Purpose: This study was conducted to develop a web-based business management system to ensure the efficient operation and transparent management of government-subsidized agricultural machinery rental businesses. Methods: An MS_SQL2000 database management system (DBMS) solution was utilized in the system for high system compatibility and integrated management. This system was targeted to be compatible with Internet Explorer 6.0 or later and to ensure security and seamless web operations. The system administrator is able to manage a fleet of agricultural machinery, including various inventory codes, release and return, fleet registry, and business performance. Users (farmers) may search the database of rental machinery and reserve them.

Results: With respect to rental reservations, the system administrator can manage the fleet by setting the rental status to Approved, Released, or Returned. Through the web, the administrator can also create a database that includes machinery specifications, features, and rental rates. In addition, business performance data can be analyzed using a diverse array of tools to streamline the rental business. Without having to go to the rental office, users can save time and money by searching for and renting agricultural machinery through the information available on the website, including availability, specifications, and rental fees. After deploying the system, the time required to analyze monthly performance and create reports was dramatically reduced from 20 days per person to one day per person. Conclusions: Since 2014, AMRB has been installed and is operating in agricultural machinery rental businesses in 31 cities and counties in South Korea. This study recommends continued expansion and dissemination of AMRB for the systematic and efficient management of agricultural machinery rental businesses.

Keywords: Agricultural machinery, Management system, Release and return, Rental business, Rental fee

Introduction

Since 2003, the South Korean government has been pushing for an agricultural machinery rental business through the Agricultural Technology Center to ease farmers' burden from purchasing agricultural machinery and to promote the mechanization of farming. The agricultural machinery rental business is being operated with a focus on one- to three-day short-term rentals of machinery, such as seeders, sowers, and reapers, for sectors with inadequate mechanization of operations.

Starting in 2014, government-subsidized agricultural machinery rental businesses are being operated autonomously throughout 140 counties and townships, with an average inventory of 200 agricultural machines. The number of farmers renting agricultural machinery has continuously increased year by year, and by collectively using such machinery, farmers have been able to dramatically reduce the cost of operating farms.

However, expansion in the scale of agricultural machinery rental businesses has significantly increased the burden on business operators and administrative duties, such as fleet, reservation, and performance management, have become difficult to handle. As such, deployment of a web-based agricultural machinery rental business is essential.
for systematic management and transparency in the agricultural machinery rental business.

As examples of web-based construction or government-owned land information systems, Jung (2011) developed a management system capable of verifying basic information, planning, and process history for the efficient maintenance of small public research facilities. Shim et al. (2008) developed a program for managing government-owned land information through image searches, data linking, and lease management functionalities by building a database utilizing the Geographic Information System.

This study was conducted to develop a web-based agricultural machinery rental business (AMRB) management system to ensure the efficient operation and transparent management of government-subsidized agricultural machinery rental businesses.

Materials and Methods

AMRB development environment

An MS_SQL2000 DBMS solution was utilized to develop AMRB for high system compatibility and integrated management. ASP, JavaScript, and ActiveX were used in the development because they are suitable for Windows NT. Additionally, compatibility with Internet Explorer 6.0 or later was targeted to ensure security and seamless web operations.

Composition of process

AMRB consists of two distinct environments for general users (farmers) and administrators depending on user permission. The interface for the administrator mode allows for systematic management of the fleet, machinery images, specifications, and rental rates. General users (farmers) are able to search for rental procedures, machinery specifications, and rental rates, and may request reservations. Agricultural machinery data are entered through the process described in Figure 1, and then stored as final data for subsequent queries.

Composition of system menu

Administrator mode

As seen in Figure 2, the administrator menu consists of code management, rental application management, fleet operations, data output, and rental fee calculations.

Figure 1. AMRB process flow.

Figure 2. Composition of administrator menu.

