Field manual on cost estimation in sawmilling industries

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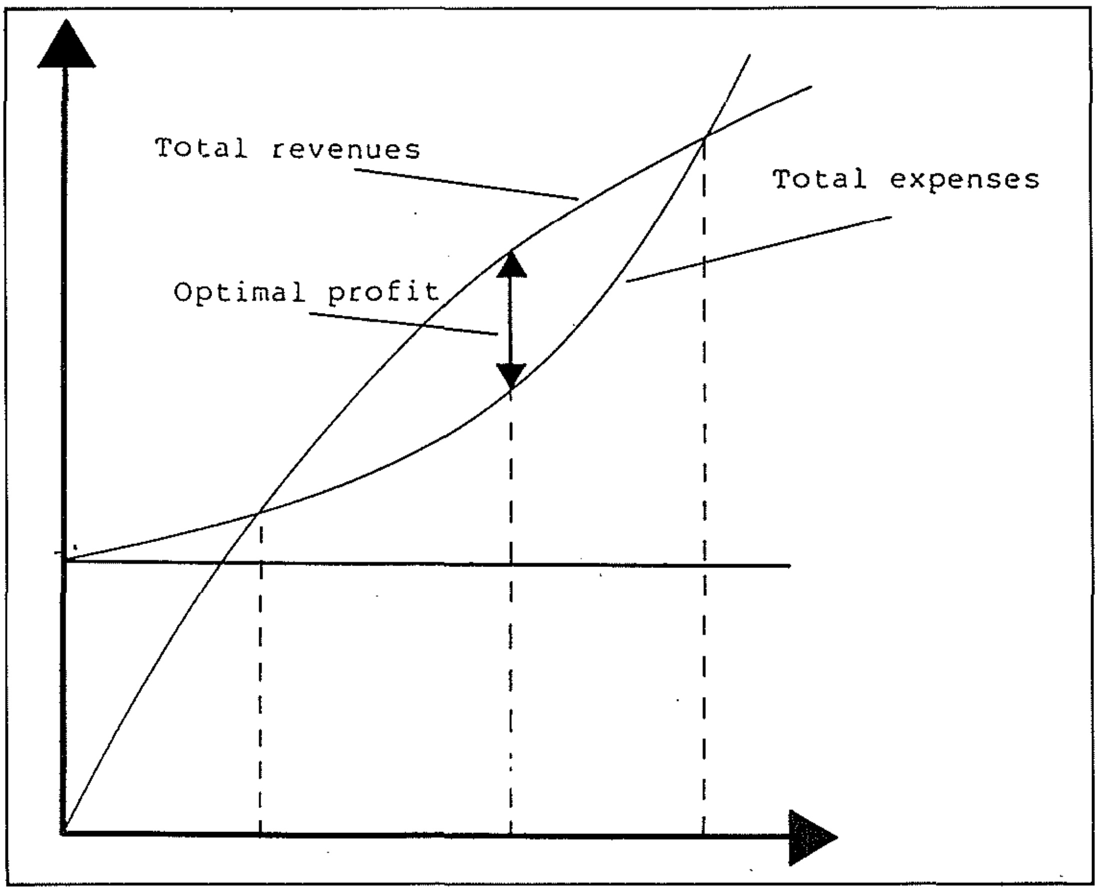

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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PREFACE

This paper is a Field Manual on Cost Estimation in Sawmilling Industries and is a follow-up to a paper ("Cost Estimating in Sawmilling Industries: Guidelines". Forestry Paper No. 52/1) issued by the FAO Forestry Department in 1984.

In contrast to the first paper, which is mostly dealing with theoretical models on managerial costing and more far-reaching problem areas, this paper is meant as a manual for managers of small and medium-sized sawmills in esimating the production cost of the sawnwood produced in their mills.

As this paper presumably will be used in many countries, a fictitious currency the monetary unit (MU) has been used in order not to divert the reader's attention from the analyses to the realism in chosen figures.

Key concepts and technical expressions have been explained in Chapter 1, Glossary.

The author has tried to simplify the costing problem as far as possible. There are limits, however, for how much a difficult problem can be simplified without making the text meaningless. To help readers, not being familiar with the concepts used, the author has used references throughout the text. The first time a new concept is introduced, it is followed by a reference to the Glossary, in which the concept is defined and numbered. A reference might for instance look like:

breakeven (d 1),

which indicates that this concept is defined in the glossary and there having Serial No. 1.

For many concepts references have been made repeatedly to serve the reader. Cross references between pages have also been used to some extent. In such cases the letter "p" and the proper page number have been given in brackets, e.g. (p. 17).

This paper is based on the work of Mr. Bo. L. Eklund, Senior Lecturer in Business Administration, University of Karlstad, Sweden, in collaboration with the FAO, Forestry Department.

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1. GLOSSARY

Economic concepts and technical expressions used in this Field Manual are defined in alphabetical order. The definitions are numbered and references to them, in the glossary and in the text, are shown in brackets, e.g. (d 1).

1. BREAKEVEN

A company is at breakeven, when it produces and sells exactly the volume needed to cover its total costs (d 21). In other words, total revenues and total expenses equal, so that profit (d 14) is zero.

2. BREAKEVEN ANALYSIS

The technique used to study the growth of both revenues and expenses in order to find the production volume at which the company is at breakeven (d 1).

3. BREAKEVEN VOLUME

The breakeven volume (BEV) is the lowest production and sales volume needed to cover the company's total costs (d 21). The concept of BEV is repeatedly used in this paper.

4. BUDGET

A budget is a quantified compilation of the company's planned actions for the budget period, which is often equal to a year. The company budget expresses the planned actions in terms of those revenues and expenses that are expected as a result of the company's actions.

5. BUDGETED PROFIT

A budgeted profit is the profit found in the company's budget (d 4). This figure, then, is an estimate of the expected, future profit.

6. BY-PRODUCTS

Log processing gives rise to two types of products. Sawn timber, which in this report is considered the main product, and bark, slabs (sometimes cut into chips), and sawdust, which in this report are named by-products, as they have an actual or potential value to the sawmill.

7. COMMON COSTS

A common cost is a sacrifice, the burden of which is commonly carried by two or more cost objectives, e.g. sawnwood or a section of the sawmill (d 11).

8. CONTRIBUTION TO PROFIT

The concept of contribution to profit (CTP) is a profitability measure, in which only traceable costs (d 22) are deducted from the revenues. Those costs not deducted are termed common costs (d 7). In profitability judgements different kinds of CTP's can be used, because each decision to be made may be based on different traceable costs. In cases of special CTP's being used they are termed relevant CTP's (d 16). The CTP-concept is repeatedly used in this manual.

9. COST

A cost is, generally speaking, a sacrifice. It can be evaluated as either an outlay (money paid for something) or a foregone opportunity, e.g. for a sale, for which the value is lost.

10. COST CENTRE

A cost centre is a part of the company - like a production or service department or a functional unit - to which costs (d 9) can be allocated. In practice, the definition of a cost centre will depend upon the purpose for which the company is collecting and analyzing costs.

11. COST OBJECTIVE

A cost objective is something that is supposed to bear the burden of a cost (d 9). The most common cost objective is either a product (e.g. a m^3 of sawn timber), a department or a whole company. From a principle point of view, however, almost anything can be a cost objective.

12. FIXED COSTS

A fixed cost is a cost (d 9) that does not change with changes (increases or decreases) in the company's production level. E.g. the general manager's salary will be the same regardless of the company's output. When the production volume increases (decreases) the unit cost (d 23) will decrease (increase). Compare variable costs (d 24).

13. POST ANALYSES

A post analysis is any kind of calculation made after the event has occured, for which the analysis has been made. In post analyses the company works with actual revenues and expenses. See and compare the concept of pre analyses (d 15).

14. PROFIT

The profit of a company or a given product is defined as the total revenues of the company (or for the given product) minus the total costs (d 21) of the company (or total cost for producing a given product). The profit concept is used primarily for indicating the long term result of a company or a product. It is not to be confused with the contribution to profit concept (d 8).

15. PRE ANALYSES

A pre analysis is any kind of calculation made before the event occurs, for which the analysis has been made. In pre analyses the company works with estimated revenues and expenses. The quality of the analytical work is, therefore, dependent on how well these estimates are made. The budgeting work of a company is an example of a pre analysis.

16. RELEVANT CONTRIBUTION TO PROFIT

In certain profitability judgements the manager has to choose different estimates of his contribution to profit (CTP, d 8). The reason is that his traceable costs (d 22) might vary from one decision to another. By carefully studying his cost, he might choose a variety of CTP's. Each such CTP is called the relevant CTP for that particular reason.

17. REQUIRED RATE OF RETURN

The required rate of return (RRR) is the yield the company demands on the capital that is invested in the company. The size of the RRR depends, among other things, on other investment opportunities that are open to the company.

18. SAFETY MARGIN

The safety margin of a company is the difference between the budgeted sales volume and the breakeven volume (d 3).

19. SAWN TIMBER RECOVERY

The sawn timber recovery is measured as the total output of sawn timber in m^3 divided by the total input of logs in m^3. This measure is established by using output/input-figures for an extended period of time, usually a whole year.

