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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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United Nations Industrial Development Organization

Workshop on Wood Processing
for Developing Countries

Vienna, Austria, 1974

A BASIS FOR ESTABLISHING CRITERIA FOR THE CHOICE OF PROCESSES AND EQUIPMENT IN THE SAWMILLING SECTOR 1/

by

T.J. Peck*

* ECE/FAO Timber Division, Geneva

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Summary

Technologically and commercially, the sawmilling industry is passing through a period of change more rapid than anything previously experienced. This is resulting in a broadening of the gap between "traditional" sawmilling methods, which are still used very extensively throughout the world, and the modern, highly automated sawmill. The sawmilling sector is interesting, however, in that the economies of scale which are so vital in other industries, such as pulp production, are not necessarily a key factor, nor for that matter is advanced technology the optimum solution under all conditions, especially in developing countries. This allows a considerable degree of flexibility in choosing the most appropriate sawmilling process or piece of equipment. This very flexibility, however, adds to the difficulty of reaching a rational decision by widening the field of choice and increasing the number of potentially viable combinations of equipment and layouts. The challenge to Group A of the Workshop is to lay down a series of guidelines which will simplify the decision-making process. In particular, there is a need to indicate how the "best value for money" may be calculated, for example by benefit/cost analysis.

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Introduction

The rather pretentious title of this paper is meant to convey the idea of a simple objective : to set out a skeleton to which Group A of the Workshop (Sawnwood processing) may add flesh and blood, namely the detailed guidelines for selecting a particular process, layout or piece of machinery in a given sawmill. These guidelines will be based on economic, technical and social factors, some of which are mentioned briefly in this paper but which will need to be examined in depth by the Workshop.

It may be useful to mention at the start a number of basic points about the sawmilling industry :

(1) While sawnwood is the most "traditional" of the processed forest products, it would be a great mistake to assume, as there is sometimes a temptation to do, that it has no future because of competition from more modern materials, such as concrete and particle board. Indeed, events in recent years, notably in the energy and environmental fields, could well lead to an improvement in sawnwood's competitivity because of (a) the relatively low energy input in sawnwood production and (b) the positive aspects of sawnwood production and use from the environmental point of view.

(2) It may not be an exaggeration to say that there have been more technological innovations and developments in the processing, handling and transport of sawnwood in the last decade than in the whole of the previous hundred years. The industry is, in fact, in a period of rapid evolution.

(3) For the developing countries, a well-run sawmilling industry is a valuable asset from several points of view. It is an industry which need not be excessively capital-intensive or highly complicated to operate which can on the one hand make economic use of what in many of these countries is an economic, abundant and above all renewable natural resource - wood; and on the other hand, make an essential contribution to the economy by providing work opportunities, foreign currency from exports and products for the construction and other industries.

(4) It is unfortunately the case in too many developing countries, however, that the industry is not performing this function effectively. The ex-mill price of sawnwood is often excessive in relation to stumpage values; while the price of sawnwood to the consumer is even more unreasonable in comparison with equivalent prices in industrialized countries and relative to its intrinsic quality, due to high distribution and marketing costs. Thus a raw material resource, whose chief merit is that it is locally available, cheap and easy to convert, is not being utilized efficiently or economically, largely because of inadequate or inappropriate equipment and know-how in processing and marketing. Given its objectives, therefore, the present Workshop will have served a valuable purpose if it can contribute towards an improvement in sawmilling efficiency in developing countries.

(5) In many parts of the world there exists a considerable surplus of sawmilling capacity - for example, capacity was being used at an operating rate of 35% in Switzerland in 1971[1/]. Much of the capacity consists of small, inadequately financed and old-fashioned units. The economics of these industries are totally different to, although not necessarily less favourable than, those of modern, large-sized capital-intensive mills. Their continued existence, however, even though their numbers are steadily declining, acts as a disincentive to new investment in technically advanced mills.

(6) No two sawmills will ever be exactly the same, mainly because the external factors affecting both the inputs to the mills and their outputs are infinitely variable. Great care must be taken, therefore, in drawing up guidelines for selecting equipment and processes, to avoid trying to impose general solutions on specific situations. Rather, the guidelines should be in the form of a checklist of factors which have to be taken into account, and pitfalls to be avoided, during the decision making process. Furthermore, since in the majority of cases a transfer of know-how and equipment from the industrialized to the developing countries will be involved, care must be taken to make due allowance for the considerable differences usually found between the one and the other in terms of climate, infrastructure, labour skills and productivity, raw materials and so on.

