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Management accounting perspectives for long-term sustainable decision-making in business, *'Past, Present and Future'*

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Abstract

Management Accounting was developed in the early 20th century to calculate the consequences of business decisions, such as equipment investments. In this article, three main development stages will be discussed, based on the ownership of production factors, the trading of production factors on markets, and new business models. New business models based on sustainability and circularity will lead to new ways of management and cost accounting grounded in ethical principles and stewardship. This will focus attention on new ways of thinking and perspectives in decision-making, especially for long-term investments, such as investment in new equipment. This will assist managers in making sound long-term investment decisions for their business. Traditional cost controllers in companies will undergo a paradigm shift in their thinking, calculations, and advice to their managers and/or decision-makers. Especially considering all relevant costs of investment and (direct) externalities, it might be a huge shift in the thinking of traditional cost-controllers. In a very hectic (VUCA) and multipolar international business environment, and the changing awareness of the impact on people and the planet, management accounting should also develop, with its toolbox of instruments to make the right calculations for management in business. The bottom line for the 21st century is alignment with the well-known bottom line of profit, people, and planet.

Keywords

Management accounting, Cost Accounting, True Cost Accounting, Life Cycle Costing, Integrated Management Accounting

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Introduction

In this article, a literature review is presented about the development of management accounting (MAC) from the past (early 20th century), as well as the development of administrative IT (ERP systems in the 1960s – 1990s), the development of non-financial information (1980s-1990s) and the measurement of externalities (circular economy/sustainability).

An important methodological aspect in the development of management accounting is to distinguish the academic development of management accounting from the development by practitioners of management accounting in business (Waweru N. , 2010). It is sometimes not so clear which of the two is in the lead: academicians or practitioners. Also, it is important to realise that most of the academic literature on management accounting is based on Anglo-Saxon authors (Kaplan, Horngren, Drury, etc.), while nowadays the influence of other academic fields (e.g. Management, Engineering, Political Sciences, and Ethics), such as the Rhineland school, plays an important role.

The literature review is based on desk research into textbooks and articles, and academics also provided valuable feedback during the research process. The model of management accounting development is a result of that review, with an outlook on new IT developments such as Large Language Models (LLMs) and Artificial Intelligence (AI). The study concludes with practical implications for cost-price models based on Total Cost of Ownership (TCO) and True Value Accounting (TVA).

Context

To understand the development of management accounting, we must first understand the economic system in which we live today. The dominant economic system is a free-market economy, with elements of planning (in countries such as Russia, Vietnam, and China) and elements of a social market economy (in countries with a Rhineland business model, such as Germany, France, the Netherlands, etc.).

Normally, economists distinguish four factors of production: Nature, Labour, Capital, and Entrepreneurship. In most economics textbooks, such as Samuelson (1973) and Mankiw & Taylor (2020), only the first three are mentioned. To understand the concept of production factors, it is helpful to assume a mixed economy with private and public ownership of production factors, with a dominant allocation via the market mechanism and some via the budget mechanism (government). The production factor nature is a combination of land, nature, and natural resources. Especially the use of natural resources is a point of discussion, should we only consider the costs of extraction, or should we also allocate money to the costs of damage caused by that extraction (based on principles like stewardship and the Rhineland business model)? Labour can be understood as labour sec, but also as the intellectual value (i.e., competencies) of a company's staff and their external network. Capital can be divided into manufactured capital (goods) such as buildings, equipment, trucks, and ships, and into financial capital, such as equity (shares) and loans. Besides the capital owned by firms, we also have large amounts of publicly owned capital, such as roads, railroads, ports, electricity networks, etc. Manufactured capital is on the asset side of the balance sheet, and financial capital on the liability side. Finally (in a mixed economy), the entrepreneurs organise the first

three production factors, as well as carrying the entrepreneurial risks and funding innovation. So, the development of technology, or Schumpeterian innovation (Sledzik, 2013), is embedded in factors of production, the knowledge (including skills) of labour, the quality of physical capital, and the entrepreneur (funding and execution). Schumpeterian innovations include new production processes, new products, new materials or resources, new markets, and new organisational forms (Ziemnowicz, 2020). Profit can be seen as a premium for organising production, a reward for investing (= equity), for carrying the risk of losses and for funding innovations. The sum of the rewards of Nature (= Rent), Labour (=Wages), Capital (=Interest and Entrepreneurship (= Profit) is called: Net National Income or Net National Product. In a mixed economy, the role of the government is particularly important because it collects taxes and other duties to finance public goods (such as education, defence, police, healthcare, legal system, etc.) and redistributes income via subsidies and tax regulations. The concept of (private) ownership of production factors influences how we calculate the cost price of a good or service, because only the costs of extraction of raw materials are taken into account, neglecting the environmental costs of pollution, restoration, damage, etc. and the social costs of cheap (underpaid) labour, poor labour conditions, child labour, etc. A financial system with socio-ecological objectives (See also Appendix I for an overview) should have macro-, meso-, and micro-scale potential to transform the existing financial system into a nature-positive financial system (Dingkuhn, Nel, Schoenmaker, & Alpizar, 2026). New ideas about the traditional factors of production (Gleeson - White, 2014) and based on that a framework of a business model (IIRC, 2021), distinguish six factors of production or 'capitals': Financial capital, Manufactured capital, Human capital, Intellectual capital, Social & Relationship capital, and Natural capital (See also Appendix II). The ideas of the social capitals (Human capital, Intellectual capital, and Social & Relationship capital) of Gleeson-White are not new. Social capital and Intellectual Capital have a history based on the (sociological) works of Durkheim, Bourdieu and Putnam (Nahapiet & Ghosal, 1998) & (Claridge, 2018). A new aspect of Gleeson-White's approach is that the macro-level of sociology is now applied at the firm level (as a private good), demonstrating its impact on a company's value potential (Gleeson - White, 2014) & (IIRC, 2021).

Literature review

To understand mainstream management accounting, we will look at four definitions of management accounting. All four definitions have in common that management accounting provides information to support sound decisions for future business activities; this is also confirmed by Bonnet et al. (1999). In Figure 1, the author provides an overview of the relationships among Financial Accounting (Bookkeeping), Cost Accounting, and Management Accounting, drawing on the four definitions in Table 1.

	Definition	Source
I	*'Management accounting relates to the provision of appropriate information for decision making, planning, control, and performance evaluation.'*	(Drury, 2000)
II	*'Management accounting is a profession that involves partnering in management decision making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organisation's strategy.'*	(IMA, 2008)
III	*'Management accounting is the process of supplying the managers and employees in an organization with relevant information, both financial and non-financial, for making decisions, allocating resources, and monitoring, evaluating, and rewarding performance.'*	(Atkinson, Kaplan, Matsumura, & Young, 2012)
IV	*'Measures, analyses, and reports financial and non-financial information that helps managers make decisions to fulfil the goals of an organisation. It focuses on internal reporting.'*	(Horngren, Datar, & Rajan, 2021)

Table 1 Four mainstream definitions of management accounting

From all four mainstream definitions, we can conclude that management accounting assists an organisation's decision-makers with financial and non-financial information to make good decisions now and in the future. This literature review used more than 50 academic resources from different periods (1930 -2025) and countries (USA, UK, Netherlands, and Germany) to balance the Anglo-Saxon view with the Rhineland view in management accounting theory. In this literature review, we will develop the new concepts of management accounting, such as Activity Based Costing (ABC), Quality Costing (QC), Life Cycle Costing (LCC), Total Cost of Ownership (TCO), and True Value Accounting (TVA). First, we will look at the development of management accounting as a tool for decision-making in business. To understand management accounting, we first have to develop some knowledge of accounting or bookkeeping. The system of bookkeeping (so-called double-entry accounting of Pacioli) has its origins in medieval Venice (Ten Have, 1933), where the balance sheet and the income statement (profit and loss account) originate from. So, in bookkeeping, we record all sorts of financial events of a company, like buying, selling, hiring staff, investing in equipment, etc., to calculate the financial result at the end of the year: Profit. All financial data from the bookkeeping is ex-post, so the question is: Can we use it for future decisions? That is the perspective of management accounting: How we can use ex-post or past data for ex-ante or future decision-making. So, typical management accounting topics include cost price calculations for new products, making or buying decisions, equipment investment, break-even analysis, forecasting, budgeting, scorecards & KPIs, etc. All examples have in common that they are ex-ante decisions based on uncertain future data, so, based on the bookkeeping system, some data might be used/or other data are forecast, and/or assumptions are made. How do we forecast future sales, labour costs, interest rates, energy costs, raw materials, etc.? In the old management accounting theory of Meij (1960) and in more recent contributions, such as Horngren et al. (2021) and Drury (2000), as mentioned above, we can observe the typical management accounting topics that assist enterprise management in making sound decisions for the future.

