Development of Forest Management Information Systems

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Introduction

Forest management requires information to be drawn from several areas of interest and integrated for forest management purposes, such as estate level modelling and planning. Integrated forest management requires access to a wide range of data that are usually sourced from different parts of an organization, such as financial, geographic, biological and operational data. The relationships between such datasets are relatively complex. Forestry management systems are therefore inherently complex and the design and development of operational systems presents special challenges.

Using integrated information systems increases the efficiency of data capture, minimizes data redundancy and maximizes the utility of information. Integrated information systems have several basic characteristics.

1. Effective management procedures for data entry, data maintenance, data processing and communication of data to the final user.
2. Coherent, efficient and transparent data structures that closely match the requirements of the organization and the data management procedures.
3. Generic data structures using common naming conventions and field formats.

The benefits of integrated systems are greater system utility, applicability, longevity, and expandability. This paper uses a case study to show how to design and develop an integrated system for forest management. It will be shown that it is necessary to provide sufficient attention to addressing the special industry requirements.

Case study

Forest Management System (FMS) is a plantation management system that is developed and maintained by Forestech Research and Development Ltd[1]. The system has a number of components:

- Comprehensive register of stand records
- Silvicultural operations management, scheduling and budgeting
- Forest accounting
- Log sale tracking
- Forest inventory
- Forest grouping (croptyping)
- Optional linkage to several GIS systems
- Forest estate modeling and valuation

The comprehensive nature and general applicability of the system is due to a commitment to generic database structures and to an object orientation development approach. The generic design has given the system a flexibility that has enabled it to be used in a wide range of plantation management situations.

Even though FMS comprises only one standard program, it has been installed in 20 sites in six different countries covering diverse forest management situations from tropical pulp and sawlog forests to temperate softwood plantations. The main users currently are mid-sized forest owners in New Zealand.

Design and development issues

The design of integrated databases requires a significant consultative process with the main stakeholders. A system specification is then prepared that prescribes the system design and the process of system development. System development requires strict management control so that the system can be completed on time and on budget and meet all specified requirements.

In the case of FMS, the stakeholders were small (1000 ha) to medium (+60,000 ha) forest plantation companies. These companies had unique requirements.

1. *Integration of datasets.* All main forest management functions had to be integrated into one management system.
2. *General applicability.* The system had to incorporate a comprehensive range of functions that adequately dealt with most forest data management problems.
3. *User friendliness.* The system had to be easy to use because often the forest manager had limited time and resources to allocate to training and data management.
4. *Reliability.* The system must be very reliable because most small companies had only limited internal system support.

These requirements are more demanding than may be the case with a large forestry corporate because these larger organizations can afford to employ full time system specialists that are backed-up by large support and maintenance resources. FMS needed all the functionality of existing packages but is packaged in an integrated framework that is easy to use.

System design and development

The design and development of a complex integrated system, such as FMS, requires a high level of planning and management. In the case of FMS, the design concept took approximately 14 months of planning and was conducted as part of Masters Thesis. The actual software design and development took one year. Finally, updates and modifications are continuously controlled by a set of procedures for documenting problems or potential changes to the system, consulting with existing system users, implementation of modifications and testing, and distribution of new upgrades to existing users.

Testing is the final but most critical component of the overall development process. Testing should be a highly controlled process and include testing of individual

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components of the system against detailed descriptions in the system specification (known as "Unit testing") as well as testing the ability of the overall system against documented performance criteria (known as "System testing").

Database design needs to documented and permanently recorded both for the development phase and the long-term maintenance of the system. Development is greatly simplified by the adoption of a standardized naming convention for all elements of the system. It is also recommended that database structure and relationships be clearly recorded in text and in diagrams.

Interface design

For users, the most important element of a system is the design of the user interface. The interface controls what elements of the system are presented to the user, how the user navigates through the system, and how the user interacts with individual elements of the system. The FMS interface has been designed to provide a simple, coherent and logical interface that tightly controls user actions and mirrors or improves workflow for the user.

FMS uses a navigation model that tightly controls navigation through the program, navigation within screens, and data entry. FMS is modeled around one menu system that provides a path to every system function. The user interface directs users through forms one at a time. Each screen includes data validation functions that check data is correctly entered. Technically speaking, this model is called Single Document Interface (SDI) and experience has found that data management systems really benefit from this controlled approach. The alternative model is called Multiple Document Interface (MDI) which is more suited to interactive modelling problems such as gaming.

We adopted a minimalist standardized approach to screen design in FMS. All interfaces have the same look and feel. For example, the standard screen colour is gray, all text uses Times New Roman font, and the use of bold text, lines, boxes, and pictures are kept to a minimum. Often it is difficult to adhere to these design guidelines especially when there are large amounts of complex data to capture.

For example, the FMS inventory module allows users to enter three alternative types of inventory - standard, stem quality and pruning quality control (Figure 1). An interactive screen was developed that allowed the user to enter all three types of inventory on the one screen. It was quite challenging to develop a simple, coherent and logical interface given the complexity of the data and the data relationships.

