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Process Cost Accounting Application in Logistics Control

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ABSTRACT: The last two decades were marked by rationalization and optimization measures in many industrial companies. Optimizing operational logistics plays a particularly important role. Adjustments and changes in internal logistics are particularly delicate, as this area plays a key role in the value chain due to the timely supply of raw materials and operational resources, while internal logistics often have great potential for cost savings. This article addresses the issue of logistics control through the application of cost accounting by processes to carry out a control that allows knowing and improving the performance indicators in the company, a practical example is used to show the possibilities of application and the limits of process costing in this area.

KEYWORDS: Process costing - Cost accounting - logistics performance index - Logistics control

JEL Codes: M41, M20, M49

I. INTRODUCTION

The expansion of sales markets, the advancement of information and communication technologies, as well as the increasing international division of labor that accompanies it, results in increasing competitive pressure for companies. In this context, logistics has become an extremely important ally to improve the profitability of any organization, as there is great potential for optimizing costs and services, especially in the field of warehousing and distribution.

The costs related to logistics, are branched into different activities inherent to the operation of the company, from the cost of internal and external transportation, to storage costs. Logistics costs are hardly accounted for exactly in an organization, these costs are usually generalized and encompassed as a whole, without the haste to section and identify them to give precise knowledge of what the organization is spending. These items are not only becoming increasingly relevant due to their growing share in total costs, but they also represent an important indicator to measure the efficiency of corporate logistics. (Mauleón, 2012).

In its main function, logistics provides security in supply and, therefore, ensures the availability of resources in the company. Due to this function, the logistics area is increasingly attracting the attention of management. In order for the management to make optimal decisions, a control system is required that takes into account the peculiarities of logistics in the best possible way and thus forms a deep information base(Guevara & Quiroz, 2014). Consequently, a well-designed logistics control helps to improve the competitiveness of the company. Therefore, it is even more surprising that logistics control in companies is taken sufficiently into account, as shown by a current study of performance indicators applied to logistics control. (Gleißner & Moeller, 2013).

The competitive environment increasingly requires customer-oriented pricing to maintain market position. The identification of measures and influencing factors for process improvement is essential in this context. (Martínez & El Kadi, 2019). This requires transparency regarding logistics costs and internal performance processes. However, traditional methods of control, such as logistics cost and performance accounting that are more frequently propagated in the literature, as well as KPI's (Key Logistics Indicators) do not meet this requirement.(Ballou, 2009). A costing method in the process can offer a solution to the problem, because it not only meets the requirement of creating transparency, but also allows costs to be allocated based on the cause(De la Arada Juarez, 2015).

Based on the above, it is intended to carry out a basic conceptual analysis of logistics control detailing the instruments most used for their application in process costing in the logistics area of a company, as well as the advantages and disadvantages associated

with their use. To carry out the above, a practical case study will be developed in which the application of process cost accounting in logistics control in a factory is described.

II. THEORETICAL FRAMEWORK

Logistic Control

Logistics control plays an important role. However, there is neither in theory nor in practice a uniform understanding of the term and its stages of expression. Mentzer & Firman mention that, initially, that the functional areas of logistics and control are within a new system called logistics control(Mentzer & Firman, 1994).

Logistics deals with the physical security of supply throughout the entire value chain of a company (Head, 2012). It covers all those activities within a company that are related to the planning, management, implementation and control of the transformation of goods in terms of time and space. To ensure an efficient flow of goods(Ballou R., 2004). The logistics components of order processing, warehousing and inventory, warehouse, packaging and transportation in the course of procurement, production, distribution, spare parts and disposal logistics are used as logistics subsystems(Ballesteros & Ballesteros, 2004)**.** The objective of logistics is to map all the processes of movement, storage and transshipment of goods from suppliers to customers. As a transversal function, logistics includes all activities depending on the flow of goods and materials and goes from acquisition to sales.(Cardona, Balza, & Henríquez, 2017)

The definition of terms and the perception of control are very varied in the literature and in practice. What they have in common is that they see control as a sub-function of corporate management, their task in obtaining, processing and analyzing information relevant to decision-making, as well as coordinating planning. Control and information systems exist for the preparation of goal-oriented decisions(Garcia, 2018). In part, this decision-making control function is complemented by a behavior control function whose task is to ensure the goal-oriented behavior of decision-makers and, therefore, the coordination of the entire management system in case of divergent interests and information asymmetries(Dorf, 2005).

