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The Efficiency Based Costing Method – Using a Sawmill as Example

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Abstract:

Purpose: *Generally in a factory it is not straight forward to discern the true, individual manufacturing costs. Thus, the necessity arouse for a calculation method that would collect and include relevant technical details along the way of each product.*
Design/Methodology/Approach: *The data received could then get associated with the pertinent book-keeping records. An equation has been developed which combines the technical details of the production process with the relevant accounting data. The method is called Efficiency Based Costing (EBC).*
Findings: *The EBC method, which incorporated essential processing details - such as product recovery, production rate, volume flow velocity through the production line, man-hour input, the physical size of the products, and, of course, overheads – delivered significantly differing manufacturing costs per unit volume for the individual products. Also, the exact value of wastes has been determined.*
Practical Implications: *The efficiency based cost calculation (EBC) is a powerful tool in searching for the true individual processing costs. With the suggested equation it is possible to combine important technical details of the production process with the accounting data.*
Originality/Value: *Using the EBC method, the minimum product selling price at any point of the production process can be computed. Product portfolio decisions and next year´s planning shall rely on more truthful data.*

Keywords: *Cost calculation, manufacturing costs, cost centres, managerial costing, sawmill.*

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1. General problem and goal setting

With accounting, it is often a problem that there is little reference to technical details of the production process. Costs arise in a factory, however, by activities and by the use of production means. Some expenditure, like wages, purchases, etc. are well identifiable, and accordingly, they can be easily located in the books. Others, however, like cutting patterns, processing rate, mass flow, and similar, which have a decisive effect on the formation of costs, cannot be traced back to accountancy data. Yet, the costs of the production largely depend on these. Expressed in a symbolic way:

Costs = function of

- material acquisition, transport
- conversion patterns, material flow
- recovery factor, product size
- processing rate
- value adding
- utilisation of production means
- capital obligations, and
- other (over-heads…)

- determined for all processing stations
- all accounting data included
- costs of capital included

Thus, the goal was to develop a cost calculation method that would include relevant technical details of the production process, and combine these with the pertinent book-keeping data.

For the development of the computing program, a sawmill was selected which usually has a complex processing agenda, and which manufactures a sizable number of product assortments with diverging cost characteristics. The program departs with the assumption that a source material of a given value enters a working station where it will be processed. Here, its value gets augmented by the processing cost of the working station, keeping also the costs of possible wastes in mind. Passing through the working station, the product obtains a new volume, shape or quality with an exact value which shall be the entry price at the following working station, and so forth. Running through all the processing stations, the value of the product increases each time according to the same logic. Thus, the route of a product through a factory is a true cost generating element. When the costs of all processing stations over all products were summed up, the total expenditure of the factory would emerge. In this manner, the true selling price of each individual product and the cost structure of the whole plant would become evident. This cost calculating procedure is called the Efficiency Based Costing (EBC).

2. A brief literature review

Here, a short synopsis of the pertinent literature will be presented with the aim to locate the niche where the EBC fits into. Managerial costing as a part of managerial accounting collects costs in a company, and helps to improve the company´s efficiency. To this goal, it focuses on management needs, analyses the company's resources and capacities, and connects them to the economic performance (White & Clinton, 2014).

Besides the traditional costing methods, having been evolved through the long history of managerial accounting, numerous innovative practices have emerged in the past decades. According to the manner of cost allocation, one can speak about *absorption costing* (full costing) and about *variable costing* (direct costing, marginal costing). The *absorption costing* allocates the cost to cost drivers, trying thus, for example, to arrive at fitting product pricing (Sprinkle & Williamson, 2006). *Variable costing* considers the variable part of the costs as manufacturing cost pure - which changes with the production intensity -, and derives the contribution margin from the net income/cost combination, subsequently weighting it against the fixed costs. The *cost-volume-profit analysis* (CVP) delivers answers to questions, for instance, as at which production level the net income would equal the total of expenses, i.e. where the break-even point could be located (Lakmal, 2014; Garrison *et al.,* 2012).

On basis of time deferment, one distinguishes between *actual costing* and *budgeted costing*. The actual costing provides a picture about the company´s effective performance through the clearing of current expenses. In contrast, the budgeted costing promotes in its future-oriented way the efficiency of management. Thus, for instance, the traditional *standard costing* – a method of implementing budget costing - analyses the deviation of the effective costs from the expected ones. The *target costing* sets the product price according to the market situation; in other words, expected manufacturing costs will be derived from a satisfactory profitability, thus reversing the traditional costs/pricing procedure. Accordingly, starting from the product planning, all suppliers and all processing steps ought to meet the costs expectations of the manufacturer (Garrison *et al.,* 2012).

