Articles

Cost Allocation Methods for Joint Products and By-products

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Summary:

The purpose of this paper is to look into the problems of costing of joint products and by-products in industrial organizations. The paper starts with an introduction to the problem of allocating joint costs (common costs up to the split-off stage) to products. The author defines the basic terms of joint products, by-products, common and joint costs and analyses how the problems of costing can be approached. Two approaches are discussed for joint products cost allocation and two approaches for by-products cost allocation. The author presents adapted methods for costing within those approaches and discusses the situations in which those will be most appropriate to apply. The paper concludes with a note on the importance of using proper methods for cost allocation of joint products and by-products as part of the broader management process of ensuring long-term profitability of the industrial organizations.

Key words: cost allocation, joint products, by-products.

JEL Classification: M400, M410

Introduction

Many industrial enterprises encounter the difficult and sometimes quite complicated problem of cost calculation and allocation between their main product and by - products and/or joint products.

The difficulties in calculating the costs of joint and by-products stem from the fact that common costs cannot be directly allocated to individual products due to the general manufacturing processes before the stage of separation of one product from another (split-off stage).

Joint costs are often confused with the total cost. However, there is a significant difference between them as the first are inseparable, while the second are separable. The total costs can be allocated between the products or services as each of the products or services can be obtained separately. Therefore, all shared costs can be logically allocated based on an appropriate basis. The typical for the joint costs – inseparability is not always recognized by the managers and in some cases joint costs are being allocated among the joint products based on some random characteristic that leads to the calculation of the total costs per unit. However, the result of such allocation is of limited use in management decision making. Therefore, enterprises can use certain approaches and models that result in "fair" cost allocation between products.

1. Joint-Cost[1]

Joint costs are the costs of a production process that yields a number of products

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[1] The author examined various publications to arrive at the definitions of the terms in this section. See for example: Horngren, C., Datar, S., Rajan, M., 2012, Cost Accounting, 14th ed., Pearson, pp. 576-606. Matz, A., Usry, M., 1977, Cost Accounting: planning and control, 6th Ed., South-Western Publishing Co., pp. 181-197

simultaneously. An example could be the processing of milk, which yields skim milk and cream. The costs of this production are joint costs. The **split-off point** is the point in a joint production process when two or more products become separately identifiable. For example, the point at which the milk becomes skim milk and cream. **Separable costs** are all costs that are incurred beyond the split-off point that can be assigned to each of the products that are identified at the split-off point. At or beyond the split-off point, decisions relating to the sale or further processing of each identifiable product could be made without regard of the decisions related to the other products produced.

There are many examples of industries in which a production process simultaneously yields multiple products, either at the split-off point or after further processing. In these examples no individual product can be finished without the accompanying products appearing, although in some cases the proportions can be varied. The focus of joint costing is on allocating costs to individual products at the split-off point.

When a joint production process yields one product with a high total sales value, compared with total sales values of other products of the process, that product is called a **main product**. When a joint production process yields two or more products with high total sales values compared with the total sales values of other products, if any, those products are called **joint products**. The products of a joint production process that have low total sales values compared with the total sales value of the main product or of joint products are called **by-products**.

2. Allocating Joint Costs to Products

There are several contexts in which joint costs are required to be allocated to individual products or services. These include the following:

- Computation of inventorial costs and cost of goods sold. Absorption costing is required for financial accounting and tax reporting purposes. This necessitates the allocation of joint manufacturing or processing costs to products for calculating ending inventory values.
- Computation of inventorial costs and cost of goods sold for internal reporting purposes. Many firms use internal accounting data based on joint cost allocations for the purpose of analyzing divisional profitability and in order to evaluate division managers' performance.
- Cost reimbursement for companies that have a few but not all of their products or services reimbursed under cost-plus contracts with a government agency, for instance. In this case, stringent rules typically specify the manner in which joint costs are assigned to the products or services covered by the cost-plus agreement.
- Rate or price regulation for one or more of the jointly produced products or services. This issue is conceptually related to the previous point, and is of great importance in the extractive and energy industries where output prices are regulated to yield a fixed return on a cost basis that includes joint cost allocations. In telecommunications, for example, it is often the case that a firm with significant market power has some products subject to price regulation (e.g., interconnection fees) and other activities that are unregulated (such as end-user equipment rentals). In this case it is critical to allocate joint costs to ensure that costs are not transferred from unregulated services to regulated ones.
- Insurance-settlement computations for damage claims made on the basis of cost information of jointly produced products. In this case, the joint cost allocations are essential in order to provide a cost-based analysis of the loss in value.