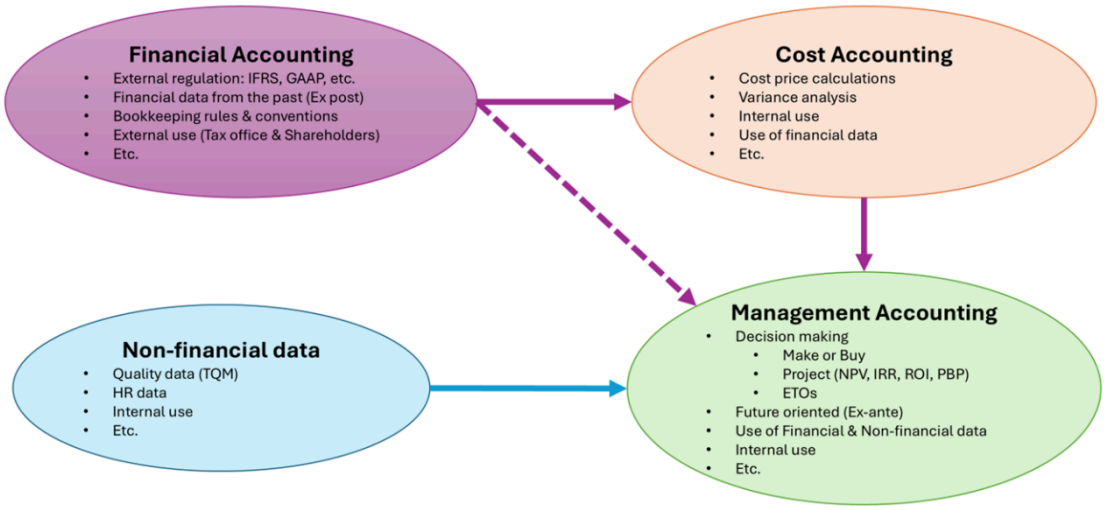


Figure 1 An overview of the relationship between Financial Accounting (Bookkeeping), Cost Accounting and Management Accounting (developed by the author)

The history of management accounting has a long and impressive tradition, just to mention a few important scholars: Johnson (1981), Kaplan (1984), Wöhe & Döring (1993), Krumwiede & Suesmair (2008), Waweru (2010), Gliaubicas (2012), Boyns & Edwards (2013), Kamal (2015), Carnegie et al. (2020), Riinawati & Sabariah (2022) and Edwards (2024); most of the research has in common the relationship between management accounting theory with the development of the business environment (with a strong link to the IT development). In Figure 1, the relationships among Accounting (or Bookkeeping), Cost Accounting, and Management Accounting are based on the traditional textbook on management accounting by Horngren et al. (2021). For the history of accounting or bookkeeping, we refer to the inventor of double-entry bookkeeping, Pacioli, referring to the original text of Pacioli & Cripps (1994) and Stone (2021). We can summarise the double-entry system of bookkeeping in four rules: $Assets = Equity + Liabilities$ (1); $Equity = Assets - Liabilities$ (2); $Profit = Revenue - Expenses$ (3); $\Delta\, Equity = Profit$ (4). In the triple-entry bookkeeping system (Ijiri, 1982) there are three dimensions (Blommaert, 1994): Past, Present and Future. In Table 2, an overview of the three dimensions is developed by Melse (2008). There are three statements based on: Single-entry (force accounting), Double-entry (momentum accounting) and Triple-entry (wealth accounting); and three actions: Debit, Credit and Trebit (Melse, 2008). The development in management accounting in the last two decades is based on developments like the awareness of the social and environmental impacts of business (stewardship), as well as the increased possibilities of IT (data science, cloud computing, distributed ledger technology (blockchain), Machine learning, Large language models, and all sorts of Artificial intelligence) in a hectic international environment.

Dimensions	Description
I Wealth	*The dimension for the administration of the magnitude of wealth and wealth composition, with accounting variables that are set apart as net wealth (equity) and liabilities (source of capital), or as assets (uses of capital), Accounts of this dimension are on the balance sheet.*
II Momentum	*The dimension for the administration of the change in magnitude of wealth (first dimension), with accounting variables that are set apart as cost (outflows) and income (inflows). Accounts of this dimension are on the momentum statements that include the income statement.*
III Force	*The dimension for the administration of the change of capacity to acquire new wealth (second dimension), with accounting variables that are set apart to administer internal and external forces. Accounts of this dimension are on the force statements that also include impulse and action.*

Table 2 Framework of triple-entry bookkeeping, developed by Melse (2008)

Often characterised as VUCA: Volatility, Uncertainty, Complexity, and Ambiguity (Bennett & Lemoine, 2014). Several authors, such as Hoskin & Macve (2000), Abdel-Kader & Luther (2006), Iacob & Taus (2014), Al-Hebry & Al-Matari (2017),Daulton (2022), Dlamin (2023), Akroyd et al. (2023), Vermeulen et al. (2023), Dai & Miklos (2023), and Roos & Vermeulen (2023), mention these developments in management accounting. In Figure 2, a possible development model of management accounting has been developed by the author, inspired by the following works of Mattessich (2008), Kamal (2015), Akroyd et al (2023), Kamp-Roelands (2024), Blommaert (1994), Waweru (2010) and Boys & Edwards (2013). Of course, some trends were already well-known in earlier stages but not implemented in management accounting, such as monetising (negative) externalities and shadow prices (Black, Hashimzade, & Myles, 2017). For the mainstream management accounting approach, the following academic textbooks were used: Kaplan (1984), Atkinson et al. (2004), Drury (2000), Horngren et al. (2021), and Taschner & Charifzadeh (2020). The IMA Management Accounting Competency Framework (2023), see also Appendix III, provides a state-of-the-art professional overview of the content of the management accountant in six domains: Strategy, Planning & Performance, Reporting & Control, Technology & Analytics, Business Acumen & Operations, Leadership, and Professional & Ethical Values. A similar approach: *'Performativity in management accounting'*, from a more academic point of view, was made by Vosselman (2014) & (2024). In Figure 2, the author has constructed a model to explain the development of management accounting. In the model, endogenous and exogenous factors play roles in the six stages of management accounting's development. Endogenous in the sense of the more academic development in management accounting, and exogenous in the sense of development in the business environment (For instance, the development of information technology). In Appendix IV, this concept has been visualised. In Figure 1, the relationships among Financial Accounting, Cost Accounting, and Management Accounting have been plotted. If we look at the top of Figure 2, we can observe the three contexts of the economic environment: Traditional costs (Bought and paid on the market), Hidden internal costs (non-monetary costs and Lifetime costs), and Monetising external costs (Social costs and Environmental costs). Now we distinguish six logical stages (See Table 3) in the development of Management Accounting (MAC). The stages of management accounting (MAC) in Figure 2 are one way to present its development; other ways are also possible. The

author has used a mixed method approach: Exogenous development in business as the leading principle, and endogenous development of management accounting as a scientific subject. Of course, other ways of presenting the past, present, and future of management accounting are also possible.