The logistics control deals with all those activities aimed at coordinating management tasks in the logistics area. Consequently, general control tasks related to logistics are used, so your processes can be planned and controlled. For this to be possible, the supply, processing and provision of the necessary information must be guaranteed, (Anaya, 2007)which at the same time reflects the central task of logistics control. In addition, logistics control plays an important role in the planning and control of logistics activities. On the one hand, it is important to record logistics activities in terms of quantity, quality, time and effectiveness with the help of control variables to evaluate. On the other hand, additional data must also be collected for a proper logistics calculation in order to solve coordination problems between purchases, production and sales. In addition, logistics control must support strategic planning, for example in relation to the supplier or distribution structure of a company, and consider not only costs but also revenue structure. (Zuluaga, Gómez, & Fernández, 2014). To do justice to the consideration of increasing the value of logistics, measurement and control instruments are required within logistics control, which ensure the operational and strategic efficiency of logistics processes, support strategic corporate management and form the basis for logistics planning.

Logistic control instruments

Nor is there a uniform conception in the literature regarding the control instruments that are used or should be used in the field of logistics. Very often, logistics key figure and cost accounting systems are propagated as logistics control tools.

As part of the overall control system, accounting for performance and logistics costs is of particular importance. This forms the basis for calculations and provides information for reporting and logistical control.(Urzelai, 2013)**.**As a preliminary stage for each control system. In logistics, cost accounting and logistics services mainly pursue the objective of causal allocation of costs and services. In practice, the complete recording of consumption and performance indicators is often difficult, so the assignment to the correct service provider, recipient or consumer is often incorrect. Logistics cost and performance accounting is primarily used for decisions affecting outsourcing in the warehousing and transportation industry.

*Key Indicators and Key Performance Metrics*also known as KPI (*Key Performance Indicator* for its acronym in English) they represent another important instrument of logistics control. They also provide information for reporting and therefore for logistics control(Arango, Ruiz, Ortiz, & Zapata, 2017)**.**The key indicators are intended to show interdependencies and developments in logistics and also serve as a target. Examples of key logistics indicators are; hit frequencies, delivery times, dwell times and delivery times, delivery preparation and service levels, as well as cost-related ratios.(Arango M., Ruiz, Ortiz, & Zapata, 2017)relate total logistics costs (for example, average logistics costs, logistics costs relative to sales) or important types of logistics costs (for

example, average storage costs, storage costs per ton, share of personnel costs). Selecting the right logistics metrics is business dependent and challenging to focus on a few meaningful metrics. (Rodríguez, Alfaro, & Carot, 2020)

Companies seem to deal mainly with costs in the course of logistics control(Guerrero, 2018)**.** However, due to increasing competition, a pure cost orientation does not go far enough; rather, customer-oriented pricing is essential to maintaining market position.

Consequently, exclusive pricing is sufficient. Consideration and review of the logistics area with the help of traditional methods such as cost and performance accounting, as well as KPI's are no longer sufficient, as these cannot make logistics costs and internal performance processes transparent(Voronova & Berezhnaya, 2019)and, consequently, little support in the identification of measures and variables of influence to improve logistics processes. Process costing, on the other hand, seems particularly suitable for use in logistics.

Cost accounting by process

The starting point for the development of process cost accounting was changes in the creation of value and therefore also in the cost structure due to increasing automation, an increase in the richness of variants and the complexity of products and increased customer service and marketing activities. In the context of the resulting sharp increase in overhead costs, instruments were sought to increase cost transparency and improve cost allocation in indirect service areas, such as materials logistics, sales, or research and development.(Cows, Bonilla, Santos, & Avilés, 2019) Process cost accounting allows causal accounting Distribution of costs and services to individual company processes and thus serves for better control and planning of overhead cost areas. In addition, it manages to allocate the costs of these indirect areas more precisely to a specific product or other cost unit. Therefore, a more precise calculation can be made(Vanderbeck, 2017). Process cost accounting is often used as a supplement to traditional cost accounting to support more accurate allocation of overhead costs (Muñoz, 2017). It is carried out in several steps and is based on a detailed performance and process analysis. Here the important activities in the main processes are mapped and an assignment is established to the respective cost unit (product, customer, etc.). Core processes consist of threads and can span multiple cost centers. The individual activities of the main processes are analyzed in detail. The objective is an exact delimitation of the activities and their precise comprehensibility (Ugalde, 2011).

