SCANDINAVIAN FOREST ECONOMICS
No. 41, 2006

Proceedings
of the Biennial Meeting of the
Scandinavian Society of Forest Economics
Uppsala, Sweden, 8th-11th May, 2006

Lars Lönnstedt and Björn Rosenquist (eds.)

Uppsala

Cost and performance management in the sawmilling industry

Torgrim Tunes, Anders Q. Nyrud and Birger Eikenes*

Abstract
Joint costs are costs which cannot be readily identified with individual products. They are especially prominent in extractive, agricultural and chemical industries. In this article we consider methods used by the Norwegian sawmilling industry to allocate joint costs. A survey of joint cost accounting systems in use in Norwegian sawmills was carried out using structured interviews. In order to analyze the results from the interviews we conducted a Cross Case Analysis. According to the results Norwegian sawmills do not allocate joint costs, except from some ad-hoc methods inapplicable for joint cost allocation to products. There are several reasons for this. The problem is perceived as difficult to solve and many of the respondents consider the benefit as limited. There are shortcomings in existing joint cost allocation systems, and finally, there is a lack of interest and knowledge about cost accounting.

Keywords**:** Joint costs, cost allocation, structured interview, sawmilling

Introduction
The profitability in the Norwegian sawmilling industry has declined over the last couple of decades. There are several reasons for this: the bargaining power of builders' merchant wood sales industry has increased, and impact from international competitive markets has led to declining sales value of sawmilling products. This development has made sawmilling companies to focus on cost efficient production. Means used to gain these goals are for example mergers and acquisitions, outsourcing and implementation of better or more efficient management systems. The purpose of this study is to explore accounting practices in Norwegian sawmills in order to survey the methods used by the industry to allocate joint costs and indirect costs. Drury and Tayles (2005) pointed out that the major role of product costing systems is to provide relevant cost information in order to manage the cost and mix of activities, products, services locations and customers. Relevant information should be generated to ensure that only profitable activities are undertaken.

The term "Sawmill paradox" was coined by Grönlund (1992). It refers to the fact that when processing a sawlog, a range of products (both main products and by-products are produced). This is a typical joint production. Some of the products, such as chips, will have a considerably lower sales value than both raw material price and sales value of other wood products produced from the core of the sawlog. Furthermore, since the raw material price is higher than the net revenue for chips and lowgrade sawnwood, the sawmill is apparently producing these products at negative net value. A profit maximizing sawmill should therefore maximize production of centre boards and minimize the production of chips and lowgrade sawnwood.

The problem explained above is a typically joint cost problem. Billera *et al*. (1981) described joint costs as "…costs which cannot be readily identified with individual products." They stated that joint costs are usually common in extractive, agricultural and chemical industries, as well in industries where different grades of the same product are obtained. The average Norwegian sawmill is producing approximately 3500 different products, many of them with different qualities and grades. Most of the production costs in sawmilling are raw material costs. Companies have to consider how they best can ascribe joint costs generated up to the splitoff point to particular products. The splitoff point in this case, is where the sawlog is divided into centre boards, side boards, chips and sawdust. If the cost system does not capture the consumption of resources by products, costs will be distorted, and there is a risk that managers decide to produce unprofitable products (Drury and Tayles 2005).

Previous studies

Johansson and Rosling (2002) developed an approach to allocate joint costs in sawmilling based on a linear programming model. This model was further developed by Johansson (2004b) and has been used for cost allocation in a Swedish pine mill. The purpose of this model was to calculate the marginal cost of centre boards. Timber costs (*i.e.* joint costs) included all costs before splitting the logs, less revenue from cellulose chips, bark and saw dust. Johansson (2004a) suggested that marginal cost estimates are useful only for centre products, (*i.e.* for products sold to regular customers at negotiated prices and often further processed). For commercial sideboards sold at fixed market prices, marginal cost estimates are of little use since prices are given and the volumes are consequences of the production of centre boards.

Activity-Based Costing (ABC) in the sawmilling industry has been investigated by Kjesbu *et al*. (2001). They concluded that ABC calculation is possible, but ABC calculation is preferred when the production involves a great share of indirect cost. This is not the case in the sawmilling industry where the amount of direct cost (raw material cost) account for more than 60% of the total cost.

