Dynamic Costing - Cost types

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Dynamic Costing

- Cost Types

BusinessSumup

Dynamic Costing - Cost Types

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Dynamic Costing[1]

Costs defined in a dynamic perspective with decision making as objective

"You cannot formulate one universal cost term, you have to establish different cost terms and measures for different purposes"

John Maurice Clark 1923[2]

"Producing a good requires an effort of resources that usually has a price. This consumption of resources is called costs. To produce a specific good with the lowest possible cost is a decisive factor for the long-term success of a business. Therefore, it is important to be able to establish costs in order to obtain the relevant management information necessary to achieve the lowest possible production costs.

Achieving the lowest possible costs is a holistic job, involving management, business culture, optimal technology, optimal internationalization, optimal size of production, etc. And costs vary with the relevant decision occasion. This is the dynamic perspective."

Troels Troelsen 2003

"By definition, a cost is considered to be relevant if it is affected by a management decision. Any cost not affected by a decision is considered irrelevant."

Paul G. Keat and Philip K.Y. Young 2000[3]

Author of the book is Troels Troelsen, Course Coordinator Department of Operations Management Copenhagen Business School, 2003

The objective of operations management is to organize the production and sales/marketing efforts in the most appropriate way for the business.

The purpose of a business is to produce a series of goods or services (from this point on, these terms are considered the same and are referred to as goods). It is a deciding factor that this process is achieved as cheaply as possible.

- Private business products: A Harboe non alcoholic beer, a box of Legos, a newspaper, a car repair.
- Public business products: A full year's work for a pupil in 7th grade, a hip operation, administration of fines.

The challenge and problem of costs can be described as:

1. Production of a good requires an effort or consumption of resources that in most cases have a price, i.e. a minimal consumption of re-sources, at the lowest possible price, is essential.
2. This consumption of resources is called costs
3. Producing a specific good at the lowest possible cost is often deci-sive for the long-term success of a business.
4. Therefore it is important to be able to establish costs in order to obtain the necessary management information, required for achiev-ing lowest possible production costs.
5. Achieving as low costs as possible is a very holistic job, involving management, business culture, the right technology, the right inter-nationalisation, the optimal size of production etc.
6. The cost of producing a good vary in terms of the relevant decision-making occasion, **which is the content of a dynamic perspective**.

A business can, among other things, be described as a string of contracts (nexus, nodes), which combined comprise the fundamental base, the production, and the liquidity access (sales or grants/appropriations).

Such contracts (to buy, sell, establish a production facility, hire staff etc.) are commonly agreed upon with contracting entities outside the group of owners and decision makers. It is therefore essential to understand a number of models which place the firm in the context of its environment.

Concerning the course of and decision-making situations in operations management, there are three central problem areas relating to a firm's decision analysis, each of which is described in compendiums, paving the way for the possibility of a future book.

- The firm in context (available in English)
- Dynamic Costing, costs in a dynamic perspective
- Dynamic Pricing, pricing in a dynamic perspective

These fields will all be described based on known and solid operations management models and theories. An extension will though be directed towards structuring decision-making in terms of the decision-making circumstances and conditions relevant to the specific occasion.

1. Different Cost Types as a Function of Different Decision-Making Situations

1.1 Introduction

General variability

In any given company there are a number of typical cost types which vary in tact with specific decisions: time horizon, product type, and production conditions, just to name a few.

- For a hotel, the cost calculation for a vacant room per night, depending on the decision-making occasion, could result in numbers as different as DKK 20 and 400.
- For an airline the calculation of costs per seat between Oslo and Copenhagen result in numbers as different as DKK 80 and 460.
- For Carlsberg the cost calculation of producing one premium pilsner result in numbers as different as DKK 0.80 and 2.20.
- For TDC the cost calculation for one minute of calling on the cellular net in numbers as different as DKK 0.15 and 0.65.

The decision-making occasion has to be specifically defined.

Cost types

Different cost types are composed of different integral aspects when examined from the perspective of specific decision-making occasions. Below, are a number of typical cost specifics:

Raw materials
Blue collar (hourly paid workers employed on short notice)
Production costs, direct
Production costs, indirect
Depreciation factors
Interest
Administration
Research
Management, consulting, and accounting

1.2 Examining Different Cost Types

Raw materials

In regards to a specific decision-making situation, raw materials are a direct variable cost, i.e. the size of the costs are dependent on the size of production. For instance, plastic is a raw material when manufacturing plastic bowls, and the amount of plastic used varies directly with the production of the plastic bowls. This relationship is illustrated in figure 1.1:

Figure 1.1: Consumption of raw materials in produktion
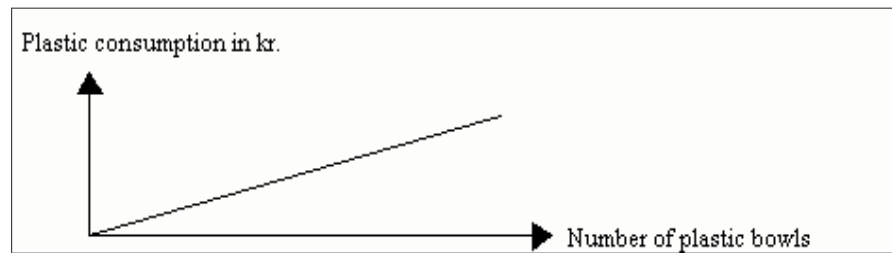
Purchasing
discounts When a firm plans production, the cost of raw materials are partially dependent on whether or not purchasing discounts (quantity discounts) have been achieved, which generally appear in two different forms:
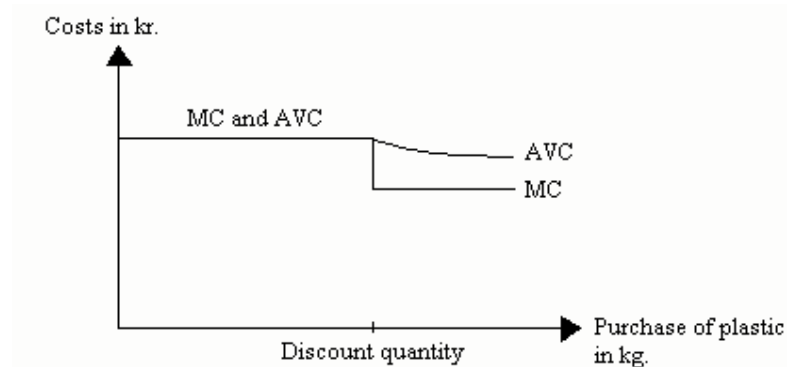
- **Non-accumulated discount (normal discount):** In this case, the firm only receives a discount for the part of the purchase that exceeds the discount boundary quantity. A normal discount could, for instance, be structured so that the plastic bowl manufacturer obtains a 15% discount on the portion of the purchases that exceed the discount boundary quantity of 1 metric ton per month. This situation is shown in figure 1.2:

Figure 1.2: Non-accumulated discount

- **Accumulated quantity discount:** In this case the firm receives a discount for the entire amount purchased, provided that the purchase equals or exceeds the discount boundary quantity. A 15% accumulated quantity discount could be structured so that the plastic bowl manufacturer obtains a 15% discount on all plastic purchased, provided that a minimium of 1 metric ton is purchased every month. This scenario is depicted in figure 1.2:

Figure 1.3: Accumulated quantity discount
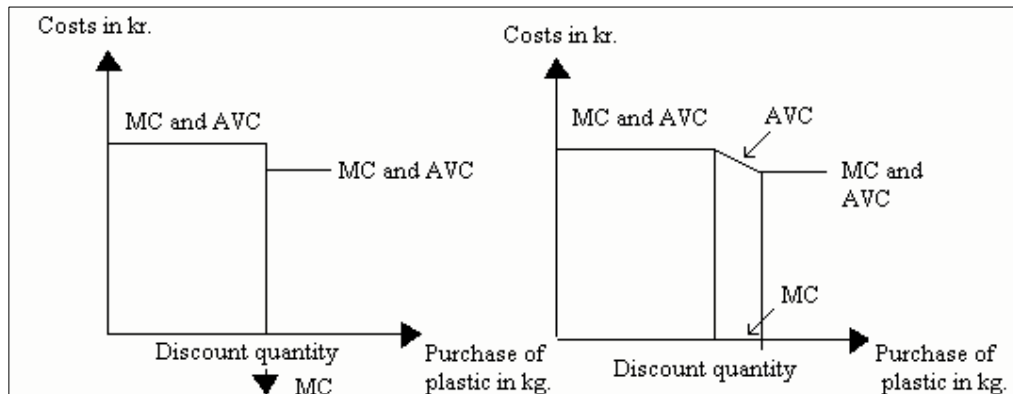
- The first of the two figures shows the accumulated quantity discount provided, which is regarded as a bonus sum, paid when the discount quantity is reached. Here, MC has a negative value, i.e. a negative cost (read: an income).
- The second figure shows the accumulated quantity discount where the last quantity purchased before the discount quantity is reached, is free of charge. This discount format should be understood in terms of the following example: if the plastic bowl manufacturer obtains an accumulated quantity discount of 15% when buying 1 metric ton, then the amount of the discount can be explained by the purchase quantity between 850 kg and a ton, being free of charge.

