ACTIVITY-BASED COSTING AND MANAGEMENT—A WAY TO IMPROVE THE PROFITABILITY OF FISH PROCESSING?

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Intensified competition and new production technologies have made accurate product cost information crucial to competitive success. Activity-based costing (ABC) systems report accurate and timely cost information in a business environment, where competition is high and the company has a diverse product mix. In addition, the information ABC supplies can be used for continuous improvement of the business. Activity-based costing traces the indirect costs first from resources to activities and then from activities to specific products (or product lines, distribution channels, customers) that create demand for or benefit from these resources. ABC allows costs to be allocated to products by the actual activities and resources consumed. The allocation bases (cost drivers) used in ABC are often measures of the activities performed (e.g., setup hours, number of setups, number of times ordered) instead of the traditional volume-related allocation bases [3].

The activities performed in contemporary production processes can be grouped in unit-level, batch-level, product-level and facility-level activities. Unit-level activities are performed each time a unit is produced. The costs of batch-level activities vary according to the number of batches made, but are common costs for all units in the batch. Product-level activities are performed to support different products in a company's product line. The costs of these activities can be assigned to individual products, but the costs are independent (fixed) regardless of the number of batches or units of each product produced. In addition to traditional unit-level allocation bases, ABC systems can also use batch-level bases and product-level bases. The facility-level activities contain the costs that are common to a variety of products and must be treated as periodic costs or allocated in some arbitrary manner to products. The difference between the traditional and the ABC view to product costing is further illustrated in Figure 1 [1].

The complexity of design of an ABC system depends on many factors, including management's objectives for the cost system and the diversity of the company's product mix. If a single management objective dominates, only few cost drivers may be required to achieve the objective. Multiple drivers may be required as design objectives become more complex. An important objective in designing the cost system is to get the greatest benefit at the lowest overall cost [2]. The number of cost drivers depends on the desired accuracy of product costs and the complexity of the product mix. As the number of cost drivers increases, the accuracy of product costs increases. The complexity of the product mix determines whether the costs of two activities can be aggregated and traced by means of a single cost driver.

Modern ABC models contain a cost view and a process view (see Figure 2). The presence of these two dimensions extends ABC beyond product costing with possibilities to achieve continuous improvements. The process view contains detailed cost and non-cost (quality, time) information provided about each activity or process used in the improvement process. Cost drivers determine the work load and effort required to perform an activity. Performance measures describe the work done and the results achieved in an activity. The cost view contains aggregated (aggregations of related detail activities) information about the cost of resources, activities, products and customers. This information is highly aggregated to guide improvements, but accurate so as to be used in product costing and strategic and tactical analyses such as evaluating customer profitability, prioritizing improvement projects and setting cost targets. Using ABC to improve business is called activity-based management (ABM). ABM uses the information ABC supplies in various analyses designed to yield continuous improvement [4].

