Accounting and Management Information Systems
Vol. 23, No. 2, pp. 365-380, 2024
DOI: http://dx.doi.org/10.24818/jamis.2024.02004

Eco-efficiency measures in the leather industry. An educational case

Gabriel Jinga[a], Mădălina Dumitru[1,a], Elena-Mariana Glăvan[a] and Gabriel Radu[a]

[a]*Bucharest University of Economic Studies, Romania*

Abstract

Research Question: How can a company in the leather industry improve its eco-efficiency?

Motivation: In the academic literature, there is a significant number of contributions that address the intersection between accounting and sustainability. However, the number of papers dedicated to education is rather limited. Management accounting is a domain which can broadly contribute to sustainability, as the professionals are collecting, interpreting, and presenting information on a regular basis.

Idea: In this paper, we provide an educational case regarding a few eco-efficiency measures in the leather industry.

Data: Data are collected from one of the biggest leather goods producers in Romania. Some of the figures were adjusted for confidentiality reasons.

Tools: The material flow cost accounting methodology was used to explain the implementation of environmental management accounting in the case company.

Contribution: The study improves the literature on educational cases that can be used in teaching environmental management accounting. The described case study is useful both in an online and offline environment.

Keywords: eco-efficiency; environmental management accounting; material flow cost accounting; case study; accounting education.

JEL codes: M410

[1] *Corresponding author:* Mădălina Dumitru, Bucharest University of Economic Studies, Email: madalina.dumitru@cig.ase.ro.

1. The case

1.1 Company profile

Company A is a wholly family-owned business. It was established in 1992, with the owners starting out with $700 in the retail business of haute couture fabrics. In 1996 they became the largest fabric retailer in the country (representing the main European manufacturer in Romania) and got in touch with the fashion world. At first, they imported shoes and other leather goods from Italy.

In 2000, Company A switched from fabric trading to the production of shoes and other leather goods. The first shoe factory (almost 600 square metres) was built at a cost of about €200,000. At first, they were made by hand due to a lack of equipment. In 2002 a second factory (1,500 square metres) was opened. In 2004 the company invested in equipment such as computerised cutting machines and production lines.

In 2007 a new factory was opened in a Romanian town with a tradition in the leather industry. The factory initially produced 450 items per day, but production has gradually increased. The company's position on the Romanian market was consolidated by opening new stores in major shopping centres and expanding to other Romanian cities.

2008 was the year when managers began to make changes in the decision-making process. The year was marked by a major financial crisis and the company had to close several stores. The management stopped developing the entity on the Romanian market and started to open and licence the business abroad. The company opened stores in Sofia and Vienna. In 2011, it also started to develop an online sales platform, which grew steadily, exceeding after the pandemic the sales of the largest physical store in Bucharest. Online trade has also been extended to other member countries of the European Union, using the 'one-stop-shop' mechanism. In 2012 it doubled the production capacity of the factory set up outside Bucharest. After the pandemic, the company acquired two new factories in other traditional regions of Romania and moved its production from the centre of Bucharest to these two locations.

The pandemic affected sales, which saw a 20% decrease compared to 2019. The effect was noticed on the short term, because in 2021 it managed to reach the same level of sales as in 2019, and in 2022 it had a spectacular 30% increase compared to 2021. During the pandemic it did not restructure, it just closed some stores based on performance, rather than on pandemic criteria. In brief, the performance for 2021 looks like this:

Table 1. Company A Performance for 2021

Items	Amounts (EUR)
Sales	20,000,000
Cost of goods sold	8,000,000
Gross income	12,000,000
EBITDA	2,600,000
Total assets	20,000,000
Total liabilities	10,000,000
Number of employees	500
Monthly average cost per employee	1100

The company is not listed at any stock exchange. It has a CEO, a CFO, and a creative director. The organisation chart includes the administrative department, the commercial department, and the production department. The production department is divided into two divisions: leather goods and footwear. The leather goods division employs about 100 people, including a director, four administrative staff, and seventy-nine workers. The footwear division has 220 employees, including two managers and six administrative employees.