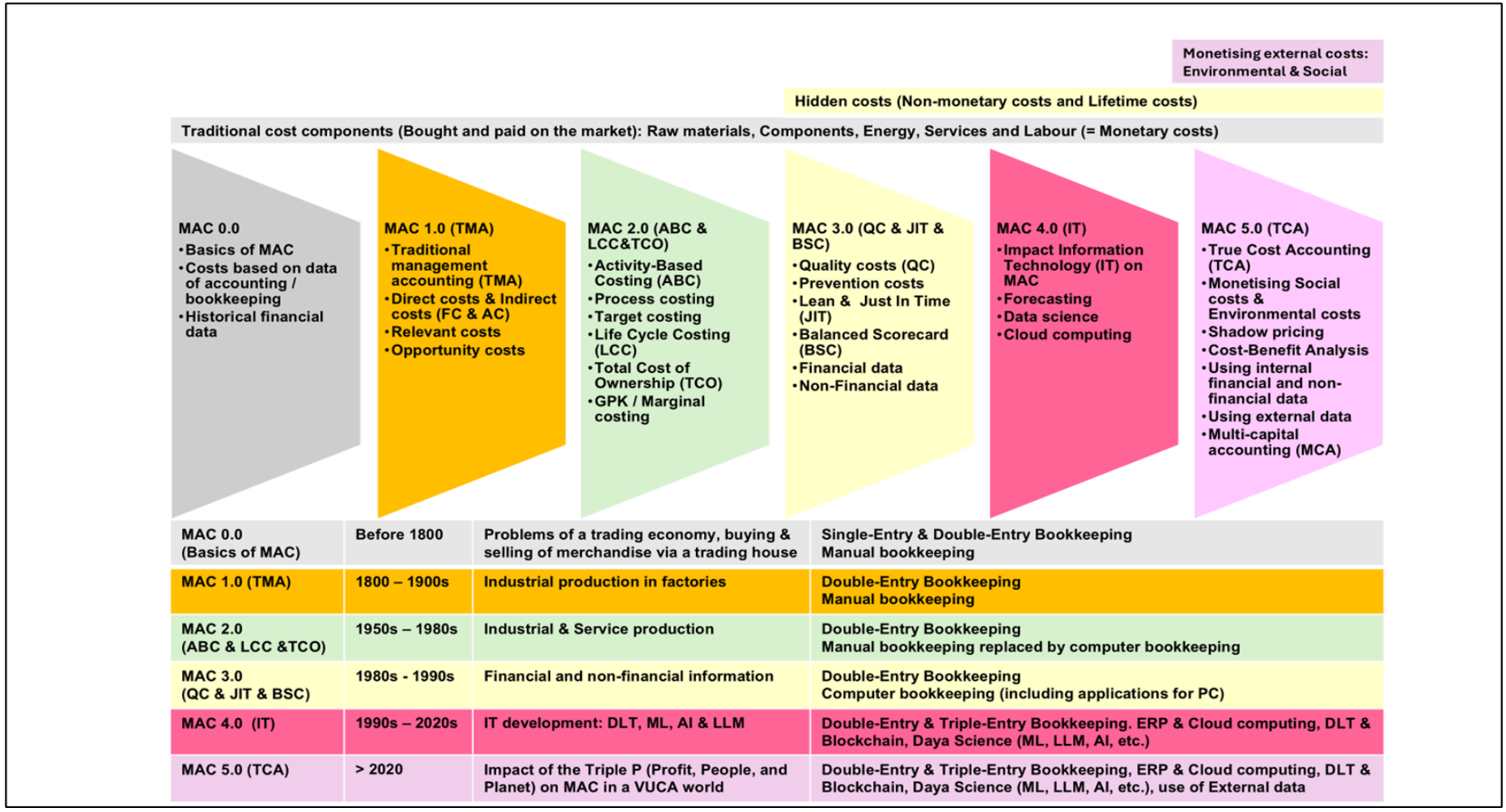
Literature about MAC stages

There are several development models of management accounting:

- IFAC (International Federation of Accountants) Model of the practice of managerial accounting (Savage & Jasch, 2005)
    - Stage 1 (to 1950): *'A focus on cost determination and financial control'*
    - Step 2 (by 1965): 'A focus on the provision of i*nformation for management planning and control'*
    - Step 3 (by 1985): *'A focus on the reduction of waste in resources used in business processes'*
    - Step 4 (by 1995): '*A focus on generation creation of value through the effective use of resources'*
- IMA (Institute of Management Accounting) Management Accounting Competency Framework (IMA, 2019) has six main competencies: *Strategy, Planning & Performance (Visionary), Reporting & Control (Steward), Technology & Analytics (Catalyst), Business Acumen & Operations (Partner), Leadership (Champion) and Professional Ethics & Values (Guide).* The IMA MAC framework is not a historical overview of management accounting development, but a state-of-the-art overview of 21st-century competencies of management accountants. Over its 100-year history, IMA looks back on the development of the profession of management accountants in the USA (Kulesza & Pollara, 2019). Similar observations were made by Waweru (2010) and Abdel-Kader & Luther (2006) regarding the development of management accounting and the profession of management accountants. Management accounting is not a static science and is always in development as a result of the interaction with the changes in the business environment. Different scholars, such as Gliaubicas (2012), Dlamin (2023), Kamal (2015), Riinawati & Sabariah (2022), and Bonnet et al. (1999), show this in their research on the development of management accounting (See also Appendix III for more details).

Stage	Description
MAC 0.0	This is the basics of management accounting, where MAC information was based on historical financial data from the bookkeeping system. We should place this in the period of international trade with Spain, Portugal, England, the Netherlands, etc., before 1800. International trade was based on resources (tea, coffee, pepper, rubber, etc.) from Asia, Africa, and the Americas. The bookkeeping system was largely based on merchants' activities, so few industrial transformations occurred at this stage. Accounting system: Manual Single-Entry and Double-Entry bookkeeping Period: Before 1800
MAC 1.0	Management accounting developed in this stage of (early) industrialisation and Taylor's scientific management (Bateman & Snell, 2004) into traditional management accounting (TMA). Topics like Cost Price Calculation, Cost Price Concepts, and Decision Making were introduced. Accounting system: Manual Double-Entry bookkeeping Period: 1800 – early 1900s
MAC 2.0	The economy shifted from a pure industrial economy to a service economy, so for intangible products (as services are), the cost price had to be calculated. Also, indirect costs played a more important role, especially in sectors such as automotive, aerospace, medical products, and electronics. Refined costing systems, like Activity Based Costing (ABC), were introduced, as well as Life Cycle Costing (LCC) & Total Cost of Ownership (TCO), and Grenzplanungskostenrechnung (GPK) or Marginal Costing, and Decision-Making Tools (Like: Break-Even Analysis, Linear Programming & Shadow Prices, Net Present Value Calculations, and Make & Buy Decisions). Accounting system: Manual and electronic Double-Entry bookkeeping Period: 1950s- 1980s
MAC 3.0	Development in IT systems made it possible to have financial and non-financial decision-making information available to enterprises (also to SMEs). The introduction of the Balanced Scorecard (BSC) created a method to monitor (and to forecast) financial information and non-financial information (Market, Business Processes, and Human Resources). Management accounting decisions were not only based on past financial data from the bookkeeping system, but also on other non-financial sources of relevant information. Accounting system: Financial data and non-financial data in ERP systems, and triple-entry bookkeeping (Blommaert, 1994) Period: 1980s – 1990s
MAC 4.0	Further development of IT in accounting, but also additional developments of financial and non-financial data (Data science, ML, LLM, AI, etc.) to assist companies in improving forecasting in sales and operational planning (S&OP). Advances in distributed ledger technology (DLT or Blockchain) and cloud technology make it easier for companies to connect within the supply chain and exchange a wide range of data. Accounting system: Cloud computing & Triple Entry bookkeeping (Blommaert, 1994) Period:1990s – 2020s
MAC 5.0	Developments in society, such as Triple-P, SDG, ESG, Circularity, Sustainability, Stewardship, Limits to Growth (LTG), etc., have made it clear that the traditional (market) cost price needs some revision. To include externalities of social issues and environmental issues. Developments such as True Cost Pricing, Oiconomy pricing, Integrated Management Accounting (IMA), or Environmental cost accounting made it clear that there should be a paradigm shift to include social and environmental costs in the traditional (market) cost price. But also, geopolitical developments in the 2020s that may be summarised as a multipolar world and a business environment being VUCA (Volatile, Uncertainty, Chaos, and Ambiguity). Accounting system: Beyond traditional accounting systems, analysing large databases should yield relevant information to monetise the social and environmental costs of externalities. Period: After 2020s

Table 3 Stages of management accounting, developed by the author



MAC 0.0 (Basics of MAC)	Before 1800	Problems of a trading economy, buying & selling of merchandise via a trading house	Single-Entry & Double-Entry Bookkeeping Manual bookkeeping
MAC 1.0 (TMA)	1800 – 1900s	Industrial production in factories	Double-Entry Bookkeeping Manual bookkeeping
MAC 2.0 (ABC & LCC &TCO)	1950s – 1980s	Industrial & Service production	Double-Entry Bookkeeping Manual bookkeeping replaced by computer bookkeeping
MAC 3.0 (QC & JIT & BSC)	1980s - 1990s	Financial and non-financial information	Double-Entry Bookkeeping Computer bookkeeping (including applications for PC)
MAC 4.0 (IT)	1990s – 2020s	IT development: DLT, ML, AI & LLM	Double-Entry & Triple-Entry Bookkeeping. ERP & Cloud computing, DLT & Blockchain, Daya Science (ML, LLM, AI, etc.)
MAC 5.0 (TCA)	> 2020	Impact of the Triple P (Profit, People, and Planet) on MAC in a VUCA world	Double-Entry & Triple-Entry Bookkeeping, ERP & Cloud computing, DLT & Blockchain, Daya Science (ML, LLM, AI, etc.), use of External data

Figure 2 *Development stages of MAC made by the author*

New Trends in MAC and Finance

Total Costs of Ownership (TCO) was developed from the management accounting concept of Life Cycle Accounting (LCA). Ellram (1994) developed a taxonomy of TCO and a TCO analysis (1995) for purchasing equipment or services (e.g., software) in a specific situation. Similar studies, such as Morssinkhoff et al. (2005), Ferrin & Plank (2002), and Barbusova et al. (2018), confirm a common base for TCO calculations. Elements in the taxonomy or framework are Investment costs, Hidden costs (e.g. Self-training hours of staff, Learning curve costs}, Quality costs (e.g. Inspection costs), Operational costs, Maintenance costs, and Disposal costs at the end of the economic lifetime.