More generally, any commercial litigation situation in which costs of joint products or services are key inputs requires the allocation of joint costs.

3. Approaches to Allocating Joint Costs[2]

- **Approach 1**: Allocate joint costs using market-based data such as revenues as a basis for allocation. There are two methods that use this approach:
  1. Sales value at split-off method
  2. Net realizable value (NRV) method
- **Approach 2**: Allocate joint costs using physical measures, such as the weight, quantity (physical units), or volume of the joint products.

Joint costs do not have a cause-and-effect relationship with individual products because the production process simultaneously yields multiple products. Using the benefits-received criterion leads to a preference for methods under **Approach 1** because revenues are, in general, a better indicator of benefits received than physical measures. Mining companies, for example, receive more benefits from 1 ton of gold than they do from 10 tons of coal.

In the simplest joint production process, the joint products are sold at the split-off point without further processing. There are also cases where joint production processes yield products that require further processing beyond the split-off point.

An example presenting the concept of joint products and joint costs is presented in figure 1 below:

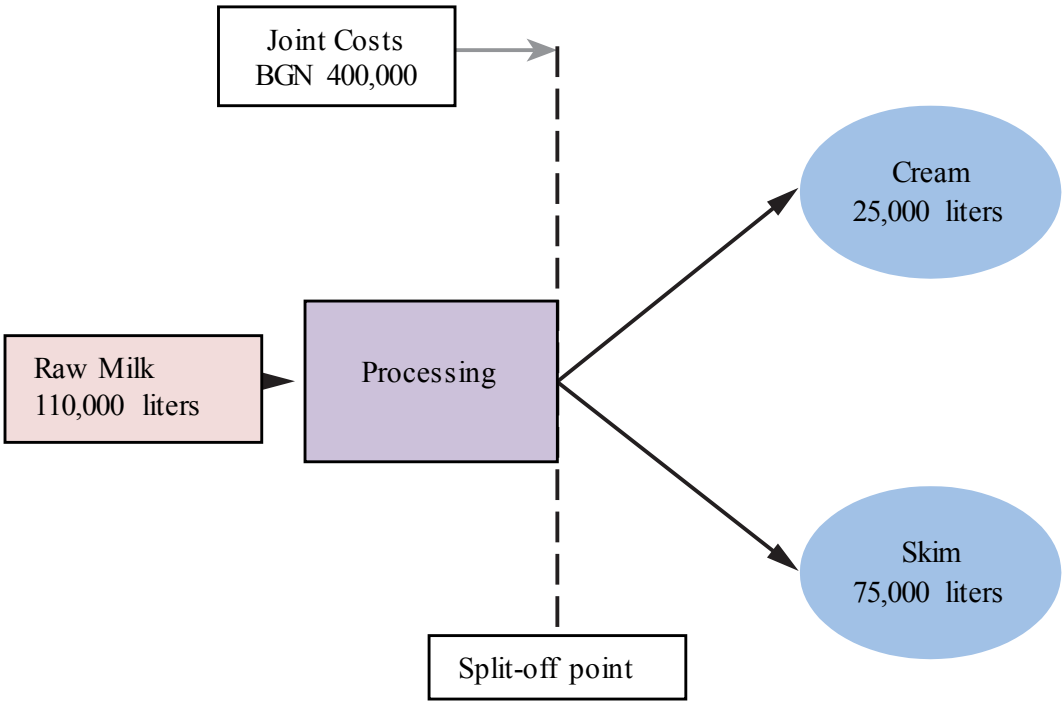

Fig. 1. Joint Costs & Joint Products: An example, Source: Author

[2] The approaches and methods associated with them are adapted from various sources. See: Horngren, C., Datar, S., Rajan, M., 2012, Cost Accounting, 14th ed., Pearson, pp. 576-606. Matz, A., Usry, M., 1977, Cost Accounting: planning and control, 6th Ed., South-Western Publishing Co., pp. 181-197. VanDerbeck, E., 2010, Principles of Cost Accounting 15th Ed, Cengage, pp. 287-335

Table 1: *Sales value at split-off method*

Sales value at split-off method
• **Step 1** – Collect data for the joint cost up to the split-off stage and the quantity of all the products produced.
• **Step 2** – Collect data for the market value (price per unit) for all the products produced.
• **Step 3** – Calculate the market value for the quantities of each type of product produced.
• **Step 4** – Calculate the relative value (in percentage terms) for each type of product based on market values calculated in Step 3.
• **Step 5 –** Multiply the calculated percentage weights in Step 4 for each product type by the total joint costs.

Source: Author

4. Description of Approaches and Methods for Joint Costs Allocation

Approach 1

Method 1: Sales value at split-off method is based on the assumption that the market value of the products is a proxy for their production costs. The assumption is that if a product has a higher value to the market, then it must be the case that the product has higher costs of production. Hence, a logical way to allocate the joint costs to individual products is to use the relative proportion of the market value of the products. The steps that need to be followed in order to apply Method 1 are presented in the following table:

Table 2: *Physical units method*

Physical Units Method