For individual products, the *job-order costing* method records costs which can be easily demarcated. The *process costing* method assigns the product costs to the manufacturing stations which the product has passed through. Thus, in the lumber industry, in order to understand the diversity of costs, process costing is recommended (Heisinger & Hoyle, 2012). In recent times, various trends increase the proportion of indirect costs. For instance, more advanced processing techniques produce less waste; increasing mechanisation and automatization lessen the proportion of wages. The *activity based costing* (ABC) aims at the conversion of such indirect costs to direct costs via identification and physical measurement of cost drivers, and their subsequent assignment to the cost bearers (Senthil-Velmurugan, 2010; Cooper & Kaplan, 1988).

Numerous other managerial costing procedures may support the management´s objectives. The *Theory of Constraints* (TOC) focuses on factors limiting an organization from reaching its goals. The *throughput accounting* refines this management approach (Goldratt & Cox, 2014, Cooper et al., 2007). Lean enterprises can also use the *lean thinking* – a method to minimize or eliminate losses[4] – which supports the management in their cost assessment efforts (Walther & Skousen, 2009; Garrison *et al.,* 2012). Other advanced approaches are the *Grenzplankostenrechnung* (GPK) – a German method – and the *resource consumption accounting* (RCA). Both procedures are discussed in depth by Clinton & van der Merwe (2006).

The *contingency theory* (Fiedler, 1966; Donaldson, 2006) describes the optimal way of leadership as a function of internal and external conditions. Accordingly, there may not be a general costing model which could be applicable to every situation, or be useful for every organization (Lakmal, 2014).

The EBC is a mix of the *absorption costing* and the *process costing* methods using the actual costs to determine the result of business activities, and to facilitate a more appropriate pricing procedure (Bariska, Pásztory, 2015). It also enables the management to interfere in the manufacturing process with the aim to lower processing costs.

The EBC also takes into account an acceptable profit as well as the cost of capital (the required rate of return). The cost of capital includes the estimated price of the capital used (risk-free interest rate) and also the required risk premium. The present paper does, however, not deal with the debate, ongoing in the literature, whether the time-value of invested money was independent from the capital structure or not. For the weighted average, both methods the cost of capital (WACC, Koller *et al.,* 2010; Quiry *et al.,* 2009; Bishop & Officer, 2013) and the calculated rate of required capital yield (Illés, 2002; Koloszár & Kállay, 2017) can be used.

3. A general equation for cost calculation

Sawmills manufacture a large assortment of products which may individually undergo conversion and further treatments, making the determination of processing costs and the minimum selling price a rather challenging task. In order to grasp the data complexity, the mill was subdivided into manageable units where the emanating costs could be easily identified, and where the lead time of semi-finished products – that is, their cost absorption ability – would become accurately measurable. These units were called cost centres, with the abbreviation CC. Such cost centres in a mill may be all working and processing stations such as the material acquisition department, transport, log yard, sawing workshop, the further processing stations,

[4]*In the lean thinking, ′wastes′ is the accepted term for `losses`. In this paper, however, we are going to calculate the value of wastes – saw dust, off-cuts, etc. Thus, in order to avoid confusion, the expression "losses" will be used here.*

value adding stations, the storage magazine, technical support units, admin and management, etc. In a medium sized mill, on average, about 30 – 40 cost centres can be demarcated, each having a specific cost generating capability. Basically, these cost centres can be regarded as independent enterprises within the company which trade their products among each other – at least on paper. Normally, an individual product passes through a selection of processing stations with genuinely differing equipment and, consequently, also production costs. Eventually, as many as 20 to 30 different products get generated, each one with a well traceable manufacturing route and an according production fee. The EBC equation tries to accommodate this multitude.