20. SENSITIVITY ANALYSIS

A sensitivity analysis is an analysis made to reduce the uncertainty of the company manager's decisions. In all kinds of pre analyses (d 15) company managers have to put in various estimates of revenues, expenses, production and sales volumes and the like. To find out what will happen, if these estimates turn out to be wrong, company managers vary all key variables among their estimates, thereby getting a number of different results. The total picture of possible outcomes is known as a sensitivity analysis.

21. TOTAL COSTS

The total costs of operating a company (or producing a given product) consists of the sum of variable (d 24) and fixed (d 12) costs.

22. TRACEABLE COSTS

A traceable cost is a cost (d 9), so defined that it disappears, if the cost objective (d 11), to which it belongs, disappears. To qualify for this concept, the cost must be indisputably traceable to its cost objective. If a company, producing many products, makes a decision to cease to produce e.g. product A, this means that the costs of raw material used for this product will disappear. The raw material is then said t be indisputably traceable to product A. The general manager's salary will, however, not be influenced by this decision. It is therefore a common cost (d 7) to all cost objectives of the company. In practice, variable costs (d 24) are often used instead of traceable costs. Although this, from a conceptual point of view, is incorrect, it might be correct in some specific cases. Actually, in this manual variable and traceable costs to some degree have been used interchangeably.

23. UNIT COSTS

The concept of a unit cost takes on two different forms. First, there is the variable, unit cost. See variable cost (d 24). Second, there is the unit cost that accrues out of a fixed cost (d 12). In the latter case the total amount of fixed costs is divided by the total number of products produced. When production volumes vary, also the unit cost varies. The unit cost of a product consists of both variable and fixed components, and, thereby, the unit cost of the product will vary from time to time depending on the production volume.

24. VARIABLE COSTS

A variable cost varies - in its total - with the production volume of the company, while its unit cost (d 23) is unchanged. If the unit cost of the raw material used in a product is the same regardless of the purchased volume, the total cost of raw material will be directly proportional to the number of units produced. Compare fixed costs (d 12).

2. THE REVENUES OF THE SAWMILL

2.1 Types of revenues

The uncomplicated sawmill, i.e. a sawmill producing nothing but sawn timber, has in general two types of revenues. Firstly, there are revenues from sawn timber and, secondly, from "other products" accruing from the log.

Processing the log means producing four types of products; sawn timber, bark, slabs and sawdust. In this manual we will treat the sawn timber as the main product of the sawmill. The remaining three products will here be referred to as by-products (d 6). The word "by-product" is defined as "anything produced in course of making another thing". In practice one often uses "residues" to denote bark, slabs and sawdust. But the word "residue" stands for "that which is left after part is taken away". We will here stress the importance of looking upon bark, slabs and sawdust as "things" possessing a potential value to the sawmill, and we will, therefore consequently use the term "by-products" in this manual.

In estimating future as well as past revenues, the sawmill manager should concentrate on profitability, even if analyses of the effects of revenues on profitability present difficulties. For example, the sawmill manager, in aiming at a certain level of revenues, may have to accept costs, which would not be incurred on other levels. The determination of net revenues, therefore, requires that also costs be taken into consideration to some extent.

2.2 Revenues from sawn timber

In estimating the revenues from sawn timber at least four questions must be answered:

1. Who decides what price to charge the customers?
2. How to account for price fluctuations?
3. How to account for price variations with regard to different wood species?
4. How to treat commissions, cash discounts, and other costs in connection with selling?

There are many possible answers to each of these questions. Let us try to give some examples.

2.2.1 Determining the price

In price-setting one of the following possibilities will occur. Either the sawmill operates in a system of price control, or it can set its prices freely, i.e. considering the market's reactions only.

In a system of price control the sawmill manager has to accept a price set by an outside body. The manager's role in connection with price-setting will then primarily be to answer the question: Can we produce the sawn timber at a cost low enough to give a reasonable profit? This, in turn, calls for a proper cost calculation system. The system can also be used to show the price-setting body what actual costs the sawmill has, thereby giving the sawmill manager an opportunity to at least influence the price of timber.

In a system of free pricing the manager himself decides what price to charge. His customers' primary interest is what price they must pay for a specific product with a given quality and other pre-determined specifications, such as time and place of delivery. The sawmill manager's first task, therefore, is to decide on a proper price, and after that, he asks himself if he can produce his product at costs low enough to give him the desired profit.

Assume the sawmill produces sawn timber from only one species of wood. Imagine further that the sawmill's traceable costs (d 22) amount to exactly MU 500 per m^3. Let us now analyze the effect on total revenues, when five different prices are used. The higher the price is, the lower the quantity demanded by the sawmill's customers will be.

Price per m^3	Traceable cost	CTP per m^3	Quantity demanded m^3	Total revenues
1,100	500	600	2,000	1,200,000
1,050	500	550	2,500	1,375,000
1,000	500	500	2,900	1,450,000
950	500	450	3,350	1,507,000
900	500	400	3,650	1,460,000

Lowering the price means a lower CTP (d 8) per m^3. But this unit reduction in profit is compensated by a higher demand. At a price of MU 950 per m^3, the sawmill's total revenues reaches a peak (boxed row). Lowering the price one step further will increase the demanded quantity, but will, lower the total revenues. The price MU 950 per m^3 will give the sawmill the highest possible profit.

To analyze the market demand at different prices is an extremely difficult - often impossible - task. Still, this is the way the market reacts in a system of free pricing. The manager should consider this fact and try to use his judgement and previous experience in setting his prices.

2.2.2 Accounting for price fluctuations

Price fluctuations will occur over time and for different customers. In budgeting the sawmill's revenues the manager has to take account of this. When budgeting expected revenues the usual procedure is to estimate the expected average price during the budget year.

The most important work in accounting for price fluctuations is the analysis of past performance. In other words, what prices did the sawmill achieve during the past budget year? This analysis should then be used to guide the sawmill's sales efforts in the year to come.

Such an analysis will most probably show that the sawmill has achieved different prices for different periods (seasonal fluctuations) as well as from different customers. If all prices are lumped together in one single average figure, the manager will get no guidance at all from this average. Instead the analysis should be made for different markets and, within each market, for different customers (or group of customers). The aim is to find those customers (or groups of customers) who are the more profitable, in order, if possible to direct future sales efforts towards such customers.

In analyzing price fluctuations due consideration must be given to seasonal variations. One cannot compare prices achieved from one customer during a period of low prices with those achieved from another, to whom goods have been sold during a price peak. Seasonal price variations must be eliminated before comparing customer profitability. Other price influencing factors, such as price cuts made for damaged goods, must also be eliminated.

In order to obtain reliable guidance from previous prices, the manager should see to that customer records are adequately maintained. Quantities sold, prices achieved and traceable costs (d 22) incurred should be recorded properly throughout the year.

2.2.3 Accounting for different wood species

Different species affect profitability in two ways. Firstly, different species might give rise to varying revenues. Secondly, costs might vary from one species to another as a result of differences in both purchase prices, sawing and handling costs.

A minimum requirement, therefore, is that estimates of average revenues should be made separately for each species. Thereby, revenues can be directly compared with costs in a meaningful way, when costs vary among species.

2.2.4 Costs influencing net prices

In determining the sawmill's "achieved price" for sawn timber we have to separate gross prices from net prices, the latter being defined as gross price minus traceable costs (d 22), i.e. those costs being directly traceable to a certain customer or a specific sale.

Cost of logs does not change with sale to customers buying the same kind of sawnwood, whereas other costs, might vary from one customer to another.

Discount is a cost that often varies between customers. Cash discounts, e.g. are often given to stimulate quick payments. Such discounts, calculated as a percentage deduction based on the price of sawn timber, should be the same for all customers, if not, problem arises in the profitability judgement, of the various customers (or groups of customers). Varying discounts to different customers have the same effect on profitability as different prices.

Quantity discounts may create differences in achieved net prices. These discounts may be given as price deductions connected with either the quantity purchased each time or the quantity purchased during e.g. a year.

If different sales commissions are paid to sales agents this will affect the actual net price achieved for the sawn timber. Transport costs have the same effect if the sawmill is supposed to pay these costs.

All cost variations of these kinds must be considered in judging market and customer profitability. This calls for recording net prices as much as possible.

2.3. Prices for by-products

Sawmills in industrialized countries always have a positive value on their by-products, as these can be sold, usually at well-established prices, or they can be used as fuel in the sawmills production process. In the latter case the positive value is estimated as the net savings as compared with other sources of energy, e.g. the net cost of oil saved by using the by-products for heating the drying kiln. In developing countries, however, by-products do not necessarily have a market although the use of by-products for the production of steam power is getting more common.

In order to estimate the value - positive or negative of the by-products, the first task is to establish the quantities of bark, sawdust, and slabs that are produced in the sawing process. To do this the sawmill manager has to study his production over an extended period of time, e.g. over one month and find out how many m3 of each catagory of by-products that are produced. To establish such figures might also be of value, e.g. in connection with expansion plans. (If the sawmill expands its production of sawn timber from, let's say 3,000 m^3 to 4,500 m^3, the sawmill manager can easily evaluate what will happen to his by-product revenues, as long as the same type of machinery equipment is used.)