1.2 Environmental management accounting at Company A

1.2.1 Organisation of management accounting

In Romania, most companies prepare financial accounting information for reporting purposes only. This was the case for Company A until 2007, when it implemented an ERP system. Since then, the decision-making process has changed. Environmental information is present in the form of reporting to state authorities. These include an annual report on waste management and an annual report on packaging materials and packaging waste. The owners of the company want to find a set of practical measures to improve the eco-efficiency in the future. Eco-efficiency is defined as "The delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle, to a level at least in line with the Earth's estimated carrying capacity" (www.wbcsd.org). As a result, the implementation of a new ERP started in 2022. One of the objectives is for the production process to track waste separately and allocate costs to it, and to take steps to recover it either by selling it at reduced prices or by selling or handing it over free of charge to waste collection and recycling companies.

The production cost is calculated by adding to the cost of raw materials a percentage of labour and other overheads (e.g. rent, utilities). This cost was calculated at the beginning of the collection, twice a year. The standard cost is established as a percentage (30%) of the selling price, which is determined by the sales department. Variances are calculated in terms of actual cost only at the global level. The CFO says: "In this industry, it's all about collection, not cost. It's the collection that

matters." Another goal of the implementation of the new ERP was to track profitability model-by-model. As a result, there will be a shift from standard production costing to actual costing. The CFO would like to implement real-time accounting. Thus, the valuation of finished goods will be done at the cost of materials consumed according to the manufacturing order plus a labour cost calculated on the basis of actual times worked plus a share of manufacturing overheads also allocated on the basis of actual time worked (direct labour). Basically, for the same product, you can have different costs for different orders. The variances will no longer be calculated at the global level after the implementation of the second ERP.

According to the CFO, one problem with the current system is the level of inventories. There are poorly procured inventories or finished goods obtained without a marketing forecast and without knowing whether a model will be sold in 100 or 500 pieces. So, acquisition is not efficient, which can lead to environmental problems (inventories of raw materials left unused or inventories of finished goods not sold). To overcome this problem, the finance manager says he wants to improve production planning, starting with marketing prospects on a focus group basis, knowing the estimated quantity to be sold for each collection. As far as raw materials are concerned, the company's representatives want to negotiate with the supplier returning the unused inventories of raw materials, and to pay only for the quantity actually consumed.

1.2.2 Reasons for using environmental management accounting

The company wants to implement environmental management accounting (EMA) to improve its performance and its production process. The most harmful environmental impact relates to the disposal of leather waste. The impact is twofold: first, due to the quantity and second, due to the type of waste. The company includes an average of 50 types of products in each collection, each with a unique design. Some products require special materials that are not used in other products. The waste resulting from the cutting of shoe uppers, for instance, represents 50-70% of the total solid waste produced by shoe factories. For natural leather the percentage of waste generated at the cutting process is 25-35% and for textiles it is 20-25% (http://www.afirm-group.com/hongkong/17%20Hengstmann%20Waste%202010.pdf). Complete disposal of this waste is not possible, but options are being sought to optimise the cutting process. In 2008, the company introduced the separation of waste types. The company pays for the removal of leather waste about €20,000 per year. As a starting point, a list of the most relevant steps in the production process has been drawn up.

1.2.3 The steps in the production process

The steps in the production process for a bag model are as follows:

- Receipt of raw materials;

- Cutting of flexible material parts (parts for the sides, outer linings, intermediate linings);
- Stamping and preparation of rigid material parts;
- Preparation of parts for assembling bag faces: levelling, thinning, edge burning, edge painting, stamping, marking parts for gluing, etc.;
- Assembly by gluing and sewing the faces;
- Positioning metal fittings, sewing zippers;
- Finishing and final inspection of the bag;
- Marking, packing, storing, and dispatching the bag.

Within this company, a production process forms a quantity centre. Therefore, a quantity centre is associated with each type of product. Quantity centres are established based on loss analysis and process analysis.