Under certain rare circumstances, it is possible to buy more product than needed, with the purpose of obtaining the discount limit. In these cases, though they seem somewhat unthinkable, the cost of destroying or transporting the excess quantity complicates the model to some degree. This situation is highly academic and will not be discussed in-depth here. For a theoretic explanation, albeit in Danish, is available found in "Opgaver i Erhvervsøkonomi – med supplerende noter" af Michael Havsteen og Ove Hedegaard, DJØF's Forlag 2003.

Raw materials – opportunity costs

If a firm utilizes raw materials that experience price fluctuations (e.g. silver for Georg Jensen), it is the rebuy-price, at the time of the decision that should be integrated into the cost calculations. A possible profit or loss based on the difference between the original cost price and the cost price at the time the decision is made should be defined as a speculative profit or loss.

Under specific circumstances, the firm can build up raw materials as a "last production." In these situations, it is possible to do a cost estimate. This estimate should use the price the raw materials could be sold for, which is often well below the cost price. A fence manufacturer having bought wood cut to a specific length, could represent a hypothetical example. These pieces of wood could only be resold at a substantial price reduction. Other examples include: companies ceasing production of a certain item, or who are going bankrupt, etc.

Hourly wages – blue collar

Blue-collar workers, or employees with an hourly wage, have traditionally been people that could be hired and laid off on a short notice. In the traditional industrial perception these people have a relatively limited knowledge and represent low training costs.

The reality in the industrial world is though quite different. The following circumstances are some of those which affect this scenario:

- There are very few jobs that do not have a required training-period, with attached training costs.
- For many jobs, the training of new employees constitutes a significant investment, which increases the repercussions of time horizon layoff decisions.
- Most hourly paid employees have a mandatory giving notice period, varying from days to weeks.
- Many hourly paid employees have competencies which are expensive for companies to replace. These competencies are often even more crucial for the firm than those possessed by white collar workers.
- Most of the job functions can be carried out in a more or less correct manner, with more or less confidence, and with a variable quality of production as a result. Therefore, employees should be ranked so that the ones most valuable to the firm are the first to be employed and so on. In this way, the wage costs per unit produced will increase with the size of production as a direct consequence of employees having different qualifications.

Production costs, direct

Direct production costs vary with production size. Regarding the production of beer, the following examples have relevance:

- Production unit element level (brew, bottle, label, top)
- Series element level (packing, internal transportation)
- Product element level (daily cleaning, power)
- Product line element level (systematic maintenance, product control)

Normally, a product or service unit would be estimated including the direct costs concerning all these element levels. This procedure is due to the decision-making situation connected with production, which also involves decision-making focusing on selling goods, and in this case, all production costs should be included. Read more about this topic in the chapter about calculations, where fixed and variable costs are addressed.

Production costs, indirect
A number of indirect costs are also involved in the produced unit, and can neither logically or unambiguously be attributed to the production – but nonetheless they can be unavoidably connected to production. These costs often include service functions related directly to the production activity, such as:

- Raw materials (control, management, waste, etc.)
- Employees (cleaning, training, illnesses, cafeterias, etc.)
- Production lines (maintenance, repairs, updates)
- Communication

Especially the principles of Activity Based Costing (ABC), examined in the calculations chapter, methodologically treat these areas and their relation to handling of costs.

Administration
In terms of costs, administrative processes are often very difficult to measure because they, in the short-term, are regarded as fixed costs. At the same time, the scope of the processes and thereby the number of employees often varies, partly with the size of production, but also in relationship to a number of decisions made on the management level.

One may be inclined to concentrate more or less on one process, such as sales, communication, IT and/or quality control. This decision is based on a number of considerations centered around increasing sales or savings.

In order to delineate processes in terms of products, or product lines can be very difficult, and it is most often necessary to estimate a percentage to cover these functions when production costs are to be assessed.

- Sales processes
- Production, production management
- Communication
- Controlling and accounting
- Human resources, training, etc.

In most cases the changes in costs, for these processes, are far slower than the changes in sales and production, and therefore they fluctuate much more slowly than the direct production costs.

If changes in production are short lived (1-6 months) adjustments in the costs for these processes can be very small, which is why they resemble fixed costs.

Depreciation	Depreciation, as related to the costs of a given production quantity, is very difficult to handle. Depreciation can be divided into a number of different components:

- Wear and tear of machinery/tools caused by use that has a direct negative impact on the machine.
  This factor applies, for instance, to cars, trucks, tractors, etc. In a situation where other influential factors remain unchanged, it is safe to say that a well used machine is in worse shape than a less used machine.
- Deterioration due to time, caused by the fact a machine getting older, and supposedly not being as technologically, or in other ways as up-to-date, as a new machine.
- Technological deterioration, caused by emerging new technology, better suited for a given job, and as thereby reducing the value of the machinery (IT hardware/software etc.).

Depending on the decision-making occasion, one or more of the above mentioned costs must be considered.

Interest	Interest, in relation to production costs, is to be included to the extent to which the carrying out the production demands capital. If storage or machines could be liquidated, interest would be a part of the costs of carrying out production.

Interest should typically be represented by the most expensive part of the financing, and NOT as the average interest. If any special ways of financing are connected to a specific object, for example, cheaply financed trucks or cars, the interest pertaining to this situation could be included in cost calculations.

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Insurance, design, etc. Insurance, research, development, design, etc., are relevant for many industries focusing of producing goods for sale. Some example products include: cars, medicine, clothes, building materials, etc.

Research can succeed or fail, and of course the cost of research has to be recovered in the long run. If not in the first attempt then in the next.

Research is an investment, and R&D efforts are not to be included in the production price of the product. These expenditures are referred to as sunk costs.

Overhead "by-one costs" In a given firm, a number of general costs have a certain status. These are:

- Management and work done by the board of directors
- Consulting and accounting
- IT systems

These elements are prerequisites for the firm's ability to take action, and most often they do not change with a smaller or larger production size. Only when using the "full cost" calculation model are these costs integrated in order to cover these costs. In relation to changes in production, and changes in costs, these factors have no significance.

2. Calculations

2.1 Introduction

The job of a calculation

Calculations serve many different purposes, but all have in common that they determine costs related to a certain job. Based on this principle, this chapter will deal with a very important job within a given firm, i.e. to establish or approach the cost function for the production activities in a firm where:

- More than one good is produced
- The time horizon is realistic
- Going concern is a main point of view (if not necessarily the only one). Going concern means that the company is expected to continue its activities in the near future.
- The production is carried out on a more or less know facility with more or less known technology etc.

Calculations on costs etc. are used in many different places within the financial system of the firm, therefore it is no surprise that the calculations can solve many different jobs. Some of these include:

- **Control:** For instance concerning pre and post calculations, controlling that a given production has the expected financial consequences. At the same time, a basis for future calculations is built upon these experiences. Examples of this relational dynamic are calculations concerning public capital investments such as: bridges, roads, metros, or calculations involved in building a house, or sewing clothes.
- **Inspiration:** Major cost entries could be investigated in order to rationalize, whereas major cost divergence, in a seemingly constant production flow, would generate extreme decision-maker curiosity.
- **Production:** Knowledge and understanding of the costs of several different alternatives is necessary, before it is possible to assess how a product is to be produced at the lowest possible cost.
- **Decisions:** Cost calculations are, for instance, used in relation to pricing and choice of product mix.