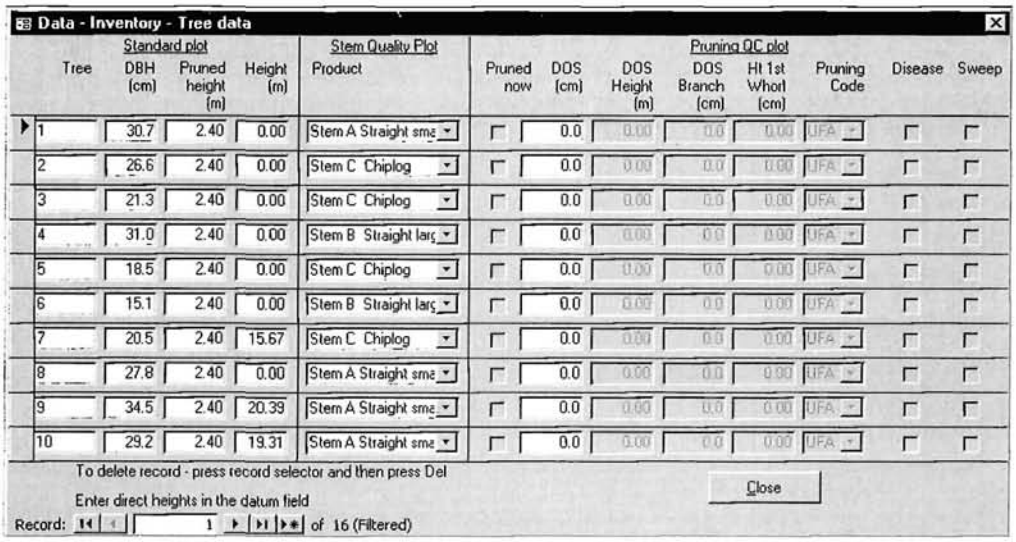

Figure 1 FMS Inventory Module

Project Management Issues

In New Zealand, there have been several large and highly visible software development project failures. Generally speaking, they all involved large integrated projects, which were poorly thought out, badly designed, and inappropriately managed. There is no one guaranteed project management methodology for ensuring successful projects. However, they are likely to include at least some of the following elements:

Controlled process for investigation of the problem to be solved, consultation with key stakeholders, documentation and discussion of findings and development of clear project objectives and performance criteria.

Preparation and review of the system specification that clearly document database and system structure. The system specification is the single most important control document on a development project and needs to be prepared by an experienced systems analyst. Reviews are required to assess the practicality and affordability of the specification.

Preparation of realistic works schedules and budgets. Reviews are required to assess the practicality and affordability of the work schedule.

Management of system development and testing of the resulting systems against project performance criteria.

Part of good management of projects at all stages is the development of, and adherence to, high standards and protocols of design and development and good programming practice. This should include a high level of documentation and document control, robust systems of design control and operational control, and good systems of communication and problem resolution.

Summary

The author has met several senior forest managers who were of the opinion that integrated forest management systems were impossible or infeasible to implement because of the inherent complexity of forest management. As FMS has shown, it is possible and feasible.

FMS has enhanced the management efficiency and effectiveness of many of its users. The initial benefits arise from the efficiencies and greater control gained from standardizing and centralizing the data processing functions in one easy to use programme. The long-term benefits arise from being able to access, relate and analyze data from a diverse range of forest management activities over an extended period.

The design, development and support of these types of systems require a high level of planning and management. A key element is the establishment of protocols of communication for problem solving and system management. Another key element is the establishment of comprehensive standards and protocols for system design and development. Lastly, system development and support requires a high level of project management to ensure that projects are practical and professionally organized and that systems are implemented within expected time and cost work schedules.

New Wood Supply Forecasts

A new set of National Exotic Forest Description (NEFD) wood supply forecasts will be produced this year. These forecasts will revise the earlier NEFD National and Regional forecasts published in 1996.

A range of supply driven scenarios will be modelled based on clear fell age and future rates of afforestation. Separate forecasts will be produced for 10 wood supply regions.

The forecasts will be based on the data contained in "A National Exotic Forest Description as at 1 April 1999".

Work on producing the forecasts will commence in February 2000 and it is expected that the results will be published in September 2000.

The forecasts have been commissioned by the Ministry of Agriculture and Forestry with the modelling work to be undertaken by Forest Research. The project will be overseen by the NEFD Steering Committee.

These forecasts are produced to:

- Inform public policy of the pending large increases in wood supply at both a national and regional level.
- Ensure information suitable for strategic planning is available for agencies involved in providing infrastructure such as transport and energy to the forestry sector.
- Demonstrate the long-term sustainable supply of wood from New Zealand's planted forests to our trading partners.
- Ensure information is available to promote investment in wood processing and further value adding.

It is the Ministry of Agriculture and Forestry's intention to ensure that these forecasts are updated at 5-yearly intervals.

For further information contact Paul Lane, Ministry of Agriculture and Forestry, Wellington.