

# Managerial Accounting

## Methods and Functions

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Management accounting . . . . .	1
1.1.1	Definition . . . . .	1
1.1.2	Scope, practice, and application . . . . .	1
1.1.3	Differences between financial accountancy and management accounting . . . . .	2
1.1.4	Traditional vs. innovative practices . . . . .	2
1.1.5	Role within a corporation . . . . .	3
1.1.6	Specific methodologies . . . . .	3
1.1.7	Resources and continuous learning . . . . .	4
1.1.8	Tasks/services provided . . . . .	4
1.1.9	Related qualifications . . . . .	5
1.1.10	Methods . . . . .	5
1.1.11	See also . . . . .	5
1.1.12	References . . . . .	5
1.1.13	External links . . . . .	6
1.2	Comparison of management accounting and financial accounting . . . . .	6
1.2.1	Regulation and standardization . . . . .	6
1.2.2	Time Period . . . . .	6
1.2.3	Other differences . . . . .	7
1.2.4	References . . . . .	7
1.3	Financial accounting . . . . .	7
1.3.1	Objectives of financial accounting . . . . .	7
1.3.2	Qualities of financial accounting . . . . .	7
1.3.3	Three components of financial statements . . . . .	8
1.3.4	Basic accounting concepts . . . . .	8
1.3.5	Graphic definition . . . . .	9
1.3.6	Financial accounting vs cost accounting . . . . .	9
1.3.7	Related qualification . . . . .	10
1.3.8	See also . . . . .	10
1.3.9	Further reading . . . . .	10
1.3.10	References . . . . .	10
<b>2</b>	<b>Methods</b>	<b>11</b>

2.1	Standard cost accounting	11
2.1.1	Overview	11
2.1.2	History	11
2.1.3	Standard cost accounting, topics	11
2.1.4	See also	12
2.1.5	References	12
2.1.6	Further reading	12
2.2	Cost accounting	12
2.2.1	Origins	13
2.2.2	Cost Accounting vs Financial Accounting	13
2.2.3	Types of cost accounting	13
2.2.4	Elements of cost	14
2.2.5	Classification of costs	14
2.2.6	Standard cost accounting	15
2.2.7	The development of throughput accounting	15
2.2.8	Activity-based costing	15
2.2.9	Integrating EVA and Process Based Costing	16
2.2.10	Lean accounting	16
2.2.11	Marginal costing	16
2.2.12	See also	17
2.2.13	References	17
2.2.14	Further reading	17
2.2.15	External links	17
2.3	Variance (accounting)	17
2.3.1	Types of variances	17
2.3.2	Variance Analysis	18
2.3.3	See also	18
2.4	Whole-life cost	18
2.4.1	Financial	18
2.4.2	Environmental and social	18
2.4.3	Whole-life cost topics	19
2.4.4	IT industry usage	19
2.4.5	Automobile industry, finances	20
2.4.6	See also	20
2.4.7	References	20
2.4.8	Further reading	20
2.4.9	External links	20
2.5	Activity-based costing	20
2.5.1	Objectives	20
2.5.2	Prevalence	21
2.5.3	Methodology	22

2.5.4	Application	22
2.5.5	Implementation	22
2.5.6	Integrating EVA and Process Based Costing	23
2.5.7	Limitations	23
2.5.8	References	23
2.5.9	External links	24
2.6	Grenzplankostenrechnung	24
2.6.1	Background	24
2.6.2	Concepts of GPK	24
2.6.3	Core elements of GPK	25
2.6.4	GPK marginal costing diagram	26
2.6.5	References	26
2.6.6	External links	27
2.7	Resource consumption accounting	27
2.7.1	Background	27
2.7.2	Concepts of Resource Consumption Accounting	28
2.7.3	The Core Elements of RCA	28
2.7.4	Additional information	28
2.7.5	References	28
2.7.6	External links	29
2.8	Throughput accounting	29
2.8.1	History	30
2.8.2	The concepts of Throughput Accounting	30
2.8.3	Explanation	31
2.8.4	Relevance	31
2.8.5	References	32
2.9	Lean accounting	32
2.9.1	Introduction	32
2.9.2	Getting Started	34
2.9.3	Financial Reports for Lean Operations	35
2.9.4	Making Decisions without the Use of Product or Process Costs	36
2.9.5	External Reporting	37
2.9.6	Further Simplifying the Accounting Processes	37
2.9.7	Focusing on Customer Value	38
2.9.8	External links	38
2.9.9	References	38
2.10	Funds transfer pricing	38
2.10.1	External links	39
<b>3</b>	<b>Functions</b>	<b>40</b>
3.1	Operations research	40
3.1.1	Overview	40

3.1.2	History . . . . .	40
3.1.3	Problems addressed . . . . .	43
3.1.4	Management science . . . . .	43
3.1.5	Societies and journals . . . . .	44
3.1.6	See also . . . . .	45
3.1.7	References . . . . .	45
3.1.8	Notes . . . . .	46
3.1.9	Further reading . . . . .	46
3.1.10	External links . . . . .	47
3.2	IT cost transparency . . . . .	47
3.2.1	Capabilities . . . . .	48
3.2.2	Analysts' take . . . . .	48
3.2.3	IT Cost Breakdown . . . . .	48
3.2.4	See also . . . . .	48
3.2.5	References . . . . .	49
3.2.6	External links . . . . .	49
3.3	Transfer pricing . . . . .	49
3.3.1	Profit allocation . . . . .	49
3.3.2	Economic theory . . . . .	50
3.3.3	General tax principles . . . . .	51
3.3.4	U.S. specific tax rules . . . . .	56
3.3.5	OECD specific tax rules . . . . .	57
3.3.6	EU . . . . .	57
3.3.7	China specific tax rules . . . . .	57
3.3.8	Agreements between taxpayers and governments and dispute resolution . . . . .	58
3.3.9	Fraud . . . . .	58
3.3.10	Reading and overall reference list . . . . .	59
3.3.11	References . . . . .	59
3.3.12	External links . . . . .	61
3.4	Cost–benefit analysis . . . . .	61
3.4.1	Theory . . . . .	61
3.4.2	Process . . . . .	62
3.4.3	Evaluation . . . . .	62
3.4.4	Time and discounting . . . . .	62
3.4.5	Risk and uncertainty . . . . .	63
3.4.6	History . . . . .	63
3.4.7	Accuracy . . . . .	64
3.4.8	See also . . . . .	65
3.4.9	References . . . . .	65
3.4.10	Further reading . . . . .	66
3.4.11	External links . . . . .	67

3.5	Cost–volume–profit analysis . . . . .	67
3.5.1	Overview . . . . .	67
3.5.2	Assumptions . . . . .	67
3.5.3	Model . . . . .	67
3.5.4	Applications . . . . .	68
3.5.5	Limitations . . . . .	68
3.5.6	See also . . . . .	69
3.5.7	Notes . . . . .	69
3.6	Capital budgeting . . . . .	69
3.6.1	Net present value . . . . .	69
3.6.2	Internal rate of return . . . . .	69
3.6.3	Equivalent annuity method . . . . .	70
3.6.4	Real options . . . . .	70
3.6.5	Ranked projects . . . . .	70
3.6.6	Funding sources . . . . .	70
3.6.7	Need for capital budgeting . . . . .	70
3.6.8	See also . . . . .	71
3.6.9	External links and references . . . . .	71
3.7	Strategic planning . . . . .	71
3.7.1	Process . . . . .	71
3.7.2	Tools and approaches . . . . .	72
3.7.3	Strategic planning vs. financial planning . . . . .	73
3.7.4	Criticism . . . . .	73
3.7.5	See also . . . . .	74
3.7.6	References . . . . .	74
3.7.7	Strategic plan examples . . . . .	74
3.7.8	Further reading . . . . .	74
3.8	Sales operations . . . . .	75
3.8.1	Sales targets . . . . .	75
3.8.2	Sales territory . . . . .	75
3.8.3	Sales forecasting . . . . .	75
3.8.4	See also . . . . .	76
3.8.5	References and notes . . . . .	76
3.8.6	External links . . . . .	76
3.9	Financial forecast . . . . .	76
3.9.1	Tools . . . . .	76
3.9.2	References . . . . .	76
3.10	Budget . . . . .	76
3.10.1	Etymology . . . . .	76
3.10.2	Purpose . . . . .	77
3.10.3	Corporate budget . . . . .	77

3.10.4	Event management budget	77
3.10.5	Government budget	78
3.10.6	Personal or family budget	78
3.10.7	Budget types	78
3.10.8	See also	79
3.10.9	References	79
3.10.10	External links	79
3.11	Cost allocation	79
<b>4</b>	<b>Addenda</b>	<b>81</b>
4.1	Profit model	81
4.1.1	Basic model	81
4.1.2	Background	81
4.1.3	Model extensions	82
4.1.4	See also	85
4.1.5	References	85
4.1.6	Further reading	85
4.2	Management information system	85
4.2.1	Management	85
4.2.2	History	86
4.2.3	Types and terminology	86
4.2.4	Advantages	87
4.2.5	Enterprise applications	87
4.2.6	Development	87
4.2.7	See also	87
4.2.8	References	88
4.2.9	External links	88
4.3	Institute of Management Accountants	88
4.3.1	Timeline	88
4.3.2	CMA (Certified Management Accountant)	89
4.3.3	Journal	89
4.3.4	See also	89
4.3.5	References	89
4.3.6	External links	89
<b>5</b>	<b>Text and image sources, contributors, and licenses</b>	<b>90</b>
5.1	Text	90
5.2	Images	94
5.3	Content license	96

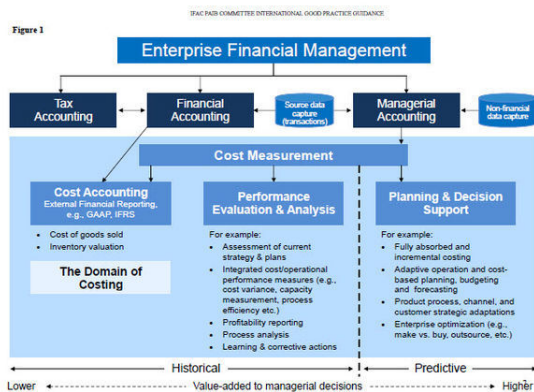
# Chapter 1

## Introduction

### 1.1 Management accounting

In **Management accounting or managerial accounting**, managers use the provisions of accounting information in order to better inform themselves before they decide matters within their organizations, which aids their management and performance of control functions.

#### 1.1.1 Definition



IFAC Definition of enterprise financial management concerning three broad areas: cost accounting; performance evaluation and analysis; planning and decision support. Managerial accounting is associated with higher value, more predictive information.<sup>[1]</sup> Copyright July 2009, International Federation of Accountants

One simple definition of management accounting is the provision of financial and non-financial decision-making information to managers.<sup>[2]</sup>

According to the Institute of Management Accountants (IMA): “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 organization’s strategy.”<sup>[3]</sup>

#### 1.1.2 Scope, practice, and application

The American Institute of Certified Public Accountants (AICPA) states that management accounting as practice extends to the following three areas:

- Strategic management—advancing the role of the management accountant as a strategic partner in the organization.
- Performance management—developing the practice of business decision-making and managing the performance of the organization.
- Risk management—contributing to frameworks and practices for identifying, measuring, managing and reporting risks to the achievement of the objectives of the organization.

The Institute of Certified Management Accountants (CMA) states “A management accountant applies his or her professional knowledge and skill in the preparation and presentation of financial and other decision oriented information in such a way as to assist management in the formulation of policies and in the planning and control of the operation of the undertaking”. Management accountants therefore are seen as the “value-creators” amongst the accountants. They are more concerned with forward looking and taking decisions that will affect the future of the organization, than in the historical recording and compliance (score keeping) aspects of the profession. Management accounting knowledge and experience can therefore be obtained from varied fields and functions within an organization, such as information management, treasury, efficiency auditing, marketing, valuation, pricing and logistics. In 2014 CIMA created the Global Management Accounting Principles (GMAPs). The result of research from across 20 countries in five continents, the principles aim to guide best practice in the discipline.<sup>[4]</sup>



### 1.1.3 Differences between financial accountancy and management accounting

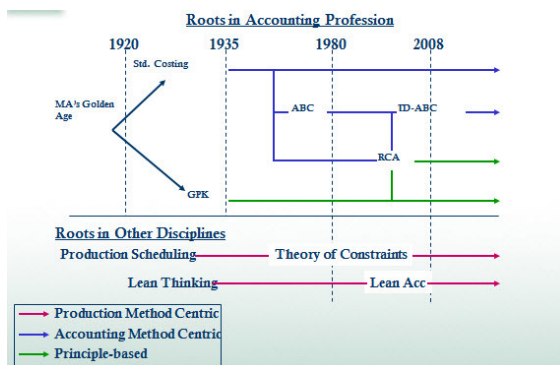
Management accounting information differs from financial accountancy information in several ways:

- while shareholders, creditors, and public regulators use publicly reported financial accountancy information, only managers within the organization use the normally confidential management accounting information;
- while financial accountancy information is historical, management accounting information is primarily forward-looking;
- while financial accountancy information is case-based, management accounting information is model-based with a degree of abstraction in order to support generic decision making;
- while financial accountancy information is computed by reference to general financial accounting standards, management accounting information is computed by reference to the needs of managers, often using management information systems.

Focus : Financial accounting focusses on the company as a whole .

Management accounting provides detailed and disaggregated information about products, individual activities, divisions, plants, operations and tasks.

### 1.1.4 Traditional vs. innovative practices



Managerial costing time line<sup>[5]</sup> Used with permission by the author A.van der Merwe Copyright 2011 All Rights Reserved.

The distinction between **traditional** and **innovative** accounting practices is perhaps best illustrated with the visual timeline (*see sidebar*) of managerial costing approaches presented at the Institute of Management Accountants 2011 Annual Conference.

Traditional standard costing (TSC), used in cost accounting, dates back to the 1920s and is a central method in management accounting practiced today because it is used for financial statement reporting for the valuation of income statement and balance sheet line items such as cost of goods sold (COGS) and inventory valuation. Traditional standard costing must comply with generally accepted accounting principles (GAAP US) and actually aligns itself more with answering financial accounting requirements rather than providing solutions for management accountants. Traditional approaches limit themselves by defining cost behavior only in terms of production or sales volume.

In the late 1980s, accounting practitioners and educators were heavily criticized on the grounds that management accounting practices (and, even more so, the curriculum taught to accounting students) had changed little over the preceding 60 years, despite radical changes in the business environment. In 1993, the Accounting Education Change Commission Statement Number 4<sup>[6]</sup> calls for faculty members to expand their knowledge about the actual practice of accounting in the workplace.<sup>[7]</sup> Professional accounting institutes, perhaps fearing that management accountants would increasingly be seen as superfluous in business organizations, subsequently devoted considerable resources to the development of a more innovative skills set for management accountants.

Variance analysis is a systematic approach to the comparison of the actual and budgeted costs of the raw materials and labour used during a production period. While some form of variance analysis is still used by most manufacturing firms, it nowadays tends to be used in conjunction with innovative techniques such as *life cycle cost analysis* and *activity-based costing*, which are designed with specific aspects of the modern business environment in mind. *Life-cycle costing* recognizes that managers' ability to influence the cost of manufacturing a product is at its greatest when the product is still at the design stage of its product life-cycle (i.e., before the design has been finalized and production commenced), since small changes to the product design may lead to significant savings in the cost of manufacturing the products.

Activity-based costing (ABC) recognizes that, in modern factories, most manufacturing costs are determined by the amount of 'activities' (e.g., the number of production runs per month, and the amount of production equipment idle time) and that the key to effective cost control is therefore optimizing the efficiency of these activities. Both lifecycle costing and activity-based costing recognize that, in the typical modern factory, the avoidance of disruptive events (such as machine breakdowns and quality control failures) is of far greater importance than (for example) reducing the costs of raw materials. Activity-based costing also deemphasizes direct labor as a cost driver and concentrates instead on activities that drive costs, as the provision of a service or the production of a product component.

Other approach that can be viewed as innovative to the U.S. is the German approach, **Grenzplankostenrechnung** (GPK). Although it has been in practiced in Europe for more than 50 years, neither GPK nor the proper treatment of 'unused capacity' is widely practiced in the U.S. GPK and the concept of unused capacity is slowly becoming more recognized in America, and *"could easily be considered 'advanced' by U.S. standards"*.<sup>[8]</sup>

One of the more innovative accounting practices available today is **resource consumption accounting** (RCA). RCA has been recognized by the **International Federation of Accountants** (IFAC) as a *"sophisticated approach at the upper levels of the continuum of costing techniques"*<sup>[9]</sup> because it provides the ability to derive costs directly from operational resource data or to isolate and measure unused capacity costs. RCA was derived by taking the best costing characteristics of the German management accounting approach **Grenzplankostenrechnung** (GPK), and combining the use of activity-based drivers when needed, such as those used in activity-based costing. With the RCA approach, resources and their costs are considered as *"foundational to robust cost modeling and managerial decision support, because an organization's costs and revenues are all a function of the resources and the individual capacities that produce them"*.<sup>[9]</sup>

### 1.1.5 Role within a corporation

Consistent with other roles in modern corporations, management accountants have a dual reporting relationship. As a strategic partner and provider of decision based financial and operational information, management accountants are responsible for managing the business team and at the same time having to report relationships and responsibilities to the corporation's finance organization and finance of an organization.

The activities management accountants provide inclusive of forecasting and planning, performing variance analysis, reviewing and monitoring costs inherent in the business are ones that have dual accountability to both finance and the business team. Examples of tasks where accountability may be more meaningful to the business management team vs. the corporate finance department are the development of new product costing, **operations research**, business driver metrics, sales management scorecarding, and client profitability analysis. (See **Financial modeling**.) Conversely, the preparation of certain financial reports, reconciliations of the financial data to source systems, risk and regulatory reporting will be more useful to the corporate finance team as they are charged with aggregating certain financial information from all segments of the corporation.

In corporations that derive much of their profits from the information economy, such as banks, publishing houses, telecommunications companies and defence contractors, IT costs are a significant source of uncontrollable spend-

ing, which in size is often the greatest corporate cost after total compensation costs and property related costs. A function of management accounting in such organizations is to work closely with the IT department to provide **IT cost transparency**.<sup>[10]</sup>

Given the above, one view of the progression of the accounting and finance career path is that financial accounting is a stepping stone to management accounting. Consistent with the notion of value creation, management accountants help drive the success of the business while strict financial accounting is more of a compliance and historical endeavor.

### 1.1.6 Specific methodologies

#### Activity-based costing (ABC)

Main article: [Activity-based costing](#)

Activity-based costing was first clearly defined in 1987 by Robert S. Kaplan and W. Bruns as a chapter in their book **Accounting and Management: A Field Study Perspective**. They initially focused on the manufacturing industry, where increasing technology and productivity improvements have reduced the relative proportion of the direct costs of labor and materials, but have increased relative proportion of indirect costs. For example, increased automation has reduced labor, which is a direct cost, but has increased depreciation, which is an indirect cost.

#### Grenzplankostenrechnung (GPK)

Main article: [Grenzplankostenrechnung\\_\(GPK\)](#)

**Grenzplankostenrechnung** is a German costing methodology, developed in the late 1940s and 1960s, designed to provide a consistent and accurate application of how managerial costs are calculated and assigned to a product or service. The term **Grenzplankostenrechnung**, often referred to as GPK, has best been translated as either *marginal planned cost accounting*<sup>[11]</sup> or *flexible analytic cost planning and accounting*.<sup>[12]</sup>

The origins of GPK are credited to Hans Georg Plaut, an automotive engineer, and Wolfgang Kilger, an academic, working towards the mutual goal of identifying and delivering a sustained methodology designed to correct and enhance cost accounting information. GPK is published in cost accounting textbooks, notably *Flexible Plankostenrechnung und Deckungsbeitragsrechnung*<sup>[13]</sup> and taught at German-speaking universities.

#### Lean accounting (accounting for lean enterprise)

Main article: [Lean accounting](#)

In the mid- to late-1990s several books were written about accounting in the lean enterprise (companies implementing elements of the **Toyota Production System**). The term *lean accounting* was coined during that period. These books contest that traditional accounting methods are better suited for mass production and do not support or measure good business practices in just-in-time manufacturing and services. The movement reached a tipping point during the 2005 Lean Accounting Summit in Dearborn, Michigan, United States. 320 individuals attended and discussed the advantages of a new approach to accounting in the lean enterprise. 520 individuals attended the 2nd annual conference in 2006 and it has varied between 250 and 600 attendees since that time.

### Resource consumption accounting (RCA)

Main article: Resource Consumption Accounting

Resource consumption accounting (RCA) is formally defined as a dynamic, fully integrated, principle-based, and comprehensive management accounting approach that provides managers with decision support information for enterprise optimization. RCA emerged as a management accounting approach around 2000 and was subsequently developed at CAM-I the Consortium for Advanced Manufacturing–International, in a *Cost Management Section RCA interest group* in December 2001.

### Throughput accounting

Main article: Throughput accounting

The most significant recent direction in managerial accounting is throughput accounting; which recognizes the interdependencies of modern production processes. For any given product, customer or supplier, it is a tool to measure the contribution per unit of constrained resource.

### Transfer pricing

Main article: Transfer pricing

Management accounting is an applied discipline used in various industries. The specific functions and principles followed can vary based on the industry. Management accounting principles in banking are specialized but do have some common fundamental concepts used whether the industry is manufacturing-based or service-oriented. For example, transfer pricing is a concept used in manufacturing but is also applied in banking. It is a fundamental principle used in assigning value and revenue attribution to the various business units. Essentially, transfer pricing in banking is the method of assigning the interest rate risk

of the bank to the various funding sources and uses of the enterprise. Thus, the bank's corporate treasury department will assign funding charges to the business units for their use of the bank's resources when they make loans to clients. The treasury department will also assign funding credit to business units who bring in deposits (resources) to the bank. Although the **funds transfer pricing** process is primarily applicable to the loans and deposits of the various banking units, this proactive is applied to all assets and liabilities of the business segment. Once transfer pricing is applied and any other management accounting entries or adjustments are posted to the ledger (which are usually memo accounts and are not included in the legal entity results), the business units are able to produce segment financial results which are used by both internal and external users to evaluate performance.

## 1.1.7 Resources and continuous learning

There are a variety of ways to keep current and continue to build one's knowledge base in the field of management accounting. Certified Management Accountants (CMAs) are required to achieve continuing education hours every year, similar to a Certified Public Accountant. A company may also have research and training materials available for use in a corporate owned library. This is more common in "Fortune 500" companies who have the resources to fund this type of training medium.

There are also journals, online articles and blogs available. The journal *Cost Management* (ISSN 1092-8057)<sup>[14]</sup> and the Institute of Management Accounting (IMA) site are sources which includes *Management Accounting Quarterly* and *Strategic Finance* publications.

## 1.1.8 Tasks/services provided

Listed below are the primary tasks/services performed by management accountants. The degree of complexity relative to these activities are dependent on the experience level and abilities of any one individual.

- Rate and volume analysis
- Business metrics development
- Price modeling
- Product profitability
- Geographic vs. industry or client segment reporting
- Sales management scorecards
- Cost analysis
- Cost–benefit analysis
- Cost-volume-profit analysis

- Life cycle cost analysis
- Client profitability analysis
- IT cost transparency
- Capital budgeting
- Buy vs. lease analysis
- Strategic planning
- Strategic management advice
- Internal financial presentation and communication
- Sales forecasting
- Financial forecasting
- Annual budgeting
- Cost allocation

### 1.1.9 Related qualifications

There are several related professional qualifications and certifications in the field of accountancy including:

- Management Accountancy Qualifications
  - CIMA
  - ICMA
  - ICAI
  - CMA
- Other Professional Accountancy Qualifications
  - Chartered Institute of Public Finance and Accountancy, CIPFA
  - Chartered Certified Accountant, (ACCA)
  - Chartered Accountant, (CA)
  - Certified Public Accountant, (CPA)
    - American Institute of Certified Public Accountants
  - Certified Practising Accountant (CPA Australia)
  - Chartered Global Management Accountant

### 1.1.10 Methods

- Activity-based costing
- Grenzplankostenrechnung (GPK)
- Lean accounting
- Resource Consumption Accounting
- Standard cost accounting
- Throughput accounting
- Transfer pricing

### 1.1.11 See also

- Differences between managerial accounting and financial accounting
- Managerial risk accounting
- Profit model

### 1.1.12 References

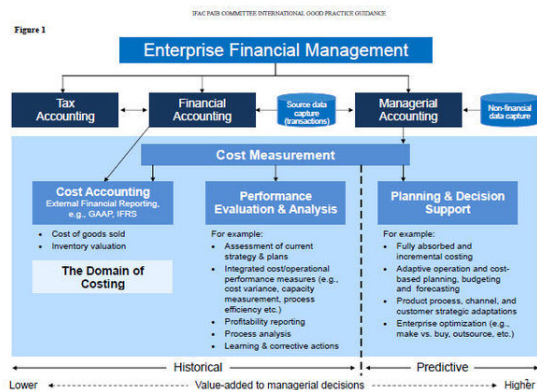
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### 1.1.13 External links

- CAM-I Consortium for Advanced Manufacturing–International
- AICPA Financial Management Center – Resource for CPAs working in business, industry and government.
- Institute of Management Accountants – Resource for Management accountants (CMA's) working in industry.
- Chartered Institute of Management Accountants – Chartered Institute of Management Accountants
- – International Federation of Accountants
- – The Accounting Adventurista Management Accounting

## 1.2 Comparison of management accounting and financial accounting



The structure of accounting as documented by the International Federation of Accountants

The differences between management accounting and financial accounting include:<sup>[1]</sup>

1. Management accounting provides information to people within an organization while financial accounting is mainly for those outside it, such as shareholders
2. Financial accounting is required by law while management accounting is not. Specific standards and formats may be required for statutory accounts such as in the I.A.S International Accounting Standard within Europe.
3. Financial accounting covers the entire organization while management accounting may be concerned with particular products or cost centres.

Managerial accounting is used primarily by those within a company or organization. Reports can be generated for any period of time such as daily, weekly or monthly. Reports are considered to be “future looking” and have forecasting value to those within the company.

Financial accounting is used primarily by those outside of a company or organization. Financial reports are usually created for a set period of time, such as a financial year or period. Financial reports are historically factual and have predictive value to those who wish to make financial decisions or investments in a company. Management Accounting is the branch of Accounting that deals primarily with confidential financial reports for the exclusive use of top management within an organization. These reports are prepared utilizing scientific and statistical methods to arrive at certain monetary values which are then used for decision making. Such reports may include:

- Sales Forecasting reports
- Budget analysis and comparative analysis
- Feasibility studies
- Merger and consolidation reports

Financial Accounting, on the other hand, concentrates on the production of financial reports, including the basic reporting requirements of profitability, liquidity, solvency and stability. Reports of this nature can be accessed by internal and external users such as the shareholders, the banks and the creditors.

### 1.2.1 Regulation and standardization

While financial accountants follow Generally Accepted Accounting Principles set by professional bodies in each country or International Financial Reporting Standards, managerial accountants make use of procedures and processes that are not regulated by a standard-setting bodies.

Multinational companies prefer to employ managerial accountants who have a widely recognised certification such as CGMA, Chartered Global Management Accountant certified by the AICPA and CIMA, ACMA certified by the Institute of Cost Accountants of India, Chartered Management Accountant certified by the Chartered Institute of Management Accountants, or CMA, Certified Management Accountant certified by the Institute of Management Accountants.

### 1.2.2 Time Period

Managerial Accounting provides top management with reports that are future-oriented, while Financial Accounting provides reports based on historical information. There is no time span for producing managerial accounting statements but financial accounting statements are

generally required to be produced for the period of 12 previous months.

### 1.2.3 Other differences

- There is no legal requirement for an organization to use management accounting, but publicly traded firms (limited companies or whose shares are bought and sold on an open market) must, by law, prepare financial account statements.
- In management accounting systems there is no requirement for an independent external review but financial accounting annual statements must be audited by an independent CPA firm.
- In management accounting systems, management may be concerned about how reports will affect employees behavior whereas financial management concerns are about the adequacy of disclosure in financial statements.

### 1.2.4 References

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## 1.3 Financial accounting

**Financial accounting** (or **financial accountancy**) is the field of accounting concerned with the summary, analysis and reporting of financial transactions pertaining to a business.<sup>[1]</sup> This involves the preparation of financial statements available for public consumption. Stockholders, suppliers, banks, employees, government agencies, business owners, and other stakeholders are examples of people interested in receiving such information for decision making purposes.

Financial accountancy is governed by both local and international accounting standards. **Generally Accepted Accounting Principles (GAAP)** is the standard framework of guidelines for financial accounting used in any given jurisdiction. It includes the standards, conventions and rules that accountants follow in recording and summarising and in the preparation of financial statements. On the other hand, **International Financial Reporting Standards (IFRS)** is a set of international accounting standards stating how particular types of transactions and other events should be reported in financial statements. IFRS are issued by the **International Accounting Standards Board (IASB)**.<sup>[2][3]</sup> With IFRS becoming more widespread on the international scene, *consistency* in financial reporting has become more prevalent between global organisations.

While financial accounting is used to prepare accounting information for people outside the organisation or not involved in the day-to-day running of the company, **management accounting** provides accounting information to help managers make decisions to manage the business.

### 1.3.1 Objectives of financial accounting

Financial accounting and financial reporting are often used as synonyms.

1. According to International Financial Reporting Standards, the objective of financial reporting is:

To provide financial information about the reporting entity that is useful to existing and potential investors, lenders and other creditors in making decisions about providing resources to the entity.<sup>[4]</sup>

2. According to the European Accounting Association:

Capital maintenance is a competing objective of financial reporting.<sup>[5]</sup>

### 1.3.2 Qualities of financial accounting

Financial accounting is the preparation of financial statements that can be consumed by the public and the relevant stakeholders using either HCA or CPPA. When producing financial statements, they must comply to the following:<sup>[6]</sup>

- **Relevance:** Financial accounting which is decision-specific. It must be possible for accounting information to influence decisions. Unless this characteristic is present, there is no point in cluttering statements.
- **Materiality:** information is material if its omission or misstatement could influence the economic decisions of users taken on the basis of the financial statements.
- **Reliability:** accounting must be free from significant error or bias. It should be capable to be relied upon by managers. Often information that is highly relevant isn't very reliable, and vice versa.
- **Understandability:** accounting reports should be expressed as clearly as possible and should be understood by those at whom the information is aimed.
- **Comparability:** financial reports from different periods should be comparable with one another in order to derive meaningful conclusions about the trends in an entity's financial performance and position over time. Comparability can be ensured by applying the same accounting policies over time.

### 1.3.3 Three components of financial statements

#### Statement of Cash Flows

The Statement of Cash Flows considers the inputs and outputs in concrete cash within a stated period. The general template of a cash flow statement is as follows: *Cash Inflow - Cash Outflow + Opening Balance = Closing Balance* Example 1: in the beginning of September, Ellen started out with \$5 in her bank account. During that same month, Ellen borrowed \$20 from Tom. At the end of the month, Ellen bought a pair of shoes for \$7. Ellen's cash flow statement for the month of September looks like this:

- Cash inflow: \$20
- Cash outflow: \$7
- Opening balance: \$5
- **Closing balance: \$20 – \$7 + \$5 = \$18**

Example 2: in the beginning of June, WikiTables, a company that buys and resells tables, sold 2 tables. They'd originally bought the tables for \$25 each, and sold them at a price of \$50 per table. The first table was paid out in cash however the second one was bought in credit terms. WikiTables' cash flow statement for the month of June looks like this:

- Cash inflow: \$50 - *How much WikiTables received in cash for the first table. They didn't receive cash for the second table (sold in credit terms).*
- Cash outflow: \$50 - *How much they'd originally bought the 2 tables for.*
- Opening balance: \$0
- **Closing balance: \$50 – \$50 + \$0 = \$0 - Indeed, the cash flow for the month of June for WikiTables amounts to \$0 and not \$50.**

Important: the cash flow statement only considers the exchange of **actual** cash, and ignores what the person in question owes or is owed.

#### Profit and Loss Statement (also called Statement of Comprehensive Income)

In case of service organisations they are called as profit&loss a/c as income statement.

the profit or loss is determined by :

Sales (revenue) – Cost of Sales – total expenses + total income – tax paid = profit/loss

- If there's a negative balance , it's a loss
- if there's a positive balance , it's a profit

#### Statement of Financial Condition (also called Balance Sheet)

The balance sheet is the statement showing assets & liabilities. As per the proforma on its right it shows assets and on its left side it shows liabilities. It helps know the status of a company. The difference between current assets and current liabilities is called working capital. The assets and liabilities are mainly divided into 2 types:

1. *fixed assets* and
2. *current assets*

The liabilities are

1. *long term liabilities* and
2. *short term liabilities or current liabilities.*

The statements assist detailed study and analysis in each segment. For suppose in case of if you analyse the income or profit and loss statement that means you analyse the real meaning to how much earned or sustained loss when compare to last financial year to this year.

### 1.3.4 Basic accounting concepts

#### THE STABLE MEASURING UNIT ASSUMPTION

One of the basic principles in accounting is "The Measuring Unit principle:

The unit of measure in accounting shall be the base money unit of the most relevant currency. This principle also assumes the unit of measure is stable; that is, changes in its general purchasing power are not considered sufficiently important to require adjustments to the basic financial statements."<sup>[7]</sup>

Historical Cost Accounting, i.e., financial capital maintenance in nominal monetary units, is based on the stable measuring unit assumption under which accountants simply assume that money, the monetary unit of measure, is perfectly stable in real value for the purpose of measuring (1) monetary items not inflation-indexed daily in terms of the Daily CPI and (2) constant real value non-monetary items not updated daily in terms of the Daily CPI during low and high inflation and deflation.

#### UNITS OF CONSTANT PURCHASING POWER

The stable measuring unit assumption is not applied during hyperinflation. IFRS requires entities to implement capital maintenance in units of constant purchasing power in terms of IAS 29 Financial Reporting in Hyperinflationary Economies.

Financial accountants produce financial statements based on the accounting standards in a given jurisdiction.

These standards may be the **Generally Accepted Accounting Principles (GAAP)** of a respective country, which are typically issued by a national standard setter, or **International Financial Reporting Standards (IFRS)**, which are issued by the **International Accounting Standards Board (IASB)**.

Financial accounting serves the following purposes:

- producing general purpose financial statements
- producing information used by the management of a business entity for decision making, planning and performance evaluation
- producing financial statements for meeting regulatory requirements.

**Objectives of Financial Accounting**

- **Systematic recording of transactions:** basic objective of accounting is to systematically record the financial aspects of business transactions (i.e. book-keeping). These recorded transactions are later on classified and summarized logically for the preparation of financial statements and for their analysis and interpretation.<sup>[8]</sup>
- **Ascertainment of result of above recorded transactions:** accountant prepares profit and loss account to know the result of business operations for a particular period of time. If expenses exceed revenue then it is said that business running under loss. The profit and loss account helps the management and different stakeholders in taking rational decisions. For example, if business is not proved to be remunerative or profitable, the cause of such a state of affair can be investigated by the management for taking remedial steps.
- **Ascertainment of the financial position of business:** businessman is not only interested in knowing the result of the business in terms of profits or loss for a particular period but is also anxious to know that what he owes (liability) to the outsiders and what he owns (assets) on a certain date. To know this, accountant prepares a financial position statement of assets and liabilities of the business at a particular point of time and helps in ascertaining the financial health of the business.
- **Providing information to the users for rational decision-making:** accounting as a 'language of business' communicates the financial result of an enterprise to various stakeholders by means of financial statements. Accounting aims to meet the financial information needs of the decision-makers and helps them in rational decision-making.

- **To know the solvency position:** by preparing the balance sheet, management not only reveals what is owned and owed by the enterprise, but also it gives the information regarding concern's ability to meet its liabilities in the short run (liquidity position) and also in the long-run (solvency position) as and when they fall due.

**1.3.5 Graphic definition**

The accounting equation (**Assets = Liabilities + Owners' Equity**) and financial statements are the main topics of financial accounting.