In short, the calculation tasks are everyday workings aspects of a firm.

To solve this complicated calculation task requires knowledge about a huge number of methods and terms, some of which are introduced in this chapter. In this text, it is naturally impossible to go in depth with all of the issues, but a number of the most important chains of reasoning will be discussed. The final part of the chapter presents some concrete methods of dividing costs, each method representing an approach to dealing with the calculation task.

Definition of a calculation

In the most traditional sense a calculation can be defined as follows:

"A calculation is a financial estimate of the costs attributed to the purchasing, manufacturing and sales of a company's goods." [4]

Or "A calculation is an estimate of the financial consequences of a given action, ex-ante or ex-post. It could be for a single product unit or a comprehensive alternative action (e.g. construction of a new factory). It can be a pure cost calculation or a calculation that incorporates (expected) future earnings."
The tool "a calculation" adapts, to a large extent, to this job.

Pre-calculation is a way of drawing up the expected costs per product unit. The pre-calculation focuses on production that has yet to take place (ex-ante). Post-calculation seeks to establish the costs that were actually involved in a completed production (ex-post).

By combining a pre- and post-calculation for the same product unit, it is possible to control whether or not the production has proceeded as expected, as well as identifying locations of cost deviations.

Costs vary with the purpose and the job.

Due to a number of factors costs can not be determined unambiguously, but have to be defined with relation to the issue at hand.

Costs and marketing/sales:
- Principally speaking, costs and marketing-conditions have to treated independently. They are not to be connected before optimization of the job has taken place. In practice however, a correlation may occur between the two disciplines, for instance, sales knowledge and marketing could inspire possibilities as to the size of a realistic production. As such, it is superfluous to calculate on the basis of output levels that are impossible to market and sell. At the same time, the time horizon should be established with regard to both cost and marketing conditions.

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Costs and dependency on quantity:

- The classic cost definition states that costs are a function of the consumed factors of production, multiplied with the price for production factors. The consumption of production factors is directly connected to the produced lot.
- Jumps in capacity are either "hard" or "soft," reversible or irreversible, and can thus result in different cost related considerations, including both expansion and reduction in production. In this way, uncertainty or fluctuations in production levels is a cost factor.
- Temporary reductions in capacity produce great difficulties using or integrating the use of factors of production, including individuals possessing key knowledge and technological set-up, which could result in overly optimistic assessments.
- Because of gradual adaptations, the marginal costs and average costs have both a tendency to avoid listing the so-called sneaking costs, whereby the dependency on quantity is underestimated. Examples of this are petty theft, power, and having ½ an extra employee.
- Production risks are not typically included in cost calculations, e.g. competitive tendering in major public works.

Costs and time dependency:

- Short-term and long-term defined as technology choice. In the short-term, existing facilities are employed. While in the long-term, it is possible to adjust to the most appropriate configuration of production and technology.
- Short-term as basis for operations decisions mean that relatively few of the fixed costs are variable. Concerning a long-term perspective, it is possible to adjust the costs, including various reversible, and irreversible cost developments.
- Learning curves, efficiency development, etc. are also included.

Costs and situation dependency:

- Costs can vary with the degree of capacity utilization. In a situation with over capacity in a business sector, businesses are inclined to assess the overhead fixed costs as being higher than in a situation with a shortage of capacity, as the variable costs are lower.
- Costs vary in accordance with the competitive situation found in a business sector. If the competition is fierce, the businesses will, when listing the calculations, assess the overhead fixed costs to be higher than if the competitive situation makes room for more long-term calculations.
- Non-going concern is a perspective where the assets are realized/sold as a result of crisis or normal phasing out, e.g. because of expectations that the firm will not exist in the near future.
- Opportunity costs, depreciation vs. real loss of value caused by wear and tear, financial life-span, alternative usage of capital, or new technology.
- Subcontracting and outsourcing both nationally and internationally, international division of labor, etc.
- Conditions inherent to returns to scale, rationalizing, management effort, technology level, etc.
- The firm's strategic situation, ownership, the industrial competitive situation, capacity of profit, and loss, etc.

The sum of all these issues influences cost estimations.

Collection of data and calculations

All these factors that influence the conception of costs also imply that data collection is not limited to measurement and registration of the firm's own production. It is necessary to access a large number of information bases for the different calculations, some of which are listed below:

Historic, internal data:
- All accounting data in the financial transaction system
- The contributing margin from a number of relevant divisions within the company, its customers, products, etc.
- Prices, price developments, key figure indexes, the "Dupont key-figure pyramid" development, etc.
- Technical data such as material consumption, time consumption, waste, degree of exploitation, etc.

Historic, external data:
- Price indexes, wage indexes, rates of exchange, interest rates, etc.
- Technical achievements, norm data, etc. for production, machinery, employees, etc.
- Industry data, macro economic data, statistical data, etc.
- Competitive data, more or less exposed.

Non-financial data, both internal and external:
- Consumer satisfaction polls, consumer attitudes
- Quality measurements, societal optimism/pessimism, expectations for business cycles/market conditions. This data is often applied when doing different kinds of bench-marking, balanced scorecards, etc.

Typical cost divisions

In a calculation task a number of the earlier mentioned cost divisions are normally applied. The most important are:

- **Fixed and variable costs.** A number of factors are crucial when costs are arranged in fixed and variable costs.

- **Direct and indirect costs.** Direct costs can be attributed to an action, a production, product line, a production facility, or a cost bearer. Furthermore, these factors are applicable on different levels, such as unit, product line, or section.

  It may be necessary to categorize costs in different forms depending on the decision that is to be made. This categorization process can go a bit against the grain of the registration assignment.
  Indirect costs then, are the costs that are not direct.
  In some cost model plans of distribution, the purpose is to divide the different indirect costs into various cost bearers/products (e.g. see the full cost model at the end of this chapter).
  In other models, such a distinction is not made (e.g. the contribution margin model).

- **Sales and administrative costs** are a special kind of costs. They are not directly variable with regards to production, but are indispensable in both the short-term and in the long-term. On the other hand, these costs are often adjusted for activity level as well as sales effort aspirations, service level, control level, etc. But these costs are dependent on the specific business, its strategy, and management. Understanding the relevant time horizon is crucial here. For instance, the size of the sales force in the perfume department of Magasin is determined according to the expected sales, but on a rainy morning there could be over capacity because the sales force in the very short term is a fixed cost, due to scheduling.

Remark: the categorization of a cost as direct or indirect depends on which cost bearer is defined, i.e. the purpose of the calculation (e.g. the production price of one working hour for an accountant, or 1 liter of milk, or a Sony CD-player). In the same way, the division into variable and fixed costs is dependent on the chosen time horizon. For instance, if a single product units is chosen as a cost bearer (e.g. a liter of milk), many costs become indirect. On the other hand, if product lines are focus units, (e.g. the milk packing line) then more costs are direct.

Optimization When calculations are applied to the optimization purposes (optimal price, optimal product mix), some of the central terms in the previous chapter on costs must be revised, starting with the calculation task, i.e. they have to be "re-interpreted in terms of the calculation perspective:"

- **Marginal costs, MC**
  According to the calculation perspective, a narrow production view can often result in a similar situation to that described in the following metaphor: the camel that eventually broke its back because the loaders kept saying: "If it can carry this, it can also carry that." A production can typically manage to manufacture one unit more or less without any consequences for the costs other than the direct product costs, such as materials and direct wages. Therefore, MC is often underestimated significantly, as so-called "sneaking costs" (such as decreasing efficiency) are rarely incorporated, even though they are significant for most production processes. Other important factors in this context include: management, repairs, internal transport, etc.

- **Average Variable Costs, AVC**
  From the calculation perspective, "half-variables" (e.g. sales and administrative costs, machinery, production management, etc.) represent a difficult problem, as they are extremely time horizon dependent. Moreover, precision is lost when it is necessary to apply many, more or less dubious distribution plans in order to achieve a calculated AVC.