Let us first assume that the by-products have a positive value. Perhaps there is a board factory that can buy sawdust and slabs, and maybe the bark can be sold to local customers as fuel for heating purposes. Assume further that these are the very best alternatives for the sawmill from an economic point of view. Analytically we can now separate two cases.

The first case is a mill sawing only one wood species. In this case all by-product revenues will be attributed to the only species of sawn timber produced. All one has to do in this case is to record the revenues received for the by-products. In other words, there will be no analytical problem at hand.

In the second case we assume there are three wood species, A, B, and C to be produced. We also assume the sawn timber recovery (d 19) to be approximately the same for all species. As long as all species of sawn timber are undoubtedly profitable, there will be no analytical need for attributing by-product revenues to each species. As in the first case, all by-product revenues can be recorded as a lump sum.

If, however, any of the species should show a loss, the picture might change, if the value of its by-products is duly considered. The reason for an analytical approach is simple. As soon as a product, (in this case one of the species) turns out to be non-profitable, there is always a possibility that management decides to stop the production of such a product. Before doing so one should examine all economic consequences of such a decision. For the sawmill, stopping the production of one of its species, means that both revenues and costs for that particular species will disappear. This means that also the revenues from the by-products, coming from this species, will disappear. To estimate the precise decrease in revenues, one must know the amount of by-products that can be derived from this particular species.

This can be done by merely allocating the total by-product revenues in relation to the volume of sawn timber produced for each species. Assume an overall by-product revenue of MU 1,240,000. Knowing the production of each species, this amount can be allocated proportionally in the following way.

Specification	Species A	Species B	Species C	Total
Sawn timber, m^3	2,000	1,500	2,700	6,200
Sawn timber, per cent of total production	32.3	24.2	43.5	100
Allocated revenues from by-products in MU	400,520	300,080	539,400	1,240,000

Total production amounts to 6,200 m^3. Out of this 32.3 per cent come from Species A, 24.2 from Species B and 43.5 from Species C. Total revenues from by-products, MU 1,240,000, have been allocated proportionally to these percentage figures, as we assumed the sawn timber recovery to be equally high for all species. If production is stopped for one of these species, we can see at once the economic effects from lost by-product revenues. If we do not allocate these revenues adequately to each species, we always run a risk of misjudging the actual profitability of the species.

From a purely accounting point of view, these figures can be added to the revenue side of the financial statement (i.e. using the gross method in estimating the cost of logs. The by-product revenues can also be deducted from the sawmill's log costs i.e. using the net method. For the sawmill, not connected with either a planing mill or any other production activities but sawing, both methods can be used, as they in such a case give the same result.

Finally, if there is no market demand for the sawmill's by-products, no revenues will accrue. Instead the sawmill will get costs for handling - and perhaps for dispose of - its by-products. In such cases, these costs must be taken into account in the cost analysis, as the by-products then represent a negative value to the sawmill.

3. CALCULATING LOG COSTS

3.1 Costing problems

Calculating the sawmill's log costs involves the following activities;

1. Listing those traceable costs (d 22) incurred in buying, sorting, and storing the logs to arrive at log costs gross
2. Finding a way to treat, economically, the by-products.
3. Making a final estimate of the log costs.

It does not matter, in principle, if the sawmill uses one or more wood species. As the principles of calculation are the same, only one species is used in the examples given below.

3.2 Listing traceable costs

In estimating log costs gross we are interested in only those traceable costs the sawmill gets for logs in order to fulfil its production plans. The following costs will be taken into consideration:

1. Buying price of logs.
2. Transportation costs from the logging area to the sawmill site, if applicable.
3. Insurance costs (if any) for the above-mentioned transport.
4. Log measuring cost, if separable.
5. Log inventory costs.

Let us give a few hints on how these costs can be treated.

The buying costs of logs must always be carefully watched. Usually, the manager makes an average estimate of his buying costs. In post analysis (d 13) he takes an average, over the whole year, of those costs he has actually had. In pre analysis (d 15) he must try to make qualified estimates of the costs he will get during the year to come. Having forecasted his log costs he should also make continuous controls in order to follow up how his cost situation develops. He does this by making continuous average estimates, e.g. month by month, of his actual costs.

If the sawmill pays for log transports, these costs should be regarded as part of the log costs gross. This is also valid for insurance costs in connection with log transports.

Costs of measuring purchased log quantities can be paid separately. In such cases they are treated as costs of log transports and insurance. If, however, the measuring job is made by the sawmill's ordinary labourers, no account will be made for the measuring costs in calculating the log costs gross.

All sawmills need to have a minimum stock of logs. Due to irregular log deliveries most sawmills get a stock variation above the minimum requirement. From past experience, gained by regular stock taking, the average log stock can be estimated. The interest cost on the capital tied up in this average stock is referred to as log inventory costs. These costs are sometimes very high.

Assume that our sawmill pays transport costs, while log sellers pay for insurance and that the average log inventory cost is MU 12.20 per m^3. With an average buying price of MU 500 and transport costs of MU 22,00, per m^3 of sawn timber (p 20), the log cost gross will be:

Specification	MU/m^3 of sawn timber
Logs at buying costs	500.00
Transportation costs	22.00
Log inventory costs	12.20
Log costs, gross	534.20

3.3 Accounting for revenues from by-products

It has been pointed out previously that the value of the by-products can be either positive or negative (p 9). If we assume that there are markets for by-products there are two methods of treating these revenues.

If the sawmill uses the gross method (p 11), whereby the proceeds from the sale of by-products are added to the general revenues of the mill, the cost estimates are not affected at all. The calculated log costs will be exactly the log cost gross, i.e. MU 534.20 in the example above.

If, on the other hand, the sawmill uses the net method, the revenues earned from selling the by-products will be deducted from the log costs gross. Assume that these revenues are MU 21.20 per m^3 of sawn timber. The log costs per m^3 of sawn timber will then be:

Specification	MU/m^3 of sawn timber
Log costs, gross	534.20
Revenues from by-products	21.20
Log costs, net	513.00

3.4 Method of calculation to be used

From the previous paragraph we learned that there are two different methods for calculating the sawmill's log costs. To decide on a suitable method to use in practice, we must separate two cases.

In the first case we assume a sawmill, the only activity of which is to produce and sell sawn timber. As long as there is a market price for the goods high enough to cover all costs and to give a reasonable profit, it does not matter what method is used. A comparison shows exactly the same contribution to profit(CTP), (d 8), per m3 of sawn timber for the two methods.

Specification	Gross method MU/m3 of sawn timber		Net method MU/m3 sawn timber	
+ Revenues, sawn timber		900.00		900.00
+ Revenues, by-products		21.20		00.00
= Total revenues		921.20		900.00
+ Log costs, gross	534.20		534.20	
- Revenues, by-products	00.00		21.20	
- Log costs, net	534.20	534.20	513.00	513.00
= Contribution to profit		387.00		387.00

We get the same CTP/m3 in both cases because we have used the same figures. The only difference between the two methods is that by-product revenues in the gross method have been added to the revenue side and in the net method they have been deducted from the log cost.

But also in this simple case it might be wise to use the net method. This method directs the interest towards the sawmill's by-products indicating that the actual log cost is less than what is paid gross. The use of this information is shown in the next example.

In the second case we will widen the activities of the sawmill to encompass also a planing mill. Let us assume that 70 percent of the sawmill's production is sold as rough unplaned timber and the remaining 30 percent is delivered to the company's planing mill, and sold as planed boards. The following question now arises: What is the log cost? The answer depends on what method of calculation we use in the "sawmill department".

If we use the gross method, we will find that the log cost will be estimated to MU 534,20 either the sawn timber is sold on the open market or it is delivered to the company's own planing mill. This is, from an analytical point of view, quite correct, if and only if 70 percent of the revenues from the by-products are credited to the sawmill's revenues and 30 percent are credited the revenues of the planing mill. If all revenues from the sawing process are credited to the sawmill, its profitability will increase at the expense of the profitability of the planing mill.

Using the net method solves this problem. All log costs are estimated at a net value, either the log is used for producing sawn timber for sale or for internal deliveries to their own planing mill.

4. CALCULATING TOTAL COSTS OF SAWN TIMBER

4.1 What costs and where they accrue

In calculating the total costs of sawn timber we have to answer two questions:

1. What costs will be considered in our calculations?
2. Where do costs accrue in the sawmill?

The first question is essential in all costing procedures. In some situations all costs must be regarded, while on other occasions certain costs can be disregarded. In this section we will work over a longer period of time. Therefore, all costs of the sawmill will be considered.

There are, however, special situations (p 30) in which the manager should disregard certain costs but be very concerned about others. These situations will be separately dealt with later on.

The second question is only a means to help the manager in finding his costs. Through a systematic split up of the sawmill's activities in cost centres (d 10), the study of costs will be easier and the sawmill manager will gain better cost control over various activities.

4.2 Cost centres and their costs

All activities in the sawmill generate costs. To find a way to study where costs accrue, we can divide the sawmill into three functional areas;

1. Log purchase, log handling and storing.
2. Sawing process.
3. Finished goods storing, selling and general administration.

There are also other ways of dividing the sawmill into cost centres, but the above, has been found simple and most useful. Each cost centre can however be sub-divided, but we will not study the costing procedure in such detail.