The **trial balance**, which is usually prepared using the **double-entry accounting system**, forms the basis for preparing the financial statements. All the figures in the trial balance are rearranged to prepare a **profit & loss statement** and **balance sheet**. Accounting standards determine the format for these accounts (**SSAP, FRS, IFRS**). Financial statements display the income and expenditure for the company and a summary of the assets, liabilities, and shareholders' or owners' equity of the company on the date to which the accounts were prepared.

Assets and expenses have normal debit balances, i.e., debiting these types of accounts increases them.

Liabilities, revenues, and capital have normal credit balances, i.e., crediting these increases them.

$$\begin{array}{r}
 0 = \text{Dr Assets} \quad \text{Cr Owners' Equity} \quad \text{Cr Liabilities} \quad . \\
 \hline
 \dots / \text{Cr Retained Earnings (profit)} \quad \text{Cr Common Stock} \backslash \dots \\
 \hline
 \dots \quad \dots \quad / \quad \text{Dr Expenses} \quad \text{Cr Beginning} \\
 \text{Retained Earnings} \quad \backslash \quad \dots \quad \text{Dr Dividends} \quad \text{Cr} \\
 \text{Revenue} \quad \dots \quad \backslash \quad \dots \quad / \\
 \hline
 \end{array}$$

increased by debits increased by credits Crediting a credit  
 Thus -----> account increases its absolute value (balance) Debiting a debit Debiting a credit  
 Thus -----> account decreases its absolute value (balance) Crediting a debit

When the same thing is done to an account as its normal balance it increases; when the opposite is done, it will decrease. Much like signs in math: two positive numbers are added and two negative numbers are also added. It is only when there is one positive and one negative (opposites) that you will subtract.

**1.3.6 Financial accounting vs cost accounting**

See also: [Cost accounting](#)

1. Financial accounting aims at finding out results of accounting year in the form of Profit and Loss Ac-



count and Balance Sheet. Cost Accounting aims at computing cost of production/service in a scientific manner and facilitate cost control and cost reduction.

2. Financial accounting reports the results and position of business to government, creditors, investors, and external parties.
3. Cost Accounting is an internal reporting system for an organization's own management for decision making.
4. In financial accounting, cost classification based on type of transactions, e.g. salaries, repairs, insurance, stores etc. In cost accounting, classification is basically on the basis of functions, activities, products, process and on internal planning and control and information needs of the organization.
5. Financial accounting aims at presenting 'true and fair' view of transactions, profit and loss for a period and Statement of financial position (Balance Sheet) on a given date. It aims at computing 'true and fair' view of the cost of production/services offered by the firm.<sup>[9]</sup>

### 1.3.7 Related qualification

Many professional accountancy qualifications cover the field of financial accountancy, including Certified Public Accountant (CPA), Chartered Accountant (CA or other national designations) and Chartered Certified Accountant (ACCA).

### 1.3.8 See also

- Constant item purchasing power accounting
- Historical cost accounting
- Philosophy of accounting
- Accounting analyst, whose job involves evaluating public company financial statements
- Management accounting, the other main division of accounting

### 1.3.9 Further reading

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### 1.3.10 References

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# Chapter 2

## Methods

### 2.1 Standard cost accounting

**Standard cost accounting** is a traditional cost accounting method introduced in the 1920s,<sup>[1]</sup> as alternative for the traditional cost accounting method based on historical costs.<sup>[2][3]</sup>

#### 2.1.1 Overview

Standard cost accounting uses ratios called efficiencies that compare the labour and materials actually used to produce a good with those that the same goods would have required under “standard” conditions. As long as actual and standard conditions are similar, few problems arise. Unfortunately, standard cost accounting methods developed about 100 years ago, when labor comprised the most important cost in manufactured goods. Standard methods continue to emphasize labor efficiency even though that resource now constitutes a (very) small part of cost in most cases.

Standard cost accounting can hurt managers, workers, and firms in several ways. For example, a policy decision to increase inventory can harm a manufacturing manager’s performance evaluation. Increasing inventory requires increased production, which means that processes must operate at higher rates. When (not if) something goes wrong, the process takes longer and uses more than the standard labor time. The manager appears responsible for the excess, even though s/he has no control over the production requirement or the problem.

In adverse economic times, firms use the same efficiencies to downsize, rightsize, or otherwise reduce their labor force. Workers laid off under those circumstances have even less control over excess inventory and cost efficiencies than their managers.

Many financial and cost accountants have agreed for many years on the desirability of replacing standard cost accounting. They have not, however, found a successor.

#### 2.1.2 History

One of the first authors to foresee standard costing was the British accountant George P. Norton in his 1889 *Textile Manufacturers’ Bookkeeping*.<sup>[4]</sup> John Whitmore, a disciple of Alexander Hamilton Church, is credited for actually presenting “the first detailed description of a standard cost system”<sup>[5]</sup> in 1906/08. The Anglo-American management consultant G. Charter Harrison is credited for designing one of the earliest known complete standard cost systems in the early 1910s.<sup>[5]</sup>

When cost accounting was developed in the 1890s, labor was the largest fraction of product cost and could be considered a variable cost. Workers often did not know how many hours they would work in a week when they reported on Monday morning because time-keeping systems (based in time book) were rudimentary. Cost accountants, therefore, concentrated on how efficiently managers used labor since it was their most important variable resource. Now however, workers who come to work on Monday morning almost always work 40 hours or more; their cost is fixed rather than variable. However, today, many managers are still evaluated on their labor efficiencies, and many “downsizing,” “rightsizing,” and other labor reduction campaigns are based on them.

Traditional standard costing (TSC), used in cost accounting, dates back to the 1920s and is a central method in management accounting practiced today because it is used for financial statement reporting for the valuation of income statement and balance sheet line items such as cost of goods sold (COGS) and inventory valuation. Traditional standard costing must comply with generally accepted accounting principles (GAAP US) and actually aligns itself more with answering financial accounting requirements rather than providing solutions for management accountants. Traditional approaches limit themselves by defining cost behavior only in terms of production or sales volume.

#### 2.1.3 Standard cost accounting, topics

## Historical costs

Historical costs are costs whereby materials and labor may be allocated based on past experience. Historical costs are a classification of costs by time. Historical costs are costs incurred in the past. Predetermined costs are computed in advance on basis of factors affecting cost elements. In the 19th century and early 20th century time books were used to register working time, and eventually determine historical costs.

In modern cost account of recording historical costs was taken further, by allocating the company's fixed costs over a given period of time to the items produced during that period, and recording the result as the total cost of production. This allowed the *full cost* of products that were not sold in the period they were produced to be recorded in inventory using a variety of complex accounting methods, which was consistent with the principles of **Generally Accepted Accounting Principles** (GAAP). It also essentially enabled managers to ignore the fixed costs, and look at the results of each period in relation to the "standard cost" for any given product.

For example: if the railway coach company normally produced 40 coaches per month, and the fixed costs were still \$1000/month, then each coach could be said to incur an Operating Cost/overhead of \$25  $(= \$1000 / 40)$ . Adding this to the variable costs of \$300 per coach produced a full cost of \$325 per coach.

This method tended to slightly distort the resulting unit cost, but in mass-production industries that made one product line, and where the fixed costs were relatively low, the distortion was very minor.

For example: if the railway coach company made 100 coaches one month, then the unit cost would become \$310 per coach  $(\$300 + (\$1000 / 100))$ . If the next month the company made 50 coaches, then the unit cost = \$320 per coach  $(\$300 + (\$1000 / 50))$ , a relatively minor difference.

## Variance analysis

An important part of standard cost accounting is a variance analysis, which breaks down the variation between actual cost and standard costs into various components (volume variation, material cost variation, labor cost variation, etc.) so managers can understand *why costs were different from what was planned* and take appropriate action to correct the situation.

### 2.1.4 See also

- Management accounting

## 2.1.5 References

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## 2.2 Cost accounting

**Cost accounting** is a task of collecting, analyzing, summarizing and evaluating various alternative courses of action. Its goal is to advise the management on the most appropriate course of action based on the cost efficiency and capability. Cost accounting provides the detailed cost information that management needs to control current operations and plan for the future.<sup>[1]</sup>

Since managers are making decisions only for their own organization, there is no need for the information to be comparable to similar information from other organizations. Instead, information must be relevant for a particular environment. Cost accounting information is commonly used in financial accounting information, but its primary function is for use by managers to facilitate making decisions.

Unlike the accounting systems that help in the preparation of financial reports periodically, the cost accounting systems and reports are not subject to rules and standards like the Generally Accepted Accounting Principles. As a result, there is wide variety in the cost accounting systems of the different companies and sometimes even in different parts of the same company or organization.

### 2.2.1 Origins

All types of businesses, whether service, manufacturing or trading, require cost accounting to track their activities.<sup>[1]</sup> Cost accounting has long been used to help managers understand the costs of running a business. Modern cost accounting originated during the industrial revolution, when the complexities of running a large scale business led to the development of systems for recording and tracking costs to help business owners and managers make decisions.

In the early industrial age, most of the costs incurred by a business were what modern accountants call "variable costs" because they varied directly with the amount of production. Money was spent on labor, raw materials, power to run a factory, etc. in direct proportion to production. Managers could simply total the variable costs for a product and use this as a rough guide for decision-making processes.

Some costs tend to remain the same even during busy periods, unlike variable costs, which rise and fall with volume of work. Over time, these "fixed costs" have become more important to managers. Examples of fixed costs include the depreciation of plant and equipment, and the cost of departments such as maintenance, tooling, production control, purchasing, quality control, storage and handling, plant supervision and engineering.<sup>[2]</sup> In the early nineteenth century, these costs were of little importance to most businesses. However, with the growth of railroads, steel and large scale manufacturing, by the late nineteenth century these costs were often more important than the variable cost of a product, and allocating them to a broad range of products led to bad decision making. Managers must understand fixed costs in order to make decisions about products and pricing.

For example: A company produced railway coaches and had only one product. To make each coach, the company needed to purchase \$60 of raw materials and components, and pay 6 laborers \$40 each. Therefore, total variable cost for each coach was \$300. Knowing that making a coach required spending \$300, managers knew they couldn't sell below that price without losing money on each coach. Any price above \$300 became a contribution to the fixed costs of the company. If the fixed costs were, say, \$1000 per month for rent, insurance and owner's salary, the company could therefore sell 5 coaches per month for a total of \$3000 (priced at \$600 each), or 10 coaches for a total of \$4500 (priced at \$450 each), and

make a profit of \$500 in both cases.

### 2.2.2 Cost Accounting vs Financial Accounting

See also: [Financial accounting](#)

- Financial accounting aims at finding out results of accounting year in the form of Profit and Loss Account and Balance Sheet. Cost Accounting aims at computing cost of production/service in a scientific manner and facilitate cost control and cost reduction.
- Financial accounting reports the results and position of business to government, creditors, investors, and external parties.
- Cost Accounting is an internal reporting system for an organization's own management for decision making.
- In financial accounting, cost classification based on type of transactions, e.g. salaries, repairs, insurance, stores etc. In cost accounting, classification is basically on the basis of functions, activities, products, process and on internal planning and control and information needs of the organization.
- Financial accounting aims at presenting 'true and fair' view of transactions, profit and loss for a period and Statement of financial position (Balance Sheet) on a given date. It aims at computing 'true and fair' view of the cost of production/services offered by the firm.<sup>[3]</sup>

### 2.2.3 Types of cost accounting

The following are different cost accounting approaches:

- Standard cost accounting
- Lean accounting
- Activity-based costing
- Resource consumption accounting
- Throughput accounting
- Life cycle costing
- Environmental accounting
- Target costing

### 2.2.4 Elements of cost

Basic cost elements are:

1. Raw materials
2. Labor
3. expenses/overhead
  - Material (Material is a very important part of business)
    - Direct material/Indirect material
  - Labor
    - Direct labor/Indirect labor
  - Overhead (Variable/Fixed)
    - Production or works overheads Factory Staff
    - Administration overheads Office Staff
    - Selling overheads - Catalogues, Advertising, Exhibitions, Sales Staff Costs
    - Distribution overheads
    - Maintenance & Repair (Office equipment/Factory machinery)
    - Supplies
    - Utilities Gas Electricity Water Rates
    - Other Variable Expenses
    - Salaries (Payroll - Wages, NI PAYE Pensions)
    - Occupancy (Rent)
    - Depreciation (Machinery/Office Equipment)
    - Other Fixed Expenses

*(In some companies, machine cost is segregated from overhead and reported as a separate element)*

### 2.2.5 Classification of costs

Classification of cost means, the grouping of costs according to their common characteristics. The important ways of classification of costs are:

1. By Element: There are three elements of costing i.e. material, labor and expenses.
2. By Nature or Traceability: Direct Costs and Indirect costs. Direct Costs are Directly attributable/traceable to Cost object. Direct costs are assigned to Cost Object. Indirect Costs are not directly attributable/traceable to Cost Object. Indirect costs are allocated or apportioned to cost objects.
3. By Functions: production, administration, selling and distribution, R&D.
4. By Behavior: fixed, variable, semi-variable. Costs are classified according to their behavior in relation to change in relation to production volume within given period of time. Fixed Costs remain fixed irrespective of changes in the production volume in given period of time. Variable costs change according to volume of production. Semi-variable costs are partly fixed and partly variable.
5. By control ability: controllable, uncontrollable costs. Controllable costs are those which can be controlled or influenced by a conscious management action. Uncontrollable costs cannot be controlled or influenced by a conscious management action.
6. By normality: normal costs and abnormal costs. Normal costs arise during routine day-to-day business operations. Abnormal costs arise because of any abnormal activity or event not part of routine business operations. E.g. costs arising of floods, riots, accidents etc.
7. By Time: Historical costs and predetermined costs. Historical costs are costs incurred in the past. Predetermined costs are computed in advance on basis of factors affecting cost elements. Example: Standard Costs.
8. By Decision making Costs: These costs are used for managerial decision making.
  - Marginal costs: Marginal cost is the change in the aggregate costs due to change in the volume of output by one unit.
  - Differential costs: This cost is the difference in total cost that will arise from the selection of one alternative to the other.
  - Opportunity costs: It is the value of benefit sacrificed in favor of an alternative course of action.
  - Relevant cost: The relevant cost is a cost which is relevant in various decisions of management.
  - Replacement cost: This cost is the cost at which existing items of material or fixed assets can be replaced. Thus this is the cost of replacing existing assets at present or at a future date.
  - Shutdown cost: These costs are the costs which are incurred if the operations are shut down and they will disappear if the operations are continued.
  - Capacity cost: These costs are normally fixed costs. The cost incurred by a company for providing production, administration and selling and distribution capabilities in order to perform various functions.
  - Sunken cost: cost already incurred
  - Other costs



### 2.2.6 Standard cost accounting

Main article: [Standard cost accounting](#)

In modern cost account of recording historical costs was taken further, by allocating the company's fixed costs over a given period of time to the items produced during that period, and recording the result as the total cost of production. This allowed the *full cost* of products that were not sold in the period they were produced to be recorded in inventory using a variety of complex accounting methods, which was consistent with the principles of GAAP (Generally Accepted Accounting Principles). It also essentially enabled managers to ignore the fixed costs, and look at the results of each period in relation to the "standard cost" for any given product.

For example: if the railway coach company normally produced 40 coaches per month, and the fixed costs were still \$1000/month, then each coach could be said to incur an Operating Cost/overhead of \$25 = (\$1000 / 40). Adding this to the variable costs of \$300 per coach produced a full cost of \$325 per coach.

This method tended to slightly distort the resulting unit cost, but in mass-production industries that made one product line, and where the fixed costs were relatively low, the distortion was very minor.

For example: if the railway coach company made 100 coaches one month, then the unit cost would become \$310 per coach (\$300 + (\$1000 / 100)). If the next month the company made 50 coaches, then the unit cost = \$320 per coach (\$300 + (\$1000 / 50)), a relatively minor difference.

An important part of standard cost accounting is a variance analysis, which breaks down the variation between actual cost and standard costs into various components (volume variation, material cost variation, labor cost variation, etc.) so managers can understand *why costs were different from what was planned* and take appropriate action to correct the situation.

### 2.2.7 The development of throughput accounting

Main article: [Throughput accounting](#)

As business became more complex and began producing a greater variety of products, the use of cost accounting to make decisions to maximize profitability came into question. Management circles became increasingly

aware of the Theory of Constraints in the 1980s, and began to understand that "every production process has a limiting factor" somewhere in the chain of production. As business management learned to identify the constraints, they increasingly adopted *throughput accounting* to manage them and "maximize the *throughput dollars*" (or other currency) from each unit of constrained resource. Throughput accounting aims to make the best use of scarce resources (bottle neck) in a JIT environment.<sup>[4]</sup>

#### Mathematical formula

throughput = revenue sales – costs variable totally

ratio accounting throughput =  $\frac{\text{return}}{\text{hours factory}}$

### 2.2.8 Activity-based costing

Main article: [Activity-based costing](#)

Activity-based costing (ABC) is a system for assigning costs to products based on the activities they require. In this case, activities are those regular actions performed inside a company.<sup>[5]</sup> "Talking with customer regarding invoice questions" is an example of an activity inside most companies.

Companies may be moved to adopt ABC by a need to improve costing accuracy, that is, understand better the true costs and profitability of individual products, services, or initiatives. ABC gets closer to true costs in these areas by turning many costs that standard cost accounting views as indirect costs essentially into direct costs. By contrast, standard cost accounting typically determines so-called indirect and overhead costs simply as a percentage of certain direct costs, which may or may not reflect actual resource usage for individual items.

Under ABC, accountants assign 100% of each employee's time to the different activities performed inside a company (many will use surveys to have the workers themselves assign their time to the different activities). The accountant then can determine the total cost spent on each activity by summing up the percentage of each worker's salary spent on that activity.

A company can use the resulting activity cost data to determine where to focus their operational improvements. For example, a job-based manufacturer may find that a high percentage of its workers are spending their time trying to figure out a hastily written customer order. Via ABC, the accountants now have a currency amount pegged to the activity of "Researching Customer Work Order Specifications". Senior management can now decide how much focus or money to budget for resolving this process deficiency. Activity-based management includes (but is not restricted to) the use of activity-based costing to manage a business.

While ABC may be able to pinpoint the cost of each activity and resources into the ultimate product, the process could be tedious, costly and subject to errors.

As it is a tool for a more accurate way of allocating fixed costs into product, these fixed costs do not vary according to each month's production volume. For example, an elimination of one product would not eliminate the overhead or even direct labor cost assigned to it. ABC better identifies product costing in the long run, but may not be too helpful in day-to-day decision-making.

### 2.2.9 Integrating EVA and Process Based Costing

Recently, Mocciano Li Destri, Picone & Minà (2012).<sup>[6]</sup> proposed a performance and cost measurement system that integrates the Economic Value Added criteria with Process Based Costing (PBC). The EVA-PBC methodology allows us to implement the EVA management logic not only at the firm level, but also at lower levels of the organization. EVA-PBC methodology plays an interesting role in bringing strategy back into financial performance measures.

### 2.2.10 Lean accounting

Main article: [Lean accounting](#)

Lean accounting<sup>[7]</sup> has developed in recent years to provide the accounting, control, and measurement methods supporting lean manufacturing and other applications of lean thinking such as healthcare, construction, insurance, banking, education, government, and other industries.

There are two main thrusts for Lean Accounting. The first is the application of lean methods to the company's accounting, control, and measurement processes. This is not different from applying lean methods to any other processes. The objective is to eliminate waste, free up capacity, speed up the process, eliminate errors & defects, and make the process clear and understandable. The second (and more important) thrust of Lean Accounting is to fundamentally change the accounting, control, and measurement processes so they motivate lean change & improvement, provide information that is suitable for control and decision-making, provide an understanding of customer value, correctly assess the financial impact of lean improvement, and are themselves simple, visual, and low-waste. Lean Accounting does not require the traditional management accounting methods like standard costing, activity-based costing, variance reporting, cost-plus pricing, complex transactional control systems, and untimely & confusing financial reports. These are replaced by:

- lean-focused performance measurements

- simple summary direct costing of the value streams
- decision-making and reporting using a *box score*
- financial reports that are timely and presented in "plain English" that everyone can understand
- radical simplification and elimination of transactional control systems by eliminating the need for them
- driving lean changes from a deep understanding of the value created for the customers
- eliminating traditional budgeting through monthly sales, operations, and financial planning processes (SOFP)
- value-based pricing
- correct understanding of the financial impact of lean change

As an organization becomes more mature with lean thinking and methods, they recognize that the combined methods of lean accounting in fact creates a lean management system (LMS) designed to provide the planning, the operational and financial reporting, and the motivation for change required to prosper the company's on-going lean transformation.

### 2.2.11 Marginal costing

See also: [Cost-Volume-Profit Analysis and Marginal cost](#)

The cost-volume-profit analysis is the systematic examination of the relationship between selling prices, sales, production volumes, costs, expenses and profits. This analysis provides very useful information for decision-making in the management of a company. For example, the analysis can be used in establishing sales prices, in the product mix selection to sell, in the decision to choose marketing strategies, and in the analysis of the impact on profits by changes in costs. In the current environment of business, a business administration must act and take decisions in a fast and accurate manner. As a result, the importance of cost-volume-profit is still increasing as time passes.

#### CONTRIBUTION MARGIN

A relationship between the cost, volume and profit is the contribution margin. The contribution margin is the revenue excess from sales over variable costs. The concept of contribution margin is particularly useful in the planning of business because it gives an insight into the potential profits that a business can generate. The following chart shows the income statement of a company X, which has been prepared to show its contribution margin:

#### CONTRIBUTION MARGIN RATIO

The contribution margin can also be expressed as a percentage. The contribution margin ratio, which is sometimes called the profit-volume ratio, indicates the percentage of each sales dollar available to cover fixed costs and to provide operating revenue. For the company Fusion, Inc. the contribution margin ratio is 40%, which is computed as follows:

$$\text{Ratio Margin Contribution} = (\text{Costs Variable} - \text{Sales}) / \text{Sales}$$

The contribution margin ratio measures the effect on operating income of an increase or a decrease in sales volume. For example, assume that the management of Fusion, Inc. is studying the effect of adding \$80,000 in sales orders. Multiplying the contribution margin ratio (40%) by the change in sales volume (\$80,000) indicates that operating income will increase \$32,000 if additional orders are obtained. To validate this analysis the table below shows the income statement of the company including additional orders:

Variable costs as a percentage of sales are equal to 100% minus the contribution margin ratio. Thus, in the above income statement, the variable costs are 60% (100% - 40%) of sales, or \$648,000 (\$1,080,000 X 60%). The total contribution margin \$432,000, can also be computed directly by multiplying the sales by the contribution margin ratio (\$1,080,000 X 40%).

### 2.2.12 See also

- Accountancy
- Cost overrun
- Fixed asset turnover
- Management accounting
- IT Cost Transparency
- Kaizen costing
- Profit model

### 2.2.13 References

- [1] *Principles of Cost Accounting - Edward J. Vanderbeck* - Google Books. Books.google.co.uk. Retrieved 2013-03-01.
- [2] Performance management, Paper f5. Kaplan publishing UK. Pg 3
- [3] *Cost and Management Accounting. Intermediate.* ICA. p. 15.
- [4] Performance management, Paper f5. Kaplan publishing UK. Pg 17

[5] Performance management, Paper f5. Kaplan publishing UK. Pg 6

[6] Mocciano Li Destri A., Picone P. M. & Minà A. (2012), Bringing Strategy Back into Financial Systems of Performance Measurement: Integrating EVA and PBC, Business System Review, Vol 1., Issue 1. pp.85-102.

[7] Maskell & Baggaley (December 19, 2003). "Practical Lean Accounting". *Productivity Press, New York, NY*.

### 2.2.14 Further reading

- Maher, Lanen and Rahan, *Fundamentals of Cost Accounting*, 1st Edition (McGraw-Hill 2005).
- Horngren, Datar and Foster, *Cost Accounting - A Managerial Emphasis*, 11th edition (Prentice Hall 2003).
- Kaplan, Robert S. and Bruns, W. *Accounting and Management: A Field Study Perspective* (Harvard Business School Press, 1987) ISBN 0-87584-186-4
- Nicholson, Jerome Lee, and John Francis Deems Rohrbach. *Cost accounting*. New York: Ronald Press, 1919.

### 2.2.15 External links

- Accounting Systems, introduction to Cost Accounting, ethics and relationship to GAAP.
- National Conference on College Cost Accounting

## 2.3 Variance (accounting)

In budgeting (or management accounting in general), a **variance** is the difference between a budgeted, planned or standard cost and the actual amount incurred/sold. Variances can be computed for both costs and revenues.

The concept of variance is intrinsically connected with planned and actual results and effects of the difference between those two on the performance of the entity or company.

### 2.3.1 Types of variances

Variances can be divided according to their effect or nature of the underlying amounts.

When **effect of variance** is concerned, there are two types of variances:

- When actual results are better than expected results given variance is described as favorable variance. In



common use favorable variance is denoted by the letter F - usually in parentheses (F).

- When actual results are worse than expected results given variance is described as adverse variance, or unfavourable variance. In common use adverse variance is denoted by the letter U or the letter A - usually in parentheses (A).

The second typology (according to the nature of the underlying amount) is determined by the needs of users of the variance information and may include e.g.:

- Variable cost variances
  - Direct material variances
  - Direct labour variances
  - Variable production overhead variances
- Fixed production overhead variances
- Sales variances

### 2.3.2 Variance Analysis

**Variance analysis**, in budgeting (or management accounting in general), is a tool of budgetary control by evaluation of performance by means of variances between budgeted amount, planned amount or standard amount and the actual amount incurred/sold. Variance analysis can be carried out for both costs and revenues.

Variance analysis is usually associated with explaining the difference (or variance) between actual costs and the standard costs allowed for the good output. For example, the difference in materials costs can be divided into a materials price variance and a materials usage variance. The difference between the actual direct labor costs and the standard direct labor costs can be divided into a rate variance and an efficiency variance. The difference in manufacturing overhead can be divided into spending, efficiency, and volume variances. Mix and yield variances can also be calculated.

Variance analysis helps management to understand the present costs and then to control future costs.

### 2.3.3 See also

- Budgeting
- Non-profit organization
- Standard budget
- Flexible budget
- Rolling budget
- Activity-based budgeting (ABB)

- Controllable items
- Non-controllable items
- Standards
- Motivation
- Performance evaluation
- direct material total variance
- direct material price variance
- direct material usage variance

## 2.4 Whole-life cost

**Whole-life cost**, or **Life-cycle cost (LCC)**, refers to the total cost of ownership over the life of an asset.<sup>[1]</sup> Also commonly referred to as “cradle to grave” or “womb to tomb” costs. Costs considered include the financial cost which is relatively simple to calculate and also the environmental and social costs which are more difficult to quantify and assign numerical values. Typical areas of expenditure which are included in calculating the whole-life cost include, planning, design, construction and acquisition, operations, maintenance, renewal and rehabilitation, depreciation and cost of finance and replacement or disposal.

### 2.4.1 Financial

Whole-life cost analysis is often used for option evaluation when procuring new assets and for decision-making to minimize whole-life costs throughout the life of an asset. It is also applied to comparisons of actual costs for similar asset types and as feedback into future design and acquisition decisions.

The primary benefit is that costs which occur after an asset has been constructed or acquired, such as maintenance, operation, disposal, become an important consideration in decision-making. Previously, the focus has been on the up-front capital costs of creation or acquisition, and organisations may have failed to take account of the longer-term costs of an asset. It also allows an analysis of business function interrelationships. Low development costs may lead to high maintenance or customer service costs in the future. When making this calculation, the depreciation cost on the capital expense should not be included (refer page 2 of <sup>[2]</sup>

### 2.4.2 Environmental and social

Main article: Life cycle assessment

The use of environmental costs in a whole-life analysis allows a true comparison options, especially where both are quoted as “good” for the environment. For a major project such as the construction of a nuclear power station it is possible to calculate the environmental impact of making the concrete containment, the water required for refining the copper for the power plants and all the other components. Only by undertaking such an analysis is it possible to determine whether one solution carries a lower or higher environmental cost than another.<sup>[3]</sup>

Almost all major projects have some social impact. This may be the compulsory re-location of people living on land about to be submerged under a reservoir or a threat to the livelihood of small traders from the development of a hypermarket nearby.

### 2.4.3 Whole-life cost topics

#### Project appraisal

Whole-life costing is a key component in the economic appraisal associated with evaluating asset acquisition proposals. An economic appraisal is generally a broader based assessment, considering benefits and indirect or intangible costs as well as direct costs.

In this way, the whole-life costs and benefits of each option are considered and usually converted using discount rates into net present value costs and benefits. This results in a benefit cost ratio for each option, usually compared to the “do-nothing” counterfactual. Typically the highest benefit-cost ratio option is chosen as the preferred option.

Historically, asset investments have been based on expedient design and lowest cost construction. If such investment has been made without proper analysis of the standard of service required and the maintenance and intervention options available, the initial saving may result in increased expenditure throughout the asset’s life.

By using whole-life costs, this avoids issues with decisions being made based on the short-term costs of design and construction. Often the longer-term maintenance and operation costs can be a significant proportion of the whole-life cost.

#### Asset management

During the life of the asset, decisions about how to maintain and operate the asset need to be taken in context with the effect these activities might have on the residual life of the asset. If by investing 10% more per annum in maintenance costs the asset life can be doubled, this might be a worthwhile investment.

Other issues which influence the lifecycle costs of an asset include:

- site conditions,

- historic performance of assets or materials,
- effective monitoring techniques,
- appropriate intervention strategies.

Although the general approach to determining whole-life costs is common to most types of asset, each asset will have specific issues to be considered and the detail of the assessment needs to be tailored to the importance and value of the asset. High cost assets (and asset systems) will likely have more detail, as will critical assets and asset systems.

Maintenance expenditure can account for many times the initial cost of the asset. Although an asset may be constructed with a design life of 30 years, in reality it will possibly perform well beyond this design life. For assets like these a balanced view between maintenance strategies and renewal/rehabilitation is required. The appropriateness of the maintenance strategy must be questioned, the point of intervention for renewal must be challenged. The process requires proactive assessment which must be based on the performance expected of the asset, the consequences and probabilities of failures occurring, and the level of expenditure in maintenance to keep the service available and to avert disaster.

### 2.4.4 IT industry usage

Whole-life cost is often referred to as “total cost of ownership (TCO)” when applied to IT hardware and software acquisitions. Use of the term “TCO” appears to have been popularised by Gartner Group in 1987<sup>[4]</sup> but its roots are considerably older, dating at least to the first quarter of the twentieth century.<sup>[5]</sup>

It has since been developed as a concept with a number of different methodologies and software tools. A TCO assessment ideally offers a final statement reflecting not only the cost of purchase but all aspects in the further use and maintenance of the equipment, device, or system considered. This includes the costs of training support personnel and the users of the system, costs associated with failure or outage (planned and unplanned), diminished performance incidents (i.e. if users are kept waiting), costs of security breaches (in loss of reputation and recovery costs), costs of disaster preparedness and recovery, floor space, electricity, development expenses, testing infrastructure and expenses, quality assurance, boot image control, marginal incremental growth, decommissioning, e-waste handling, and more. When incorporated in any financial benefit analysis (e.g., ROI, IRR, EVA, ROIT, RJE) TCO provides a cost basis for determining the economic value of that investment.

Understanding and familiarity with the term TCO has been somewhat facilitated as a result of various comparisons between the TCO of open source and proprietary

software. Because the software cost of open source software is often zero, TCO has been used as a means to justify the up-front licensing costs of proprietary software. Studies which attempt to establish the TCO and provide comparisons have as a result been the subject of many discussions regarding the accuracy or perceived bias in the comparison.

### 2.4.5 Automobile industry, finances

Total cost of ownership is also common in the automobile industry. In this context, the TCO denotes the cost of owning a vehicle from the purchase, through its maintenance, and finally its sale as a used car. Comparative TCO studies between various models help consumers choose a car to fit their needs and budget.

TCO can and often does vary dramatically against TCA (total cost of acquisition), although TCO is far more relevant in determining the viability of any capital investment, especially with modern credit markets and financing. TCO also directly relates to a business's total costs across all projects and processes and, thus, its profitability. Some instances of "TCO" appear to refer to "total cost of operation", but this may be a subset of the total cost of ownership if it excludes maintenance and support costs.

### 2.4.6 See also

- Benefits Realisation Management
- Infrastructure
- Asset management

### 2.4.7 References

- [1] Association of Local Government Engineers New Zealand: "Infrastructure Asset Management Manual", June 1998 - Edition 1.1
- [2] <http://www.business.govt.nz/procurement/pdf-library/agencies/guides-and-tools/guide-total-cost-ownership.pdf>
- [3] Whole Life Costing For Sustainable Drainage
- [4] About Gartner TCO
- [5] TCO: What's Old is New

### 2.4.8 Further reading

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- Norris, G. A. (2001): Integrating Life Cycle Cost Analysis and LCA, in: *The International Journal of Life Cycle Assessment*, Jg. 6, H. 2, p. 118–120.

- Schaltegger, S. & Burritt, R. (2000): *Contemporary Environmental Accounting. Issues, Concepts and Practice*. Sheffield: Greenleaf Publ.
- Kicherer, A.; Schaltegger, S.; Tschochohei, H. & Ferreira Pozo, B.: Eco-Efficiency. Combining Life Cycle Assessment and Life Cycle Costs via Normalization, *International Journal of LCA*, 2007, Vol 12, No 7, 537-543.

### 2.4.9 External links

- Whole-life cost forum
- Whole-life costing for sustainable drainage
- BSRIA article: "What is whole life cost analysis?"
- Role of depreciation
- Cost Structure and Life Cycle Cost (LCC) for Military Systems - Papers presented at the RTO Studies, Analysis and Simulation Panel (SAS) Symposium held in Paris, France, 24-25 October 2001

## 2.5 Activity-based costing

**Activity-based costing (ABC)** is a costing methodology that identifies activities in an organization and assigns the cost of each activity with resources to all products and services according to the actual consumption by each. This model assigns more indirect costs (overhead) into direct costs compared to conventional costing.

**CIMA (Chartered Institute of Management Accountants)** defines ABC as an approach to the costing and monitoring of activities which involves tracing resource consumption and costing final outputs. Resources are assigned to activities, and activities to cost objects based on consumption estimates. The latter utilize cost drivers to attach activity costs to outputs.<sup>[1]</sup>

### 2.5.1 Objectives

With ABC, a company can soundly estimate the cost elements of entire products, activities and services. That may help inform a company's decision to either:

- Identify and eliminate those products and services that are unprofitable and lower the prices of those that are overpriced (product and service portfolio aim)
- Or identify and eliminate production or service processes that are ineffective and allocate processing concepts that lead to the very same product at a better yield (process re-engineering aim).

In a business organization, the ABC methodology assigns an organization's resource costs through activities to the products and services provided to its customers. ABC is generally used as a tool for understanding product and customer cost and profitability based on the production or performing processes. As such, ABC has predominantly been used to support strategic decisions such as pricing, outsourcing, identification and measurement of process improvement initiatives.

### 2.5.2 Prevalence

Following initial enthusiasm, ABC lost ground in the 1990s, to alternative metrics, such as Kaplan's balanced scorecard and economic value added. An independent 2008 report concluded that manually driven ABC was an inefficient use of resources: it was expensive and difficult to implement for small gains, and a poor value, and that alternative methods should be used.<sup>[2]</sup> Other reports show the broad band covered with the ABC methodology.<sup>[3]</sup>

However, application of an activity based recording may be applied as an addition to **activity based accounting**, not as a replacement of any *costing* model, but to transform concurrent process accounting into a more authentic approach.

#### Historical development

Traditionally, cost accountants had arbitrarily added a broad percentage of analysis into the indirect cost.<sup>[4]</sup> In addition, activities include actions that are performed both by people and machine.

However, as the percentages of indirect or overhead costs rose, this technique became increasingly inaccurate, because indirect costs were not caused equally by all products. For example, one product might take more time in one expensive machine than another product—but since the amount of direct labor and materials might be the same, additional cost for use of the machine is not being recognized when the same broad 'on-cost' percentage is added to all products. Consequently, when multiple products share common costs, there is a danger of one product subsidizing another.