The next step is to allocate costs to individual processes, before determining cost drivers in a later step. They describe those factors that trigger processes and, therefore, are decisive for the generation of costs(Zapata, 2020)**.** With the help of cost drivers, the question of factors influencing costs in the area of overhead costs is clarified (Morillo, 2001). Depending on your participation in the scheduling activity, the processes can be performance neutral (lmn) or quantity induced production (lmi). The processes that are induced by amounts of energy depend on the volume of energy. Consequently, a cost driver can be identified as a measure of cost causality. However, this is not possible for processes that are neutral in terms of volume of service, since they do not depend on the volume of service and therefore on a reference value.

In the next step, the process quantities are determined for the respective cost drivers. This is often associated with considerable effort, as this data is generally unavailable and time-consuming to collect. In the penultimate step, the process costs per unit of measure are determined before the costs are finally allocated using the process cost rate in the process cost calculation. Here the relevant cost unit is charged with the calculated process costs.

Cost accounting in logistics

In the logistics area in particular, the share of overhead in total costs is very high. Consequently, it is also of great importance for this area to map operational events holistically with the help of individual processes or activities in order to be able to allocate the overall costs incurred according to the cause.(Orjuela, Suárez, & Chinchilla, 2016). With the help of process cost accounting, cost allocation errors, overhead costs and accounting biases that often arise when using traditional total cost accounting with markup rates can be avoided. In this way, costs and services can not only be allocated according to their causality, but potential savings can also be identified. As an indirect area, logistics and the design of its processes offer a high potential for savings.

The benefit of process costing is greater the greater the variety of products, customers and processes(Polimeni, Fabozzi, Adelberg, & Kole, 2001). In the logistics sector in particular, the company is often faced with many different and specific customer requests. Process cost accounting enables monetary evaluation, evaluation of the processes that trigger these customer requests, as well as evaluation of the profit contribution of customer orders.(Cuervo, Osorio, & Duque, 2007)**.**

Process Cost Accounting Application in Logistics Control

Process costing: advantages and disadvantages

Compared to other instruments, process costing is particularly important due to the differential treatment of overhead costs. In process costing, for example, overhead is allocated according to cause, while, for example, in classic total cost calculation mostly only approximate flat rate allocation methods are used(Rayburn & Gómez Mont, 1999). Logistics costs are usually incorrectly assigned to the respective cost object with the help of a material overhead rate based on individual material costs(Mauleón, 2012). In particular, administrative services and costs are not recorded in traditional cost accounting systems or are only recorded using very approximate flat rate accounting methods.(Vanderbeck, 2017). With the help of process cost accounting, dependencies on cost drivers and costs actually incurred can be better analyzed in comparison to other logistics control methods. This means that costs are more precisely assigned according to their causality.(Cuervo, Osorio, & Duque, 2007).

This also provides better cost information for pricing of logistics services. In particular, process cost accounting allows decreases in quantities to be taken into account, which is increasingly relevant in the context of smaller and smaller order quantities from customers.(Cuevas, 2004). When determining the specific costs of special customer requests.

On the one hand, process costing offers the company a basis for deciding whether to accept an order from a customer or under what conditions. On the other hand, pricing becomes more transparent and understandable to the customer with a process-based calculation.

By determining directly attributable indirect costs (lmi) and the associated best representation of relationships and dependencies, costs can be better predicted. For example, with a higher volume of handling, directly attributable additional costs can be assumed. In addition, the identification and documentation of logistics processes alone leads to greater transparency in the logistics area. (Solórzano, 2018). This can provide incentives for active structuring of overhead costs by optimizing processes and orders by providing decision makers with the costs of small quantities, rush orders, and specifications. - know all the treatments. (Zapata, 2020)

Despite the more causal allocation of overhead costs to cost units and increased transparency, process cost accounting in logistics also has disadvantages. The corresponding process costs are often determined on the basis of the assumption that personnel costs represent the most important cost component in the logistics area. In practice, however, capital immobilization costs that are independent of the personnel situation, depreciation, and insurance and energy costs also form a considerable component of logistics, but especially storage costs, thus that even with the help of process cost accounting, a fully cause-based allocation of overhead costs is often only conditional.(Muñoz, 2017)

Furthermore, production volume induced costs are largely fixed costs that cannot be changed in the short term. Consequently, process costs do not represent an adequate performance benchmark for evaluating cost center profitability. In addition, they should only be used in a very limited way as a control instrument, since cost center managers or those responsible for processes can hardly influence the level of costs in the short term.(Dorf, 2005)**.**

III. METHODOLOGY

Following the methodology of (Hernández, Fernández, & and Baptista, 2003)there are exploratory, descriptive, correlational and explanatory studies. This is a descriptive study with a quantitative approach since data or figures will be collected on different processes in the activities of the organization to be studied and an analysis and measurement of them will be carried out.