- **Average Total Costs, ATC**
  ATC equals AVC + AFC. AFC is only marginally related to the actual production. AFC may be comprised of depreciation on historic goodwill, development costs, and other sunk costs.

- **ABC – costs per cost-object, CCO**
  CCO estimates the costs attributed to a cost-object as having applied the ABC cost classification, and subsequently the division on cost-objects using the cost-drivers as tool. This relationship will be explained later in greater depth.

American economists often use the ATC, suggesting that in this way a long-term optimization is achieved, combined with a safeguard against the liability to compete recklessly, and not cover the fixed costs.

European calculation traditions are more devious, maybe because there is not the same tradition of tough competition between companies, as is found in the USA.

The calcula- When calculations are used in optimization (e.g. pricing and optimal product mix),
tion problem it is important that costs are attributed to the relevant decision. Whether or not a product, a product line, or an activity is profitable depends on which costs are included in the action.

As not every cost can be attributed directly to the specific product unit (e.g. sales and administrative costs), one of the central problems involved in the calculation task is to deal with costs that are common to several products, product lines, and/or business sections. Should such joined costs be distributed to specific product units? And if yes, then how? It is also up to the calculations to solve the issue of how theoretical correct, meaningful, and objectively accurate, this distribution of the joined costs is executed.

Costs centers and cost bearers

The following terms are central for establishing a calculation:

- **Cost centers** focus on organizational work, process oriented, or production oriented elements in a business. A number of costs can be measured, attributed, or applied to these respective foci.
  In order to determine the focus, the reporting system and the account plans of the firm must be adequate and approachable in their arrangement.
  A number of cost centers are presented below. These cost centers are described within the framework of a firm HKP, a woodworking factory with 5 employees, producing windows and doors with different measurements.

  - Depreciation of the machinery value
  - Cost of cleaning, service, and power for the woodworking section.
  - Repairs, sharpening of cutting edges etc. for different machine sections.
  - Wage costs for different tasks
  - Total costs for office and accounting tasks

- **Cost bearers** are the production elements whose costs are to be analyzed and calculated. Typically, these are the firm's products, groups of products, and/or services. Often these elements include many costs that cannot be measured directly (unlike the cost centers). Cost bearers can also be semi-manufactured goods, or internal services aiming to establish cost prices between the sections. Using the HKP case, cost bearers could include:

  - The price of a window or an established number of windows of a specific type.
  - The price for one woodworker's hour of labor, including wages attached to the estimation of special
    assignments
  - The price of dip-impregnating a batch of wood.
  - The price for installing a typical window in a typical house.

Distribution plans

- **Plans of distribution** are applied in order to distribute costs from cost centers to cost bearers. When distributing a number of costs from cost centers to cost bearers, the distribution keys aim at finding the most objectively correct connection between the costs of the cost center, and the cost bearer's use of the same. As a rule, this process occurs in such a fashion that a variation in the cost bearer's production causes the same variation in the costs of the cost center. The better the distribution key is at executing this task, the more objective it is. Likewise, the worse the distribution key is to execute the task, the more arbitrary (random) it becomes.

  An example of a bad distribution key could be when wood consumption for producing a window is included in the work hours. "Experiences tell us that it takes an hour to produce a window, and that in one hour, 9.3 meters of wood are processed." Such a distribution key would not be able to manage shorter or longer series in production, or different types of windows, with different numbers of panes, etc.

A number of typical distribution keys are presented below. The calculation task defines based on, among other things, precision and decision task requirements. The more precise, the more costs are included in the calculation task:

Activity based:
- Wages or time worked
- Production size, consumption of raw materials etc.
- Turnover
- Number of customer visits and number of offers made.

Process based:
- Number of machines
- Process turnaround time
- Number of processes or number of m2 occupied by the process
- Number of customer visits, number of products or product lines.

One of the main tasks implicit in the calculation task is the distribution of costs, placed in cost centers, to cost bearers.

ABC terms

During the 90s an American calculation model called Activity Based Costing, won increasing recognition.[5] This model operates with cost divisions that are somewhat different from those described above. The ABC model is explained fully later in this paper, but its terms are introduced here.

Fundamentally, the same chains of reasoning are applied in the ABC:

- **Cost pools** are more or less the same as cost centers. In the same way the term cost pools deals with the firm's activities as attributed to a source of resources.
- **Cost objects** are the ABC term for cost bearers. In this way ABC seeks to establish a sensible connection between cost pools and cost objects (which in ABC can be processes).

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ABC sets out to distribute a single cost pool over several cost objects. It is not necessary for each cost pool to have a cost object.

Even though the ABC calculation is reminiscent of the full cost calculation mentioned earlier, there is a difference between the basic philosophies behind full cost and ABC.

Possible cost attribution

The calculation task is often focused on establishing the costs of a given activity. This activity will typically be established by analyzing the costs of producing one unit of a given product. A concrete example referring to the HKP company context mentioned earlier: **"producing a Dannebrog-window measuring 82 x 128 cm with thermal panes."**

In this case, a downward-moving tendency of possible cost attributing would be typical, where an objective distribution key is necessary between phases.

Cost type:	Definition:	Examples :	Possible distribution key:
Direct product unit costs	Costs directly attributed to the producing entity.	Number working hours used Helping materials Direct wood consumption	None, as the costs are direct
Direct product costs	Costs directly attributed to the specific production	Estimated training Illness Holiday allowance Petty theft/shrinkage	A 22% wage supplement. Experienced shrinkage/petty theft totalling 8%
Direct product line costs	Costs that are directly attributed to the specific product line	Special machinery for window production Tests Approvals Quality control	Distribution based on working/machine hours Distribution as a fixed supplement per window
Direct sectional or departmental costs	Costs attributed to the section /department	Operation of buildings Cleaning Insurance Other machinery etc.	Supplement per working hour Supplement per machine hour
Additional indirect costs	Costs that cannot be attributed to the items above.	Offices Sales and marketing effort Generating estimates	Supplement per order Supplement per DKK in turnover Supplement per order created

As only the direct variable costs that are tied to the specific product units, can be distributed without complications, principally will all other costs be distributed using a distribution key, see above matrix.

When or if a cost center is to be distributed to cost bearers, this is accomplished with the most suitable distribution key, being as correct or as simple as possible. Thus a distribution key is a statement of the criteria by which the costs are to be distributed. The table below shows how a distribution key could be used to distribute both indirect costs to direct costs, and fixed costs to variable cost. Variations occur depending on the "cost school."

Great skill and experience are required in order to establish good and simple distribution keys. Furthermore, simplicity is crucial, as the necessary calculation information should be obtainable, but also measurable through an appropriate organization of the firm's accounting and financial controlling.

## 2.2 Different Calculation Models

Cost models   Several methods of solving the calculation problem exist. The most common procedures are split into the following three models, each with its own "cost school."

- **Full cost model - absorption cost model:** This model is used by many companies as a method of measuring the lowest price the product could be sold for. This model distributes both fixed and variable costs to the cost bearer; i.e. both direct as indirect variable and fixed costs are distributed. Often the distribution key for the fixed costs becomes quite arbitrary, i.e. random. The issue here is that the indirect fixed costs cannot be logically distributed, and should not be included in the optimization considerations, at least not in the short-term.

- **Contribution margin model - Cost-volume-profit-model:** This model is the most classic and applied model in Denmark. Among those who use or have used this model are Danish professors: Palle Hansen and Zakken Worre, both from CBS. This method distributes the variable costs to the cost bearers; i.e. both the direct and indirect variable costs are distributed. To some extent the model distributes variable costs to the cost bearers by using distribution keys. The distribution keys are usually sufficiently objective, but the adjustment of the time horizon to the calculation task is the great concern of this model. Here, the problem is that the sales and administration costs are partially variable within a certain time horizon; how far should this time horizon go?

- **Activity Based Costing (ABC):** Is represented by R. Cooper and Rober Kaplan[6]. This method distributes the direct costs on cost objects; i.e. the method distributed both direct variable and the direct fixed costs of a given activity, but does not attempt to distribute the indirect cost. The ABC model is increasingly applied by many companies. The model distributes all the costs caused by a given action, which is quite logical but has a downside in that the cost definition obtained is not coherent with an optimization model, neither the "total model" nor the MC model.