ABC is based on George Staubus' Activity Costing and Input-Output Accounting.<sup>[5]</sup> The concepts of ABC were developed in the manufacturing sector of the United States during the 1970s and 1980s. During this time, the *Consortium for Advanced Management-International*, now known simply as *CAM-I*, provided a formative role for studying and formalizing the principles that have become more formally known as Activity-Based Costing.<sup>[6]</sup>

Robin Cooper and Robert S. Kaplan, proponents of the Balanced Scorecard, brought notice to these concepts in a number of articles published in *Harvard Business Review* beginning in 1988. Cooper and Kaplan described

ABC as an approach to solve the problems of traditional cost management systems. These traditional costing systems are often unable to determine accurately the actual costs of production and of the costs of related services. Consequently managers were making decisions based on inaccurate data especially where there are multiple products.

Instead of using broad arbitrary percentages to allocate costs, ABC seeks to identify cause and effect relationships to objectively assign costs. Once costs of the activities have been identified, the cost of each activity is attributed to each product to the extent that the product uses the activity. In this way ABC often identifies areas of high overhead costs per unit and so directs attention to finding ways to reduce the costs or to charge more for costly products.

Activity-based costing was first clearly defined in 1987 by Robert S. Kaplan and W. Bruns as a chapter in their book *Accounting and Management: A Field Study Perspective*.<sup>[7]</sup> They initially focused on manufacturing industry where increasing technology and productivity improvements have reduced the relative proportion of the direct costs of labor and materials, but have increased relative proportion of indirect costs. For example, increased automation has reduced labor, which is a direct cost, but has increased depreciation, which is an indirect cost.

Like manufacturing industries, financial institutions have diverse products and customers, which can cause cross-product, cross-customer subsidies. Since personnel expenses represent the largest single component of non-interest expense in financial institutions, these costs must also be attributed more accurately to products and customers. Activity based costing, even though originally developed for manufacturing, may even be a more useful tool for doing this.<sup>[8][9]</sup>

Activity-based costing was later explained in 1999 by Peter F. Drucker in the book *Management Challenges of the 21st Century*.<sup>[10]</sup> He states that traditional cost accounting focuses on what it costs to *do something*, for example, to cut a screw thread; activity-based costing also records the cost of *not doing*, such as the cost of waiting for a needed part. Activity-based costing records the costs that traditional cost accounting does not do.

The overhead costs assigned to each activity comprise an activity cost pool.

#### Alternatives

Main article: [Management accounting](#)

Lean accounting methods have been developed in recent years to provide relevant and thorough accounting, control, and measurement systems without the complex and costly methods of manually driven ABC. However lean accounting is a snapshot concept for capturing just par-

tial derivatives or differentials of selected cost functions. Lean accounting takes an opposite direction from ABC by working to eliminate peculiar cost allocations rather than apply complex methods of resource allocation.

Lean accounting is primarily used within lean manufacturing. The approach has proven useful in many service industry areas including healthcare, construction, financial services, governments, and other industries.

Application of Theory of constraints (TOC) is analysed in a study<sup>[11]</sup> showing interesting aspects of productive co-existence of TOC and ABC application. Identifying cost drivers in ABC is described as somewhat equivalent to identifying bottlenecks in TOC. However the more thorough insight into cost composition for the inspected processes justifies the study result: ABC may deliver a better structured analysis in respect to complex processes, and this is no surprise regarding the necessarily spent effort for detailed ABC reporting.

### 2.5.3 Methodology

Methodology of ABC focuses on cost allocation in operational management. ABC helps to segregate

- Fixed cost
- Variable cost
- Overhead cost

The split of cost helps to identify cost drivers, if achieved. Direct labour and materials are relatively easy to trace directly to products, but it is more difficult to directly allocate indirect costs to products. Where products use common resources differently, some sort of weighting is needed in the cost allocation process. The **cost driver** is a factor that creates or drives the cost of the activity. For example, the cost of the activity of bank tellers can be ascribed to each product by measuring how long each product's transactions (**cost driver**) takes at the counter and then by measuring the number of each type of transaction. For the activity of running machinery, the driver is likely to be machine operating hours. That is, machine operating hours drive labor, maintenance, and power cost during the running machinery activity.

### 2.5.4 Application

ABC has proven its applicability beyond academic discussion. ABC is applicable throughout company financing, costing and accounting:

- ABC is a modeling process applicable for full scope as well as for partial views.
- ABC helps to identify inefficient products, departments and activities.

- ABC helps to allocate more resources on profitable products, departments and activities.
- ABC helps to control the costs at any per-product-level level and on a departmental level.
- ABC helps to find unnecessary costs that may be eliminated.
- ABC helps fixing the price of a product or service with any desired analytical resolution.

A report summarizes reasons for implementing ABC as mere unspecific and mainly for case study purposes<sup>[12]</sup> (in alphabetical order):

- Better Management
- Budgeting, performance measurement
- Calculating costs more accurately
- Ensuring product /customer profitability
- Evaluating and justifying investments in new technologies
- Improving product quality via better product and process design
- Increasing competitiveness or coping with more competition
- Management
- Managing costs
- Providing behavioral incentives by creating cost consciousness among employees
- Responding to an increase in overheads
- Responding to increased pressure from regulators
- Supporting other management innovations such as TQM and JIT systems

Beyond such selective application of the concept, ABC may be extended to accounting, hence proliferating a full scope of cost generation in departments or along product manufacturing. Such extension, however requires a degree of automatic data capture that prevents from cost increase in administering costs.

### 2.5.5 Implementation

According to Velmurugan, Activitybased costing must be implemented in the following ways:<sup>[13]</sup>

1. Identify and assess ABC needs - Determine viability of ABC method within an organization.



2. Training requirements - Basic training for all employees and workshop sessions for senior managers.
3. Define the project scope - Evaluate mission and objectives for the project.
4. Identify activities and drivers - Determine what drives what activity.
5. Create a cost and operational flow diagram – How resources and activities are related to products and services.
6. Collect data – Collecting data where the diagram shows operational relationship.
7. Build a software model, validate and reconcile.
8. Interpret results and prepare management reports.
9. Integrate data collection and reporting.

### 2.5.6 Integrating EVA and Process Based Costing

Recently, Mocchiari Li Destri, Picone & Minà (2012)<sup>[14]</sup> proposed a performance and cost measurement system that integrates the **Economic Value Added (EVA)** criteria with **Process Based Costing (PBC)**.

Authors note that activity-based costing system is introspective and focuses on a level of analysis which is too low. On the other hand, they underscore the importance to consider the cost of capital in order to bring strategy back into performance measures.

### 2.5.7 Limitations

Applicability of ABC is bound to cost of required data capture. That drives the prevalence to slow processes in services and administrations, where staff time consumed per task defines a dominant portion of cost. Hence the reported application for production tasks do not appear as a favored scenario.

### Tracing Costs

Even in ABC, some overhead costs are difficult to assign to products and customers, such as the chief executive's salary. These costs are termed 'business sustaining' and are not assigned to products and customers because there is no meaningful method. This lump of unallocated overhead costs must nevertheless be met by contributions from each of the products, but it is not as large as the overhead costs before ABC is employed.

Although some may argue that costs untraceable to activities should be "arbitrarily allocated" to products, it is important to realize that the only purpose of ABC is to provide information to management. Therefore, there is no reason to assign any cost in an arbitrary manner.

### Transition to automated Activity-based costing accounting

The prerequisite for lesser cost in performing ABC is automating the data capture with an accounting extension that leads to the desired ABC model. Known approaches for event based accounting simply show the method for automation. Any transition of a current process from one stage to the next may be detected as a relevant event. Paired events easily form the respective activity.

The state of the art approach with authentication and authorization in IETF standard **RADIUS** gives an easy solution for accounting all workposition based activities. That simply defines the extension of the *Authentication and Authorization (AA)* concept to a more advanced *AA and Accounting (AAA)* concept. Respective approaches for AAA get defined and staffed in the context of mobile services, when using smart phones as e.a. intelligent agents or smart agents for automated capture of accounting data .

### Public sector usage

When ABC is reportedly used in the public administration sector, the reported studies do not provide evidence about the success of methodology beyond justification of budgeting practise and existing service management and strategies.

Usage in the US Marine Corps started in 1999.<sup>[15][16][17][18]</sup> Its use by the UK Police has been mandated since the 2003-04 UK tax year as part of England and Wales' National Policing Plan, specifically the Policing Performance Assessment Framework.<sup>[19]</sup>

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### 2.5.9 External links

- Who Wins in a Dynamic World: Theory of Constraints Vs. Activity-Based Costing? article on SSRN
- International Federation of Accountants proposed International Good Practice Guidance on Costing to Drive Organizational Performance

## 2.6 Grenzplankostenrechnung

**Grenzplankostenrechnung (GPK)** is a German costing methodology, developed in the late 1940s and 1950s, designed to provide a consistent and accurate application of how managerial costs are calculated and assigned to a product or service. The term Grenzplankostenrechnung, often referred to as GPK, has been translated as either *Marginal Planned Cost Accounting*<sup>[1]</sup> or *Flexible Analytic Cost Planning and Accounting*.<sup>[2]</sup>

The GPK methodology has become the standard for cost accounting in Germany<sup>[2]</sup> as a "result of the modern, strong controlling culture in German corporations".<sup>[3]</sup> German firms that use GPK methodology include Deutsche Telekom, Daimler AG, Porsche AG, Deutsche

Bank, and Deutsche Post (German Post Office). These companies have integrated their costing information systems based on ERP (Enterprise Resource Planning) software (e.g., SAP) and they tend to reside in industries with highly complex processes.<sup>[4]</sup> However, GPK is not exclusive to highly complex organizations; GPK is also applied to less complex businesses.

GPK's objective is to provide meaningful insight and analysis of accounting information that benefits internal users, such as controllers, project managers, plant managers, versus other traditional costing systems that primarily focus on analyzing the firm's profitability from an external reporting perspective complying with financial standards (i.e., IFRS/FASB), and/or regulatory bodies' demands such as the Securities and Exchange Commission (SEC) or the Internal Revenue Services (IRS) taxation agency. Thus, the GPK marginal system unites and addresses the needs of both financial and managerial accounting functionality and costing requirements.

Resource Consumption Accounting (RCA) is based, among others, on key principles of German managerial accounting that are found in GPK.<sup>[5]</sup>

### 2.6.1 Background

The origins of GPK are credited to Hans-Georg Plaut, an automotive engineer and Wolfgang Kilger, an academic, working towards the mutual goal of identifying and delivering a sustained methodology designed to correct and enhance cost accounting information.<sup>[3]</sup> Plaut concentrated on the practical elements of GPK, while Kilger provided the academic discipline and GPK documentation that is still being published in cost accounting textbooks taught in German-speaking universities. The primary textbook on GPK is *Flexible Plankostenrechnung und Deckungsbeitragsrechnung*.<sup>[6]</sup>

In 1946, Plaut founded an independent consulting business in Hannover, Germany which continued to grow employing more than 2,000 consultants.<sup>[3]</sup> Plaut and Kilger focused on creating a cost accounting system that would cater to managers who are responsible for controlling costs, managing profits and providing information that would enable managers to make informed decisions.

### 2.6.2 Concepts of GPK

GPK is a marginal costing system and is decidedly more comprehensive than most U.S. cost management systems because of the level of organizational planning and control and its emphasis on accurate operational modeling.<sup>[7]</sup>

With GPK's marginal-based approach, internal service and saleable product/service costs should only reflect the direct and indirect costs that can be linked to individual outputs (whether final product or support service) on a causal basis (referred to as the *principle of causal-*

ity). Proportional costs in GPK consists of direct and indirect costs that will vary with the particular output. Proportional costs provide the first contribution margin level that supports short-term decisions and once proportional costs are subtracted from revenue, it reveals whether the product or service is profitable or not. GPK adopters' marginal practices have varied, for example, not all adopters adhere to strict marginal practices such as the pre-allocation of fixed costs based on planned product/service volumes.

Fixed costs, innately do not vary with outputs and usually are not associated with individual outputs' costs. However, in practice, GPK adopters often calculate a standard per-unit-rate for fixed product/service costs and a separate per-unit-rate for proportional product/service costs. The balance of costs not causally assignable to the lowest level product or service can be assigned at yet higher levels within the marginal costing system's multi-level Profit & Loss (P&L) statement. For example, with GPK, fixed costs that relate to a product group or a product line (e.g., R&D, advertising costs) are assigned to the product group or product line reporting/management dimension in the P&L. This marginal costing approach offers managers greater flexibility to view, analyze and monitor costs (e.g., all product and cost-to-serve costs) for their area of responsibility. Thus GPK assigns all costs to the P&L but it does not fully absorb to the lowest level product or service. GPK's multi-dimensional marginal view of the organization supports operational managers with the most relevant information for strategic decision-making purposes about "what products or services to offer" and "what price to sell them".<sup>[2]</sup>

### 2.6.3 Core elements of GPK

According to German Professors Dr.'s Friedl, Kuepper and Pedell,<sup>[1]</sup> the fundamental structure of GPK consists of four important elements:

1. Cost-type accounting,
  2. Cost center accounting,
  3. Product[service] cost accounting, and
  4. Contribution margin accounting for profitability analysis.
- **Cost-type accounting** separates costs like labor, materials, and depreciation, followed by each cost account then being broken down into *fixed* and *proportional* costs along with the assignment of these cost accounts to cost centers.
  - **Cost center accounting** is the most important element in GPK. A cost center can be defined as an area of responsibility that is assigned to a manager who is held accountable for its performance. It is

common to have from 200 to over 2,000 cost centers in a typical GPK adopter organization.

GPK distinguishes two types of cost centers:

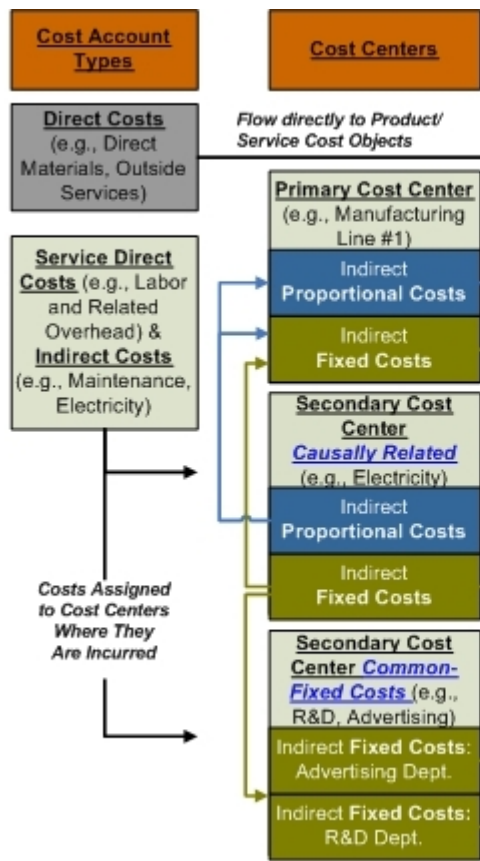
- **Primary Cost Centers** - are cost centers that provide output directly consumed by a saleable product or service is considered to be a *primary* cost center. related to the service or manufacturing process.
- **Secondary Cost Centers** - are cost centers that incur costs but exist to support the functions of the primary cost centers. Typical secondary cost centers include: information technology (IT) services and; human resources (HR) areas that offer hiring and training functions.

With the GPK marginal costing approach, *primary cost centers* outputs consumed by products/services reflect direct causal relationships, as well as causally-linked costs originating from supporting *secondary cost centers* that primary cost centers need to function. As such, both of these causally-linked outputs—if proportional in nature—will vary with product/service output volume (albeit the secondaries only indirectly) and are reflected in the appropriate product/service contribution margin in the P&L.

- **Product/Service cost accounting** also referred to as *Product Costing*, is where all of the assigned costs that are *product related* will be collected in the GPK costing model. In GPK's purest marginal form only proportional costs are assigned to products or services, but as indicated above a compromise is often struck by also assigning product-related fixed costs.
- **Profitability management** is the final component that completes the marginal costing system by adding in the revenues, cost-to-serve and common fixed costs along with the *product/service cost accounting* information discussed above. (Refer to the Exhibit below for a graphic depiction of cost flows in GPK.) The GPK structure allows for a more detailed analysis because of the multi-dimensional contribution margin view. This type of multi-level *profitability management* not only supports short-term decision making such as pricing decisions or internal pricing transfers, but it also provides relevant costing information for long-term decisions.<sup>[1]</sup>



### 2.6.4 GPK marginal costing diagram



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### 2.6.6 External links

- "Institute of Management Accounting (IMA) - Publisher of *Management Accounting Quarterly* and *Strategic Finance*".
- "RCA Institute Official Web Site".
- "Plaut - the consulting company still dedicated to the tradition of its founder Hans-Georg Plaut".

## 2.7 Resource consumption accounting

**Resource Consumption Accounting (RCA)** is formally defined as a dynamic, fully integrated, principle-based, and comprehensive management accounting approach that provides managers with decision support information for enterprise optimization. RCA is a relatively new, flexible, comprehensive management accounting approach based largely on the German management accounting approach *Grenzplankostenrechnung (GPK)* and also allows for the use of activity-based drivers.

### 2.7.1 Background

Initially, RCA had emerged as a management accounting approach beginning around 2000, and was subse-

quently developed at CAM-I (The Consortium of Advanced Management, International) in a Cost Management Section RCA interest group<sup>[1]</sup> commencing in December 2001. Over the next seven years RCA was refined and validated through practical case studies, industry journal publications, and other research papers.

In 2008, a group of interested academics and practitioners established the **RCA Institute** to introduce Resource Consumption Accounting to the marketplace and raise the standard of management accounting knowledge by encouraging disciplined practices.

By July 2009, Professional Accountants in Business (PAIB) Committee of International Federation of Accountants (IFAC), recognized Resource Consumption Accounting in the International Good Practice Guidance (IGPG) publication called *Evaluating and Improving Costing in Organizations*<sup>[2]</sup> and its companion document, *Evaluating the Costing Journey: A Costing Levels Continuum Maturity Model*. The guide focuses on universal costing principles and with the Costing Levels Maturity Model<sup>[3]</sup> acknowledges RCA attains a higher level of accuracy and visibility compared to activity based costing for managerial accounting information when the incremental benefits of RCA's better information exceed the incremental administrative effort and cost to collect, calculate and report its information.

As stated in the International Good Practice Guidance,<sup>[2]</sup>

*"A sophisticated approach at the upper levels of the continuum of costing techniques provides the ability to derive costs directly from operational resource data, or to isolate and measure unused capacity costs. For example, in the resource consumption accounting approach, resources and their costs are considered as foundational to robust cost modeling and managerial decision support, because an organization's costs and revenues are all a function of the resources and the individual capacities that produce them."*

— International Federation of Accountants, 2009

Resource Consumption Accounting was also recognized in a Sustainability Framework Report issued by the International Federation of Accountants (IFAC), for having the capability of helping organizations "improve their understanding of environmental (and social) costs through their costing systems and models".<sup>[4]</sup> This Sustainability Framework highlights RCA under the sub-heading *Improving Information Flows to Support Decision* and informs readers that proper cost allocation can be built 'directly into the cost accounting system', thereby enhancing an organization's performance for "identifying, defining and classifying costs in a useful way".<sup>[4]</sup>

## 2.7.2 Concepts of Resource Consumption Accounting

RCA concepts that distinguish it from other management accounting approaches include the following:

1. Germany's GPK method of quantity-based operational modeling using fixed and proportional costs established at the resource level in a company (i.e., cost center/resource pools or value streams");<sup>[5]</sup>
2. Gordon Shillinglaw's concept of attributable cost;<sup>[6]</sup>
3. Flexible use of activity-based drivers (only where needed) based on specific, and restrictive rules;
4. Value chain integration<sup>[7]</sup> of management accounting into operational systems;
5. Use of fundamental operations transactions as the primary source for financial and quantitative data (rather than the general ledger);
6. Replacing the *principle of variability* with the *principle of responsiveness* for operational modeling;<sup>[8]</sup>
7. Support for a multi-level, contribution margin-based *profit & loss statement* that supports managerial decision making without the cost distortions and complexity of inappropriate (not based on the *principle of causality*) allocations of cost.

## 2.7.3 The Core Elements of RCA

There are three core elements that enable RCA to lay a very different foundation for its cost model.<sup>[9]</sup>

- The view of resources – resources and their costs are considered foundational to proper cost modeling and decision support. An organization's cost and revenues are all a function of the resources that produce them.
- Quantity-based modeling – the entire model is constructed using operational quantities. Operational data is the foundation of value creation and the leading indicator of economic outcomes.
- Cost behavior – value is added as a veneer to the quantity-based model and costs/dollars behavior is determined by the behavior of resource quantities as they are applied to value creating operations within an organization.

## 2.7.4 Additional information

The goals of the RCA Institute, in promoting the acquisition of knowledge and skills to apply RCA, include the following:

- Improve management accounting knowledge and practice by clarifying and embracing sound principles that will enhance enterprise decision making and the public welfare through optimum resource usage.
- Advance the knowledge and practice of Resource Consumption Accounting (RCA) through:
  - A community of active, high quality practitioners and academics.
  - Consistent and disciplined practice centered on a core body of RCA knowledge that is not diluted by wide variations in use or form.
  - Education of adopters, practitioners and vendors and the certification of vendors' products and services.
  - Increased adoption of RCA, over the long-term, as the dominant management accounting approach in business, government, and non-profit organizations.

The RCA Institute library contains an annotated bibliography that is currently divided into four sections:

1. RCA theory,
2. management accounting landscape and management accounting philosophy,
3. RCA related research and
4. other materials.

This annotated bibliography provides more information for recommended reading and some guidance on how to get the most out of the information that is there.

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### 2.7.6 External links

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- "Institute of Management Accounting (IMA) - Publisher of *Strategic Finance*".
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## 2.8 Throughput accounting

**Throughput Accounting** (TA) is a principle-based and simplified management accounting approach that provides managers with decision support information for enterprise profitability improvement. TA is relatively new in management accounting. It is an approach that identifies factors that limit an organization from reaching its goal, and then focuses on simple measures that drive behavior in key areas towards reaching organizational goals. TA was proposed by Eliyahu M. Goldratt<sup>[1]</sup> as an alternative to traditional cost accounting. As such, Throughput Accounting<sup>[2]</sup> is neither cost accounting nor costing because it is cash focused and does not allocate all costs (variable and fixed expenses, including overheads) to products and services sold or provided by an enterprise. Considering the laws of variation, only costs that vary totally with units of output (see definition of T below for TVC) e.g. raw materials, are allocated to products and services which are deducted from sales to determine Throughput. Throughput Accounting is a management accounting technique used as the performance measure in the Theory of Constraints (TOC).<sup>[3]</sup> It is the business intelligence used for maximizing profits, however, unlike cost accounting that primarily focuses on 'cutting costs' and reducing expenses to make a profit, Throughput Accounting primarily focuses on generating more throughput. Conceptually, Throughput Accounting seeks to increase the speed or rate at which throughput (see definition of T below) is generated by products and services with respect to an organization's constraint, whether the constraint is internal or external to the organization.



Throughput Accounting is the only management accounting methodology that considers constraints as factors limiting the performance of organizations.

Management accounting is an organization's internal set of techniques and methods used to maximize shareholder wealth. Throughput Accounting is thus part of the management accountants' toolkit, ensuring efficiency where it matters as well as the overall effectiveness of the organization. It is an internal reporting tool. Outside or external parties to a business depend on accounting reports prepared by financial (public) accountants who apply Generally Accepted Accounting Principles (GAAP) issued by the Financial Accounting Standards Board (FASB) and enforced by the U.S. Securities and Exchange Commission (SEC) and other local and international regulatory agencies and bodies such as International Financial Reporting Standards (IFRS).

Throughput Accounting improves profit performance with better management decisions by using measurements that more closely reflect the effect of decisions on three critical monetary variables (throughput, investment (AKA inventory), and operating expense — defined below).

### 2.8.1 History

When cost accounting was developed in the 1890s, labor was the largest fraction of product cost and could be considered a variable cost. Workers often did not know how many hours they would work in a week when they reported on Monday morning because time-keeping systems were rudimentary. Cost accountants, therefore, concentrated on how efficiently managers used labor since it was their most important variable resource. Now however, workers who come to work on Monday morning almost always work 40 hours or more; their cost is fixed rather than variable. However, today, many managers are still evaluated on their labor efficiencies, and many “downsizing,” “rightsizing,” and other labor reduction campaigns are based on them.

Goldratt argues that, under current conditions, labor efficiencies lead to decisions that harm rather than help organizations. Throughput Accounting, therefore, removes standard cost accounting's reliance on efficiencies in general, and labor efficiency in particular, from management practice. Many cost and financial accountants agree with Goldratt's critique, but they have not agreed on a replacement of their own and there is enormous inertia in the installed base of people trained to work with existing practices.

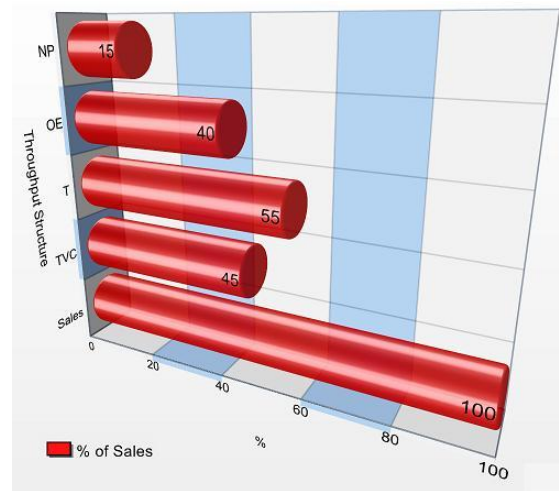
Constraints accounting, which is a development in the Throughput Accounting field, emphasizes the role of the constraint, (referred to as the Archimedian constraint) in decision making.<sup>[4]</sup>

### 2.8.2 The concepts of Throughput Accounting

Goldratt's alternative begins with the idea that each organization has a goal and that better decisions increase its value. The goal for a profit maximizing firm is easily stated, to increase profit now and in the future. Throughput Accounting applies to not-for-profit organizations too, but they have to develop a goal that makes sense in their individual cases.

Throughput Accounting also pays particular attention to the concept of 'bottleneck' (referred to as *constraint* in the Theory of Constraints) in the manufacturing or servicing processes.

Throughput Accounting uses three measures of income and expense:



The chart illustrates a typical throughput structure of income (sales) and expenses (TVC and OE).  
 $T = \text{Sales less TVC}$  and  $NP = T \text{ less OE}$ .

- **Throughput (T)** is the rate at which the system produces “goal units.” When the goal units are money<sup>[5]</sup> (in for-profit businesses), throughput is net sales (S) less totally variable cost (TVC), generally the cost of the raw materials ( $T = S - \text{TVC}$ ). Note that T only exists when there is a sale of the product or service. Producing materials that sit in a warehouse does not form part of throughput but rather investment. (“Throughput” is sometimes referred to as “throughput contribution” and has similarities to the concept of “contribution” in marginal costing which is sales revenues less “variable” costs – “variable” being defined according to the marginal costing philosophy.)
- **Investment (I)** is the money tied up in the system. This is money associated with inventory, machinery, buildings, and other assets and liabilities. In earlier Theory of Constraints (TOC) documentation, the “I” was interchanged between “inventory” and

“investment.” The preferred term is now only “investment.” Note that TOC recommends inventory be valued strictly on totally variable cost associated with creating the inventory, not with additional cost allocations from overhead.

- **Operating expense (OE)** is the money the system spends in generating “goal units.” For physical products, OE is all expenses except the cost of the raw materials. OE includes maintenance, utilities, rent, taxes and payroll.

Organizations that wish to increase their attainment of *The Goal* should therefore require managers to test proposed decisions against three questions. Will the proposed change:

1. Increase throughput? How?
2. Reduce investment (inventory) (money that cannot be used)? How?
3. Reduce operating expense? How?

The answers to these questions determine the effect of proposed changes on system wide measurements:

1. **Net profit (NP)** = throughput – operating expense =  $T - OE$
2. **Return on investment (ROI)** = net profit / investment =  $NP/I$
3. **TA Productivity** = throughput / operating expense =  $T/OE$
4. **Investment turns (IT)** = throughput / investment =  $T/I$

These relationships between financial ratios as illustrated by Goldratt are very similar to a set of relationships defined by DuPont and General Motors financial executive Donaldson Brown about 1920. Brown did not advocate changes in management accounting methods, but instead used the ratios to evaluate traditional financial accounting data.

Throughput Accounting <sup>[6]</sup> is an important development in modern accounting that allows managers to understand the contribution of constrained resources to the overall profitability of the enterprise.

### 2.8.3 Explanation

Throughput  
Costs Variable Total – revenue Sales <sup>[7]</sup> =

Ratio accounting Throughput  
hour factory per Return/hour factory per Cost <sup>[8]</sup> =

For example: The railway coach company was offered a contract to make 15 open-topped streetcars each month, using a design that included ornate brass foundry work, but very little of the metalwork needed to produce a covered rail coach. The buyer offered to pay \$280 per streetcar. The company had a firm order for 40 rail coaches each month for \$350 per unit.

The cost accountant determined that the cost of operating the foundry vs. the metalwork shop each month was as follows:

The company was at full capacity making 40 rail coaches each month. And since the foundry was expensive to operate, and purchasing brass as a raw material for the streetcars was expensive, the accountant determined that the company would lose money on any streetcars it built. He showed an analysis of the estimated product costs based on standard cost accounting and recommended that the company decline to build any streetcars.

However, the company’s operations manager knew that recent investment in automated foundry equipment had created idle time for workers in that department. The constraint on production of the railcoaches was the metalwork shop. She made an analysis of profit and loss if the company took the contract using throughput accounting to determine the profitability of products by calculating “throughput” (revenue less variable cost) in the metal shop.

After the presentations from the company accountant and the operations manager, the president understood that the metal shop capacity was limiting the company’s profitability. The company could make only 40 rail coaches per month. But by taking the contract for the streetcars, the company could make nearly all the railway coaches ordered, and also meet all the demand for streetcars. The result would increase **throughput** in the metal shop from \$6.25 to \$10.38 per hour of available time, and increase profitability by 66 percent.

### 2.8.4 Relevance

One of the most important aspects of Throughput Accounting is the relevance of the information it produces. Throughput Accounting reports what currently happens in business functions such as operations, distribution and marketing. It does not rely solely on GAAP’s financial accounting reports (that still need to be verified by

external auditors) and is thus relevant to current decisions made by management that affect the business now and in the future. Throughput Accounting is used in Critical Chain Project Management (CCPM),<sup>[9]</sup> Drum Buffer Rope (DBR)—in businesses that are internally constrained, in Simplified Drum Buffer Rope (S-DBR)<sup>[10]</sup>—in businesses that are externally constrained (particularly where the lack of customer orders denotes a market constraint), as well as in strategy, planning and tactics, etc.

## 2.8.5 References

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- [3] Eric Noreen - Theory of Constraints and its Implications for Management Accounting - ISBN 978-0-88427-116-1.
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## 2.9 Lean accounting

The purpose of **Lean Accounting** is to support the lean enterprise as a business strategy. It seeks to move from traditional accounting methods to a system that measures and motivates excellent business practices in the lean enterprise.

### 2.9.1 Introduction

What we now call lean manufacturing was developed by Toyota and other Japanese companies. Toyota executives claim that the famed Toyota Production System was inspired by what they learned during visits to the Ford Motor Company in the 1920s and developed by Toyota leaders such as Taiichi Ohno and consultant Shigeo Shingo after World War II. As pioneer American and European

companies embraced lean manufacturing methods in the late 1980s, they discovered that lean thinking must be applied to every aspect of the company including the financial and management accounting processes.<sup>[1]</sup> (See also, William Deming.)

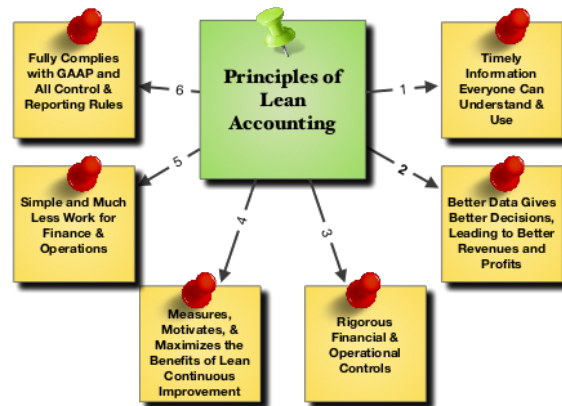
There are two main thrusts for Lean Accounting. The first is the application of lean methods to the company's accounting, control, and measurement processes. This is no different from applying lean methods to any other processes. The objective is to eliminate waste, free up capacity, speed up the process, eliminate errors and defects, and make the process clear and understandable.

The second (and more important) thrust of Lean Accounting is to fundamentally change the accounting, control, and measurement processes so they motivate lean change and improvement, provide information that is suitable for control and decision-making, provide an understanding of customer value, correctly assess the financial impact of lean improvement, and are themselves simple, visual, and low-waste. Lean Accounting does not require the traditional management accounting methods like standard costing, activity-based costing, variance reporting, cost-plus pricing, complex transactional control systems, and untimely confusing financial reports. These are replaced by

- lean-focused performance measurements
- simple summary direct costing of the value streams
- decision-making and reporting using a *box score*
- financial reports that are timely and presented in "plain language" that everyone can understand
- radical simplification and elimination of transactional control systems by eliminating the need for them
- driving lean changes from a deep understanding of the value created for the customers
- eliminating traditional budgeting through monthly sales, operations, and financial planning processes (SOFP)
- value-based pricing
- correct understanding of the financial impact of lean change

As an organization becomes more mature with lean thinking and methods, they recognize that the combined methods of Lean Accounting in fact creates a Lean Management System (LMS) designed to provide the planning, the operational and financial reporting, and the motivation for change required to prosper the company's on-going lean transformation.<sup>[2]</sup>

Up until 2006, the methods of Lean Accounting were not clearly defined because they had been developed by different people in different companies. A meeting was held at the 2005 Lean Accounting Summit (*Lean Accounting Summit*) conference including a number of leaders in the field, and a decision was made to develop a document called “The Principles, Practices, and Tools of Lean Accounting” (PPT) (*Lean Accounting PPT*). While the methods of lean accounting are continually evolving, the PPT lays out the primary methods of Lean Accounting and shows how they fit together into a Lean Management System. The PPT emphasizes not only the tools and methods of Lean Accounting, but also the need for focusing on customer value and the empowerment (or respect) for people. The PPT was published in *Target*, the *Journal of the Association of Manufacturing Excellence (AME)* in 2006. (*Lean Accounting PPT article*)



### The Vision for Lean Accounting

1. Provide accurate, timely, and understandable information to motivate the lean transformation throughout the organization, and for decision-making leading to increased customer value, growth, profitability, and cash flow.
2. Use lean tools to eliminate waste from the accounting processes while maintaining thorough financial control.
3. Fully comply with generally accepted accounting principles (GAAP), external reporting regulations, and internal reporting requirements.
4. Support the lean culture by motivating investment in people, providing information that is relevant and actionable, and empowering continuous improvement at every level of the organization.

### Why is lean accounting needed?

There are positive and negative reasons for using Lean Accounting. The positive reasons include the issues addressed in the “Vision for Lean Accounting” shown above. Lean Accounting provides accurate, timely and understandable information that can be used by managers, sales people, operations leaders, accountants, lean improvement teams and others. The information gives clear insight into the company’s performance; both operational and financial. The Lean Accounting reporting motivates people in the organization to move lean improvement forward. It is often stated that “what you measure is what will be improved.” Lean accounting measures the right things for a company that wants to drive forward with lean transformation.

Lean Accounting is also itself lean. The information, reports, and measurements can be provided quickly and

easily. It does not require the complex systems and wasteful transactions that are usually used by manufacturing companies. The simplicity of Lean Accounting frees up the time of the financial people and the operational people so that they can become more actively involved in moving the company forward towards its strategic goals. The role of the financial professional moves away from book-keeper and reporter and towards strategic partnering with the company leaders.