"Descriptive research seeks to specify important properties, characteristics and features of any phenomenon that is analyzed" (Hernández, Fernández, & and Baptista, 2003). Descriptive studies measure rather independently the concepts or variables to which they refer and focus on measuring as accurately as possible(Hernández, Fernández, & and Baptista, 2003)

Study subject

The subject of study is a manufacturer of agro-industrial products derived from coconut located in the town of Armería, Colima, Mexico. The company has 5 work areas; Production, Marketing, Finance, Human Resources and Systems. However, for the development and data collection in this research, only the Production area was analyzed for the observation of activities inherent to logistics (distribution, handling and storage of merchandise) and the Finance area to obtain data. figures on costs reported to this department.

Instruments for research

The instrument used to collect data in the company was through selective non-participant observation of the logistics and accounting processes of the Production and Finance area. A measurement and quantification was carried out using a record table

with the number of operations observed, as well as the amount of product mobilized. By observing documents (invoices, notes and purchase orders) in the Finance department, it was possible to quantify the inherent cost of the observed logistics processes for subsequent registration in the researcher's database.

IV. RESULTS

The analyzed company has a very simple business model in the area of inbound logistics. The basic materials needed for production are priced in a very narrow range and do not require special treatment. The workflow is easy to plan and extremely stable. The company has long been optimizing the delivery of goods in the inbound logistics area, as transients must book their deliveries through an IT-based reservation system, ensuring a stable workload in the goods delivery area. . The flow of goods from the goods receipt warehouse to production is also very well coordinated and hassle-free. The work preparation department provides the incoming warehouse with the production plan for the next day no later than 3:00 p.m. the day before. The excellent spatial arrangement of the department with a very large buffer zone enables the team to prepare products for production with a relatively long lead time of up to 12 hours. This means that the workload in the production interface can be easily planned and is very continuous. Table 1 shows the cost structure of the cost center "raw material storage / inbound logistics": The excellent spatial arrangement of the department with a very large buffer zone enables the team to prepare products for production with a relatively long lead time of up to 12 hours. This means that the workload in the production interface can be easily planned and is very continuous. Table 1 shows the cost structure of the cost center "raw material storage / inbound logistics": The excellent spatial arrangement of the department with a very large buffer zone enables the team to prepare products for production with a relatively long lead time of up to 12 hours. This means that the workload in the production interface can be easily planned and is very continuous. Table 1 shows the cost structure of the cost center "raw material storage / inbound logistics":

Table 1. Cost structure "raw materials warehouse / inbound logistics"

Cost type	Costs (in thousands of MXN)
Wages and salaries	398
Non-salary costs and social expenses	22
Rent and lease	2. 3
maintenance	33
Energy, water, sewage	31
Telephone	2
Insurance costs	5
Third parties and services	15
Other costs	9
Depreciation	76
Total	**614**

Source: self made

A simple surcharge rate based on the value of the goods passing through the cost center is used to offset the cost center “raw material warehouse / inbound logistics” (see Table 2)

Table 2. Calculation of the surcharge rate based on the value of the merchandise in MXN

Calculation of the surcharge rate	
Yield of goods in tons	4,700
Production of goods	14,100,000
Cost of raw material input / storage logistics	614,000
Surcharge rate	**4.35%**

Source: self made

Since the raw materials are in a narrow range in terms of value, the general allocation hardly distorts the results and the company is responsible for the consciously accepted confusion. Table 3 provides an overview of the fluctuation range of logistics costs based on the value of the goods:

Table 3. Logistics costs based on the value of the merchandise in MXN

	minimum	maximum	weighted average
Value of the goods	2.85	3.1	3
Logistic participation	**0.12**	**0.13**	**0.13**

Source: self made

Cost center performance is primarily measured using the key cost per ton figure (see Table 4).