1.2.4 Important environmental issues

Important environmental issues arise:

(a) in the production processes, from cut scraps of unusable raw materials (especially leather, cardboard);
(b) in the distribution and return processes, due to products that are no longer sold because the collection changes.

Materials used in the production process include leather, textiles, metal fittings, cardboard, packaging materials, and other consumables. Electricity is consumed in production, and waste (mostly leather pieces), dust, and odours are generated in the production unit. All finished products are packed in cardboard boxes for transport from factories to stores. Raw materials are also received in boxes. During the most recent five years, the company has taken steps to manage this cardboard waste by contracting a specialised company to collect and recycle it. For paper waste, separate collection bins have been purchased for each administrative office. Some types of glue used in the production process have a dangerous chemical composition. They are harmful to the health of employees. Greenhouse gas emissions are generated by company cars, as goods are transported with owned vehicles. For online sales, the delivery to the customer is done by courier, which uses road transport and generates more pollution than the delivery from the store. The company is concerned about contracting with electric car courier companies. The dust from the production process is stored in bags. The production process of company A has an environmental impact on water, air, and soil.

The situation of material consumption for one month and generated waste is shown in Table 2.

Table 2. Materials used and waste generated by the production process for 32,750 pairs of shoes and 20,160 units of other finished goods

No.	Materials	Quantity consumed	Packaging materials	Waste quantity	Waste management
	Raw materials				
1	Natural leather	11,400 kg	Cardboard and plastic	1620 kg (14.21%)	Specialized company
2	Synthetic leather	1600 kg		37 kg (2.31%)	Specialized company
3	Textile materials	3600 kg		85 kg (2.36%)	Specialized company
4	Inner sole	32,750 pairs	Cardboard	1000 kg	Temporary storage and lifting by a specialised company
5	Sole	32,750 pairs			
6	Other stiffeners	9600 pieces			
7	Metallic accessories	7300 kg			
	Consumables				
8	Sewing thread	2000 m			
9	Sewing needles	9600 pieces			
10	Shoe cream	200 pieces	Plastic containers	200 pieces	Specialized company
11	Glue	900 kg	Metallic boxes	150 metallic boxes	Managed within the company
12	Water-based paints	300 kg			
13	Thinner	20 l			
14	Marking pencils	18,000 pieces	Cardboard	2 kg	Temporary storage and lifting by a specialised company
15	Sealing tape	200,000 pieces	Cardboard	3 kg	Temporary storage and lifting by a specialised company
	Packaging materials				
16	Paper	2820 kg	-	400 kg	Temporary storage and lifting by a specialised company
17	Cardboard boxes	32,750 pieces	Cardboard	30 kg	Temporary storage and lifting by a specialised company
18	Plastic bags	140 kg	-	-	
19	Binding rope	450 kg	-	-	
20	Cardboard	1200 kg	Bulk	1200 kg	Specialized company
21	Paper bags	16,700 pieces	Cardboard	10 kg	Specialized company

To get an overview of the production process, an accounting system has been set up for material and energy flows, and associated costs. We present the inventories balances (material balance in a quantity centre defined for a type of bag) (Table 3).

Table 3. Material balance (in physical units)

Item	Initial balance	Input	Ending balance	Output
0	1	2	3	4 = 1 + 2 – 3
Natural leather (m^2)	6	65	8.54	62.46
Textile materials (m^2)	2	19	1	20
Metallic accessories (no.)	20	1750	44	1726
Paper bags (no.)	5	35	10	30

Part of the input-output table for a bag type is shown below (Table 4). Some of the costs (energy, maintenance) are allocated at the end of the month. The type of bag chosen for this study is representative of the company, as it follows the average values recorded in one month.