At a deeper level Lean Accounting matches the cultural goals of a lean organization. The simple and timely information empowers people at all levels of the organization. The financial and performance measurement information is organized around value streams and thereby honors the lean principle of value stream management. The emphasis on customer value is also derived from the principles of lean thinking. The way a company accounts and measures its business is deeply rooted in the culture of the organization. Lean Accounting has an important role to play in developing a lean culture within an organization.

### Why is traditional accounting not needed?

The negative reasons for using Lean Accounting lie with the inadequacy of traditional accounting systems to support a lean culture. Everybody working seriously on the lean transformation of their company eventually bumps up against their accounting systems. Traditional accounting systems (particularly those using *standard costing*, *activity-based costing*, or other full absorption methods) are designed to support traditional management methods. As a company moves to lean thinking, many of the fundamentals of its management system change and traditional accounting, control, and measurement methods become unsuitable. Some examples of this are:

- Traditional accounting systems are large, complex processes requiring a great deal of non-value work. Lean companies are anxious to eliminate this kind of non-value work.
- They provide measurements and reports like labor efficiency and overhead absorption that mo-





*Traditional Accounting Pushes Back Against Lean*

tivate large batch production and high inventory levels. These measurements are suitable for mass production-style organizations but actively harmful to companies with lean aspirations.

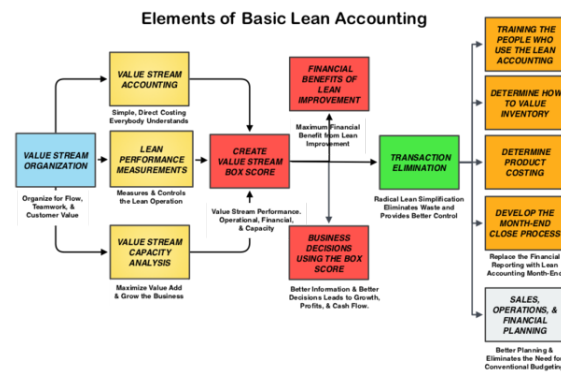
- The traditional accounting systems have no good way to identify the financial impact of the lean improvements taking place throughout the company. On the contrary, the financial reports will often show that bad things are happening when very good lean change is being made. One example of this is that traditional reporting shows a reduction in profitability when inventory is reduced. Lean companies always make significant inventory reductions and the accounting reports show negative results.<sup>[3]</sup>
- Traditional accounting reports use technical words and methods like “overhead absorption”, “gross margin”, and many others. These reports are not widely understood within most organizations. This may be acceptable when the financial reports are restricted to senior managers, but a lean company will seek to empower the entire workforce. Clear and understandable reporting is required so that people can readily use the reports for improvement and decision-making.
- Traditional companies use standard product (or service) costs which can be misleading when making decisions related to quoting, profitability, make/buy, sourcing, product rationalization, and so forth. Lean companies seek to have a clearer understanding of the true costs associated with their processes and value streams.

There are of course traditional methods for overcoming some of these issues and problems. Indeed, few of the methods of Lean Accounting are new ideas. They are mostly adaptations of methods that have been used for many years, and have been codified into a Lean Management System designed to support the needs of lean thinking organizations.

## Where does Lean Accounting apply?

As with most lean methods Lean Accounting was developed to support manufacturing companies, and most of the implementation of Lean Accounting has been within manufacturing organizations. Now that lean methods are moving into other industries like financial services, healthcare, government, and education there are some initial examples of the application of Lean Accounting in these industries.

## 2.9.2 Getting Started



## Application to accounting processes

In the early stages of lean it is important to apply lean improvement throughout the organization; and there is nowhere more suitable than the accounting processes. These include the month-end close, accounts payable, accounts receivable, payroll, cost accounting, expense reporting, and so forth. There are three reasons for applying lean improvement methods to the accounting processes:

1. The processes will be improved and the company's operations made better.
2. The finance people will learn a lot about lean methods. Lean is not learned from books but by actual hands-on experience.
3. The removal of waste will free up time for the finance people to work on the introduction of Lean Accounting.

Some people object to making changes to the Accounting processes because they ask why we would want to spend time making processes better when in fact we will be eliminating them in the future. The answer to this is that with lean we are always interested in making many small improvements. We are not looking for the "silver bullet" that will solve all problems. On the contrary, we are looking to engage the entire work force in many smaller

changes that lead to massive improvement over time. It is, of course, our objective over time to largely eliminate most of these wasteful accounting processes, but at the earlier stages of lean change we are content to improve the processes, provide learning to the finance people, and free up their time for the more significant lean changes in the future.<sup>[2][4]</sup>

### Lean performance measurements

The control of the production (and other) processes is achieved by visual performance measurements at the shop-floor and value stream level. These measurements eliminate the need for the shop-floor tracking and variance reporting favored by traditional cost accounting systems. There are (at least) three levels of operational performance measurements.

Continuous improvement (CI) is motivated and tracked using value stream performance boards. Typically these visual boards are updated weekly and used by the value stream CI team to identify improvement areas, initiate PDCA projects, and monitor their progress. These boards show the value stream performance measurements, pareto charts (or other root cause analysis), and information about the CI projects. The boards also show the current and future state maps together with the project plan to move from current to future state. The Value Stream Performance Boards become “mission control” for both break-through improvement and continuous improvement of the value stream.

Typical measurements include:<sup>[5]</sup>

- Productivity (sales/person)
- Process control (on-time shipment to customer requirement)
- Flow (dock-to-dock days or hours)
- Quality & Standardized Work (first time through without scrap or rework)
- Linearity and overall improvement (average cost)
- People participating in CI
- Safety (Safety cross showing lost time, accidents, near-misses, etc.)

Cell and process measurements are reported frequently – often hourly – by the people working in the cell or the process. The measurements are used to control the process and identify defects. When defects are identified they are “fixed” in the short term to serve the customers today and solved over the longer term so that they never occur again.

Typical measurements include:

- Day-by-the-Hour production quantities

- First Time Thru without scrap or rework
- WIP to SWIP (work-in-process inventory within the cell or process compared to the standard work-in-process required within the process)
- Operational equipment effectiveness – OEE (for machine driven operations and particularly for bottleneck or constraint machines.)
- “Just-Do-It” suggestions per person.

For a “starter set” of lean performance measurements: [Lean Performance Measurements Starter Set](#)

## 2.9.3 Financial Reports for Lean Operations

### Value stream costing

Cost and profitability reporting is achieved using Value Stream Costing, a simple summary direct costing of the value streams. The value stream costs are typically collected weekly and there is little or no allocation of “overheads.” This provides financial information that can be clearly understood by everybody in the value stream which in turn leads to good decisions, motivation to lean improvement across the entire value stream, and clear accountability for cost and profitability. Weekly reporting also provides excellent control and management of costs because they can be reviewed by the value stream manager while the information is still current.<sup>[5][6]</sup>

### Plain language financial statements

Lean accounting provides financial reports that are readily understandable to anyone in the company. The income statements are in “plain language” and the information is presented in a way that is no more complicated than a household budget. Plain language income statements are easy to use because they do not include misleading and confusing data relating to standard costs and hosts of incomprehensible variance figures. When used in meetings, plain language financial statements change the question from “What does this mean?” to “What should we do?”.

### Box Score reporting

Box Scores are used widely within lean accounting. The standard format of the box score shows a 3-dimensional view of value stream performance; operational performance measurements, financial performance, and how the value stream capacity is being used. The capacity information shows how much of the capacity within the value stream is used productively, how much is used to do non-productive activities, and how much value stream capacity is available for use. The box score shows the value

		7/15/2009	7/16/2009	7/17/2009	7/18/2009	7/19/2009	8/23/2009	8/30/2009	GOAL
OPERATIONAL	Units per Person	244	194	241	241	229			272
	On-Time Shipment	97.20%	98.00%	98.00%	98.00%	96.00%			98.50%
	First Time Thru	72%	82%	95%	72%	86%			95%
	Dock-to-Dock Days	8.9	8.5	9	12	8.9			7.1
	Average Cost	\$68.51	\$46.50	\$40.72	\$47.73	\$43.53			\$39.01
	AP days - AR days	8	8	8.8	8	8			8
CAPACITY	Productive	31%	35%	31%	31%	31%			31%
	Non-Productive	56%	62%	56%	41%	41%			41%
	Available Capacity	13%	3%	13%	28%	28%			28%
FINANCIAL	Revenue	\$1,811,456	\$1,816,988	\$1,816,988	\$1,816,988	\$1,816,988			\$1,826,088
	Material Costs	\$498,296	\$676,161	\$581,556	\$767,819	\$642,825			\$626,810
	Conversion Costs	\$497,933	\$599,091	\$498,129	\$498,129	\$511,120			\$488,804
	Inventory	\$271,163	\$211,223	\$233,648	\$298,191	\$289,566			\$176,433
	Value Stream Profit	\$623,227	\$530,712	\$738,551	\$551,938	\$664,241			\$841,393
	Value Stream ROI	38.67%	29.32%	40.96%	30.32%	36.46%			43.46%

Example of a Box Score used for weekly value stream performance reporting

stream performance on a single sheet of paper and using a simple and accessible format.

The box score shown on the right shows weekly value stream performance. Other box scores are used for decision-making, for assessing the financial impact of lean improvement, for selecting or prioritizing such issues as capital acquisitions using the 3P approach, and other reporting and decision-making requirements. Companies using lean accounting often have a standard box score format and require that all decisions relating to a value stream be presented using the standard box scores. This leads to operational and financial information being consistent and well understood when it is used.<sup>[5]</sup>

### 2.9.4 Making Decisions without the Use of Product or Process Costs

#### Decision-Making using Box Scores and Value Stream Cost Information

		Current State	Make Product	Buy in China	Buy Locally
OPERATIONAL	Units per Person	29.31	26.05	32.56	32.56
	On-Time Shipment	97.20%	98.00%	95.70%	96.00%
	First Time Thru	54%	63%	52%	60%
	Dock-to-Dock Days	8.9	8.5	16.28	10.21
	Average Cost	\$111.74	\$113.10	\$113.90	\$112.66
	AP days - AR days	8	8	8.8	8
CAPACITY	Productive	31%	35%	31%	31%
	Non-Productive	56%	62%	56%	41%
	Available Capacity	13%	3%	13%	28%
FINANCIAL	Revenue	\$1,811,456	\$1,821,456	\$1,821,456	\$1,821,456
	Material Costs	\$498,296	\$588,296	\$575,296	\$672,296
	Conversion Costs	\$497,933	\$527,036	\$545,933	\$550,254
	Inventory	\$271,163	\$234,433	\$448,361	\$316,484
	Value Stream Profit	\$623,227	\$708,124	\$700,227	\$646,906
	Value Stream ROI	38.67%	38.88%	38.44%	35.52%

Routine decision-making – including quotes, profitability, make/buy, sourcing, product rationalization, and so forth – is achieved using simple yet powerful information that is readily available from the box score. There is no need to use a standard cost again for these important decisions. The Box Score shows an example of this method for decision-making related to sourcing of a new product.

Most companies using lean accounting create standard templates for the various kinds of daily routine decisions. These will include assessing the profitability of a sales order or request for quote, make-buy decisions for products or components, the impact of improvement projects, and so forth. These templates often access box score infor-

mation from the lean accounting information within the company’s systems. The availability of capacity is often a crucial issue when making these kinds of short-term decisions.

The box score shown in this example demonstrates a short term decision and assumes that the company’s capacity and costs are largely fixed. There are two other kinds of decisions used regularly in lean companies; medium term decisions and strategic decisions. Box Scores are also used for medium term decisions but there is no assumption of fixed capacity and costs. The template shows how the capacity and resources need to be changed to fulfill the decision. These decisions are linked in the SOFP (Sales, Operations, and Financial Planning) process that typically looks out 12–18 months. The Box Score is also used for strategic decisions such as the introduction of new products, and the templates feed into the company’s Strategy Deployment (Hoshin Kanri) and Target Costing processes.

The Box Score method is flexible to meet the needs of different kinds of decisions, yet using the same underlying approach that we do not try to calculate a fully absorbed product cost. Instead the impact of these decisions on the value stream as a whole is used to assess the suitability of each of our choices. This leads to better understanding and better decisions, when used with standard decision-making processes.<sup>[2]</sup>

#### Product or service costing

Under most circumstances it is not necessary to calculate product or service costs.<sup>[4]</sup> Traditional manufacturing companies usually calculate a fully absorbed product cost using complex methods for the allocation of overhead costs, and they use these product costs for decision-making, inventory valuation, and performance measurements in the form of variance analysis and such metrics as individual efficiency. Similar methods are used in service organizations to estimate the cost of each service they provide. Companies employing lean accounting methods recognize that standard costs and other methods for fully absorbed product or service costing lead to poor decisions and motivate anti-lean behavior.<sup>[7]</sup> These companies also find that there is no need to calculate a product cost because all the uses of product costs within traditional companies can be addressed in lean accounting using simpler and better methods. Decision-making, inventory valuation, performance measurements, and other uses of fully absorbed product costs are all achieved using other lean accounting methods. If a product cost is required – for reporting international transfer pricing, for example – then these can be calculated using simpler and more lean-focused methods like Features & Characteristics costing.<sup>[5]</sup>

## 2.9.5 External Reporting

### Closing the books

	Cartridge	Manifold	Flexible	Temperature	New	Support	Total
	April-10	April-10	April-10	April-10	Products	April-10	April-10
Sales	\$3,412,726	\$719,315	\$3,494,895	\$969,215			\$8,596,150
Commissions	\$153,178	\$32,286	\$156,866	\$43,503			\$385,833
Wages & Fringes	\$1,179,256	\$313,930	\$784,958	\$152,914	\$402,354	\$215,339	\$3,048,751
Materials	\$95,141	\$46,519	\$79,427	\$45,886	\$12,778		\$16,005
Freight	\$54,619	\$3,779	\$78,034	\$3,446	\$12,043	\$3,214	\$155,135
Supplies & Tooling	\$68,438	\$24,950	\$31,936	\$13,068	\$51,833	\$1,256	\$191,481
Outside Services	\$118,903	\$2,000	\$114,212	\$0	\$2,109	\$4,600	\$241,824
Depreciation	\$12,876	\$6,962	\$33,052	\$15,959	\$32,577	\$2,399	\$103,825
Rentals	\$10,637	\$0	\$0	\$0			\$10,637
Facilities / Utilities	\$18,763	\$6,031	\$20,773	\$5,361	\$5,696	\$10,387	\$67,011
T&E	\$2,146	\$798	\$3,411	\$488	\$1,982	\$4,366	\$15,161
Warranty	\$91,191	\$10,790	\$52,423	\$14,258			\$129,842
Other	\$8,630	\$6,465	\$18,261	\$3,405		\$20,149	\$56,910
TOTAL COSTS	\$2,514,778	\$956,480	\$2,087,384	\$706,568	\$921,372	\$279,715	\$6,666,296
VALUE STREAM PROFIT	\$897,948	\$162,835	\$1,407,511	\$262,647	(\$521,372)	(\$279,715)	\$1,929,854
Value Stream Margin %	26%	23%	40%	28%	-6%	-3%	22%
					Inventory change adjustment		\$54,933
					Exchange rate adjustment		(\$3,266)
					Corporate overheads		(\$300,869)
					<b>NET PROFIT</b>		<b>\$1,680,656</b>

The primary collection of revenue and costs is done using Value Stream Costing, and (typically) weekly value stream income statements are used by the value stream managers to control costs and work to reduce costs. A typical lean organization will have several revenue earning or *order fulfillment* value streams, one or two *new product development* value streams, and then a small group of people and departments that *support* the value streams but are not in the value streams. These external support people include, for example, a plant or division manager, HR, Information systems, and so forth. The costs of these support people is relatively small in comparison to the value streams.

External reporting is achieved by taking the monthly value stream income statements and the financial statement for the support people and adding them together to provide the consolidated financial report for the company or division as a whole. This month-end close provides financial reports for the company that can be used for all external reporting. There is usually a requirement for some “below the line” adjustments to bring the income state in line with *generally accepted accounting principles* (GAAP). These adjustments include any change of inventory value between now and last month, group and corporate overhead allocations, and other miscellaneous adjustments like exchange rate gains and losses. The “bottom line” of the adjusted statement will of course be the same as the traditional statements. There is no formal change of accounting method and the bottom line will therefore be the same.

### Inventory valuation

An important aspect of financial control is the evaluation of inventory. Lean manufacturing always leads to substantial inventory reductions. When inventories are low and under good control (using pull systems, single-piece flow, supplier partnerships, etc.), the valuation of inventory becomes much less complex. Lean Accounting contains a number of methods for valuing inventory that are

simple, accurate, and often visual. Several of these methods do not require any computer-based inventory tracking at all.

### Compliance to regulatory requirements

A question that always comes up when discussing lean accounting is whether these methods comply with regulatory accounting requirements and GAAP (generally accepted accounting principles). Lean accounting fully complies with all statutory and generally accepted accounting requirements in the United States and Europe, including the unique requirements of German, Swiss, and Italian regulation. Lean accounting also complies with the increasingly popular *International Accounting Standards* (IAS) that is seeking to create a single worldwide approach. When moving from traditional accounting methods to lean accounting there is no “change of accounting” because the external reporting outcome of lean accounting uses the same accrual based actual costing required by GAAP and statutory regulations. There is an argument that lean accounting lends itself better to statutory regulations because they require reporting at actual cost. Lean accounting uses actual costs throughout, whereas traditional accounting uses standard costs that must then be adjusted to actual costing for external reporting

## 2.9.6 Further Simplifying the Accounting Processes

### Transaction elimination

Traditional companies use complex, transaction-based information systems like MRPII or Enterprise Systems (ERP) to maintain financial and operational control of their processes. Lean organizations bring their process under good control using lean methods, visual control, low inventories, short lead times, and – most importantly – identifying the root causes of the problems that create the lack of control. Once these root causes have been addressed and the process brought under control, it is no longer necessary to use these complex and wasteful transactional systems, and they can be gradually eliminated.

In manufacturing companies the transaction-heavy documents tend to be production work orders and inventory tracking on the computer. Over time, as lean methods eliminate the need for these documents in favor of visual management, these documents can be eliminated and the thousands of wasteful transaction can be eliminated. One large North American aircraft manufacturer eliminated three trillion transactions in one year using this approach. The “ideal” for a manufacturing company is to have only two types of transactions within the production processes; the receipt of raw materials and the shipment of finished product. These two transactions are legally required ow-



ing to change of ownership. Everything else within the production process can be addressed better, quicker, easier, and less wastefully using visual, lean methods.

Other kinds of service companies like banks, healthcare, insurance and others, have similarly transaction-heavy processes that can be radically simplified through the use of lean methods of control. Almost every company can largely eliminate their purchasing and accounts payable processes together with the wasteful and complicated three-way matching through using lean methods.

Accounting controls have always been important, and it is essential that Lean Accounting enhance these controls, and does not weaken them. It is important to bring the company's auditors into the Lean Accounting process at the earliest stages. A primary tool to ensure that Lean Accounting changes are made prudently is the *Transaction Elimination Matrix*. Using the transaction elimination matrix we can determine what lean methods must be in place to enable us to eliminate traditional, transaction-based processes without jeopardizing financial (or operational) control. These decisions are made ahead of time and become a part of the overall lean transformation; in some cases driving the lean changes and improvements.

## 2.9.7 Focusing on Customer Value

### Target costing

Target costing is the tool for understanding how the company creates value for the customer and what must be done to create more value. Target Costing is used when new products are being designed and/or when the value stream team needs to understand the changes required to increase the value for the customers. The outcome of this highly cross-functional and cooperative process is a series of initiatives to create more value for the customer and to bring the product costs into line with the company's need for short and long term financial stability. These improvement initiatives encompass sales and marketing, product design, operations, logistics, and administrative processes within the company.<sup>[8]</sup>

### Value-based pricing

The first of the five principles of lean thinking is *value to the customer*. The prices of products and services are set according to the value created for the customers. Lean accounting includes methods for calculating the amount of value created by a company's products and services, and form that knowledge to establish prices. This approach is in stark contrast to many traditional companies that calculate their prices using the cost-plus method. The cost-plus method establishes prices by calculating a fully absorbed product cost and then adding on an acceptable profit margin. This cost-plus methods leads to serious errors in pricing because it creates a false linkage between

price and cost. The price of a product is unrelated to the cost of manufacturing and supplying that product. The price of a product or services is entirely determined by the amount of value created by the product in the eyes of the customers. Lean accounting methods enable value-based pricing.

## 2.9.8 External links

- **Lean Accounting: What's It All About?**, collaborative article written by lean accounting thought leaders following the 2005 inaugural Lean Accounting Summit in Dearborn, MI
- **Lean Accounting Summit**, Annual gathering of the world's lean accounting thought leaders

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## 2.10 Funds transfer pricing

**Funds transfer pricing** (FTP) is a process used in banking to adjust the reported performance of different business units of a bank. A bank could have different kinds of business units. The split of these units between deposit-raising units and funds-advancing units affects whether they receive a positive or negative revenue adjustment. Both borrowing and lending contribute to the performance of the bank as a whole. FTP is a mechanism



to adjust these profitabilities to incorporate true funding costs.

An intermediary is created within the organisation usually *treasury* or *central office*. All the fund-raising units raise funds from the market at a particular rate and lend the same to the central office at a higher rate. All the lending units borrow the funds from the central office at a particular rate and lend the same to the borrowers at a higher rate. The central office rate is notional in nature and is aligned to market conditions. Thus for all the units there are two rates available to measure the performance. For a deposit-raising unit the difference between interest paid to the deposit-holders and interest receivable from central office is the contribution to the bank's profitability. For a lending division the difference between *Interest* payable to central office and the interest received from the borrowers is the contribution to the bank's performance.

FTP is therefore a revenue adjustment made to the bank's Balance Sheet to reflect funding cost impact.

For example, a business unit which manages funds for high-net-worth individuals will create cash which is held on deposit. That deposit will accrue interest therefore the Wealth business unit's profits will have to be increased by the deposit interest which can easily be calculated by using the prevailing rate of interest.

This approach became problematic during the 2007/8 financial crisis because actual interest rates paid began to differ from published rates such as Libor or bank base rates very substantially. With poor credit availability the profit adjustment made in favour of depositing business units was effectively understated. This had been less an issue when banks' borrowing costs were close to base rates or quoted rates such as LIBOR.

Failure to calculate FTP correctly can cause loans to be much less profitable than they initially appear and the fact that banks have extended unprofitable loans is a key factor in the recent financial crisis.

FTP has become important because banks are expected to state their funding costs accurately as a regulatory requirement, because funding costs affect a banks liquidity reporting. Failure and bail-outs of banks has made reported liquidity a hot topic. FTP calculation is complicated by a number of factors which make calculation of the revenue adjustment needed difficult. Factors affecting funding cost include the length of time an asset or liability is repaid (Liquidity Term Premium), the extent to which an asset has been or can be securitised (which affects its liquidity) and the *\*behaviour\** of customers in particular product/customer niches, customers propensity to withdraw long term asset deposits at penalty or to repay obligations such as mortgages early all affect real funding cost. This behaviour factor complicates the calculation of FTP and has required significant and expensive changes to banking systems. Balance sheets now incorporate new attributes for customer and product which were not previously significant reporting dimensions.

One important issue to be considered in calculating FTP is the need to value funding costs on an "at arms length" basis.

To understand "at arms length" one has to understand how relationships affect behaviour. Some conventional transfer pricing issues can be considered to explore this.

A good example is a father selling a home to his son. The value of such a transfer may not be considered to be the same as what would be achieved on the open market. Similarly businesses often manipulate sales of asset through inter-company trades to maximise profitability in low tax environments.

In banking terms the fact that a loan is made between business units may reflect agreed or contracted recognition of (too low in the financial crisis) costs rather than prevailing actual accurate funding costs and this is both an important audit concern and of taxation interest as transfer pricing affects where and in which business unit profit is reported.

### 2.10.1 External links

- [thefreelibrary.com](http://thefreelibrary.com)

# Chapter 3

## Functions

### 3.1 Operations research

For the academic journal, see [Operations Research](#).

**Operations research**, or **operational research** in British usage, is a discipline that deals with the application of advanced analytical methods to help make better decisions.<sup>[1]</sup> Further, the term 'operational analysis' is used in the British (and some British Commonwealth) military, as an intrinsic part of capability development, management and assurance. In particular, operational analysis forms part of the Combined Operational Effectiveness and Investment Appraisals (COEIA), which support British defence capability acquisition decision-making.

It is often considered to be a sub-field of mathematics.<sup>[2]</sup> The terms [management science](#) and [decision science](#) are sometimes used as synonyms.<sup>[3]</sup>

Employing techniques from other mathematical sciences, such as [mathematical modeling](#), [statistical analysis](#), and [mathematical optimization](#), operations research arrives at optimal or near-optimal solutions to complex decision-making problems. Because of its emphasis on human-technology interaction and because of its focus on practical applications, operations research has overlap with other disciplines, notably [industrial engineering](#) and [operations management](#), and draws on [psychology](#) and [organization science](#). Operations research is often concerned with determining the maximum (of profit, performance, or yield) or minimum (of loss, risk, or cost) of some real-world objective. Originating in military efforts before World War II, its techniques have grown to concern problems in a variety of industries.<sup>[4]</sup>

#### 3.1.1 Overview

Operational research (OR) encompasses a wide range of problem-solving techniques and methods applied in the pursuit of improved decision-making and efficiency, such as simulation, mathematical optimization, queueing theory and other stochastic-process models, Markov decision processes, econometric methods, data envelopment analysis, neural networks, expert systems, decision anal-

ysis, and the [analytic hierarchy process](#).<sup>[5]</sup> Nearly all of these techniques involve the construction of mathematical models that attempt to describe the system. Because of the computational and statistical nature of most of these fields, OR also has strong ties to [computer science](#) and [analytics](#). Operational researchers faced with a new problem must determine which of these techniques are most appropriate given the nature of the system, the goals for improvement, and constraints on time and computing power.

The major subdisciplines in modern operational research, as identified by the journal *Operations Research*,<sup>[6]</sup> are:

- Computing and information technologies
- 
- Financial engineering
- Manufacturing, service sciences, and supply chain management
- Marketing Engineering<sup>[7]</sup>
- Policy modeling and public sector work
- Revenue management
- Simulation
- Stochastic models
- Transportation

#### 3.1.2 History

As a discipline, operational research originated in the efforts of military planners during World War I (convoy theory and Lanchester's laws). In the decades after the two world wars, the techniques were more widely applied to problems in business, industry and society. Since that time, operational research has expanded into a field widely used in industries ranging from petrochemicals to airlines, finance, logistics, and government, moving to a focus on the development of mathematical models that can be used to analyse and optimize complex systems, and has become an area of active academic and industrial research.<sup>[4]</sup>

### Historical origins

Early work in operational research was carried out by individuals such as Charles Babbage. His research into the cost of transportation and sorting of mail led to England's universal "Penny Post" in 1840, and studies into the dynamical behaviour of railway vehicles in defence of the GWR's broad gauge.<sup>[8]</sup> Percy Bridgman brought operational research to bear on problems in physics in the 1920s and would later attempt to extend these to the social sciences.<sup>[9]</sup>

Modern operational research originated at the Bawdsey Research Station in the UK in 1937 and was the result of an initiative of the station's superintendent, A. P. Rowe. Rowe conceived the idea as a means to analyse and improve the working of the UK's early warning radar system, Chain Home (CH). Initially, he analysed the operating of the radar equipment and its communication networks, expanding later to include the operating personnel's behaviour. This revealed unappreciated limitations of the CH network and allowed remedial action to be taken.<sup>[10]</sup>

Scientists in the United Kingdom including Patrick Blackett (later Lord Blackett OM PRS), Cecil Gordon, Solly Zuckerman, (later Baron Zuckerman OM, KCB, FRS), C. H. Waddington, Owen Wansbrough-Jones, Frank Yates, Jacob Bronowski and Freeman Dyson, and in the United States with George Dantzig looked for ways to make better decisions in such areas as logistics and training schedules

### Second World War

The modern field of operational research arose during World War II. In the World War II era, operational research was defined as "a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control."<sup>[11]</sup> Other names for it included operational analysis (UK Ministry of Defence from 1962)<sup>[12]</sup> and quantitative management.<sup>[13]</sup>

During the Second World War close to 1,000 men and women in Britain were engaged in operational research. About 200 operational research scientists worked for the British Army.<sup>[14]</sup>

Patrick Blackett worked for several different organizations during the war. Early in the war while working for the Royal Aircraft Establishment (RAE) he set up a team known as the "Circus" which helped to reduce the number of anti-aircraft artillery rounds needed to shoot down an enemy aircraft from an average of over 20,000 at the start of the Battle of Britain to 4,000 in 1941.<sup>[15]</sup>

In 1941 Blackett moved from the RAE to the Navy, after first working with RAF Coastal Command, in 1941 and then early in 1942 to the Admiralty.<sup>[16]</sup> Blackett's

team at Coastal Command's Operational Research Section (CC-ORS) included two future Nobel prize winners and many other people who went on to be pre-eminent in their fields.<sup>[17]</sup> They undertook a number of crucial analyses that aided the war effort. Britain introduced the convoy system to reduce shipping losses, but while the principle of using warships to accompany merchant ships was generally accepted, it was unclear whether it was better for convoys to be small or large. Convoys travel at the speed of the slowest member, so small convoys can travel faster. It was also argued that small convoys would be harder for German U-boats to detect. On the other hand, large convoys could deploy more warships against an attacker. Blackett's staff showed that the losses suffered by convoys depended largely on the number of escort vessels present, rather than the size of the convoy. Their conclusion was that a few large convoys are more defensible than many small ones.<sup>[18]</sup>



*A Liberator in standard RAF green/dark earth/black night bomber finish as originally used by Coastal Command*

While performing an analysis of the methods used by RAF Coastal Command to hunt and destroy submarines, one of the analysts asked what colour the aircraft were. As most of them were from Bomber Command they were painted black for night-time operations. At the suggestion of CC-ORS a test was run to see if that was the best colour to camouflage the aircraft for daytime operations in the grey North Atlantic skies. Tests showed that aircraft painted white were on average not spotted until they were 20% closer than those painted black. This change indicated that 30% more submarines would be attacked and sunk for the same number of sightings.<sup>[19]</sup> As a result of these findings Coastal Command changed their aircraft to using white undersurfaces.

Other work by the CC-ORS indicated that on average if the trigger depth of aerial-delivered depth charges (DCs) were changed from 100 feet to 25 feet, the kill ratios would go up. The reason was that if a U-boat saw an aircraft only shortly before it arrived over the target then at 100 feet the charges would do no damage (because the U-boat wouldn't have had time to descend as far as 100 feet), and if it saw the aircraft a long way from the target it had time to alter course under water so the chances of it be-



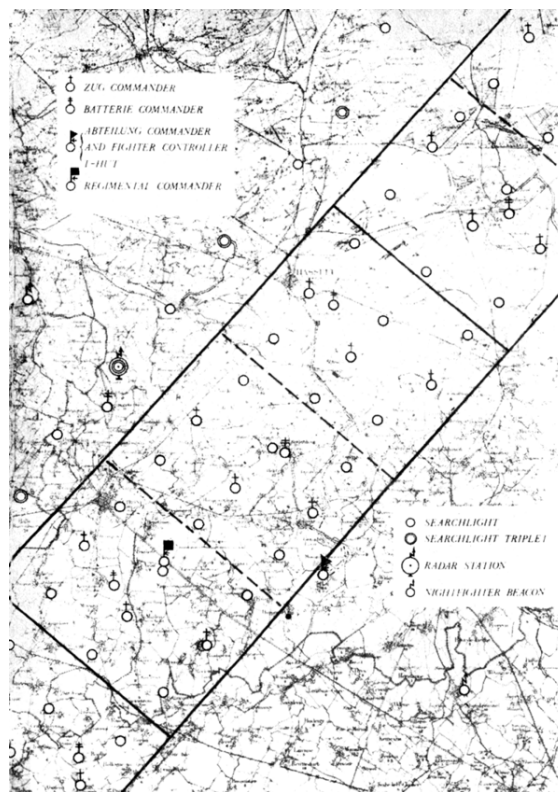


A Warwick in the revised RAF Coastal Command green/dark grey/white finish

ing within the 20-foot kill zone of the charges was small. It was more efficient to attack those submarines close to the surface when the targets' locations were better known than to attempt their destruction at greater depths when their positions could only be guessed. Before the change of settings from 100 feet to 25 feet, 1% of submerged U-boats were sunk and 14% damaged. After the change, 7% were sunk and 11% damaged. (If submarines were caught on the surface, even if attacked shortly after submerging, the numbers rose to 11% sunk and 15% damaged). Blackett observed "there can be few cases where such a great operational gain had been obtained by such a small and simple change of tactics".<sup>[20]</sup>

Bomber Command's Operational Research Section (BCORS), analysed a report of a survey carried out by RAF Bomber Command. For the survey, Bomber Command inspected all bombers returning from bombing raids over Germany over a particular period. All damage inflicted by German air defences was noted and the recommendation was given that armour be added in the most heavily damaged areas. This recommendation was not adopted because the fact that the aircraft returned with these areas damaged indicated these areas were NOT vital, and adding armour to non-vital areas where damage is acceptable negatively affects aircraft performance. Their suggestion to remove some of the crew so that an aircraft loss would result in fewer personnel losses, was also rejected by RAF command. Blackett's team made the logical recommendation that the armour be placed in the areas which were completely untouched by damage in the bombers which returned. They reasoned that the survey was biased, since it only included aircraft that returned to Britain. The untouched areas of returning aircraft were probably vital areas, which, if hit, would result in the loss of the aircraft.<sup>[21]</sup>

When Germany organised its air defences into the Kammhuber Line, it was realised by the British that if the RAF bombers were to fly in a bomber stream they could overwhelm the night fighters who flew in individual cells directed to their targets by ground controllers. It was then a matter of calculating the statistical loss from collisions against the statistical loss from night fighters to



Map of Kammhuber Line

calculate how close the bombers should fly to minimise RAF losses.<sup>[22]</sup>

The "exchange rate" ratio of output to input was a characteristic feature of operational research. By comparing the number of flying hours put in by Allied aircraft to the number of U-boat sightings in a given area, it was possible to redistribute aircraft to more productive patrol areas. Comparison of exchange rates established "effectiveness ratios" useful in planning. The ratio of 60 mines laid per ship sunk was common to several campaigns: German mines in British ports, British mines on German routes, and United States mines in Japanese routes.<sup>[23]</sup>

Operational research doubled the on-target bomb rate of B-29s bombing Japan from the Marianas Islands by increasing the training ratio from 4 to 10 percent of flying hours; revealed that wolf-packs of three United States submarines were the most effective number to enable all members of the pack to engage targets discovered on their individual patrol stations; revealed that glossy enamel paint was more effective camouflage for night fighters than traditional dull camouflage paint finish, and the smooth paint finish increased airspeed by reducing skin friction.<sup>[23]</sup>

On land, the operational research sections of the Army Operational Research Group (AORG) of the Ministry of Supply (MoS) were landed in Normandy in 1944, and they followed British forces in the advance across Europe. They analysed, among other topics, the effectiveness of artillery, aerial bombing and anti-tank shooting.

## After World War II

With expanded techniques and growing awareness of the field at the close of the war, operational research was no longer limited to only operational, but was extended to encompass equipment procurement, training, logistics and infrastructure. Operations Research also grew in many areas other than the military once scientists learned to apply its principles to the civilian sector. With the development of the simplex algorithm for Linear Programming in 1947<sup>[24]</sup> and the development of computers over the next three decades, Operations Research can now “solve problems with hundreds of thousands of variables and constraints. Moreover, the large volumes of data required for such problems can be stored and manipulated very efficiently.”<sup>[24]</sup>

### 3.1.3 Problems addressed

- **Critical path analysis or project planning:** identifying those processes in a complex project which affect the overall duration of the project
- **Floorplanning:** designing the layout of equipment in a factory or components on a computer chip to reduce manufacturing time (therefore reducing cost)
- **Network optimization:** for instance, setup of telecommunications networks to maintain quality of service during outages
- Allocation problems
- Facility location
- Assignment Problems:
  - Assignment problem
  - Generalized assignment problem
  - Quadratic assignment problem
  - Weapon target assignment problem
- Bayesian search theory : looking for a target
- Optimal search
- Routing, such as determining the routes of buses so that as few buses are needed as possible
- Supply chain management: managing the flow of raw materials and products based on uncertain demand for the finished products
- Efficient messaging and customer response tactics
- Automation: automating or integrating robotic systems in human-driven operations processes
- Globalization: globalizing operations processes in order to take advantage of cheaper materials, labor, land or other productivity inputs

- Transportation: managing freight transportation and delivery systems (Examples: LTL Shipping, intermodal freight transport, travelling salesman problem)
- Scheduling:
  - Personnel staffing
  - Manufacturing steps
  - Project tasks
  - Network data traffic: these are known as queueing models or queueing systems.
  - Sports events and their television coverage
- Blending of raw materials in oil refineries
- Determining optimal prices, in many retail and B2B settings, within the disciplines of pricing science

Operational research is also used extensively in government where evidence-based policy is used.