Table 4. Calculation of the costs in MXN of the yield indicator per ton

Calculation of the performance indicator	
Cost basis	614,000
Yield of goods in tons	4,700
Costs per ton	**130.64**

Source: self made

The cost center manager has a relatively high degree of creative freedom in his cost center, that is, the implementation of maintenance services is a decision-making freedom of the cost center manager as much as the use of temporary staff. in case of staff shortage. The cost center manager is responsible for ensuring that average costs per ton are less than $ 135 MXN. Exceeding the cost limit leads to a reduction in the annual bonus for all warehouse equipment. If, on the other hand, the costs per ton remain below $ 125 MXN, the whole team receives a special bonus.

New situation

The system shown above is greatly disrupted by the use of a new raw material that must be stored refrigerated until processing. There are no significant changes in the volume and value structure of the raw materials used in the company. Only one raw material worth 400 tonnes is traded and, unlike other raw materials, it must be stored strictly refrigerated. Heating the raw material to more than 10 degrees Celsius before processing could have a massive impact on the quality of the finished product and lead to costly complaints. By using the new raw material, the finished product has better application properties and, based on feedback from the sales team, can be sold much more easily than conventional products.

The above calculation, which in no case takes into account complexity effects, favors the promotion of the new raw material, since the additional costs of refrigeration and special treatment of the new material are assigned to all raw materials. The following tables show how the cost structure, calculation, and benchmarks change when new raw material is added and what challenges arise for the company. Table 5 shows the change in the cost structure.

Table 5. Change in the cost structure due to the new situation

Cost type	Previous (in thousands of MXN)	New (in thousands of MXN)
Wages and salaries	398	**440**
Non-salary costs and social security expenses	22	**24**
Rent and lease	2. 3	**2. 3**
Maintenance	33	**37**
Energy, water, sewage	31	**45**
Telephone	2	**2**
Insurance costs	5	**6**
Third parties and services	15	**16**
Other costs	9	**9**
Depreciation	76	**97**
Total	**614**	**699**

Source: self made

As can be seen in Table 6, the surcharge rate for the calculation goes from 4.35% to 4.92% due to the new situation. The big problem in this context is that the flat-rate surcharge does not take into account that the storage process of the chilled raw material is significantly more complex than the storage of the other products. The complexity effect is not attributed to chilled products based on cause, but is distributed across all products. The effect on costs per kilogram is negligible due to the softening effect with an increase of approximately 2 cents (see Table 7).

Table 6. Change in the surcharge rate based on the value of the merchandise due to the new situation

Calculation of the surcharge rate	Previous	New
Yield of goods in tons	4,700	4,700
Production of goods	14,100,000	14,200,000
Cost of raw material input / storage logistics	614,000	699,000
Surcharge rate	**4.35%**	**4.92%**

Source: self made

Table 7. Variation of logistics costs based on the value of the merchandise in MXN

	Last situation			New Situation		
	Minimum	Maximum	Weighted Average	Minimum	Maximum	Weighted Average
Value of the goods	2.85	3.1	3	2.85	3.1	3
Logistic participation	**0.12**	**0.13**	**0.13**	**0.14**	**0.15**	**0.15**

Source: self made

The situation looks much more problematic with respect to costs per ton. The cost center manager has no chance of reaching his unaltered cost targets after receiving the raw materials to be refrigerated (see Table 8).

Table 8. Change in costs in MXN per ton of the key performance indicator

Calculation of the performance indicator	Previous	Current
Cost base in MXN	614,000	699,000
Yield of goods in tons	4,700	4,700
Costs per ton	**130.64**	**148.72**

Source: self made

The cost center manager is aware of the risk of control errors if the increasing complexity caused by new raw materials that need to be refrigerated is ignored, and is building a simple process costing for the logistics area. In the first step, the processes that are neutral in terms of production, that is, those activities that are not directly related to production, are calculated from the cost structure. Warehouse management activities, for example, are considered production neutral. For this reason, the entire personnel costs of the Warehouse Manager and 15% of the Warehouse Assistant Manager, which is only not operational during the holiday coverage, are considered neutral costs in terms of volume of service. Rental and leasing costs refer to technical equipment (forklifts and freight stackers) and are therefore classified in their entirety as "lmi costs". In the case of maintenance, only the maintenance of the warehouse office is considered neutral in terms of volume of service. In terms of insurance and depreciation costs, those parts that concern the warehouse office are considered "minimum costs." The remaining costs, which

mainly relate to depreciation and insurance costs for technical equipment, are considered "lmi costs". Behind the external services and services is a project to improve work efficiency in the warehouse area. One third of the project's product was affected by the reorganization of the office's activities, the rest of the time was devoted to improvements in operations. The warehouse logistics process is reversed and is considered to be throughput volume driven.