A survey of accounting practices in the European oil and gas industry was conducted by Coe *et al*. (1997). They stated that the accelerating pace of change in the energy industry created uncertainty, and information on the accounting aspects of this dynamic environment was needed. As early as in 1977 Feller highlighted the need for management accounting systems designed for handling joint costs in the oil refinery industry. The oil crisis in 1973/74 had made by-products highly profitable, and other costing systems were needed to allocate joint costs in a more appropriate way.

Billera *et.al* (1981) presented a unique procedure for allocating common costs from a production process. This approach was suitable to allocate joint costs in a production process which yield different products or services, or different grades of the same product. The procedure enabled calculation of marginal unit costs for products produced and finally a relative cost per unit produced of products. This is the procedure implemented by Johansson (2002, 2004a, 2004b) on a Swedish sawmill.

Balachandran and Ramakrishnan (1981) also presented a way of allocating joint costs by assembling earlier joint cost allocation models developed by Moriarity (1975) and Louderback (1976). Balachandran and Ramakrishnan (1981) used a combination of both Moriarity (1975) and Louderback (1976) to provide a new approach called "prosperity to contribute". Divisions' "prosperity to contribute" were calculated as the minimum cost of each division acting independent of the company or together (internally) with the other divisions in the company, minus the internal processing cost of each division. Each division's relative share of the contribution was used as distribution formula when joint costs (*i.e.* purchasing raw material, joint production cost, etc.) should be allocated. Balachandran and Ramakrishnan (1981) also suggested a Shapley Value based scheme to allocate joint costs. A more thorough discussion of game theoretic concepts and Shapley Value based allocation can be found in Hamlen *et al*. (1977). The methods presented by Balachandran and Ramakrishnan (1981) allocated joint costs to divisions and not to products.

Finally Jang *et al.* (2006) proposed a method to allocate joint in the gas industry (*i.e.* liquid and gaseous). The method was called "The design benefit method (DBM)" and joint costs are allocated to products based on an ideal product's utilization of real capital. Jang *et al.* (2006) focused on minimizing the total costs connected to producing a number of products. The joint costs of utilizing specific equipment were allocated to the products using a regression analysis to determine each of the products utilization of the equipment.

Theory and methods

Economic theory

Horngren *et al*. (2006) described four different methods to allocate joint costs:
(1) Sales value at splitoff point: The relative amount of cost is the same as the relative amount of sales value.
(2) Physical measure: The relative physical part of one product at splitoff point is used as cost allocation key.
(3) Net realizable value (NRV): Final sales value for one product minus separable costs (costs connected directly to that product), relative to total net realizable value, is used as an allocative key to allocate joint costs to each product.
(4) Constant gross-margin percentage NRV: The gross-margin is deducted from a products' total revenue using the gross-margin percentage. The remaining amount is total production cost for that product. Then separable cost is deducted, and the cost remaining is the joint cost to each product.

Which method of allocating joint costs should be used?

Horngren *et al*. (2006) stated that the sales value at splitoff point method should be used when the sales price of the products is available (even if further processing is done) and they presented four reasons for this: first, it measures the value of the joint product immediately at the end of the joint process; second, there are no anticipations of subsequent management decisions; third, it is meaningful to allocate joint costs based on relative revenues. The fourth reason is connected to its simplicity compared to the other methods described above.

Kaplan and Atkinson (1989) emphasized the importance of joint cost allocation: first, it can be used in order to provide the product valuations required for financial accounting and regulatory purposes and to determine transfer prices when market prices not are available. In addition joint cost allocation can be used to coordinate the activities of decision makers in a decentralized firm.

Allocating joint costs: an example

The two first joint cost allocation methods presented by Horngren *et al*. (2006) can be explained using an example from the sawmilling industry:

Given that a sawmill is producing 40% centre boards, 10% side boards, 37% chips and 8% sawdust when processing a sawlog. In addition, kiln and drying results in 5% reduced production volume. Inputs are purchased for 450 NOK/m^3. Outputs are sold for 1400 NOK/m^3 (centre boards), 900 NOK/m^3 (side boards), 300 NOK/m^3 (chips) 100 NOK/m^3 (sawdust), the following example is presented:

Table 1: Example of joint cost allocation, physical measure method

	Yield [%]	Timber cost [NOK/m^3]	Share of timber cost [NOK/m^3]	Sales-value [NOK]	Gross-margin [NOK/m^3]
Centre-boards	40	450	180	560	380
Sideboards	10	450	45	90	45
Chips	37	450	166.5	111	-55.5
Sawdust	8	450	36	8	-28
Shrinkage	5	450	22.5	0	-22.5
Sum	100		450		319