Environmental management accounting (EMA) considers environmental costs in the cost price (Savage & Jasch, 2005), using management accounting techniques such as Activity Based Costing (ABC), Life Cycle Costing (LCC), and Quality Costing (QC). Vosselman (2014) & (2024) argues for a broader perspective of management accounting, especially to assist managers in making sound decisions. Bainbridge (2023) introduced True Cost Accounting (TCA) as a method for calculating the 'right' cost price that considers social and environmental costs. Similar approaches are known under impact accounting of Velez Caicedo (2022) and Fahel (2022). In the impact accounting model (Daulton, 2022), three components of impact are distinguished: Value chain (Upstream, Own operations, Distribution/Processing, Use Phase & End of life), Stakeholders (Investors, Nature, Clients/Customers, Employees, Suppliers & Governments) and Capital (Financial, Intellectual, Natural, Manufactured, Human & Social). The impact accounting model also distinguishes direct and indirect scope of impact, as well as absolute and marginal outcomes. In the impact accounting model, there is an impact pathway in three steps:

I. Primary data measuring the scale of impact
II. Quantify the change in the well-being of a customer as a result of the impact
III. Value the change in well-being using a monetised coefficient

There are two interesting calculation tools to estimate the social and environmental costs of (agricultural) products. The True Price Foundation (2020) and the Impact Institute (Rusman, et al., 2023) developed several case studies, such as the true price of t-shirts (2021) and business case studies (Sipkens, et al., 2014). Recently, they developed an open-access database (True Price Foundation, 2026) to calculate the true price of several products. A similar organisation, called the Oiconomy Pricing Foundation (2026), developed the Oiconomy Pricing Tool. The Oiconomy Pricing standard (Oiconomy Pricing, 2026) is based on a full-cost accounting methodology that includes measuring hidden costs and aligns with the Triple P principles (especially the impact on People and Planet). The costs are calculated in ESCU (Eco Cost Social Unit) and include the SDGs (Sustainable Development Goals) of the UNO. The method is justified by Croes & Vermeulen (2023), and some initial empirical results are reported in Vermeulen et al. (2023). Oiconomy Pricing uses some confusing terms: Real Price for the True Price and Full Cost Accounting for True Cost Accounting. The Oiconomy Pricing Tool uses a two-dimensional model that combines the life cycle with the Triple P model (including ten subcategories), resulting in a matrix with five rows and ten columns.

In most management accounting approaches, the role of the supply chain is increasingly important, as already introduced by Horngren et al. (2021) and further developed by Taschner

& Charifzadeh (2020). A framework of the true cost price of coffee in the supply chain was developed by Jansen (2026).

Sustainable finance (Schoenmaker & Schramade, 2023), climate finance (Klok, Pauw, De Gooyert, Van Tilburg, & De Conick, 2026), and Multi-capital accounting (Dupuy, 2025) are just a few topics to show the new trend in finance and accounting to take into account the typical long-term orientation of the Rhineland model (Van Aken, Riepma, & Westerdijk, 2018), representing the financial and non-financial interests of all the shareholders of a firm.

Overview of traditional Cost Accounting concepts

Let us first define some basic concepts in costing (Horngren, Datar, & Rajan, 2021):

'Costs are resources sacrificed or forgone to achieve a specific objective'

'Cost accounting measures, analyses, and reports financial and non-financial information relating to the costs of acquiring or using resources in an organisation. It provides information for both management and financial accounting'

'Management accounting measures, analyses, and reports financial and nonfinancial information that helps managers make decisions to fulfil the goals of an organisation. It focuses on internal reporting'

Normally, the cost price is defined as the per-unit cost of a product or service.

The following functions of the cost price (Atrill & McLaney, 2012) (Halari, 2025) are distinguished:

- Base of the selling price
- Evaluating internal efficiency
- Tool to calculate the (transaction) profit
- Valuing inventories
- Decision tool for: Make or buy decisions, Product portfolio decisions, Investment decisions, etc.

To evaluate internal efficiency, variance analysis (Hongren, Datar, & Rajan, 2021) (Bakker & Van Houten, 2018) can be applied to direct materials usage. The standard costs (ex-ante) are $P_S * Q_S$; the actual costs (ex post) are $P_A * Q_A$; the total variance is $P_A * Q_A - P_S * Q_S$ The analysis of the total variance into a price variance: $(P_A - P_S) * Q_A$ and an efficiency variance: $(Q_A - Q_S) * P_S$. In the standard textbooks of cost accounting (Atkinson, Kaplan, & Young, 2004) (Atrill & McLaney, 2012) (Drury, 2000) (Horngren, Datar, & Rajan, 2021) several cost price methods are distinguished: Direct costing (DC), Absorption costing (AC), Full costing (FC), Activity-based costing (ABC), Quality costs (QC), and Life cycle costing (LCC) or Total costs of ownership (TCO). Like the well-known 1923 quote of Clark: *'Different costs for different purposes'* (Van Der Schroeff & Groeneveld, 1980) (Atkinson, Kaplan, & Young, Management Accounting, 2004) shows that the theoretical concept of the cost price is quite pluriform. In the standard or traditional theory of cost accounting, costs are measurable in monetary terms because the resources are traded on a market and thus have a market price. An example of a simple cost price (CP) formula (Van Der Schroeff & Groeneveld, 1980) (Bakker & Van Houten, 2018) is :

$$Cost\ Price = \frac{Total\ Variable\ Costs}{Actual\ production} + \frac{Total\ Fixed\ Costs}{Expected\ production}$$

Actual production can be equal to, larger than, or smaller than expected production, and that might lead to some mispricing of the cost price in cases of larger or smaller production than expected to cover the fixed costs. So, the mathematics behind cost prices is quite basic: linear models are used, so that the total variable costs will have the following equation: $TVC = aQ$ (with a>0) and total fixed costs will have the following equation: $TFC = b$ (with b>0). The total costs are defined like: $TC = TVC + TFC$, the several average costs are defined like: $ATC = \frac{TC}{Q}$; $AVC = \frac{TVC}{Q}$ and $AFC = \frac{TFC}{Q}$; the marginal costs are defined like: $MC = \frac{\Delta TVC}{\Delta Q} = \frac{\Delta TC}{\Delta Q} = a.$

In different sources *(Boyns & Edwards, 2013) (Horngren, Datar, & Rajan, 2021) (Atrill & McLaney, 2012)*, we find the distinction between direct & indirect costs and variable & fixed costs, see Table 4. Activity-based costing is a very refined system of costing *(Horngren, Datar, & Rajan, 2021)*, it often takes too much time to calculate an ABC cost price than for instance one based on absorption costing. In most textbooks, the difference between full costing and absorption costing is difficult to determine (Atrill & McLaney, 2012) *(Horngren, Datar, & Rajan, 2021)* (Atkinson, Kaplan, Matsumura, & Young, 2012). Therefore, we regard the two concepts as identical in this article.

Absorption Costing is defined as *'A method of costing in which a fair share of the total manufacturing/service provision overhead cost is included when calculating the cost of a particular product or service'* and Full Costing is defined as *'Deducing the total direct and indirect (overhead) costs of pursuing some activity or objective'* Atrill & McLaney (2012); other authors like Drury (2000) and Bhimani, Horngren, Datar, & Foster (2008) give similar definitions. Drury (2000) distinguishes the following components in the absorption costs: Manufacturing costs (Material costs, Labour costs, and Overhead costs) and Non-Manufacturing Overhead costs).

Activity-Based Costing (ABC) is defined as: '*An approach to costing that focuses on individual activities as the fundamental cost objects. It uses the costs of these activities as the basis for assigning costs to other cost objects, such as products or services.* ' (Horngren, Datar, & Rajan, 2021)

		Marginal Costing / Variable Costing / Direct Costing	
		Variable Costs	Fixed Costs
Full Costing / Absorption Costing	Direct Costs	I. Direct material costs, Direct labour costs, Direct transport costs, etc.	II. Cost of direct factory overhead, Costs of direct factory management, Costs of direct energy (lighting & heating), etc.
	Indirect Costs	IV. Energy costs of machinery, Cost of indirect materials (lubricants), Costs of (preventive) maintenance, etc.	III. Costs of administration, costs of general management, costs of HRM department, etc.

Table *4* Full Costing versus Marginal Costing (developed by the author)

Target costing is based on a Target price (the estimated price that potential customers will pay) minus the Target profit margin, a long-term cost price (Horngren, Datar, & Rajan, 2021). Target costing can also be interpreted as a willingness to pay (Black, Hashimzade, & Myles, 2017). Target costing is, in fact, a revised way of calculating the selling price:

- **Target Costing: Target Selling Price – Target Profit Margin = Target Cost Price**
- **Traditional Costing: Cost Price + Profit Margin = Selling Price**

Quality costs (Atkinson, Kaplan, & Young, Management Accounting, 2004) are incurred on quality-related processes and are divided into four categories: Prevention costs, Appraisal

costs, Internal failure costs and External failure costs. Examples include supplier selection costs, rework costs, inspection costs, warranty costs, returned product costs, etc.

Life Cycle Costing (LCC) & Total Costs of Ownership (TCO)

A traditional approach in management accounting (Koolschijn & Wijnberg, 1978) to investment decisions is to distinguish initial costs (such as depreciation & interest costs) from complementary costs (such as maintenance costs). As a decision rule (Van Der Schroeff & Groeneveld, 1980) is used for a new investment:

$$(Initial + Complementary\ costs)_{old} > (Initial + Complementary\ costs)_{new}$$

Life Cycle Costing (LCC) is defined as *'A system that tracks and accumulates business function costs of the value chain attributable to each product from initial R&D to final customer service and support '* (Horngren, Datar, & Rajan, 2021), three cycles are distinguished in Life Cycle Costing or Environmental Costing (Atkinson, Kaplan, & Young, 2004): Research, Development & Engineering Cycle, Manufacturing Cycle, and Post-Sale & Disposal Cycle. In the *Guidelines for life cycle cost analysis and cost-benefit analysis* (Mearig, Morris, & Morgan, 2024) a framework is developed to calculate the total life cycle costs of an investment project, taking into account the long-term real discount rate and the main cost categories: Initial investment costs, Operations cost, Maintenance & repair cost and Residual value. Future values are made present using this formula:

$$PV = A_t * \frac{1}{(1+d)^t}$$

In which PV = Present value, A_t =Amount of one-time cost at time t, d = real discount rate and t = Time (expressed as a number of years). For instance, the choice of a long-term interest rate is another type of study. It is discussed by Schoenmaker & Schramade (2023) in their handbook of sustainable finance and in a similar study by Roncalli (2024).

