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Department of Conservation
and Land Management

Wood Utilisation Research Centre

GUMTREE©
GENERAL UTILISATION MODEL OF TIMBER
RESOURCES - ECONOMIC EVALUATION
D.L. Kent

November 1990
W.U.R.C. Technical Report No. 21

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- ECONOMIC EVALUATION

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SUMMARY

GUMTREE© is an economic model of the sawmill sector of the forest products industry. The suggested modelling options are discussed, including expansion of GUMTREE© beyond the sawmilling sector, using a market-driven approach, and optimisation techniques. GUMTREE© has been used successfully for a number of simple economic analyses, but its scope is inappropriate for many expected applications. The main use of GUMTREE© at this stage has been to examine the economics of installation of kiln drying systems. In addition, production figures supplied to the Department of Conservation and Land Management could be used in the model. The current proposal is to use GUMTREE© in-house to provide a consultation service to sawmillers.

The concept of an economic model of the forest products industry is farsighted, but no structured systems analysis and design techniques were followed before modelling was commenced. Thus the product does not fully meet the requirements of all end users. However, some useful research projects have developed from the original proposals and an increased understanding of the industry has been achieved.

INTRODUCTION

Log resources from Australian eucalypt forests, the raw material of the forest products industry, are changing. The volume of mature logs harvested is decreasing continually, and more regrowth is being harvested. Confronted with these changes and a variable market environment, the industry is facing unprecedented challenge to review its structure and operations, and plan for the future. Computer modelling can assist in understanding the complexities involved in meeting consumer demands, and in making more efficient use of a changing resource.

The Department of Conservation and Land Management (CALM) operates the Wood Utilisation Research Centre (W.U.R.C.) at Harvey in Western Australia. A four-year program of research and development into the utilisation of regrowth eucalypts (the Small Eucalypt Processing Study), commenced in July 1986, but did not initially include a computer model. However, to establish priorities for research and development, development of a model was accepted early in the project as a worthwhile exercise. Towards the end of 1986, Whittakers Ltd was contracted by CALM for a six-month period to direct the production of an economic model of the forest products industry. I was employed as the Programmer/Analyst to develop the model.

The computer model was to simulate all aspects of a vertically and horizontally integrated forest products industry, from the standing tree to the marketing of timber products. It was to provide policy makers and managers with a management tool for the efficient production and use of forest resources, and to integrate with forest management models for the simultaneous investigation of forest production, wood processing, manufacturing and marketing strategies. Specifically, it was to:
- simulate the volume and value flows of timber in an integrated forest products industry;
- chart existing production processes;
- highlight the impact of by-products generated within the processes;
- permit evaluation of alternative flow patterns;
- assist in setting research and development priorities for the Small Eucalypt Processing Study.

DEVELOPMENT ASPECTS

As seen from the Introduction, the original scope of the model was very extensive. No formal design plan was formulated, and no specific end users of the model were targeted. The design has changed within the course of the project, to meet changing end user needs.

At the time I was employed at CALM, I was a newcomer to the timber industry, and was guided in the format of the model by Mr Hiski Kippo of Whittakers Ltd. He decided initially to address the sawmilling sector of the hardwood industry, because it was the largest and best understood sector. I wrote the economic model (GUMTREE©) of the sawmill sector of the forest products industry in 1987, within the limits specified. The area in which I had specialist knowledge was the choice of language for the model. The 'Lotus' spreadsheet was recommended, but

for small sawmillers with no computing equipment or interest, the cost of Lotus would be prohibitive. GUMTREE© was therefore written in a compiled BASIC language and is completely independent of other software.

GUMTREE© was completed after Whittakers' contract had ended, and some revenue alterations were specified by Mr Phil Shedley (Manager of the Small Eucalypt Processing Study) and an industry and marketing working group. Appendix 1 contains a description of the model's operation, data and results. More detailed information can be obtained by using the model itself, or reading the associated User's Manual.

Most of the structure on which GUMTREE© was originally based was researched by Hiski, and I implemented those structures. Subsequently, I was able to visit sections of the forest products industry, including small and large sawmills, veneer plants, a particle board plant and furniture manufacturers. During the time with CALM I have developed a wide knowledge of the forest products industry, particularly the hardwood industry, both in Western Australia and the Eastern States. As I gained more knowledge it became increasingly obvious that GUMTREE© needed refining to be commercially useful.

