Summaries modules 1 and 2

International Business Administration

Study Association Stress
RAVELIJN BUILDING | RA1336

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Stress

Stress is the study association for Business Administration (BA), International Business Administration (IBA) and Industrial Engineering and Management (IEM) of the University of Twente. Stress was founded on May 21st, 1974. Currently, Stress has over 2100 members and is the largest UT (study) association. Stress organizes various activities to support, expand and complement all of its studies. Stress has five principles, which will greatly enhance your time as a student: Study, Meet, Practice, Develop and International. Following these, several activities are organized by the roughly 120 active members, and are partially made possible thanks to the sponsorship and participation of various companies. Moreover, we have regular contact with other business and management study associations across the Netherlands.

Education

As a study association, Stress represents its members towards the faculty. Therefore we have a Commissioner of Educational Affairs who, with help of the Education Committee, deals with everything concerning your education. From collecting summaries to handling complaints to organizing educational events. If you have any questions concerning your study, the teachers, the faculty or anything else, feel free to ask the Commissioner of Educational affairs!

Education Committee

The committee consists of representatives of every cohort. The representative of the freshmen will be introduced during the first module. This committee is aimed at forming the bridge between teachers and students and therefore, improving the quality of the study. They keep the summary database on the Stress site up to date, organise study evenings and try to keep an eye out for the quality of our education. When there are complaints from the students concerning education, about one of the courses of one of our studies for example, they will be handled by this committee.

Summaries

Next to handling complaints, we also collect and check summaries of all the courses you follow! So it does not matter if the course is in the first, fifth or eighth module, you can send your summary in and we will check if your summary will make a good addition to our collection. To hand in your summary, simply send the file to ec@stress.utwente.nl. The Education Committee will then check the summary and if it is found to be sufficient, you will be compensated for your efforts. If your summary is the first one of a course, you will receive €15. If it is the second one, €10, and for the third one you will get €5. If you think you have made a better summary than the ones online, you can also send yours in and earn €5,-. Our summary collection can be found at the bottom of the 'study' page on www.stress.utwente.nl.

Panel Meetings

The panel meetings are organised in every module to improve the education. Here, the teachers of the module together with some students discuss the module. The students are able to give their opinion about the module and what they would like to see improved. The teachers can also ask questions about the opinions of the students. This way teachers know what went right in a module and what went wrong so they can improve the module for next year. The panel meetings are for all the students which are taking the module. You can also join the feedback panel. This means that you join a group of student who attends the panel meeting each module and gives valuable feedback to the programme.

Study sessions

For some courses, Stress organises study sessions. During these afternoons or evenings one or two student assistants of the course will be present. The study sessions are free to attend and coffee, tea and snacks are provided for you by Stress. If you think a study session will be valuable for a course you are following, please contact the Commissioner of Educational Affairs or the Education Committee. They will check if there is more demand for a study evening for this course and act accordingly.

Complaints

If you have a complaint, you can submit it at the 'Study' page on www.stress.utwente.nl or talk to someone of the Education Committee. However, if you feel it is a really important complaint or you want to explain it personally, you can come to the Stress room and talk to the Commissioner of Educational Affairs or send an email. We will then contact the programme management team and discuss what actions can be taken. They value bundled complaints greatly because it tells them a lot more when multiple people have the same complaint, this is the most important reason to always voice your opinion.

Ordering Books

For the first module, you can order your books during the Kick-In. For the following modules, you will have to order them by yourself. You can do this online, at our website. The only requirement to order the books is that you are a member of Stress.

To order books online you have to go to the 'Study' page on www.stress.utwente.nl. On the left of the screen you find a header: 'BOOKSALE', and below the option: 'Order your books'; select this option. Next, you can use the dropdown menus to select your study and module. Once you have chosen the correct options, press 'To booklist'. After this, you can select all the books you would like to order, and then proceed to 'Checkout. After paying, the books will be shipped to the address you enter.

For any questions about the books you need, the ordering of the books or anything else book-related, you can send an email to books@stress.utwente.nl.

Tutor platform

If you are having trouble studying for a course, we have the tutor platform to provide you with the right student for your struggles. We have a wide variety of students who have gone before you and who are willing to help you out for a small compensation. Send an email to tutor@stress.utwente.nl and mention your study, study-year, course you need help with, how many hours you need and any requirements you might have for the tutor. The payment of the tutor can be negotiated but keep in mind that students get paid €10 to €15 by the university when working as a teaching assistant, and you have to pay for it yourself.

The other way around, we are always looking for new tutors. If you are interested in joining our tutor pool let us know. We will add you to the WhatsApp group and you can reply to students asking for tutoring.

HELP!

Often, students do not know where to go with any problems, either study-related or personal. Here you find some information about the most common places to find help.

Study advisor

The study advisor is not only there to answer all your questions about your study, but also there to help you with any personal conditions or other issues that might affect you or your study progress. If you have any problem at all, go see your study advisor. Even if they are not the person who can help you, they can send you to someone who can. Every talk with the study advisor is confidential and she will always do her best to help you. You can make an appointment with the study advisor on www.bms.planner.utwente.nl. The study advisors for IBA are Lena Balci-Ay and Eline de Ruiter. The office of Lena is RA3248 and the office of Eline is RA3276. Their emails are l.balci-ay@utwente.nl and e.j.deruiter@utwente.nl.

Red desk / Student Affairs Coaching & Counselling

If your study and personal life are all on track, this bit of information might not be really relevant for you. But if it is not the case, when your study is completely going the wrong way, or you find it hard to adapt to living away from your parents or you have a difficult situation back at home, the Student Affairs Coaching & Counselling, also called the 'Red Desk', is the place where they can help you. Every possible question about study or personal issues will be answered here, or you will be forwarded to a trained professional. The Red Desk can be contacted at sacc@utwente.nl and is located in the Vrijhof (building 47), third floor, room 311.