1/ B. Bittig and F. Hofer, Développement des structures et modernisation dans l'industrie suisse de la scierie. Paper to be presented to ECE Symposium on the modernization of the sawmilling industry, January 1973.

External factors affecting the operation of a sawmill and the choice of equipment

At the UNIDO Technical Meeting on the Selection of Woodworking Machinery, November 1973, an excellent paper was presented by Mr. Travnik (Lignoprojekt, Czechoslovakia) on "General selection guidelines for woodworking machinery", which was supplemented by a paper by the ECE/FAO Timber Division on "Some economic and commercial factors determining the selection of woodworking machinery"[1]. These papers discussed the external factors on both the input and output sides, and some of the main points are repeated here briefly in the form of questions which members of Group A may wish to use as a basis for more detailed discussion.

A. Materials and other inputs

1. Wood raw material

What is the wood raw material supply situation in terms of:

(a) quantity and continuity of supply over the expected life-time of the mill or equipment being considered; delivered cost

(b) species - heterogeneity or homogeneity

(c) minimum and maximum dimensions - length, diameter, form

(d) physical properties - workability, density, susceptability to fungus and insect attack, colour, silica content, extractives, etc?

2. Other material inputs

What other materials will be needed by the mill, e.g. glues, preservatives, steel strapping, plastic wrappings, office equipment; how reliable are the supplies; are they locally available or imported; costs?

3. Infrastructure

How adequate is the existing infrastructure - access roads, railways and waterways, community development (housing, schools, shops, etc.), drainage and sewage, etc.?

4. Servicing, maintenance and spare parts

How adequate are the local service and maintenance facilities for the proposed equipment? In the case of imported machinery, how efficiently and quickly can maintenance technicians and spare parts be brought in, in the case of malfunction or breakdown? What would be the cost of maintaining stocks of all spare parts likely to be needed?

5. Labour, supervision and management

How adequate would be the local availability of labour

- unskilled
- skilled
- supervisory level
- management level?

How well educated and receptive to technical training is the local population? Is the standard of nutrition and health adequate? What is the reputation for -

1/ ID/WG.151/6 and ID/WG.151/2, respectively.

reliability and conscientiousness among the workforce; how much supervision will the workers need? Do they have a 'feel' for machinery?

6. Power supplies

How adequate and reliable are local supplies of electricity and/or other forms of energy (fuel oil, natural gas, coal); and, in the light of this, what need is there for supplementary or emergency power generation equipment?

7. Climate

What are the key climatic features that may affect the working of machinery, working conditions and transport and storage of raw materials and finished products

- heat and humidity
- cold, snow and ice
- rainy seasons, flooding, blocked roads
- drought, fire risks

8. Competitors for inputs

What are the main industries in the region which may be competitors for labour, raw materials, transport facilities, etc.?

B. Markets and outlets for by-products

1. Local markets

What is the structure of local markets to which the products would be offered at wholesale, retailer and consumer levels? What are the main uses for sawnwood in the area

- the construction industry, including joinery
- the furniture industry
- the packaging industry
- other ?

What are the preferred species, qualities and assortments of sawnwood used in each of these sectors and what is the price structure? Is there a controlled grading system in operation?

2. National markets

What are the prospects for selling to markets further away than the strictly local market? Is there a reliable and regular transport system and what are the freight charges? What expenses would be incurred in setting up new sales offices, supply depots, etc.?

3. Export markets

What are the prospects for selling to overseas markets? What are the preferred species, qualities, assortments and moisture contents in the main

sawnwood importing countries and how does the mill's output compare with these? What is the price structure for sawnwood in the importing countries; what are the freight and handling costs; tariffs? What is the appropriate marketing channel - direct to importers and consumers or via agents? What export or import quality controls are there and what problems would there be in producing economically to these standards?

4. Outlets for by-products

What uses can be found for slabs and edgings, sawdust and bark

- within the mill
- sales to other mills or users

What are the economics of using mill residues for heat and power generation in the mill? What are the possibilities of adding a residue-using operation, e.g. particle board plant, to the sawmill from the investment, technical and marketing points of view? If external outlets exist, what prices are being offered for residues? Are any environmental problems involved in burning or dumping residues which cannot otherwise be disposed of?

5. Market competitors

What are the industries that will be competing locally, nationally or overseas with the mill's products

- other sawnwood producers
- producers of competing forest products (particle board, plywood, etc.)
- non-wood materials (steel, concrete, plastics)?

What are the relative strengths and weaknesses of the mill's products in the market - technically; price-wise?