I soon determined that GUMTREE© would be more useful to the small sawmilling companies than to the large companies which have enough computing resources to write economic models specific to their particular operations. GUMTREE© is not a general economic model of the sawmilling industry in Western Australia, or the sawmilling industry in general, but basically an accounting model of Whittakers' operation. The model represents the methods of accounting and stock control used by Whittakers, but does not necessarily represent the methods used by many small sawmills in Western Australia, although it can be used for this purpose. The model contains functions not relevant for small sawmills, some of which are mentioned in Appendix 2.

Many of the more complex structures available in GUMTREE© could be used by relatively small sawmillers with more than one processing stream (for example if they cut small and large logs by different methods), if it were made more flexible. However, it is difficult to know whether the expected gains would outweigh the resources required for the model's alteration.

Initial discussions on the direction of the model were with Mr Shedley, but a computer modelling team was set up which included Dr George Malajczuk (Principal Economic Officer), Mr Trevor Morgan (Data Processing Manager), Mr Don Challis (Marketing Officer) of CALM, and Mr Mike Goddard (Bunnings, Manager Planning & Development) . This team was requested by the Small

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Eucalypt Processing Study Review Group to have CSIRO, Bunnings, and Whittakers assess the GUMTREE© model prior to commencing new modelling. Responses from these three groups indicated some specific criticisms of the GUMTREE© model, but in general a confidence in the aims of the project.

MODELLING OPTIONS

Suggested directions for the modelling project are discussed below:

Expansion of GUMTREE© to include other sectors

The original intention was to build onto the GUMTREE© model, to include other sectors of the forest products industry, such as veneer slicing, veneer peeling, paper pulping, manufacturing, and reconstituted wood processing. However, there are very few examples of these sectors in the hardwood industry, particularly in Western Australia, and they would be difficult to model in the same format as GUMTREE©. In addition, reservations about GUMTREE© in its present form made this action premature.

A New Model of the Forest Products Industry

This proposal involved considering GUMTREE© as an original prototype program, and using the lessons learned in the construction of a new model. The new model would consist of a series of modules representing each sector of the industry, with input and output from each module in an identical format so that the modules could be linked in various ways. Again, the few examples in the hardwood industry of the sectors other than sawmilling, and the detailed research required before these sectors could be modelled in the same way as sawmilling, made this impractical for the time and staff available.

A Market Driven Model

The most useful type of simulation model for the forest products industry would be a market driven model, so that market forces would direct the allocation of scarce resources. The market driven approach is recommended, but is complex, difficult to implement, and requires a large modelling team.

An Optimisation Model

The simulation approach to modelling can only choose the best of any defined solutions to a problem, whereas an optimisation approach will select the most suitable solution for a defined set of data . An attempt was made to use linear programming techniques to develop a model designed to optimise profit, within the constraints of a limited timber resource, for the forest products industry.

However, it was discovered that much of the necessary data (such as profitability of individual mills) was unavailable, and in the case of the larger mills, unlikely ever to be available. Therefore no further work on this model is planned.

The end user must be considered in the discussion on the various alternatives for modelling. Although a requirement of the overall four-year research project was that the results of any research must be directly available to the forest products industry, the model could probably only be used by an institution such as CALM. Consequently other possible uses were considered.

OTHER RESEARCH PROJECTS DEVELOPING FROM GUMTREE©

Small Sawmiller's Study
A team from the Wood Utilisation Research Centre comprising the Programmer/ Analyst, Engineer and Marketing Officer contacted most of the small sawmillers in Western Australia with a view to using GUMTREE© to examine the economics of the installation of kiln drying systems. This study has been described in a separate report (Kent 1990).

Analysis of Summary of Timber Processing Returns (Form CLM 182)
Preliminary work on the optimisation model described above showed a shortage of data on the relative profitability of the sawmills in Western Australia. Production figures for all mills must be supplied to CALM on CLM 182 forms, and it was decided to use these data, along with the known log supply, royalty figures, and standard selling prices, to determine productivity factors. These factors could be used in determining royalty prices and log allocations in the future.

USING GUMTREE©

The GUMTREE© program has been used regularly by W.U.R.C., but has not been distributed to industry. Currently it has been decided that W.U.R.C. will act as a consultant to industry in the use of GUMTREE©, and will process any confidentially supplied data. This is because in its present form GUMTREE© is more complex than necessary for most expected applications, and can be difficult for those inexperienced with computers and models to use. In many cases small sawmillers requiring the use of GUMTREE© would also need information from other members of the W.U.R.C. research team.