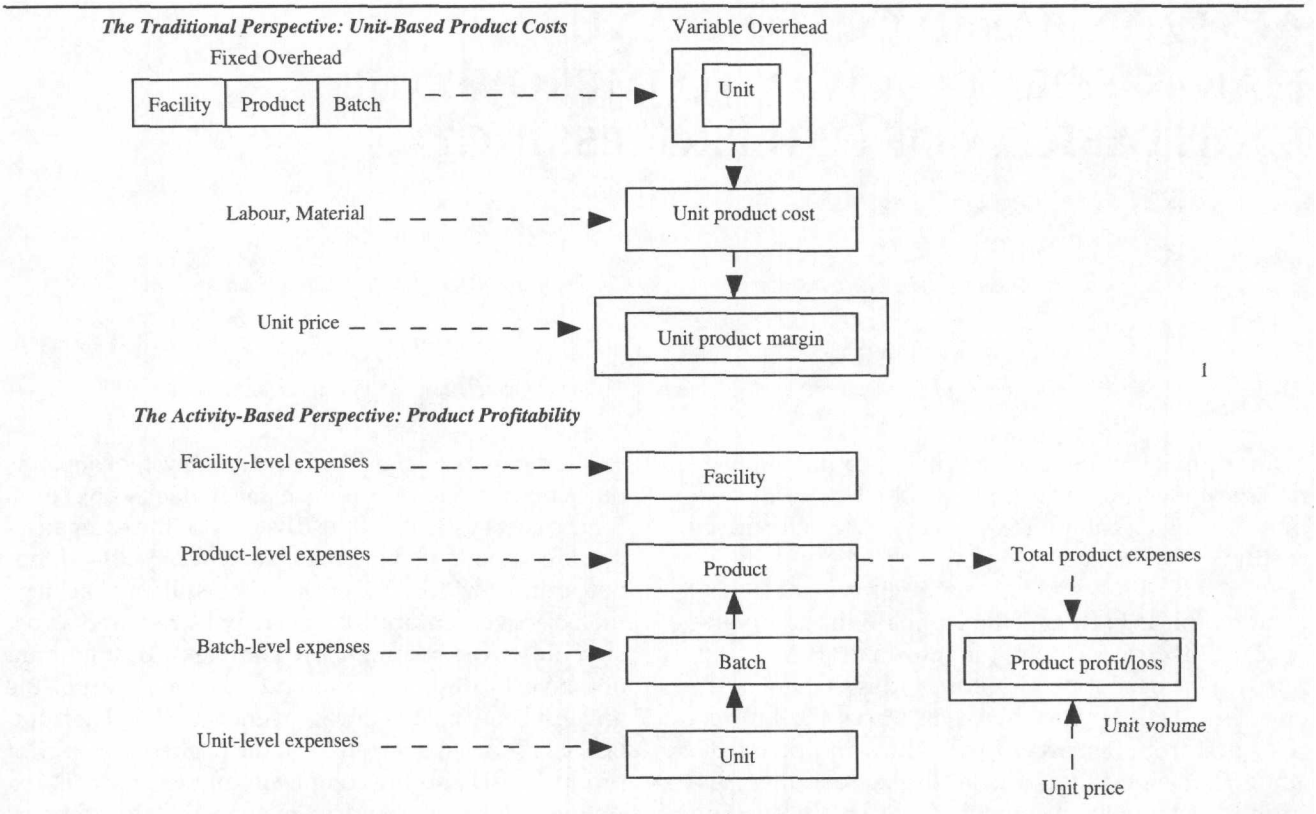

FIGURE 1: Difference between traditional and ABC product costing

FINNISH FISH PROCESSING INDUSTRY

The Finnish fish business has traditionally been a very conservative branch. The fish traders rely on their own experience and intuition in costing. At present, fish processing and its trading have undergone many changes. Competition in the fish processing industry has been diversified and intensified. The old experi-

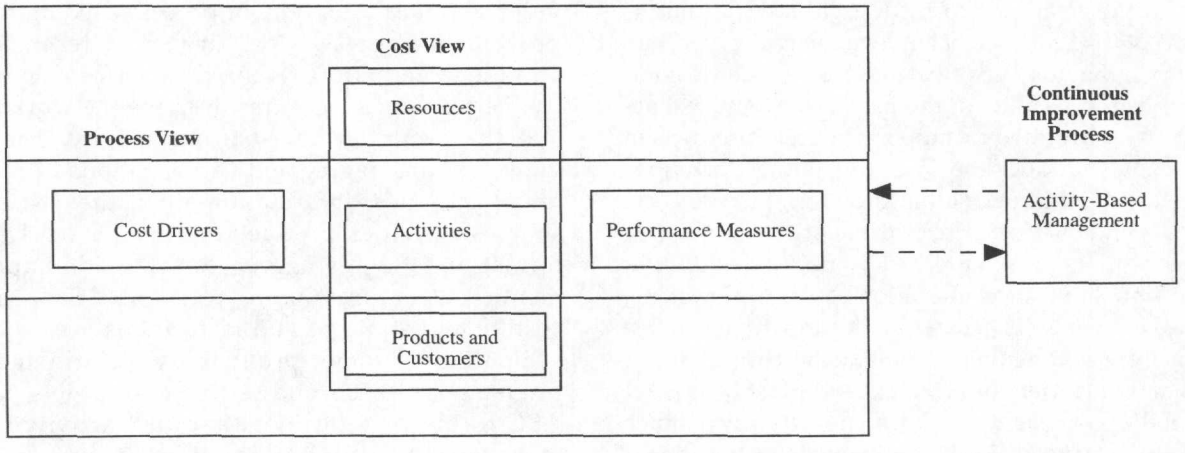

FIGURE 2: Two-dimensional activity-based information and activity-based management

ences and skills are less relevant now than they were in the past. Reliable product cost information has become an important part of a successful business. About 30,000 metric tons of fish were processed in Finland during 1993. Over half of the processed fish was filleted, one fifth was smoked, and one tenth was used in the fish preserving industry. The fish processing industry used mainly domestic Baltic herring (51% of the processed fish), rainbow trout (20%) and imported raw material (17%). Also, a number of minor fish species like whitefish, salmon, pike, pike-perch, perch, vendace, burbot and sprat were processed.