Table 2: Example of joint cost allocation, sales value method

	Price in [NOK/m^3]	Yield [%]	Sales value [NOK]	Relative sales value [NOK]	Timber cost [NOK/m^3]	Share of timber cost [NOK/m^3]	Gross-margin [NOK/m^3]
Centre-boards	1400	40	560	0.73	450	328.5	231.5
Side-boards	900	10	90	0.12	450	54	36
Chips	300	37	111	0.14	450	63	48
Sawdust	100	8	8	0.01	450	4.5	3.5
Shrinkage	0	5	0	0	450	0	0
Sum	2700	100	769	1		450	319

Using the physical measure method or the sales value method obviously affects the gross-margin for a single product, but the overall gross-margin is the same for both methods.

When sales prices of all products at the splitoff point not are available, other methods can be used. Two of them are the net realizable value (NRV) method and constant gross-margin percentage NRV method presented above. According to Horngren *et al.* (2006) the NRV method measures products income better than the gross-margin percentage NRV method. Also compared to physical-measure method, the NRV method is perceived as better. However, there are instances when physical measure methods are preferred. Market price based methods are for instance difficult to use in the context of rate and price regulations. In addition, the concepts of future income and costs are of great importance. The idea is that only expected future revenues and costs are taken into consideration when the decisions on whether a joint product or main product should be processed further or sold at the splitoff point. Horngren *et al.* (2006) emphasized that joint costs incurred up to the splitoff point are irrelevant because these costs would have incurred whether the product is sold at the splitoff point or processed further. Joint costs up to the splitoff point are frequently not available (this is not only raw material costs and labor costs, but includes a range of costs such as deprecations, house rent and administration). That is one of the reasons why Horngren *et al.* (2006) suggested that further processing should depend on products revenue attainable beyond the splitoff point.

Data collection

Nine Norwegian sawmills were investigated. Structured interviews with the business manager and the production manager were conducted to acquire exact information about production and management accounting. The interviews were based on a questionnaire containing questions about products, production, management accounting and product costing. A tour through the sawmills visited was used to gain a more thorough understanding of how sawmills do cost allocation.

The nine interviewed sawmills consumed between 55000 m^3 and 330000 m^3 sawlogs with an average of 169222 m^3. The yield of centre boards range between 50% - 55%.The sawmills consumed about 35% (1523000 m^3) of the available amount of sawnwood in Norway in 2005 (Statistics Norway 2006).

Method

The material was analyzed using descriptive case study methodology. Emphasis was placed on the qualitative part, in order to obtain detailed understanding of how these companies are doing their cost accounting and product calculation.

Case studies

Case study methodology is presented in Scapens (1990). Case studies can be descriptive, explorative, illustrative, explanatory or experimental, but distinctions between different types of case studies are not clear and it can be difficult to place a study in one category. According to Drury and Tayles (2005) case studies have the potential to provide richer insight into explaining why, and under what circumstances, some organizations adopt simplistic systems and others do not.

In this analysis, the case study method used is both descriptive and exploratory. Based of the interviews, a description of accounting systems, techniques and procedures currently used was provided. The explorative part represented a preliminary investigation intended to generate ideas and hypotheses for a more thorough research later.

Miles and Huberman (1994) provided approaches for analyzing qualitative data. One of these approaches is Cross Case Analysis (CCA). An advantage with CCA is its generalizability; the researcher would like to know the relevance or applicability of his findings to other similar settings. Furthermore, CCA explain more thorough the investigated cases. Miles and Huberman (1994) emphasized two strategies for analysing cross case data: *case-oriented analysis* and *variable-oriented analysis*. *Case-oriented analyses* focus on differences and similarities between cases or types and families of cases while *variable-oriented analyses* focus on the correlation between variables explaining the cases. Sawmill size and degree of further processed products can be examples of explanatory variables, and subsequently evaluated regarding their significance for cases. A mix of *case-oriented strategy* and *variable-oriented strategy* was used in the further analysis of the interviews. All sawmills were displayed in matrix form (see Miles and Huberman 1994, figure 7.1) and by looking at all the cases (sawmills), patterns and similarities could be revealed, and sawmills could be placed into groups dependent on qualitative properties.

