FOREST DESCRIPTION SYSTEMS: LINKING CROP AND LAND INFORMATION

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ABSTRACT

This paper gives examples of how, by making use of tools such as data modelling and geographic information systems, combined with modern databases, the staff at Carter Holt Harvey Forests, Kinleith Region, have changed their view of the management of forest information.

It introduces concepts of crop, operation, pod (piece of dirt) and uniformity and describes life without stands.

The advantages provided to the management of operations and harvest planning are also noted.

THE OPPORTUNITY

A different approach to the management of forest operations and information can be taken if the concepts of yesterday are not simply applied to today's technology, ie we don't just computerise a manual system.

Instead, to maximise the opportunity of new technology it is necessary to rethink our view of the world and how we might best represent it within a modern management information system, to give those charged with managing the forest a more responsive, flexible and realistic model.

WHY CHANGE ?

Ten years ago it was satisfactory to take several months to decide on a harvest plan for the next period or two and it could then be locked away known as "The Plan".

The keepers of the plan could modify it without detailed review and still be comfortable as there was plenty of flexibility in the system. Flexibility had a cost in terms of excessive inventory, waste and less than optimum solutions.

In practice there were many plans held, one by each department. It was held, not unreasonably, in their most useful land units which often involved a labour intensive process to convert to another.

The conditions that allowed this situation to occur no longer exist. There is now little flexibility in the system, and because of this there can only be one plan.

Our customers are more demanding, we must be more responsive to their needs, changes must be evaluated in days not months. We now have fifty log specifications whereas we once had only four, hence the selection of areas to harvest and in what order requires more inputs.

With the above new conditions and a change in the forest being harvested from old to much younger we had got to the point where the demands on the old information systems exceeded what they could provide.

When this point is reached in any system, it must be examined and the

assumptions tested to see if they are still useful for the new environment.

What follows is a description of the implemented outcomes of that examination.

UNIFORMITY AND PODS

Using data modelling techniques we now have classified the things involved in forest management as simply as possible.

We have defined those things that we need to know about and recognised their existence separately as a set of fundamental entities each with a set of attributes.

The underlying premise is that we describe the forest in terms of pods (pieces of dirt) uniform with respect to those things that we need to know about. We have pods uniform with respect to landowner, another set uniform with respect to watersheds, another to slope classes.

These are kept separate, as layers in the GIS, with their attributes. They are only combined or summarised when they are required to contribute to the solution of a problem.

Under past manual stand based systems the temptation was to record more and more information on a single unit of area and summarise early.

The stand was considered uniform with respect to whatever anyone wanted it to be, up to the level that those who maintained them could manage the process of subdivision.

The process of the addition of important attributes will never cease, there will always be a valid reason to further subdivide for example soil type, watershed, altitude or Regional Council.

The stand attempted to be all things to all users and in doing so it's usefulness was compromised.

OPERATIONS

The view of operations that we have taken again has a different focus from the traditional basis. We previously had stands on which we performed various operations like pruning or thinning, we stuck rigidly (or tried to) to stand boundaries, splitting only if the area affected by an operation was greater than a minimum size.

We frequently recorded in the data that something different had occurred on some part of the stand but not where it happened in an easily accessible medium, eventually adding time and effort to the process of harvest planning.

Under stands, staff focused on managing the land, not on managing operations.

Managing operations is the way we as a business, actually have some effect on the forest. Now we have turned that around by focusing on operations.

We simply record the boundaries of operations and their associated data. The GIS then does the rest, subdivision (up to a point defined by hardware capability and sensibility) is not an issue.

No longer is there a groan from the Draughtsperson of "do I have to split this one too"?

New operation types are added easily under this model, without as in the past, having to pull the record system apart to scrape up a few bytes to add a new field.

Applying the theme of uniformity therefore, we have operation pods that are uniform with respect to the operations that have occurred in the past and the future.

An operation is now defined as anything that we do that modifies the yield, creates woodflows or changes the access to the crop.

It includes and handles easily the cyclone Bola type event that refused to follow the stand boundaries and that caused nightmares for those recording and trying to analyse the effects.

The focus on the management of operations has allowed us to expand the temporal aspects of the old stand system, creating useful dates for planning, not simply financial years, or even a single real date but dates that recognise that operations take a finite time to complete.

Operations can exist not only in the past defined by actual start and finish dates, but also the future (planned start and planned finish dates). The key here is that these future operations are recorded in the same place as those that have already happened.

We can create operations as far in advance as we wish. Multiple rotations can now be recorded.