In 1994, there were 196 fish processing and/or wholesale firms in Finland. Their total sales were about one billion Finnish marks (FIM) and they employed about 1,100 persons. Over half of the firms are very small (sales under 1 million FIM/year). The sales of 25 firms exceeded 10 million FIM/year and their share of the total sales in the fish business was over 70%. The sales of only two cooperating groups of companies exceeded 50 million FIM/year. The smaller processing firms focus their activities mainly on processing, and their distribution channels vary.

The diversity of the processing firms is high. Small firms often operate regionally and they process mainly manually. Many companies fillet Baltic herring by machine. There were about 40 Baltic herring filleting machines in Finland in 1994. The capacity of Baltic herring filleting machines was about 300 metric tons a day, and the effective utilization rate for the machines was about 21%. The production processes in the fish preserving industry are highly automated. Nowadays smokehouses mainly use automated equipment, but much of the handling and packing is done manually. The capacity of smokehouses was about 165 metric tons a day, and the effective utilization rate of the smokehouses was about 29%. Other fish species are mostly filleted manually as compared to Baltic herring; although some companies have specific filleting machines for rainbow trout, cod, whitefish and perch (17 machines altogether).

The business environments for a Finnish fish processing firm are very unstable. Since fish products are perishable, they must be quickly handled and processed. The supply of domestic raw material is uncertain, because of the seasonal and long-term variations in fish catches. The quality of raw material also varies seasonally. The price of raw material and the fishery's products vary mainly depending on the volume of fish landed. The number of suppliers (fishermen) is high and the daily purchases per supplier are often very low (only kilos of fish). The Finnish fish catches are substantially smaller than the catches in most of the other countries in Europe [5]. The low volumes and high variations in the volume of raw material make it more risky to invest in modern technology and difficult to compete with economies of scale. The variation in cash flows increases the financial risk of the business. The raw material prices are lower or at the same level in Finland than in competing countries, but the prices for the end products are significantly lower.

The most typical accounting system for a fish trader is somewhere inside his or her head, and there may be several reasons for this. Most of the fish traders are oriented to practical work. The traders mostly believe in their own skills and experience and hence do not easily adopt any new methods or tools in evaluating performance. They do not like paperwork, and therefore many traders leave all the firm's paperwork to separate consulting accounting firms. The motivations behind entrepreneurship in small firms vary. In many cases the small-scale processors are not interested in maximizing their profits, and accurate cost information does not really matter. For example, a fisherman wants to extend his fishing income by further processing his or her catches [6]. Some are only interested in working at the archipelago. The educational level of old fish traders is low and they do not master new technologies and complicated cost systems; therefore they have no interest in them. In addition, small firms cannot afford to invest in a cost accounting system or employ a clerk.

The working routines, especially in manually operating firms, are very flexible and diversified due to unpredictable purchase volumes of different fish species. The same staff works with almost all products and activities from production processes to marketing. The owners and management also participate in the production. They have a better practical knowledge of the operating costs than the management in bigger and more centrally controlled companies. They may be doubtful whether a cost accounting system would be a reasonable investment. They might even think that a cost accounting system gives misleading figures because of their rapidly varying production processes. However, fish processing has become a more and more professionally managed business due to the changes in the business environment and the new and more educated generation of fish traders. The share of fixed and indirect costs are increasing steadily in fish processing firms, although the share of direct labor costs is still very significant. The costs of new technology, marketing, distribution and general costs are increasing as the share of processing labor costs decreases. Thus, the management of indirect costs and efficiency is becoming increasingly important.

Twenty-seven percent of the firms that buy their raw material from fishermen used computers for invoicing or accounting purposes in 1994. Another 23% planned to change over to a computerized system [7]. The management at two Baltic herring filleting firms and three full-scale processors were interviewed to find out about their cost accounting systems. The filleting firms did not have any cost accounting system in use, because they felt that it would not be very reliable in their business environment. One company was, however, developing a cost accounting system. All three full-scale processors had implemented cost accounting systems. Their system calculates variable costs of processing in detail; but either the indirect costs were not allocated to fish products or allocations were based on the product's share of the total sales revenue. The accounting systems were individually well tailored to processing operations, but ABC ideas were not adopted.