From a practitioner's point of view, Gartner's (2026) definition of TCO is interesting because it focuses on IT spending: *'a comprehensive assessment of information technology or other costs across enterprise boundaries over time. For Information Technology, the total cost of ownership includes hardware and software acquisition, management and support, communications, end-user expenses and the opportunity cost of downtime, training, and other productivity losses.'*

The following formula for TCO calculations, from different sources like (Barbusova, Medvecka, & Gaso, 2018), is often used during the economic life of the asset:

$$TCO = Acquisition\ Costs\ (Purchase\ Price) + Operating\ Costs + Hidden\ Costs + Maintenance\ Costs + Disposal\ Costs - Residual\ Value$$

Ellram (1994) & (1995), Morssinkhoff et al. (2005), and Ferrin & Plank (2002) provide examples of TCO approaches, for instance, in procurement decisions within the supply chain.

True Cost Accounting (TCA)

In the true cost price, the traditional costs (direct & indirect costs of the full cost price or absorption cost prices) are included, as well as the social costs and environmental costs.

Social costs are monetised costs of externalities, such as underpayment, poor labour conditions, slavery, exploitation, etc. These social cost components are not included in the traditional cost price, but from an ethical point of view, they should be. Environmental costs are monetised externalities, such as damage from deforestation, excessive water use (irrigation), and damage from mining (landscape).

These two cost components (social and environmental) are not included in the traditional cost price. Still, from a stewardship and ethical considerations, they should be included in the true cost price. So true cost accounting (TCA) has two normative components (social costs and environmental costs) included in the traditional cost price. Or in a formula:

$$True\ Cost\ Price = Traditional\ Cost\ Price + Social\ Costs + Environmental\ Costs$$

The issue is that the monetisation of the two sorts of externalities is not traded on a (factor-)market; so, we have to calculate the costs (as there is no price on the factor market). There are several techniques to calculate the impact on the true costs, such as:

- Life Cycle Costing (Ellram, 1994) (Horngren, Datar, & Rajan, 2021)
- Cost-Benefit Analysis
- Opportunity costs (Drury, 2000)
- Shadow pricing, determine λ or the Lagrange multiplier (Jansen, 2024) (Draper & Klingman, 1972)
- Grenzplankostenrechnung (GPK) or Marginal costing (Friedl, Küpper, & Pedell, 2005) (Wöhe & Döring, 1993)
- Estimation techniques (Bainbridge, 2023)
- True Profits (Conaway & Schouten, 2025)
    - True Profit = Financial Profit – Social costs – Environmental costs
- Databases of true pricing tools
    - True Price Organisation (True-Price-Foundation & Impact-Economy-Foundation, 2020) (True Price Foundation, 2026)
    - Oiconomy Pricing Foundation (Vermeulen, Croes, & Van Der Feen, 2023) (Croes & Vermeulen, 2023)

So, the true cost price has some subjective elements, because the impact costs of externalities (social and environmental) are difficult to estimate or calculate, as they are not traded on a (factor-)market. Also, the traditional cost price, based on full cost accounting or absorption cost accounting, has subjective (arbitrary) elements, especially in estimating ex-ante inputs for direct and indirect costs. Even ex post, there might be some estimations of the realised costs.

There is some confusion about the use of the term "true cost accounting" (TCA) to calculate the true cost price. Over the past two decades (2000-2025), there has been a lot of attention to implementing circular and sustainable aspects into the traditional cost-price model. Some of the reasons are more closely linked to developments in economic science, such as Limits to Growth (Meadows, Meadows, Randers, & Behrens, 1972), Doughnut Economics (Raworth, 2017), and Regenerative Economics (Regenerative Economics, 2025). Other aspects can be classified as changes in the business environment itself, such as the Rhineland business

model (Van Aken, Riepma, & Westerdijk, 2018), SDG (Miranda & Scholz, 2023), ESG frameworks (European Council, 2024), etc. Some aspects are linked to a geopolitical shift in thinking, based on changes in the economic systems: neo-liberal market economy, social market economy, planned economy, mixed economies (Grossman, 1967); and political systems: multipolarity (Habib, Amin, & Khan, 2026) in a VUCA world (Bennett & Lemoine, 2014). The above-mentioned three aspects support the idea of a paradigm shift in cost price accounting from the traditional full cost accounting or absorption accounting to true cost accounting (TCA). True cost accounting has several approaches, like Environmental Accounting (Schaltegger & Burritt, 2017) and Social and Environmental Full Cost Accounting (Roos Lindgren & Vermeulen, 2023). All methods have in common that they include social costs and environmental costs in the cost price calculation.

So, the development of True Cost Accounting (TCA) can be explained by both endogenous (within MAC) and exogenous (outside MAC) factors. Especially for (SME) entrepreneurs, it is important to know the reason (Berendsen, Van Liere, Venselaar, Ansems, & Appelman, 2006) is to implement a true cost price system:

- Expected regulations and legislation of governments
- Expected needs from customers
- Internal reasons from the entrepreneur, linking his ideas of stewardship and fair economic behaviour

Especially in a multi-polar world (Bharadwaj, Rodriguez-Chiffelle, Urbano, Zdunic, & Azevedo, 2025), which is also characterised as being VUCA (Bennett & Lemoine, 2014), with different ideas about the true cost agenda. Some economies can be characterised as mixed economies according to the Rhineland model, while others can be characterised as a classical market economy according to the Anglo-Saxon model. And other economies have different views on the ownership of natural resources and on allocation mechanisms (e.g., forms of central planning). This brings us to the costs of natural resources: should we only include the extraction costs of mining, drilling, exploration, processing, and transportation, or should we also include environmental costs (e.g., costs of pollution, restoration, damage, etc.) and social costs (e.g. costs of underpayment, poor labour conditions, child labour, etc.). So, the true cost price in country X can differ from that in country Y, depending on the economic and political context in which the company or producer operates. Again, the well-known quote of Clark: *'different costs for different purposes'* is applicable. The valuation of the cost price depends very much on the economic and political situation in which the company is situated, and what is, for instance, a fair wage level. The same issue regarding the costs of damage and pollution from the extraction of raw materials (such as oil, timber, precious metals, etc.), in some countries the extraction of raw materials should not damage or pollute the land. The land should be restored so that future generations can benefit from it (stewardship). A similar line of thought can be developed regarding the use of the product after its useful life: what to do with its residue (e.g., a car, a bike, a fridge, etc.). Is it possible to recycle the residue, or can it be processed in such a way that a new product is made of this resource (formerly called waste)? Think of a garden bank made of recycled plastics or a pen made of recycled aluminium from coffee pads. Assigning environmental costs and social costs to the true cost price is complicated. The complexity is grounded in the concept of externalities (Black, Hashimzade, & Myles, 2017), which externality you have to consider. The author's suggestion is to consider the direct externalities, direct in the sense of a cause-and-effect relationship. Second, third, and more order effects are indirect, and those

indirect externalities are difficult to calculate their impact (and monetisation) on the true cost price. At the end, it is important to have a concise set of cost drivers, based on the four main categories of a true cost price: Direct costs, indirect costs, social costs, and environmental costs. Each main category might have 3-5 subcategories, so in the end, the true cost price will have about 20 subcategories. Transparency about the structure and substructure of the true cost price is even more valuable to the final consumer in a product's supply chain.

Externalities have a long tradition in economics; Marshall (1890/2013) and Pigou (1920) introduced the concept as the divergence between internal (or private) costs and external (or social) costs. Externalities can be positive or negative and can be caused during production and/or consumption. Externalities can be social and environmental, and finally direct or indirect. So, externalities have many dimensions, which makes them difficult to measure and monetise. In this article, we assume negative, direct externalities from production that have social and/or environmental impacts. We use the definition of Perloff (2014) for an externality: *'An event in which a person's well-being or a firm's production capability is directly affected by the actions of other consumers or firms rather than indirectly through changes in prices'.*

	Externalities caused by:	
	Consumption	**Production**
Positive	• Enjoying music from neighbours • Help from neighbours • Free ride • ...	• Beekeeper • Research & development • Training staff • ...
Negative	• Noise generation • Passive smoking • Traffic jams • Waste / Pollution • ...	• Pollution • Deforestation • Waste • Excessive use of water (irrigation) • ...

Table 5 Examples of externalities (developed by the author)

We use negative externalities caused by production directly, with social and environmental impacts. These are quite strong choices and make the definition of the true cost price in a way subjective and imperfect. On the other hand, it is quite impossible to measure all externalities, so we restrict ourselves to social costs (ethical aspects) and environmental costs (stewardship aspects).

