

THE CONSTRUCTION AND IMPLEMENTATION OF DIGITIZATION PLATFORM FOR PRECISION FEEDING OF COMMERCIAL PIG

Shihong Liu^{*}, Huoguo Zheng, Haiyan Hu, Yunpeng Cui, Xi Su

Agricultural Information Institute of CAAS, 100081, Beijing, China

** Corresponding author, Address: 12# Zhongguancun South Street, 100081, Beijing, P.R. China*

Tel: +86-10-68975098, Fax: +86-10-68975098, Email: lius@mail.caas.net.cn

Abstract: In this paper, we described the solution method, system implementation, critical technology, etc. of “The Construction and Realization of Digitization Platform for Precision Feeding of Commercial Pig”. What’s more, we pointed out the architecture main functions of the platform and critical technology taken to achieve the system in detail. The platform includes the following modules: production management, feedstuff management, illness management and production monitor & statistic, implants the digital management of the commercial pig form.

Key words: Precision Feeding, Platform, J2EE, Component Technology

1. INTRODUCTION

Modern enterprises utilize information technology, and make use of information resources, in order to improve the efficiencies and levels of production, management, and decision making.

Compared with the rural economy, agriculture enterprises, as a main force of Chinese agriculture production, own lots of advantages in human resources, technologies, management etc. The digitization of agriculture enterprises possesses the importance of reality and operation and is being applied widely. The agriculture enterprise digitization technologies have been diffusely applied in agriculture production management systems, agriculture decision supporting systems, agriculture production monitor

systems, agriculture production inspection systems, and agriculture product e-Commerce systems (Shihong Liu, 2003).

There are a couple of problems existing in agriculture enterprises, especially in animal husbandry including expanding production scale, soaring intensive level and exaggerating difficulties in production management. Aimed at the peculiar problems in Chinese feeding enterprises and taken the commercial pigs feeding enterprises as an example, it is applicable to establish a comprehensive technology platform which incorporates information collection, information transmission, information optimization, and information monitor. Based on this platform, the enterprises would digitally and visually express, design, monitor and manage all the objects and production processes. Consequently utilizing of computer technologies would support the decision making, and improve the effects of production management. Information technology, as an important factor in agriculture production, is becoming the indispensable part applied in each phase of the feeding process.

Platform for Precision Feeding of Commercial Pig utilizes modern network technology, web technology, modeling technology and component technology. Moreover, it focuses on three significant factors: information collection, information procession and information application. The construction of unified digital platform would effectively avoid the data redundancy, and realize the different functional modules' completely integration, and by implementing network technology and across-platform technology to eliminate the information-isolates, and provide reliable support to breeding and breed selection, scientific feeding, research analysis.

2. SYSTEM SOLUTION

2.1 System Technology Scenario

The system introduces the enterprise architect frame – J2EE, which is comparatively excellent and low-cost. J2EE is designed to provide a component based solution to design, develop, assembly and deploy enterprise application and offer a multi layers distribution application model which could support component based reuse solution, XML based data exchange, unified security patten and agile transaction monitoring (Xiaohua, Liu, 2003). J2EE has superiority in scalability, deployment, operation system independence, platform independence, high performance and total cost. Thus, it could achieve a system design goal with the availability, maintenance, manageability, high performance, high reliability, scalability,

and security. Implementation of J2EE could reduce the cost, speed up system design and application development significantly (Huajun Chen , 2002).

2.2 System Framework

From the point of view of information procession, the technology platform for precision breeding of commercial pig could be divided into 3 layers: information selection, information procession and information application, as shown in figure1 (Renchu Gan, 2000).

Within layer of information collection, the major goal is to acquire knowledge of the domain knowledge and the enterprises' specific requirement of the platform, and prepare for the system analysis and design.

Within layer of information procession, the major goal is to build up the commercial pig's production record database, production inspection database, feedstuff prescription database, and animal disease diagnostic knowledge base. With the support of four databases, the core business process logic layer would be realized by using web development, component based and graphic & report and etc technologies.

Within layer of information application, through the web UI interfaces which are designed to orient to the mass system users, users could promote system level domain knowledge base to accomplish the breeding enterprises' specific business processes. In the module of system statistics analysis, intuitionistic graphics and reports would exhibit the situation of enterprise production and management, thus give support to enterprise decision making. Meanwhile, users could also take their own enterprise' practical need into account, and add data and related knowledge into the database to proliferate the platform's resources (Weidong Zhou et all, 2002).