### 3.1.4 Management science

Main article: Management science

In 1967 Stafford Beer characterized the field of management science as “the business use of operations research”.<sup>[25]</sup> However, in modern times the term management science may also be used to refer to the separate fields of organizational studies or corporate strategy. Like operational research itself, management science (MS) is an interdisciplinary branch of applied mathematics devoted to optimal decision planning, with strong links with economics, business, engineering, and other sciences. It uses various scientific research-based principles, strategies, and analytical methods including mathematical modeling, statistics and numerical algorithms to improve an organization’s ability to enact rational and meaningful management decisions by arriving at optimal or near optimal solutions to complex decision problems. In short, management sciences help businesses to achieve their goals using the scientific methods of operational research.

The management scientist’s mandate is to use rational, systematic, science-based techniques to inform and improve decisions of all kinds. Of course, the techniques of management science are not restricted to business applications but may be applied to military, medical, public administration, charitable groups, political groups or community groups.

Management science is concerned with developing and applying models and concepts that may prove useful in helping to illuminate management issues and solve managerial problems, as well as designing and developing new and better models of organizational excellence.<sup>[26]</sup>



The application of these models within the corporate sector became known as management science.<sup>[27]</sup>

### Related fields

Some of the fields that have considerable overlap with Operations Research and Management Science include:

### Applications

Applications of management science is abundant in industry as airlines, manufacturing companies, service organizations, military branches, and in government. The range of problems and issues to which management science has contributed insights and solutions is vast. It includes:<sup>[26]</sup>

- scheduling airlines, including both planes and crew,
- deciding the appropriate place to site new facilities such as a warehouse, factory or fire station,
- managing the flow of water from reservoirs,
- identifying possible future development paths for parts of the telecommunications industry,
- establishing the information needs and appropriate systems to supply them within the health service, and
- identifying and understanding the strategies adopted by companies for their information systems

Management science is also concerned with so-called "soft-operational analysis", which concerns methods for strategic planning, strategic decision support, and Problem Structuring Methods (PSM). In dealing with these sorts of challenges mathematical modeling and simulation are not appropriate or will not suffice. Therefore, during the past 30 years, a number of non-quantified modeling methods have been developed. These include:

- stakeholder based approaches including metagame analysis and drama theory
- morphological analysis and various forms of influence diagrams.
- approaches using cognitive mapping
- the Strategic Choice Approach
- robustness analysis

### 3.1.5 Societies and journals

#### Societies

The International Federation of Operational Research Societies (IFORS)<sup>[28]</sup> is an umbrella organization for operational research societies worldwide, representing approximately 50 national societies including those in the US,<sup>[29]</sup> UK,<sup>[30]</sup> France,<sup>[31]</sup> Germany, Canada,<sup>[32]</sup> Australia,<sup>[33]</sup> New Zealand,<sup>[34]</sup> Philippines,<sup>[35]</sup> India,<sup>[36]</sup> Japan and South Africa (ORSSA).<sup>[37]</sup> The constituent members of IFORS form regional groups, such as that in Europe.<sup>[38]</sup> Other important operational research organizations are Simulation Interoperability Standards Organization (SISO)<sup>[39]</sup> and Interservice/Industry Training, Simulation and Education Conference (I/ITSEC)<sup>[40]</sup>

In 2004 the US-based organization INFORMS began an initiative to market the OR profession better, including a website entitled *The Science of Better*<sup>[41]</sup> which provides an introduction to OR and examples of successful applications of OR to industrial problems. This initiative has been adopted by the Operational Research Society in the UK, including a website entitled *Learn about OR*.<sup>[42]</sup>

#### Journals

The Institute for Operations Research and the Management Sciences (INFORMS) publishes thirteen scholarly journals about operations research, including the top two journals in their class, according to 2005 Journal Citation Reports.<sup>[43]</sup> They are:

- Decision Analysis
- Information Systems Research
- INFORMS Journal on Computing
- *INFORMS Transactions on Education*<sup>[44]</sup> (an open access journal)
- *Interfaces: An International Journal of the Institute for Operations Research and the Management Sciences*
- *Management Science: A Journal of the Institute for Operations Research and the Management Sciences*
- *Manufacturing & Service Operations Management*
- *Marketing Science*
- *Mathematics of Operations Research*
- *Operations Research: A Journal of the Institute for Operations Research and the Management Sciences*
- Organization Science
- Service Science
- *Transportation Science*.

#### Other journals

- *4OR-A Quarterly Journal of Operations Research*: jointly published the Belgian, French and Italian Operations Research Societies (Springer);
- *Decision Sciences* published by Wiley-Blackwell on behalf of the Decision Sciences Institute
- *European Journal of Operational Research (EJOR)*: Founded in 1975 and is presently by far the largest operational research journal in the world, with its around 9,000 pages of published papers per year. In 2004, its total number of citations was the second largest amongst Operational Research and Management Science journals;
- *INFOR Journal*: published and sponsored by the Canadian Operational Research Society;
- *International Journal of Operations Research and Information Systems (IJORIS)*: "an official publication of the Information Resources Management Association, published quarterly by IGI Global";<sup>[45]</sup>
- *Journal of Defense Modeling and Simulation (JDMS): Applications, Methodology, Technology*: a quarterly journal devoted to advancing the science of modeling and simulation as it relates to the military and defense.<sup>[46]</sup>
- *Journal of the Operational Research Society (JORS)*: an official journal of The OR Society; this is the oldest continuously published journal of OR in the world, published by Palgrave;<sup>[47]</sup>
- *Journal of Simulation (JOS)*: an official journal of The OR Society, published by Palgrave;<sup>[47]</sup>
- *Mathematical Methods of Operations Research (MMOR)*: the journal of the German and Dutch OR Societies, published by Springer;<sup>[48]</sup>
- *Military Operations Research (MOR)*: published by the Military Operations Research Society;
- *Operations Research Letters*;
- *Opsearch*: official journal of the Operational Research Society of India;
- *OR Insight*: a quarterly journal of The OR Society, published by Palgrave;<sup>[47]</sup>
- *Production and Operations Management*, the official journal of the Production and Operations Management Society
- *TOP*: the official journal of the Spanish Society of Statistics and Operations Research.<sup>[49]</sup>

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### 3.1.7 References

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### 3.1.8 Notes

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### 3.1.9 Further reading

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### 3.1.10 External links

- What is Operations Research?
- International Federation of Operational Research Societies
- The Institute for Operations Research and the Management Sciences (INFORMS)
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## 3.2 IT cost transparency

the cost of

**IT cost transparency** is a new category of information technology management software and systems that enables enterprise IT organizations to model and track the total cost to deliver and maintain the IT Services they provide to the business. It is increasingly a task of management accounting. IT cost transparency solutions integrate financial information such as labor, software licensing costs, hardware acquisition and depreciation, data center facilities charges, from general ledger systems and combines that with operational data from ticketing, monitoring, asset management, and project portfolio management systems to provide a single, integrated view of IT costs by service, department, GL line item and project. In addition to tracking cost elements, IT Cost Transparency tracks utilization, usage and operational performance metrics in order to provide a measure of value or ROI. Costs, budgets, performance metrics



and changes to data points are tracked over time to identify trends and the impact of changes to underlying cost drivers in order to help managers address the key drivers in escalating IT costs and improve planning.

IT cost transparency combines elements of activity based costing, business intelligence, operational monitoring and performance dashboards. It provides the system on which to implement ITIL v3 Financial Management guidelines to assist with Financial Management for IT services and is closely related to IT Service Management.

### 3.2.1 Capabilities

While specific solutions vary, capabilities can include:

- Simplified or automated collection of key cost driver data
- An allocation or cost modeling interface
- Custom reporting and analysis of unit cost drivers, including CIO dashboards
- Ability to track operational metrics such as utilization, service levels, support tickets along with cost
- Bill of IT reports for chargeback or service allocation to Lines of Business
- Forecast and budget tracking versus actual and over time
- Hypothetical scenario planning for new project ROI analysis
- Cost benchmarking against industry averages or common metrics
- Self-service portal for employees to manage assigned assets

### 3.2.2 Analysts' take

*"Globalization, consumerization, new competitors and new service models are radically 'changing the shape of IT'. IT leaders must develop greater transparency into the costs, utilization and operations of their IT services in order to optimize their IT investments and evolve from being technology managers to being stewards of business technology." -- Barbara Gomolski, Research Vice President, Gartner*

*"By making these costs transparent, the IT organization can fundamentally change the way business units consume IT resources, drive down total enterprise IT costs, and focus on IT spending that delivers real business value. The CIO who leads this change can usher in a new era of strategic IT management--and true partnership with the business." — Andrew M. Appel, Neeru Arora, and Raymond Zenklich. McKinsey & Company.*

*"Companies can get an understanding of the best candidates for virtualization or consolidation, for instance, and further reduce the cost of resources. IT organizations consistently try to become more efficient, and this type of detailed information enables visibility, billing and chargeback in the future," -- [1]*

### 3.2.3 IT Cost Breakdown

The average IT budget has the following breakdown:

31% – personnel costs (internal) 29% – software costs (external/purchasing category) 26% – hardware costs (external/purchasing category) 14% – costs of external service providers (external/services)

This is confirmed by independent research from McKinsey and the Sand-Hill Group.<sup>[2]</sup>

In addition to the considerations above about the current volume of software asset costs, even more important is their growth – their absolute growth (in EUR) and relative growth (relative to growth of other costs in the IT budget). Software asset costs are growing, endogenously and exogenously:

- Endogenous growth – Recent technology shifts and IT cost reduction initiatives, e.g. server virtualization, remote desktops and cloud computing, have delivered flexibility and security in operations and a cost advantage on the hardware/infrastructure side – but have generated increased software demand, and thus supplementary costs, on the software asset side.
- Exogenous growth – Software vendors have transformed the process of discovering incompliance into a business model. The technology shift to virtualized/cloud environments has provided the right platform. Nowadays, most vendors have increased the complexity licensing requirements, taking into account more attributes for more licensing metrics. They have accelerated the pace of change and created more pitfalls, thus increasing the level of software licensing expertise required in order to remain compliant.<sup>[3]</sup>

### 3.2.4 See also

- Cost management
- IT Service Management
- ITIL v3
- Service level management
- Software as a service



### 3.2.5 References

- [1] CIOs seek IT cost transparency in 2010 by Denise Dubie, comment on IT cost optimization by Yisrael Dancziger, president and CEO of Digital Fuel
- [2] “IT Costs – The Costs, Growth And Financial Risk Of Software Assets”. OMT-CO Operations Management Technology Consulting GmbH. Retrieved 26 June 2013.
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- *Unraveling the Mystery of IT Costs* Andrew M. Appel, Neeru Arora, and Raymond Zenkich. The McKinsey Quarterly, August 2005.
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- *IT Cost Transparency: Optimizing ITIL v3 Service and Financial Management* Kurt Shubert, IT Manager, Certified ITIL v2 and v3. July 2008.
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- *Know Your Costs: The Key to IT Business* David Stodder. April 2010.
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### 3.2.6 External links

- *How to cut IT costs without Hemorrhaging*
- *Scalpel or Cleaver: CIOs Can Show CFOs the Light*
- *Can IT Spending Shift from Reactive to Proactive?*
- The Challenges Of Software Licensing
- *Avoid spending more 'just in case'*
- *IT Costs – The Costs, Growth And Financial Risk Of Software Assets*

## 3.3 Transfer pricing

**Transfer pricing** is the setting of the price for goods and services sold between controlled (or related) legal entities within an enterprise. For example, if a subsidiary company sells goods to a parent company, the cost of those goods paid by the parent to the subsidiary is the transfer price. Legal entities considered under the control of a single corporation include branches and companies that are wholly or majority owned ultimately by the parent corporation. Certain jurisdictions consider entities to be under common control if they share family members on their boards of directors. Transfer pricing can be used as a profit allocation method to attribute a multinational corporation’s net profit (or loss) before tax to countries where it does business. Transfer pricing results in the setting of prices among divisions within an enterprise.

In principle, a transfer price should match either what the seller would charge an independent, arm’s length customer, or what the buyer would pay an independent, arm’s length supplier. While unrealistic transfer prices do not affect the overall enterprise directly, they become a concern for government taxing authorities when transfer pricing is used to lower profits in a division of an enterprise located in a country that levies high income taxes and raise profits in a country that is a tax haven that levies no (or low) income taxes.

Transfer pricing is the major tool for corporate tax avoidance<sup>[1]</sup> also referred to as Base Erosion and Profit Shifting (BEPS).

### 3.3.1 Profit allocation

The term “transfer pricing” covers the setting, analysis, documentation, and adjustment of charges made between related parties for goods, services, or use of property (including intangible property) via separate accounting for each related party. Transfer prices among divisions of an enterprise should reflect allocation of resources among such components. The transfer prices are supposed to be set at arm’s length prices – similar to charges between unrelated parties.

Setting transfer prices enables multinational corporations to attribute net profit (or loss) before tax among the countries where they do business. An alternative approach is formulary apportionment, where corporate profits are allocated according to the metrics of activity in the countries. According to the *amicus curiae* brief, filed by the attorney generals of Alaska, Montana, New Hampshire, and Oregon in support of the state of California in the U.S. Supreme Court case of *Barclays Bank PLC v. Franchise Tax Board*, the formulary apportionment method, which is also known as the unitary apportionment method, has at least three major advantages over the separate accounting system when applied to multi-jurisdictional businesses. First, the unitary method cap-

tures the added wealth and value resulting from economic interdependencies of multistate and multinational corporations through their functional integration, centralization of management, and **economies of scale**. A unitary business also benefits from more intangible values shared among its constituent parts, such as reputation, good will, customers and other business relationships. See, e.g., *Mobil*, 445 U.S. at 438-40; *Container*, 463 U.S. at 164-65. Separate accounting, with its emphasis on carving out of the overall business only income from sources within a single state, ignores the value attributable to the integrated nature of the business. Yet, to a large degree, the wealth, power, and profits of the world's large multinational enterprises are attributable to the very fact that they are integrated, unitary businesses. Hellerstein Treatise, P8.03 at 8-32.n9

As one commentator has explained: To believe that multinational corporations do not maintain an advantage over independent corporations operating within a similar business sphere is to ignore the economic and political strength of the multinational giants. By attempting to treat those businesses which are in fact unitary as independent entities, separate accounting "operates in a universe of pretense; as in Alice in Wonderland, it turns reality into fancy and then pretends it is the real world"

Because countries impose different corporate tax rates, a corporation that has a goal of minimizing the overall taxes to be paid will set transfer prices to allocate more of the worldwide profit to lower tax countries. Many countries attempt to impose penalties on corporations if the countries consider that they are being deprived of taxes on otherwise taxable profit. However, since the participating countries are sovereign entities, obtaining data and initiating meaningful actions to limit tax avoidance is hard.<sup>[2]</sup> A publication of the Organisation for Economic Co-operation and Development (OECD) states, "Transfer prices are significant for both taxpayers and tax administrations because they determine in large part the income and expenses, and therefore taxable profits, of associated enterprises in different tax jurisdictions."

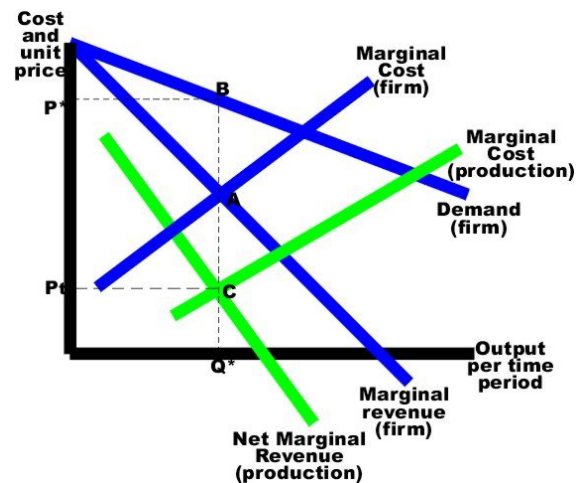
### Regulations

Over 60 governments have adopted transfer pricing rules.<sup>[3]</sup> Transfer pricing rules in most countries are based on the "arm's length principle" – that is to establish transfer prices based on analysis of pricing in comparable transactions between two or more unrelated parties dealing at arm's length. The OECD has published guidelines based on the arm's length principle, which are followed, in whole or in part, by many of its member countries in adopting rules. The United States and Canadian rules are similar in many respects to the OECD guidelines, with certain points of material difference. A few countries, such as Brazil and Kazakhstan, follow rules that are materially different overall. Since tax havens do not attempt to collect taxes, they can ignore the issue.

The rules of nearly all countries permit related parties to set prices in any manner, but permit the tax authorities to adjust those prices (for purposes of computing tax liability) where the prices charged are outside an arm's length range. Rules are generally provided for determining what constitutes such arm's length prices, and how any analysis should proceed. Prices actually charged are compared to prices or measures of profitability for unrelated transactions and parties. The rules generally require that market level, functions, risks, and terms of sale of unrelated party transactions or activities be reasonably comparable to such items with respect to the related party transactions or profitability being tested.

Most systems allow use of multiple methods, where such methods are appropriate and are supported by reliable data, to test related party prices. Among the commonly used methods are comparable uncontrolled prices, cost-plus, resale price or markup, and profitability based methods. Many systems differentiate methods of testing goods from those for services or use of property due to inherent differences in business aspects of such broad types of transactions. Some systems provide mechanisms for sharing or allocation of costs of acquiring assets (including intangible assets) among related parties in a manner designed to reduce tax controversy.

### 3.3.2 Economic theory

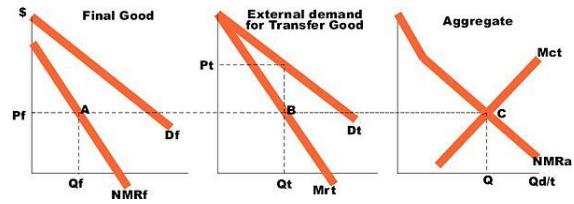


*Transfer Pricing with No External Market*

The discussion in this section explains an economic theory behind **optimal transfer pricing** with *optimal* defined as transfer pricing that maximizes overall firm profits in a non-realistic world with no taxes, no capital risk, no development risk, no externalities or any other frictions which exist in the real world. In practice a great many factors influence the transfer prices that are used by multinational corporations, including performance measurement, capabilities of accounting systems, import quotas, customs duties, VAT, taxes on profits, and (in many cases) simple lack of attention to the pricing.

From marginal price determination theory, the optimum level of output is that where marginal cost equals marginal revenue. That is to say, a firm should expand its output as long as the marginal revenue from additional sales is greater than their marginal costs. In the diagram that follows, this intersection is represented by point A, which will yield a price of  $P^*$ , given the demand at point B.

When a firm is selling some of its product to itself, and only to itself (i.e. there is no external market for that particular transfer good), then the picture gets more complicated, but the outcome remains the same. The demand curve remains the same. The optimum price and quantity remain the same. But marginal cost of production can be separated from the firm's total marginal costs. Likewise, the marginal revenue associated with the production division can be separated from the marginal revenue for the total firm. This is referred to as the **Net Marginal Revenue** in production (NMR) and is calculated as the marginal revenue from the firm minus the marginal costs of distribution.



Transfer Pricing with an Imperfect External Market

If the firm is able to sell its transfer goods in an imperfect market, then it need not be a price taker. There are two markets each with its own price ( $P_f$  and  $P_t$  in the next diagram). The aggregate market is constructed from the first two. That is, point C is a horizontal summation of points A and B (and likewise for all other points on the Net Marginal Revenue curve (NMRa)). The total optimum quantity ( $Q$ ) is the sum of  $Q_f$  plus  $Q_t$ .

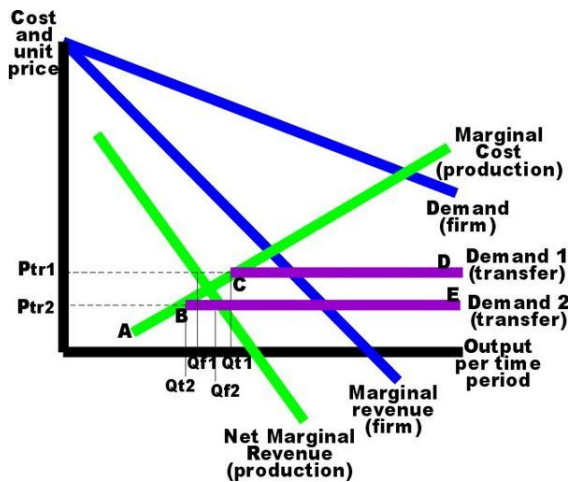
### 3.3.3 General tax principles

Commonly controlled taxpayers often determine prices charged between such taxpayers based in part on the tax effects, seeking to reduce overall taxation of the group. OECD Guidelines state, at 1.2, "When independent enterprises deal with each other, the conditions of their commercial and financial relations (e.g., the price of goods transferred or services provided and the conditions of the transfer or provision) ordinarily are determined by market forces. When associated enterprises deal with each other, their commercial and financial relations may not be directly affected by external market forces in the same way." Recognizing this, most national and some sub-national income tax authorities have the legal authority to adjust prices charged between related parties. Tax rules generally permit related parties to set prices in any manner they choose, but permit adjustment where such prices or their effects are outside guidelines.<sup>[4]</sup>

Transfer pricing rules vary by country. Most countries have an appeals process whereby a taxpayer may contest such adjustments. Some jurisdictions, including Canada and the United States, require extensive reporting of transactions and prices, and India requires third party certification of compliance with transfer pricing rules.

#### History

Transfer pricing adjustments have been a feature of many tax systems since the 1930s. Both the U.S. and the Organization for Economic Cooperation and Development (OECD, of which the U.S. and most major industrial countries are members) had some guidelines by 1979. The United States led the development of detailed, comprehensive transfer pricing guidelines with a White Paper in 1988 and proposals in 1990-1992, which ultimately became regulations in 1994.<sup>[5]</sup> In 1995, the OECD issued the first draft of its current transfer pricing guide-



Transfer Pricing with a Competitive External Market

It can be shown algebraically that the intersection of the firm's marginal cost curve and marginal revenue curve (point A) must occur at the same quantity as the intersection of the production division's marginal cost curve with the net marginal revenue from production (point C).

If the production division is able to sell the transfer good in a competitive market (as well as internally), then again both must operate where their marginal costs equal their marginal revenue, for profit maximization. Because the external market is competitive, the firm is a price taker and must accept the transfer price determined by market forces (their marginal revenue from transfer and demand for transfer products becomes the transfer price). If the market price is relatively high (as in  $P_{tr1}$  in the next diagram), then the firm will experience an internal surplus (excess internal supply) equal to the amount  $Q_{t1}$  minus  $Q_{t2}$ . The actual marginal cost curve is defined by points A,C,D.

lines (hereinafter called merely “the OECD guidelines”, but distinct from its better-known general guidelines for MNCs), which it expanded in 1996 and 2010.<sup>[6]</sup> The two sets of guidelines are broadly similar and contain certain principles followed by many countries. The OECD guidelines have been formally adopted by many European Union countries with little or no modification.

The OECD<sup>[7]</sup> and U.S.<sup>[8]</sup> systems provide that prices may be set by the component members of an enterprise in any manner, but may be adjusted to conform to an **arm’s length standard**. Each system provides for several approved methods of testing prices, and allows the government to adjust prices to the midpoint of an arm’s length range. Both systems provide for standards for comparing third party transactions or other measures to tested prices, based on comparability and reliability criteria. Significant exceptions are noted below.

### Government authority to adjust prices

Most governments have granted authorization to their tax authorities to adjust prices charged between related parties.<sup>[9]</sup> Many such authorizations, including those of the United States, United Kingdom, Canada, and Germany, allow domestic as well as international adjustments. Some authorizations apply only internationally. Most, if not all, governments permit adjustments by the tax authority even where there is no intent to avoid or evade tax.<sup>[10]</sup>

Adjustment of prices is generally made by adjusting taxable income of all involved related parties within the jurisdiction, as well as adjusting any withholding or other taxes imposed on parties outside the jurisdiction. Such adjustments generally are made after filing of tax returns. For example, if Bigco US charges Bigco Germany for a machine, either the U.S. or German tax authorities may adjust the price upon examination of the respective tax return. Following an adjustment, the taxpayer generally is allowed (at least by the adjusting government) to make payments to reflect the adjusted prices.

Most rules require that the tax authorities consider actual transactions between parties, and permit adjustment only to actual transactions.<sup>[11]</sup> Multiple transactions may be aggregated or tested separately, and testing may use multiple year data. In addition, transactions whose economic substance differs materially from their form may be recharacterized under the laws of many systems to follow the economic substance.

### Arm’s length standard

Nearly all systems require that prices be tested using an “arm’s length” standard.<sup>[12]</sup> Under this approach, a price is considered appropriate if it is within a range of prices that would be charged by independent parties dealing at arm’s length. This is generally defined as a price that an

independent buyer would pay an independent seller for an identical item under identical terms and conditions, where neither is under any compulsion to act.

There are clear practical difficulties in implementing the arm’s length standard. For items other than goods, there are rarely identical items. Terms of sale may vary from transaction to transaction. Market and other conditions vary geographically or over time. Some systems give a preference to certain transactional methods over other methods for testing prices.

In addition, most systems recognize that an arm’s length price may not be a particular price point but rather a range of prices. Some systems provide measures for evaluating whether a price within such range is considered arm’s length, such as the *interquartile range* used in U.S. regulations. Significant deviation among points in the range may indicate lack of reliability of data.<sup>[13]</sup> Reliability is generally considered to be improved by use of multiple year data.<sup>[14]</sup>

### Comparability

Most rules provide standards for when unrelated party prices, transactions, profitability or other items are considered sufficiently comparable in testing related party items.<sup>[15]</sup> Such standards typically require that data used in comparisons be reliable and that the means used to compare produce a reliable result. The U.S. and OECD rules require that reliable adjustments must be made for all differences (if any) between related party items and purported comparables that could materially affect the condition being examined.<sup>[16]</sup> Where such reliable adjustments cannot be made, the reliability of the comparison is in doubt. Comparability of tested prices with uncontrolled prices is generally considered enhanced by use of multiple data. Transactions not undertaken in the ordinary course of business generally are not considered to be comparable to those taken in the ordinary course of business. Among the factors that must be considered in determining comparability are:<sup>[17]</sup>

- the nature of the property or services provided between the parties,
- functional analysis of the transactions and parties,
- comparison of contractual terms (whether written, verbal, or implied from conduct of the parties), and
- comparison of significant economic conditions that could affect prices, including the effects of different market levels and geographic markets.

**Nature of property or services** Comparability is best achieved where identical items are compared. However, in some cases it is possible to make reliable adjustments for differences in the particular items, such as differences



in features or quality.<sup>[18]</sup> For example, gold prices might be adjusted based on the weight of the actual gold (one ounce of 10 carat gold would be half the price of one ounce of 20 carat gold).

**Functions and risks** Buyers and sellers may perform different functions related to the exchange and undertake different risks. For example, a seller of a machine may or may not provide a warranty. The price a buyer would pay will be affected by this difference. Among the functions and risks that may impact prices are:<sup>[19]</sup>

- Product development
- Manufacturing and assembly
- Marketing and advertising
- Transportation and warehousing
- Credit risk
- Product obsolescence risk
- Market and entrepreneurial risks
- Collection risk
- Financial and currency risks
- Company- or industry-specific items

**Terms of sale** Manner and terms of sale may have a material impact on price.<sup>[20]</sup> For example,

**buyers will pay more if they can defer payment and buy in smaller quantities.** Terms that may impact price include payment timing, warranty, volume discounts, duration of rights to use of the product, form of consideration, etc.

**Market level, economic conditions and geography**

Goods, services, or property may be provided to different levels of buyers or users: producer to wholesaler, wholesaler to wholesaler, wholesaler to retailer, or for ultimate consumption. Market conditions, and thus prices, vary greatly at these levels. In addition, prices may vary greatly between different economies or geographies. For example, a head of cauliflower at a retail market will command a vastly different price in unelectrified rural India than in Tokyo. Buyers or sellers may have different market shares that allow them to achieve volume discounts or exert sufficient pressure on the other party to lower prices. Where prices are to be compared, the putative comparables must be at the same market level, within the same or similar economic and geographic environments, and under the same or similar conditions.<sup>[21]</sup>

**Testing of prices**

Tax authorities generally examine prices actually charged between related parties to determine whether adjustments are appropriate. Such examination is by comparison (testing) of such prices to comparable prices charged among unrelated parties. Such testing may occur only on examination of tax returns by the tax authority, or taxpayers may be required to conduct such testing themselves in advance or filing tax returns. Such testing requires a determination of how the testing must be conducted, referred to as a transfer pricing method.<sup>[22]</sup>

**Best method rule** Some systems give preference to a specific method of testing prices. OECD and U.S. systems, however, provide that the method used to test the appropriateness of related party prices should be that method that produces the most reliable measure of arm's length results.<sup>[23]</sup> This is often known as a "best method" rule. Under the system may require that more than one testing method be considered. Factors to be considered include comparability of tested and independent items, reliability of available data and assumptions under the method, and validation of the results of the method by other methods.

**Comparable uncontrolled price (CUP)** Most systems consider a third party price for identical goods, services, or property under identical conditions, called a comparable uncontrolled price (CUP), to be the most reliable indicator of an arm's length price. All systems permit testing using this method, but it is not always applicable.<sup>[24][25]</sup> Further, it may be possible to reliably adjust CUPs where the goods, services, or property are identical but the sales terms or other limited items are different. As an example, an interest adjustment could be applied where the only difference in sales transactions is time for payment (e.g., 30 days vs. 60 days). CUPs are based on actual transactions. For commodities, actual transactions of other parties may be reported in a reliable manner. For other items, "in-house" comparables, i.e., transactions of one of the controlled parties with third parties, may be the only available reliable data.

**Other transactional methods** Among other methods relying on actual transactions (generally between one tested party and third parties) and not indices, aggregates, or market surveys are:

- **Cost-plus (C+) method:** goods or services provided to unrelated parties are consistently priced at actual cost plus a fixed markup. Testing is by comparison of the markup percentages.<sup>[26]</sup>
- **Resale price method (RPM):** goods are regularly offered by a seller or purchased by a retailer to/from unrelated parties at a standard "list" price less a fixed



discount. Testing is by comparison of the discount percentages.<sup>[27]</sup>

- Gross margin method: similar to resale price method, recognised in a few systems.

**Profitability methods** Some methods of testing prices do not rely on actual transactions. Use of these methods may be necessary due to the lack of reliable data for transactional methods. In some cases, non-transactional methods may be more reliable than transactional methods because market and economic adjustments to transactions may not be reliable. These methods may include:

- Comparable profits method (CPM): profit levels of similarly situated companies in similar industries may be compared to an appropriate tested party.<sup>[28]</sup> See U.S. rules below.
- Transactional net margin method (TNMM): while called a transactional method, the testing is based on profitability of similar businesses. See OECD guidelines below.<sup>[29]</sup>
- Profit split method: total enterprise profits are split in a formulaic manner based on econometric analyses.<sup>[30]</sup>

CPM and TNMM have a practical advantage in ease of implementation. Both methods rely on microeconomic analysis of data rather than specific transactions. These methods are discussed further with respect to the U.S. and OECD systems.

Two methods are often provided for splitting profits:<sup>[31]</sup> comparable profit split<sup>[32]</sup> and residual profit split.<sup>[33]</sup> The former requires that profit split be derived from the combined operating profit of uncontrolled taxpayers whose transactions and activities are comparable to the transactions and activities being tested. The residual profit split method requires a two step process: first profits are allocated to routine operations, then the residual profit is allocated based on nonroutine contributions of the parties. The residual allocation may be based on external market benchmarks or estimation based on capitalised costs.

**Tested party and profit level indicator** Where testing of prices occurs on other than a purely transactional basis, such as CPM or TNMM, it may be necessary to determine which of the two related parties should be tested.<sup>[34]</sup> Testing is to be done of that party testing of which will produce the most reliable results. Generally, this means that the tested party is that party with the most easily compared functions and risks. Comparing the tested party's results to those of comparable parties may require adjustments to results of the tested party or the comparables for such items as levels of inventory or receivables.

Testing requires determination of what indication of profitability should be used.<sup>[35]</sup> This may be net profit on the transaction, return on assets employed, or some other measure. Reliability is generally improved for TNMM and CPM by using a range of results and multiple year data.<sup>[36]</sup> This is based on circumstances of the relevant countries.

### Intangible property issues

Valuable intangible property tends to be unique. Often there are no comparable items. The value added by use of intangibles may be represented in prices of goods or services, or by payment of fees (royalties) for use of the intangible property. Licensing of intangibles thus presents difficulties in identifying comparable items for testing.<sup>[37]</sup> However, where the same property is licensed to independent parties, such license may provide comparable transactional prices. The profit split method specifically attempts to take value of intangibles into account.

### Services

Enterprises may engage related or unrelated parties to provide services they need. Where the required services are available within a multinational group, there may be significant advantages to the enterprise as a whole for components of the group to perform those services. Two issues exist with respect to charges between related parties for services: whether services were actually performed which warrant payment,<sup>[38]</sup> and the price charged for such services.<sup>[39]</sup> Tax authorities in most major countries have, either formally or in practice, incorporated these queries into their examination of related party services transactions.

There may be tax advantages obtained for the group if one member charges another member for services, even where the member bearing the charge derives no benefit. To combat this, the rules of most systems allow the tax authorities to challenge whether the services allegedly performed actually benefit the member charged. The inquiry may focus on whether services were indeed performed as well as who benefited from the services.<sup>[38][40]</sup> For this purpose, some rules differentiate stewardship services from other services. Stewardship services are generally those that an investor would incur for its own benefit in managing its investments. Charges to the investee for such services are generally inappropriate. Where services were not performed or where the related party bearing the charge derived no direct benefit, tax authorities may disallow the charge altogether.

Where the services were performed and provided benefit for the related party bearing a charge for such services, tax rules also permit adjustment to the price charged.<sup>[41]</sup> Rules for testing prices of services may differ somewhat from rules for testing prices charged for goods due to the

inherent differences between provision of services and sale of goods. The OECD Guidelines provide that the provisions relating to goods should be applied with minor modifications and additional considerations. In the U.S., a different set of price testing methods is provided for services. In both cases, standards of comparability and other matters apply to both goods and services.

It is common for enterprises to perform services for themselves (or for their components) that support their primary business. Examples include accounting, legal, and computer services for those enterprises not engaged in the business of providing such services.<sup>[42]</sup> Transfer pricing rules recognize that it may be inappropriate for a component of an enterprise performing such services for another component to earn a profit on such services. Testing of prices charged in such case may be referred to a cost of services or services cost method.<sup>[43]</sup> Application of this method may be limited under the rules of certain countries, and is required in some countries e.g. Canada.

Where services performed are of a nature performed by the enterprise (or the performing or receiving component) as a key aspect of its business, OECD and U.S. rules provide that some level of profit is appropriate to the service performing component.<sup>[44]</sup> Canada's rules do not permit such profit. Testing of prices in such cases generally follows one of the methods described above for goods. The cost-plus method, in particular, may be favored by tax authorities and taxpayers due to ease of administration.

