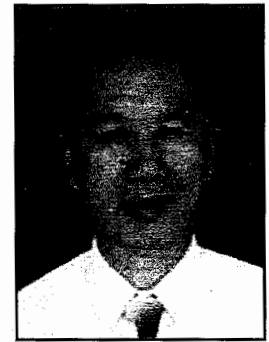# Recent Trends and Challenges of HIS in China: The Growth Potential Using M and Caché

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1. Introduction

During the past six years, several new developments and implementations of hospital information systems (HIS) were made in China. These developments mean that a new milestone in progress and achievements has been made in Chinese HIS history. A number of issues and concerns still remain to be solved. The objective of this paper is to describe briefly those related challenges. We believe that the way we adopt the mature technical innovations and absorb the experiences of HIS is very important.

2. Background

Compared to developed countries, in China we have unique conditions that must be considered in developing computer applications. As we review the systems and the progress of developing Chinese hospital information systems, it is important to see the unusual factors that have had significant impact here on these applications in hospitals. In the past, most hospitals in China lacked adequate budgets, long-term vision, and human resources. The main thing they could do about HIS was to develop or implement small computer applications running on microcomputers for some hospital departments. During the period from the '80s to the beginning of the '90s, there were no HIS running on mainframe machines in our country. Only a very few hospitals in main cities, like Beijing, Shanghai, or Guangzhou were able to use even minicomputers as the hardware platform for computer applications. At that time, most of the hospitals developed small applications software using dBase, Foxbase, or Foxpro databases running on PCs. Although we know of some successful experiences in other countries in developing larger HIS, we could not efficiently share their experiences because of our limited resources. However we still struggled to do everything we could and to build our own systems. The most important result we got was an increase in the number of trained technical people and teams working in the hospital environment. In addition, we also had the experience of using M technology to develop the applications for the medical and other applications. Even now, there are some hospitals in China that still rely only on M for their HIS applications. Meanwhile, the special committee of M Technology of the China Medical Informatics Association (CMIA) was established in 1982 to promote the application of M in China. Many people worked hard on this effort, with considerable success. We also have received a lot of help from our good friends in foreign countries, such as Dr. Ichiro Wakai in Japan, Professor Richard Walters in the U.S.A. and many others, including help from InterSystems Corporation and MTA-NA. While we talk about the progress in using M technologies in China, we should never forget the effort contributed by pioneers, and the help from friends.

3. Recent Trends in the Development of HIS in China

A lot of progress has been made. During the past six years several new HIS were developed and implemented in Chinese hospitals. Most of these new HIS systems were sponsored either by our government or by foreign companies. After 1994, the development of HIS in China entered an important stage: the second wave of HIS development. With the support of the Ministry of Health and Trisum/Wise Company (which is a joint venture company between the Institute of Hospital Management of the Ministry [China] and NEC [Japan]), the project of HIS based on client/server infrastructure was started in order to meet the basic requirements of Chinese hospitals. In 1996 they finished the first stage of their CHIS development plan. Almost at the same time, the staff at Number 301 Hospital designed and implemented another HIS. A little later the Shi Long hospital also finished their new HIS. These new systems focused on GUI and client/server architecture based on network technologies. They all chose PC computers as the end-user desktops, and use PowerBuilder or other rapid development tools to develop the application software running on client's and windows NT Server platforms. The systems were based on relational technology using Microsoft SQL server or Oracle. The main objectives of

those HIS projects have been achieved. The previous experiences of developing department applications in Chinese hospitals were very useful in developing new HIS systems. The engineers of technical teams were mainly taken from the different hospitals that already had computer applications. Among them, some chief engineers had more than 10 or 20 years' experience working in the hospital environment of developing computer applications, so they could easily understand the actual needs of hospitals and could better communicate and cooperate with healthcare professionals. These factors were of great benefit to assure the success of the HIS projects.

So far, three new HIS products mentioned above have passed the evaluation processes and gotten approval from The Ministry of Public Health to formally enter the market. These three products are: "CHIS" from the Trisum/Wise company; the "InforMed" from the Number 301 Hospital; and the "HIS-SL" from Shi Long Hospital. This effort marks a new milestone in the development of HIS in China. However, when you look at those newly-developed HIS in more detail, you find that they have both strengths and weaknesses.

● Strong points:
  ● More powerful functions covered than previous HIS used in China;
  ● GUI and client/server infrastructure-based;
  ● Commercialized HIS products;
  ● Evaluated and approved by the Ministry of Public Health;
  ● More easily accepted by other hospitals.

● Weak points:
  ● Mainly centered on financial and administrative usage, and not centered on electronic patient records;
  ● Lack of testing maximum load conditions;
  ● Inadequate speed, reliability and security;
  ● Difficulty in adapting the application software for end users;
  ● Performance and scalability of systems need to be enhanced.

While we fully acknowledge the achievement of these newly-developed HIS, we should be very clear that there is still much more to be done. The narrow focus and inflexibility of the existing HIS make it almost impossible to build on these systems for future enhancements. It is necessary to design more advanced, robust and powerful HIS systems from scratch to meet the challenges at the transition to a new century.

4. Challenges

Health information is vital and complex. For example, when a patient seeks health care, a caregiver needs to know allergies, chronic conditions, current medication, and other pertinent healthcare information in order to provide effective treatment. Yet, such information is not always easily accessible. Obviously, we need advanced HIS to create, use, store, and retrieve patient records.

