University of Glasgow

UoG / UESTC Joint School of Engineering

Engineering Project Management & Finance

Introduction to Engineering Economics

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Lecture contents

- Company financial records
  - Balance Sheet
  - Cash Flow Statement
  - Profit & Loss (Income) statement

- Why do engineers care?
  - Impacts on Projects:- Finances AND Technical decisions
  - Calculating Budgets
  - Reading company / business unit reports
  - In order to communicate to others in a management team (Finance, sales, marketing, CEO)

What is Engineering Economics?

- It is a collection of quasi-mathematical techniques that simplifies economic comparisons.
- It provides a rational and systematic approach for enabling evaluation of different economic decision

  e.g.
  - purchase of a new piece of manufacturing equipment
  - evaluating different manufacturing methods in terms of economic value to the company
  - replacing existing manufacturing equipment or methods
  - Deciding whether to rent or buy equipment
  - Deciding whether to add a new product feature or not

Evaluating the Alternatives

- Alternatives are **always** present for any economic decision
- **Identifying** appropriate alternatives is as important as - evaluating the alternatives

- Alternatives evaluation variables:
  - initial cost; Interest rate (rate of return)
  - anticipated life of equipment (economic life)
  - annual maintenance /operating cost or benefit
  - End-of-life resale or salvage value

Types of financial analysis

- Many types of financial reports are concerned with **planning ahead**.
- These include cashflow forecasting, break-even analysis and budget setting.
- Others are concerned with **reporting results** at the end of the year.
- These include the Profit and Loss (P & L) account (income statement) and the balance sheet.

Statutory Company Reporting

- If you own a company, you must tell the government the state of your company annually. This statutory information is used to calculate the tax the company owes. It is illegal and fraudulent to misrepresent a company's financial position on an annual return.

- In order to run a successful company, you need to know what the financial position is within the company. Internal (management) accounts are usually prepared every month

- **Statutory** accounts (for UK, other countries similar) must include:
  - A '**balance sheet**', which shows the value of everything the company owns, owes, and is owed on the last day of the financial year
  - A '**profit and loss account**' which shows the company's sales, running costs, and the profit or loss it has made over the financial year
  - Notes about the accounts
  - A director's report

True and fair views

- *THE BALANCE SHEET MUST GIVE A TRUE AND FAIR VIEW OF THE STATE OF AFFAIRS OF THE COMPANY AS AT THE END OF THE **FINANCIAL YEAR**;*
- *AND THE PROFIT AND LOSS ACCOUNT MUST GIVE A TRUE AND FAIR VIEW OF THE PROFIT OR LOSS OF THE COMPANY FOR THE **FINANCIAL YEAR**.*

- This means the accounts must honestly represent the trading business of your company. The judgement of what is 'True and Fair' is a decision of the law courts

Extracted from: UK Financial Reporting Council: Financial Reporting Standard for Smaller Entities (effective January 2015)

The Balance Sheet

- Summary of the financial position of a company at a particular point in time (date). The Balance Sheet records:
  - Assets: cash, accounts receivable, inventory, land, buildings, equipment and intangible items
  - Liabilities: accounts payable, notes payable and mortgages payable
  - Owners' Equity: net assets after all obligations have been satisfied
- Engineers (except company owners) do not usually need to know the details of the Balance Sheet. It principally reflects the **value** of the business at a point in time.
  - Normally prepared by accountants
  - Important when selling company or attracting investment

Statement of Cash Flows

- Reports the amount of cash collected and paid out by a company in operating, investing and financing activities for a period of time.
- How /where did the company receive cash?
- How /where did the company use its cash?
- Complementary to the income (Profit and Loss) statement.
- Indicates ability of a company to generate income in the future.

