

# IS THE AGRIBUSINESS SUITABLE TO MODERN COST SYSTEMS?

**Luiz Carlos Miranda**

## **Resumo:**

*A maior parte das pesquisas sobre modernos sistemas de custos, em especial o custeio baseado na atividade (ABC), tem como alvo as empresas com alto nível de tecnologia, as chamadas manufaturas modernas. Este trabalho apresenta o resultado de um estudo empírico realizado pelo autor para identificar a estrutura de custos de produção das empresas de agribusiness. Como fonte de dados utilizou-se o Censo Industrial dos Estados Unidos. A estrutura de custo de todos os quarenta e nove setores classificados pelo Departamento de Comércio Americano no grupo Alimentos e Produtos Similares, que será doravante referenciado como setor alimentício, foi estudado e comparado com o setor das indústrias modernas. Os resultados não permitem concluir sobre a semelhança de estrutura entre o setor alimentício e o setor moderno da indústria. Todavia, um importante resultado emerge da pesquisa: a alta participação das matérias primas no custo total, indica a possibilidade do setor alimentício se beneficiar da implementação da análise de cadeia produtiva (supply chain management). Com base nos resultados obtidos, será possível estender os resultados das pesquisas sobre custeio nos setores de manufatura moderna às empresas do setor alimentício.*

## **Palavras-chave:**

**Área temática:** *Modelos de mensuração e gestão de custos no setor primário (agrário, florestal, pecuário, extrativo)*

## **IS THE AGRIBUSINESS SUITABLE TO MODERN COST SYSTEMS? EMPIRICAL EVIDENCE OF THE PRODUCTION COST STRUCTURE**

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### **Resumo**

A maior parte das pesquisas sobre modernos sistemas de custos, em especial o custeio baseado na atividade (ABC), tem como alvo as empresas com alto nível de tecnologia, as chamadas manufaturas modernas. Este trabalho apresenta o resultado de um estudo empírico realizado pelo autor para identificar a estrutura de custos de produção das empresas de agribusiness. Como fonte de dados utilizou-se o Censo Industrial dos Estados Unidos. A estrutura de custo de todos os quarenta e nove setores classificados pelo Departamento de Comércio Americano no grupo “Alimentos e Produtos Similares”, que será doravante referenciado como setor alimentício, foi estudado e comparado com o setor das indústrias modernas. Os resultados não permitem concluir sobre a semelhança de estrutura entre o setor alimentício e o setor moderno da indústria. Todavia, um importante resultado emerge da pesquisa: a alta participação das matérias primas no custo total, indica a possibilidade do setor alimentício se beneficiar da implementação da análise de cadeia produtiva (supply chain management). Com base nos resultados obtidos, será possível estender os resultados das pesquisas sobre custeio nos setores de manufatura moderna às empresas do setor alimentício.

**ÁREA TEMÁTICA:** Modelos de Mensuração e Gestão de Custos no Setor Primário, Casos Aplicados.

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### **INTRODUCTION**

The existing literature has mainly addressed ABC to multiproduct firms with high level of automation, the so called "advanced manufacturing technologies." As one of few exceptions, Rotch (1990) discusses the application of ABC in service industries, presenting some cases where ABC was applied in such industries.

This paper will not discuss activity based cost system. For interested reader, the works of Beaujon (1990), Borden (1990), Cooper (1987, 1988a, 1988b, 1989a, 1989b, e 1990), Cooper and Kaplan (1992) and Norren (1991) are recommended.

This study addresses the question whether agribusiness companies have a similar structure as the advanced manufacturing firms. Agribusiness firms, in great number, do not fit in the category of firms for which ABC was initially proposed. The majority of firms have multiproduct facilities, which is one of the requisites for ABC. However, to determine the appropriateness of ABC for agribusiness firms it is necessary to know their production and marketing characteristics and, particularly, their cost structure. It is expected that agribusiness firms have a distinct cost structure that makes it uncertain whether ABC can or cannot be appropriate for them to use.