So, in the end, the true cost price is a balance among market cost (traditional cost price based on full costing or absorption costing), social costs, and environmental costs. See Figure 3 to balance the true cost price in three factors in the Triple-P model: Economic costs (Profit), Social costs (People), and Environmental costs (Planet). The cost price, using principles of True Cost Accounting (TCA) or Integrated Management Accounting (IMA), should be the real cost price at the end stage of a sustainable business model in the (international) supply chain. In the meantime, we are doing business in a transition period with price competition based solely on traditional cost accounting (TCA), and only governments can intervene through legislation and/or tariffs to protect against unfair competition.

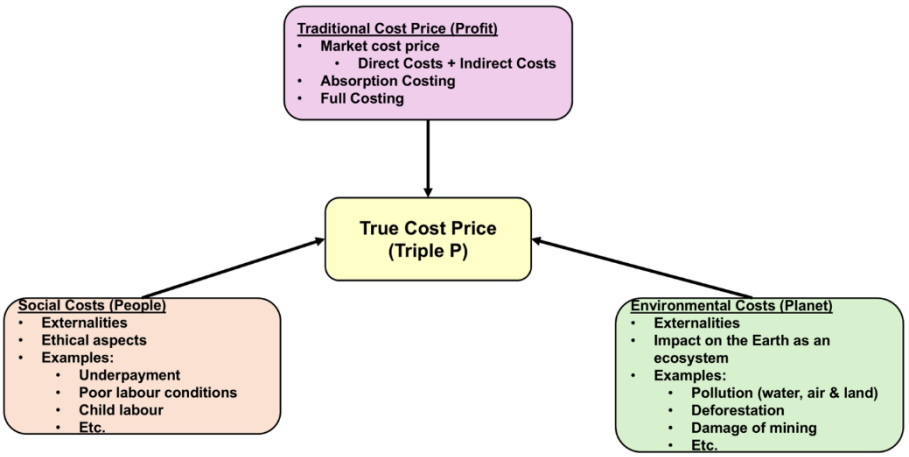


Figure 3 True Cost Price Factors (developed by the author)

Empirical research on true cost prices in different sectors (Jansen, 2024) & (Jansen, 2026) & (Maddison, et al., 1996) shows that, under specific macroeconomic conditions, a cost price based on TCA is possible for a company to make (long-term) business decisions. Several scholars defined opportunity costs and shadow prices. See two well-accepted definitions:

'An opportunity cost is the cost that measures the opportunity that is lost or sacrificed when the choice of one course of action requires that an alternative course of action be given up' (Drury, 2000)

The shadow price is defined as the opportunity cost of a marginal increase of a scarce resource (Drury, 2000) or as: *'Prices of goods, services, and resources that are proportional to opportunity cost for the economy, taking account of any externalities. The Lagrange multipliers appearing in constrained optimisation problems can be interpreted as the shadow price'* (Black, Hashimzade, & Myles, 2017).

There are three main carbon pricing instruments (World-Bank, 2025): ETS (= Emission Trading Systems), Carbon taxes and Carbon credit mechanisms. All instruments have an impact on the price (a nearly 30% increase in 2025) of products associated with carbon emissions (e.g., fuels), to reduce GHG (= Greenhouse Gas) emissions. The technique of shadow prices is used to determine the internal carbon price. Carbon Pricing Metrics has three dimensions (PCT, 2023): Policy coverage, Rate (/ Form) of carbon pricing covered by metrics, and Purpose of metrics.

Environmental management accounting (EMA) integrates environmental impacts in traditional business decisions (Halari, 2025), so managers are more aware of the results of their decisions on sustainability topics. For instance, managers should be aware that their business also contributes to CO_2 emissions and other environmental issues. Kassim et al. (2024) argue in their article that '*fundamental environmental criticism of conventional management accounting is that it largely ignores separate identification, classification, measurement and reporting of environmental information, especially environmental costs'*; so they propose EMA tools like: Material Flow Analysis (MFA), Life Cycle Assessment (LCA), Activity Based Costing (ABC), and Total Cost Assessment (TCA) to monetise the, often

physical, information provide by these tools. Savage & Jasch (2005) link their guidance document from the International Federation of Accountants (IFAC) in more detail to the EMA concept across different business levels (including projects) and the national accounting system. IFAC defines EMA as:

'*The management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, environmental management accounting typically involves life-cycle costing, full-cost accounting, benefits assessment, and strategic planning for environmental management'* (Savage & Jasch, 2005).

Integrated Management Accounting (IMA) is perhaps the most appropriate term for this development in management accounting (Szczerbak & Wikarczyk, 2023), as it integrates traditional cost price information with quality and environmental cost price information. Other terms, like full cost accounting, might not fit this new development in management accounting. A term like Environmental Full Cost Accounting, as used by Herrera et al. (2022), Dascalu et al. (2009), Herbrohn (2005), and the FCA Agenda of the UK accountants 2001 (Bebbington, Gray, Hibbitt, & Kirk, 2001). In the FCA agenda of the UK accountants in 2001, FCA is defined as: '*The consumption and use of environmental resources are accounted for as part of the full cost of production and reflected in market prices'.* According to Bebbington et al. (Bebbington, Gray, Hibbitt, & Kirk, 2001) there are four approaches: Democratic / Accountability, Full privatisation, Law, market instrument & structural change, and Shadow price. The full cost approach consists of five levels: Usual costs (direct & indirect costs), Hidden costs, Liability costs, Less tangible costs, and Environment-focused costs. According to Bebbington et al. (2001), the term full cost accounting is misleading, which is why the author prefers: True Cost Accounting (TCA), Environmental Social Full Cost Accounting (ESFCA), or Integrated Management Accounting (IMA). Similar approaches are found in Dupuy's (2025) Multiple Capital Accounting (MCA) and in Sustainability Management Accounting (SMA) (Schaltegger, Christ, Wenzig, & Burrit, 2021). The Situational Context, Action, and Transformation (CAT) framework provides an overview at the macro level, meso level and micro level to introduce Sustainability Management Accounting (SMA) at multi-levels. So, SMA is not only relevant to study at the firm level, but also at the level of professional associations of accounts, and the (international) governments. Finally, ethical aspects, for instance, unfair remuneration of labour, can be found in Meijaard & Shei (2019), play a role in True Cost accounting (TCA) or Integrated Management Accounting (IMA).

Results and Discussion

There are now some empirical tools for calculating the true cost price of a product, issued by *'The True Price Organisation'* (2020) and *'Oiconomy Pricing Foundation'* (Croes & Vermeulen, 2023). A numerical example of the true price of coffee has been calculated by the author using retail data from Ahold (Ahold-Delhaize, 2025) and the true price gap for 1 kg of coffee of €13,96 from The True Price Calculation Tool (True Price Foundation, 2026). Although the tool is in development, it provides us with a first impression of the true price gap, the difference between the true price and the traditional market price. The tool is developed for agricultural products with a tropical background (like coffee); however, the number of data points still needs to be improved to make it a more robust tool.

We expect that the true pricing tools will become increasingly accurate in the coming years, as the underlying databases become more developed.

The basic idea is the cost price structure across the supply chain (Jansen, 2026), and communicating that structure to final customers using, for instance, distributed ledger technology (DLT) or blockchain (Mougayar, 2016). Transparency about cost prices and fair profit margins may be a new way to explain to customers why they should pay more for a product, showing their *'willingness to pay'* (Black, Hashimzade, & Myles, 2017).

Another issue is a *'fair playing field'* for producers and customers in the supply chain; not every country in the world embraces the principle of the Rhineland business model (Van Aken, Riepma, & Westerdijk, 2018). We have to be aware of different approaches in a multipolar world. Trade policies (of a country or a bloc of countries) might alter the level playing field of equal rules for each participant in the global supply chain for a product.

Finally, the customer decides to buy the product at a higher price or not. So convincing to pay more (based on the principle of willingness to pay) is even more essential. Communicating the cost price structure, profit margins, and product origin might be an important first step.

Several university programmes have a common structure for studies in Finance, Accounting & Control, namely: Accounting, Control, Management Accounting, Financial Accounting, Cost Accounting, and Corporate Finance. Where, of course, management accounting is connected with the other subjects, to educate and train professionals in Finance, Accounting & Control. Several new ideas are included in those programmes in higher education, like: Risk management, Behavioural finance, Supply chain finance, True cost accounting, Sustainable finance, Enterprise resource planning (ERP), Distributed ledger technology (DLT) & Blockchain, Cloud technology, Data science, Machine learning, Artificial intelligence, Large language models, etc. In the *'True Cost Accounting Agrifood Handbook'* (Müller & Bandel, 2022) a framework is developed to combine the value chain stages on one hand side with true cost accounting indicators, such as GHG emissions, Soil erosion, Water pollution, Gender pay gap, Forced labour, etc., as indicators for Environmental costs and Social costs. In their model, these factors are monetised to calculate true costs. The model is based on four capitals: Natural capital, Human capital, Produced capital and Social capital; and is quite similar to the six capitals model of Gleeson-White (2014)

Table 6 summarises True Cost Accounting (TCA).