Statement of Cash Flows

Cash inflows

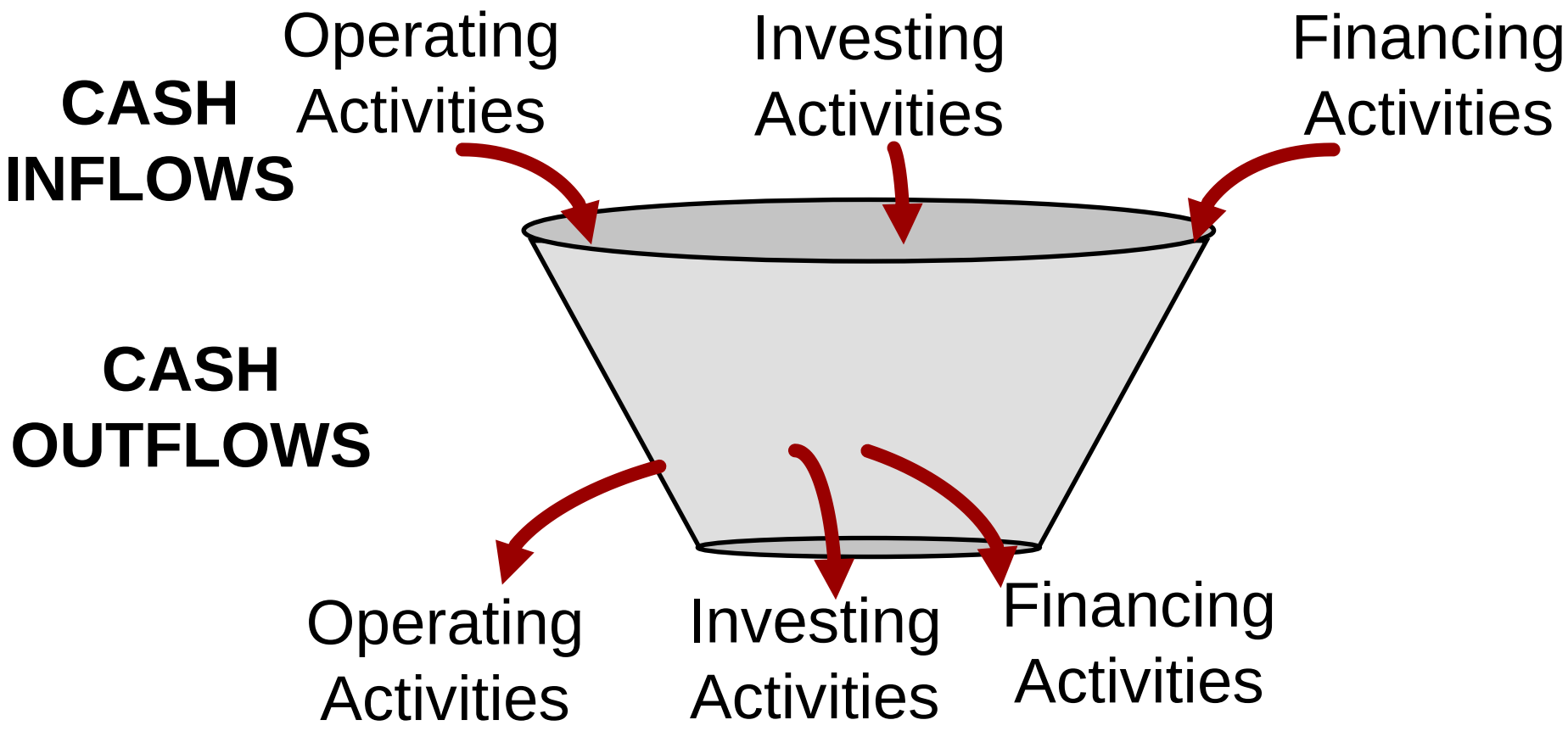
- Sale of goods or services (Cash receipts)
- Sale of other assets or by borrowing (Cash receipt)
- Cash receipts from investments by owners

Cash outflows

- Payment of operating expenses
- Expansion of operations, repayments on loans
- Payment to owners as a return on investment
- Cash Flow is **THE** life blood to small businesses. No Cash== No business

Large companies will have dedicated accountant (treasury) to manage cash flow

Statement of Cash Flows



Note: If **Cash Outflows > Cash Inflows**, the company **cannot** trade!! Many companies **go out of business** because of cash flow problems