To avoid forgetting certain costs the manager can simply ask himself: What do we do, or what activities are performed, in the sawmill? Answering this question helps him to find the costs. So what do we do in various cost centres ("departments") of the sawmill?

In log handling:

- logs are purchased,
- logs are transported,
- logs are measured,
- logs are sorted,
- logs are taken care of in many other ways (covered, watered, safeguarded and so forth),
- logs are stored, and
- logs are internally transported (e.g. from the storage place to debarker).

In the sawing process:

- logs are debarked,
- logs are moved (process flow),
- logs are sawn,
- sawn timber is sorted,
- sawn timber is dried,
- dry timber is trimmed and graded,
- material is stored,
- by-products are produced and stored, and
- various kinds of internal transport tasks are carried out.

In the sales and administration function of the sawmill:

- finished goods are stored,
- sales activities are performed,
- deliveries are made, and
- the sawmill's administration is carried out.

Most activities are common to all sawmills, but to some extent the activities can vary among companies. It is important for the manager to analyze all activities carried out in his sawmill in order to find what costs his company has.

The listing above is far from complete. There are lots of activities left out. Nothing has been mentioned about e.g. supervisory activities, repair and maintenance work, and protection measures against insect attacks. Other activities could have been split up in greater detail. The administration could have been divided into bookkeeping, cost budgeting, personnel administration and so forth.

The main idea here, however, is not to show all possible activities that are carried out in a sawmill. Instead it is important to point out two things. Firstly, all activities performed create costs. Secondly, some activities, and thereby costs, can easily be overlooked, if a proper analysis is not carried out. A typical example is the activity "to store". Storing is an expensive activity. At the same time, there will be no invoices accruing from storing. This means that the sawmill manager himself must find out the cost. For a manager who wants to improve the costing procedures of the sawmill, this kind of analysis serves as a good starting point.

4.3 Putting costs together: Model I

In this sub-sector we will put together the total costs of the sawmill. We will do this in a fairly detailed way using the split up in the above-mentioned three functional areas.

Cost figures will be given as both total costs and costs per m^3 of sawn timber. We will assume that the sawmill manager has made a budget (d 4) for the year to come. In this budget he has tried to estimate all costs of the sawmill for an expected production and sale of 6,000 m^3 of sawnwood. The estimated total costs have been divided by the expected production volume in order to arrive at a unit cost (d 23), i.e. a cost in MU per m^3 of sawn timber.

Sometimes, however, he has started from the unit cost. Most probably he knows (or can make a qualified guess at) the log cost per m^3. Also other cost items, like sales commissions or cash discounts, might be known as a cost per unit figure. The manager has a choice, therefore, to make his estimates either on a cost-per-unit-basis or on a total-cost-basis. In this example we have given both figures.

The following Exhibit 4.1 shows the total budget cost for a yearly production of 6,000 m^3 of sawnwood. It is seen that the budget is divided in three cost centres and each cost item has been given a code number (Item No.). The purpose of this is to be able to refer quickly to various cost items in the comments given on the following pages. These references will be given in the left margin as IN 100 and so forth.

IN 100

Log costs contain those costs that in other industries usually are called direct material. They include cost items 101-106.

IN 101

Log costs at buying prices have been estimated in the following way. It is assumed that the sawmill buys logs at a cost of MU 250 per m^3 and that, the sawn timber recovery (d 19) to be 50 per cent. This gives the log cost per m^3 of sawn timber in the following way:

Log costs	MU 250 per m^3 of logs bought
Sawn timber recovery	50 per cent (0.5)
Log costs, gross: 250/0.5 =	MU 500 per m^3 of sawn timber

In estimating log costs per m^3 of logs bought the sawmill manager will take an average log cost, when the sawmill has more than one supplier.

IN 102

From last year's transport costs the sawmill manager can estimate a unit cost. After adjustments for probable price changes this figure is then used, as a forecast for the coming year. The unit cost is multiplied by the expected purchase volume to arrive at a total. Also for costs other than transport costs it is probable that the forecast will be based on last year's actual cost. Due consideration must be taken, however, to price changes and other deviations. New suppliers e.g. might give rise to both lower and higher costs.

Item No.	Specification	MU per m3 of sawn timber	Total cost in MU
100	Log costs		
101	+ Log costs at buying prices	500,00	3,000,000
102	+ Transport costs	22,00	132,000
103	+ Log inventory costs	12,20	73,200
104	= Log costs, gross	534,20	3,205,200
105	- Revenues from by-products	21,20	127,000
106	= Log costs, net	513,00	3,078,200
107	Log handling costs		
108	+ Labour costs	4,00	24,000
109	+ Watering	2,50	15,000
110	+ Repair & maintenance	4,50	27,000
111	+ Fuel & miscellaneous	3,00	18,000
112	+ Depreciations	9,00	54,000
113	= Log and log handling costs	536,00	3,216,200
200	Sawing		
201	+ Labour costs	48,50	291,000
202	+ Repair & maintenance	8,20	49,200
203	+ Heating costs	15,70	94,200
204	+ Consumption material	12,30	73,800
205	+ Fuel, etc.	7,20	43,200
206	+ Work-in-process inventory	1,80	10,800
207	+ Depreciations	50,00	300,000
208	= Manufacturing costs	679,70	4,078,400
300	Storing, selling and general administration		
301	+ Labour costs	4,00	24,000
302	+ Cash discounts	18,00	108,000
303	+ Sales commissions	27,00	162,000
304	+ Travelling	3,40	20,400
305	+ Salary, sales manager	10,50	63,000
306	+ Finished goods inventory costs	19,25	115,500
307	+ Depreciations	7,20	43,200
308	+ Salary, general manager	12,70	76,200
309	+ Salary, office clerk	6,20	37,200
310	+ Office, miscellaneous	4,80	28,800
311	+ Full cost of sawn timber	792,75	4,765,700

Exhibit 4.1 Compilation of the sawmill's budget at total cost. Model I

IN 103

Inventory costs are often overlooked in budgets. To estimate this cost two questions must be answered:

1. What average log quantity will be tied up during the year to come?

2. What does it cost to store one unit (m^3) of logs during a year?

To answer the first question the manager has to estimate his future production in more detail. He must know how many m3 will be produced during each month of the coming year. He must also estimate when log deliveries will be made. In doing so he can, to some extent, base his estimates on previous experience. An example of such an estimate has been given in Exhibit 4.2.

The opening inventory at the beginning of the first month less logs consumed for planned production during this month plus expected log deliveries gives the opening inventory for the second month. The sum of all opening inventories over 13 months (the 13th month being the first month of the year after the budget year) divided by 13 gives the average log inventory.

Each m^3 of logs stored ties up a capital of MU 250. The cost of storing is the interest lost on the value of logs in storage. Storing one m3 of logs means, economically, that MU 250 are stored. If there is an average inventory of 2,930 m3, this is the same as "storing" a capital (capital tied up) of MU.250 x 2,930 = 732,500 as an average throughout the whole year. If that capital has not been tied up, the sawmill could have got at least a bank interest on its money back. The costs of capital tied up is the amount of money that the sawmill loses not using its money in another way. Assuming that the sawmills required rate of return is 10 percent, it will thus cost MU 73,250 per year to keep an average of 2,930 m^3 of logs in stock (d 17).

IN 104-106

Adding the costs so far shown gives the log cost gross. We recognize this from our previous examples. From this cost we deduct the estimated revenues from by-products in order to arrive at log costs net. All these figures have been used in previous examples.

IN 107

The next grouping of costs - still in the first cost centre - are all costs that accrue as a result of log handling.

Month No. Specification	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
+ Beginning inventory	4040	4280	4160	3880	2800	1720	1120	1320	1440	4360	3880	2800	2320	38120
- Logs for production	1080	1080	1080	1080	1080	600	600	1080	1080	1080	1080	1080	-	-
+ Log deliveries	1320	960	800	0	0	0	800	1200	4000	600	0	600		

Average log inventory = Sum of beginning inventories over 13 months divided by 13. This results in 2930 m3.

- Costs of capital tied up at 10 percent interest 2930 x 250 x0.1 = 73250 or MU 12.20 per m3 of sawn timber.

Exhibit 4.2 Estimated capital cost for log inventory at 10 percent interest.

IN 108-111

Such costs as labour, watering, repair & maintenance, fuel and miscellaneous costs have been put in as examples of costs typical for log handling. Labour costs can be estimated from the company's payroll. The remaining cost items will most probably be taken from the accounting books of the previous year. Due consideration will, however, be given to expected cost increases.

IN 112

The last item in this cost grouping is the depreciation costs. These costs refer to buildings and machinery used in log handling only. Very often depreciation costs are estimated as a lump sum for the whole sawmill, as has been done in the next example, Model II. There might be good reasons, however, for separating depreciation costs among cost centres. Firstly, it gives a more detailed cost control. Secondly, depreciation rates might vary for different machines and buildings.

IN 113

Adding together the costs so far treated gives the full cost of the sawmill's log purchases and log handling activities.

IN 200

Sawing costs show all costs from the start of the actual production - in most cases the debarking station - up to the point where the finished sawn timber is brought into the sawmill's warehouse for ready made goods.

