Decision support: in this frame, users are able to define their condition in order to know the performance and look for the similar case for referring. Since data and case creations are trivial and space is not allowed, this paper focuses on the decision support demonstration as follows.

Step1: When entering the decision support interface, users can refer the suitable indicator first. The indicator includes the five aspects discussed earlier, i.e., who, what, when, where and which. As an example, we select the "what" in Figure 5 and go to next step.

Step2: If we select "what" for further information, the corresponding chart will be displayed. At this moment, we can think about what situation we stand and consider carefully through our know-how. If we do not quite follow its implication for our decision making, we can click the button "Let's go!" to search for more helpful information. In this example, as can be seen in Figure 6, when we enter this page from "what", we can see the summarized data related to each of the hospital's departments. If we feel that the patient numbers of Obstetrics-Gynecology and Pediatrics are less significant but have no idea what has caused this, we can go next into the case base for consultation (i.e., click "Let's go!").

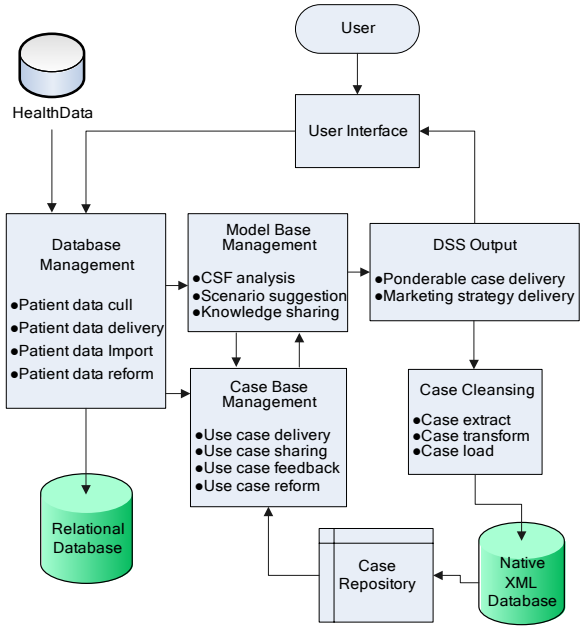

Figure 4. The system architecture

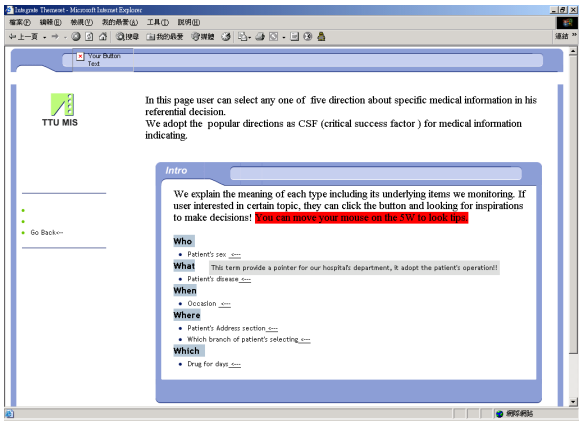

Figure 5. The decision support Interface

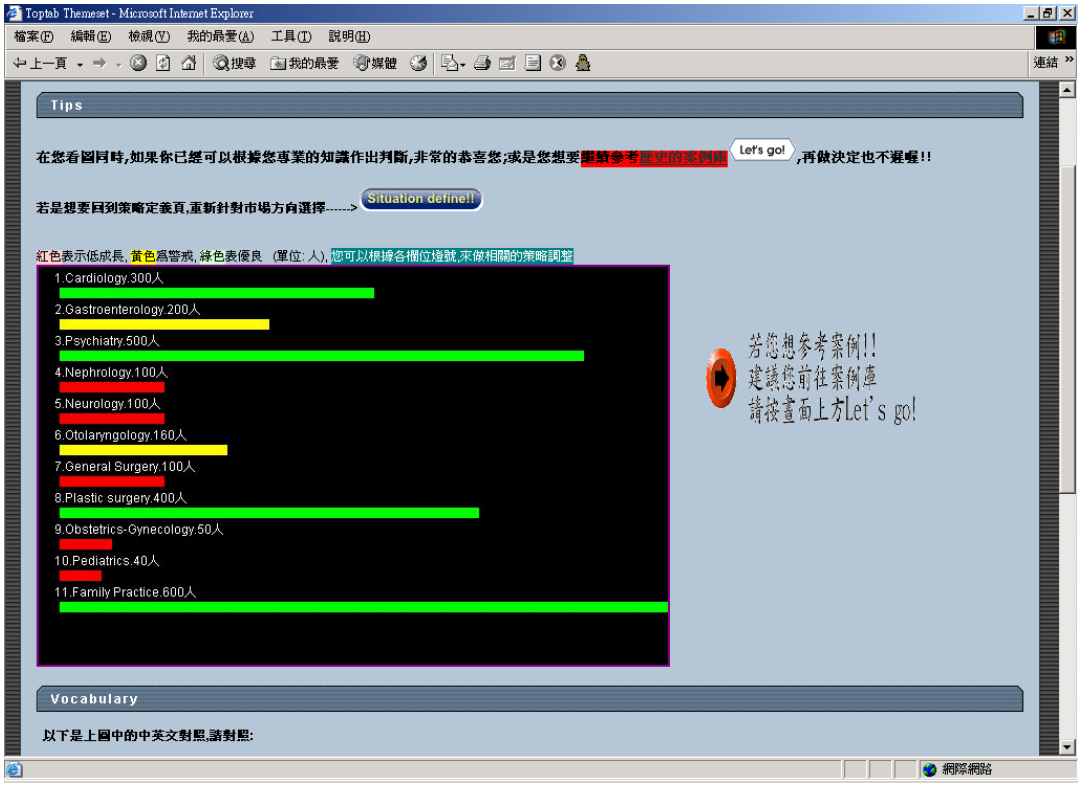

Figure 6. The CSF related chart for the "What"