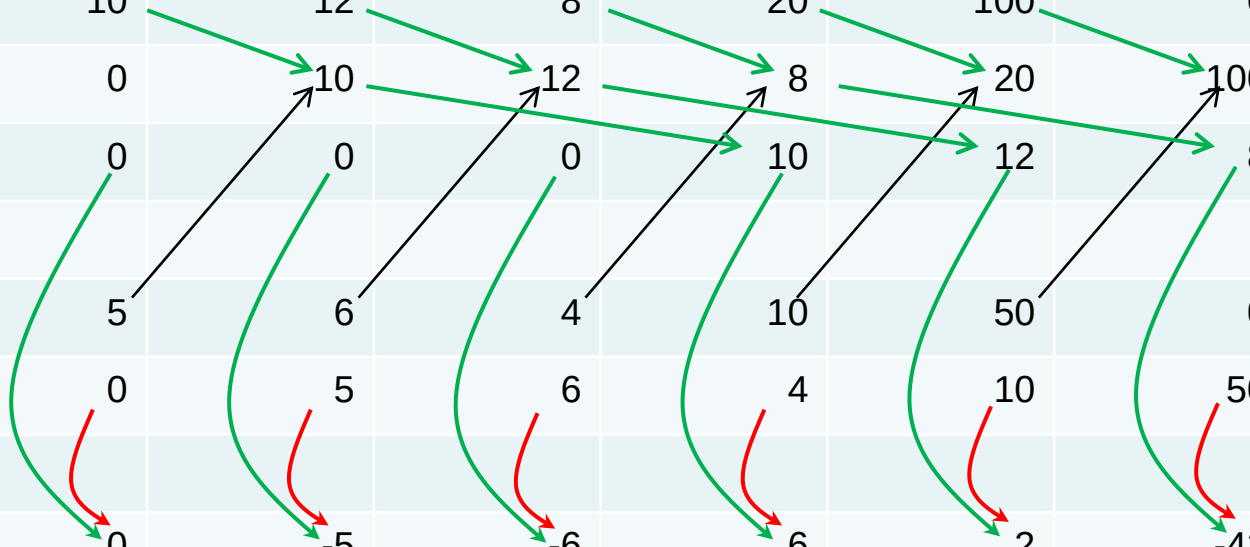
Cash Flow Failure: Simple Example of 'Over trading'

	Month 0	Month 1	Month 2	Month 3	Month 4	Month 5
Sales Bookings ($)	10	12	8	20	100	0
Shipments ($)	0	10	12	8	20	100
Cash In(30 days) ($)	0	0	10	12	8	20
Component Order ($)	5	6	4	10	50	0
Cash Out (30 days) $	0	5	6	4	10	50
Cash Balance ($)	0	-5	4	8	-2	-30
Cumulative Cash ($)	0	**-5**	**-1**	+7	+5	**-25**

The above table shows how too large an order to a small company could result in the company running out of cash (and therefore cease trading).
Too much business can kill a company as well as too little!!

Cash Flow Failure 2: Simple Example of 'Over trading'

	Month 0	Month 1	Month 2	Month 3	Month 4	Month 5
Sales Bookings	10	12	8	20	100	0
Shipments	0	10	12	8	20	100
Cash In(60 days)	0	0	0	10	12	8
Component Order	5	6	4	10	50	0
Cash Out (30 days)	0	5	6	4	10	50
Cash Balance	0	-5	-6	6	2	-42
Cumulative Cash	0	**-5**	**-11**	**-5**	**-3**	**-45**



The above table shows how a further delay in payment from customers (60 days instead of 30 days) can result in company running out of cash

The Profit and Loss (Income) Statement

- It summarises all the **sales revenue** for the financial year.
- It summarises all the **payments or expenses** for the same year.
- The difference between the two totals is the **profit or loss** made in that year.

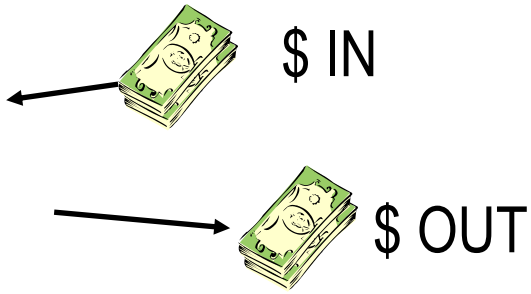
The Profit and Loss (Income) Statement is the most useful to engineers to appreciate the state of the company. Variants of this are used internally to manage the business

Elements of the Income Statement

Let's just think of what a company does …

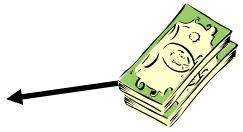
Very roughly, from a financial point of view, there are only two things: Money IN and Money OUT. Or, in more proper terms, we have:

- Income
- Expenses



That would give us some idea, but not really enough. Hence we'll need a little more detail and it is customary to split Income and Expenses up into the main items.