Code management

Agricultural machinery identification codes have been implemented to systematically manage fleet registry, release/return status, and performance analysis. Using model category index numbers from the “Agricultural Machinery Price Book” (Korea Agricultural Machinery Industry Cooperative) as a reference, agricultural machinery is coded using a three-digit number for the model, a two-digit
number for the attachment, and another two-digit number as a unique identification code (Figure 3). In addition, rental offices (HQ or branch), crops, and job types may also be codified for efficient management.

**Status management**

The administrator can manage the release and return of agricultural machinery by querying the user (farmer) reservation list stored on the database server. The administrator may change the rental status to Rejected, Approved, Canceled, Released, or Returned as required. The number of rentals and the rental fees for the year and by daily rentals may also be viewed.

**Fleet management**

The administrator may enter data, such as specifications, price, format name, rental rate, key features, and images, into the Fleet Registry screen to create a database. The entered data are provided to farmers through the general user screen and saved in the same registry format required by the Ministry of Agriculture, Food, and Rural Affairs.

**Output management**

Completed application forms, contracts (between users and the rental office), and payment receipts can be automatically generated and viewed, printed, or exported. In addition, various business performance aspects can be analyzed on the basis of machinery, period, region, and user by exporting the data to Microsoft Excel. Machinery management cards maintained by rental offices can be printed or exported in the desired format.

**Rental fee calculation**

To continuously operate an agricultural machinery rental business, reasonable rental rates must be set and new machinery must be purchased at the end of product life cycles. Rental rates are calculated by referencing the repair costs and value depreciation for each piece of agricultural machinery. When machinery is selected on the Rental Fee Calculation screen, the corresponding fields are automatically populated with purchase price and repair factor data. The one-day rental fee is calculated using product life and available rental days after entering the residual price ratio and estimated annual rental days. The rental fee calculation formula is prescribed in Equation (1).

\[ R = \frac{D + rc}{d} \]  

where, 
- \( R \) = rental fee (won/day)  
- \( D \) = depreciation (won/year)  
- \( rc \) = repair cost (won/year)  
- \( d \) = estimated rental period (day/year)

**User mode**

As Figure 4 shows, the User (Farmer) Menu consists of “Service Description” and “Rental Reservation.”

**Service description**

Business description, regulations, terms and conditions, safety precautions, rental procedures, machinery, and rental fee information are provided to farmers. Figure 5 illustrates the rental procedures prescribed within the Business Description.

**Rental application**

A user searches through the agricultural machinery
database (set up by the administrator) and selects the desired equipment to rent, at which point the terms and conditions and the rental fee are confirmed and an online application form is submitted. The contents of the application are stored on the DB server, and the administrator queries the reservation list and manages the fleet of agricultural machinery.

AMRB usage effects

The AMRB is provided free-of-charge from the RDA to the respective autonomous rental businesses; thus, a separate purchase is not required. The average fleet of rental agricultural machinery per rental business has approximately 200 units; thus, manual management requires significant time and effort. In reality, many difficulties exist in accurately quantifying the effects of deploying the management system. This study primarily focused on the qualitative effects of deploying the management system and the data collection efforts required for performance reports that were compared before and after deployment.

Results and Discussion

Code and registration management

For a more efficient process to manage agricultural machinery codes, the user is allowed to directly input, modify, and save the data (Figure 6). When registering agricultural machinery, select “Add New” from the “Machinery Type” field and enter a new model name into the “Name” field. When registering attachments, select the main unit from the “Machinery Type” field that corresponds to the attachment, and then select “Add New” from the “Attachment” field to automatically generate and save the code.

The administrator may enter details for newly coded machinery into the Fleet Registry screen. Machinery-specific data such as product purpose, financing, purchase date, product life, specifications, features, and rental fee may be entered along with images (Figure 7).

Rental application and fleet management

For the rental application process, a user searches the text and image database of available machinery and rates
created by the administrator to select the desired item (Figure 8).