In this paper I provide the results of a research which I carried out extending the work of Böer and Jeter. The results of the papers by Böer and Jeter (1993) and Albright and Sparr (1994), and the extension of Böer and Jeter's work, which I make in this paper, suggest that ABC can be applied to some agribusiness firms. The finding provides a good starting point to a deeper and focused study on the issue, to be conducted later. The paper by Böer and Jeter (1993) shows that there is a general tendency for reduction of labor cost in production cost over time. The paper of Albright and Sparr (1994) based on a field study in labor intensive manufacturers concludes that, even in such an environment, ABC produces better cost figures than the standard cost system which uses direct labor hours to allocate overhead costs.

The structure of manufacturing cost of the industries classified by the U.S. Department of Commerce in the group "Food and Kindred Products" is identified and compared with the cost structure of the industries representing the modern industry for which ABC was primarily developed.

The results are not conclusive about whether the food industry cost structure resembles the modern industry structure. Agribusiness firms present some of the characteristics for which ABC is recommended, but not all. An interesting result emerges from the analysis: the high share of material cost in the total cost suggests that food industries may benefit from implementing chain value analysis.

### **METHODOLOGY**

The manufacturing cost structure of all industries (49 industries) classified by the U.S. Department of Commerce in the group "Food and Kindred Products", referred to as food sector from now on, was studied. As a benchmark to represent the modern industry

sector, all the industries (123 industries) classified by the U.S. Department of Commerce in the following groups were chosen:

- Group 35 - Industrial and Commercial Machinery and Computer Equipment (51 industries);
- Group 36 - Electronic and Other Electrical Equipment and Components, Except Computer Equipment (37 industries);
- Group 37 - Transportation Equipment (18 industries);
- Group 38 - Measuring, Analyzing, and Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks (17 industries).

The Census does not provide information about total cost of production. A natural substitute for that would be total value of sales, but that is not published as well. The value of shipment was used as a surrogate for sales. A number of ratios were created to characterize the cost structure of each industry, following the methodology of Böer and Jeter (1993). Based on these ratios some statistics were calculated in order to compare the food sector and the modern industry. The following ratios were created:

- a) To represent Labor Cost share: Wages/Sales;
- b) To represent Material Cost share: Cost of Materials/Sales;
- c) To represent Overhead Cost: Payroll/Wages; Machinery & Equipment/Sales; New Machinery & Equipment/Sales; Inventories/Sales; and Payroll/Sales.

The following statistics were calculated: minimum, maximum, mean and standard deviation. A one-sided test for difference between the mean of food sector and the mean of modern industry was conducted for each ratio and the results are discussed in the following sub-sections. The test was conducted based on the test for the differences between two population means for large samples and unknown variances presented by Newbold (1988, p.363).

## LABOR COST

The following table presents the set of statistics related to labor cost for both the food sector and the modern industry sector. The ratio Wages/Sales was chosen to represent the share of labor cost in total production cost.

<b>TABLE 1 WAGES/SALES</b>			
<b>ITEM</b>	<b>FOOD SECTOR</b>	<b>MODERN INDUSTRY</b>	<b>COMMENTS</b>
Minimum	1.24%	3.35%	
Maximum	14.43%	37.32%	
Mean	6.32%	12.98%	significantly different at 1%
Standard Deviation	2.71%	4.66%	

The analysis shows that there are wide variations in ratios within each of the two groups. However, labor costs are significantly low in the food sector, presenting a mean

that is statistically lower than for the modern industry, at 1% level of significance. The ratio wages/sales presents a mean of 6.3% for the food sector, with a standard deviation of 2.7%, while the modern industry has a mean of 13.0%, with a standard deviation of 4.7%. The highest value within the food sector is 14.4%, still low when compared with the highest value of the modern industry (37.3%). From the 49 industries analyzed in the food sector, 18 (37% of all industries) presented a percentage equal or smaller than 5%.

The results are a clear indication that labor cost is no longer the adequate basis to allocate overhead costs in the food industries. Depending on the complexity of production environment, the result may indicate that ABC would improve cost information. However, additional research must be undertaken in order to assess the degree of complexity of the food sector industries in order to permit a conclusive statement about the appropriateness of ABC for food industries.

## MATERIAL COST

As it shown in Table 2, material cost constitutes the highest share in total sales for both sectors. The mean for the food sector is 59% while the mean for the modern industry sector is 45%. Based on the results above, the hypothesis that the two means are equal can be rejected at 1% level of significance. This result leads to the conclusion that the share of material cost in the total cost of food sector is statistically higher than for the modern industry.