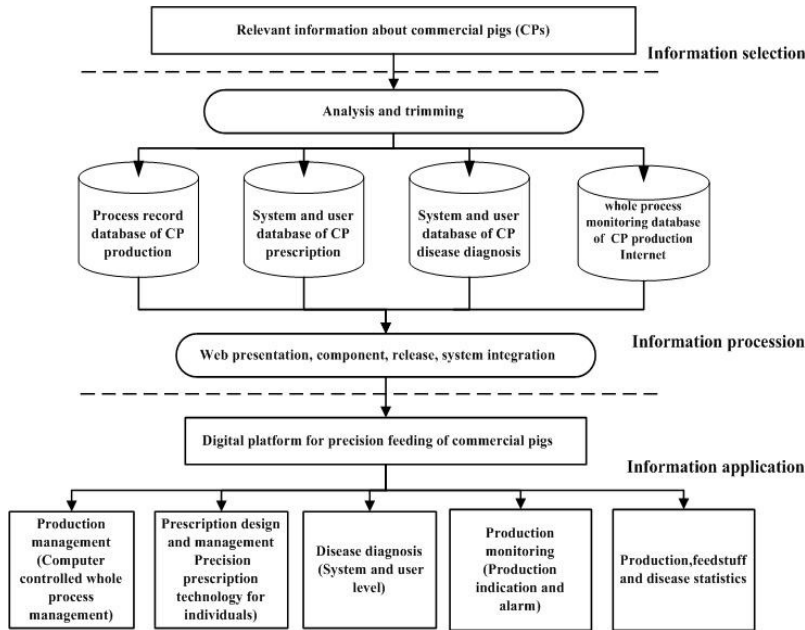


Figure 1. Information procession and information application

2.3 System Functional Module

The technology platform for precision feeding of commercial pig includes functions following: system management, production management, feedstuff management, prescription management, animal disease management, and production inspection & statistics, as shown in figure 2.

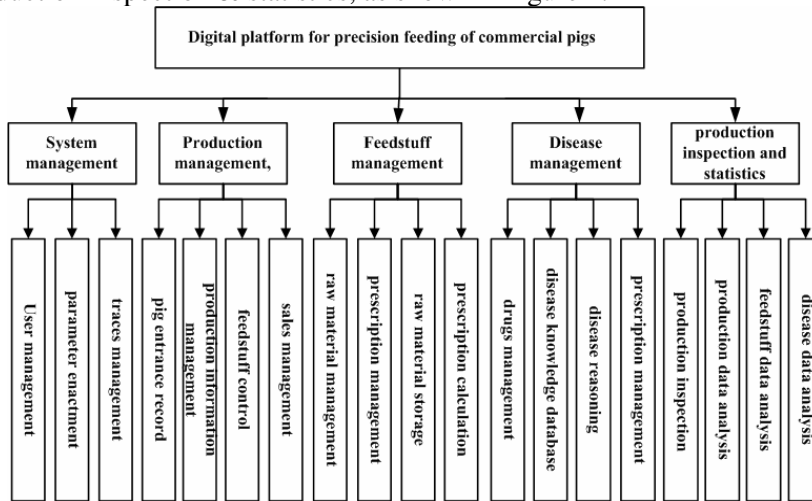


Figure 2. Functional Module

3. SYSTEM IMPLEMENTATION

3.1 Major Function Descriptions

The technology platform for precision feeding of commercial pig introduces J2EE framework, MVC design pattern, client layer / business layer / data layer – three independent layers' component based development method (Chuan Chen, 2001). The 5 major system functions in the platform are as follows:

(1) System Management Sub System: It is responsible for system parameters configuration, user registration, user information maintenance, user authorization, system visit record, database operation record's query, and maintenance. This part is the fundamental premise of the entire platform.

(2) Production Management Sub System: This module monitors the entire processes in commercial pig feeding, and includes several parts: phase management of pig feeding, pig house moving management, feedstuff putting in management, cost management, feedstuff modifying management and sales record management.

In this module, through comparative analysis of feeding patterns in Chinese pig feeding enterprise, couples of common production patterns were found, including 4PF3M (4-Phase-Feeding-3-Moving), 5PF4M (5-Phase-Feeding-4-Moving), and 6PF5M (6-Phase-Feeding-5-Moving). Finally, we chose the 6PF5M pattern which is standard, professional and easy to implement All-In and All-Out streamline technical process to achieve systematic production management.

(3) Feedstuff Management Sub System: It processes the feedstuff, prescription and other related issues, and includes feedstuff resources management, prescription management, feedstuff warehouse management, and prescription computing.

Besides the basic warehouse management functions, this module implements the feedstuff prescription import interfaces, and put forward a java based linear programming minimum cost model to achieve optimum feedstuff computing. Therefore, users could modify and gain their featured prescription according to the enterprise's characteristics.