Table 4. Input-output table for a type of bag produced in November 2021

Input					Output				
Article	Unit	Q	Total cost (EUR)	Data source and quality	Article	Unit	Q	Total cost (EUR)	Data source and quality
Natural leather	m^2	20.4	489.60	Computed	Bag	pieces	30	…	Computed
Textile materials	m^2	6.9	31.74	Computed	Leather waste	m^2	…	…	Computed
Other raw materials	EUR		100	Computed	Textile waste	m^2	…	…	Computed
Metallic accessories (rivets, ornaments, shaped rings, zippers, letter)	pieces	480	131.88	Computed	Dust	m^3	0.1	-	Estimated
Other consumables	EUR	-	56,98	Computed	…				
Cardboard boxes	pieces	5	45	Computed					
Electricity	kWh	-	1,28	Estimated					

Input					Output				
Article	**Unit**	**Q**	**Total cost (EUR)**	**Data source and quality**	**Article**	**Unit**	**Q**	**Total cost (EUR)**	**Data source and quality**
System cost (labor – design and assemble, depreciation and maintenance, transport)	EUR	-	972	Estimated					
Waste management	EUR	-	7	Estimated					

It is assumed that the leather and textile waste follow the same average percentages as shown in Table 2. As it is part of normal losses, it is not valued in the accounts (zero value) but it will be valued according to the material flow cost accounting (MFCA) method. Note that raw material inputs and losses are given in square metres. The MFCA method requires inventories to be valued in the same unit of measurement, allowing costs to be apportioned.

1.2.5 Cost allocation

Applying the concept of MFCA changes slightly the view that the cost is fully absorbed by the finished goods. MFCA treats waste as (abnormal) material losses and allocates a share of the cost of raw materials and processing to them. The allocation is based on the amount of raw material that is transformed into finished goods or becomes waste. The cost of waste management is fully included in the cost of material loss.

1.2.6 Gross margin

The input-output tables help Company A track environmental cost values. With their help, it is possible to estimate the financial consequences of material losses in production. One of the indicators calculated by the entity is the gross margin.

1.2.7 Measures to increase eco-efficiency

The implementation of MFCA allows the company to identify waste processing costs and processes with high raw material losses. Measures to increase eco-efficiency are currently being sought for the production process and the sales (distribution) process.

1.3 Case questions

1. *Could you mention other reasons for companies to improve environmental performance (in addition to what is presented in section 1.2.2.)?*
2. *Analyse Table 2. From your point of view, what environmental aspects related to the inventories are relevant to Company A?*
3. *Complete the material matrix, knowing that the total value of the outputs equals the total value of the inputs (calculated from Table 4). How much raw material is wasted? Is this a crucial issue in this production process for Company A?*

Table 5. Material flow cost matrix for the bag for the period...

Cost (Value and percentages)	Material	Energy	System	Waste management	Total
Product					
Material loss					
Total					

4. *Given that the revenue from the sale of bags is 19,320 EUR, calculate the gross margin on sales. Assume that all the bags obtained have been sold (section 1.2.6). Use the model below.*

Table 6. Gross margin

No.	Items	Amounts	Percentages
1.	Sale		
2.	Product cost		
3.	Material loss cost		
4.	Gross margin		

5. *The input-output tables developed to track raw material consumption, waste treatment, and energy consumption in Company A made it possible to identify all relevant environmental aspects. Provide some solutions for reducing environmental impacts and improving eco-efficiency at Company A. Provide your answer in the format presented below, detailing your answer as much as necessary. In answering this point, one can rely on the available literature.*

Table 7. Solutions to reduce environmental impacts and improve eco-efficiency in Company A

Description of the identified problem	Description of the possible solution

6. *What other management accounting tools can support Company A's management in its objective of improving environmental performance?*
7. *Based on the EMA conceptual framework (Burritt et al., 2002), in which situations do you consider Company A to fit?*