### Cost sharing

Multi-component enterprises may find significant business advantage to sharing the costs of developing or acquiring certain assets, particularly intangible assets. Detailed U.S. rules provide that members of a group may enter into a cost sharing agreement (CSA) with respect to costs and benefits from the development of intangible assets.<sup>[45]</sup> OECD Guidelines provide more generalized suggestions to tax authorities for enforcement related to cost contribution agreements (CCAs) with respect to acquisition of various types of assets.<sup>[46]</sup> Both sets of rules generally provide that costs should be allocated among members based on respective anticipated benefits. Inter-member charges should then be made so that each member bears only its share of such allocated costs. Since the allocations must inherently be made based on expectations of future events, the mechanism for allocation must provide for prospective adjustments where prior projections of events have proved incorrect. However, both sets of rules generally prohibit applying hindsight in making allocations.<sup>[47]</sup>

A key requirement to limit adjustments related to costs of developing intangible assets is that there must be a written agreement in place among the members.<sup>[48]</sup> Tax rules may impose additional contractual, documentation, ac-

counting, and reporting requirements on participants of a CSA or CCA, which vary by country.

Generally, under a CSA or CCA, each participating member must be entitled to use of some portion rights developed pursuant to the agreement without further payments. Thus, a CCA participant should be entitled to use a process developed under the CCA without payment of royalties. Ownership of the rights need not be transferred to the participants. The division of rights is generally to be based on some observable measure, such as by geography.<sup>[49]</sup>

Participants in CSAs and CCAs may contribute pre-existing assets or rights for use in the development of assets. Such contribution may be referred to as a platform contribution. Such contribution is generally considered a deemed payment by the contributing member, and is itself subject to transfer pricing rules or special CSA rules.<sup>[50]</sup>

A key consideration in a CSA or CCA is what costs development or acquisition costs should be subject to the agreement. This may be specified under the agreement, but is also subject to adjustment by tax authorities.<sup>[51]</sup>

In determining reasonably anticipated benefits, participants are forced to make projections of future events. Such projections are inherently uncertain. Further, there may exist uncertainty as to how such benefits should be measured. One manner of determining such anticipated benefits is to project respective sales or gross margins of participants, measured in a common currency, or sales in units.<sup>[52]</sup>

Both sets of rules recognize that participants may enter or leave a CSA or CCA. Upon such events, the rules require that members make buy-in or buy-out payments. Such payments may be required to represent the market value of the existing state of development, or may be computed under cost recovery or market capitalization models.<sup>[53]</sup>

### Penalties and documentation

Some jurisdictions impose significant penalties relating to transfer pricing adjustments by tax authorities. These penalties may have thresholds for the basic imposition of penalty, and the penalty may be increased at other thresholds. For example, U.S. rules impose a 20% penalty where the adjustment exceeds USD 5 million, increased to 40% of the additional tax where the adjustment exceeds USD 20 million.<sup>[54]</sup>

The rules of many countries require taxpayers to document that prices charged are within the prices permitted under the transfer pricing rules. Where such documentation is not timely prepared, penalties may be imposed, as above. Documentation may be required to be in place prior to filing a tax return in order to avoid these penalties.<sup>[55]</sup> Documentation by a taxpayer need not be relied upon by the tax authority in any jurisdiction per-

mitting adjustment of prices. Some systems allow the tax authority to disregard information not timely provided by taxpayers, including such advance documentation. India requires that documentation not only be in place prior to filing a return, but also that the documentation be certified by the chartered accountant preparing a company return.

### 3.3.4 U.S. specific tax rules

U.S. transfer pricing rules are lengthy.<sup>[56]</sup> They incorporate all of the principles above, using CPM (see below) instead of TNMM. U.S. rules specifically provide that a taxpayer's intent to avoid or evade tax is not a prerequisite to adjustment by the Internal Revenue Service, nor are nonrecognition provisions. The U.S. rules give no priority to any particular method of testing prices, requiring instead explicit analysis to determine the best method. U.S. comparability standards limit use of adjustments for business strategies in testing prices to clearly defined market share strategies, but permit limited consideration of location savings.

#### Comparable profits method

The Comparable Profits method (CPM)<sup>[57]</sup> was introduced in the 1992 proposed regulations and has been a prominent feature of IRS transfer pricing practice since. Under CPM, the tested party's overall results, rather than its transactions, are compared with the overall results of similarly situated enterprises for whom reliable data is available. Comparisons are made for the profit level indicator that most reliably represents profitability for the type of business. For example, a sales company's profitability may be most reliably measured as a return on sales (pre-tax profit as a percent of sales).

CPM inherently requires lower levels of comparability in the nature of the goods or services. Further, data used for CPM generally can be readily obtained in the U.S. and many countries through public filings of comparable enterprises.

Results of the tested party or comparable enterprises may require adjustment to achieve comparability. Such adjustments may include effective interest adjustments for customer financing or debt levels, inventory adjustments, etc.

#### Cost plus and resale price issues

U.S. rules apply resale price method and cost-plus with respect to goods strictly on a transactional basis.<sup>[58]</sup> Thus, comparable transactions must be found for all tested transactions in order to apply these methods. Industry averages or statistical measures are not permitted. Where a manufacturing entity provides contract manufacturing for both related and unrelated parties, it may readily have re-

liable data on comparable transactions. However, absent such in-house comparables, it is often difficult to obtain reliable data for applying cost-plus.

The rules on services expand cost-plus, providing an additional option to mitigate these data problems.<sup>[59]</sup> Charges to related parties for services not in the primary business of either the tested party or the related party group are rebuttably presumed to be arm's length if priced at cost plus zero (the services cost method). Such services may include back-room operations (e.g., accounting and data processing services for groups not engaged in providing such services to clients), product testing, or a variety of such non-integral services. This method is not permitted for manufacturing, reselling, and certain other services that typically are integral to a business.

U.S. rules also specifically permit shared services agreements.<sup>[60]</sup> Under such agreements, various group members may perform services which benefit more than one member. Prices charged are considered arm's length where the costs are allocated in a consistent manner among the members based on reasonably anticipated benefits. For instance, shared services costs may be allocated among members based on a formula involving expected or actual sales or a combination of factors.

#### Terms between parties

Under U.S. rules, actual conduct of the parties is more important than contractual terms. Where the conduct of the parties differs from terms of the contract, the IRS has authority to deem the actual terms to be those needed to permit the actual conduct.<sup>[61]</sup>

#### Adjustments

U.S. rules require that the IRS may not adjust prices found to be within the arm's length range.<sup>[61]</sup> Where prices charged are outside that range, prices may be adjusted by the IRS unilaterally to the midpoint of the range. The burden of proof that a transfer pricing adjustment by the IRS is incorrect is on the taxpayer unless the IRS adjustment is shown to be arbitrary and capricious. However, the courts have generally required that both taxpayers and the IRS to demonstrate their facts where agreement is not reached.

#### Documentation and penalties

If the IRS adjusts prices by more than \$5 million or a percentage threshold, penalties apply. The penalty is 20% of the amount of the tax adjustment, increased to 40% at a higher threshold.<sup>[62]</sup>

This penalty may be avoided only if the taxpayer maintains contemporaneous documentation meeting requirements in the regulations, and provides such documenta-

tion to the IRS within 30 days of IRS request.<sup>[63]</sup> If documentation is not provided at all, the IRS may make adjustments based on any information it has available. Contemporaneous means the documentation existed with 30 days of filing the taxpayer's tax return. Documentation requirements are quite specific, and generally require a best method analysis and detailed support for the pricing and methodology used for testing such pricing. To qualify, the documentation must reasonably support the prices used in computing tax.

### Commensurate with income standard

U.S. tax law requires that the foreign transferee/user of intangible property (patents, processes, trademarks, know-how, etc.) will be deemed to pay to a controlling transferor/developer a royalty commensurate with the income derived from using the intangible property.<sup>[64]</sup> This applies whether such royalty is actually paid or not. This requirement may result in **withholding tax** on deemed payments for use of intangible property in the U.S.

### 3.3.5 OECD specific tax rules

OECD guidelines are voluntary for member nations. Some nations have adopted the guidelines almost unchanged.<sup>[65]</sup> Terminology may vary between adopting nations, and may vary from that used above.

OECD guidelines give priority to transactional methods, described as the "most direct way" to establish comparability.<sup>[66]</sup> The Transactional Net Margin Method and Profit Split methods are used either as methods of last resort or where traditional transactional methods cannot be reliably applied.<sup>[67]</sup> CUP is not given priority among transactional methods in OECD guidelines. The Guidelines state, "It may be difficult to find a transaction between independent enterprises that is similar enough to a controlled transaction such that no differences have a material effect on price."<sup>[68]</sup> Thus, adjustments are often required to either tested prices or uncontrolled process.

### Comparability standards

OECD rules permit consideration of business strategies in determining if results or transactions are comparable. Such strategies include market penetration, expansion of market share, cost or location savings, etc.<sup>[69]</sup>

### Transactional net margin method

The transactional net margin method (TNMM)<sup>[70]</sup> compares the net profitability of a transaction, or group or aggregation of transactions, to that of another transaction, group or aggregation. Under TNMM, use of actual,

verifiable transactions is given strong preference. However, in practice TNMM allows making computations for company-level aggregates of transactions. Thus, TNMM may in some circumstances function like U.S. CPM.

### Terms

Contractual terms and transactions between parties are to be respected under OECD rules unless both the substance of the transactions differs materially from those terms and following such terms would impede tax administration.<sup>[71]</sup>

### Adjustments

OECD rules generally do not permit tax authorities to make adjustments if prices charged between related parties are within the arm's length range. Where prices are outside such range, the prices may be adjusted to the most appropriate point.<sup>[72]</sup> The burden of proof of the appropriateness of an adjustment is generally on the tax authority.

### Documentation

OECD Guidelines do not provide specific rules on the nature of taxpayer documentation. Such matters are left to individual member nations.<sup>[73]</sup>

### 3.3.6 EU

In 2002, the European Union created the **EU Joint Transfer Pricing Forum**. The Communication on "Tax and Development – Cooperating with Developing Countries in Promoting Good Governance in Tax Matters", COM (2010) 163 final, highlighted the need to support developing countries' capacity in mobilizing domestic resources for development in line with the principles of good governance in taxation. In this context, PwC prepared the report *Transfer pricing and developing countries*.<sup>[74]</sup>

### 3.3.7 China specific tax rules

Prior to 2009, China generally followed OECD Guidelines. New guidelines were announced by the State Administration of Taxation (SAT) in March 2008 and issued in January 2009.<sup>[75]</sup> The new rules continue to apply to domestic and international transactions. These guidelines differ materially in approach from those in other countries in two principal ways: 1) they are guidelines issued instructing field offices how to conduct transfer pricing examinations and adjustments, and 2) factors to be examined differ by transfer pricing method. The guidelines cover:



- Administrative matters
- Required taxpayer filings and documentation
- General transfer pricing principles, including comparability
- Guidelines on how to conduct examinations
- Advance pricing and cost sharing agreement administration
- Controlled foreign corporation examinations
- Thin capitalization
- General anti-avoidance

### Documentation

Under the Circular, taxpayers must disclose related party transactions when filing tax returns.<sup>[76]</sup> In addition, the circular provides for a three-tier set of documentation and reporting standards, based on the aggregate amount of intercompany transactions. Taxpayers affected by the rules who engaged in intercompany transactions under RMB 20 million for the year were generally exempted from reporting, documentation, and penalties. Those with transactions exceeding RMB 200 million generally were required to complete transfer pricing studies in advance of filing tax returns.<sup>[77]</sup> For taxpayers in the top tier, documentation must include a comparability analysis and justification for the transfer pricing method chosen.<sup>[78]</sup>

### General principles

Chinese transfer pricing rules apply to transactions between a Chinese business and domestic and foreign related parties. A related party includes enterprises meeting one of eight different tests, including 25% equity ownership in common, overlapping boards or management, significant debt holdings, and other tests. Transactions subject to the guidelines include most sorts of dealings businesses may have with one another.<sup>[79]</sup>

The Circular instructs field examiners to review taxpayer's comparability and method analyses. The method of analyzing comparability and what factors are to be considered varies slightly by type of transfer pricing analysis method. The guidelines for CUP include specific functions and risks to be analyzed for each type of transaction (goods, rentals, licensing, financing, and services). The guidelines for resale price, cost-plus, transactional net margin method, and profit split are short and very general.

### Cost sharing

The China rules provide a general framework for cost sharing agreements.<sup>[80]</sup> This includes a basic structure for

agreements, provision for buy-in and exit payments based on reasonable amounts, minimum operating period of 20 years, and mandatory notification of the SAT within 30 days of concluding the agreement.

### 3.3.8 Agreements between taxpayers and governments and dispute resolution

Tax authorities of most major countries have entered into unilateral or multilateral agreements between taxpayers and other governments regarding the setting or testing of related party prices. These agreements are referred to as **advance pricing agreements** or **advance pricing arrangements** (APAs). Under an APA, the taxpayer and one or more governments agree on the methodology used to test prices. APAs are generally based on transfer pricing documentation prepared by the taxpayer and presented to the government(s). Multilateral agreements require negotiations between the governments, conducted through their designated **competent authority** groups. The agreements are generally for some period of years, and may have retroactive effect. Most such agreements are not subject to public disclosure rules. Rules controlling how and when a taxpayer or tax authority may commence APA proceedings vary by jurisdiction.<sup>[81]</sup>

### 3.3.9 Fraud

Main article: [Transfer mispricing](#)

Fraudulent transfer pricing, sometimes called *transfer mispricing*, also known as *transfer pricing manipulation*,<sup>[82]</sup> refers to trade between related parties at prices meant to manipulate markets or to deceive tax authorities.

For example, if company *A*, a food grower in Africa, processes its produce through three subsidiaries: *X* (in Africa), *Y* (in a tax haven, usually offshore financial centers) and *Z* (in the United States). Now, Company *X* sells its product to Company *Y* at an artificially low price, resulting in a low profit and a low tax for Company *X* based in Africa. Company *Y* then sells the product to Company *Z* at an artificially high price, almost as high as the retail price at which Company *Z* would sell the final product in the U.S.. Company *Z*, as a result, would report a low profit and, therefore, a low tax.<sup>[83]</sup> About 60% of capital flight from Africa is from improper transfer pricing.<sup>[84]</sup> Such capital flight from the developing world is estimated at ten times the size of aid it receives and twice the debt service it pays.<sup>[85][86]</sup>

The African Union reports estimates that about 30% of Sub-Saharan Africa's GDP has been moved to tax havens.<sup>[87]</sup> Solutions include corporate "country-by-country reporting" where corporations disclose activities in each country and thereby prohibit the use of tax havens



where real economic activity occurs.<sup>[84]</sup>

In 2014, the Leverhulme Center for the Study of Value, based at the University of Manchester, published a report authored by Sarah Bracking and Khadija Sharife, identifying over \$3 billion in price fixing of South African rough diamond trade, through transfer pricing manipulation from 2005-2012. The report found significant evidence of profit shifting through volume and value manipulation.<sup>[88]</sup>

### 3.3.10 Reading and overall reference list

#### International:

- Wittendorff, Jens: *Transfer Pricing and the Arm's Length Principle in International Tax Law*, 2010, Kluwer Law International, ISBN 90-411-3270-8.

#### Canada:

- Section 247 of the Income Tax Act (Canada)
- Information Circular 87-2R - International Transfer Pricing (1999)
- Information Circular 94-4R - International Transfer Pricing: Advance Pricing Arrangements (APAs) (2001)
- TPM 07 - Referrals to the Transfer Pricing Review Committee (2005)
- TPM 09 - Reasonable efforts under section 247 of the Income Tax Act (2006)

**China:** Major international accounting and law firms have published summaries of the guidelines. See their web sites.

#### India:

- Income Tax Department's compilation of Transfer Pricing Rules
- Domestic Transfer Pricing Overview

#### OECD:

- *OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations 2010*. OECD publishing. July 2010. doi:10.1787/tpg-2010-en. ISBN 9789264090330.
- OECD Transfer Pricing Country Profiles, a useful cross reference to guidance in each member country
- Base Erosion and Profit Shifting (BEPS), OECD landing page

#### United Kingdom:

- Transfer pricing statute: ICTA88/Sch 28AA
- HMRC International Manual Transfer Pricing INTM430000

#### United States:

- Law: 26 USC 482
- Regulations: 26 CFR 1.482-0 through 9
- IRS view on OECD rules: [http://www.irs.gov/pub/irs-apa/apa\\_training\\_oecd\\_guidelines.pdf](http://www.irs.gov/pub/irs-apa/apa_training_oecd_guidelines.pdf)
- APA Procedure: Rev. Proc. 2008-31
- Feinschreiber, Robert: *Transfer Pricing Methods*, 2004, ISBN 978-0-471-57360-9
- Parker, Kenneth and Levy, Mark: *Tax Director's Guide to International Transfer Pricing*, 2008, ISBN 978-1-60231-001-8
- Services by Thompson RIA and Wolters Kluwer: search "transfer pricing" on their websites

#### Russian Federation:

- Tax Code of Russian Federation

### 3.3.11 References

- [1] Michel Aujean (chair) (2001): *Company Taxation in the Internal Market*; Commission of the EC, 23 Oct 2001
- [2] Ronen Palan (2010): *The Offshore World: Sovereign markets, Virtual Places, and Nomad Millionaires*; Cornell University Press, 2006.
- [3] Several websites provide overviews of transfer pricing regulations by country, such as the Country References on the TP analytics website.
- [4] Note, however, that customs, anti-dumping and import restrictions may in effect impose advance restrictions on prices charged.
- [5] TD 8552, 1994-2 C.B. 93.
- [6] For a history of the earlier OECD efforts, see paper presented to the United Nations in 2001.
- [7] See OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations, hereinafter OECD xx, where xx is the cited paragraph number. Update: this is the new version: OECD (2010), *OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations 2010*, OECD Publishing
- [8] See 26 CFR 1.482-0 et seq.

- [9] See, e.g., law of the U.S. at 26 USC 482, UK at ICTA88/s770, Canada. Note that OECD Guidelines leave this issue to member governments.
- [10] See, e.g., 26 CFR 1.482-1(f)(1)(i).
- [11] OECD 1.36-1.41, and 26 CFR 1.482-1(f)(2)(ii).
- [12] See, e.g., OECD 1.1 et seq., 26 CFR 1.482-1(b).
- [13] OECD 1.45, 41; 26 CFR 1.482-1(e).
- [14] OECD 1.49-1.51; 26 CFR 1.482-1(f)(2)(iii).
- [15] OECD 1.15, *et seq.*, 26 CFR 1.482-1(d).
- [16] OECD 1.15, 26 CFR 1.482-1(d)(2).
- [17] OECD 1.19-1.29; 26 CFR 1.482-1(d).
- [18] OECD 1.19, 2.7, 26 CFR 1.482-3(b)(2)(ii)(A), 26 CFR 1.482-9(c)(2)(ii)(A).
- [19] OECD 1.20-1.27, 26 CFR 1.482-1(d)(3)(i) and (iii).
- [20] OECD 1.28, 1.29, 26 CFR 1.482-1(d)(3)(ii).
- [21] OECD 1.30, 26 CFR 1.482-1(d)(3)(iv).
- [22] OECD 2.5, 26 CFR 1.482-.
- [23] OECD 1.68-1.70, 26 CFR 1.482-1(c), 26 CFR 1.482-8.
- [24] OECD 2.6-2.13, 26 CFR 1.482-5.
- [25] Why tax isn't a shore thing, *Accountancy Age*, July 15, 2011. Retrieved September 27, 2011.
- [26] OECD 2.32-48, 26 CFR 1.482-3(d), 26 CFR 1.482-9(e).
- [27] OECD 2.14-2.31, 26 CFR 1.482-3(c), 26 CFR 1.482-9(d).
- [28] 26 CFR 1.482-5.
- [29] OECD 3.26-3.33.
- [30] OECD 3.5-3.25, 26 CFR 1.482-6.
- [31] OECD 3.5.
- [32] 26 CFR 1.482-6(c)(2).
- [33] 26 CFR 1.482-6(c)(3).
- [34] OECD 3.43, 26 CFR 1.482-5(b)(2).
- [35] OECD 3.41, 26 CFR 1.482-5(b)(4).
- [36] OECD 3.43, 3.44, 26 CFR 1.482-1(e)(2).
- [37] OECD Chapter VI, 26 CFR 1.482-4.
- [38] For the U.S., see, e.g., *Young and Rubicam*, 410 F.2d 1233 (Ct.Cl., 1969), PLR 8806002.
- [39] OECD 7.5, 26 CFR 1.482-9.
- [40] OECD 7.5-7.18
- [41] OECD 7.19 *et seq.*, 26 CFR 1.482-9.
- [42] Such services may be referred to those not integral to the functioning of the primary business.
- [43] OECD 7.33, 26 CFR 1.482-9(b).
- [44] OECD 7.29 *et seq.*, 26 CFR 1.482-9(b)(2).
- [45] OECD Chapter VIII, 26 CFR 1.482-7T.
- [46] OECD 8.3.
- [47] Note that few countries besides the U.S. have formally adopted cost sharing rules, as of 2009. The OECD Guidelines do not specifically require such rules, so adoption of the Guidelines may not constitute approval of cost sharing under the laws of some countries.
- [48] U.S. rules permit, in some cases, actions of members consistent with the principles of a CSA to be considered to constitute a CSA.
- [49] OECD 8.9, 26 CFR 1.482-7T(b)(4).
- [50] OECD 8.16, 8.17, 26 CFR 1.482-7T(c).
- [51] OECD 8.13-8.18, 1.482-7T(c).
- [52] OECD 8.8, 8.9, 26 CFR 1.482-7T(e).
- [53] OECD 8.31-8.39, 26 CFR 1.482-7T(g).
- [54] USC 6662. A second threshold based on the relative magnitude of the adjustment may also apply.
- [55] 26 CFR 1.6662-6.
- [56] basic rules through 2001 26 CFR 1.482-0 through –8 plus the cost sharing (26 CFR 1.482-7) and services (26 CFR 1.482-9) regulations together exceed 120,000 words.
- [57] 26 CFR 1.482-5.
- [58] 26 CFR 1.482-3(c)(2) and (d)(2).
- [59] 26 CFR 1.482-9(c)
- [60] 26 CFR 1.482-9(c).
- [61] 26 CFR 1.482-.
- [62] 26 USC 6662.
- [63] 26 CFR 1.6662-6(d)(2)(iii).
- [64] 26 USC 367(d) and 26 CFR 1.367(d)–1T.
- [65] German law incorporates OECD guidelines by reference. Note that while Canada and the United States are OECD members, each has adopted its own comprehensive regulations that differ in some material respects from the OECD guidelines.
- [66] OECD 2.5.
- [67] OECD 3.50-3.51
- [68] OECD 2.8
- [69] OECD 1.31-1.35.
- [70] OECD 3.26 *et seq.*

- [71] OECD 1.28-29, 1.37
- [72] OECD 1.45-1.48
- [73] OECD 4.4.
- [74] Transfer pricing and developing countries, 15. July 2011
- [75] Implementation Measures of Special Tax Adjustment (Trial), Guo Shui Fa (2009) No. 2 [Circular 2, as revised] issued by the State Administration of Taxation of the Peoples Republic of China, in Chinese. English translations are available from most of the major accounting firms, and vary slightly. See, e.g., KPMG's version of the complete circular. Hereafter referred to as the Circular or China Circular 2 Art. xx, where xx is the article number of Circular 2.
- [76] China Circular 2 Art. 11.
- [77] China Circular 2 Art. 13-20.
- [78] China Circular 2 Art. 14 (iv) and (v).
- [79] China Circular 2 Art. 9-10.
- [80] China Circular 2 Art. 64, *et seq.*
- [81] See OECD 4.124 *et seq.*; U.S. IRS Rev. Proc. 2008-31; China Circular 2 Art. 46 *et seq.*
- [82] "Transfer Pricing". *Tax Justice Network*. Taxjustice Network. Retrieved 2012-08-09.
- [83] "How transfer mispricing works". *thedailystar.net*. July 15, 2012. Retrieved July 13, 2013.
- [84] Sharife, Khadija (2011-06-18). "'Transparency' hides Zambia's lost billions". *Al-Jazeera*. Retrieved 2011-07-26.
- [85] Kristina Froberg and Attiya Waris (2011). "Introduction". *Bringing the billions back: How Africa and Europe can end illicit capital flight* (PDF). Stockholm: Forum Syd Forlag. ISBN 9789189542594. Retrieved 2012-07-26.
- [86] "Africa losing billions in tax evasion". *aljazeera.com*. 16 January 2012. Retrieved 18 May 2013.
- [87] Mathiason, Nick (2007-01-21). "Western bankers and lawyers 'rob Africa of \$150bn every year'". *The Guardian* (London). Retrieved 2011-07-05.
- [88] Sarah Bracking and Khadija Sharife <http://thestudyofvalue.org/wp-content/uploads/2014/05/WP4-Bracking-Sharife-Rough-and-polished-15May.pdf>

### 3.3.12 External links

- OECD Guidelines for Multinational Enterprises (2008)
- OECD transfer pricing resources
- Ernst & Young \*2010 Global Transfer Pricing survey

- Ernst & Young \*2009 Global Transfer Pricing survey
- OECD Transfer Pricing Country Profiles
- China's new transfer pricing regulations 2009
- IRS transfer pricing documentation
- Customs vs Tax agencies in transfer pricing
- *Transfer Pricing Litigations*
- Transfer Pricing Systems

## 3.4 Cost–benefit analysis

**Cost–benefit analysis (CBA)**, sometimes called **benefit–cost analysis (BCA)**, is a systematic approach to estimating the strengths and weaknesses of alternatives that satisfy transactions, activities or functional requirements for a business. It is a technique that is used to determine options that provide the best approach for the adoption and practice in terms of benefits in labor, time and cost savings etc.<sup>[1]</sup> The CBA is also defined as a systematic process for calculating and comparing benefits and costs of a project, decision or government policy (hereafter, "project").

Broadly, CBA has two purposes:

1. To determine if it is a sound investment/decision (justification/feasibility),
2. To provide a basis for comparing projects. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.<sup>[2]</sup>

CBA is related to, but distinct from cost-effectiveness analysis. In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "net present value."

Closely related, but slightly different, formal techniques include cost-effectiveness analysis, cost–utility analysis, risk–benefit analysis, economic impact analysis, fiscal impact analysis, and Social return on investment (SROI) analysis.

### 3.4.1 Theory

Cost–benefit analysis is often used by governments and other organizations, such as private sector businesses, to appraise the desirability of a given policy. It is an analysis

of the expected balance of benefits and costs, including an account of foregone alternatives and the *status quo*. CBA helps predict whether the benefits of a policy outweigh its costs, and by how much relative to other alternatives (i.e. one can rank alternate policies in terms of the cost–benefit ratio).<sup>[3]</sup> Generally, accurate cost–benefit analysis identifies choices that increase *welfare* from a *utilitarian* perspective. Assuming an accurate CBA, changing the status quo by implementing the alternative with the lowest cost–benefit ratio can improve *Pareto efficiency*.<sup>[4]</sup> An analyst using CBA should recognize that perfect appraisal of all present and future costs and benefits is difficult, and while CBA can offer a well-educated estimate of the best alternative, perfection in terms of economic efficiency and social welfare are not guaranteed.<sup>[5]</sup>

### 3.4.2 Process

The following is a list of steps that comprise a generic cost–benefit analysis.<sup>[6]</sup>

1. List alternative projects/programs.
2. List *stakeholders*.
3. Select measurement(s) and measure all cost/benefit elements.
4. Predict outcome of cost and benefits over relevant time period.
5. Convert all costs and benefits into a common currency.
6. Apply *discount rate*.
7. Calculate *net present value* of project options.
8. Perform *sensitivity analysis*.
9. Adopt recommended choice.

### 3.4.3 Evaluation

CBA attempts to measure the positive or negative consequences of a project, which may include:

1. Effects on users or participants
2. Effects on non-users or non-participants
3. *Externality effects*
4. *Option value* or other social benefits.

A similar breakdown is employed in environmental analysis of total economic value. Both costs and benefits can be diverse. Financial costs tend to be most thoroughly represented in cost-benefit analyses due to relatively abundant market data. The net benefits of a project

may incorporate cost savings or public *willingness to pay* compensation (implying the public has no legal right to the benefits of the policy) or *willingness to accept* compensation (implying the public has a right to the benefits of the policy) for the welfare change resulting from the policy. The guiding principle of evaluating benefits is to list all (categories of) parties affected by an intervention and add the (positive or negative) value, usually monetary, that they ascribe to its effect on their welfare.

The actual compensation an individual would require to have their welfare unchanged by a policy is inexact at best. Surveys (*stated preference techniques*) or market behavior (*revealed preference techniques*) are often used to estimate the compensation associated with a policy; however, survey respondents often have strong incentives to misreport their true preferences and market behavior does not provide any information about important non-market welfare impacts.

One controversy is valuing a human life, e.g. when assessing road safety measures or life-saving medicines. However, this can sometimes be avoided by using the related technique of cost-utility analysis, in which benefits are expressed in non-monetary units such as *quality-adjusted life years*. For example, road safety can be measured in terms of *cost per life saved*, without formally placing a financial value on the life. However, such non-monetary metrics have limited usefulness for evaluating policies with substantially different outcomes. Additionally, many other benefits may accrue from the policy, and metrics such as 'cost per life saved' may lead to a substantially different ranking of alternatives than traditional cost–benefit analysis.

Another controversy is valuing the environment, which in the 21st century is typically assessed by valuing *ecosystem services* to humans, such as air and *water quality* and *pollution*.<sup>[7]</sup> Monetary values may also be assigned to other intangible effects such as business reputation, market penetration, or long-term enterprise strategy alignment.

### 3.4.4 Time and discounting

CBA usually tries to put all relevant costs and benefits on a common temporal footing using *time value of money* calculations. This is often done by converting the future expected streams of costs and benefits into a *present value* amount using a discount rate. Empirical studies and a technical framework suggest that in reality, people do discount the future like this.<sup>[8]</sup>

The choice of discount rate is subjective. A smaller rate values future generations equally with the current generation. Larger rates (e.g. a market rate of return) reflects humans' attraction to *time inconsistency*—valuing money that they receive today more than money they get in the future. The choice makes a large difference in assessing interventions with long-term effects. One issue is the

equity premium puzzle, in which long-term returns on equities may be rather higher than they should be. If so then arguably market rates of return should not be used to determine a discount rate, as doing so would have the effect of undervaluing the distant future (e.g. climate change).<sup>[9]</sup>

### 3.4.5 Risk and uncertainty

Risk associated with project outcomes is usually handled using probability theory. This can be factored into the discount rate (to have uncertainty increasing over time), but is usually considered separately. Particular consideration is often given to *risk aversion*—the preference for avoiding loss over achieving gain. *Expected return* calculations do not account for the detrimental effect of uncertainty.

Uncertainty in CBA parameters (as opposed to risk of project failure etc.) can be evaluated using a sensitivity analysis, which shows how results respond to parameter changes. Alternatively a more formal risk analysis can be undertaken using *Monte Carlo simulations*.<sup>[10]</sup>

### 3.4.6 History



*The French engineer and economist Jules Dupuit, credited with the creation of cost–benefit analysis.*

The concept of CBA dates back to an 1848 article by Jules Dupuit and was formalized in subsequent works

by Alfred Marshall. The Corps of Engineers initiated the use of CBA in the US, after the Federal Navigation Act of 1936 effectively required cost–benefit analysis for proposed federal waterway infrastructure.<sup>[11]</sup> The *Flood Control Act of 1939* was instrumental in establishing CBA as federal policy. It demanded that “the benefits to whomever they accrue [be] in excess of the estimated costs.”<sup>[12]</sup>

### Public policy

The application for broader public policy started from the work of *Otto Eckstein*,<sup>[13]</sup> who in 1958 laid out a welfare economics foundation for CBA and its application for water resource development. Over the 1960s, CBA was applied in the US for water quality,<sup>[14]</sup> recreation travel,<sup>[15]</sup> and land conservation.<sup>[16]</sup> During this period, the concept of *option value* was developed to represent the non-tangible value of preserving resources such as national parks.<sup>[17]</sup>

CBA was later expanded to address both intangible and tangible benefits of public policies relating to mental illness,<sup>[18]</sup> substance abuse,<sup>[19]</sup> college education,<sup>[20]</sup> and chemical waste policies.<sup>[21]</sup> In the US, the *National Environmental Policy Act of 1969* first required the application of CBA for regulatory programs, and since then, other governments have enacted similar rules. Government guidebooks for the application of CBA to public policies include the Canadian guide for regulatory analysis,<sup>[22]</sup> Australian guide for regulation and finance,<sup>[23]</sup> US guide for health care programs,<sup>[24]</sup> and US guide for emergency management programs.<sup>[25]</sup>

### Transportation investment

CBA application for transport investment started in the UK, with the M1 motorway project in 1960. It was later applied on many projects including London Underground's Victoria line. Later, the *New Approach to Appraisal (NATA)* was introduced by the then Department for Transport, Environment and the Regions. This presented cost–benefit results and detailed environmental impact assessments in a balanced way. NATA was first applied to national road schemes in the 1998 Roads Review but subsequently rolled out to all transport modes. As of 2011 it was a cornerstone of transport appraisal in the UK and is maintained and developed by the Department for Transport.

The EU's 'Developing Harmonised European Approaches for Transport Costing and Project Assessment' (HEATCO) project, part of its Sixth Framework Programme, reviewed transport appraisal guidance across EU member states and found that significant differences exist between countries.<sup>[26]</sup> HEATCO's aim was to develop guidelines to harmonise transport appraisal practice across the EU.<sup>[27]</sup>



Transport Canada promoted the use of CBA for major transport investments with the 1994 issuance of its Guidebook.<sup>[28]</sup>

In the US, both federal and state transport departments commonly apply CBA, using a variety of available software tools including HERS, BCA.Net, StatBenCost, Cal-BC, and TREDIS. Guides are available from the Federal Highway Administration,<sup>[29][30]</sup> Federal Aviation Administration,<sup>[31]</sup> Minnesota Department of Transportation,<sup>[32]</sup> California Department of Transportation (Caltrans),<sup>[33]</sup> and the Transportation Research Board Transportation Economics Committee.<sup>[34]</sup>

### CBA and Regulation under various US Administrations

The increased usage of CBA in the US regulatory process is often associated with President Ronald Reagan's administration. Though the use of CBA in US policy making dating back many decades, Reagan's Executive Order 12291 mandated the use of CBA in the regulatory process. Reagan campaigned on a deregulation platform, and once he took office in 1981 quickly issued this EO, which vested the Office of Information and Regulatory Affairs (OIRA) with the authority to review agency regulations and required federal agencies to produce regulatory impact analyses when the annual impact could be estimated over \$100M. Shortly thereafter, in the 1980s, academic and institutional critiques of CBA started to emerge. Three main criticisms<sup>[35]</sup> were:

1. That CBA could be used for political goals. Debates on the merits of cost and benefit comparisons can be used to sidestep political or philosophical goals, rules and regulations.
2. That CBA is inherently anti-regulatory, therefore not a neutral analysis tool. This is an ethical argument: that the monetization of policy impacts is an inappropriate tool for assessing things such as mortality risks and distributional impacts.
3. That the length of time necessary to complete CBA can create significant delays, which can impede policy regulations.

These criticisms continued through the 1990s under the Clinton administration, who furthered the anti-regulatory environment through his Executive Order 12866.<sup>[36]</sup> EO 12866 changed some of Reagan's language, requiring benefits to justify, rather than exceed costs, and added "reduction of discrimination or bias" as one of the benefits to be analyzed. Criticisms of aspects of CBA, including uncertainly valuations, discounting future values, and the calculation of risk, were used to argue that CBA should play no part in the regulatory process.<sup>[37]</sup> The use of CBA in the regulatory process continues today under the Obama administration, though the debate over its

practical and objective value continues. Some analysts oppose the use of CBA in policy making, while those in favor of its use favor improvements to the analysis and calculations.

### 3.4.7 Accuracy

The value of a cost-benefit analysis depends on the accuracy of the individual cost and benefit estimates. Comparative studies indicate that such estimates are often flawed, preventing improvements in Pareto and Kaldor-Hicks efficiency. Causes of these inaccuracies include:

1. Overreliance on data from past projects (often differing markedly in function or size and the skill levels of the team members)
2. Use of subjective impressions by assessment team members
3. Inappropriate use of heuristics to derive money cost of the intangible elements
4. Confirmation bias among project supporters (looking for reasons to proceed).