Despite the progress in HIS in China, we still have much to do to meet current and future requirements and functionality. Not only do we face the task of providing the huge number of Chinese hospitals with appropriate HIS to promote the quality of health care in the near future, but we must also consider the coming healthcare delivery systems reform and re-engineering needed for each hospital. The task of developing new HIS still remains, and we have more challenges. These challenges include:

  ● meeting the further requirements of the next generation HIS. Until now, the HIS used in Chinese hospitals have been centered on financial and administrative functions. There are only a few direct clinical functionalities involved. Most of them are small-sized HIS and might not run robustly in heavy-load situations. We not only need to expand the functionality of these hospital information systems, but also to start the work of developing the next generation HIS that is based on the Electronic Patient Record as soon as possible.

  ● meeting the needs of the changing healthcare delivery system. It is said that we will have a new healthcare delivery system in China by the end of this century or the beginning of the new century.

  ● adapting the fast-changing environment of technology innovations, such as Internet web applications, object technologies, and component programming methods.

Considering the above challenges, we should have more powerful and scalable databases as the foundation of HIS. Thus, it is much better to choose the new Caché databases based on M Technology instead of a relational database. Caché is a high-performance, post-relational database management system that was announced in September 1997. This is a new class of database combining the speed and scalability of transactional multidimensional data models with the power and flexibility of object technology. In Caché there are full object capabilities, an efficient and scalable multidimensional data model, multi-ways integrated access including optimized SQL access, and distributed data caching protocol. Caché is ideal for complex transaction processing applications needed in HIS. Because of Caché's unique data model structure, Caché transcends the limit of relational database models. The multidimensional data server of Caché is able to

eliminate the time-consuming joins and table-hopping that are the bottlenecks and limitation of relational databases. With Caché, data access is virtually unaffected by the size of the database, allowing your applications to scale up without slowing down. Scaled from a few users to tens of thousands of users, Caché still can perform with unusually high speed.

For application development, Caché comes with built-in mechanisms for creating ActiveN, C++, Java and web-based interfaces. Developers have full flexibility to choose their preferred rapid development tools or programming languages including Visual Basic, Power-Builder, Delphi, etc.

The WebLink and its WebLink Developer environment integrated with Caché provide a high-performance, state-of-the-art connection between Caché post-relational database and Web server, and make it easy to craft the Web interface for Caché applications using popular Web page creation tools as well.

According to the research profile of the Aberdeen Company1, object databases are rapidly improving in flexibility/extensibility to support the complex data typically required by new application. Aberdeen finds that Inter-Systems' Caché is now achieving the kind of scalability, robustness, extensibility, programmer productivity support, and Internet "goodness of fit" that makes it an attractive choice for new complex-data transaction-processing applications.

5. Growth Potential Discussion
By the end of this century and in the beginning of the coming century, HIS in China will certainly make great and significant progress. M Technology and Caché will play a more important role in the development and deployment of Chinese HIS.

Today, innumerable real-world applications are demanding more complex types of information and the database that supports them must deliver complex-data scalability, flexibility, and greater programmer productivity. After our evaluation, we find that new object databases like Caché allow us to add performance, functions, and access techniques to the core database engine. The new features give us not only the ability to meet the new application needs with complex-data scalability, extensibility, and programmer productivity, but also better fit new technology innovations, such as the Internet and object-oriented development tools.

In the past, only a few people in China adopted the M

Technology to develop the applications used in hospitals and the medical field. Since the developers lacked experience with M, they did not know the unique benefits that could be gained from M Technology. On the other hand, it is very interesting to see that those people in China who have used M Technology all became enthusiasts to promote the applications of M in China, because they recognized the benefits of the excellent M Technology. Since China is so big a country and market, and the development and deployment of HIS in our country is still in its pilot or infant stage, there should be plenty of room for M to enter. Because of the continuous evolution of M, such as binding to object technology and other innovations, M and Caché became more powerful and easier to use, and will be accepted as platforms to develop HIS in China.

The unique features of Caché have shown that it is worthwhile to adopt to replace the relational database and become the next generation of HIS in China. Those kinds of new HIS not only will be centered around the electronic patient records, but will be the foundation and architecture for Internet-based EPR (Electronic Patient Record) applications. The objective is to meet the needs of the reform of health care through establishing region-wide or nationwide integrated delivery networks.

Recently we made a couple of presentations on M Technology and its new progress with Caché post-relational databases to hospital and application developers. For the first time in Beijing in April of this year we also had InterSystems training courses on Caché (including Caché ObjectScript and WebLink). Through these activities, some people were impressed by the speed, performance, and scalability of Caché. They all have shown increasing interest in using Caché databases in HIS and other areas.

The Electronic Patient Records will be the nucleus of our next generation of HIS. These kinds of records are not a "record" in the traditional sense of the term. They must be extended to include health records in the future. The computer-based patient record is beyond the scope of a solo hospital implementing records and will be accessed through an Integrated Health Network (IHDN). All healthcare stakeholders, hospitals, outpatient clinics, community nursing services centers, emergency centers, pharmacies, insurance companies, and healthcare administration organizations, etc. will use computer-based patient record systems across the IHDN.

In order to meet the clinical, financial, legal, and administrative requirements a strong infrastructure must be in

place to support various data capture, storage, processing, communication, security, and other needs. An advanced, flexible, robust and proven technology like Caché database should be given priority as a choice. For example, M and Caché technology have been chosen by all the top ten hospitals in the U.S.A., and thousands of hospitals in the world are using it as the foundation of their HIS. The biggest client/server HIS in the Brigham and Women's Hospital is now daily running Caché-based HIS systems on computer networks linking 5,000-10,000 workstations, and they have a plan to extend its scale to 50,000 workstations by Year 2000.

In China, we are evaluating the Caché database technology in detail, and starting the work of developing a Caché-based new Chinese HIS to meet the requirements of the new century. Hopefully, we will establish a health information framework and complete development of a next-generation HIS for different level hospitals in China in the near future. The new HIS will be centered around the electronic patient records and will have the potential for improving healthcare access, quality, cost and satisfaction.

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