		Environmental Management Accounting (EMA)			
		Monetary Environmental Management Accounting (MEMA)		Physical Environmental Management Accounting (PEMA)	
		Short Term Focus	**Long Term Focus**	**Short Term Focus**	**Long Term Focus**
Past Oriented	Routinely generated information	1. Environmental cost accounting (eg. variable costing, absorption costing, and activity based costing)	2. Environmentally induced capital expenditure and revenues	9. Material and energy flow accounting (short term impacts on the environment – product, site, division and company levels)	10. Environmental (or natural) capital impact accounting
	Ad hoc information	3. *Ex post* assessment of relevant environmental costing decisions	4. Environmental life cycle (and target) costing Post investment assessment of individual projects	11. *Ex post* assessment of short term environmental impacts (e.g. of a site or product)	12. Life cycle inventories Post investment assessment of physical environmental investment appraisal
Future Oriented	Routinely generated information	5. Monetary environmental operational budgeting (flows) Monetary environmental capital budgeting (stocks)	6. Environmental long term financial planning	13. Physical environmental budgeting (flows and stocks) (e.g. material and energy flow activity based budgeting)	14. Long term physical environmental planning
	Ad hoc information	7. Relevant environmental costing (e.g. special orders, product mix with capacity constraint)	8. Monetary environmental project investment appraisal Environmental life cycle budgeting and target pricing	15. Relevant environmental impacts (e.g. given short run constraints on activities)	16. Physical environmental investment appraisal Life cycle analysis of specific project

Figure 1. EMA conceptual framework
Source: Burritt et al. (2002)

8. *What financial factors should be considered when making decisions about improving environmental performance?*

2. Teaching note

2.1 Introduction to environmental management accounting

Environmental Management Accounting is "the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices" (IFAC, 1998: paragraph 1).

Environmental issues are increasingly influencing the economic performance of companies and organisations. Increasing environmental regulations, United Nations Sustainable Development Goals, rising costs of electricity, fuel, and raw materials, stakeholders demand for environmental information, and customer demands for environmentally friendly products provide some important examples (Dragomir & Dumitru, 2024). Managers therefore need to incorporate environmental considerations into their regular activities and decision-making processes. The financial impact of environmental decisions is often underestimated or not considered at all (Burritt *et al.*, 2010). In addition, a company that does not pay attention to the environmental aspects of its production process, generating pollution and waste, is not efficient, and this will have consequences for its overall performance (Schaltegger *et al.*, 2008).

Accounting has long been presented as being used by management and external users (Schaltegger & Burritt, 2000). For sustainability accounting, it is necessary to identify costs and benefits related to social and environmental issues, measure and quantify these costs and benefits where appropriate, provide qualitative data when intangible costs and benefits arise, use commonly accepted physical and monetary performance indicators, and recognise that many of the impacts of companies occur over a long period of time (Aras & Crowther, 2009; Herzig *et al.*, 2012).

2.2 Educational objectives

2.2.1 Context of the case study

The study is based on the example of a Romanian company involved in the fashion industry. Europe is considered the most active area in terms of sustainability. The European Commission adopted several strategies to support sustainable development, such as the European Green Deal (Dragomir & Dumitru, 2024). Developments have also been reported for Romania, sustainability evolving from an imposed concept to a practice conducted with a focus on improving business models (Albu *et al.*, 2021). In this context, education is crucial for preparing future

practitioners to answer sustainability issues (Vanini & Bochert, 2024). More specifically, management accounting is a domain which can broadly contribute to sustainability, as the professionals are "gathering reliable data, evaluating alternatives, and making recommendations that align with an organization's purpose, values, business model, strategic initiatives, and risk management" (IMA, 2022: 13). The study presented here addresses the broader role of management accountant, as described by IMA (2019):

> Management accounting is a profession encompassing accountants and financial professionals working inside organizations. Their role involves partnering in management decision making, devising planning and performance management systems, and providing expertise in financial reporting and control to formulate and implement an organization's strategy (IMA, 2019: 3).

This case study focuses on the application of EMA in Company A, a medium-sized family business in Bucharest, the capital of Romania. The company produces leather goods and deals with environmental issues such as odour, noise, and waste.