Conclusion and Discussion

There is definitely a shift in thinking (perhaps a paradigm shift) about the calculation of the 'right' or 'real' cost price. In addition to the traditional cost price approach (full costing or absorption costing), we must consider social and environmental costs in a rapidly changing world. Based on the broad definition of the four production factors, we should calculate the cost price using True Cost Accounting (TCA) or Integrated Management Accounting (IMA). In both academic discussions, the cost price will look like:

$$True\ Cost\ Price = Traditional\ Cost\ Price + Social\ Costs + Environmental\ Costs$$

TCA True Cost Accounting						
TCO Total Costs of Ownership						
OPEX				CAPEX	TC (True Costs)	

Direct Costs:
• COGS
• Mainly variable
	Indirect Costs:
	• Overhead costs
	• Mainly fixed
	• Including:
	  • Depreciation costs(CAPEX)
	  • Interest cost (CAPEX)
		Hidden Costs:
		• Time to learn
		• Time to coordinate
		• Additional services
		• Etc.
				Investement Exepenses:
				• Investment amount
				• Link to depreciation costs(OPEX)
				• Link to interest costs of financing (OPEX)
					Social Costs:
					• Fair purchase prices
					• Fair labour costs
					• Safe labour conditions
					• Etc.
						Environmental Costs:
						• Monetise negative Externalities
						• Damage costs environment
						• Cost of pollution (air, water & soil)
						• Etc.

Table 6 Developed by the author

True Profit distinguishes three sorts of capital: Financial capital, Natural capital, and Social & Human capital. The calculation framework of true profit is based on those three capitals. So, the true profit consists of: Financial profit, Social & Human profit, and Natural profit. The theoretical foundation of the True Profit method is based on the True Price method (Conaway & Schouten, 2025).

$$True\ Profit = Finnacial\ Profit + External\ Postive\ Impacts - External\ Negative\ Impacts$$

In the report on true profits (Conaway & Schouten, 2025) twenty companies generate a financial profit of + € 209 billion, a natural profit of - € 201 billion and a social profit of + € 92 billion; so the true profit is + € 100 billion (= + €209 - € 201 + € 92) and that is smaller than the financial profit of € 209 billion. True price models should not be too complicated, the author suggests using a downsized calculation method based on monetised social and environmental negative and direct externalities (See Table 7 and Figure 4).

Monetising Environmental Externalities	Positive	Negative
Direct	?	External cost
Indirect	?	?

Table 7 Monetising Environmental Externalities

Finally (see Figure 4), the true price is determined by the market equilibrium between two factors: consumer-driven and producer-driven.

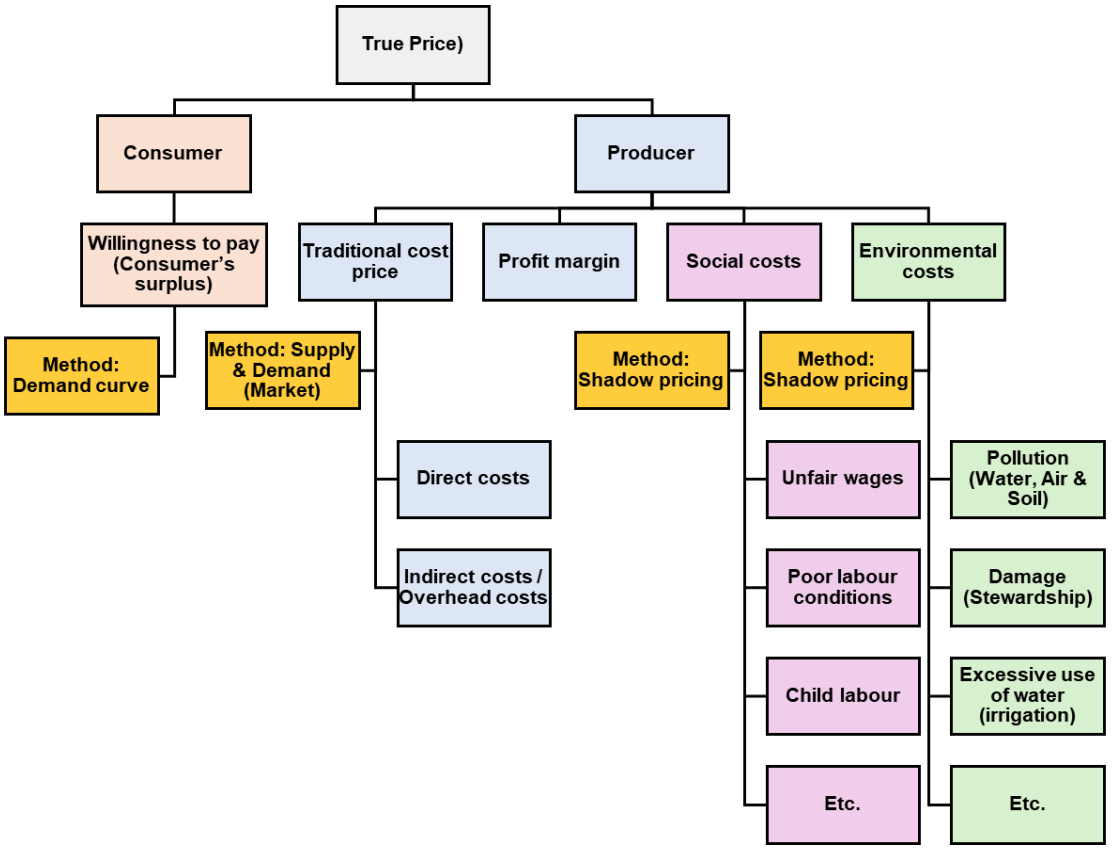


Figure 4 True cost price an overview (constructed by the author)

The summary provided by Figures 3 & 4 and the overview of the supply chain (in Appendix VI) might be useful for future empirical research on the true cost price in a product's supply chain. The future research agenda on MAC 5.0 or True Cost Accounting (TCA) should at least have the following topics:

- Transparency of the supply chain (actors)
- Transparency of true cost prices and true profits in the supply chain (See Appendix VI)
- IT projects like digital product passport or DPP (Rukanova, et al., 2026) and distributed ledger (DLT) or blockchain technology (Sign Arun, Cuomo, & Gaur, 2019) might be helpful to bridge the gap between the true cost price, the true profit margin and the willingness to pay (from the consumer's point of view) in the supply chain
- The global developments like VUCA (Bennett & Lemoine, 2014) and the multipolarity view on the world (Bharadwaj, Rodriguez-Chiffelle, Urbano, Zdunic, & Azevedo, 2025) & (Habib, Amin, & Khan, 2026), create a more different and complex level playing field for participants in international business (and their supply chains).

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Appendix I Factors of production in schools of economic thought

Production factors (Schools of economic thought)		
Traditional production factors (Samuelson, 1973)	**Six capitals (Gleeson-White, 2014 & IIRC)**	**Triple P (Elkington, 1997) & Doughnut Economics (Raworth, 2017)**

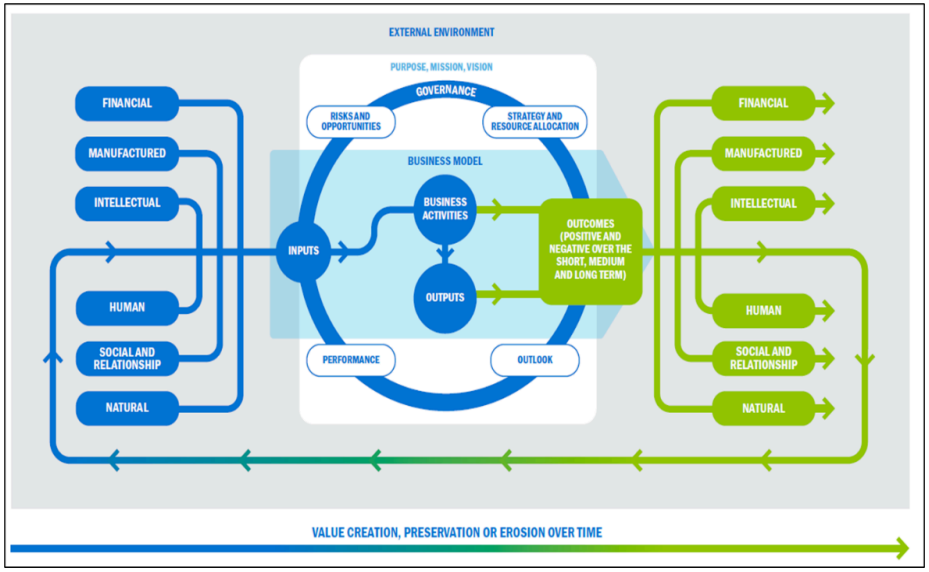
Nature
• Natural resources
• Ecosystem
  • Water
  • Air
  • Land
	Natural capital (1)	Planet
		• Planetary boundaries
		• Stewardship

Labour
• Manual labour
• Intellectual labour
	Intellectual capital (2)
	Human capital (3)
	Social & Relationship capital (4)
		People
		• Social boundaries
		• Labour ethics
		  • Slavery
		  • Exploitation / Underpayment
		  • Child labour