ABC IN THE FISH PROCESSING INDUSTRY

A cost accounting system in a Finnish fish processing firm is quite a new phenomenon. Thus the appropriate systems are still under development. The existing cost systems use labor hours to trace processing costs and the overheads are allocated in some arbitrary way. The operations in fish processing are very flexible and batch sizes are small. The raw material (whole or gutted fish) is often handled or processed after supply volumes, customer demand and staff are available. For example, 2,000 kilos of Baltic herring and rainbow trout may be smoked, 1,000 kilos of various fish species filleted and 300 kilos of fillets slightly salted, cold-smoked and staked partly by the same personnel in one day. The hygienic regulations impose that raw materials must be stored in a separate cold store from the end products. End products are stored in a cold store or preserved in a freezing plant. Also, different production operations (gutting, filleting, salting, smoking) must be performed in separate rooms. There are many material handling (moving) operations: from store to processing, between processing sites and back to store.

The batch sizes vary greatly, depending on the supply of fish. The cultivated rainbow trout is a basic species for processing, because of a more constant supply than that of caught fish. Rainbow trout is often processed in the same plant simultaneously with the minor fish species, but the batch sizes for rainbow trout are larger than those of minor fish species. Rainbow trout is also larger than many other fish species. Thus the volume-related cost drivers may overcost products made of rainbow trout and undercost the products made of minor and smaller fish species. However, the flesh loss ratios for different fish species and size classes were taken into account in the existing cost system. Also, the physical size bias was avoided.

Purchase and distribution costs may be substantial for a processing firm. Raw materials and purchasing costs are often over 50% of the product costs. Some raw materials (e.g., imported frozen raw materials) are transported to the production plant, while some fish species are gathered from many fishing ports with the firm's means of transport. The costs of gathering the same amount of fish from 50 fishermen is different from buying it from a single wholesaler. Also, it means that 50 more receipts must be written. Hence, the costs of exporting, wholesaling, distributing to retailers or institutional kitchens and their own retail sale is different. The allocation method overcosts rainbow trout products, because rainbow trout is an expensive fish, the batch sizes are large, and the purchasing and selling costs are low. Conversely, the costs of minor fish species will be undercosted.

The processors prefer to use labor hours as allocation bases in processing, because it is difficult to find other appropriate cost drivers for the flexible processes. An owner of a large Baltic herring filleting firm described the dynamics of the environment in the following way: "a cost system appropriate in the morning could be obsolete in the evening." The processors felt that the accurate tracing of indirect costs (general costs, marketing) was not a necessity. This may reflect the influence of generally accepted accounting principles which define product cost to average full manufacturing costs [9]. Also, the accurate allocation would have been very difficult. The difficulty of finding practical solutions for allocations may also be due to the unawareness of alternative ways that, for example, ABC offers to attack the allocation problem. Cost drivers such as the number of batches or transactions may not have been considered at all. The processors were also aware that the share of fixed and indirect costs had increased and accurate product costs were needed in the highly competitive markets.

There are very few studies about the profitability of fish processing in Finland. These studies indicate that major improvements and cost reduction can be achieved in processing activities by measuring the performance and costs in fish processing firms. It has been found that the costs of manually filleting whitefish could be remarkably reduced by changing the work flow from individual work to serial work [8]. In a case study, the profit of processing whitefish increased 170% when a firm started to use the fish meat from the

TABLE 1: Micro and Macro Activities, Cost Drivers and Performance Measures for a Filleting Operation

Micro Activities	Level	Cost Drivers	Performance Measure	Macro Activities
1. Moving pallet from the raw material cold store to the filleting site	Batch	Distance between the cold store and the filleting site	Time	Moving
2. Unloading the boxes	Unit	Number of fishes	Time	Filleting
3. Cutting off the fillets	Unit	Number of fishes	Time, flesh loss	Filleting
4. Cutting off the ribs	Unit	Number of fillets	Time, flesh loss	Filleting
5. Cutting off the fins	Unit	Number of fishes filleted and fins cut off	Time, flesh loss	Filleting
6. Removing the skin from the fillets	Unit	Number of fish filleted and skinned	Time, flesh loss	Filleting
7. Washing the fillets	Unit	Number of fillets	Time	Filleting
8. Quality inspection	Unit	Number of fillets	Time, number of defects	Filleting
9. Loading the fillets in the boxes	Unit	Number of fillets	Time	Filleting
10. Moving boxes to the end product cold store	Batch	Distance between the filleting site and the end product cold store	Time	Moving

filleting leftovers. A general observation was that very few processors knew their actual costs. In particular, the new firms were optimistic about the profitability of their business. They did not understand how much the indirect or fixed costs and waste (flesh loss in processing) effected the overall profits and product costs. The characteristic of this branch is that many new companies are grounded and closed down yearly. This may be evidence that many beginners were optimistic about the profitability of fish processing. Another reason may be that many new processors receive financial support to start their firms. Afterwards, they have difficulty holding on to a profitable business after the support money is consumed.