After selection, detailed information and a calendar indicating availability of the agricultural machinery are displayed on the screen (Figure 9). The manufacturer, specifications, purpose, and local rental office are included in the detailed information. The user verifies the agricultural machinery and rental terms and conditions and then submits an online application on the basis of his or her desired work schedule.

The rental period, type and scope of work, location, land dimensions, and dates are included in the rental application. The type of crop being worked is selectable in the scope of work (Figure 10). When a rental application is submitted, the machinery name, rental fee, and renter’s address are automatically populated according to the server database set up by the administrator, and the application details are presented in the reservation list within the administrator’s menu.

The administrator may verify rental application details through the application list screen. After making the application, the rental status is registered as Applied, and the administrator may change the status to Rejected, Approved, Released, or Returned as required (Figure 11). The rental status is set to Approved after a renter’s payment is successfully processed or to Rejected for reasons including payment issues or difficulty in using rented machinery. Similarly, the status is set to Released after the rented machinery is released to the renter or to Returned after the renter successfully returns the machinery without any outstanding issues.

**Fleet operation and data output management**

Fleet operation and data output management allows the administrator to view, print, and manage the fleet registry, rental contracts, and earnings. Completed application forms, contracts (between the users and the rental office), payment receipts, and return checklists can be viewed, printed, and managed within the Rental Contracts screen (Figure 12).

The fleet registry, generated according to the administrator’s data entry, can be printed onto cards in the same registry format required by the Ministry of Agriculture, Food, and Rural Affairs, and the full list can be exported in Microsoft Excel format (Figure 13).
Various rental records such as earnings, rental count, and days can be viewed, printed, or exported from the Records Management screen according to year, office, machinery type, or unit (Figure 14). In addition, these records can be exported to Microsoft Excel for a detailed analysis of rental performance.

### Rental fee calculation

When machinery is selected on the Usage Fee Calculation screen, the corresponding fields are automatically populated with price, repair factor, and product life data from the fleet registry. The one-day rental fee to initial purchase price ratio is calculated after entering the residual price ratio, estimated annual rental days, and rental fee rate from the rental rate table (RDA, 2011) on the database server (Figure 15).

#### AMRB usage effects

The effects of AMRB can be evaluated from the perspectives of both the farmer and the business operator. Farmers can save time and money by searching for and renting agricultural machinery without having to go to the rental office by using the wide range of information available on the Internet, including rental procedures, available equipment, and rental fees. The rental business operator can save time and money by systematically managing the fleet, business promotion, rental demand, and performance.

Generally, an agricultural machinery rental office creates performance reports after analyzing various factors, including monthly earnings, number of renters, rental days, and collected amounts according to region, equipment, and purpose (for example, crops and work). After deploying AMRB, the time required to create monthly performance reports was dramatically reduced from 20 days per person to one day per person.
Conclusions

The web-based management system for the agricultural machinery rental business (AMRB) was created to ensure the efficient operation and transparent management of a government-supported agricultural machinery rental business.

(1) An MS_SQL2000 DBMS solution was utilized to develop AMRB for high system compatibility and integrated management. Additionally, compatibility with Internet Explorer 6.0 or later was targeted to ensure security and seamless web operation.

(2) When users reserve machinery for rent, the AMRB administrator can manage the rental fleet by approving, releasing, and returning agricultural machinery in the rental application list, and can analyze various earnings data, thereby streamlining the rental business.

(3) AMRB users can research machinery, specifications, and rental fees, and conveniently complete and submit application forms online.

(4) After deploying AMRB, the time required to create monthly performance reports at an agricultural machinery rental office was significantly reduced from 20 days per person to one day per person.

(5) As of 2014, AMRB is installed and operating in agricultural machinery rental businesses in 31 cities and counties in South Korea. This study recommends continued expansion and dissemination of AMRB for the systematic and efficient management of agricultural machinery rental businesses.

Conflict of Interest

The authors have no conflicting financial or other interests.

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