IN 201

Labour costs include all operators from debarking to trimming. Costs for truck drivers, repairmen etc. might be included, but they can be taken up under different headings. Wages for repairmen can be put under repair and maintenance costs and so forth.

IN 202-205

The next four items - repair and maintenance, heating, consumption material (saw blades, etc.), and fuel costs - will probably be estimated based on experience and last year's costs. It has in this example been assumed that the sawmill uses artificial drying. (See also Item No. 206).

IN 206

The work-in-process inventory should here be considered separately. As for the log inventory there will be no invoices showing the actual cost. At the same time, all industries have some work-in-process inventory, and thereby capital tied up, which create a cost.

There are two types of work-in-process inventories. All industries have material flows in their production giving rise to flow inventories. In order to avoid a process stop, if a machine breaks down, or for other reasons, there must also be a buffer inventory or buffer stock. The sawmill e.g. must have a stock of sawn but green timber in various dimensions in order to feed the drying kiln economically. Based on experience the sawmill manager should be able to estimate these inventories. In this example it has been assumed that the flow inventory amount to 120 m^3 at an average. The buffer inventory has been estimated at 80 m^3. The value of these inventories has been set at MU 536 per m^3, i.e. the sum of log and log handling costs (Item No. 113). The capital cost per m^3 of sawn timber is then estimated in the following way:

Work-in-process, flow inventory	120 m3
Work-in-process, buffer inventory	80 m3
Work-in-process, total inventory	200 m3
Capital tied up, 200 x 536 =	MU 107,200
Capital cost, total (10 per cent)	MU 10,720
Capital cost per m^3 of sawn timber	MU 1.80

The total capital cost of MU 10,720 has been divided by the expected sawn timber production volume of 6,000 m^3. The cost is extremely moderate, but the principle is important. In case of airdrying e.g. the work-in-process inventory increases tremendously and thereby also the capital cost per m^3.

IN 207

Depreciation costs refer totally to the sawing process. For further comments, see Item 112.

IN 208

Adding cost items 101-207 gives the total manufacturing costs on a full cost basis, i.e. the sum of log and log handling costs and the costs of sawing.

IN 300

The last cost grouping consists of storing, selling, and general administration costs.

IN 301

Labour costs consist of payments to the sawmill's store-keeper or keepers.

IN 302

Cash discounts might vary greatly. It has been assumed here that the sawmill pays two percent of the sales price in cash discounts. The sales price has been set to MU 900 per m^3 of sawn timber.

IN 303

Sales commissions have been fixed at three percent of the sales price. Also this figure might vary among sawmills.

IN 304

Travelling costs always accrue in connection with sales. Probable source of information is last year's costs duly adjusted for price increases.

IN 305

In this example it has been assumed that the sawmill has one sales manager with a yearly salary of MU 63,000.

IN 306

Another important cost item, for sawmills (as well as for other industries), is the finished goods inventory costs. To estimate this cost the sawmill manager can proceed in the same way as is proposed for the log inventory costs (see Exhibit 4.2). The underlying calculations are not shown here, but they have been made in the following way. Starting with an opening inventory the production during the first month has been added and thereafter the estimated sales value has been deducted. The result is "the opening inventory for the second month", for which the same kind of calculation is to be repeated.

The sum of all opening inventories during a 13-month period has then been divided by 13 to arrive at an average, finished goods inventory of 1,692 m^3 or approximately 1,700 m^3 of sawn timber. The capital tied up has been estimated at <u>manufacturing cost</u>, i.e.. MU 679,70. At 10 percent interest the capital cost becomes:

1,700 x 679.70 x 0.1 = 115,549 or approximately MU 115,500.

IN 307

For depreciation costs, see Item No. 112.

IN 308

The salary for the sawmill manager is fixed at MU 76,200 p.a.

IN 309

One office clerk has been assumed to have a yearly salary of MU 37,200.

IN 310

Miscellaneous office expenses can easily be estimated from last year's expenses.

IN 311

Adding all cost items gives the total cost for the budget year for the company as a whole as well as per m^3 of sawn timber.

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We will return to the budget figures later on. But let us first look into the possibility of making a somewhat less complicated budget, i.e. a budget that is less split up than the one already presented.

4.4 Putting costs together: Model II

The compilation of costs in Exhibit 4.1 is fairly complicated in the sense that costs are split up in rather great detail. In practice, however, one finds that both sawmills and other industries often have very few cost items in their budgets. Reducing the number of items might give an impression of simplification. But there is a pitfall. True, the budget itself will look simple, as compared to the one in Exhibit 4.1, but working actively with such a budget may turn out to be difficult, which will be demonstrated later on in this chapter.

A simplified budget has been shown in Exhibit 4.3. It builds on exactly the same figures as the previous one. The difference is only that some cost items have been brought together under common titles. In this budget, here called "Model II", the item codes have been shown as four-digit numbers. The following costs are composites from Exhibit 4.1.

Item No.	Specification	MU per m^3	Total costs in MU
1000	Log costs		
1001	+ Log costs at buying prices	500,00	3,000,000
1002	+ Transport costs	22,00	132,000
1003	= Log costs, gross	522,00	3,132,000
1004	- Revenues from by-products	21,20	127,200
1005	= Log costs, net	500,80	3,004,800
1006	Log handling costs		
1007	+ Watering	2,50	15,000
1008	= Log and log handling costs	503,30	3,019,800
2000	Sawing		
2001	+ Labour costs	56,50	339,000
2002	+ Repair & maintenance	12,70	76,200
2003	+ Heating	15,70	94,200
2004	+ Consumption material	12,30	73,800
2005	+ Fuel etc.	10,20	61,200
2006	= Manufacturing costs	610,70	3,664,200
3000	Storing, selling, and general administration		
3001	+ Sales costs	58,90	353,400
3002	+ Administration costs	23,70	142,200
3003	+ Depreciations	66,20	397,200
3004	= Full cost of sawn timber excl. inventory costs	759,50	4,557,000
3005	+ All inventory costs	33,25	199,500
3006	= Full cost of sawn timber, incl. of inventory costs	792,75	4,756,500

Exhibit 4.3 Compilation of the sawmill's budget at total cost. Model II.

2001: Labour costs

Under the title "labour costs" all labour has been brought together, i.e. MU 56.50 is the sum of the unit cost items 108, 201 and 301 in Exhibit 4.1. This is a common way of bringing labour costs together in sawmill budgeting. Companies often cannot see any reason to separate labour costs for log handling, sawing and storing. All activities are considered necessary for the whole process. But this is not always true. Changing the production volume in either way might involve changes in labour needs for one function but not necessarily for the others.

2002: Repair and maintenance costs

Repair and maintenance costs in Exhibit 4.1 will be found under Item No.'s 110 and 202. They have here been brought together and placed under sawing.

2005: Fuel costs

The fuel cost item represents Items Nos. 111 and 205 in Exhibit 4.1. Bringing these costs together can be justified, especially for small sawmills, as it might be difficult to separate fuel costs, if e.g. the same fork lift truck is used all over the sawmill.

3001: Sales costs

Sales costs represent a composite of cost items 302, 303, 304 and 305 in Exhibit 4.1. This is very unsatisfactory. It is, however, a mistake often found in practice. The objection that can be raised against this composite is that it brings together costs of completely different character. Costs items 302 and 303 are both variable costs (d 24), while cost items 304 and 305 represent fixed costs (d 12). In addition, Item No. 304 might be called a fixed cost, but it will probably take on different values in relation to production and sales volumes. Cost item 305, however, can most probably be regarded as totally fixed for reasonable changes in production and sales volumes. Mixing costs of different character always creates problems in the analytical work. It should, therefore, be avoided as much as possible.

3002: Administration costs

Administration costs represent the sum of Item Nos. 308-310. Bringing these items together does not mean too much to future analyses. However, separating costs as in Exhibit 4.1 and preferably even further, makes the cost control an easier task.

3003: Depreciations

Under the title "depreciations" Item Nos. 112, 207 and 307 are brought together. This is a common way of handling the sawmill's depreciation costs. In most situations this composite will do.

3004: Full cost of sawn timber, excluding inventory costs

This cost item includes all costs except inventory costs. See the following cost item.

3005: Inventory costs

Inventory costs in Exhibit 4.2 represent all inventory cost items in Exhibit 4.1. In Model I these costs were divided into three different cost items, namely 103, 206 and 306.

In the simplified form of budget inventory costs are usually disregarded with the result, in this case, that the unit cost of sawn timber is MU 759.50. Inventory costs have been added as Item No. 3005 so as to make the total budget figure identical to that in Exhibit 4.1. In simplified budgets inventory costs are disregarded for either or both of the following reasons: managers are not aware of these costs or they underestimate their importance.

4.5 Comparing the two models

Although Models I and II are constructs, they represent two different approaches to budgeting and cost estimating. Model I indicates the possibility of splitting up composite cost items into their parts, while Model II shows a more "traditional" picture that will often be found in small-scale industries, in which less is paid to various kinds of economic analyses. We will come back to our models later on to illustrate different uses of various approaches. Obviously, more elaborate procedures will be more useful for analytical purposes than simplified approaches like the one in Exhibit 4.2.