The differences between the three models are shown in figure 2.1. A brief verbal sketch of the model's illustrated points:

- The contribution margin model only distributes the direct and indirect variable costs
- The ABC model distributes the direct variable costs and the direct fixed costs. The indirect variable costs are to a certain extent distributed using of cost drivers.
- The full cost model distributes all costs

Figure 2.1
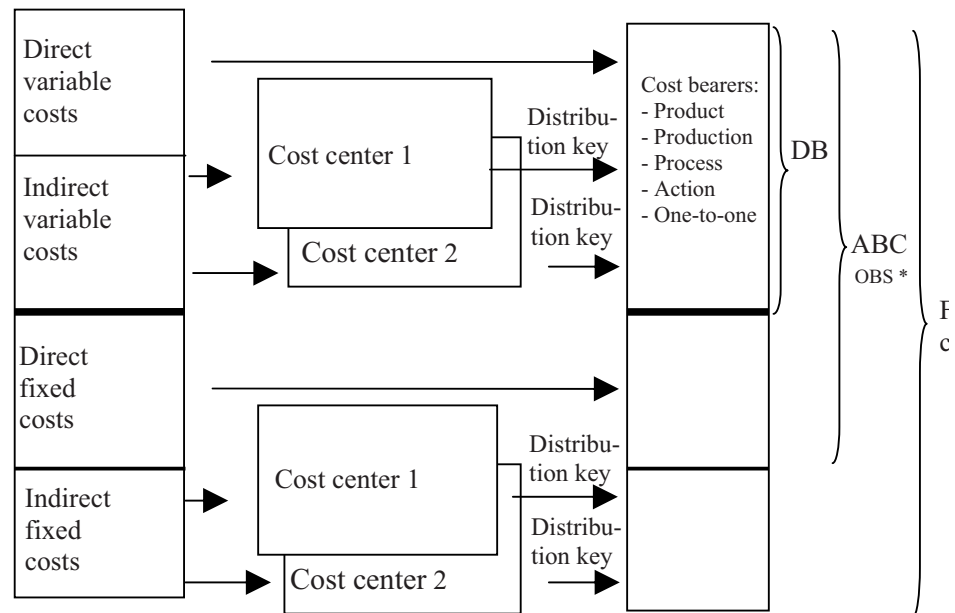
The ABC model does not distribute all indirect variable costs

Advantages and drawbacks of the different models are discussed later, although such a discussion is similar to standing in the eye of the storm. Experts and re-searchers, also at CBS, disagree on the different models, and especially about which one of them is the best. It may be sensible to argue that it depends on which type of calculation task is to be performed.

Variable costs and capacity costs

All the models have in common that they represent a trade-off between living up to sound economic reasoning and being practically applicable. It is for instance a theoretical weakness that the models, only to a very limited extent, include a time perspective (short-term, long-term).[7] This time factor, though not present in all models, is fixed, and cannot adapted to the specific decision-making task. Result-ingly, the models generally use differing definitions of variable and fixed costs (also called capacity costs).

Here are the definitions professor Zakken Worre, applied in the marginal contribu-tion model[8]:

- **Variable costs** are costs that in a any situation are given by the amount of activity and type of activity.
- The firm's capacities are the number of factors (in the widest sense), that are not in any situation controlled by the amount of the activity and the type of ac-tivity. We define **capacity costs** as the costs caused by a (red. production) ca-pacity.

Worre's definition of variable costs may be criticized as too narrow, it only em-braces costs that are directly tied to the specific product unit, and furthermore, there is no implied time variability.
But the definition illustrates the difference between the polished cost theory and the more pragmatic calculation discipline. The contribution margin model has thus been constructed based upon the firm's accounting system, which does not tradi-tionally include any aspects of time.

All the models contain more than just the principles of how to handle the joint costs, but in this chapter the models are presented focusing on that topic. Later, the full cost model and the contribution margin model are shortly introduced, while the ABC model is presented more thoroughly.

The full cost model

The philosophy of the full cost model (also called the cost absorption model) is that all the firm's costs at one time or another have to be attributed to or distributed between the cost bearers (typically products). That is to say, a part of the overhead fixed (capacity) costs is assigned to each specific cost bearer, and added to the variable costs of the good. In this manner, the good's own price is found.

All capacity costs are distributed to the cost bearers, according to distribution keys. The distribution keys in the full cost model are often considered arbitrary (random) in the sense that the distribution of the costs has nothing to do with how much the specific cost bearer use of the company resources.

In the figure below illustrates the emergence of the sales price of a good as the sum of the variable costs of the good, the good's share of the over head fixed (capacity) costs, and the net profit.

Sales price	Net profit	Own price + net profit
Own price	Part of the over-head fixed (ca-pacity) costs	Distributed through distribution keys = distributed fixed costs + the variable costs below
Cost price	Variable costs	Distributed over a fixed time horizon to each unit, possibly through a distribu-tion key.

The contribution margin model

The contribution margin model is based on the idea that the capacity costs are not to be distributed on to the cost bearers at all. The only costs that are attributed to a product are the ones that are directly connected to the product (i.e. variable costs). It is based on this information that financial control and decisions are to be carried out.

In this sense, the contribution margin model is as true to the economic marginal theory's marginal reasoning as possible. As mentioned earlier, the weakness is that the established time horizon must be extremely secure. The precision of the meas-urements are dependent on the complexity of the production, i.e. the number of processes, products, etc. Moreover MC is easily confused with the AVC, i.e. linear cost functions.

Sales price	Contribution to covering capacity costs	Contribution to ca-pacity costs. Also covers profit. The profit is estab-lished as MC=MR, remembering that AVC is NOT equal to MC.
Variable costs	Variable costs	Distributed due to a fixed time horizon, possibly through a distribution key.

2.3 Activity Based costing

ABC

Even though ABC[9] employs a slightly different terminology and another set of thoughts in distributing the costs than does the contribution margin model, the issues at hand are similar: relating the firm's costs to earnings-producing activities.

When a decision concerning pricing or product mix is about to be made, it is es-sential to know which costs belong to which earnings. If the costs are not in one way or the other contributing to the production of earnings, they may in an eco-nomic sense be superfluous. For instance, surplus capacity is a superfluous cost. The purpose of ABC is among other things to identify superfluous activities (=superfluous costs).

It may appear to be a very narrow economic perspective, but ABC is not constructed to stand alone or to be the sole basis for decision making. It is a tool for inspirational analysis, contributing with an estimate of the cost related consequences of the firm's activities.

Cost pools /   Resources are divided into **cost pools** (some writers[10] use the term **cost centers**).
Cost centers   Cost pools are for the specific firm defined so that every cost defrayed can be attributed to a cost pool. Examples of costs pools are employees, locations and information systems. Cost pools are always defined in DKK, which emphasize the direct connection to the firm's costs. A cost pool is typically controlled by a decision maker, responsible for the size and progress of the costs.

Cost objects   Cost bearers are in the ABC terminology called **cost objects**. Examples of cost objects are customers, groups of customers, product groups, and orders. Thus the term is closely aligned to what is traditionally referred to as division of purpose. Like cost bearers, the cost objects can be half-manufactured products and products that are traded internally in the firm.

A prudent connection between the cost centers and cost bearers corresponds to the creation of a rational linkage between cost pools and cost objects. However, it is not meaning that the cost pools and cost objects are to be combined one by one, the cost pools are too broad for that. The specific cost pool is to be distributed to several cost objects, and thus ABC can be conceived through a refined distribution key, supposedly less arbitrary than the traditional models.

*Cost drivers/* The coherence between cost pools and cost objects is created by a link called a
Activities **cost driver / activity**. An activity is an action that draws on one or more resources,
i.e. cost pools. This joining must not be confused with the activity term in the con-
tribution margin model, where activity is an expression of the firm's output level.