• Capital
• Private owned
  • Physical capital
  • Financial capital
• Public-owned
  • Infrastructure
	Financial capital (5)
	Manufactured capital (6)
		Profit
		• Ethical boundaries
		• Rhineland business model
		  • Long-term orientation
		  • Stakeholders' value
		  • Financial goals
		  • Non-Financial goals
		  • Stewardship

Entrepreneurship • Combining production factors • Risk • Innovation		

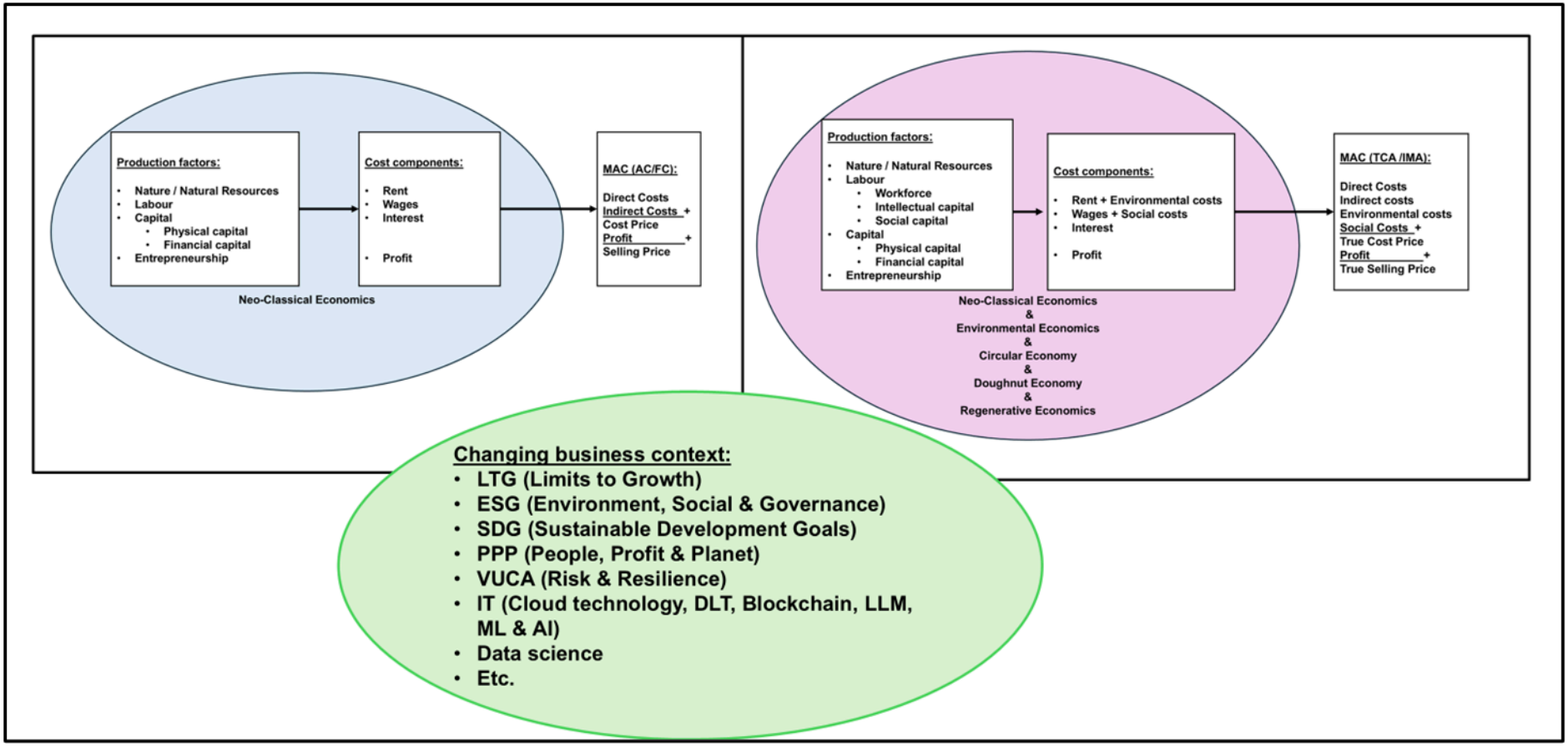
Appendix II <IR> Framework (IIRC, 2021)



Appendix III IMA Management Accounting Framework (2023)

Domains	**Competencies**
Strategy, Planning & Performance	• Strategic and Tactical Planning • Decision Analysis • Strategic Cost Management • Capital Investment Decisions • Enterprise Risk Management • Budgeting and Forecasting • Corporate Finance • Performance Management
Reporting & Control	• Internal Control • Financial Recordkeeping • Cost Accounting • Financial Statement Preparation • Financial Statement Analysis • Tax Compliance and Planning • Integrated Reporting
Business Acumen & Operations	• Industry-Specific Knowledge • Operational Knowledge • Quality Management and Continuous Improvement • Project Management
Technology & Analytics	• Information Systems • Data Governance • Data Analytics • Data Visualization
Leadership	• Communication Skills • Motivating and Inspiring Others • Collaboration, Teamwork, and Relationship Management • Change Management • Conflict Management • Negotiation • Talent Management
Professional Ethics & Values	• Professional Ethical Behaviour • Recognizing and Resolving Unethical Behaviour • Legal and Regulatory Requirements

Appendix IV **Endogenous and exogenous factors that play a role in management accounting's development**



Appendix V True Pricing Scenarios at retail level

						Scenario I			Scenario II			Scenario III			
					Cost Price	€ 12,98			€ 12,98			€ 12,98			
					Social Costs	€ 6,01			€ 6,01			€ 6,01			
					Environmental Costs	€ 7,95			€ 7,95			€ 7,95			
Traditional Cost Price															
Cost Price	€ 12,98	73%	100%		**True Cost Price**	**€ 26,94**	100%		**€ 26,94**	100%		**€ 26,94**	100%		
Profit Margin	€ 4,80	27%	37%		Profit Margin	€ 4,80	18%		€ 9,96	37%		€ 2,40	9%		
Selling Price	**€ 17,78**	100%	137%		Selling Price	**€ 31,74**	118%		**€ 36,90**	137%		**€ 29,34**	109%		

In this appendix, three scenarios are calculated to show the consequences at the retail level for consumer prices (Excl. VAT) for 1 kg of coffee of € 17,78 (Albert Heijn, 2026). To calculate the (gross) profit margin, first the *'Cost of Sales'* (73%) were calculated from the 2024 Annual Report of Ahold-Delhaize (2025) and related to the *'Net Sales'* (100%), so the *'Gross Proft (Margin)'* was 27%. This resulted in a profit margin in currency of € 4,80 per kg of coffee beans.

Based on data of the coffee market from True Price Organisation (2026), the social costs of € 6,01 and the environmental costs of € 7,95 were used to calculate the True Price Gap of € 13,96 (=€ 6,01 + € 7,95) for 1 kg of coffee beans.

In the three scenarios the profit margin in currency stayed the same (Scenario I), the profit margin in percentages stayed the same (Scenario II) and the profit margin in currency and as percentage were lower (Scenario III). In all three scenarios the final customer paid more than the original retail price of € 17,78.

Appendix VI General true cost accounting model for the coffee supply chain

	True Cost Accounting (TCA) or Integrated Management Accounting (IMA)							
	Traditional cost price Full costing or Absorption costing							
	Direct costs	**Indirect costs**	**Social costs**	**Environmental costs**	**Profit margin**	**True price**		**Added value**
1 Farmers	C_1	$\alpha*C_1$	S_1	E_1	M_1	$P_1= C_1(1+\alpha)+S_1+E_1+M_1$		$P_1 - 0$
2 Syndicates	C_2	$\beta*C_2$	S_2	E_2	M_2	$P_2= C_2(1+\beta)+S_2+E_2+M_2$		$P_2 - P_1$
3 Exporter	C_3	$\gamma*C_3$	S_3	E_3	M_3	$P_3= C_3(1+\gamma)+S_3+E_3+M_3$		$P_3 - P_2$
4 Importer & Factory	C_4	$\delta*C_4$	S_4	E_4	M_4	$P_4= C_4(1+\delta)+S_4+E_4+M_4$		$P_4 - P_3$
5 Wholesale	C_5	$\varepsilon*C_5$	S_5	E_5	M_5	$P_5= C_5(1+\varepsilon)+S_5+E_5+M_5$		$P_5 - P_4$
6 Retail	C_6	$\eta*C_6$	S_6	E_6	M_6	$P_6= C_6(1+\eta)+S_6+E_6+M_6$		$P_6 - P_5$
								P_6

C_i = Direct costs of a company in the supply chain

Indirect cost factors: α, β, γ, δ, ε, and η (expressed in terms of direct costs)

S_i = Social costs of a company in the supply chain

E_i = Environmental costs of a company in the supply chain

M_i = Profit margin of a company in the supply chain

Pi = True price of a company in the supply chain

This supply chain consists of six companies, so i = 1, 2, 3 … 6