It is virtually impossible to obtain a perfect computing model the first time, and GUMTREE© requires improvements to make it more user-friendly and perhaps simpler. However, apart from the original design specifications, now considered unsuitable in many ways, the program has no more deficiencies than could be expected. Some months ago I began to update and improve GUMTREE© using the original QuickBASIC language.

The Lotus spreadsheet may have been a better format for presenting GUMTREE©, but for many small sawmillers with no interest in becoming computer-literate, a spreadsheet would be difficult to use. Comments have indicated that the format of GUMTREE© is easier to understand than Lotus, but the model has not had enough exposure. It does seem that with the minimal interest shown by most small sawmillers in technological improvements to their mills and in drying equipment, that the simplest model will be the most effective.

Within W.U.R.C., the GUMTREE© model has been used quite extensively, and some of those applications are:

(i)   Small Sawmiller's Study (Kent 1990).

(ii)   Sensitivity studies of sawing, drying and other processing, including VALWOOD®, at W.U.R.C.'s Harvey mill. Preliminary economic analyses of VALWOOD® were performed prior to a business plan being commissioned, and subsequently sensitivity studies of VALWOOD mills of varying intakes have been done. In addition, there have been sensitivity analyses of varying drying options such as jet drying, air and high temperature drying, and the CALM Drying System (McDonald 1990), and other processes such as pre-soaking timber before drying.

(iii) Sensitivity studies of N.S.W. mill profitabilities for a consultant to the N.S.W. Government. Data were sent to W.U.R.C. for rapid analysis of the profitability of alternative options for marginal sawmills.

(iv)   Investment advice to individuals intending to set up sawmills in Western Australia. The advisability of entering the sawmilling industry depends heavily on the quality of available sawlogs, the cost of production (including transportation), and the expected markets for the sawn products. In conjunction with W.U.R.C.'s marketing specialist, GUMTREE© has been used to assess the viability of additional sawmills, although confirmation by a business plan is always recommended.

RECOMMENDATIONS FOR GUMTREE©

GUMTREE© is still in its original form, with no modifications. The main applications for the model to date use only a few of the functions available. Rewriting GUMTREE© to create two versions is an option for the future. One version could be a simplified model for uses such as the Small Sawmillers Study and for distribution to small sawmillers, and the second version could be a more versatile form of the current model. However, using GUMTREE© 'in-house' to provide consulting to industry seems to be very effective to date, and more appropriate than spending more resources upgrading the model. Most sawmillers who could use the type of results produced by GUMTREE© also need other resource, technological and economic advice, and they require a general consultation format such as provided by W.U.R.C. at the moment.

The original GUMTREE© proposal has led to widespread research into the forest products industry, and identification of a number of important areas for continued attention. In line with the objectives of W.U.R.C. for better utilisation of eucalypts, it was important that this work was continued after the termination of the four-year Small Eucalypt Processing Study in June 1990.

The original proposed economic model of the whole forest products industry has never been written, owing to the limitation on resources. It is doubtful whether a model of this type could be produced without the joint participation of Commonwealth and States. The rapidly changing demands of society for improved utilisation of the forest resource increases the need, and would justify the large resource required.

REFERENCES

KENT, D.L. (1990). Predicting the profitability of small hardwood sawmills which dry timber. Department of Conservation and Land Management. W.U.R.C. Technical Report No. 22.

McDONALD, T.J.G. (1990). Developing a solar, low cost, timber drying system. Department of Conservation and Land Management. W.U.R.C. Technical Report No. 23.

APPENDIX 1

SUMMARY OF THE OPERATION, DATA AND
RESULTS OF GUMTREE©

GUMTREE© is an independent program that runs on IBM-PC compatible microcomputers.

GUMTREE© is an economic model of the sawmill sector of the forest products industry. It simulates the flow of wood through a sawmill taking user-selected component processes. It calculates the cost of wood production at each process, allowing for sales of wood after certain processes. The final result produced by GUMTREE© is a profit/loss statement showing the total cost of production and total sales revenue.

PROCESSES
GUMTREE© allows for the following process types:
1. **Resource** - mandatory as the first process. Provides a single input volume of wood (m^3) at a certain cost ($/m^3$) to the Harvest process.

2. **Harvest** - mandatory as the second process. Adds harvesting costs to the wood.

3. **Green conversion** - mandatory as the third process. Adds sawmilling costs. Has a maximum processing capacity. If the mill capacity is exceeded, wood will accumulate in the harvest stock. Grades the single log volume into three sawn grades and residues.