• Step 1 - Collect data for the joint cost up to the split-off stage and the quantity of all the products produced.
• Step 2 – Measure the physical units of for each type of products produced.
• Step 3 – Calculate the relative quantity (in percentage terms) for each of the jointly produced products at the split-off stage on the basis of chosen physical unit.
• Step 4 – Multiply the percentage for each product by the total joint costs.

Source: Author

Method 2: Net realizable value (NRV) method can be applied using the same steps as in Method 1, but with one important difference. Products for which there is no market in the form that they appear at the split-off stage, and hence they have no market price, need to be further processed in order to become marketable. In those cases the allocation base is a hypothetical market value at the split-off stage. If we want to arrive at the allocation base, we must calculate the net realizable value of the products that are not marketable yet at the split-off stage. One must take the market value (price) of the product that can be realized after further processing and subtract the costs of this further processing. With this we arrive at a hypothetical market value of the product at the split-off stage. If we look at Table 1 above, we can see that Method 2 adds an extra step between Step 2 and Step 3.

Approach 2: There are different methods within the physical units

approach. Methods use different physical units (weight, quantity, volume, length, area, etc.) depending on the nature of the products, their characteristics and assumptions used. However, the logic of this group of methods is the same and can be described in the following table:

As one can see, the methods within this approach try to allocate the costs of the joint products based on some physical measure. For this purpose, it is required that all the products be measured with the same underlying physical measure that is chosen. This is sometimes not the case. For example, in the oil refinery industry joint products might be liquid fuel and gas. Gas can have different volumes at different pressures. In this case, it is required that the physical units of all the joint products must be converted in standard units.

In many industries this approach does not reflect fully all the production specifics and therefore does not produce "fair" allocation of joint costs between joint products. This problem can be overcome by assigning appropriate coefficients as weights in the calculation and allocation of costs. Those coefficients might depend on volume of the units produced, the relative difficulties in the production process, the production time, the difference in the labor needed to produce the different products, the quantity of materials used for production, and other factors.

5. By-products

As it was noted above, the products of a joint production process which have low total sales values compared with the total sales value of the main product or of joint products are called **by-products**. By-products can be classified in two main groups: (1) Products that are marketable (can be sold) at the split-off stage without further processing, or (2) Products that need further processing at the split-off stage in order to become marketable.