Elements of the Income Statement

Income  $ IN

In many cases, especially in the case of smaller companies, this is just one or two items depending on the nature of the business

- Sales (a retail or manufacturing operation)
- Disposal of assets (car, land etc)
- Service (a doctor or consulting firm)

Elements of the Income Statement

Expenses →  $ OUT

Usually, there are a least a few categories. Exactly which ones again depends on the nature of the business.

- Cost of Sales (Manufacturing costs + labour costs)
- Wages (not incurred in the manufacturing operation)
- Interest (on loans)
- Rent (for office and store space)
- Taxes
- …

A quick preview

+	Sales
-	Cost of Sales
=	Gross Profit
-	Other Expenses
=	EBITDA
-	Interest, Taxes and Amortization
=	Net Income (hence Profit if + and Loss if -)

So many terms …we'll go over them one by one.

The structure of a profit and loss account 1

Top part is concerned with **gross profit**, e.g.

	£
Sales	300,000
Cost of sales	100,000
Gross profit	200,000

Note: cost of sales is the same as 'cost of purchases'. It is **deducted** from sales.

The structure of a profit and loss accounts 2

Second part is concerned with **net profit**, i.e. gross profit minus expenses.

Sales	300,000
Cost of sales	100,000
Gross profit	200,000
Expenses	
Salaries	55,000
Rent	10,000
Other	5,000
Total expenses	70,000
Net profit	130,000

Elements of the Income Statement

Gross Profit

This is the first indication of how a company is doing (if this is negative, watch out!).

The gross profit is basically the difference between the income from the main line of the business minus the actual cost associated with generating that income.

For a shop i.e. : Gross Profit = Sales – Cost of Goods sold.

Gross Profit

Be careful though! Gross Profit (as is the case with quite a few accounting terms) can be defined in many ways.

- In the case of a small shop, there will probably be little dispute about what Gross Profit is (sales price – cost price). But how about service or labor intensive industries.
- In general, wages closely related to e.g. production are included in ‘cost of sales’ but wages of the upper management are not. The question will be: where to draw the line?
- It is often up to the individual company to decide what exactly is part of the ‘cost of sales’ and what not.

Elements of the Income Statement

EBITDA

Earnings Before Interest, Taxes, Depreciation and Amortization

This is quite a mouthful, but fortunately not as difficult to understand as one would initially think.

EBITDA provides important insight into how well the company is doing from an operational point of view. This is also called ‘operating profit’

Let’s have a closer look at the five terms.

Elements of the Income Statement

EBITDA - Earnings

This is probably the easiest term.

To many, it is just another word for profit.

Contrary to profit, however, the term earnings is also used when certain items are excluded (as in Earnings Before ITDA)

Engineers can fundamentally influence earnings by:

- Increasing sales (more features)
- Decreasing costs (reduce component / manufacturing costs)
- Reduce development costs

Elements of the Income Statement

EBITDA - Interest

Many companies borrow money in order to finance their operation or their expansion plans. Naturally, the companies will need to pay interest on the money they borrow.

Sometimes this number can be negative when companies have excess cash; i.e. their own cash is earning interest with a borrower.

Interest does affect the P&L but usually is relatively small. There is little engineering can do to affect the interest charges so leave it to the finance department.

EBITDA - Taxes

We all need to pay taxes and so do companies … well most of the time. There are many exceptions and rules of course.

Company tax is calculated / agreed by your accountants. In general terms, if a company is in start-up / growth phase (i.e. non-profit making), it usually does not pay tax.

Again, there is little engineering can do to affect tax payments; this is a finance department negotiation

EBITDA - Depreciation

When a company buys equipment, it is reasonable to spread the costs every year such that the entire cost is accounted for by the time the equipment reaches the end of its useful life.

A computer e.g. is often written off over a time period of three years. This means that each year, e.g., one third of the computer's cost is subtracted from the Gross Profit.

Doing this provides a more accurate picture of the true performance of the company.

EBITDA – Depreciation continued

If a company would write off its equipment in one go, it would incur an unnatural loss in the first year and an unnatural profit in subsequent years. Such a distortion of the financial performance would make it very difficult to judge whether the company is doing well or not.

Engineering can influence depreciation slightly by reducing spend on Capital equipment (outsourcing is one way)

EBITDA - Amortization

Basically, this is the same as depreciation but rather than spreading the cost of equipment over a time span, Amortization is the systematic reduction of a lump sum paid or the write off of an intangible asset over time.