The steps are organized chronological depending on level of detail of information for each step. *Partially ordered displays* are less detailed than *conceptually ordered displays* which are in turn less detailed than *case ordered displays*. The first step was to set up a *partially ordered meta-matrix (partially ordered displays)*. All the information collected were placed into a meta-matrix, defined by Miles and Huberman (1994) as master charts assembling descriptive data from each of several cases in a standard format. The simplest form is a juxtaposition of all sawmills displayed on one very large sheet. Conclusions concerning Norwegian sawmills as one group were made. After all sawmills were assembled on one sheet, the variables were divided into three parts founded on the questionnaire used for interviews, that is, smaller matrices consisting of answers connected to products, production and management accounting and product costing. These three matrices were analyzed individually and statements connected to the three categories, production, products, and management accounting and product costing were provided.

Results

Partially ordered displays

None of the sawmills in the sample allocated joint costs. The interviewed sawmills considered the joint cost problem very interesting, but pointed out that this problem is not easily solved. For example, there is clearly a shortcoming in management systems designed for handling joint cost allocation. Further, the sawmills consider the cost-benefit effect of a joint cost accounting system to be limited compared to benefit received from effort put into other parts of the company management, for example customer relationship and raw material suppliers.

Answers from the questions about accounting and costing indicated that all sawmills registered and allocated costs in cost units. Cost units were defined as sections based on geographical position at the site, or cost centers assembled by production units or simply constructed cost centers. A monthly or quarterly closing of accounts was common among all the interview sawmills.

Sawmills allocate fixed indirect costs, but practices differ. For example, many sawmills use internal determined allocative keys in order to divide fixed indirect cost to cost centers. It is also common to benchmark cost centers, (*i.e.* units within the same company) based on the relative amount of fixed indirect cost. Another method of handling fixed indirect costs is to accumulate all fixed cost and subtract them at the bottom of the management account.

None of the sawmills tried to allocate raw material cost (*i.e.* joint costs) in the way presented by Horngren *et al.* (2006) and Johansson (2002, 2004a, 2004b). Other techniques were used, such as cost per timber class, which is appropriate when using fixed settings (sawing patterns). Another method in use was to subtract raw material costs directly from revenues in the management accounts. One mill used an approximation to the physical measure method to allocate joint costs (*i.e.* the joint production costs of by-products (chips and sawdust) are allocated to the main products. Product costing for sawdust and chips were not made, but by-products' joint costs are allocated to the main products.

Discussion

There are several reasons for calculating product cost, for example profitability analyses of markets, customers and products, to estimate the value of inventories or amount of insurance premiums etc. Sawn products are sold in international markets, and consequently Norwegian sawmilling companies can not affect product prices. In order to be profitable they have to concentrate on the products, customers and markets with best net profit (*i.e.* they have to produce and sell products with the lowest total costs). Sawmills have to offer a range of products to customers and markets which are profitable. The best way to determine profitable markets and customers are to know the exact cost of sold products.

Joint cost allocation by Norwegian Sawmills

Despite of the fact that all the interviewed sawmills see joint cost allocation as important in cost accounting, there is a lack of joint cost allocation in the Norwegian sawmilling industry. The interviewed persons confirm that the joint cost problem is perceived as difficult to solve, and also consider the cost-benefit effect of a joint cost system as limited. Effort in other parts of a company's day to day management is perceived as more cost effective than development of sophisticated costing systems.

There are shortcomings in management systems designed for handling joint cost allocation that presently are in use. Some sawmills have developed accounting systems for cost allocation. For example, sawing pattern calculation for one entire timber class and sawing pattern. In this case the joint cost allocation is not solved.

One should also take into consideration that the staff at most sawmills have general knowledge of accounting systems, but lack expertise in cost accounting. Questions about education were not asked, but theoretic competence and interest are important when adopting new accounting systems and using economic theory to solve problems.

Johansson (2004b) found that the profitability measures differ considerably between cost allocation by his model and the costing system used at the investigated sawmill. Johansson (2004b) investigated five products, the system in use at the sawmill indicated that products with high market price were most profitable. The results from Johansson's (2004a, 2004b) model indicated that these products were the least profitable, implying that the company should be better off if it decreased the sales volumes of these products. Differences in cost allocation and product costing methods are important in sales price determination. In the worst case, a company can, based on misleading cost allocation systems, focus on products with the lowest profitability.