6. Economic development planning

What can be expected to be governmental attitudes towards proposals for establishing or modernizing the mill? How well do the objectives of the mill, in terms of labour recruitment, resource utilization, products, etc. conform with the government's overall development objectives for the region or country? What investment grants or loans, tax holidays, import licences for machinery and materials, export licences for the finished products, etc. will be obtainable or needed? What about planning permission, building permits, environmental impact studies?

With information on the above questions, even if not complete in all cases, a basis will have been formed for the decisions to be made on the process and equipment, and already certain broad aspects will have become clear, for instance

- the optimum scale of operation
- the extent of integration desirable or possible
- the degree of sophistication and capital-intensiveness of the equipment
- the range of product qualities and grades to be produced.

Sawmill equipment and layout

In planning the technical aspects of building or modernizing a sawmill, a combination of the following are likely to be the major constraints:

- investment capital and amortization period
- availability and quality of labour
- availability and dimensions of wood raw materials
- space, inside and outside the mill.

Having determined the limits which these impose on the choice of equipment and layouts, the next and crucial stage is to consider the technical alternatives available. For convenience in Group A's discussion, it may be best to distinguish between equipment and layout in three stages: - log sorting and storage yard

- mill
- sawnwood drying and storage yard,

while operations which also have to be considered include heat and power generation and office activities.

It should be noted, of course, that there is a close interdependence between the three stages of production and that great care must be taken to correlate throughout the capabilities of one with the others. This is especially important where a mill is being modernized: the introduction of a new machine may boost throughput or eliminate a bottleneck at one stage of output, but create new problems and bottlenecks elsewhere in the mill. With this proviso in mind, however, the situation in the three stages of production may be considered here separately. To give an idea of the relative importance of the three stages of production in terms of labour input, the following examples can be quoted of manhours worked per m3 of timber sawn in mills of different capacities:

	<2000 m3/year	2000-6000 m3/year	>10,000 m3/year
Log storage site	0.7	0.4	0.2
Milling sheds	2.7	1.8	1.0
Lumber yard	2.5	1.5	1.1
Sharpening shop	0.3	0.23	0.18
Sub-total	6.2	3.93	2.48
Supervisory personnel	0.25	0.75	1.8

The above example relates to gangsaws in the Federal Republic of Germany [1] operating in the mid-1960s. The labour inputs at different stages can vary not only according to mill size but also to individual mill conditions. An example from Finland [2] of what was in the mid-1960s a modern, quite large gangsaw mill gave the following breakdown (manhours/m³ of sawnwood):

Sorting, barking and storage of logs	0.75 (26%)
Sawing	0.32 (11%)
Sticking and kiln-drying	0.86 (30%)
Trimming and bracking	0.43 (15%)
Storage and delivery	0.10 (3%)
Handling and sawing waste	0.43 (15%)
	2.89(100%)

While efficiency in the use of labour is one of the important considerations in setting up and operating a mill, it is by no means the only one. Taking the above Finnish gangsaw mill again, production costs were as follows (% of the total):

Raw materials, gross value	76%	
- Less sales of residues	13%	
Raw materials, net		63%
Power, heating maintenance		15%
Wages		10%
Administration, sales, etc.		3%
Interest and depreciation		8%
Taxes		1%
Total		100%

Other sources quote raw material costs (gross) as accounting for from a half to four-fifths of total production costs, and consequently a principal objective must be to obtain as high a recovery rate, in terms of both quantity and quality, as possible. It is no doubt possible to find situations where high recovery rates are not of such overriding importance, for instance, with a capital-intensive profile chipper-canter processing small diameter, relatively cheap logs and having a ready market for chips, maximum throughput may be a prime objective. But this seems likely to remain the exception to the rule, increasingly so as the drive towards total utilization of the log grows.

1/ K. Fronius, Sawmills equipped with gangsaws. Reports presented to ECE Symposium on economic aspects of, and productivity in, the sawmilling industry. Supplement 2 to Volume XVIII of the Timber Bulletin for Europe, June 1965.

2/ P.E. Johansson, Recent technical progress in Sawmilling in Finland, op. cit.

It would be beyond the possibilities of the present paper to discuss the advantages and disadvantages, technical and economic, of all the alternative types of equipment and layout. The best that can be done here may be to list the main items and leave it to Group A to discuss them in detail.

I. Log storage and sorting yard

Measurement of logs	- manual - weighbridge - electronic - mixed methods
Buffer stocks of logs	- ponds - on land
Movement within yard	- cranes, portal/bridge, cable, mobile - front-end loaders - conveyors (jack ladders)
Log sorting and grading	- visual and manual - log-sorting machines - mixed methods
Debarking	- manual - rotary - drum
Cutting to length	- circular saws - chain saws
Other operations	- log washing - stock sprinklers - metal detectors - log pond equipment (boats, etc.) - removal of bark and other waste.