The fish processors are familiar with most of the earlier mentioned methods of improvements (e.g., activity-based cost reduction). The processing plant layout effects the functionality and the effectiveness of the processing activities. The processing sites should be located so that the related operations are close to each other and the operations can be done in a continuous flow. In fish processing where various manual operations are performed simultaneously and the batch sizes are small, the plant layout must be carefully planned to reduce costs. The new hygienic regulations set limitations to functional rationality. Some prehandling activities (gutting, scaling, roe keeping) that otherwise should be done in separate rooms could be transferred to fish suppliers. It could also improve the quality of fishery products.

The sharing of activities may cut down costs in many operations of fish processing. Many companies have grounded product families. Therefore, identical packages (mainly vacuum packages) and packing methods can be used for several product variations. Products in a similar package associate the taste and quality to a certain company. The better use of fish meat and reducing waste in fish processing are very important. The animal fodder market is vital for firms that fillet Baltic herring. The flesh loss ratio (the share of filleting leftovers) for Baltic herring is about 55%. The filleting leftovers are deep-frozen and sold to firms that produce animal fodder. Furthermore, the fish meat from leftovers of other fish species can be removed and further processed to ready meals. A number of operations have been improved in the fish processing industry even without any cost accounting. However, a cost accounting system that supplies information for improving activities encourages continuous improvements and provides incontrovertible facts concerning the present performance and the success of improvement activities.

The details of an activity-based analysis to fish filleting operation are illustrated in Table 1. A filleting operation can be split into ten micro activities: four separate cutting operations, washing, quality inspection and two loading and two moving activities. The moving activities are batch-level activities and the other unit-level activities. The cost driver for the moving activity is the distance between filleting site and stores. The actual cost drivers for other micro activities are the number of fish taken to production or the number of fillets produced. These cost drivers can easily be calculated in proportion to kilos of fish taken to production, if the flesh loss ratios are known. All the unit-level micro activities can then be aggregated to a macro activity, as well as both batch-level moving operations to another macro activity. The cost of each macro activity can be assigned to products using a single activity driver (e.g., cost per kilo of fish taken to production and cost per moving).

Micro activity-level performance measures call attention to operational improvements. The cost driver for moving activity points out the possibility of reduc-

ing moving costs by reorganizing the plant layout. The important performance measure following filleting efficiency is the time consumed by filleting activities. Flesh loss ratio is an especially important measure in a filleting operation and the number of defects may be a good performance measure for quality inspection. The working efficiencies and flesh loss ratios may be different for different persons. The flesh loss varies with fish species, size of fish and season. The data on the optimal output ratios and variations can be fed into the accounting system. The best practices form good targets with which the actual performance can be compared. The above-presented ideas are already partly in use in the existing systems.

Quality must also be insured in retail trade of the fish processing industry. A customer may not be interested in whose fault it was, when he or she gets a bad quality product. However, the name of the processor will be on the package. The retailers should be trained to handle fish products correctly, and the equipment in retail shops should be controlled. The selling operations should include expertise in marketing services such as food preparation and preservation recipes. The work processes in a processing firm should be split into details and the workers should be trained to improve quality in all their activities. An ABC system makes it possible to separately follow the quality costs in the entire firm. The quality aspects can also be followed by suppliers and customers to validate their total value. ABC counts the real costs of bad quality and proves the benefits of quality improvements.

New measurements increase the cost of the system (more weighting, more accurate working time estimating). The benefits from more accurate information must be greater than the costs of the new measurement. The share of overheads and the complexity of operations vary by firms and recall different needs for cost accounting. Large full-scale processors need more detailed information than small firms with focused production. The cost system may be centralized and complex, based on the accounting system with on-line connection to several divisions, or inexpensive worksheet programs developed to calculate accurate costs for individual operations of small firms [8]. Computerizing activities (invoicing, statistics, production control, cost accounting) may also lead to improved efficiency and cost savings.

According to research and case studies from the manufacturing industry, ABC would be a very appropriate system in fish processing. According to fish processors it would be uneconomical to use a detailed measurement system such as ABC provides. In addition to product costing, an advanced information system could be an indispensable tool for both activity analysis and quality improvement purposes. This study also provides insights into the suitability of ABC and implementation issues in other business areas.

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