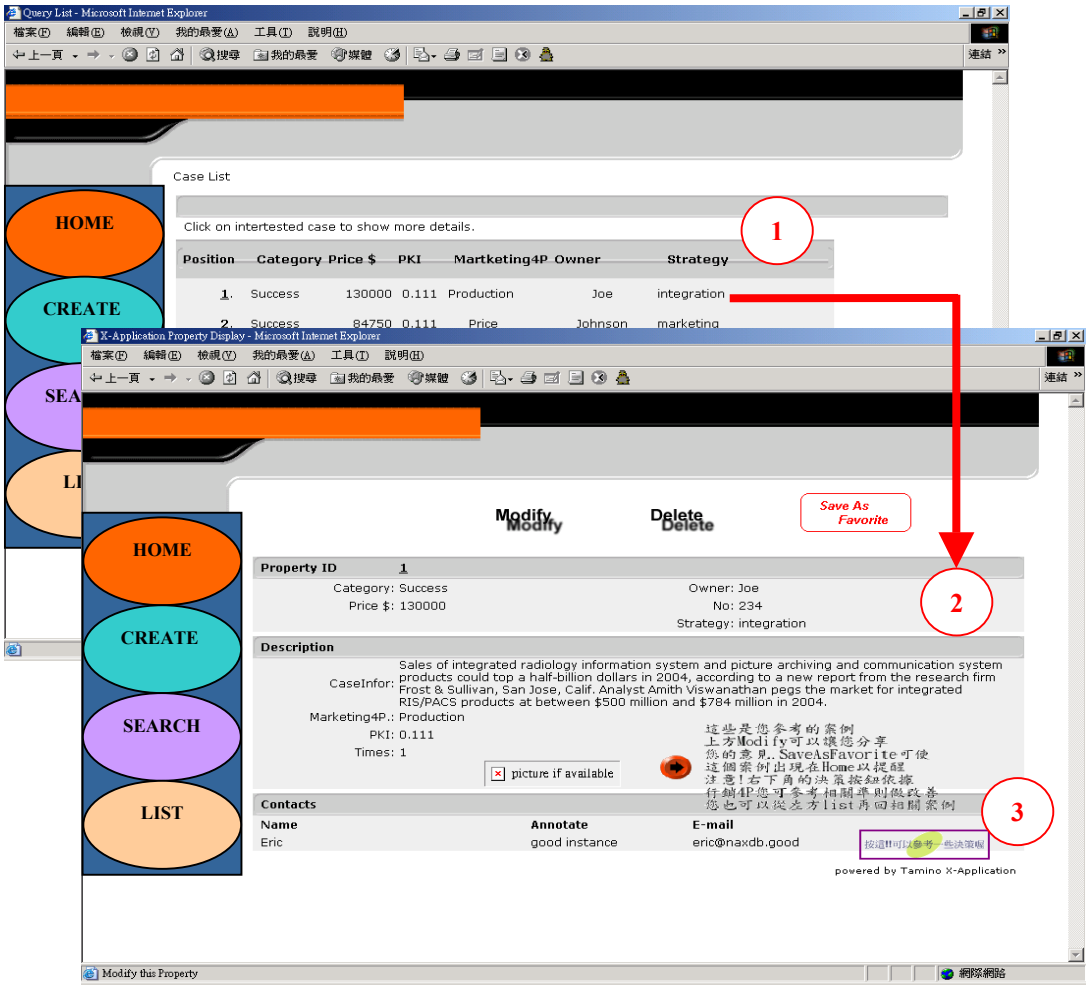

Figure 7. The case list and case information

Step3: In the case-searching frame, the important search key fields are "Category", "Owner" and "PKI". The "Category" means it is a successful or failed case; the "Owner" means the case's ownership; the "PKI" means the rate of certain case is to be executed, i.e., the case practiced frequencies divided by total practiced frequencies in this case base. In this instance, suppose we want to look for the "success" case to refer.

Step4: In Figure 7, successful cases are listed in the first window, and the second window shows the detail case information when selecting one. Base on the perspectives of Marketing4P we may be able to select the one suits our problem. In this instance, we select the "production" case (in area "1") to look it up further. If we still have no idea about what to do after referring the case, click the button at the right lower area (marked "3" here), some useful decision suggestions will be provided (see next step).

Step5: In Figure 8, when clicking the "decision help" button highlighted at "1", the frame with the Marketing4P rules will be popped up (as shown in where marked "2"). We can select one topic related to the case in step4 to take a look at the physical decision rules. As illustrated in the window where we marked "3", the suggestion about the production strategy is provided.

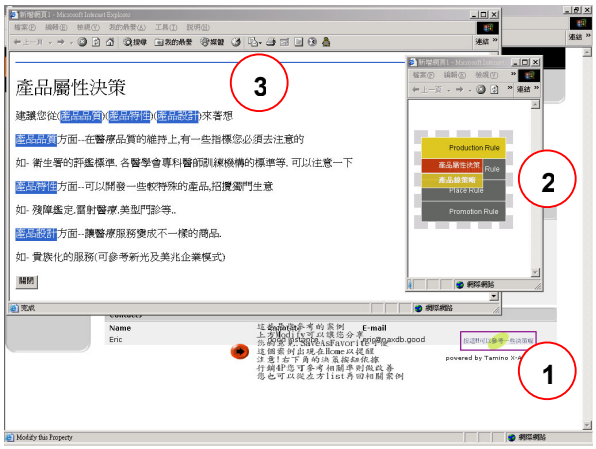

Figure 8. Auxiliary decision and doctrines

In a word, the particular users can refer to the valuable decisions or ponderable cases made or picked by our system component. In the next place, the case we refer will follow a common widely known XML standard and will be managed in an innovative trial that by this way its database model can be applied to the case in XML-format exactly.

In decision support aspect, since our system combines the historic cases with the doctrines came into effect, it is able to exhibit some unique properties that lead to finding out the way to deal with the situation users had met.

5. Conclusions

This paper has addressed how the introduction of a new paradigm for knowledge sharing can lead to a closer integration of IT application and medical industries. In practice, the emphasis in this study has been on relating the development of XML database to those decision support frameworks in which the "knowledge" is the archetype. The implications include: 1) encouraging the used case operation in substance, 2) enriching the intension of case based result in the knowledge sharing, 3) establishing a modified problem solving diagram to provide the more valuable experience for case repository.

Theoretically, the case cleansing process we adopted allows users who are in hesitant situation to follow the direction for decision making. In sum, the hospital marketing DSS in health industries not only promises to revolutionize marketing related strategy formulating but provides a historic case interactive mechanism for sharing experiences. Knowledge's recurring makes the experience enriched and provides a right-decision shield for decision makers.

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