The treatment of by-products requires a very good understanding of technological factors in production process, as they can have very different origin in the production process. By-products can be a result of refining (cleaning) of the main product. They can be a result of production waste of the production process of the main product, etc. In other cases by-products might not be a result of a production process, but rather a result of the preparation of the raw materials for use in the production process of the main product.

6. Approaches to Calculating By-product Costs[3]

- **Approach 1**: If this approach is used, common costs are not allocated to by-products for the purposes of cost calculations and management. All the income from sales of by-products is credited to the total revenue or to the revenue of the main product. Methods 1, 2 and 3 described below are examples of using this approach.
- **Approach 2**: If this approach is used, a part of the common costs

[3] The approaches and methods associated with them are adapted from various sources. See: Horngren, C., Datar, S., Rajan, M., 2012, Cost Accounting, 14th ed., Pearson, pp. 576-606. Matz, A., Usry, M., 1977, Cost Accounting: planning and control, 6th Ed., South-Western Publishing Co., pp. 181-197. VanDerbeck, E., 2010, Principles of Cost Accounting 15th Ed, Cengage, pp. 287-335

is allocated to by-products. Method 4 described below is an example of using this approach.

Method 1: Revenues from sales of by-products are included in the income statement as:

a. Other income

b. Additional sales revenue

c. In reduction in costs of goods sold of the main product

d. In reduction in the total production costs of the main product

Method 1 is a common procedure which is not related to the costs (non-cost procedure). This is an accounting method. By using it, the final costs of the main product inventory are overvalued to such an extent that part of the costs are allocated to the by-products yielded in the production. This drawback is somewhat removed in the latest technology, where production costs are lower due to the revenues generated from the by-product. However, even in this case, we deduct sales value instead of costs.

Method 2: Revenues from sales of by-products less costs of disposal (marketing and administrative costs) and less any additional costs in the processing of by-products are shown in the Income statement in a manner similar to that shown in Method 1

Method 2 acknowledges the need to refer part of the costs to the by-product. However, it does not attempt to allocate the main product joint costs to the by-product. The purpose here is to create separate accounts for any expense associated with further processing or marketing of by-product.

Method 3: Method based on replacement value (replacement cost method). The expenditure allocated to the by-product is the acquisition price or the replacement value on the current market.

Method 3 should be used by companies whose by-products, yielded in the production process, are used within the factory, thereby avoiding the need to purchase certain materials and supplies from external suppliers. The provision of such materials leads to a reduction in production costs, associated with the main product.

Method 4: A method based on market value (reversal cost method). Basically it is similar to the last technique of Method 1. However, it reduces the production costs of the main product not with the actual revenue received but with the estimated market value of the by-product that prevails at the time of its extraction or sale. It depends on the stability of the market and the price and sales opportunities of the by-product. Any additional costs for materials, labor and overhead production costs, incurred after the by-product is separated from the main product, are directly charged on the by-product. Any income from future sales of by-products is credited to the account of the by-product. The balance in this account can be presented in the income statement in the manner described for Method 1, except that the production costs applicable to inventories of a by-product should be reported in the balance sheet.

This method rests on the assumption that all by-product costs are proportionate to its selling price. This is a step towards the recognition of the cost of by-product prior to its separation from the main product. This is also the approach which

is most similar to the methods used for calculating the costs of the joint products.

Conclusion

Calculation of costs of joint and by-products highlightd the importance of the problem of cost allocation by products, where the origin, the equipment used, share of raw materials and labor costs and other facilities is impossible to be defined precisely. Reviewed approaches and methods for treatment of common and joint costs can give the manufacturing companies the necessary tools for cost allocation. Those methods for calculating and allocating costs to joint and by-products are very important step in the more broadly defined process of cost management and managerial decision making within organizations. The quality and reliability of the calculated and allocated costs are important inputs to the decisions made by managers of the companies, which often impacts the long-term profitability of companies.

References

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