Cost centres have the following characteristics: (i) invested capital is known, (ii) the semi-finished product undergoes just one conversion step, (iii) the processing time, i.e. cost absorbing capacity of the product, is well measurable. These points form the backbone of the general equation, and allow the exact determination of manufacturing fees. The generally applicable cost calculating equation will thus contain the following elements:

receiving price + processing costs + cost of capital => hand-over price

The equation calculates the manufacturing costs of a product emphasizing a number of important technical elements along the production procedure. The result is the hand-over price (HOP) which shall be the input value at the next CC. As a working equation, the following will be used:

$$\mathbf{HOP_i} = \overbrace{\mathbf{RP / rf}}^{\text{enhanced receiving price}} + \overbrace{\mathbf{\{(FC * pr_{vol} + VC * pr_{surf}) / (VF * OT)\}}}^{\text{processing cost}} + \overbrace{\mathbf{CoC}}^{\text{cost of capital}}$$

$$\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow$$

$$[\text{€}/m^3] = [\text{€}/m^3]/[..] + \underbrace{\{([\text{€}/h]*[..] + [\text{€}/h]*[..]) / ([m^3/h] * [..])\}}_{[\text{€}/m^3]} + [\text{€}/m^3]$$

The semi-finished product is then accompanied from station to station through the whole manufacturing process, and its entire fabrication history is recorded. Legend to the elements of the above equation:

- **HOP_i** – the hand-over price stands for the manufacturing cost of an individual product at a given cost centre in €/m^3. Actually, it will reach its full value when the product leaves the CC, and it will become the receiving price at the next cost centre.
- **RP** – means the receiving price in [€/m^3] at the cost centre gate. It can indicate the purchasing price of the raw material, or the takeover price of the semi-

finished product from the previous CC including all costs accrued on its way hereto.

- **rf** – is the product recovery factor, a dimensionless unit. It denotes the quotient of the outgoing-volume versus the incoming-volume at the station. The outgoing product is the semi-finished product, and the incoming volume represents the source material. The difference forms the wastes.
- **FC** – fixed costs occur also in absence of production activities. Its constituents are depreciation rates of buildings and equipment, the fix part of crew salaries, energy consumed for general purposes, the allotted portion of overheads, and others. This sum is determined over an observation period (number of shifts, quarter, one year). Its dimension is [€/h].
- $\mathbf{pr_{vol}}$ – product rate is the volume proportion of an individual product in the volume total of all products processed during the observation period. It takes care of the diverse assortments of the products. This number is without dimension with a value between 1 and 0. The volume is selected as reference basis because (almost) all other productivity related figures are related to the volume. In this manner, all members of the equation will be converted to the dimension of HOP.
- **VC** – variable costs develop in course of the production. Its constituents are: Value of source material (raw material, semi-finished product, or purchased materials), the costs of energy consumed in the manufacturing process, production related part of salaries, maintenance and repair expenses, and others. Its dimension is [€/h]. The **EBC** method regards part of the workers' salaries as variable, though these are usually registered as fixed expense in the books of a company. (Here, we do not speak of performance bound salaries.) Referring to the product, however, labour costs are individual and variable depending on the product's size and quality.
- $\mathbf{pr_{surf}}$ – production rate of the surface area of a product as referred to the total surface area of all products processed during the observation period. It takes care of the particularities of the product – here the product surface. In a sawmill energy consumption, tool wear, man-hours, materials used are all related to the extent of manufactured surface. Consequently, the variable costs will greatly depend on the surface extent, and calculated for each product according to its share in the total surfaces. This number is also without dimension with a value between 1 and 0. **(**$\mathbf{pr_{xy}}$ – if instead of surfaces, product pieces, coating materials, etc. are of relevance, similar considerations as above shall apply with a changed index.)
- **VF** – volume flow is a measure for the efficiency of the production line. It defines the volume stream of material through the cost centre per time unit with a dimension [m^3/h]. The peculiarity is that if it was measured on site by an investigation team, the workers might feel observed, and will go an extra mile to do their best. The results will yield the maximum production capacity which is, of course, a rare event in a real manufacturing situation. Yet, it is mandatory to get these values for all production lines, because they enable the management

to estimate the capacity utilisation of the production means. Its dimension is [m^3/h].

The fixed and variable processing costs are given in €uro per hour. In order to get the results in [€/m^3] units, which is the dimension of the $\mathbf{HOP_i}$, the numbers with a dimension [€/h] have to be divided by the material stream data **VF** with the dimension of [h/m^3]. Now, each member of the equation will have the same unit of [€/m^3].

Once more: $\mathbf{pr_{vol}}$ and $\mathbf{pr_{surf}}$ are production rates, and **VF** is the material flow rate, all three indicating the production intensity at the cost centre. These figures together determine the process efficiency of the cost centre.