4. **Pre-drying** - adds the cost of drying, but does not account for loss of wood due to shrinkage. Wood is not regraded. Processing capacity is determined by the volume of the charge and the drying time.

5. **Drying** - the same as pre-drying.

6. **Processing and products** - any process that adds cost to wood without affecting the size or grade distribution. Examples are stripping and handling.

7. **Manufacturing** - any process provides for the addition of costs, regrading (including to residues) and redistribution of sizes. Has a maximum processing capacity. Examples are dressing and docking.

8. **Markets** - mandatory as the last process. Adds a marketing cost.

GUMTREE© provides for up to 20 process types from the above processes in the vertical flow structure, and up to nine operations within a process at any horizontal level. At each process after Resource there is one set of associated stock files.

DATA

GUMTREE© operates on a twelve-month time period. All costs are required in $, or input $/m³ per annum, and all volumes in m³/annum. Data received in other forms are converted to these units.

Data required for the various processes are:

Royalty
log royalty cost ✱
input log volume✱

Harvest
in-forest production costs✱
transport costs✱

Sawmilling
maximum input capacity✱
recovery and % distribution of sawn material into various
  grades and residues✱
prices received for residues and any timber not dried✱
costs associated with sawing✱
- e.g. depreciation
    interest on loans
    insurance
    log storage costs
    sprinkler costs
    labour
    power
    maintenance
    fuel
    saw sharpening

Pre-drying/
drying
maximum volume of charge✱
drying time in days✱
prices received for dried timber✱
costs associated with drying✱
- e.g. capital
    heating
    labour.

Note:
1. Those items marked with an ✱ are mandatory.

RESULTS

GUMTREE© provides a results summary and a revenue summary, and examples of these are shown below.

GUMTREE© results summary file

No	Process	Grade	Cost ($/m³)	%	Volume (m³)
1	Resource		18		
2	Harvest		50	100	
3	Sawmill	1	314	21.60	0
		2	314	3.00	0
		3	314	5.40	0
		4	0	70.00	45
7	Regrading	1	314	3.78	0
		2	314	1.62	0
5	Drying	1	359	3.78	0
		2	359	1.62	0

GUMTREE© revenue file

		Grade	Volume sold	Cost	Revenue
Sawmill		1	1080	338947	378000
		2	150	47076	30000
		3	0	0	0
		4	3500	0	9275
	Total		4730	386023	417275
Regrading		1	0	0	0
		2	0	0	0
		3	0	0	0
		4	0	0	0
	Total		0	0	0
Drying		1	189	67821	151200
		2	81	29066	16200
		3	0	0	0
	Total		270	96887	167400
	Final Total		5000	482910	584675

Interpretation of Results Summary

1. Residue costs are $0/m^3$. The cost of producing residues is added to the sawn timber cost. Sales of all residues are considered as profit.

2. GUMTREE© allows for three sawn timber grades and one grade of residues. Grades 1, 2 and 3 are user defined, and Grade 4 is residues.

3. The % column shows the percentage of input logs produced within the process and grade.

4. The volume column shows the volume remaining in the stocks for the process after execution is complete. In this example there are some residues unsold from the sawmilling process, but there are no stocks.

Interpretation of Revenues

1. The units for the volume sold are m^3.

2. The units for costs and revenues are $.

APPENDIX 2
GUMTREE© FACILITIES WITH LIMITED USE FOR SMALL SAWMILLERS

1. The model enables up to 9 versions of any one process at a single level in the vertical process stream from resource to marketing. Thus for example a variety of logs of different species and grades, and from different sources, could be processed by a number of different sawmills with varying recoveries. In fact, most small sawmills in Western Australia process only one species of log, and if they process more than one, subsequent species are a very small percentage of the input. Most sawmill operators cannot distinguish the different recoveries they obtain from the different species and grades.

2. The model divides the sawn timber into 72 sizes of 45, 70, 90, 115, 135, 185, 235 or 285 mm width, 25, 38 or 50 mm thickness, and lengths of small, medium and long. While these sizes are cut by the small sawmills, they generally do not distinguish between and record the various sizes, and they register an overall selling price for a particular quality of sawn product, rather than a size.

3. The model allows for three sawn grades of timber and one grade of residues. In some cases more than three sawn grades are produced, and in most small sawmills several grades and types of residues are produced, and sold for varying amounts. These calculations must be done by hand before using GUMTREE©.

4. The model allows for stock control, and most small sawmillers have limited stocks.