(4) Illness Management Sub System: It primarily handles pig illness and other related issues, includes illness knowledge base management, illness knowledge query, medicine information management, medicine warehouse management, and epidemic disease management.

This module capsules lots of illness information, meanwhile providing users with accessible interfaces to expand their own illness knowledge base.

It also realizes the FAO AgroVoc based light weight ontology to achieve ontology based pig diseases reasoning algorithm.

(5) Production Monitor & Statistics Sub System: It partly fulfills the alerts and forecasts to production management items in all above sub systems. Besides, the items would view all the forecasts in the module. Moreover, the module partly realizes the numbering statistics of pig, feedstuff employed situation statistics, illness incidence situation statistics to facilitate the managers monitoring the enterprise production operation conditions.

3.2 System Operation

3.2.1 System Runtime Environment

The system's development and operation pattern introduces Tomcat + Java + XML + Crystal Reports + DBMS. The system's specific runtime environment is as follows:

Operation System: Windows 2000 Server (SP4) / Windows XP (SP1)

Java Runtime Environment: J2SDK 1.4.2

Web Container: Tomcat 5.0.19

Database: MS SQL Server 2000 (SP3) Enterprise Edition

Report Server: Crystal Enterprise Report Application Server 9.2 (SP2)

The Client must be compatible of MS IE, and IE 6 (SP1) which are recommended.

3.2.2 System Operation

Put URL into explorer's address, for example <http://localhost:8080/pig-login.jsp>, and the system would turn into a system login page, as was shown in Figure 3.

If the username and password are validated, the system turns into a portal page, as was shown in Figure 4.



Figure 3. system login page



Figure 4. portal page

On the portal page, choosing different functional menus could enter corresponding functional modules, as shown in Figure4.

The feedstuff management interface is as shown in Figure 5.The statistic interface is as shown in. Figure 6



Figure 5. feedstuff management interface



Figure 6. statistic interface

4. KEY TECHNOLOGY

4.1 Object-Oriented Analysis and Design Technology

The research uses the object-oriented analysis and design technology. Feature of the OO is describing the entity in real-life with the properties of the object and integrating the operation relation to the entity. It is better to reflect the characteristic of the entity in the world.

4.2 Enterprise Architect Frame – J2EE

J2EE is a popular architecture frame to be used in enterprise, key feature of which includes better extension, Cross-platform, strong integrating, OO whole, easy to reuse and deploy, independent of operation system, high performance. This frame can offer the whole support to design enterprise application software, so it can be used widely (Ming Li, 2001).

4.3 Component - Based Development Approach

Components have the key features of high-cohesion, loose-coupling, independence-function, strong extension and easy to reuse. Based on program technique of components can program a loosely coupled system, the system is composed of several independent function module so that easy to upgrade and maintenance.

4.4 Information Visualization Technology

The platform shows the daily production data in charts and graphics. Those data relating to statistic and analyze can reflect the disadvantage and advantage directly during the management of enterprise; what's more, it also can forecast the trend and give some supports to the supervisor.

4.5 Thin Client Technology

The platform adopts the B/S module so that the user can access the system through Browser such as IE. It can be efficient to allow the programmer get away from considering the client Browser. Then it make easy to deploy, upgrade and maintain.

5. SYSTEM IMPLEMENTATION FEATURES

(1) We implementing digitization management in precision feeding of commercial pigs including production management, prescription computing, feedstuff management, illness diagnostics, production monitor & statistics.

(2) We introduced J2EE based system platform into commercial animal breeding domain, and developing robust, scalable and high maintenance system.

(3) We built FAO AgroVoc based light weight ontology of pig illness, introducing the ontology based reasoning mechanism and consequently enhance the accuracy of disease diagnostics, and apply the ontology concept and related methods on animal disease diagnostics.

(4) We adopted UML modeling, object oriented database modeling and etc design methods, based on fully understand of domain knowledge and users requirements building system business models, accomplishing the high availability, rationality, reusability and scalability.

(5) We adopted Java technology to develop component based platform of precision feeding of commercial pig. We developed our own warehouse management, production monitor, illness reasoning, feedstuff management, medicine management, prescription management, database encapsulation, user management with 8 high aggregations, loose coupled, high flexibility, and independent function components reusable.

(6) Through data convergent procession, apply data mining, graphic reporting analysis, and tendency analysis technologies, users can realize visual management in feeding enterprise's decision making. Managers can get qualitative judgments from quantificational analysis, consequently improving the pertinence of decision supporting and rationality of decision making.

(7) We Utilized Java technology to design feedstuff and prescription management function based on linear programming and its related principles based design.

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