<b>ITEM</b>	<b>FOOD SECTOR</b>	<b>MODERN INDUSTRY</b>	<b>COMMENTS</b>
Minimum	25%	23%	
Maximum	91%	73%	
Mean	59%	45%	significantly different at 1%
Standard Deviation	17%	10%	

There is some evidence that the high share of material cost in manufacturing companies, especially in the food sector, is a worldwide phenomenon. A research conducted by Marc P. Joye and Paul J. Blayney in Australian Manufacturing Companies shows that direct material is the principal factor of production in all industries, ranging from a high of 72% in Food to a low of 45% in Printing & Publishing with an overall average of 61% for all manufacturing companies.

Since material is the most important cost item for the industries in the food sector, it may be an indication that the firms in this sector are the appropriate candidates to adopt an approach superior to ABC on its own. Perhaps they should benefit from combining ABC with what is known as value chain analysis (Shank and Govindarajan, 1993; and Herbert and Morris, 1989). This is one of the most recent tools of strategic planning used for a deeper analysis of a complete chain by which inputs flow to generate products or services for the end consumer. For example, if a firm with a cost structure similar to the average of food sector negotiates with its supplier to reduce, say, 2% of cost and/or usage of materials,

this reduction would be equivalent to a reduction of 18.7% in direct labor (2% of 59% is equal to 1.18% and 18.7% of 6.32% is equal to 1.18% as well).

## **OVERHEAD COST**

This is the key component of costs (not only production costs but total costs in a broad and relevant sense for managerial purposes) to determine whether ABC produces improved cost information. Assuming that overhead increases with complexity, then it can be argued that firms with higher level of overhead costs will get the most informational improvement from ABC. The level of complexity is influenced by the degree of diversification of production line. The first indicator chosen to measure the level of overhead cost is the one defined by Böer and Jeter: "payroll/wages". It is expected that this indicator captures the labor-related overhead costs.

The present analysis attempts to partially overcome the problem identified by Böer and Jeter with respect to the non-inclusion of non-labor related overhead (especially capital costs). To capture the effect of capital related overhead, two measures were chosen:

- a) the ratio "Machinery and Equipment/Sales" was chosen under the assumption that the bigger the ratio, the more capital intensive the firm is. A critique that can be done to this measure is that "machinery and equipment are valued by book value and this can weaken the measure since high capital intensive firms with old machinery and equipment can present a low ratio; and
- b) the ratio "new machinery and equipment/sales" was chosen in order to overcome the problem mentioned above. A critique to this measure is that it uses information of only one year for new machinery and equipment. To minimize this problem, a further extension of this study would use a mean of the last 5 years.

To capture another portion of overhead, the ratio "inventories/sales" was created. The rationale for this indicator is as follows. It is expected that the higher the level of inventories, the higher the overhead cost. Firm's inventories necessitate activities such as storage, handling, controlling, financing, and security, among others. This measure also has the problem related with the fact that it uses information of only one year. The table that follows presents these indicators for the two sectors that are being analyzed.

Labor cost was presented as a separate item following the traditional view that labor cost is a direct cost related with the volume of production. However, currently this item of cost is no longer directly related with the volume of production. The existence of transaction costs (in the economic sense of the term) related with employees who are laid off places restrictions on such costs, causing them to be treated as fixed costs. These restrictions are such that firms maintain the labor costs fixed under short-term fluctuations of production. It is only when the variation in volume is believed to be of a more long-term nature that there is variations in labor cost, but not always in the same intensity. Among the transaction costs that cause this behavior, the followings can be mentioned:

- legal and contractual costs related with laid off employee;
- training costs and time required to prepare an employee to work and reach the desired productivity;
- high level of technology that makes difficult to contract a new employee to replace one laid off in the period of low demand;
- the increasing view by the managers that employees represent an asset and not a liability.

Following a more modern way to classify costs, the total costs could be divided only into material costs and overhead costs (the traditional overhead plus labor cost). Under this new classification a new indicator for overhead costs should be calculated as "total payroll/sales".

Results from tables 3 and 4 show that overhead costs in the food sector are lower than those in modern industries, by any measure selected. The hypothesis that the two sectors have the same mean for those indicators is rejected at 1% level of confidence.