On the other hand, the more cost items are split into their basic components, the more complicated and the more expensive will the budgeting work become. In choosing between budgeting and cost estimation procedures, the manager has to analyze the needs of his company. There is no intrinsic value in the complicated procedure.

5. SENSITIVITY ANALYSES AND SPECIAL COST ESTIMATIONS

5.1 How to use the company budget

Compiling the total budget is only the starting point in using the budget actively. The overall cost figures show what the manager believes will occur during the budget year. But we must always remember that even an elaborate budget is no more than qualified guesswork.

But even if the budget is properly constructed on the basis of thorough analyses, there is always a high degree of uncertainty in the final result. To account for this uncertainty the concept of sensitivity analyses (d 20) is important. In such analyses the manager tries to study possible deviations from his budgeted figures and the effects these deviations might have on the overall result.

In this last section we will estimate the expected, overall profit of the sawmill. Based on this profit we will find how large deviations can be accepted without turning the sawmill's economic result into a loss. We will do this by using a few standard analyses, but we will also study some special situations that might arise.

All the way through we will base our analyses on the elaborated budget, Model I. But we will also look into Model II to find out the constraints to actual decision-making using the simplified budget.

5.2 Estimating the sawmill's profit

The first task in the area of profitability judgement is to estimate the expected economic result for the budget year, i.e., the company's budgeted profit (d 5). We have previously estimated the overall cost of the sawmill. We also recall that the budgeted sales volume was set at 6,000 m^3 of sawn timber.

In order to calculate the expected profit the sawmill manager has to estimate a probable price of sawn timber. This is also part of his budgeting work. Let us assume that his judgement indicates a possible average price of MU 900 per m^3 of sawn timber. To estimate company profit we use the formula:

Profit = Total revenues - Total expenses (costs)

If the sawmill succeeds in selling exactly 6,000 m^3, the profit becomes:

Profit = 6,000 x 900 - 6,000 x 792.75 = 643,500

The first term in the formula expresses total revenues as expected sales volume multiplied by xpected average unit price per m^3 of sawn timber. The second term shows the expected volume times the budgeted full cost per m^3 according to Exhibit 4.1 (p 20).

We could also have estimated the profit as:

Profit = 6,000 x 900 - 4,756,500 = 643,500

(MU 4,756,500 is the total cost figure in Exhibit 4.1)

5.3 Sensitivity analysis I: The breakeven volume

We recall that the breakeven volume (BEV, d 3) was defined as the lowest volume needed to cover a company's total costs, i.e., the volume at which the company's profit is zero. Volumes less than the breakeven volume give rise to losses, while larger volumes create profits.

In order to estimate the breakeven volume, we must separate total costs into fixed (d 12) and variable costs (d 24). In Exhibit 4.1 we can study the cost character of the sawmill, and from this try to find out which costs are variable and which are fixed. (In practice we can do a thorough analysis so that we then know more about individual cost items). The result of this study is shown in Exhibit 5.1, in which we have made use of our code numbers for cost identifications.

Item No.		Variable costs in MU per m3	Fixed costs, totals
106		513.00	
108-112	(A)		138,000
201-202			340,200
203	(B)		94,200
204-205	(C)	19.50	
206	(D)	1.80	
207			300,000
301			24,000
302-303	(E)	45.00	
304-305			83,400
306	(F)	19.25	
307-310			185,400
Total costs		598.55	1,165,200

(A)-(F): Comments to footnotes are given in the text

Exhibit 5.1 Total costs divided into variable and fixed costs.

To split up costs into variable and fixed costs is a difficult task. Let us comment upon the footnotes in Exhibit 5.1:

(A) These costs are most probably to some extent a mix of variable and fixed costs. To be on the safe side, they have been considered fixed i.e. they have been slightly overestimated.

(B) Heating costs are also a mix between variable and fixed costs. But, on the other hand, the cost of heating the fully loaded kiln will be roughly the same as for heating a kiln loaded to e.g. 90 percent.

(C) Also these costs are most probably a mixture of both variable and fixed costs. It has here been assumed that the former costs dominate. Often a more detailed analysis is needed.

(D) This costs depends on both production volume and number of dimensions sawn. It has here been assumed that total inventory costs can be reduced, if production volume goes down. However, one must carefully analyse this cost. Often one will find that inventories of this kind will remain the same regardless of the production volume. In such cases this cost should be treated as a fixed cost.

(E) If cash discounts and sales commissions are paid as a percentage of the sales price, as is the case here, they are variable.

(F) The same comments as for footnote (D).

What use can we have of the analysis in Exhibit 5.1? To put it simply, the average sales price of sawn timber is MU 900. If our analysis in Exhibit 5.1 is correct, the average variable cost is MU 598.55. The difference is the average contribution to profit (CTP):

+ Average sales price per m^3	MU 900.00
- Average variable cost per m^3	MU 598.55
= CTP per m^3 of sawn timber	MU 301.45

How many m^3 do we have to sell before we have covered our fixed costs? The answer is:

(Fixed costs)/(CTP per m^3) or (1,165,200/301.45) = 3,865 m^3

This is the breakeven volume (BEV, d 3). We can also find the sawmill's BEV by using our profit formula:

Profit = Total revenues - Total expenses (costs)

Recalling that total costs can be defined as the sum of variable and fixed costs, we get:

Profit = Total revenues - (Variable costs + Fixed costs)

If we denote the BEV Z and remember that profit is zero at this volume, we get the following standard expression for estimating the BEV:

$$0 = 900 \times Z - (598.55 \times Z + 1,165,200)$$

Solving this expression gives Z = 3,865 m^3.

In other words, the sawmill must produce (and also sell) 3,865 m^3 of sawn timber just to cover its total costs. For each additional m^3, the profit increases by MU 301.45. At exactly 6.000 m^3, the profit becomes:

Profit (at 6,000) = 301.45 x (6,000 - 3,865) = 643,596

(The difference between what we previously estimated, 643,500, and this figure is due to rounding.)

If we look at the volume figures we have used, we can estimate the sawmill's safety margin (d 18).

+ Budgeted sales volume	6,000 m^3
- Breakeven volume	3,865 m^3
= Safety margin	2,135 m^3

It is the safety margin - in the event that the sales volume is as budgeted - that gives rise to the whole profit. This margin, therefore, is crucial in our budgeting work. For every m^3 budgeted but not sold the safety margin is reduced, and thereby the budgeted profit will be reduced by MU 301.45.

5.4 Sensitivity analysis II: The safety margin

The main purpose of estimating the safety margin is to judge the economic consequences of possible errors in our yearly budget. In principle, there are two ways of making an error in the budget. Either we make a mistake in budgeting the sales volume, or we make a mistake in forecasting prices and/or costs. We assume that fixed costs can be estimated with (almost) certainty.

Let us now study what happens, if the budgeted sales volume remains unchanged (6,000 m^3) but a change occurs in either the price of sawn timber or the variable costs or both. Both changes will affect the contribution to profit (CTP, d 8). If the average price of sawn timber goes down by e.g. MU 25, this will affect the CTP/m^3 in exactly the same way as a variable cost increase of the same size.

We estimated a CTP/m^3 of MU 301.45. Let us round off this amount to MU 300/m^3 of sawn timber. (We do this here just for convenience.) What happens with the sawmill's breakeven volume (BEV, d 3) and safety margin (SM, d 18), if the CTP/m^3 is reduced? We can use the following formula to find out:

$$0 = (CTP/m^3) \times Z - \text{Fixed costs}$$

Here Z denotes, as before, the BEV we are looking for.

Solving for Z gives BEV's for various CTP's. Let us assume e.g. that the budgeted price at an average decreases by 5, 10, and 15 percent during the year to come. The new prices will then be MU 855, 810 and 765 respectively. The effects are shown in Exhibit 5.2.

Price change, percent	Actual price	CTP in MU	BEV in m^3	SM in m^3
0	900	300	3,865	2,135
- 5	855	255	4,570	1,430
- 10	810	210	5,550	450
- 15	765	165	7,060	- 1,060

Exhibit 5.2 Changes in breakeven volumes and safety margins as a function of price changes.

The first row shows the situation according to budget and with the CTP-rounded off to MU 300. The following rows show the increases in BEV's and decreases in SM's, when prices go down by the given percentage figures. At a price decrease of 15 percent, the BEV increases to 7,060 m^3, i.e. 1,060 m^3 more than we have budgeted. In other words, despite the "fairly good" SM (2,135 m^3) we have according to our budget, the sawmill will make a clear loss, if the average price decreases by 15 percent or variable costs increase correspondingly.

If the budgeted volume of 6,000 m^3 is the very best we can hope for, the average price must not go down by more than roughly 11.8 percent or MU 106 per m^3. In estimating this figure the same formula as before has been used.

$$0 = CTP \times 6{,}000 - 1{,}165{,}200$$

This gives a CTP of MU 194.20 per m^3, which corresponds to a price decrease of 300 - 194.20 = MU 105.80. This is equivalent to a reduction of the budgeted price of approximately 11.8 percent.

It should be remembered that, for convenience, all CTP-changes have been attributed to price decreases. They can, however, equally well reflect either cost changes or combined changes in both prices and costs.