The coherence between the central terms mentioned above is shown in the figure
below:
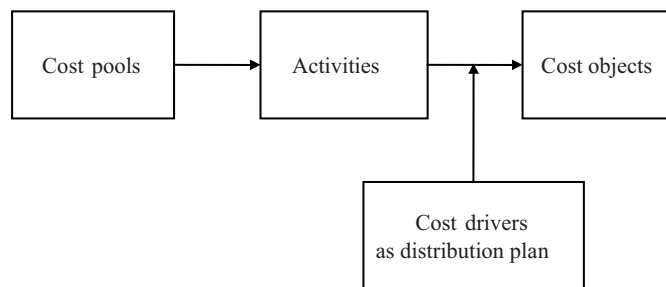
As is the case of cost pools and cost objects, the activities have to be categorized in
sensible way, if the coherence of the different terms is to be found in practice.
Johnson and Kaplan, who introduced ABC in the end of the 80s, are very specific
when it comes to categorizing the activities. They suggest four main groups of
activities:

- **Unit determined activities:** These are directly determined by the production
  of a specific product unit. A product unit is typically a good or a service, and
  examples of the corresponding activities are consumption of raw materials,
  consumption of power, and the working process, that is directly related to the
  specific unit.

- **Activity series:** i.e. activities that are directly determined by the production of
  the particular product series. Costs that are caused by activity series do in prin-
  ciple not vary with the number of units produced in each series. Typical activ-
  ity series are: reorganization of machinery for a new series, or quality control
  of a given existing series.

- **Product preserving activities:** This group of activities is tied to the particular
  product types and models. Thus the activity is independent of how many prod-
  uct series the specific product type is produced in, and the quantity of units
  produced. Examples: product development and product design.

- **Business preserving activities:** ABC operates with "the rule of one": Some
  activities, such as top level management and auditing are necessary no matter
  how much is produced in the company. Broadly speaking, these activities do
  not vary with the number of units, series, and products that are produced in the
  company, and as such they are irrelevant to distribute.

It is reasonable to consider the unit determined activities in the ABC equal to the variable costs from the contribution margin model (not to be confused with variable costs from the cost theory). In both circumstances, the terms vary wholly with the particular product. However one should be aware of the differences of activities in the ABC and costs in the contribution margin model. Activities are actions that can not be fully determined financially, whereas costs are always listed in kroner and øre. Herein lies ABC requirement for some kind of distribution key in order to distribute the activities between the cost pools that represent the costs.

More long-term oriented

The four activity terms above can be seen in relation to the more static contribution margin model, that only operates with two levels: Either the costs are variable or not.

Variable costs are in the contribution margin model exclusively defined with outset in the specific product unit, where ABC operates with series, product types and company specific levels, meaning that more costs can be distributed and fewer costs are classified as capacity costs. Business preserving activities are the ABC equivalent to capacity costs:

More true and fair

The positive idea is that the distribution carried out in ABC is somewhat more true and fair than the one carried out through, for example, the full cost model. Product costs that are independent of the production volume (product development and design for instance) will be distributed onto the particular products in the full cost model. This process gives the impression that the cost is dependent on the amount produced. In ABC, these costs, would on the other hand, be distributed onto the series, product type, or company levels.

Cost drivers

After the company has established a sound connection between the cost pools and the activities, it has to identify a linkage between the activities and the cost objects. This is found by using **cost driver**. Cost drivers can be compared to the units of use, and express how much a cost object draws on a given activity. A cost driver has a direct influence on how much a given resource is drawn upon; e.g. the number of invoices (cost drivers) has a direct connection to how much a given accounting employee (cost pool), who is in charge of billing (activity), is utilized. The cost driver for a mechanical engineer (cost pool) who re-calibrates machines (activity) for new production series, could be the complexity of the calibration for a given series.

ABC and the full distribution cost model

ABC and the full costs model differ from each other on the following points:

- ABC does not have the ambition of distributing all costs, as some activities are considered business preserving activities. This principle is in opposition to the full cost model, which seeks to distribute all costs.
- ABC operates with four different types of cost objects (units, series, product types, and company) while the full cost model only distributes costs at the unit level.
- ABC proposes a less arbitrary distribution key than the full cost model; i.e. distribution keys considered draw on real resources.
- ABC only distributes the indirect variable costs to a certain extent.

ABC and the margin contribution model

In relation to the margin contribution model, some substantial differences are worth drawing attention to:

In the margin contribution model, variable costs are defined on the unit level. Furthermore, ABC defines variable costs (by activities) on series and product levels. From the ABC perspective, this application method means that the capacity costs in the contribution margin model embrace both series, product, and company activities. In this way, ABC has the possibility of distributing more costs as (partially) variable and thereby decision-making relevant. A comparison of the ABC, the full cost model (FC), and the margin contribution model (MC) is shown in the table below:

	ABC	FC	MC
Units	V	V	V
Series	V	V	C
Product types	V	V	C
Company	C	V	C

V	= Variable/distributed costs
C	= Capacity costs

ABC provides certain guidelines for how the distribution keys are set up, in line with activity categorization, and cost drivers (even though there still is a great difference between the specific implementations). The contribution margin model is not that specific in comparison, meaning that from a margin contribution perspective the ABC is only one way of determining distribution keys. The ABC focus on activities means that the model is suitable for cost minimizing, where the non-value creating activities are liquidated.

As ABC treats series and product level so specifically, the model becomes more long-term oriented than the margin contribution model's focus on the particular product's margin contribution. This focus makes it difficult to handle events such as replacement of product types, which are typical long-term initiatives.

The justifica-
tion of ABC

The limitations of the **margin contribution model,** concerning the fact that it only distributes the volume dependent costs, have with been criticized through the years. Increasing automation has resulted in fewer costs that vary directly with production volume, and an ever larger part of the company costs become capacity costs, applying the margin contribution terminology. As the capacity costs are considered irrelevant for decision making, the financial controlling rests on increasingly inadequate and short-term foundations in the contribution margin model.

Also, the fact that outsourcing (where the supplier insist on having his ATC covered as a minimum) is becoming increasingly popular, results in the variable costs are changing fundamentally with the choices of whether to outsource or not. Moreover, the margin contribution model does not consider that MC can be either progressive or digressive with economies or diseconomies of scale as a result, and thereby differ substantially from AVC.

Opposite the contribution margin model, the **full cost model** seeks to distribute all the company's costs onto the company's products. However, this only happens through the use of distribution keys, and so the full cost model often moves far away from an economic theory where the distribution keys can be explained objectively. Thus, when the costs are attributed to products in conjunction with which they do not vary, the profitability of the products are presented in a true and fair way. [11]

As we see, there are such essential issues at hand in the case of both the margin contribution model and the full cost model, that serious alternatives are more than welcome. ABC (activity based costing) seeks to counter some of the challenges faced by the two other models, in the process of which new problems arise. No wonder cost is a difficult issue.

Criticism of
ABC

One could easily get the impression that ABC places itself between the margin contribution model and the full cost model, effectively incorporating the best from both worlds. Critics, on the other hand, point to the fact that ABC more likely places itself in a void, and fails when it comes to financial stringency.

Essential critique:

- It is problematic to continue ABC calculations in optimization situations, because ABC includes different levels of cost objects. It is too restraining that ABC can only be used as a source of inspiration for cost minimizing etc.

- ABC is a comprehensive solution, making it quite difficult to do ad hoc analyses on single products without setting up a relatively considerable system.
- The ABC model does not incorporate considerations of measurement, variability, and reversibility, which are regarded as fundamental for financial control. [12] These factors are, for instance, central to the margin contribution model.

No universal recipe For some people, the choice of calculation method is more a question of religion or politics than a rational choice. One can hardly wonder why, when considering all the choices and limitations that are tied to the particular methods. When all essential factors are to be considered in a calculation, the problem at hand becomes so immense that at this point there are no complete solutions in model form. When choosing the calculation model, the choice also falls upon advantages and disadvantages, opportunities and limitations.

When confronting the problem, it is crucial to weigh both advantages and disadvantages of the different methods and relate them to the situation at hand. Different methods are suitable means for different ends, and a model that seem appropriate in one occasion may be useless in another. The best choice is achieved by knowing the different methods well, and at the same time, be conscious of the aims and conditions of each calculation. The choice is hard, and only few have a good understanding of all methods.

Case 2.1: DK Bodywork Parts Ltd.