- **OT** – the operational time is an additional measure of the cost centre utilisation, and takes care of the administrative stoppages enforced by the management. It tells basically as to what extent of time the station was in productive operation - which includes maintenance as part of the production time. Yet, on order of management, a production line may stand idle for lack of feedstock, repair, renewal, or for administrative reasons (e.g. if more than one shift per day is operational some production lines may remain unused in the second/third shift. Also, lack of orders might temporarily stop production). This component must be included in the equation because (i) the capacity utilisation of a production line is deliberately lowered, and (ii) fixed costs are paid also during stoppages. **OT** caters for the degree of time exploitation:

  OT = (total working hours – administrative stoppage times) / total working hours

  It is a number between one and zero, a dimensionless value.

- **Processing costs,** synonym to **manufacturing fees** – can be calculated at this stage. They are represented by the central term of the above equation = $\{(FC*pr_{vol}+VC*\ pr_{surf})/\ (VF*OT)\}$. Its dimension is [€/$m^3$]. Without the term VF, it has also a meaning; in this case, it yields the hourly manufacturing fee [€/h].

  At this point, the production cost of waste wood, fallen by the wayside at the manufacturing station, can be calculated. The processing costs shall be proportionally divided among the lumber and wood-wastes. Because the volume of wood-waste will normally be sold in bulk volume, the manufacturing costs of sawdust and offcuts, calculated so far in terms of solid wood volume, need to be reduced by a factor of 3 - which is the generally accepted loosening ratio of tossed saw dust.

- **CoC** – the cost of capital includes the estimated price for the use of capital (risk-free interest rate) and also the required risk premium. In the timber industry, besides in machines, a substantial part of the capital is invested in raw material[5], and hence needs to be profitable. Actually, CoC shall become due

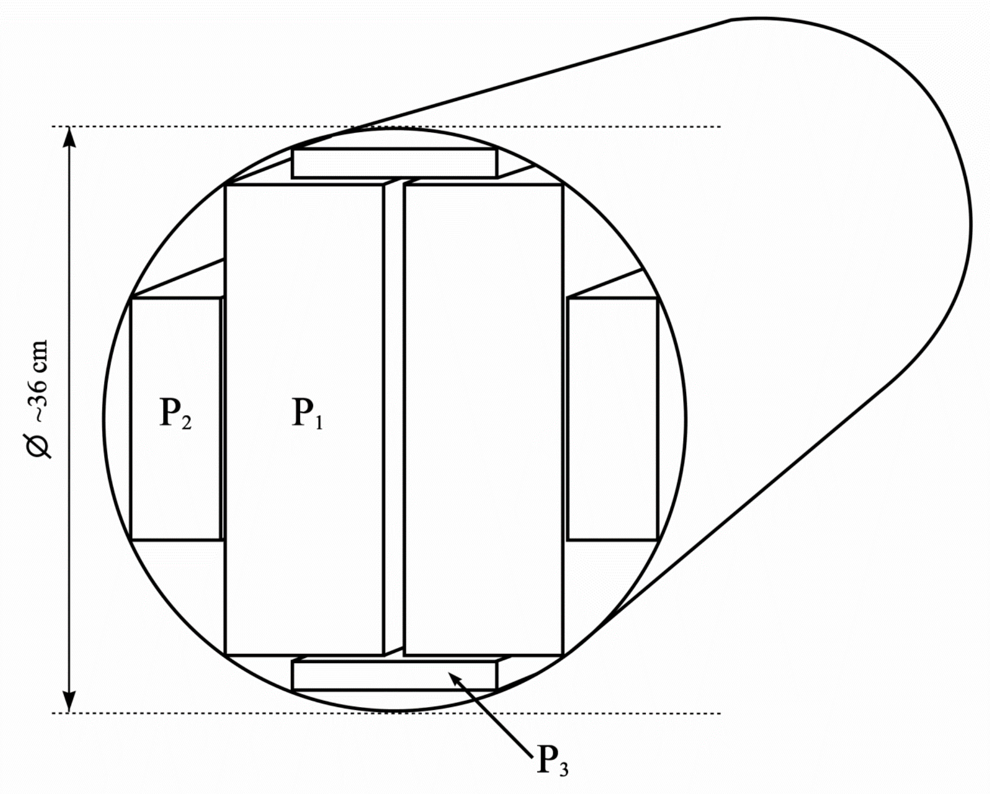
[5]*Normall in the timber industry, the whole of raw material is purchased at the beginning of (or after) the winter felling season. Therefore, it is a substantial short term investment. Accordingly, the current inventory value equals the half of the purchasing price as calculated for a given time span.*

when a product is about to get sold from any of the cost centres. Thus, the minimum selling price can be calculated. The cost of capital is specified in [€/m^3].