Example of Lump Sum: Spread out the costs of hiring a 'super CEO' over the time of his contract.
Example of Write Off: Spread the expenses related to a copyright over the economic lifetime of the copyright.

Again, a finance department instrument; leave it to them!

Elements of the Income Statement

Other Expenses

In the end, all expenses need to be accounted for somewhere. Hence everything that is not part of ‘Cost of Sales’ and ‘EBITDA’ is lumped together here.

This may include: Wages, Rent, Advertising ….

Elements of the Income Statement

Net Income

Net income is the real profit or loss of the company. In other words, the money that the company has earned (unless it's losing money of course) for its owners.

An Example in Excel

A	B	C	D	E	F	G
2						
3	Golden Win Double Dragon International					
4	Income Statement					
5						
6	Sales		11200			
7	Cost of Sales		7200			
8	Gross Profit		4000	⇦	=D6 - D7	
9	Other Expenses		1200			
10	EBITDA		2800	⇦	=D8 - D9	
11	ITDA		800			
12	Net Income		2000	⇦	=D10 - D11	

The data is here, but this is neither very informative nor very easy to understand.

An Example in Excel

A	B	C	D	E	F	G
2						
3	Golden Win Double Dragon International					
4	Income Statement					
5						
6	Sales		11200			
7	Cost of Sales		7200			
8	**Gross Profit**		**4000**	⇦	**=D6 - D7**	
9	Other Expenses		1200			
10	**EBITDA**		**2800**	⇦	**=D8 - D9**	
11	ITDA		800			
12	**Net Income**		**2000**	⇦	**=D10 - D11**	

Use the Center and Merge Button Change the Font

Underline before the subtotal

Make the subtotal bold

This looks a lot better but it's still not so informative.

An Example in Excel

2						
3	Golden Win Double Dragon International					
4	Income Statement					
5						
6	Sales		11,330	100%	⇦	=D6/D$6
7	Cost of Sales		7,200	64%	⇦	=D7/D$6
8	**Gross Profit**		**4,130**	36%	⇦	=D8/D$6
9	Other Expenses		1,200	11%	⇦	=D9/D$6
10	**EBITDA**		**2,930**	26%	⇦	=D10/D$6
11	ITDA		800	7%	⇦	=D11/D$6
12	**Net Income**		**2,130**	19%	⇦	=D12/D$6
13						

Add the percentage for each row

A simple income statement is indeed easy to make in Excel!

Why produce a profit and loss account?

- It is a legal requirement. Tax is paid on the profit.
- It summarises all the year's transactions – as recorded in documents such as invoices.
- It shows the financial 'health' of the business.
- It is studied by managers, shareholders, banks, financiers and other relevant groups of people.

Your turn!

	£	£
Sales		320,000
Cost of sales		160,000
Gross profit		**160,000**
Expenses		
Salaries	68,000	
Rent	12,000	
Electricity	5,000	
Other	5,000	
Total expenses		**90,000**
Net profit		**70,000**

Income Statement: Company Example

National Semiconductor Corporation

TWO-YEAR SELECTED FINANCIAL DATA
(In Millions, Except Per Share Amounts and Employee Figures)

Years Ended	May 29, 2011	May 30, 2010
OPERATING RESULTS		
Net sales	$ 1,520.4	1,419.4
Cost of sales	482.0	484.2
Gross margin	1,038.4	935.2
Operating expenses	586.8	609.4
Operating income	451.6	325.8
Interest (expense) income, net	(52.5)	(58.5
Other non-operating (expense) income, net	3.9	1.3
Income before income taxes	403.0	268.6
Income tax expense	104.2	59.4
Net income	$ 298.8	209.2

Summary

- Balance Sheet
  - Tells you the status of a company at a given point in time
  - Important when raising finance or being acquired
  - One part of a company statutory return to government
  - The balance sheet shows the monetary worth of company

- Profit & Loss (Income) Statement
  - Shows the overall business performance over a given time period usually 1 year but may be monthly or quarterly
  - Used as the basis for project, division, or product performance
  - Often the basis of management accounts
  - Very useful for engineers to understand cost-benefit analysis

Post Lecture Reading Material

- Read the following:
  - US Securities & Exchange Commission: Beginners Guide to Financial statements
  - Illinois Small Business Centre: Understanding where you stand: A simple guide to your company's financial statements.
  - You should also carry out a web search to identify a similar introductory document from a Chinese perspective. Then advise the class (& me)

Skim | Read | Understand | Critique