Interest groups may attempt to include or exclude significant costs from an analysis to influence the outcome.<sup>[38]</sup>

In the case of the Ford Pinto (where, because of design flaws, the Pinto was liable to burst into flames in a rear-impact collision), the company's decision was not to issue a recall. Ford's cost-benefit analysis had estimated that based on the number of cars in use and the probable accident rate, deaths due to the design flaw would cost it about \$49.5 million to settle wrongful death lawsuits versus recall costs of \$137.5 million. Ford overlooked (or considered insignificant) the costs of the negative publicity that would result, which forced a recall and damaged sales.<sup>[39]</sup>

In health economics, some analysts think cost-benefit analysis can be an inadequate measure because willingness-to-pay methods of determining the value of human life can be influenced by income level. They support use of variants such as cost-utility analysis and quality-adjusted life year to analyze the effects of health policies.<sup>[40]</sup>

In environmental and occupational health regulation, it has been argued that if modern cost-benefit analyses had been applied prospectively to decisions such as whether to mandate the removal of lead from gasoline, build the Hoover Dam in the Black Canyon of the Colorado, and regulate workers' exposure to vinyl chloride, these measures would not have been implemented even though they are considered to be highly successful in retrospect.<sup>[41]</sup> The Clean Air Act has been cited in retrospective studies as a case where benefits exceeded costs, but the knowledge of the benefits (attributable largely to the benefits

of reducing particulate pollution) was not available until many years later.<sup>[41]</sup>

### 3.4.8 See also

- Guns versus butter model
- Business case
- Have one's cake and eat it too
- Opportunity cost
- Scarcity
- Tax choice
- There ain't no such thing as a free lunch
- Trade-off

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### 3.4.11 External links

- [Benefit-Cost Analysis Center at the University of Washington's Daniel J. Evans School of Public Affairs](#)
- [Intro to Cost-Benefit Analysis](#)

## 3.5 Cost–volume–profit analysis

**Cost–volume–profit (CVP)**, in managerial economics, is a form of cost accounting. It is a simplified model, useful for elementary instruction and for short-run decisions.

### 3.5.1 Overview

A critical part of CVP analysis is the point where total revenues equal total costs (both fixed and variable costs). At this **break-even point**, a company will experience no income or loss. This break-even point can be an initial examination that precedes more detailed CVP analysis.

CVP analysis employs the same basic assumptions as in breakeven analysis. The assumptions underlying CVP analysis are:

- The behavior of both costs and revenues are linear throughout the relevant range of activity. (This assumption precludes the concept of volume discounts on either purchased materials or sales.)
- Costs can be classified accurately as either fixed or variable.
- Changes in activity are the only factors that affect costs.
- All units produced are sold (there is no ending finished goods inventory).
- When a company sells more than one type of product, the product mix (the ratio of each product to total sales) will remain constant.

The components of CVP analysis are:

- Level or volume of activity
- Unit selling prices
- Variable cost per unit
- Total fixed costs

### 3.5.2 Assumptions

CVP assumes the following:

- Constant sales price;
- Constant variable cost per unit;
- Constant total fixed cost;
- Units sold equal units produced.

These are simplifying, largely linearizing assumptions, which are often implicitly assumed in elementary discussions of costs and profits. In more advanced treatments and practice, costs and revenue are **nonlinear** and the analysis is more complicated, but the intuition afforded by linear CVP remains basic and useful.

One of the main methods of calculating CVP is profit–volume ratio which is  $(\text{contribution} / \text{sales}) \times 100$  = this gives us profit–volume ratio.

- contribution stands for sales minus variable costs.

Therefore it gives us the profit added per unit of variable costs.

### 3.5.3 Model

#### Basic graph

The assumptions of the CVP model yield the following linear equations for **total costs** and **total revenue (sales)**:

costs Total = costs fixed + (cost variable unit  $\times$  units of number

revenue Total = price sales  $\times$  units of number

These are linear because of the assumptions of constant costs and prices, and there is no distinction between units produced and units sold, as these are assumed to be equal. Note that when such a chart is drawn, the linear CVP model is assumed, often implicitly.

In symbols:

$$TC = TFC + V \times X$$

$$TR = P \times X$$

where

- **TC = Total costs**
- **TFC = Total fixed costs**
- **V = Unit variable cost (variable cost per unit)**
- **X = Number of units**
- **TR = S = Total revenue = Sales**
- **P = (Unit) sales price**

Profit is computed as  $TR - TC$ ; it is a profit if positive, a loss if negative.

### Break down

Costs and sales can be broken down, which provide further insight into operations.

One can decompose total costs as fixed costs plus variable costs:

$$TC = TFC + V \times X$$

Following a matching principle of matching a portion of sales against variable costs, one can decompose sales as contribution plus variable costs, where **contribution** is “what’s left after deducting variable costs”. One can think of contribution as “the marginal contribution of a unit to the profit”, or “contribution towards offsetting fixed costs”.

In symbols:

$$\begin{aligned} TR &= P \times X \\ &= ((P - V) + V) \times X \\ &= (C + V) \times X \\ &= C \times X + V \times X \end{aligned}$$

where

- **C = Unit Contribution (Margin)**

Subtracting variable costs from both costs and sales yields the simplified diagram and equation for profit and loss.

In symbols:

$$\begin{aligned} PL &= TR - TC \\ &= (C + V) \times X - (TFC + V \times X) \\ &= C \times X - TFC \end{aligned}$$

These diagrams can be related by a rather busy diagram, which demonstrates how if one subtracts variable costs, the sales and total costs lines shift down to become the contribution and fixed costs lines. Note that the profit and

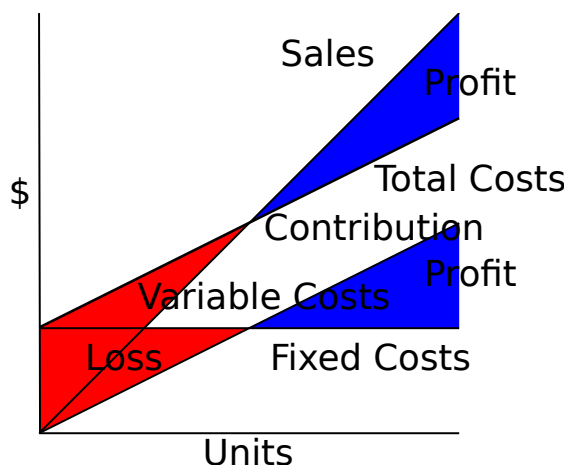


Diagram relating all quantities in CVP.

loss for any given number of unit sales is the same, and in particular the break-even point is the same, whether one computes by sales = total costs or as contribution = fixed costs. Mathematically, the contribution graph is obtained from the sales graph by a shear, to be precise  $\begin{pmatrix} 1 & 0 \\ -V & 1 \end{pmatrix}$ , where  $V$  are unit variable costs.

### 3.5.4 Applications

CVP simplifies the computation of breakeven in break-even analysis, and more generally allows simple computation of target income sales. It simplifies analysis of short run trade-offs in operational decisions.

### 3.5.5 Limitations

CVP is a **short run, marginal** analysis: it assumes that unit variable costs and unit revenues are constant, which is appropriate for small deviations from current production and sales, and assumes a neat division between fixed costs and variable costs, though in the long run all costs are variable. For longer-term analysis that considers the entire life-cycle of a product, one therefore often prefers activity-based costing or throughput accounting.<sup>[1]</sup>

When we analyze CVP is where we demonstrate the point at which in a firm there will be no profit nor loss means that firm works in breakeven situation

1. Segregation of total costs into its fixed and variable components is always a daunting task to do.
2. Fixed costs are unlikely to stay constant as output increases beyond a certain range of activity.
3. The analysis is restricted to the relevant range specified and beyond that the results can become unreliable.
4. Aside from volume, other elements like inflation, efficiency, capacity and technology impact on costs.
5. Impractical to assume sales mix remain constant since this depends on the changing demand levels.
6. The assumption of linear property of total cost and total revenue relies on the



assumption that unit variable cost and selling price are always constant. In real life it is valid within relevant range or period and likely to change.

### 3.5.6 See also

- Contribution margin

### 3.5.7 Notes

- [1] The Controversy over the contribution margin approach, in MAAW, Chapter 11.

## 3.6 Capital budgeting

**Capital budgeting**, or **investment appraisal**, is the planning process used to determine whether an organization's long term **investments** such as new machinery, replacement machinery, new plants, new products, and research development projects are worth the funding of cash through the firm's capitalization structure (debt, equity or retained earnings). It is the process of allocating resources for major **capital**, or investment, expenditures.<sup>[1]</sup> One of the primary goals of capital budgeting investments is to increase the value of the firm to the shareholders.

Many formal methods are used in capital budgeting, including the techniques such as

- Accounting rate of return
- Average accounting return
- Payback period
- Net present value
- Profitability index
- Internal rate of return
- Modified internal rate of return
- Equivalent annual cost
- Real options valuation

These methods use the incremental cash flows from each potential investment, or *project*. Techniques based on accounting earnings and accounting rules are sometimes used - though economists consider this to be improper - such as the *accounting rate of return*, and "return on investment." Simplified and hybrid methods are used as well, such as *payback period* and *discounted payback period*.

### 3.6.1 Net present value

Main article: [Net present value](#)

'*Net Present value:*'

Project Classifications

Capital Budgeting projects are classified as either Independent Projects or Mutually Exclusive Projects. An Independent Project is a project whose cash flows are not affected by the accept/reject decision for other projects. Thus, all Independent Projects which meet the Capital Budgeting criterion should be accepted.

Mutually Exclusive Projects are a set of projects from which at most one will be accepted. For example, a set of projects which are to accomplish the same task. Thus, when choosing between "Mutually Exclusive Projects" more than one project may satisfy the Capital Budgeting criterion. However, only one, i.e., the best project can be accepted.

Of these three, only the Net Present Value and Internal Rate of Return decision rules consider all of the project's cash flows and the Time Value of Money. As we shall see, only the Net Present Value decision rule will always lead to the correct decision when choosing among Mutually Exclusive Projects. This is because the Net Present Value and Internal Rate of Return decision rules differ with respect to their Reinvestment Rate Assumptions. The Net Present Value decision rule implicitly assumes that the project's cash flows can be reinvested at the firm's Cost of Capital, whereas, the Internal Rate of Return decision rule implicitly assumes that the cash flows can be reinvested at the projects IRR. Since each project is likely to have a different IRR, the assumption underlying the Net Present Value decision rule is more reasonable.

### 3.6.2 Internal rate of return

Main article: [Internal rate of return](#)

The **internal rate of return** (IRR) is defined as the discount rate that gives a net present value (NPV) of zero. It is a commonly used measure of investment efficiency.

The IRR method will result in the same decision as the NPV method for (non-mutually exclusive) projects in an unconstrained environment, in the usual cases where a negative cash flow occurs at the start of the project, followed by all positive cash flows. In most realistic cases, all independent projects that have an IRR higher than the hurdle rate should be accepted. Nevertheless, for mutually exclusive projects, the decision rule of taking the project with the highest IRR - which is often used - may select a project with a lower NPV.

In some cases, several zero NPV discount rates may exist, so there is no unique IRR. The IRR exists and is unique if

one or more years of net investment (negative cash flow) are followed by years of net revenues. But if the signs of the cash flows change more than once, there may be several IRRs. The IRR equation generally cannot be solved analytically but only via iterations.

One shortcoming of the IRR method is that it is commonly misunderstood to convey the actual annual profitability of an investment. However, this is not the case because intermediate cash flows are almost never reinvested at the project's IRR; and, therefore, the actual rate of return is almost certainly going to be lower. Accordingly, a measure called **Modified Internal Rate of Return (MIRR)** is often used.

Despite a strong academic preference for NPV, surveys indicate that executives prefer IRR over NPV, although they should be used in concert. In a budget-constrained environment, efficiency measures should be used to maximize the overall NPV of the firm. Some managers find it intuitively more appealing to evaluate investments in terms of percentage rates of return than dollars of NPV.

### 3.6.3 Equivalent annuity method

Main article: [Equivalent annual cost](#)

The *equivalent annuity* method expresses the NPV as an annualized cash flow by dividing it by the present value of the annuity factor. It is often used when assessing only the costs of specific projects that have the same cash inflows. In this form it is known as the *equivalent annual cost (EAC)* method and is the cost per year of owning and operating an asset over its entire lifespan.

It is often used when comparing investment projects of unequal lifespans. For example if project A has an expected lifetime of 7 years, and project B has an expected lifetime of 11 years it would be improper to simply compare the net present values (NPVs) of the two projects, unless the projects could not be repeated.

The use of the EAC method implies that the project will be replaced by an identical project.

Alternatively the *chain method* can be used with the NPV method under the assumption that the projects will be replaced with the same cash flows each time. To compare projects of unequal length, say 3 years and 4 years, the projects are *chained together*, i.e. four repetitions of the 3-year project are compared to three repetitions of the 4-year project. The chain method and the EAC method give mathematically equivalent answers.

The assumption of the same cash flows for each link in the chain is essentially an assumption of zero inflation, so a real interest rate rather than a nominal interest rate is commonly used in the calculations.

### 3.6.4 Real options

Main article: [Real options analysis](#)

**Real options** analysis has become important since the 1970s as **option pricing models** have gotten more sophisticated. The discounted cash flow methods essentially value projects as if they were risky bonds, with the promised cash flows known. But managers will have many choices of how to increase future cash inflows, or to decrease future cash outflows. In other words, managers get to manage the projects - not simply accept or reject them. Real options analysis tries to value the choices - the option value - that the managers will have in the future and adds these values to the NPV.

### 3.6.5 Ranked projects

The real value of capital budgeting is to rank projects. Most organizations have many projects that could potentially be financially rewarding. Once it has been determined that a particular project has exceeded its hurdle, then it should be ranked against peer projects (e.g. - highest **Profitability index** to lowest Profitability index). The highest ranking projects should be implemented until the budgeted capital has been expended.

### 3.6.6 Funding sources

Capital budgeting investments and projects must be funded through excess cash provided through the raising of debt capital, equity capital, or the use of retained earnings. Debt capital is borrowed cash, usually in the form of bank loans, or bonds issued to creditors. Equity capital are investments made by shareholders, who purchase shares in the company's stock. Retained earnings are excess cash surplus from the company's present and past earnings.

### 3.6.7 Need for capital budgeting

1. As large sum of money is involved which influences the profitability of the firm making capital budgeting an important task.
2. Long term investment once made can not be reversed without significance loss of invested capital. The investment becomes sunk, and mistakes, rather than being readily rectified, must often be borne until the firm can be withdrawn through depreciation charges or liquidation. It influences the whole conduct of the business for the years to come.
3. Investment decision are the base on which the profit will be earned and probably measured through the

return on the capital. A proper mix of capital investment is quite important to ensure adequate rate of return on investment, calling for the need of capital budgeting.

- The implication of long term investment decisions are more extensive than those of short run decisions because of time factor involved, capital budgeting decisions are subject to the higher degree of risk and uncertainty than short run decision.<sup>[2]</sup>

### 3.6.8 See also

- Operating budget

### 3.6.9 External links and references

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## 3.7 Strategic planning

Not to be confused with Strategic thinking.

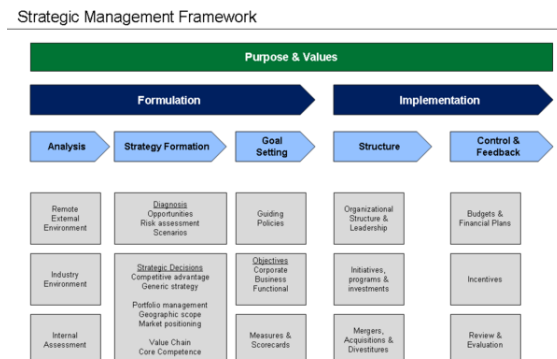
**Strategic planning** is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy. It may also

extend to control mechanisms for guiding the implementation of the strategy. Strategic planning became prominent in corporations during the 1960s and remains an important aspect of **strategic management**. It is executed by strategic planners or **strategists**, who involve many parties and research sources in their analysis of the organization and its relationship to the environment in which it competes.<sup>[1]</sup>

Strategy has many definitions, but generally involves setting goals, determining actions to achieve the goals, and mobilizing resources to execute the actions. A strategy describes how the ends (goals) will be achieved by the means (resources). The senior leadership of an organization is generally tasked with determining strategy. Strategy can be planned (intended) or can be observed as a pattern of activity (emergent) as the organization adapts to its environment or competes.

Strategy includes processes of formulation and implementation; strategic planning helps coordinate both. However, strategic planning is analytical in nature (i.e., it involves “finding the dots”); strategy formation itself involves synthesis (i.e., “connecting the dots”) via strategic thinking. As such, strategic planning occurs around the strategy formation activity.<sup>[1]</sup>

### 3.7.1 Process



*Strategic management processes and activities*

#### Overview

Strategic planning is a process and thus has inputs, activities, outputs and outcomes. This process, like all processes, has constraints. It may be formal or informal and is typically iterative, with feedback loops throughout the process. Some elements of the process may be continuous and others may be executed as discrete projects with a definitive start and end during a period. Strategic planning provides inputs for strategic thinking, which guides the actual strategy formation. The end result is the organization's strategy, including a diagnosis of the environ-

ment and competitive situation, a guiding policy on what the organization intends to accomplish, and key initiatives or action plans for achieving the guiding policy.<sup>[2]</sup>

Michael Porter wrote in 1980 that formulation of competitive strategy includes consideration of four key elements:

1. Company strengths and weaknesses;
2. Personal values of the key implementers (i.e., management and the board);
3. Industry opportunities and threats; and
4. Broader societal expectations.<sup>[3]</sup>

The first two elements relate to factors internal to the company (i.e., the internal environment), while the latter two relate to factors external to the company (i.e., the external environment).<sup>[3]</sup> These elements are considered throughout the strategic planning process.

### Inputs

Data is gathered from a variety of sources, such as interviews with key executives, review of publicly available documents on the competition or market, primary research (e.g., visiting or observing competitor places of business or comparing prices), industry studies, etc. This may be part of a **competitive intelligence** program. Inputs are gathered to help support an understanding of the competitive environment and its opportunities and risks. Other inputs include an understanding of the values of key stakeholders, such as the board, shareholders, and senior management. These values may be captured in an organization's **vision** and mission statements.

### Activities

The essence of formulating competitive strategy is relating a company to its environment.

Michael Porter<sup>[3]</sup>

Strategic planning activities include meetings and other communication among the organization's leaders and personnel to develop a common understanding regarding the competitive environment and what the organization's response to that environment (its strategy) should be. A variety of strategic planning tools (described in the section below) may be completed as part of strategic planning activities.

The organization's leaders may have a series of questions they want answered in formulating the strategy and gathering inputs, such as:

- What is the organization's business or interest?

- What is considered "value" to the customer or constituency?
- Which products and services should be included or excluded from the portfolio of offerings?
- What is the geographic scope of the organization?
- What differentiates the organization from its competitors in the eyes of customers and other stakeholders?
- Which skills and resources should be developed within the organization?<sup>[1][4]</sup>

### Outputs

The output of strategic planning includes documentation and communication describing the organization's strategy and how it should be implemented, sometimes referred to as the strategic plan. The strategy may include a diagnosis of the competitive situation, a guiding policy for achieving the organization's goals, and specific action plans to be implemented.<sup>[2]</sup> A strategic plan may cover multiple years and be updated periodically.

The organization may use a variety of methods of measuring and monitoring progress towards the objectives and measures established, such as a **balanced scorecard** or **strategy map**. Companies may also plan their financial statements (i.e., balance sheets, income statements, and cash flows) for several years when developing their strategic plan, as part of the goal setting activity. The term operational **budget** is often used to describe the expected financial performance of an organization for the upcoming year. Capital budgets very often form the backbone of a strategic plan, especially as it increasingly relates to Information and Communications Technology (ICT).

### Outcomes

Whilst the planning process produces outputs, as described above, **strategy implementation** or execution of the strategic plan produces Outcomes. These outcomes will invariably differ from the strategic goals. How close they are to the strategic goals and vision will determine the success or failure of the strategic plan. There will also arise unintended Outcomes, which need to be attended to and understood for strategy development and execution to be a true learning process.

### 3.7.2 Tools and approaches

A variety of analytical tools and techniques are used in strategic planning.<sup>[1]</sup> These were developed by companies and management consulting firms to help provide a framework for strategic planning. Such tools include:



Video explaining the strategic plan of the Wikimedia Foundation



Wikimedia Movement Strategic Plan (PDF)

- Growth-share matrix, which involves portfolio decisions about which businesses to retain or divest; and
- Balanced Scorecards and strategy maps, which creates a systematic framework for measuring and controlling strategy.
- The Nine Steps to Success(TM)<sup>[5]</sup> - The Balanced Scorecard Institute's framework for Strategic Planning and Management.

### 3.7.3 Strategic planning vs. financial planning

Simply extending financial statement projections into the future without consideration of the competitive environment is a form of financial planning or budgeting, not strategic planning. In business, the term “financial plan” is often used to describe the expected financial performance of an organization for future periods. The term “budget” is used for a financial plan for the upcoming year. A “forecast” is typically a combination of actual performance year-to-date plus expected performance for the remainder of the year, so is generally compared against plan or budget and prior performance. The financial plans accompanying a strategic plan may include 3–5 years of projected performance.

McKinsey & Company developed a capability maturity model in the 1970s to describe the sophistication of planning processes, with strategic management ranked the highest. The four stages include:

1. Financial planning, which is primarily about annual budgets and a functional focus, with limited regard for the environment;
2. Forecast-based planning, which includes multi-year financial plans and more robust capital allocation across business units;
3. Externally oriented planning, where a thorough situation analysis and competitive assessment is performed;
4. Strategic management, where widespread strategic thinking occurs and a well-defined strategic framework is used.

Categories 3 and 4 are strategic planning, while the first two categories are non-strategic or essentially financial planning. Each stage builds on the previous stages; that is, a stage 4 organization completes activities in all four categories.<sup>[6]</sup>

### 3.7.4 Criticism

- PEST analysis, which covers the remote external environment elements such as political, economic, social and technological (PESTLE adds legal/regulatory and ecological/environmental);
- Scenario planning, which was originally used in the military and recently used by large corporations to analyze future scenarios;
- Porter five forces analysis, which addresses industry attractiveness and rivalry through the bargaining power of buyers and suppliers and the threat of substitute products and new market entrants;
- SWOT analysis, which addresses internal strengths and weaknesses relative to the external opportunities and threats;



### Strategic planning vs. strategic thinking

Strategic planning has been criticized for attempting to systematize strategic thinking and strategy formation, which Henry Mintzberg argues are inherently creative activities involving synthesis or “connecting the dots” which cannot be systematized. Mintzberg argues that strategic planning can help coordinate planning efforts and measure progress on strategic goals, but that it occurs “around” the strategy formation process rather than within it. Further, strategic planning functions remote from the “front lines” or contact with the competitive environment (i.e., in business, facing the customer where the effect of competition is most clearly evident) may not be effective at supporting strategy efforts.<sup>[1]</sup>

### 3.7.5 See also

- Business strategy mapping
- Chief strategy officer
- Decision making software
- Enterprise planning systems
- Hoshin Kanri
- Integrated business planning
- Military strategy and The Art of War for the origins
- Situational analysis
- Strategic planning software
- Strategy Markup Language (StratML)

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### 3.7.7 Strategic plan examples

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### 3.7.8 Further reading

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## 3.8 Sales operations

**Sales operations** is a set of business activities and processes that help a sales organization run effectively, efficiently and in support of business strategies and objectives. Sales operations may also be referred to as sales, sales support or business operations.

The set of sales operations activities vary from company<sup>[1]</sup> to company but often include these five categories:<sup>[2]</sup>

### Sales Force Enablement

- Sales Process Development
- Sales Process Adoption and Compliance
- CRM Development and Processes
- Sales Tool Development
- Sales Training
- Sales Force Communications Management

### Business Analytics

- Sales Metrics
- Sales Forecasting

### Sales Administration

- Proposal/Contract Development
- Vendor Selection and Management
- Planning Process Stewardship

### Attainment Planning

- Incentive Sales Compensation Plan Design
- GTM Strategy Alignment with Roles and Components
- Territory Analysis and Definition
- Goal Setting

### Sales Operations Mandate and Design

- Chief of Staff to the Sales Organization
- Stewardship of Sales Force Capacity
- Initiative Change Management
- Sales Operations Team Design
- Sales Operations Talent Management

The sales operations team members are often liaisons for sales to other parts of the organisation such as finance, marketing, legal and IT departments. They will represent the needs of sales in meetings and cross-functional projects.

### Sales operations as a function

More and more companies are forming sales operations departments within their organizations and, per the sales operations excellence center, sales operations is an established process and considered to be vital contributor to business operations and accounting functions.

Sales Operation Analysts as a department usually have Sales Analysts that work directly under them. Supplying them with the data needed to make decisions. These decisions can transform a fragmented and silted model into a customer-adaptive enterprise.

Nowadays, a lot of companies or small businesses start to use [internet] tools to improve sales function.

### 3.8.1 Sales targets

Sales target is the minimum sales goal for a set time span. A sales target may be minimum amount of pounds (Monetary Value) or product sold (Volume). Sales targets may also be for sales activities like: number of calls per day. Management usually sets the sales targets and the sales territory. The time span could be set for the day, week, month, fiscal quarter or year.

### 3.8.2 Sales territory

Main article: [Sales territory](#)

A **Sales territory** is usually the customer group or geographical area assigned to an individual salesperson or a sales team. The geographical area may also be assigned to a franchisee, distributor, or agent. A sales territory may also be assigned by industry verticals, such as all retailers or all wholesalers in a geographical area. A sales territory may be as large as a continent, country, state or province, or as small as a precinct, suburb, town or city. Generally, a sales manager will assign a sales territory based on the territories of the sales resources reporting to him/her.

### 3.8.3 Sales forecasting

Sales forecasting uses past sales figures to predict the short-term or long-term future performance to enable sound financial planning.<sup>[3]</sup> For shops and stores, market research may yield the following indicators for deriving initial forecasts:<sup>[4]</sup>

- average sales volume per unit area for similar shops in similar locations of similar size

- number of consumers or consumer households in appropriate vicinity of the store and their annual expenses on the product in question

### 3.8.4 See also

- Choice architecture
- Customer Relationship Management (CRM)
- Customer service
- Demand forecasting
- Point of sale
- Retailing
- Sales (accounting)
- Sales incentive plan
- Sales management
- Sales process engineering
- Sales promotion
- Sales territory
- Sales variance
- Selling
- Trade
- Transaction

### 3.8.5 References and notes

- [1] What's The Difference Between Sales and Sales Operations?
- [2] Bob Bacon – B2B Software Sales Operations
- [3] How Sales Forecasting Works
- [4] Three Methods Of Sales Forecasting - Sales Forecasting By Multiple Methods Is Most Accurate

### 3.8.6 External links

- CEB's Sales & Service, a division of the Corporate Executive Board
- Marketing on Answers.com

## 3.9 Financial forecast

A **financial forecast** is an estimate of future financial outcomes for a **company** or **country** (for futures and currency markets). Using historical internal accounting and sales data, in addition to external market and economic indicators, a financial forecast is an economist's best guess of what will happen to a company in financial terms over a given time period—which is usually one year. See [Financial modeling](#).

Arguably, the most difficult aspect of preparing a financial forecast is predicting revenue. Future costs can be estimated by using historical accounting data; variable costs are also a function of sales.

Unlike a **financial plan** or a **budget** a financial forecast doesn't have to be used as a planning document. Outside analysts can use a financial forecast to estimate a company's success in the coming year.

### 3.9.1 Tools

Financial tools can be used by entrepreneurs to help them building their company's forecast (Score, Business Model Forecast, ...).

### 3.9.2 References

A financial forecast is simply a financial plan or budget for your business. It is an estimate of two essential future financial outcomes for a business

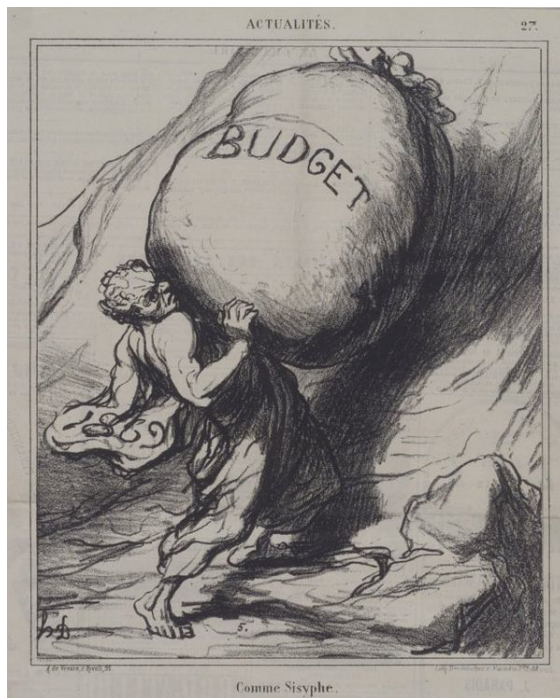
## 3.10 Budget

For the rental car company, see [Budget Rent a Car](#). For the car insurance company Budget, see [Budget Group of Companies](#).

A **budget** is a quantitative expression of a plan for a defined period of time. It may include planned sales volumes and revenues, resource quantities, costs and expenses, assets, liabilities and cash flows. It expresses strategic plans of business units, organizations, activities or events in measurable terms.<sup>[1]</sup> International Budget Partnership regularly monitors global budget information for the civil society.<sup>[2]</sup>

### 3.10.1 Etymology

A budget (derived from old French word *bougette*, purse) is a quantified financial plan for a forthcoming accounting period.<sup>[3]</sup>



Brooklyn Museum - *Comme Sisyphe* - Honoré Daumier

A budget is an important concept in microeconomics, which uses a **budget line** to illustrate the trade-offs between two or more goods. In other terms, a budget is an organizational plan stated in monetary terms.

### 3.10.2 Purpose

Budget helps to aid the planning of actual operations by forcing managers to consider how the conditions might change and what steps should be taken now and by encouraging managers to consider problems before they arise. It also helps co-ordinate the activities of the organization by compelling managers to examine relationships between their own operation and those of other departments. Other essentials of budget include:

- To control resources
- To communicate plans to various responsibility center managers.
- To motivate managers to strive to achieve budget goals.
- To evaluate the performance of managers
- To provide visibility into the company's performance
- For accountability

In summary, the purpose of budgeting tools:

1. Tools provide a forecast of revenues and expenditures, that is, construct a model of how a business might perform financially if certain strategies, events and plans are carried out.
2. Tools enable the actual financial operation of the business to be measured against the forecast.
3. Lastly, tools establish the cost constraint for a project, program, or operation.

### 3.10.3 Corporate budget

The budget of a company is often compiled annually, but may not be a finished budget, usually requiring considerable effort, is a plan for the short-term future, typically allows hundreds or even thousands of people in various departments (operations, human resources, IT, etc.) to list their expected revenues and expenses in the final budget.

If the actual figures delivered through the budget period come close to the budget, this suggests that the managers understand their business and have been successfully driving it in the intended direction. On the other hand, if the figures diverge wildly from the budget, this sends an 'out of control' signal, and the share price could suffer. Campaign planners incur two types of cost in any campaign: the first is the cost of human resource necessary to plan and execute the campaign. the second type of expense that campaign planners incur is the hard cost of the campaign itself.

### 3.10.4 Event management budget

A budget is a fundamental tool for an **event director** to predict with a reasonable accuracy whether the event will result in a profit, a loss or will break-even. A budget can also be used as a **pricing tool**.

There are two basic approaches or philosophies, when it comes to budgeting. One approach is telling you on mathematical models, and the other on people.

The first school of thought believes that financial models, if properly constructed, can be used to predict the future. The focus is on variables, inputs and outputs, drivers and the like. Investments of time and money are devoted to perfecting these models, which are typically held in some type of financial spreadsheet application.

The other school of thought holds that it's not about models, it's about people. No matter how sophisticated models can get, the best information comes from the people in the business. The focus is therefore in engaging the managers in the business more fully in the budget process, and building accountability for the results. The companies that adhere to this approach have their managers develop their own budgets. While many companies would



say that they do both, in reality the investment of time and money falls squarely in one approach or the other.

### 3.10.5 Government budget

For more details on this topic, see [Government budget](#).

The budget of a **government** is a summary or plan of the intended revenues and expenditures of that government. There are three types of government budget : the operating or current budget, the capital or investment budget, and the cash or cash flow budget.<sup>[4]</sup>

#### United Kingdom

The budget is prepared by the **Treasury** team led by the Chancellor of the Exchequer and is presented to Parliament by the **Chancellor of the Exchequer** on Budget Day. It is customary for the Chancellor to stand on the steps of Number 11 Downing Street with his or her team for the media to get photographic shots of the Red Box, immediately prior to them going to the **House of Commons**. Once presented in the House of Commons it is debated and then voted on. Minor changes may be made however with the budget being written and presented by the party with the majority in the House of Commons, (The Government), the **Whips** will ensure that it is passed as written by the Chancellor.

#### United States

Main article: [United States federal budget](#)

The federal budget is prepared by the **Office of Management and Budget**, and submitted to Congress for consideration. Invariably, Congress makes many and substantial changes. Nearly all American states are required to have **balanced budgets**, but the federal government is allowed to run deficits.

#### India

Main article: [Union budget of India](#)

The budget is prepared by the Budget Division Department of Economic Affairs of the **Ministry of Finance** annually. This includes supplementary excess grants and when a proclamation by the President as to failure of Constitutional machinery is in operation in relation to a State or a Union Territory, preparation of the Budget of such State. The railway budget is presented separately by the **Ministry of Railways**. Thus budget is presented in two categories: **The General Budget** and **The Railway Budget**

#### Philippines

The Philippine budget is considered the most complicated in the world, incorporating multiple approaches in one single budget system: line-item (budget execution), performance (budget accountability), and **zero-based budgeting**. The **Department of Budget and Management** prepares the National Expenditure Program and forwards it to the Committee on Appropriations of the House of Representative to come up with a General Appropriations Bill (GAB). The GAB will go through budget deliberations and voting; the same process occurs when the GAB is transmitted to the **Philippine Senate**.

After both houses of Congress approves the GAB, the President signs the bill into a General Appropriations Act (GAA); also, the President may opt to veto the GAB and have it returned to the legislative branch or leave the bill unsigned for 30 days and lapse into law. There are two types of budget bill veto: the **line-item veto** and the veto of the whole budget.

### 3.10.6 Personal or family budget

For more details on this topic, see [Personal budget](#).

In a personal or family budget all sources of **income** (inflows) are identified and **expenses** (outflows) are planned with the intent of matching outflows to inflows (making ends meet). In **consumer theory**, the equation restricting an individual or household to spend no more than its total resources is often called the **budget constraint**.

Elements of a personal or family budget usually include, **fixed expenses, monthly payments, insurance, entertainment, and savings**.

There are many informational sites and software available for use in personal and family budgeting.

### 3.10.7 Budget types

- **Sales budget** – an estimate of future sales, often broken down into both units and currency. It is used to create company sales goals.
- **Production budget** - an estimate of the number of units that must be manufactured to meet the sales goals. The production budget also estimates the various costs involved with manufacturing those units, including labor and material. Created by product oriented companies.
- **Capital budget** - used to determine whether an organization's long-term investments such as new machinery, replacement machinery, new plants, new products, and research development projects are worth pursuing.



- **Cash flow/cash budget** – a prediction of future cash receipts and expenditures for a particular time period. It usually covers a period in the short-term future. The cash flow budget helps the business determine when income will be sufficient to cover expenses and when the company will need to seek outside financing.
- **Marketing budget** – an estimate of the funds needed for promotion, advertising, and public relations in order to market the product or service.
- **Project budget** – a prediction of the costs associated with a particular company project. These costs include labour, materials, and other related expenses. The project budget is often broken down into specific tasks, with task budgets assigned to each. A cost estimate is used to establish a project budget.
- **Revenue budget** – consists of revenue receipts of government and the expenditure met from these revenues. Tax revenues are made up of taxes and other duties that the government levies.
- **Expenditure budget** – includes spending data items.