II. Wet Milling shop

Pre-breakdown	- feed-in systems, carriages - round-cutters
Breakdown	- gangsaws (framesaws) - bandsaws - circular saws - profile chippers - 2 or more lines with different headsaws - resawing, choice of saws
Slipping or edging	- choice of saw/chipper
Cross-cutting or trimming	- choice of equipment (multiple saw, etc.)
Movement of logs and sawn wood within mill	- manual - carriages - link conveyors - use of hydraulics and pneumatics for movement, handling and positioning of logs and sawnwood
Removal of sawdust and solid residues	- manual - conveyors - suction (dust extractors) - forklift truck

Layout in general	- flowline, continuous or reciprocating feed - elevated (upper deck) or groundlevel operation - space requirements and layout for different types of equipment
Saw-sharpening and repair and general maintenance	- saw-shop and doctor - cutter and knife-sharpening - equipment - degree of self-reliance for servicing and repairs
Other questions	- worker safety, first aid facilities - noise, vibration, ergonomics - canteens, toilets, general welfare - fire protection

III. Sawnwood drying, storage and preparation for shipment and other post-sawmill operations

Seasoning	- air seasoning, solar - kilning, natural draught, forced draught, progressive - radio-frequency heating - combined air and kiln-drying
Bracking, grading	- visual - mechanical - marking
Planing and other further processing	- planing, thicknessing and moulding - finger-jointing - tongue-and-grooving, 'V'-jointing, etc. - sanding
Conservative treatments	- dipping, spraying, pressure treatment, etc. of anti-stain, fungicides, insecticides, fire-retardants
Packaging	- manual - mechanical
Processing of residues	- chipping of solid residues - briquetting of sawdust and bark - residue-using heat, steam and power generation
Pre-shipment storage	- under cover, in the open - loose, in packages
Transport in the sawnwood storage area	- forklift trucks or other wheeled loaders - cranes - appropriate storage layout
Stock control, sales invoicing and despatch	- extent of computerization possible - loading of road, rail, water transport.

The above list is not meant to be comprehensive; for instance, because of the way it has been constructed, it does not mention specifically a number of important aspects of a general nature which will probably need to be discussed, including:

- the applicability under given conditions of EDP, automation, linear programming and mathematical modelling to parts or the overall process
- the effect of feed speeds, tooth profiles, kerfs, saw stroke depth and speed and other technical variables on recovery rates, productivity and quality
- allowance in initial plans for gradual improvement and modernization as future finance, better worker skills and demand allow
- special sawing practices for valuable or decorative species
- potential for mobile sawmills in developing countries.