4. The Data

The data listed below will be used in the following comparative calculation examples. In order to make the logic of the new calculation method easily understandable, it shall be assumed that for one hour only the products indicated in Figure 1 were manufactured from the same log class. The cost centre selected for the calculation was the big band-saw line in a sawmill. There, 10'000 m^3 soft wood has been processed in a year, using 2'000 hours[6]. The log acquisition price amounted to 88 €/m^3, transport and handling costs made an additional 12 €/m^3. Thus, 100 €/m^3 was the log receiving price (RP) at the head rig. The total investment in raw-material was 1 million € a year.

Figure 1: *Positioning of products in a log*



[6]*The numbers are rounded in order to allow easy comprehension, are, however, close to the real values.*

The average diameter of the log class was 0.36 m. The round wood has been sawn up into three different products (P_1, P_2, P_3) according to the drawing in *figure 1*. The recovery factor (rf) amounted to 0.56. With a flow rate of (VF) 5 m^3/h, the amount of sawn timber amounted to 2.8 m^3, and that of waste wood to 2.2 m^3 per hour. Processing costs of the production line was given with 150 €/h, or 30 €/m^3 (=150 €/h / 5 m^3/h). Of the 150 €/h, fixed costs were 82 €/h, and variable costs 68 €/h (book data). The cost of capital (CoC) is 5%. The book value of the machines is 200'000 €[7]. The 2.2 m^3 waste was made up of 1.2 m^3 saw dust, and of 1 m^3 chips and offcuts, as calculated on solid wood basis. In the following, waste will be charged by the processing costs only, the value and the mass of which shall increase with each additional processing station touched. Eventually, when sold as raw material for secondary use, the exact price can be calculated.

For the three products with 1 m length the dimensions, volumes and surface areas are given in Table 1. Because with some sawing cuts, two surfaces have been simultaneously produced, the table will indicate the accordingly reduced surface areas for the products. (If the correction was not taken into account, the deviation was about 35%, and it varied from product to product. Thus, it is mandatory to be exact on this issue.)

Table 1: *Dimensions, volumes and surface areas of the three products in a sawlog of 1 m length*

Product * number produced	Thickness mm	Width mm	Volume m^3	Volume production rate (pr_{vol})	Surface area m^2	Surface area production rate (pr_{surf})
P_1 * 2	80	250	0.0400	0.70175	0.82	0.4481
P_2 * 2	45	140	0.0126	0.22105	0.60	0.3279
P_3 * 4	20	110	0.0044	0.07720	0.41	0.2240
Σ	-	-	**0.0570**	1.000	**1.83**	1.000

5. Comparative calculations

For comparison, the two calculation methods – the traditional according to Fronius K. (1982) and the EBC – will be carried out, and discussed.

5.1 The traditional method

According to the traditional cost calculation method, the production cost at the band saw line was 30 €/m^3. After swing 5 m^3 round wood with a recovery factor of 0.56 in an hour, 2.8 m^3 sawn timber had been generated (also called lumber), and 2.2 m^3 waste (sawdust and off-cuts).

[7] *For simplicity, it is assumed that the company uses its own equity, and thus there is no need to include potentially different return due to the capital structure.*

After sawing, the value of the main product rose form 100 €/m^3 to 178.57 €/m^3 (≈ 100 €/m^3 / 0.56). The value obtained in one hour for sawn timber was 584.00 €/h (≈ {178.57 €/m^3 + 30.00 €/m^3} * 2.80 m^3/h), and for the waste 71.05 €/h (≈ 32.30 €/m^3 * 2.2 m^3/h … see the just following calculation).

The manufacturing costs of waste wood at the band-saw line was calculated as follows:

1.2 m^3 sawdust will be charged with the same processing fee as sawn wood, i.e. by 30.0 €/m^3

1 m^3 off-cuts shall get chipped in order to become sellable as sawdust. The data needed are: processing fee of the chipping station 10 €/h (data from the books), chipping rate 2 m^3/h. Hence, the handover-price of processed off-cuts amounts to 35.0 €/m^3 (= 30.0 €/m^3 + (10 €/h / 2 m^3/h)).