DK bodywork parts Ltd. "DK bodywork parts Ltd." is a 50 year old family owned business situated outside Tønder. The company manufactures bodywork parts for both cars and trucks, and has just below 3,000 different items in its selection. DK bodywork has 70 employees, of which 10 are administrative (sales, purchasing, accounting, and diverse administration) and 60 work in production. The firm has an annual turnover of 100 million DKK, and annual fixed costs of 20 million DKK.

Working procedure on a front wing/fender In the firm's selection the item no. F127-98, a front wing/fender for a Fiat 127. The working procedure for the production is as follows:

1. Cut out the basic unit from a 1.5 x 3.2 meter galvanised metal plate.
2. Press the cut basic unit so that it takes the right shape.
3. Prime the wing/fender (degreasing, dipping in paint, and processing in oven)
4. Apply label with barcode and item number
5. Place wing/fender on a rack
6. Internal transportation from production hall to warehouse on a truck.
7. Shipment

Choice of cost calculations The firm applies different cost calculations in different decision-making situations.

- The contribution margin model is applied in cases of short term optimization, or if there is idle capacity in production.

- The ABC model is applied when the excessive costs, for example, for idle capacity are to be identified. Here, the model relates to the costs for the activities that create earnings, so that the redundant activities can be localized.

- The full cost model is applied when the company has to settle on a "minimum sales price" in regards to the long-term planning of the products.

In the following examples of the margin contribution model, the ABC model, and the full cost model are presented based item no. F127-98, i.e. a front wing/fender for a Fiat 127.

The margin contribution model

The margin contribution model for one unit of the front wing for a Fiat 127:

Direct variable costs:

- Materials, including paint, metal, labels, etc. as well as shrinkage (experienced)   21.50 DKK/unit.
- Wages for production workers, including supplement of 28% for training/education, illness, etc.   24.25 DKK/unit
- Transport of purchases, quality control of raw materials   3.30 DKK/unit
- Power for production machinery   12.00 DKK/unit

Total   **61.05 DKK/unit**

Indirect variable costs

- Safety equipment, work clothes, etc. for production workers   2.30 DKK/unit
- Repair and maintenance of production machines. Distributed using machine hours as distribution key   6.90 DKK/unit
- Control of finished goods   4.20 DKK/unit
- Re-calibration of machines   5.90 DKK/unit
- Insurance of production workers   1.25 DKK/unit

Total   **20.55 DKK/unit**

	Total costs of a single front wing/fender for a Fiat 127 according to the margin contribution model:	**81.60 DKK/unit**

The ABC model

The ABC model for a single front wing for a Fiat 127

Production unit costs:

• Materials, including paint, metal, labels, etc. and shrinkage (experienced)	21.50 DKK/unit
• Wages for production workers, including supplement of 28% for training/education, illness, etc.	24.25 DKK/unit
• Transport of purchases, quality control of raw materials	3.30 kr./unit
• Power for production machinery	12.00 DKK/unit
• Safety equipment, work clothes etc. for production workers Distributed using wages as cost driver	2.30 DKK/unit
• Insurance of production workers Distributed using wages as cost driver	1.25 DKK/unit
Total	**64.60 DKK/unit**

Production series costs:

• Control of finished goods	4.20 DKK/unit
• Re-callibration of machines	5.90 DKK/unit
Total	**10.10 DKK/unit**

Production type costs

• Development of tools for production of the front wing	**16.70 DKK/unit**

Costs for a single front wing for a Fiat 127 according to the ABC model	**91.40 DKK/unit**

The full cost model

The full cost model for a single front wing for a Fiat 127:

Direct variable costs:

• Materials, including paint, metal, labels etc. as well as shrinkage (experienced)	21.50 DKK/unit.
• Wages for production workers, including supplement of 28% for training/education, illness, etc.	24.25 DKK/unit
• Transport of purchases, quality control of raw materials	3.30 kr./unit
• Power for production machinery	12.00 DKK/unit
Total	**61.05 DKK/unit**

Indirect variable costs
- Safety equipment, work clothes, etc.
  for production workers   2.30 DKK/unit
- Repair and maintenance of production
  machines. Distributed using machine hours as
  distribution key   6.90 DKK/unit
- Control of finished goods   4.20 DKK/unit
- Re-calibration of machines   5.90 DKK/unit
- Insurance of production workers   1.25 DKK/unit

  Total   **20.55 DKK/unit**

Direct fixed costs
- Depreciations of production machinery
  Distributed by using machine hours as
  distribution key   19.75 DKK/unit
- Development of tools for production of the
  front wing   16.70 DKK/unit
- Interests in capital tied to machinery
  (opportunity costs)   1.10 DKK/unit

  Total   **37.55 DKK/unit**

Indirect fixed costs
- Administrative costs
  Distributed with turnover as distribution key   4.38 DKK/unit
- Lawyer and accountant
  Distributed with turnover as distribution key   0.80 DKK/unit
- Salary and car expenses (directors)   0.20 DKK/unit
- Operation of buildings (maintenance, property
  taxes, etc.)
  Distributed with turnover as distribution key   3.90 DKK/unit
- Interests of capital tied to buildings
  (opportunity costs)   0.20 DKK/unit

  Total   **9.48 DKK/unit**

Costs of a single front wing for a Fiat 127
according to the full cost model   **128.63 DKK/unit**

2.4 Assignments for Chapter 2

Mini-case 4.1: "The Bicycle Mosquito"

The Bicycle Mosquito is a bicycle store in Østerbro. It was established in the mid 1990s by a former professional bicycle rider. Apart from the owner, the store has 2 employees: an experienced bicycle mechanic and a second-year apprentice. The bicycle store is competing fiercely with the other bicycle stores in Copenhagen, which is why the owner focuses much on attracting customers with good offers.

One of The Bicycle Mosquito's offers is tire repairs for DKK 28 not including VAT, which results in a sales price of DKK 35 (34.95) including VAT. For a period of time now, the owner has been wondering why the competitors do not follow the low mending prices offered by The Bicycle Mosquito. Therefore, he wishes to determine whether or not the offer is profitable. To that end, the following information has been listed:

- When estimated, including all bonuses, the real hourly wage is DKK 140 for the experienced bicycle mechanic and DKK 75 for the apprentice.
- The capital tied up in the business is worth DKK 1 million.
- A chain of bicycle stores establishing itself in Denmark is ready to buy The Bicycle Mosquito for DKK 2 million.
- The annual rent is DKK 60,000 - The rent can be divided between the sales/show room (DKK 40,000) and the workshop (DKK 20,000)
- The owner has been offered a job as sports journalist for Ekstrabladet, with an annual salary of DKK 200,000 if he sells the bicycle store.

demands for versatile working conditions stipulated by apprentice legisla-
tion, the apprentice is not allowed to handle all the mending repairs, even
though that would the cheaper alternative. Therefore they have to take
turns doing the repairs.

- In connection with each mending, a schematic is filled out, a note to be
  fixed to the bike, a bill is to be written, etc. all of which take about 6 min-
  utes.
- The costs of the mending, glue, power etc. equals DKK 2 per mending.
- Last year 6,000 mending repairs were carried out, contributing with 15%
  of the total turnover of the workshop.
- Maintenance of tools etc. caused by wear and tear reached DKK 30,000
  last year.
- The owner can invest surplus capital at 5% annually.

Case assignment 4.1:
Make a calculation using both the margin contribution model and the full cost
model. The calculations are to be made with the purpose of helping the owner to
assess the profitability of the offer.

Case assignment 4.2:
Discuss the applicability of the two calculations regarding the assessment of the
offer.

Case assignment 4.3:
Which other circumstances than those related to the costs/turnover of the mending
repairs could influence whether the offer is profitable or not?

Question 4.1 List the most frequent decision-making situations for a pizzeria, where the pizzeria
should apply calculations – and assign a useful calculation model to each of the
situations.

Question 4.2 List a number of examples of distribution keys, which could be relevant for Har-
boe concerning the production of Harboe Pilsner.

Question 4.3 How are time horizons included in the models?

Question 4.4 Which calculation model is typically the basis of MC functions and why?
Why are MC functions so hard to define in reality?