Investment considerations

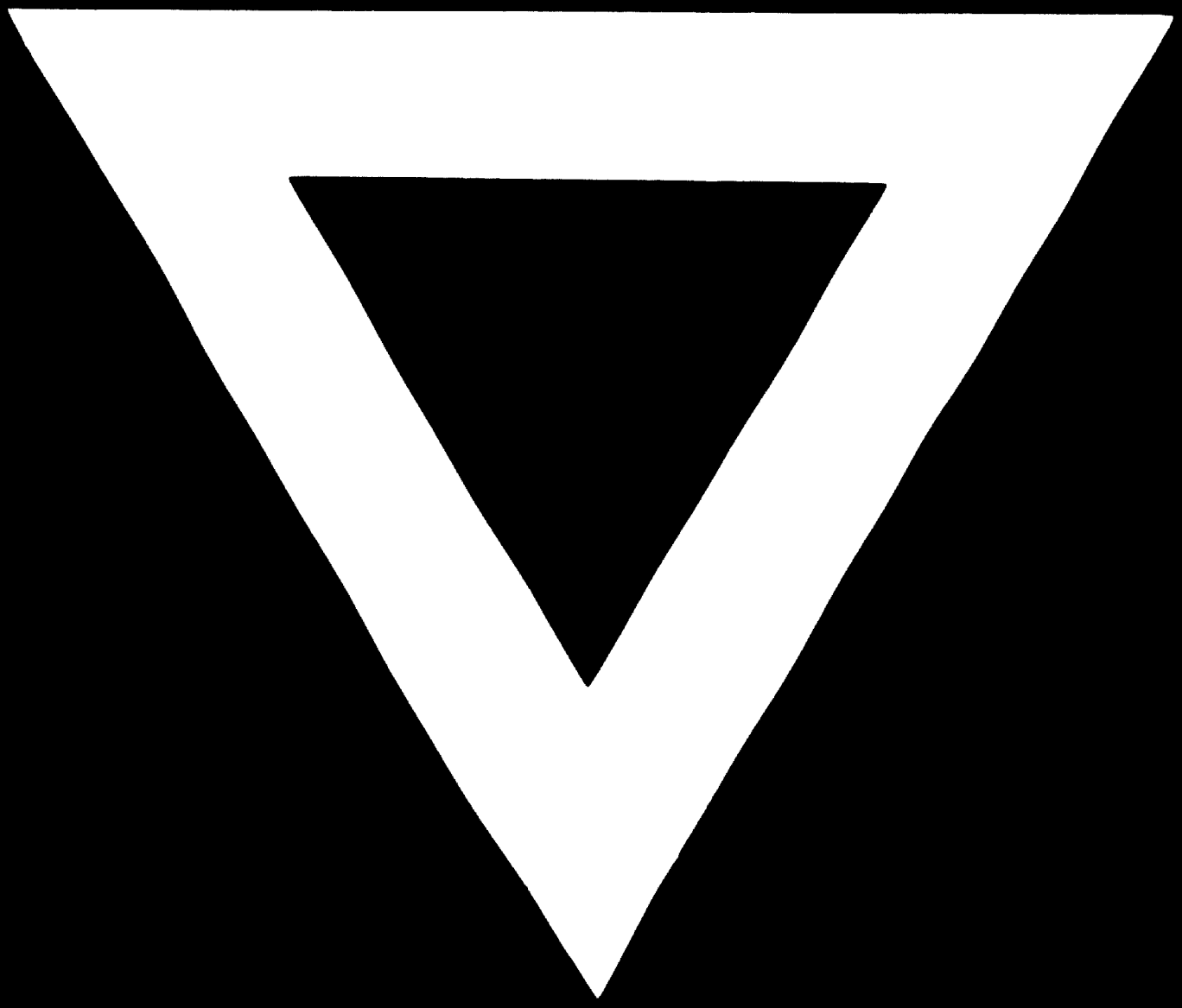
For obvious reasons, great interest is always shown in data on capital investment and returns on investment in new mills or processes or in modernization. For equally obvious reasons, there is often reluctance to divulge such information. It must be admitted that statistics of this type, unless carefully presented and controlled, may be very misleading. This remark applies particularly to the return on investment, calculations for which will incorporate a considerable number of assumptions and uncertainties relating to periods of depreciation, discount rates, future levels of demand and product prices, running costs, fuel prices and so on. Nonetheless, it seems indispensable to carry out a benefit-cost analysis (B/C A), even if somewhat rough and ready, of the alternative processes available, as one of the management tools with which to arrive at an investment decision. In the case of modernization of a process or rebuilding an old mill, the B/C A will need to demonstrate the economic superiority of the proposed investment over the existing situation, making due allowance for costs involved in making the change-over. In this connexion, it should be noted that in the case of labour-saving investments, social costs may be involved as a result of redundancies, although these will probably not figure in the individual firm's B/C A.

In the light of the above, it may be felt that the presentation of figures of the delivered or installed costs of individual processes or even the turn-key prices of a complete mill, which no doubt are obtainable from the equipment manufacturers or industrial consultants are not significant in themselves. Even where they can be supported by reliable technical performance data, the difficulties of presenting the latter in discounted cost and benefit terms remain.

Accordingly, it may be useful for the Workshop to consider the desirability of expressing technical performance in value (benefit/cost) terms and possible methodologies, including the basis on which such information could be made comparable. This is clearly a very complicated and involved problem which probably cannot be resolved at the present meeting, but might be a suitable subject for follow-up action.

Closing remarks

Technologically and commercially, the sawmilling industry is passing through a period of change more rapid than anything previously experienced. This is resulting in a broadening of the gap between 'traditional' sawmilling methods, which are still used very extensively throughout the world, and the modern, highly automated sawmill. The sawmilling sector is interesting, however, in that the economies of scale which are so vital in other industries, such as pulp production, are not necessarily a key factor, nor for that matter, is advanced technology the optimum solution under all conditions, especially in developing countries. This allows a considerable degree of flexibility in choosing the most appropriate sawmilling process or piece of equipment. This very flexibility, however, adds to the difficulty of reaching a rational decision by widening the field of choice and increasing the number of potentially viable combinations of equipment and layouts. The challenge to Group A of the Workshop is to lay down a series of guidelines which will simplify the decision-making process. In particular, there is a need to indicate how the 'best value for money' may be calculated, for example by benefit/cost analysis



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