Harvesting becomes an operation defined by a boundary in GIS along with planting, pruning, thinning, releasing, preparation, a cyclone, fire or any other event that fits the criteria above.

Over time, each pod builds up what can be thought of as an operation stack, the set of events over time, some in the past, some in the present and some in the future. This operation stack forms the raw data for the generation of the crop the basis for the forest description system.

THE CROP

A crop in this model is a piece (or pieces) of the forest (pods) which is nominally uniform with respect to current yield, to yield at all future points in time (if not harvested) and to the method of estimating yield. Once again we have a set of pods uniform with respect to one concept only that of yield. The stand tried to equal crop at the same time as trying to be useful in managing operations.

Unlike stands, things that do not affect the yield do not cause subdivision of crop. Some stands were split by topography or ownership, or simply if they would not fit on an A4 piece of paper even though their yields were identical.

The concept of crop provides an application independent method of providing yield estimates for arbitrary areas of forest, eg harvest operations, woodcatchments, ownership, watersheds, for the purpose of yield forecasting, harvest planning, forest valuation, reconciliation, environmental assessment and ad hoc reporting.

In other words we can draw an arbitrary boundary on a map and rapidly answer the question if I harvest this area at this point in time what products will I expect to get out of it?

Systems of the past required that the recording system give the picture of the forest as at one point in time, after a stand was clearfelled it ceased to be. All information was then stored in a different, usually difficult to access location.

The crop, as we have defined it persists after clearfelling for reconciliation and environmental auditing purposes. We will have the expected and actual yields of today recorded to compare with those of future rotations, essential data for measuring sustainability.

PLANNING

Planning in this paper is recording what you are going to do, (the operation), when you intend do it (real dates), where you intend to do it (which pods), and what you expect to happen (in the harvesting case, the yield you expect). Having a plan means recording in one place a best prediction of what we expect to happen.

Having many plans is no longer necessary, all parties can examine the single plan and determine if it is a good one or whether it can be made better. Our plan is now represented as operations with planned start and finish dates that are continually being refined. Short, medium and long term plans are stored in the same place, and are modified and reported on in the same manner. Planting, pruning, releasing and clearfelling, in fact all operations types are accessible in the same system.

HARVEST PLANNING

From the previous definition a harvest plan exists if in one place we have a list of pods we intend to carry out clearfelling operations on, when we intend to do it and what yield we expect when we do it.

Harvest boundaries have never followed stand boundaries irrespective of how hard we have tried. Customers, accountants, contractors, engineers, machine constraints and cyclones have conspired to ensure this utopia was and never will be reached.

How is harvest planning achieved under this model?

The crop is searched for likely candidates (generally age class based), these are reported on in an attribute and map form linked using GIS. The maps show the spatial relationship of the candidates and make sensible boundaries more obvious.

The boundaries are converted into operations pods, given dates and clearfelling operations are created in the database.

The entire set of clearfelling operations, ie present and future is then extracted and presented to an optimiser together with their yields (by overlaying operation with crop) and constraints (by overlay with for example watersheds).

The optimiser modifies the planned start and finish dates. The plan is then evaluated according to the initial criteria (modified if necessary) and the new operations dates are applied to the operations. Once that is done others may use these dates to plan their operation timing, eg road and landing construction.

The points to note here are that the planning time horizon is continuous and the plan exists in only one place visible to all. It is not fixed once and left, but represents our best estimate of when we expect an operation to start and end. That allows inferences to be made and the plan to be continually evaluated and improved.

GEOGRAPHIC INFORMATION SYSTEM: GIS

From the data modelling exercise, to use the uniformity concept we determined we required a tool to overlay or make associations between the fundamental entities. A GIS did this.

It is a tool that allows the overlay of differing pods producing a new intersection pod with a known area.

It allows us to manage operation pods and to recombine the fundamental layers as required. It keeps the view as simple as possible.

GIS is a reporting tool also, it quickly calculates and shows the spatial relationship between pods without resorting to metres of line flow, filing cabinet searches, light tables and coloured pencils to shade the next set of stands of interest.

CONCLUSION

The changing business environment over the last few years has placed more demand on information systems than the old systems could satisfy. By using data modelling techniques we have derived a set of generally useful entities that better describe and support our business. Each entity is described by a set of uniform pods together with attributes.

The concept of operation provides a generally useful planning framework which caters not only for harvesting but all forest management operations. The use of planned start and finish dates as well as actual start and finish recognises that operations occur over a definite time and that they may occur in the future.

Modern technology in the form of GIS and databases allows these entities to be combined rapidly to satisfy these information demands.

In today's environment if you are not maximising the use of information then you are heading for trouble - as one of your competitors will be!