### 3.10.8 See also

- Budget crisis
- Budget Day
- Budget theory
- Budgett, a surname
- Cost overrun
- Government budget balance
- Canadian federal budget
- Constitutional economics
- Envelope system
- Film budgeting
- List of government budgets by country
- List of sovereign states in Europe by budget revenues
- Participatory budgeting
- Performance-based budgeting
- Personal finance
- Planning fallacy
- Profit model
- Public finance
- United States budget process
- Variance (accounting)

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- [3] Sullivan, Arthur; Steven M. Sheffrin (2003). *Economics: Principles in action*. Upper Saddle River, New Jersey 07458: Pearson Prentice Hall. p. 502. ISBN 0-13-063085-3.
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### 3.10.10 External links

- The dictionary definition of budget at Wiktionary
- Media related to Budget at Wikimedia Commons
- Origin of the word

## 3.11 Cost allocation

**Cost allocation** is a process of providing relief to shared service organization’s cost centers that provide a product or service. In turn, the associated expense is assigned to internal clients’ cost centers that consume the products and services. For example, the CIO may provide all IT services within the company and assign the costs back to the business units that consume each offering.

The core components of a cost allocation system consist of a way to track which organizations provides a product and/or service, the organizations that consume the products and/or services, and a list of portfolio offerings (e.g. service catalog). Depending on the operating structure within a company, the cost allocation data may generate an internal invoice or feed an ERP system’s chargeback module. Accessing the data via an invoice or chargeback module are the typical methods that drive personnel behavior. In return, the consumption data becomes a great source of quantitative information to make better business decisions. Today’s organizations face growing pressure to control costs and enable responsible financial management of resources. In this environment, an organization is expected to provide services cost-effectively and deliver business value while operating under tight budgetary constraints. One way to contain costs is to implement a **cost allocation** methodology, where your business units become directly accountable for the services they consume.

An effective cost allocation methodology enables an organization to identify what services are being provided and what they cost, to allocate costs to business units, and to manage cost recovery. Under this model, both the service provider and its respective consumers become aware

of their service requirements and usage and how they directly influence the costs incurred. This information, in turn, improves discipline within the business units and financial discipline across the entire organization. With the organization articulating the costs of services provided, the business units become empowered – and encouraged – to make informed decisions about the services and availability levels they request. They can make trade-offs between service levels and costs, and they can benchmark internal costs against outsourced providers.

# Chapter 4

## Addenda

### 4.1 Profit model

The **profit model** is the linear, deterministic algebraic model used implicitly by most **cost accountants**. Starting with, profit equals sales minus costs, it provides a structure for modeling cost elements such as materials, losses, multi-products, learning, depreciation etc. It provides a mutable conceptual base for spreadsheet modelers. This enables them to run deterministic simulations or 'what if' modelling to see the impact of price, cost or quantity changes on profitability.

#### 4.1.1 Basic model

$$\pi = pq - (Fn + wq)$$

where:

$\pi$  is profit

$p$  is sales price

$Fn$  is fixed costs

$w$  is variable costs per unit sold

$q$  is quantity sold

For an expansion of the model see below.

#### 4.1.2 Background

The justification for wanting to express profit as an algebraic model is given by Mattessich in 1961.

"To some operations analysts the mere translation of accounting models into mathematical terminology, without a calculus for determining an optimum, might appear to be a rather pedestrian task. We are convinced, however, that as long as accounting methods are acceptable to the industry the mere change to a mathematical formulation will be advantageous for several reasons: (1) it can be considered a prerequisite for applying electronic data processing to certain accounting problems, (2) it articulates the structure of the accounting models and illuminates accounting methods from a

new point of view, revealing many facets so far neglected or unobserved, (3) it enables a general and hence more scientific presentation of many accounting methods, (4) it facilitates the exploration of new areas, thereby accelerating the advancement of accounting, (5) it leads to more sophisticated methods and might help to lay the foundations for close cooperation of accounting with other areas of management science.<sup>[1]</sup>

Most of the definitions in cost accounting are in an unclear narrative form, not readily associated with other definitions of accounting calculations. For example, preparing a comparison of fixed cost variances in stock under different stock valuation methods can be confusing. Another example is modelling labour variances with learning curve corrections and stock level changes. With the absence of a basic profit model in an algebraic form, confident development of such models is difficult.

The development of spreadsheets has led to a decentralisation of financial modelling. This has often resulted in model builders lacking training in model construction. Before any professional model is built it is usually considered wise to start by developing a mathematical model for analysis. The profit model provides a general framework plus some specific examples of how such an a priori profit model might be constructed.

The presentation of a profit model in an algebraic form is not new. Mattessich's model (1), while large, does not include many costing techniques such as learning curves and different stock valuation methods. Also, it was not presented in a form that most accountants were willing or able to read. This paper presents a more extended model analysing profit but it does not, unlike Mattessich, extend to the balance sheet model. Its form, of starting with the basic definition of profit and becoming more elaborate, may make it more accessible to accountants.

Most cost accounting textbooks <sup>[2]</sup> explain basic Cost Volume Profit modeling in an algebraic form, but then revert to an 'illustrative' <sup>[3]</sup> approach. This 'illustrative' approach uses examples or narrative to explain management accounting procedures. This format, though useful when communicating with humans, can be difficult to translate

into an algebraic form, suitable for computer model building. Mephram <sup>[4]</sup> extended the algebraic, or deductive, approach to cost accounting to cover many more techniques. He develops his model to integrate with the optimizing models in operations research. The profit model comes out of Mephams work, extending it but only in a descriptive, linear form.

### 4.1.3 Model extensions

The basic profit model is sales minus costs. Sales are made up of quantity sold multiplied by their price. Costs are usually divided between Fixed costs and variable costs.

Using:

- Sales revenue =  $pq$  = price  $\times$  quantity sold
- Cost of sales =  $wq$  = unit cost  $\times$  quantity sold
- Administration, selling, engineers, personnel etc. =  $F_n$  = fixed post-manufacturing overheads
- Profit =  $\pi$

Thus the profit can be calculated from:

$$\pi = pq - (F_n + wq) \quad (1)$$

Notice that  $w$  (average unit production cost) includes the fixed and variable costs. The square brackets contain the cost of goods sold,  $wq$  not cost of good made  $wx$  where  $x$  = cost of good sold.

To show cost of good sold, the opening and closing finished goods stocks need to be included The profit model would then be:

- Opening stock =  $g_0 w$  = opening stock quantity  $\times$  unit cost
- Cost of stock =  $g_1 w$  = closing stock quantity  $\times$  unit cost
- Cost of production =  $wx$  = unit production cost  $\times$  quantity made:

$$\pi = pq - [F_n + wx + g_0w - g_1w] \quad (2)$$

Presenting the profit calculation in this form immediately demands that some of the costs be more carefully defined.

#### Production costs

The unit production costs ( $w$ ) can be separated into fixed and variable costs:

$$w = \frac{F_m + vx}{x} \quad (3)$$

where

- $F_m$  = manufacturing fixed costs;
- $v$  = variable costs per unit;
- $x$  = production quantity.

The introduction of this separation of  $w$  allows for consideration of the behaviour of costs for different levels of production. A linear cost curve is assumed here, divided between the constant ( $F$ ) and its slope ( $v$ ). If the modeller has access to the details of non-linear cost curves then  $w$  will need to be defined by the appropriate function.

Replacing  $wx$  in (equation 2) and making  $F = F_n + F_m$ :

$$\pi = pq - [F + vx + g_0w - g_1w] \quad (4)$$

#### Variable-cost elements

Moving on to other extensions of the basic model, the cost elements such as direct materials, direct labour and variable overheads can be included. If a non-linear function is available and thought useful such functions can be substituted for the functions used here.

The material cost of sales =  $m * \mu * q$ , where

$m$  is the amount of material in one unit of finished goods.

$\mu$  is the cost per unit of the raw material.

The labour cost of sales =  $l \lambda q$ , where

- $l$  is the amount of labour hours required to make one unit of finished goods
- $\lambda$  is the labour cost (rate) per hour.

The variable overhead cost of sales =  $nq$  where  $n$  is the variable overhead cost per unit.

This is not here subdivided between quantity per finished goods units and cost per unit.

Thus the variable cost  $v * q$  can now be elaborated into:

$$\pi = pq - [F + (m\mu q + l \lambda q + nq)] \quad \dots\dots\dots(\text{equation 5})$$

If the production quantity is required the finished goods stock will need to be added.

In a simple case two materials can be accommodated in the model by simply adding another  $m * \mu$ . In more realistic situations a matrix and a vector will be necessary (see later).

If material cost of purchases is to be used rather than material cost of production it will be necessary to adjust for material stocks. That is,

$$mx = md_0 + mb - md_1 \dots \dots \dots \text{(equation 6)}$$

where

- d = material stock quantity,
- 0 = opening, 1 = closing,
- b = quantity of material purchased
- m = the amount of material in one unit of finished goods
- x = quantity used in production

**Depreciation**

All depreciation rules can be stated as equations representing their curve over time. The reducing balance method provides one of the more interesting examples.

Using c = cost, t = time, L = life, s = scrap value, Fd = time based depreciation:

$$\text{Depr/yr} = Fd = c (s/c)(t-L)/L * [L(s/c)1/L] \dots \dots \dots \text{(equation 7)}$$

This equation is better known as the rule: Depreciation per year = Last year's written down value multiplied by a constant %

The limits are  $0 < t < L$ , and the scrap value has to be greater than zero. (For zero use 0.1).

Remembering that time-based depreciation is a fixed cost and usage-based depreciation can be a variable cost, depreciation can easily be added into the model (equation 5).

Thus, the profit model becomes:

$$\pi = pq - [F + F_d + (m\mu + l\lambda + n + n_d)q] \dots \dots \dots \text{(equation 8)}$$

where,  $n_d$  = usage (as q) based depreciation and  $\pi$  = annual profit.

**Stock valuation**

In the above, the value of the unit finished goods cost 'w' was left undefined. There are numerous alternatives to how stock (w) is valued but only two will be compared here.

The marginal versus absorption costing debate, includes the question of the valuation of stock (w).

Should  $w = v$  or as (3)  $w = (F_m + v x)/x$ .

(i) Under marginal costing:  $w = v$ . Inserting in (4),

$$\pi = pq - [F + v x + g_0 w_0 - g_1 w_1]$$

Becomes

$$\pi = pq - [F + v x + g_0 w_0 - g_1 v]$$

This can be simplified by taking v out and noting, opening stock quantity + production - closing stock quantity = sales quantity (q) so,

$$\pi = p q - [F + v q] \dots \dots \dots \text{(equation 9)}$$

Note,  $v q$  = variable cost of goods sold.

(ii) Using full (absorption) costing Using (equation 3), where  $x_p$  = planned production,  $x_1$  = period production  $w = (F_m + v x_p)/x_p = F_m/x_p + v$ . This can be shown to result in:

$$\pi = p q - [F_n + F_m + v q + F_m/x_p * (q - x_1)] \dots \dots \dots \text{(equation 10)}$$

Note the strange presence of 'x' in the model. Notice also that the absorption model (equation 10) is the same as the marginal costing model (equation 9) except for the end part:

$$F/x_p * (q - x_1)$$

This part represents the fixed costs in stock. This is better seen by remembering  $q - x = g_0 - g_1$  so it could be written

$$F/x_p * (g_0 - g_1)$$

The model form with 'q' and 'x' in place of 'g<sub>0</sub>' and 'g<sub>1</sub>' allows profits to be calculated when only the sales and production figures are known.

A spreadsheet could be prepared for a company with increasing then decreasing levels of sales and constant production. It could have another column showing profit under increasing sales and constant production. Thus the effects of carrying fixed costs in stock can be simulated. Such modelling thus provides a very useful tool in the marginal versus full costing debate.

**Modelling for losses**

One way of modeling for losses is to use:

- Fixed losses, (quantity) =  $\delta f$ ,



- Variable losses (%) =  $\delta v$ ,
- Material losses =  $m\delta$ ,
- Production losses =  $p\delta$

The model, with all these losses together will look like,

$$\pi = vq - [F + \mu * m\delta f + \{m\mu(1 + m\delta v) + l\lambda + n\} * (1 + p\delta * (q + p\delta f)) \dots \dots \dots \text{(equation 11)}$$

Note that labour and variable overhead losses could also have been included.

**Multi-products**

So far the model has assumed very few products and/or cost elements. As many firms are multi-product the model they use must be able to handle this problem. Whilst the mathematics here is straightforward the accounting problems introduced are enormous: the cost allocation problem being a good example. Other examples include calculation of break-even points, productivity measures and the optimisation of limited resources. Here only the mechanics of building a multi-dimension model will be outlined.

If a firm sells two products (a and b) then the profit model (equation 9),

$$\pi = pq - (F + vq) \text{ becomes}$$

$$\pi = (p_a * q_a + p_b * q_b) - [F + v_a * q_a + v_b * q_b]$$

All fixed costs have been combined in F

Therefore for multiple products

$$\pi = \Sigma(pq) - [F + \Sigma(vq)] \dots \dots \text{(equation 12)}$$

Where  $\Sigma$  = the sum of. Which can be drafted as a vector or matrix in a spreadsheet

or

$$\pi = \Sigma pq - [F + \Sigma(m\mu + \Sigma l\lambda + \Sigma n)q] \dots \dots \text{(equation 13)}$$

**Variiances**

The profit model may represent actual data (c), planned data (p) or standard data (s) which is the actual sales quantities at the planned costs.

The actual data model will be (using equation 8):

$$\pi = p_c * q_c - [F_c + (m\mu_c + l\lambda_c + n_c)q_c]$$

The planned data model will be (using equation 8):

$$\pi = p_p * q_p - [F_p + (m\mu_p + l\lambda_p + n_p)q_p]$$

The standard data model will be (using equation 8):

$$\pi = p_s * q_s - [F_s + (m\mu_s + l\lambda_s + n_s)q_s]$$

Operating variances are obtained by subtracting the actual model from the standard model.

**Learning Curve Model**

It is possible to add non linear cost curves to the Profit model. For example, if with learning, the labour time per unit will decrease exponentially over time as more product is made, then the time per unit is:

$$l = r * q^{-b}$$

where r = average time. b = learning rate. q = quantity.

Inserting into equation 8

$$\pi = pq - [F + (m\mu + r q^{-b} \lambda + n)q]$$

This equation is best solved by trial and error, Newton Raphson or graphing. Like depreciation within the model, the adjustment for learning does provide a form of non-linear sub-modelling.

**Percentage Change Model**

Rather than the variable be absolute amounts, they might be percentage changes. This represents a major change in approach from the model above. The model is often used in the 'now that ... (say) the cost of labour has gone up by 10%' format. If a model can be developed that only uses such percentage changes then the cost of collecting absolute quantities will be saved.<sup>[5]</sup>

The notation used below is of attaching a % sign to variables to indicate the change of that variable, for example,  $p\% = 0.10$  if the selling price is assumed to change by 10%,

Let  $x = q$  and  $C = \text{contribution}$

Starting with the absolute form of the contribution model (equation (9) rearranged):

$$\pi + F = C = (p - v)q.$$

The increase in the contribution which results from an increase in p, v and/or q can be calculated thus:

$$C(1 + C\%) = [p(1+p\%) - v(1+v\%)]q(1+q\%)$$

rearranging and using  $\alpha = (p - v)/p$ ,

$$C\% = ((1+q\%)/\alpha)[p\%-(1 - \alpha)v\%]+q\%.....$$

(equation 18)

This model might look messy but it is very powerful. It makes very few demands on data, especially if some of the variables do not change. It is possible to develop most of the models presented above in this percentage change format.

#### 4.1.4 See also

- Budgets
- Cost accounting
- Financial modeling
- Income statement
- Management accounting

#### 4.1.5 References

- [1] Mattessich, R. (1961). 'Budgeting models and system simulation', *The Accounting Review*, 36(3), 384–397.
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- [5] Eilon, S. (1984). *The Art Of Reconciling*, London: Academic Press.

#### 4.1.6 Further reading

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## 4.2 Management information system

A **Management Information Systems (MIS)** focuses on the management of information systems to provide efficiency and effectiveness of strategic decision making.

The concept may include systems termed transaction processing system, decision support systems, expert systems, and executive information systems. The term MIS is often used in the business schools. Some of MIS contents are overlapping with other areas such as information system, information technology, informatics, e-commerce and computer science. Therefore, the MIS term sometimes can be inter-changeable used in above areas.

**Management Information Systems** (plural) as an academic discipline studies people, technology, organizations, and the relationships among them.<sup>[1]</sup> This definition relates specifically to “MIS” as a course of study in business schools. Many business schools (or colleges of business administration within universities) have an MIS department, alongside departments of accounting, finance, management, marketing, and may award degrees (at undergraduate, master, and doctoral levels) in Management Information Systems.

MIS professionals help organizations to maximize the benefit from investments in personnel, equipment, and business processes.

### 4.2.1 Management

There are different areas of concentration with different duties and responsibilities in information system managers starting from the Chief information officer (CIOs), Chief technology officer (CTOs), IT directors and IT security managers. Chief information officer (CIOs) are responsible for the overall technology strategy of their organizations. Basically they are more of the decision makers and action takers when it comes down determining the technology or information goals an organization and making sure the necessary planning to implement those goals are being met ..

Chief technology officer (CTOs) are responsible for evaluating how new technology can help their organization. They usually recommend technological solutions to support the policies issued by the CIO<sup>[2]</sup>

IT directors including MIS directors are in charge of both their organizations Information technology departments and the supervision of there of. They are also in charge of implementing the policies that have been chosen by the other top branches (CIOs, CTOs). It is their role to ensure the availability of data and network services by coordinating IT activities

IT Security Managers oversee the network and security data as the title implies. They develop programs to offer information and awareness to their employees about security threats. This team is very important because they must keep up to date on IT security measures in order to be successful in their organization. Any security violations need to be investigated and supervised by this specific team.

## 4.2.2 History

Kenneth and Aldrich Estel identify six *eras* of Management Information System evolution corresponding to the five phases in the development of computing technology:<sup>[3]</sup>

1. mainframe and minicomputer computing,
2. personal computers,
3. client/server networks,
4. enterprise computing, and
5. cloud computing.
6. business cluster.

The *first era* (mainframe and minicomputer) was ruled by IBM and their mainframe computers; these computers would often take up whole rooms and require teams to run them — IBM supplied the hardware and the software. As technology advanced, these computers were able to handle greater capacities and therefore reduce their cost. Smaller, more affordable minicomputers allowed larger businesses to run their own computing centers in-house.

The *second era* (personal computer) began in 1965 as microprocessors started to compete with mainframes and minicomputers and accelerated the process of decentralizing computing power from large data centers to smaller offices. In the late 1970s minicomputer technology gave way to personal computers and relatively low cost computers were becoming mass market commodities, allowing businesses to provide their employees access to computing power that ten years before would have cost tens of thousands of dollars. This proliferation of computers created a ready market for interconnecting networks and the popularization of the Internet. (NOTE that the first microprocessor - a four-bit device intended for a programmable calculator - was introduced in 1971, and microprocessor-based systems were not readily available for several years. The MITS Altair 8800 was the first commonly-known microprocessor-based system, followed closely by the Apple I and II. It is arguable that the microprocessor-based system did not make significant inroads into minicomputer use until 1979, when VisiCalc prompted record sales of the Apple II on which it ran. The IBM PC introduced in 1981 was more broadly palatable to business, but its limitations gated its ability to challenge minicomputer systems until perhaps the late 1990- 1980s.)

As technological complexity increased and costs decreased, the need to share information within an enterprise also grew—giving rise to the *third era* (client/server), in which computers on a common network access shared information on a server. This lets thousands and even millions of people access data simultaneously.

The *fourth era* (enterprise) enabled by high speed networks, tied all aspects of the business enterprise together offering rich information access encompassing the complete management structure. Every computer is utilized.

The *sixth era* (cloud computing) is the latest and employs networking technology to deliver applications as well as data storage independent of the configuration, location or nature of the hardware. This, along with high speed cellphone and wifi networks, has led to new levels of mobility in which managers may access the MIS remotely with laptop, tablet computers and smartphones.

## 4.2.3 Types and terminology

The terms *management information system* (MIS), *information system*, *enterprise resource planning* (ERP), and *information technology management* are often confused. Information systems and MIS are broader categories that include ERP. Information technology management concerns the operation and organization of information technology resources independent of their purpose.

- *Management information systems*, produce fixed, regularly scheduled reports based on data extracted and summarized from the firm's underlying transaction processing systems<sup>[4]</sup> to middle and operational level managers to identify and inform structured and semi-structured decision problems.
- *Decision support systems (DSS)* are computer program applications used by middle and higher management to compile information from a wide range of sources to support problem solving and decision making. A DSS is used mostly for semi-structured and unstructured decision problems.
- *Executive information systems (EIS)* is a reporting tool that provides quick access to summarized reports coming from all company levels and departments such as accounting, human resources and operations.
- *Marketing Information Systems* are Management Information Systems designed specifically for managing the marketing aspects of the business
- Accounting information systems are focused accounting functions.
- Human resource management systems are used for personnel aspects.
- *Office automation systems (OAS)* support communication and productivity in the enterprise by automating workflow and eliminating bottlenecks. OAS may be implemented at any and all levels of management.

- *School Information Management Systems (SIMS)* cover school administration, and often including teaching and learning materials.
- *Enterprise resource planning* facilitates the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders.<sup>[5]</sup>

#### 4.2.4 Advantages

The following are some of the benefits that can be attained using MISs.<sup>[6]</sup>

- Companies are able to identify their strengths and weaknesses due to the presence of revenue reports, employees' performance record etc. Identifying these aspects can help a company improve its business processes and operations.
- Giving an overall picture of the company.
- Acting as a communication and planning tool.
- The availability of customer data and feedback can help the company to align its business processes according to the needs of its customers. The effective management of customer data can help the company to perform direct marketing and promotion activities.
- MISs can help a company gain a competitive advantage. Competitive advantage is a firm's ability to do something better, faster, cheaper, or uniquely, when compared with rival firms in the market.

#### 4.2.5 Enterprise applications

- *Enterprise systems*—also known as *enterprise resource planning (ERP)* systems—provide integrated software modules and a unified database that personnel use to plan, manage, and control core business processes across multiple locations. Modules of ERP systems may include finance, accounting, marketing, human resources, production, inventory management, and distribution.
- *Supply chain management (SCM)* systems enable more efficient management of the supply chain by integrating the links in a supply chain. This may include suppliers, manufacturers, wholesalers, retailers, and final customers.<sup>[7]</sup>
- *Customer relationship management (CRM)* systems help businesses manage relationships with potential and current customers and business partners across marketing, sales, and service.<sup>[8]</sup>

- *Knowledge management system (KMS)* helps organizations facilitate the collection, recording, organization, retrieval, and dissemination of knowledge. This may include documents, accounting records, unrecorded procedures, practices, and skills. Knowledge management (KM) as a system covers the process of knowledge creation and acquisition from internal processes and the external world. The collected knowledge is incorporated in organizational policies and procedures, and then disseminated to the stakeholders.<sup>[9]</sup>

#### 4.2.6 Development

"The actions that are taken to create an information system that solves an organizational problem are called system development".<sup>[10]</sup> These include system analysis, system design, computer programming/implementation, testing, conversion, production and finally maintenance.

Conversion is the process of changing or converting the old system into the new. This can be done in three basic ways, though newer methods (prototyping, Extreme Programming, JAD, etc.) are replacing these traditional conversion methods in many cases:

- **Direct cut** – The new system replaces the old at an appointed time.
- **Pilot study** — Introducing the new system to a small portion of the operation to see how it fares. If good then the new system expands to the rest of the company.

#### 4.2.7 See also

- Enterprise Information System
- Bachelor of Computer Information Systems
- Business intelligence
- Business performance management
- Business rule
- Corporate governance of information technology
- Data mining
  - Predictive analytics
  - Purchase order request
- Enterprise architecture
- Enterprise planning system
- Management by objectives
- Online analytical processing
- Online office suite
- Real-time Marketing

## 4.2.8 References

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- [2] <http://www.bls.gov/ooh/management/computer-and-information-systems-managers.htm#tab-2>
- [3] Laudon, Kenneth C.; Laudon, Jane P. (2009). *Management Information Systems: Managing the Digital Firm* (11 ed.). Prentice Hall/CourseSmart. p. 164.
- [4] *Transaction processing systems (TPS)* collect and record the routine transactions of an organization. Examples of such systems are sales order entry, hotel reservations, payroll, employee record keeping, and shipping.
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- [9] Joshi, Girdhar (2013). *Management Information Systems*. New Delhi: Oxford University Press. p. 328. ISBN 9780198080992.
- [10] Laudon, K., & Laudon, J. (2010). *Management information systems: Managing the digital firm*. (11th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

## 4.2.9 External links

- Index of Information Systems Journals
- MIS Links (University of York)
- Executive Information Systems: Minimising the risk of development
- Central Michigan University - MSIS

## 4.3 Institute of Management Accountants

The **Institute of Management Accountants (IMA)** is a professional organization headquartered in Montvale, New Jersey, USA. The organization also has offices in Zurich, Switzerland; Dubai, UAE; and Beijing, China.

IMA members work in business, with job responsibilities distinct from those in public accounting. IMA raises awareness of management accounting, which includes jobs in decision support, planning and control positions.

With a network of more than 70,000 professionals, IMA provides certification, the **Certified Management Accountant (CMA)**, for internal financial management responsibilities, including planning, budgeting, business reporting, decision analysis and risk management. Members can achieve career development through access to one of IMA's 200 local chapters, online professional communities, continuing education, information and resources.

The Institute of Certified Management Accountants (ICMA), the certification division of IMA, awards the **Certified Management Accountant (CMA)** certification. This covers four areas: financial planning, analysis, control, and decision support. The CMA assesses competency of internally focused accounting skills and is appropriate for professionals working in large, small, publicly traded and privately held enterprises, not-for-profit organizations, academia, and government. More than 37,000 professionals in the U.S. and around the world have earned the CMA since the program was introduced in 1972.

### 4.3.1 Timeline

- **1919:** Founding of the National Association of Cost Accountants (NACA) in Buffalo, N.Y., forerunner of the IMA
- **1920:** First chapter of NACA formed in Chicago / First NACA Annual Conference held in Atlantic City
- **1925:** NACA Bulletin introduced
- **1935:** Library established at NACA national office
- **1943:** First international chapter chartered
- **1945:** Research committee established
- **1949:** NACA Bulletin became monthly publication
- **1957:** NACA became National Association of Accountants (NAA)
- **1959:** Student Publication Services inaugurated
- **1969:** Management Accounting Practices Committee established
- **1972:** Certified Management Accountant (CMA®) program created / The first Statement on Management Accounting (SMA), Concepts for Contract Costing, issued
- **1983:** Standards of Ethical Conduct of Management Accountants, the first code of ethics for management accountants in the U.S., issued
- **1989:** Financial Executive of the Year Award (FEYA) program established



- **1991:** National Association of Accountants became the Institute of Management Accountants (IMA)
- **1992:** IMA became a founding member of the Committee of Sponsoring Organizations of the Treadway Commission (COSO), a private-sector organization dedicated to improving the quality of financial reporting
- **1994:** IMA Foundation for Applied Research (FAR) formed for the advancement of management accounting
- **1996:** IMA established the Certified Financial Manager (CFM®) program
- **1999:** IMA relaunched and renamed its flagship magazine, *Strategic Finance*, which also became available online / *Management Accounting Quarterly* debuted Fall 1999
- **2000:** First IMA Student Conference held in Colorado Springs
- **2006:** First IMA Global Conference held in Dubai, UAE
- **2009:** LinkUp IMA, exclusive online professional community, launched <sup>[1]</sup>
- **2013:** IMA became a member of IFAC<sup>[2]</sup>

### 4.3.2 CMA (Certified Management Accountant)

The CMA exam has two parts. Part 1 covers Financial Reporting, Planning, Performance, and Control. It includes: External Financial Reporting Decisions, Planning, budgeting, forecasting, performance management, cost management and internal controls. Part 2 covers Financial Decision Making and includes financial statement analysis, corporate finance, decision analysis, risk management, investment decisions & Professional Ethics.<sup>[3]</sup> The exam is administered electronically through the worldwide network of Prometric Testing Centers. Each exam part lasts four hours with 100 multiple-choice questions and two 30-minute essay questions. The CMA exams for parts 1 and 2 will be given during the following three testing window periods: January and February, May and June as well as September and October.

#### Requirements

To be certified as a CMA, candidates must fulfill both an education requirement and an experience requirement in addition to passing the exam.

1. Bachelor's degree from an accredited college or university

2. Foundational knowledge of economics, basic statistics, and financial accounting
3. Two continuous years of professional experience

For certified CMAs, 30 hours of CPE credits, including two hours of ethics, and annual IMA Membership are required to maintain active status.

### 4.3.3 Journal

IMA publishes the quarterly academic journal *Management Accounting Quarterly*, focusing on corporate accounting and financial management. IMA also publishes the "Strategic Finance Magazine", an award winning publication that provides the latest information about practices and trends in finance and accounting.

### 4.3.4 See also

- Certified Management Accountant

### 4.3.5 References

- [1] "Our History". IMA.
- [2] "IMA granted IFAC membership". *The Accountant*. Retrieved November 18, 2013.
- [3] "CMA Essential Credential".

### 4.3.6 External links

- Institute of Management Accountants
- *Management Accounting Quarterly*
- *Strategic Finance Magazine*

## Chapter 5

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  - **Cost-benefit analysis** *Source:* [https://en.wikipedia.org/wiki/Cost%E2%80%93benefit\\_analysis?oldid=690897020](https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis?oldid=690897020) *Contributors:* Edward, Kku, Pde, Pcb21, Ronz, Silverfish, Mydogategodshat, Caknuck, Tim Bell, Cutler, Alan Liefiting, Giftlite, Bfinn, Alison, Craigwb, Quinwound, Meara, Christopherlin, Utcursch, Alotau, Imroy, Discospinster, LindsayH, Gobimurali, Bender235, Aaronbrick, Femto, Cretog8, Maurreen, The shaggy one, Alansohn, Gary, Arthena, John Quiggin, Pioneer-12, Matbrundage, DavidCane, BD2412, TobyJ, Sjakalle, Rjwilmsi, MZMcBride, Yamamoto Ichiro, Wragge, RobotE, Michael Slone, CambridgeBayWeather, Tony1, Bucketsofg, Eclipsed, Yonidebest, Douglaspatton, Allens, SmackBot, Phlegethon, Andy M. Wang, Chris the speller, MartinPoulter, Miquonranger03, Normxxx, Richard001, Kuru, Majorclanger, Grumpyyoungman01, Beetstra, RichardF, Hu12, Levineps, White Ash, Markbassett, Eastlaw, Thomasmeeks, Krakfly, JohnInDC, Thijs!bot, Epb123, Sonderbro, Laidi-enwiki, A3RO, Mentifisto, Seaphoto, Bigglesjames, Tmpokisn, Jacqke, Spencer, Lfstevens, BKfi, Ph.eyes, Kaoeki, Hubbardaie, Dlindbloom, Rettetast, Redian, J.delanoy, Pilgaard, Titusmars, Samwaltersdc, TXiKiBoT, Swanseaeu1, Katoa, SueHay, GcSwRhIc, Littlealien182, Rwgreen1173, SieBot, Dluther31, Flyer22 Reborn, Pattigustafson, Pm master, Millstream3, Alanadexter, JusticeIvory, NVar, JL-Bot, ClueBot, Waldoemerson, ImperfectlyInformed, Patrick Grady, M4gnum0n, Noneforall, Nagika, Ankeet.shah, Flou11, Ps07swt, Roxy the dog, Jytdog, Cheapskate08, Fede.Campana, Stickee, Addbot, Mortense, Don'tKnowItAtAll, Justbr, Binary TSO, Diptanshu.D, Daicaregos, Misunderestimator, Jarble, Luckas-bot, Yobot, Fraggle81, AnomieBOT, Galoubet, Kingpin13, Xqbot, Srich32977, Econo67a, RibotBOT, Amaury, Doulos Christos, 4RugbyRd, Jamesooders, I dream of horses, LauraHale, Herbs505, Lotje, Vrenator, Vanished user aoiwaiuyr894isdik43, Mean as custard, EmausBot, Dewritech, Dnazip, 7Adrian7, Xerographica, Orange Suede Sofa, ClueBot NG, Blumandarin, UWEvansSchool, Gareth Griffith-Jones, Fundraiser, Educatedseacucumber, Wbm1058, BG19bot, Easychord, Debastein, Econ1174, Scmbwis, Ameliaclopez, Vinophil, Ecbrown, Jeremy112233, Cyberbot II, Br808, Cupco, Sabine.Nicole, Harris.lj, JackieNarvaez, Gabelglesia, BreakfastJr, Aellithy, Zptt55, Skr15081997, Monkbot, Lajh87, MarshalRodreck, Mohammed Hamed Ahmed Soliman, Loraof, Pinnate foliage, Sgarmisa, Tchengt67, Morran vikas, KasparBot, EditingGeek and Anonymous: 187
  - **Cost-volume-profit analysis** *Source:* [https://en.wikipedia.org/wiki/Cost%E2%80%93volume%E2%80%93profit\\_analysis?oldid=692056365](https://en.wikipedia.org/wiki/Cost%E2%80%93volume%E2%80%93profit_analysis?oldid=692056365) *Contributors:* GregorB, Astronaut, Lmatt, Tony1, CastAStone, Nbarth, Mike hayes, Kuru, Future Perfect at Sunrise, Lemming64, Tgeairn, Comp25, SieBot, RudolfSimon, Addbot, Yobot, Gemms1985, BobKilcoyne, Daviessimo, MastiBot, Lotje, Toastcard, DARTH SIDIOUS 2, K6ka, ClueBot NG, Floatjon, Sftuitt, Kkumaresan26, Tentinator, Csusarah, Josephat.yator, Eteethan and Anonymous: 34
  - **Capital budgeting** *Source:* [https://en.wikipedia.org/wiki/Capital\\_budgeting?oldid=680963536](https://en.wikipedia.org/wiki/Capital_budgeting?oldid=680963536) *Contributors:* Dml078, Utcursch, Fintor, Alansohn, PaulHanson, Reinoutr, Woohookitty, Guy M, Uncle G, BD2412, Expurgator, Winhunter, Chobot, Whitejay251, Katieh5584, SmackBot, Elonka, Chris the speller, Kotra, Mitsuhiro, Smallbones, Pondster123, MichaelBillington, Mtmelendez, Kuru, Ckatz, TastyPoutine, Skapur, CmdrObot, Future Perfect at Sunrise, Srajan01, Alaibot, Seaphoto, MikeLynch, Barek, Patstuart, Romistrub, Drewwiki, Stathisgould, MarceloB, Farhanmukadam, Cometstyles, Kenckar, Malik Shabazz, SueHay, Lamro, PatentSearch, Quest for



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- **Sales operations** *Source:* [https://en.wikipedia.org/wiki/Sales\\_operations?oldid=694332259](https://en.wikipedia.org/wiki/Sales_operations?oldid=694332259) *Contributors:* Kku, The Land, Malcolm, Tony1, SmackBot, Edgar181, Kuru, Wwengr, PKT, Katharineamy, Telecineguy, Erik9bot, FrescoBot, Reynoldswriting, EmausBot, Karenmharvey, ClueBot NG, Helpful Pixie Bot, BG19bot, Smaughan, Mohamed-Ahmed-FG, Apipia, BobBacon1, Zelbook, Bbacon.wwsalesops and Anonymous: 17
- **Financial forecast** *Source:* [https://en.wikipedia.org/wiki/Financial\\_forecast?oldid=658961611](https://en.wikipedia.org/wiki/Financial_forecast?oldid=658961611) *Contributors:* Heron, Fintor, Allens, EdGI, IronGargoyle, SMasters, Hu12, Fabrictramp, Pilgaard, SueHay, Jojalozzo, UnCatBot, Yobot, Levispires, FedericoMorandini, Dianna, DexDor, SPECIFICO, Remi.berthier and Anonymous: 8
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