A specific tool used in EMA for waste management is MFCA. The popularization of the instrument was supported by the development of voluntary international standards (ISO 14051 *Environmental management – Material flow cost accounting – General framework*; ISO 14053 *Environmental management. Material flow cost accounting. Guidance for phased implementation in organisations*) and its implementation in Germany and Japan (Burritt *et al.*, 2023). The overall objective of MFCA is the quantification and monetary visualisation of material losses. The difference between MFCA and conventional cost accounting is that materials and other production costs are first allocated to products and to product-related waste using physical units (quantity) as allocation bases. Thus, MFCA treats waste as material losses and allocates a share of the cost of raw materials and processing to it (Asian Productivity Organization, 2014; Kokubu *et al.*, 2009). The approach addresses the environmental costs hidden in overheads (Burritt *et al.*, 2023). MFCA implies a linear relationship between inputs and outputs: a reduction in product-related waste leads to a reduction in input flows (Schaltegger & Burritt, 2000; Wagner & Enzler, 2006). Improvement is possible by identifying the processes that lead to waste and emissions (Wagner, 2015). The approach aims to reduce waste-induced inefficiencies in business decision making (Burritt *et al.*, 2023).

For this study, we suggest using the framework of EMA developed by Burritt *et al.* (2002). To measure and improve eco-efficiency, it is not sufficient to measure quantitative impacts, but it is also necessary to have monetary information and for both types of data to be consistent (Schaltegger & Burritt, 2000; Burritt *et al.*, 2002). Burritt *et al.* (2002) framework recognises that decisions vary according to the type of data (monetary or physical), time frame (short or long), scope (past or future) and periodicity (regular or ad hoc).

2.2.2 Case learning objectives

One of the objectives of the case is to show students that there are significant opportunities for performance improvement starting from considering the environmental impacts of the companies. They also learn to use a specific tool for EMA, MFCA, which is easy to use and can be implemented in further detail at their work sites. Another major focus is on improving eco-efficiency. Today, there are sustainability reporting requirements in place (such as those included in the Corporate Sustainability Reporting Directive in the European Union and the accompanying European Sustainability Reporting Standards) which ask companies to disclose information. Sound, relevant, and verifiable information can only be obtained through rigorous internal systems, such as EMA (Burritt *et al.*, 2023).

Other learning objectives are as follows:

- Recognise environmental issues;
- Integrate financial (i.e. waste cost) and nonfinancial (i.e. waste quantity) indicators;
- Identify the dysfunctions of the present system;
- Develop communication competences;
- Expand knowledge of sustainability and management accounting.

2.3 Applicable courses

The case study was designed for Advanced Management Accounting or Sustainability (Integrated) Reporting disciplines. As such, we recommend that this educational case is approached in a single tutorial integrated in a traditional discipline, which has a technical focus, or in a tutorial dedicated to sustainability (Berg & Lyngstadås, 2023; Sharma & Stewart, 2022). The courses are included in the curricula of the master's degree programmes or in the final years of the bachelor's degree programmes. Thus, students usually know management accounting and understand the notion of eco-efficiency. Theoretical aspects regarding MFCA are presented before introducing this educational case.

2.4 Implementation guidance

The file containing the case study is posted in advance on the online platform that students use for their classes. The students are asked to read the description of the company so that they are familiar with the context. If the cohort studies in Romanian, additional references can be provided from the local media so that the students can be familiar with Company A. The case is introduced during a tutorial of 80 minutes. The teacher presents the context and discusses the requirements. Students are required to prepare their own calculations and to make comments on the results obtained. During the class, points 1 to 4 are solved. The rest of the case is solved by

students at home, in teams, by a specific deadline. During the following tutorial, the solutions are discussed in a plenary session.

Two approaches can be used. For the first, more difficult approach, the professor only presents the case. In the second, easier version, the teacher gives the students templates in which they present their solutions.

The case can be delivered face-to-face or online.

2.5 Case efficacy

A simpler version of the case was tested in the Integrated Reporting tutorial, with a cohort of students. Similarly to Krawczyk and Showalter (2020), the case was posted on the online platform prior to the class. The students were interested in solving the case. It is particularly accessible because it provides a practical side, with real quantities, components, and production processes of a good that is commonly used, a bag.

2.6 Recommended solution

The recommended solution can be obtained from the corresponding author on request.

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