Weighted manufacturing costs of saw-dust is getting thus **32.30 €/m^3** (≈ 1.2 m^3*30 €/m^3+1m^3*35 €/m^3) / 2.2 m^3). Calculated for bulk volume then 10.80 €/m^3 (≈ 32.30 €/m^3 / 3).

Summing up: The price for one m^3 sawn timber turned out to be **208.57 €/m^3** (= 178.57 €/m^3 + 30 €/m^3) irrespective of the product assortment, and that of the waste **32.30 €/m^3**. The total value produced amounted to **655.05 €/h** (≈ 208.60 €/m^3*2.8 m^3 + 32.30 €/m^3*2.2 m^3). These data form the comparison basis for the **EBC** calculations, and are presented in Table 2.

5.2 The efficiency based cost calculations (EBC)

By using the **EBC** equation the following picture emerges:

Hand-over-price = enhanced receiving price + processing costs + cost of capital

$$HOP_i = RP / rf + (FC * pr_{vol} + VC * pr_{surf}) / (VF * OT) + CoC^8$$

where RP=100 €/m^3, rf=0.56, FC=82 €/h (data from the books), pr_{vol}=volume_rates and pr_{surf}=surface_rates as in *table 1*, VC=68 €/h (data from the books), VF=5 m^3/h, OT=0.8, CoC – 5% = 3.5 €/m^3 (= (200’000 € + 1’000’000 € / 2) * 0.05/y / 2000h/y / 5 [m^3/h … the division by 2 gives the average inventory value over the year).

Calculation for the product P_1:

HOP_{P1} = 100 €/m^3/0.56 + (82 €/h*0.70175 + 68 €/h*0.4481) / (5 m^3/h*0.8) + 3.50 €/m^3 =

= 178.60 €/m^3 + (57.55 €/h + 30.47 €/h) / (4 m^3/h) + 3.50 €/m^3 =

= 178.60 €/m^3 + **22.00 €/m^3** + 3.50 €/m^3 = **204.08 €/m^3**

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[8] *In present example is assumed that the product is getting sold from here, therefore, CoC is due.*

Calculation for the product P_2:

HOP_{P2} = 100 €/m^3/0.56 + (82 €/h*0.22105 + 68 €/h*0.3279) / (5 m^3/h*0.8) + 3.50 €/m^3 =
= 178.60 €/m^3 + (18.13 €/h + 22.30 €/h) / (4 m^3/h) + 3.50 €/m^3 =
= 178.60 €/m^3 + **10.10 €/m^3** + 3.50 €/m^3 = **192.18 €/m^3**

Calculation for the product P_3:

HOP_{P3} = 100 €/m^3/0.56 + (82 €/h*0.07720 + 68 €/h*0.2240) / (5 m^3/h*0.8) + 3.50 €/m^3 =
= 178.60 €/m^3 + (6.33 €/h + 15.23 €/h) / (4 m^3/h) + 3.50 €/m^3 =
= 178.60 €/m^3 + **5.40 €/m^3**+ 3.50 €/m^3 = **187.46 €/m^3**

The processing costs of waste wood at the band-saw line will be calculated as follows:

1.2m^3 sawdust will be charged with the same processing fee as the sawn wood, i.e. by **37.50 €/m^3** (= 22.00 €/m^3 + 10.10 €/m^3 + 5.40 €/m^3).

1m^3 off-cuts shall get chipped in order to become able to sell it as sawdust. The data are: processing fee of chipping station 10 €/h (data from the books), chipping rate 2 m^3/h. Hence, the cost for the processing fee and for the conversion of offcuts to sawdust amounts to **42.50 €/m^3** (= 37.50 €/m^3 + 10 €/h / 2 m^3/h).