Further research

In order to evaluate similarities among sawmills, the next step of this study is to classify the meta-matrix in groups depending on different properties (for example, cubic meters of lumber produced, whether the mill is a part of a bigger company or perceive themselves as job production units, etc.). Miles and Huberman (1994) called these *conceptually ordered displays*. The point is to focus primarily on the content of a meta-matrix, without reference to specific cases, and to find out if there are any clear distinctions among groups of the investigated sawmills.

The third step, concentrates on more detailed information than the *partially ordered meta-matrix* and the *conceptually ordered displays* and is described by Miles and Huberman (1994) as *case-ordered displays*. Instead of using discrete variables, (*i.e.* part of a bigger company), the sawmills are sorted into groups depending on continuous variables as, for example share of processed products. The gradation will make it possible to see differences between cases.

References

Balachandran, B.V. & Ramakrishnan, R.T.S., 1981. Joint Cost Allocation: A Unified Approach. The Accounting Review 56, 85-96.

Billera, L.J., Heath, D.C., Verrecchia, R.E., 1981. A Unique Approach for Allocating Common Cost form a Production Process. Journal of Accounting Research 19, 185-196.

Bjørnenak, T., 1997a. Conventional Wisdom and costing practices. Management Accounting Research 8, 367-382.
Coe, T.L., Gilbert, K., Heather, M. 1997. Survey of accounting practices in the European oil and gas industry. Institute of Petroleum Accounting, University of North Texas. Denton, Texas 76203. USA.
Drury, C. & Tyles, M. 2005. Explicating the design of overhead absorption procedures in UK organizations. The British Accounting Review 37, 47-84.
Feller, R E. 1977. Accounting for Joint Products in the Petroleum Industry. Management Accounting 59, 43.
Grönlund, A., 1992. Sägverksteknik del II. Processen. Sveriges Skogsindustriförbund Sweden. pp. 293.
Hamlen, S.S., Hamlen, jr. W.A., Tschirhart, J.T., 1977. The Use of Core Theory in Evaluating Joint Cost Allocation Schemes. The Accounting Review 52(3), 616-627.
Hoff, K.G. & Bjørnenak,T. 2006. Driftsregnskap og budsjettering. 4.utgave Universitetsforlaget.
Horngren, Charles T., Datar, Sirkant M., Foster, G., 2006. Cost Accounting. A Managerial Emphasis. Upper Saddle River, N.J. Prentice Hall. Pp. 868
Jang, W.H., Hahn, J., Hall, K. R., 2006. The design benefit method: Allocate joint costs among shared products. Gas processing developments, Special report. Department of Chemical Engineering, Texas A&M University, College Station, Texas
Johansson, M. & Rosling, K., 2002. The Timber Cost of a Board. In: Helles, F. and Strange, N. (Eds.). Scandinavian Forest Economics 39, 229-239
Johansson, M 2004a. Allocating the Timber Cost to Sawn Products – A Case Study. In: Baudin, A., 2004. Industrial and Market perspectives on the Forest Sector. Proceedings from the International Conference on Forest Industry and Markets, May 2003. pp. 17.
Johansson, M. 2004b. Allocating the Timber Cost to Sawn Products – A Case Study. Costing in sawmills for sales management: Thesis for the Licentiate's degree. Vaxjö University 2004.
Kaplan, R.S. & Atkinson. A.A., 1989. Advanced Management Accounting. Prentice-Hall Internatioanl Inc. 1989, Second edition.
Kjesbu, H., Eikenes, B. & Mellem, A., 2001. ABC-kalkyler i trelaslindustrien. Trelastindustriens Landsforening. Norges landbrukshøgskole, Institutt for skogfag.
Louderback, J.G., 1976. Another Approach to Allocating Joint Cost: A Comment. The Accounting Review 51, 683-685.
Miles, M. B. and Huberman, A. M. 1994., Qualitative Data Analysis: An Expanded Sourcebook. 2nd ed. pp. 338. SAGE Publications, Inc.
Moriarity, S., 1975. Another Approach to Allocating Joint Cost. The Accounting Review 50, 791-795.
Scapens, R., 1990. Researching management accounting practice: The role of case study methods. British Accounting Review 22, 259-281
Statistics Norway 2006. Statistisk sentralbyrå (SSB). Commercial roundwood removals. http://www.ssb.no/english/subjects/10/04/20/skogav_en/tab-2006-06-02-02-en.html Accessed: June 28, 2006.