All the costs of the mandatory audits were recorded in the area of “other costs”, these costs are considered completely neutral in terms of performance. Table 9 shows the breakdown of the cost center's total costs into its performance-quantity-neutral and performance-quantity-induced components.

Table 9. Distribution of costs in yield, neutral in quantity and yield induced in quantity

Cost Type	Costs (in thousands of MXN)	lmn (in thousands of MXN)	lmi (in thousands of MXN)
Wages and salaries	440	80	360
Non-salary costs and social expenses	24	5	19
Rent and lease	2. 3	0	2. 3
maintenance	37	3	3. 4
Energy, water, sewage	45	1	44
Telephone	2	2	0
Insurance costs	6	2	4
Third parties and services	16	5	11
Other costs	9	9	0
depreciation	97	25	72
total	**699**	**132**	**567**

Source: self made

In the next step, the production volume induced costs will be divided between the two main processes "Handling of non-refrigerated raw materials" and "Handling of refrigerated raw materials". In order to calculate volume-induced costs for depreciation, insurance costs, energy, water, sewerage, and maintenance of the "lmi-cooled" cost group with manageable effort, a sub-cost center for the cold room is established. This allows the exact allocation of the fixed assets to the new cost subcenter and thus an exact determination of the depreciation values. The maintenance department is also instructed to assign all "cold room specific" activities to the cost sub-center.

The exact allocation of "energy costs, the distribution of wage costs between the two process categories" Uncooled "and" Refrigerated "is particularly complex. For this, employee time records are carried out during a period of twice 10 working days each with an interval of two months. Since the salary costs of the individual warehouse employees differ only slightly from each other, the total salary costs for activities that depend on production quantities are calculated from according to the time required for the two main processes "Handling of non-refrigerated raw materials" and additional "Handling of refrigerated raw materials".

Tables 10 and 11 below show the time record and the resulting breakdown of wages and salaries.

Table 10. Division according to "operating time" into "lmi - uncooled" or "lmi - cooled"

Type of Activity Performed	lmi - uncooled	lmi - cold
Movement of goods	59.10%	17.30%
Cleaning and preparation time	21.17%	2.43%
Total	**80.27%**	**19.73%**

Source: self made

Table 11. Distribution of wages and salaries in "lmi - not refrigerated" and "lmi - refrigerated

Wages and salaries	Distribution		in thousands of MXN
lmi - uncooled	80.27%	→	289
lmi - cold	19.73%		71
total	100.00%		360

Source: self made

The rental and leasing costs of MXP 23 thousand, which are incurred exclusively for rented forklifts, are divided according to the "lmi - unrefrigerated" and "lmi - refrigerated" goods movement ratio and amount to 18 thousand MXP for handling refrigerated merchandise and 5 thousand MXP for handling non-refrigerated merchandise. Table 12 shows the cost allocation for all cost types from the "raw material warehouse / inbound logistics" cost center to the "lmi - non-refrigerated" and "lmi - refrigerated" processes.

Table 12. Distribution of cost center costs between "lmi - uncooled" and "lmi - cooled"

Cost type	lmi (in thousands of MXN)	→	lmi - uncooled	lmi - cold
Wages and salaries	360		289	71
Non-salary costs and expenses sec. Social	19		15	4
Rent and lease	2. 3		18	5
maintenance	3. 4		30	4
Energy, water, sewage	44		30	14
Telephone	0		0	0
Insurance costs	4		3	1
Third parties and services	11		10	1
Other costs	0		0	0
depreciation	72		50	22
total	**567**		**445**	**122**

Source: self made

In the last step, the costs of the processes that are neutral in terms of production are added to the processes induced by production through a surcharge rate (see Table 14). The costs induced by the production volume represent the basis for the calculation of the surcharge (see Table 13).