<b>TABLE 3 OVERHEAD COST INDICATORS</b>			
<b>ITEM</b>	<b>FOOD SECTOR</b>	<b>MODERN INDUSTRY</b>	<b>COMMENTS</b>
Payroll/Wages			
Minimum	123.14%	124.75%	
Maximum	304.66%	453.05%	
Mean	159.15%	197.62%	significantly different at 1%
Standard Deviation	33.76%	62.42%	
Machinery & Equipment/Sales			
Minimum	4.61%	6.36%	
Maximum	74.00%	187.76%	
Mean	23.69%	56.12%	significantly different at 1%
Standard Deviation	15.79%	31.50%	
New Machinery & Equipment/Sales			
Minimum	0.40%	0.00%	
Maximum	5.18%	8.49%	
Mean	2.07%	2.54%	significantly different at 1%
Standard Deviation	0.94%	.93%	
Inventories/Sales			
Minimum	1.83%	3.47%	
Maximum	36.36%	58.07%	
Mean	12.17%	20.26%	significantly different at 1%
Standard Deviation	9.80%	8.02%	

The fact that food industries present, on average, lower overhead cost than that industries classified as modern industries does not mean that ABC is not appropriate to them. Additional research is needed to determine the degree of complexity of their production process. Moreover, given the big range within the values of the ratios of food sector are spread out, maybe this could be an indicator that the analysis should be conducted by industry and not by a group of industries.

<b>TABLE 5</b>			
<b>PAYROLL/SALES</b>			
<b>ITEM</b>	<b>FOOD SECTOR</b>	<b>MODERN INDUSTRY</b>	<b>COMMENTS</b>
Minimum	1.90%	7.78%	
Maximum	26.59%	47.56%	
Mean	9.78%	24.17%	significantly different at 1%
Standard Deviation	4.33%	6.66%	

Other limitation of the data that may compromise the analysis is the high level of aggregation. It may be the case that firms within an industry present different characteristics. To overcome this problem it may be proper to extend the analysis using accounting information for individual firms. The database provided by Compustat may be a good source for that and it is intend to be used in a further extension of this study.

## **CONCLUSION**

Compared to the modern industry, it can be said that the food sector has, on average:

- a) a lower share of labor cost;
- b) a higher share of material costs; and
- c) a lower share of overhead costs.

Analyzed together, the results about the share of labor cost and overhead costs are not conclusive whether ABC can be appropriate to the food sector, because they do not reinforce each other. If the share of labor cost was lower and the share of overhead costs was equal or higher than for modern industry, the indication that ABC would improve the cost information would be stronger. The conclusions that can be made up to this point are:

- a) the lower share of labor cost is a clear indication that labor cost is no longer a good basis to allocate overhead costs for most of the food industries;
- b) the high share of material cost in total cost suggests that food industries may benefit from implementing chain value analysis; and
- c) the lower share of both labor cost and overhead cost, compared with modern industries, do not provide conclusive results as to whether ABC may or may not improve their cost information.

Further research is needed to assess the degree of product diversity, a key element to determine the usefulness of ABC. The high level of disparity in the results at group level suggest that such research should be conducted at industry level, or even at firm level, depending of the degree of heterogeneity of cost structure among firms in the same industry. Considering the findings of the study, it is possible to state, even though in a preliminary character, that the use of ABC in agribusiness companies is promising.

Agribusiness companies fulfill, in most of the cases, some of the criteria identified as indicative that ABC can be used to produce product cost information with improved quality, specially the low participation of labor in costs.

Another conclusion from the research is that the high participation of material in total cost may be an indicator that agribusiness firms, and the food sector in particular, may benefit from implementing chain value analysis.

The results are preliminary and further research is needed to improve the conclusions. Among the problems that should be considered are:

- a) the definition of an indicator that accounts for more information of overhead costs;
- b) the selection of a broader sample to constitute the benchmark in representing the modern manufacturing;
- c) the extension of the analysis at firm level to overcome the problem caused by aggregation;
- d) the development of indicators that may capture the degree of diversity and complexity of production and the intensity of competition, pointed out by Cooper (1988b) as indicators of the need for ABC in multiproduct firms. To focus only in the structure of costs to determine whether ABC is or not recommended may be very restrictive.

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