5.5 Sensitivity analysis III: Combined changes in CTP-values and sales volumes

Let us now assume that the sawmill manager will study combined changes in sales volumes, prices and variable costs. In doing so, it is still possible to use the same formula as before. We only put in different CTP-values (d 8) and different sales volumes at the same time. Again, CTP-changes might reflect both price and variable costs changes. In this example, we have chosen slightly different CTP-values. Here we study CTP-changes of MU 50 for each step. For volume changes we have chosen stepwise decreases of 500 m^3 down to a volume of 3,500 m^3. The results are presented in Exhibit 5.3, as the profits (d 14) accruing for various combinations of CTP'S and sales volumes. Each profit figure has been estimated with the following formula, which we recognize from our previous calculations.

Profit = CTP x (Sales volume) - Fixed costs

CTP's in MU \ Sales volumes, m^3	6,000	5,500	5,000	4,500	4,000	3,500
300	644 1/	485	335	185	35	-115
250	335	210	85	-40		
200	35	-65				
150	-265					

1/ Profit according to budget, i.e. CTP = MU 301.45. All other values on this row are based on a CTP OF MU 300.

Exhibit 5.3 Profits in MU 1,000 as a function of changes i CTP and sales volume.

Exhibit 5.3 the combined effects of CTP and volume change have been shown as profit estimates. We find that the sawmill i not particularly sensitive to changes in volume. As long as the CTP (MU 300 per m^3) remains unchanged, sales volumes can decrease to less than 4,000 m3, before the profit becomes negative, i.e. turns into a loss. We know from Section 5.3 that the breakeven volume is 3,865 m3 (p 31).

But combined changes in volumes and CTP's very quickly give negative results. E.g., the combination of a CTP of MU 200 and a sales volume of 5,500 gives a loss of MU 65,000. This corresponds to a volume decrease of only some 8 percent and a CTP decrease of some 33 percent (based on the budgeted CTP). A 33 percent decrease in CTP looks extremely high. But the decrease in MU is 100. If this figure can be attributed to only a price change, it would correspond to a price decrease of approximately 11 percent. But if we once again recall that the CTP-decrease might be attributed to both the price of sawn timber and the variable costs of the sawmill, a decrease of MU 100 is quite plausible.

5.6 Sensitivity analyses in the simplified budget

The more simplified the budget is, the less suitable it becomes for sensitivity analyses. Let us here repeat the sensitivity analyses we have already performed but now using Model II in Exhibit 4.3 (p 27) as a base for our estimates.

We need an estimated profit to start with. Using the same sawmill as in Model I, the budgeted profit will be MU 643,500. (Cf Section 5.2, p 31)

5.6.1 Model II and the breakeven volume

In estimating the breakeven volume (BEV, d 3) we need to split the sawmill's costs into variable (d 24) and fixed costs (d.12). This was done in Exhibit 5.1 (p 31) for the BEV-analysis of the more elaborate budget in Model I.

If we now try to perform the same kind of analysis for Model II, we will have difficulties. To explain the problems encountered we must refer to both Section 4.4 (p 26) where the compilation of costs for Model II was described, and Exhibit 5.1 (p 31), in which total costs of Model I were split into variable and fixed costs. The comments on Exhibit 5.1 indicated that, even for the elaborated budget, we had some problems in splitting our costs. Now, for Model II, these problems become still more troublesome - at least in principle. In Exhibit 5.4 below we have made a comparison of the results when splitting the costs in the two models.

Model I			Model II		
Item No.	Variable costs in MU per m^3	Fixed costs, totals	Item No.	Variable costs in MU per m^3	Fixed costs, totals
106	513.00		1005	500.80	
108-112		138,000	1007		15,000
201-202		340,200	2001-2003		509,400
203		94,200	2004-2005	22.50	
204-205	19.50				
206	1.80				
207		300,000			
301		24,000	3001 (A)		353,400
302-303	45.00		3002		142,200
304-305		83,400	3003		397,200
306	19.25		3005 (B)	33.25	
307-310		185,400			
Total costs	598.55	1,165,200	Total costs	556.55	1,417,200

(A) To a high degree of mix of both variable and fixed costs.
(B) Costs of inventory are normally not part of a simplified budget procedure.

Exhibit 5.4 Total costs divided into variable and fixed costs and for both Model I (see Exhibit 5.1) and Model II.

For Model II we get the following contribution to profit d 8) per m^3 of sawn timber:

+ Average price per m^3	MU 900.00
- Average, variable cost per m^3	" 556.55

With the same procedures as before (p 32) we estimate the BEV.

BEV = (Fixed costs)/(CTP per m^3) = (1,417,200)/(343.45) = 4,126m^3

Let us assume that the analysis for Model I is "correct" but this is not necessarily true, because the cost split up might be poor for Model I also, as was previously pointed out. However, if the estimate made for Model I is correct, the estimate for Model II obviously is far from being true. As a matter of fact we find that the two Models show a difference of 441 m^3 in their BEV-estimates.

+ BEV, Model II	4,126	m^3
- BEV, Model I	3,685	"
= Model difference	441	"

It might be confusing to say "if the estimate for Model I is correct". We must, however, always recall that cost estimates in a company to some degree are based on judgements. And judgements are "good" or "bad" but not necessarily "true". The manager must learn to live with this kind of uncertainty.

5.6.2 Model II and the safety margin

If the BEV changes, then also the safety margin (SM, d 18) will be different.

SM (Model II) = 6,000 - 4,126 = 1,874 m^3

A shrinking SM means that we get less "room" - volumewise - before we turn the sawmill into a loss. Recalculating Exhibit 5.2 (p 34) with the Model II CTP per m^3, using the same percentage price decreases as before, gives the results shown in Exhibit 5.5.

Price change percent	Actual price	CTP in MU	BEV in m^3	SM in m^3
0	900	343	4,126	1,874
- 5	855	298	4,755	1,245
- 10	810	253	5,601	399
- 15	765	208	6,813	- 813

Exhibit 5.5 Changes in breakeven volume and safety margins as a function of price changes.

But due to the fact that we in Model II have overestimated our CTP (some variable costs have been considered fixed), we also get another effect. Let us find out, what CTP m^3 is needed to break even:

0 = CTP x 6,000 - 1,417,000
CTP = 236,20

This means that our CTP can shrink from MU 343.45 to MU 236.20, i.e. by MU 107.25, and we will still break even at 6,000 m^3. (For Model I we found a CTP of MU 105.80). In other words, we can "allow" the price to go down 107.25/900 or 11.9 percent of the variable costs to increase correspondingly. For Model I this percentage figure was 11.8.

5.6.3 Model II and combined changes in CTP-values and sales volumes

Without describing once more the estimations in detail we can make an analysis of the combined effects of CTP- and sales volume changes. The results are shown in Exhibit 5.6, which is estimated in the same way as Exhibit 5.3 for Model I. Here also we have changed the CTP stepwise by MU 50, starting at a CTP of MU 343, and sales volumes by 500 m^3, starting at the budgeted volume of 6,000 m^3.

Sales volumes, m^3 / CTP:s in MU	6,000	5,500	5,000	4,500	4,000
343	644 1/	469	298	126	-45
283	281	139	-2		
233	-19				

1/ Profit according to budget, i.e. CTP = MU 343.45. All other values on this row are based on a CTP of MU 343.

Exhibit 5.6 Profits in MU 1,000 as a function of changes in CTP and sales volume.

The sawmill becomes "more sensitive" to price (and/or variable cost) changes. The reason is obvious. As compared with Model I, we have overestimated the fixed costs of the sawmill.

5.7 Cost estimates in special situations

So far we have worked with the sawmill's budget in a fairly conventional way. If a company makes a budget, it is most probable that the manager will also pay at least some attention to various sensitivity analyses.

But the budget of a company can be actively used in many other ways. In this last part of the paper we will illustrate this by studying what we have termed some special situations. During the budget year many decisions must be taken, the economic consequences of which can and should be analyzed by using the budget actively.

The kind of decisions we refer to here are often, but not always, unforeseen in the normal budget work. If they are unforeseen, their economic consequences often become very expensive, as they then give rise to production disturbances. Akin to the unforeseen decisions that have to be made are such decisions, which, although they might be properly planned, are of a non-routine character, e.g. the purchase of a new piece of production equipment. All these decisions require special analyses from the economic point of view.

Some of the decisions to be made are of short-run nature, and the manager can perhaps influence only part of his cost structure. To use the budget information correctly in this kind of decision requires a careful analysis of the cost structure. Here, only those costs that are undisputable traceable (d 22) should be taken into consideration.

Other decisions might be both possible to plan and be of long-run character, e.g. various investment decisions. Being of a non-routine character often means that the manager must carry through special analyses, in which he cannot always use his original budget figures. But he both can and should use his budget actively. In doing so, he must, however, be prepared to "rearrange" his budget figures to fit the decision at hand.

5.7.1 Production disturbances and their economic effects

Production disturbances will here refer to all such things that stop the production flow in an unplanned way. It might be interruptions of deliveries from logyard, power failure, damage to saws or machine breakdowns.

The economic effects of such production stops vary depending on the length of the stop. The general economic problem is to find a relevant contribution to profit concept (d 16) for such stops.