Table 13. Calculation of the lmn surcharge rate

Calculation of the surcharge rate per lmn	
Costs - lmi in thousands of MXN	567
Costs - lmn in thousands of MXN	132
Surcharge rate	**23.3%**

Source: self made

Table 14. Calculation of the total costs of the processes in thousands of MXN

Process	Base (lmi costs)	Surcharge lmn	Total cost
Handling of non-refrigerated raw materials	$ 445	$ 104	$ 549
Handling of refrigerated raw materials	$ 122	$ 28	$ 150

Source: self made

In the last step, the total costs are divided by the amount of chilled and uncooled raw materials passing through the cost center and a process cost rate per kilogram (kg) is calculated (see Table 15).

Table 15. Calculation of the cost of the process

Process	Total costs in thousands of MXN	Amount in Kg	Cost / Kg in MXN
Handling of non-refrigerated raw materials	$ 549	4,300,000	$ 0.13
Handling of refrigerated raw materials	$ 150	400	$ 0.38

Source: self made

Comparison with the billing rate based on a simple surcharge calculation, which averaged 15 cents, shows very clearly the complexity effect between unrefrigerated and uncomplicated materials (13 cents per kg) and complex "chilled" raw material (38 cents per kg). Therefore, it is only recommended to force the production of goods with refrigerated ingredients if the company can compensate the additional costs of 25 cents in the market with higher sales prices.

Assessing cost center performance on the basis of costs per ton would be problematic even if materials were treated uniformly due to fixed costs that cannot be reduced in the short term in the event of fluctuations in capacity utilization. However, in the case of non-homogeneous treatment of materials (as in the example shown above), this figure is not suitable as a performance benchmark.

Since the process costing is not separated into fixed and variable costs, but only into service volume and induced costs, which in turn contain fixed and variable costs, no significant short-term benchmarks can be derived from process cost accounting. Even if process costing is not the issue in this case study it can solve short-term behavior control, it makes an important contribution in the context of decision support by showing the costs involved in handling chilled raw materials. and the conditions under which customer orders with this raw material contribute positively to success. For the control of the behavior in the medium and long term,

CONCLUSIONS

Internal logistics and warehousing represent a particularly sensitive function in the value chain. On the one hand, the potential for rationalization in this area has often been recognized in the last two decades and attempts to increase it; on the other hand, any instability in the flow of goods leads to a massive disruption in the operational process huge follow-up costs The importance of internal logistics was also increasingly recognized by the control department and they worked on replacing simple ratios traditionally used, such as costs per ton, by control tools tailor-made for the logistics area. As in other indirect service areas (e.g. quality management, job preparation), process costing is also very important for this function. The practical example cited in this article shows that process costing can reveal complexity in the logistics area and assign causal factors to triggers (cost drivers). This is particularly important to identify undesirable developments at an early stage and take corrective action. However, the example also clearly showed the application limits of process costing. Because process costing is a complete cost accounting

system, it is not possible, for example, to define short-term performance benchmarks based on process costing. As part of the behavior control for the logistics area, process cost accounting is only suitable as a medium- and long-term instrument. Reveal the complexity in the logistics area and assign the triggers (cost drivers) to the cause. This is particularly important to identify undesirable developments at an early stage and take corrective action. However, the example also clearly showed the application limits of process costing. Because process costing is a complete cost accounting system, it is not possible, for example, to define short-term performance benchmarks based on process costing. As part of the behavior control for the logistics area, process cost accounting is only suitable as a medium and long-term instrument. Reveal the complexity in the logistics area and assign the triggers (cost drivers) to the cause. This is particularly important to identify undesirable developments at an early stage and take corrective action. However, the example also clearly showed the application limits of process costing. Because process costing is a complete cost accounting system, it is not possible, for example, to define short-term performance benchmarks based on process costing. As part of the behavior control for the logistics area, process cost accounting is only suitable as a medium and long-term instrument. to identify undesirable developments at an early stage and take corrective action. Nevertheless, the example also clearly showed the application limits of process costing. Because process costing is a complete cost accounting system, it is not possible, for example, to define short-term performance benchmarks based on process costing. As part of the behavior control for the logistics area, process cost accounting is only suitable as a medium and long-term instrument. to identify undesirable developments at an early stage and take corrective action. However, the example also clearly showed the application limits of process costing. Because process costing is a complete cost accounting system, it is not possible, for example, define short-term performance benchmarks based on process costing. As part of the behavior control for the logistics area, process cost accounting is only suitable as a medium and long-term instrument.

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