Accordingly, the weighted hand-over price for lumber will be…

HOP_{lumber} = 200.15 €/m^3

{ = (1.965 m^3 /h * 204.10 €/m^3 + 0.619 m^3/h * 192.20 €/m^3 + 0.216 m^3/h * 187.45 €/m^3) / 2.8 m^3/h
where 1.965 m^3 = 2.8 m^3 * 0.70175
0.619 m^3 = 2.8 m^3 * 0.22105 and
0.216 m^3 = 2.8 m^3 * 0.0772 are }

…and for the waste wood will be:

$HOP_{sawdust}$ = 39.80 €/m^3 (≈1.2 m^3*37.50 €/m^3 + 1m^3*42.50 €/m^3) / 2.2 m^3 for solid saw dust or = **13.25 €/m^3** (≈39.80 €/m^3 / 3) for dust bulk volume.

If any of the products was put on sale directly after leaving the sawing station, the minimum selling price would be the value as calculated above, augmented by the profit margin as determined by the company management.

For better comparison, the sets of data used for the two calculating methods are assembled in Table 2.

Table 2: *Results of the traditional and the EBC accounting procedures*

Product (volumes)	Traditional counting				**EBC** counting				
	Receiving price / rf €/m³	Processing fee €/m³	HOP €/m³	Value generated in one hour[9] €/h	Receiving price / rf €/m³	Processing fee €/m³	Cost of capital €/m³	HOP €/m³	Value generated in one hour €/h
P_1 (1.965m³/h)	178.57	30.00	208.57	409.80	178.60	22.00	3.50	204.08	401.00
P_2 (0.619m³/h)	178.57	30.00	208.57	129.10	178.60	10.10	3.50	192.18	118.95
P_3 (0.216m³/h)	178.57	30.00	208.57	45.10	178.60	5.40	3.50	187.46	40.50
Weighted average			208.57					200.65	
sawn timber (2.8m³)				584.00					560.45
solid saw dust (2.2m³)	0	32.30	32.30	71.05	0	39.80	3.50	43.30	95.25
bulk volume price		10.80				13.25		14.41	
Total value of timber and dust				655.05					655.70

6. Comparison of the results

Table 2 reveals the difference between the two accounting procedures which we would like to highlight in following paragraphs:

- Irrespective of the calculating method, the product's hourly generated value must remain the same (this is the case, with a negligible inaccuracy though). Interesting is the detail that the total value of sawn timber with the traditional method lies a bit higher (584.00 €/h) than with EBC (560.45 €/h), but the value of sawdust somewhat lower (71.05 €/h vs. 95.25 €/h). Nevertheless, their sums remain unaltered.
- Regarding the manufacturing fees, the traditional method does not show any difference for the different products. Consequently, it is up to the management

[9] The end results of calculations are rounded to the nearest 5 cents

to determine his product price which must be individually different in the end. The decision will probably not be taken on a technical ground, but rather on a speculative one.

- The EBC finds, however, substantial differences between the products. It can be even stated that there is a tendency in the production fees to grow with decreasing product size. Pointedly calculated, if the band-saw line was continuously producing only the one and the same product for an hour the manufacturing fees would yield the value 31.35 €/m^3 for P_1 (=22.0 €/m^3 / 0.70175 … see *tables 1 and 2*), and analogously, 45.70 €/m^3 for P_2 and 69.80 €/m^3 for P_3; actually, doubling from P_1 to P_3. This trend proves the correctness of the EBC logic which states that resources consumption will increase if the surface area of a cubicmeter product gets larger.
  Also, the hand-over prices of the individual products are distinctly different. The above mentioned decreasing tendency is due to the influence of the products absolute size. Quite obviously, the ones with big volumes have a greater share of the production costs.
- Calculated for wastes, the manufacturing price is significantly higher with EBC.

7. Conclusions

The efficiency based cost calculation (EBC) is a powerful tool in searching for the true processing costs. With the suggested equation it is possible to combine important technical details of the production process with accounting data.

In particular, the recovery factor (indicating the exploitation degree of source material), the production rates (indicating the extent of the capacity utilisation of the production line), the mass flow through the CC (indicating the production intensity), operational time ratio (indicating the continuity of production activities), all could be translated to expenses, and included in the equation. With this method, also the monetary value of unused production potential, and losses through idle times might be back tracked.

The same computation method applies for all processing stations. Following the route of a product through the manufacturing process, and by keeping record of the costs, it will become possible to determine the minimum selling price at any point of the production process. The value of waste has been precisely computed. The equation reveals the influence of products' particularities on the manufacturing costs. If EBC was applied to the whole assembly of the products - wastes included - the cost structure of the company would become transparent. The above equation has been developed for sawmills, yet, the similar logic may be applied to various manufacturing situations in other industry types.

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