Let us start with the (usually) frequent production stops, which occur due to technical problems. The question to be answered is: How will the sawmill's revenues be affected by such stops?

1. Every stop reduces the production and sales volume of sawn timber. Each m^3 foregone means an effect on the sawmill's revenues in either of the following ways:

   a. Total income will diminish, if the sawmill operates at full capacity. (There will be no time to recover the lost volume.)

   b. No economic effects, if the sawmill operates below full capacity. (Temporarily lost production can be regained later by a period of operation at capacity.)

2. Every short stop reduces only those costs being directly and undisputably traceable (d 22) to the m^3 produced and sold.

3. Almost all other costs remain unchanged.

Assume here that the sawmill can sell everything it produces. What costs will change during a short production stop?

1. The raw material not used as a result of the stop will be "saved".

2. Cash discounts and sales commissions will not be paid out.

3. No other costs of significance will be affected.

Also the revenues will be affected as a result of a short production stop. The sawmill loses revenues from the sale of sawn timber as well as from by-products.

For our sawmill this means that each m^3 not produced and sold will deprive the sawmill of the following net income, which is what we have termed the relevant contribution to profit (d 16). All costs are taken from Exhibit 4.1 (p 20).

Specification	MU per m^3
+ Sales revenues from sawn timber	900.00
- Log costs, net (revenues from by-products are deducted)	513.00
+ Log inventory costs (see text comments)	12.20
- Cash discounts	18.00
- Sales commissions	27.00
= Relevant CTP per m^3 of sawn timber	354.20

Log inventory costs are part of log costs net in Exhibit 4.1 (p 20).

Therefore, they have been added here and as a short stop will not cause any change in the average inventory level. Also other variable costs might disappear. For short stops, however, only those costs will be accounted for that have a significant effect on the sawmill's contribution to profit. In these situations, therefore, we cannot accept only the split up in variable and fixed costs. We must go one step further and find costs that are indisputably traceable.

Let us now try to give another aspect of the economic effects of short production stops. During the budget year there will most probably be many stops, each of which might be economically insignificant. But taken over the whole year, an enormous amount of money will be involved. So let us estimate a relevant CTP per time unit.

Assume the sawmill during a normal year has a production time of 235 working days, each day having a working time of eight hours. With a budgeted production volume of 6,000 m^3 per year, this means 25.53 m^3 per day, or 3.19 m^3 per hour, or, finally 0.053 m^3 per minute.

Specification		MU per time unit
Relevant CTP per:		
Day:	25.53 x 354.20 =	9,043.00
Hour:	3.19 x 354.20	1,130.00
Minute:	0.053 x 354.20	18.77

These relevant CTP's per time unit can of course, and should, be estimated in advance.

5.7.2 The CTP and preventive maintenance

From the estimations in the previous sub-section we learned that even fairly short production stops turn out to be costly in terms of lost CTP's. A way to improve the economic results of the sawmill is to increase the preventive maintenance in order to reduce the total amount of down-time. To do so the sawmill manager must:

1. Record his production stops over an extended period of time to find causes and relative frequencies for various kinds of stops.

2. Analyze for each cause what possible measures are needed to reduce down-time.

3. Evaluate both economic and other effects of each possible measure that he considers.

Obviously, whatever measure the sawmill manager resorts to, it will give rise to new expenses. The manager then has to compare these expenses with possible new earnings in terms of increased CTP's. To do so, let us assume once again that 6,000 m^3 a year is the maximum production quantity that can be squeezed out of the equipment today.

Without being too specific let us assume that the manager has studied stop causes during the last year. Suppose he has found three major reasons for the standstills and their relative frequencies.

Cause	No. of hours of down-time	Percent of theoretical production time
Chain breakages in log conveyor	117	6.2
Power failures due to poor electric equipment	41	2.2
Poor quality in green trimmer equipment causing board clustering	53	2.8
Total down-time	211	11.2

Out of a theoretical production time of 235 days time 8 hours per day, which equals 1,880 hours per year, total down-time is 211 hours. This is 11.2 percent of the theoretical production time. If, in theory, all stops could be eliminated, the sawmill's production capacity would increase from 6,000 m^3 to 6,000/(1.0 - 0.112) = 6,756 m^3.

Slightly simplified we can say there is an improvement potential of 756 x 354.20 or MU 267,775. This calculation is simplified because with such a large increase in production, we must also account for increases in such variable costs as fuel, electricity, etc. These costs are not included in our CTP of 354.20 (p 41). On the other hand, using the overall variable costs according to the budget would give a CTP per m^3 of MU.301.45, which gives a potential improvement of MU 227.896. In addition, actual production time is very often not larger than 50 to 60 percent of the theoretical production time! Often it is even less than 50 percent, if one studies all stops carefully!

The sawmill manager must avoid a possible pitfall. Taking a measure against a production problem does not mean that the total down-time will be eliminated. The manager must, therefore, judge how much he can reduce recorded down-time with the measures he considers! Assume our manager makes the following judgements concerning the log conveyor problem.

Cost of new chain equipment, installation costs included.	MU 150,000
Possible reduction in down-time	65 - 75 %

What will the effects - economic and otherwise - be of improving the conveyor equipment? At first glance, it is fairly simple to estimate the economic effects.

Reduction in down-time (rounded):	
Max. 0.75 x 117	88 hours
Min. 0.65 x 117 =	76 "
CTP per hour	MU 1,130
Possible CTP improvement:	
Max. 88 x 1.130 =	MU 99,440
Min. 76 x 1,130 =	MU 85,880
Pay-back period:	
Max. improvement 150,000/99,440 =	1.50 yrs
Min. improvement 150,000/85,880 =	1.75 "

In other words, if the manager's judgements are correct, investing in a new conveyor equipment will have a pay-back period of in between 1,5 to 1,75 years. But there are also other problems to be taken into consideration.

1. It is enough to improve the production flow through the log conveyor? Are there other bottlenecks that must be eliminated first? Or will other bottlenecks (like the poor electrical equipment and/or the green trimmer) reduce the effect of the conveyor improvement and, if so, by how much.

2. Whatever measure is taken, the manager must ask himself, if it will have other effects inside or outside his company. Will workers be influenced psychologically? If so: Positively or negatively?

The first set of questions can in principle be answered by a wider exmination of the problem at hand. It is important that the manager examines the whole problem and not just tries to "solve" part - and especially "the wrong part".

The second set of questions indicates the existence of non-economic factors. Personnel problems are often pyschological but, if all-owed to develop, may well come to influence the economic result.

6. APPENDIX

BUDGET FORMS FOR BOTH MODEL I AND MODEL II

COMPILATION OF THE SAWMILL'S BUDGET AT FULL COST - MODEL I

Specification	MU per m3 of sawn timber	Total cost in MU
Log costs		
+ Log costs at buying prices	------	-------
+ Transport costs	------	-------
+ Log inventory costs	------	-------
= Log costs, gross	------	-------
- Revenues from by-products	------	-------
= Log costs, net	------	-------
Log handling costs		
+ Labour costs	------	-------
+ Watering	------	-------
+ Repair & Maintenance	------	-------
+ Fuel & miscellaneous	------	-------
+ Depreciations	------	-------
= Log and log handling costs	------	-------
Sawing		
+ Labour costs	------	-------
+ Repair & maintenance	------	-------
+ Heating costs	------	-------
= Balance to be carried forward	------	-------

COMPILATION OF THE SAWMILL's BUDGET, cont.

Specification	MU per m3 of sawn timber	Total cost in MU
= Balance carried over	------	-------
+ Consumption material	------	-------
+ Fuel, etc.	------	-------
+ Work-in-process inventory	------	-------
+ Depreciations	------	-------
= Manufacturing costs	------	-------
Storing, selling and general administration		
+ Labour costs	------	-------
+ Cash discounts	------	-------
+ Sales commissions	------	-------
+ Travelling	------	-------
+ Salary, sales manager	------	-------
+ Finished goods inventory costs	------	-------
+ Depreciations	------	-------
+ Salary, general manager	------	-------
+ Salary, office clerk	------	-------
+ Office, miscellaneous	------	-------
= Full cost of sawn timber	------	-------

COMPILATION OF THE SAWMILL'S BUDGET AT FULL COST - MODEL II

Specification	MU per m3	Total costs in MU
Log costs		
+ Log costs at buying prices	------	-------
+ Transport costs	------	-------
= Log costs, gross	------	-------
- Revenues from by-products	------	-------
= Log costs, net	------	-------
Log handling costs		
+ Watering	------	-------
= Log and log handling costs	------	-------
Sawing		
+ Labour costs	------	-------
+ Repair & maintenance	------	-------
+ Heating	------	-------
+ Consumption material	------	-------
+ Fuel, etc.	------	-------
= Manufacturing costs & balance to be carried over	------	-------

COMPILATION OF THE SAWMILL'S BUDGET, CONT.

Specification	MU per m3	Total costs in MU
Balance to be carried over	------	-------
Storing, selling, and general administration		
+ Sales costs	------	-------
+ Administration costs	------	-------
+ Depreciation	------	-------
= Full cost of sawn timber, excl. of inventory costs	------	-------
+ All inventory costs	------	-------
= Fuel cost of sawn timber, incl. inventory costs	------	-------

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