3. Guiding solutions for chapter 2

<div style="float:left">Case assignment 4.1</div>

The contribution margin model for a single bicycle mending operation:

Direct variable costs:

- The apprentice's wage per mending = DKK 75 per hour / 6 mending repairss per hour = **DKK 12.5**
  The mechanic's wage per mending = DKK 140 per hour / 10 mends per hour = **DKK 14**
- It is not known who receives the customer and thereby uses 6 minutes per mending. Therefore it is assumed that they take turns at this too. Assuming this the average wage for reception etc. => (DKK 75 per hour + DKK 140 per hour) / 2 = DKK 107.5 per hour = 107.50. As it takes 6 minutes per reception the costs of wage per reception etc. = DKK 107.50 per hour / 10 receptions per hour = **DKK 10.75.**
- Costs of patch, glue, power, etc. per mending is = **DKK 2**

- The direct variable costs per mending, if the mending is carried out by the apprentice = DKK 12.50 + DKK 10.75 + DKK 2 = ***DKK 25.25***
- The direct variable costs per mending, if the mending is carried out by the mechanic = DKK 14 + DKK 10.75 + DKK 2 = ***DKK 26.75***

The indirect variable costs:

- In connection to each mending operation, the tools are worn to some degree. This wear and tear cannot be attributed to the single task in the workshop, why a distribution key must be applied. The distribution key in this case is the share in turnover. As 15% of the turnover are created by mending operations, 15% of the workshop maintenance is attributed to the mending as well. In this way DKK 30,000 x 0.15 = DKK 4.500 is attributed to the mends. Subsequently these costs are divided on to the number of mending operations carried out the year before. This yields an indirect variable cost of = DKK 4,500 / 6,000 mends = **DKK 0.75**

- Indirect variable costs per mend = ***DKK 0.75***

Costs for a single mending using the contribution margin model are, if carried out by the apprentice = DKK 25.25 + DKK 0.75 = ***DKK 26***

Costs for a single mending using the contribution margin model are, if carried out by the mechanic = DKK 26.75 + DKK 0.75 = ***DKK 27.50***

The full cost model for a single bicycle mending operation:

As estimated by using the contribution margin model, the total variable costs per mending, if carried out by the apprentice = DKK 26, and 27.50 if carried out by the experienced bicycle mechanic.

The direct fixed costs:

- The rent for the workshop, which is a relevant part of the building, is distributed using the turnover as distribution key. In this way DKK 20,000 x 0.15 = DKK 3,000 are attributed to the mending operations per year. Subsequently this cost is divided on to the number of mending operations carried out last year. These yields a fixed cost per mending operation of DKK 3,000 / 6,000 mending operations = **DKK 0.50**

- The direct fixed costs per mending operation = ***DKK 0.50***

Indirect fixed costs:

- The rent for the sales and show room, which is a non-attributable location, can be distributed by using the share of turnover of 15%. This yields a total cost of DKK 40,000 x 0.15 = DKK 6,000 a year. This cost is distributed on the number of mends last year, yielding an indirect fixed cost per mend of DKK 6,000 / 6,000 mends = **DKK 1**
- The bicycle shop and the assets could be sold which would release capital worth DKK 2 mill. + DKK 1 mill. = DKK 3 mill. The released capital could be invested at 5% a year, which results in an opportunity cost of operating the shop of DKK 3 mill. x 0.05 = DKK 150,000 a year. This opportunity cost is distributed on to the mends using the share of turnover of 15% as distribution key. This results in a total cost of DKK 150,000 x 0.15 = DKK 22,500 for mends per year. These costs are distributed to the number of mends last year, which yields an indirect fixed cost per mend of DKK 22,500 / 6,000 mends = **DKK 3.75**

- The owner could earn DKK 200,000 annually by accepting another job, which likewise represents an opportunity cost. This opportunity cost can be distributed by using the share of turnover of 15% as a distribution key. This yields a total opportunity cost of 200,000 x 0.15 = DKK 30,000 for mends per year. This cost is subsequently divided on to the number of mends per year, yielding an indirect fixed cost per mend of DKK 30,000 / 6,000 mends = **DKK 5**

- Indirect fixed costs per mend = DKK 1 + DKK 3.75 + DKK 5 = ***DKK 9.75***

By using the full cost model, the costs of a single bicycle mending operation is, if carried out by the apprentice = DKK 26 + DKK 9.75 = ***DKK 35.75***

By using the full cost model, the costs of a single bicycle mending operation is, if carried out by the experienced mechanic = DKK 27.50 + DKK 9.75 = ***DKK 37.25***

Case assignment 4.2   If the owner wishes to continue the operation of the store, and thereby just wants to assess whether or not the price of mending is to be raised, the contribution cost model is the most suitable. This owes to the owner in this situation just considers one activity that has no effect on the fixed costs.

On the other hand, if the owner considers to sell the store, and thereby wishes to assess whether or not the mends are profitable from a comprehensive point of view, then the full cost model may be more suitable. This owes to the owner in this circumstance has to include the fixed costs, as these are to be defrayed if operations are to be continued.

Case assignment 4.3   Besides the costs/turnover of the mends, the following consditions should be considered:
- The cheap mends' derived effects. When the customer has first entered the store, the employees are often capable of convincing him of changing tires and inner tubes instead of having it mended. Moreover it is possible to sell other bicycle equipment, and once in a while maybe a brand new bicycle.
- The customer reactions on changes in price of mends, including price elasticity.
- What tasks the apprentice and the bicycle mechanic could carry out in liberated working time.

Question 4.1   **Frequent decision situations for a pizzeria:**

1. How much should a pizza slice cost? Here could one distinguish between next week's price and the minimum sales price. Under both circumstances the pizzeria should know the costs of producing one pizza slice. Concerning next week's price, the contribution margin model would be suitable. If it is about the minimum sales price, then the full cost model will be more appropriate, as all costs in the long term are to be covered by the turnover.

2. How much should a special version cost? In this case it is relevant to know the extra costs of putting extra stuffing on the pizza. As this does not affect the fixed costs, such as rent, depreciations, etc. it only affects the variable costs. Therefore the contribution margin model is suitable.

3. Should the pizzeria make the pizza dough itself, or should they outsource

it to the local baker's? In this case the pizzeria should know all the costs connected to the production of pizza dough. In this case the ABC model should be applied as it focuses on the costs that would possibly be eliminated by outsourcing.

4. Should the pizzeria be open Thursday, Friday and Saturday night because of the active night life in the city? Here the pizzeria should know all the extra costs of this initiative. The fixed costs og rent, depreciations, etc. are defrayed under all circumstances. Therefore this change concerns the variable costs only, and as such the contribution margin model is most suitable. However is should be mentioned that the increased exploitation of capacity will pull the average costs downward from a full cost point of view, while the night bonus will pull the costs upward.

Question 4.2   Examples of distribution keys that could be relevant for Harboe in relation to calculations of production of Harboe pilsners:
- Size of the area of relevant building sections compared to the total production area.
- Turnover of Harboe Pilsner in relation to total turnover.
- Number of employees exclusively working with Harboe Pilsners, in relation to the total number of employees. Here you could distinguish between white-collar and blue-collar.
- Production of Harboe Pilsners measures in units compared to the total production.

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Question 4.3   The time horizon is included in calculations relating to the division of costs into fixed and variable. In the short-term the company employs the existing facilities – and has thereby a number of fixed costs in relation to this. In the long-term the company can adjust the facilities in relation to the production and new technology, why more costs are considered variable.

Question 4.4   As the MC function expresses the costs of producing one unit more, only the variable costs should be included in this. Therefore the contribution margin model is typically the basis of the MC function. This owes to the ABC model and the full cost model both operate with distribution of fixed costs.

The MC functions are hard to define in reality because of the following points (not exhaustive):
- It is difficult to assess the draw on resources when producing a single unit more, e.g. which unit triggers the additional costs of wage bonuses and administration, etc.
- The costs of producing one unit more depends on a number of factors that are difficultly established in advance, e.g. the fluctuating worker efficiency during the day.
- It is difficult to establish mathematical functions in real businesses because of the lack of full information, and unambiguous connections between the quantity produced and the costs, the continuity of production, etc.