Become active at Stress!

Next to your study, you can become an active member of our association! Stress offers many different committees which have organisational tasks or supporting tasks. On our website, you can check out all the committees from Stress. To find out which committee suits you best, email the Commissioner of Internal Affairs at internal@stress.utwente.nl.

Member Initiative

Have you always wanted to organize something big, but never had the resources? We appreciate initiatives from our members! So, if you have a clever idea for something within Stress or the committees, please contact us and we can see what is possible.

More information about Stress

Do you want to know more about Stress? Or do you want to check out our website and social media? Make sure to scan the QR code:

Module 1: Technology, Organisation and People

Module code: 202000550

! Disclaimer: always check what you need to study corresponds with the content of the summaries, courses can be changed which could cause changes in study material for your exams

This module consists of two courses and a project. Both courses have two tests during the module, so we have split the summaries into two parts. Below you find information about which courses you have this module, and about the summaries for this module. If you made a summary for a course this module you can sent them to education@stress.utwente.nl and depending on how many summaries we have for this course you will receive compensation for your work.

Courses

- Research Methods
- Organisation Theory
- Analysing Organisations in Practice (Project)

Summary 1

Course: Research Methods*
Book: Babbie, E. (2012). *The Practice of Social Research.* 15th edition, Cengage Learning.
Chapters: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
Year the summary was received: 2022

Summary 2

Course: Organisation Theory *
Book: Robbins, S.P. & N. Barnwell, *Organisation Theory: Concepts and Cases*, 5th edition, Pearson Education.
Chapters: 1, 2, 3, 4, 5, 6, 7, 8
Year the summary was received: 2021

* There is another summary available on www.stress.utwente.nl

Summary 1: Research Methods

Notes from video lectures and book (The Practice of Social Research 15th edition) 2022

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Topic 1 – What is empirical research?

Henk van der Kolk (2016) short paper summary:

Six phases in decision making

1. Identify, describe and analyze a problem or opportunity – **problem definition and analysis**
2. Develop options/design options – **design**
3. Compare options, using criteria – **multi-criteria analysis, ex ante evaluation**
4. select a preferred alternative on the basis of this evaluation – **decision-making rules**
5. act on the decision/implement the decision **– implementation**
6. monitor and evaluate the consequences – **ex post evaluation**

by reflection on the six phases, it is easier to see what the limitations of your choice are. By careful analysis in all phases, you can more easily defend the choices you have made

Empirical questions – questions that can only be answered by observation.

Decision- making and doing empirical research are closely connected activities, although decision-making is often done without a lot of research and a lot of research is done without the explicit intention to use it as part of decision-making. Doing research in the context of decision-making (applied research → using existing knowledge, such as theories and methods to better understand a particular case or problem, but not always, new theories etc. may arise) Research is about systematically answering questions. If often starts with a question, a preliminary answer, a research design, operationalization, data analysis and drawing conclusions.

Research is an inherent part of decision-making. It can be both 'quick and dirty' and 'systematically, taking years to answers, because consequences are terrible' BOTH ARE EMPIRICAL RESEARCH. Allows connect options to criteria. It gives clues about the extent to

which the option will give what you want. Decision-making and doing research are not alternative courses of action: you do both at the same time.

Problem – what is or will be in the foreseeable future & what is desired or what ought to be the case

Book (The Practice of Social Research 15th edition)

Reality, how can you really know what's real?
Agreement reality – accept the reality of things they don't personally experience

epistemology – science of knowing
methodology – subfield of epistemology, science of finding out

variables – logical sets of attributes, the variable sex is made of up the attributes male and female
attributes – characteristics or qualities of people or things

Relationship between two variables is causal relationship – presumed cause is the independent variable, and the affected variable is the dependent variable. 3 major purposes of social research: *exploration, description, explanation*

Independent variable – a variable with values that are not problematic in an analysis, but are taken as simply given. An independent variable is presumed to cause or determine a dependent variable.
Dependent variable – a variable assumed to depend on or be caused by another (independent variable).

Idiographic explanation – type of causal reasoning, an approach to explanation in which we seek to exhaust the idiosyncratic causes of a particular condition or event, present specific cases fully
Nomothetic – an approach to explanation in which we seek to identify a few causal factors that generally impact a class of conditions or events. Imagine the two or three factors that determine which colleges students choose, generalized understanding of many cases
Induction – logical model in which general principles are developed from specific observations
Deduction – logical model in which specific expectations of hypotheses are developed on the basis of general principles.

Tolerance for ambiguity – the ability to hold conflicting ideas in your mind simultaneously without denying or dismissing any of them. (Important ability in the world of social research)

Quantification – makes our observations more explicit, make it easier to aggregate, compare and summarize data, opens the possibility of statistical analyses

Qualitative data – nonnumerical data
Quantitative data – numerical data

Both types of data are useful for different research purposes. Every observation is qualitative at the outset, whether it is our experience of someone's intelligence, the location of a pointer on a measuring scale, or a check mark entered in a questionnaire.

Video Lectures

"Doing empirical research" – systematically answering empirical questions using observations
Systematically: excluding the possibility that other answers are better than the answer we give
Observations: about things we can observe by using our senses
Empirical: about things we can observe

Procedure of empirical research question (clear thinking & observing) to knowledge/answer:

1. thinking; theory
2. planning; research design
3. observing; data collection
4. analyzing; data analysis

Wheel of science:

1. question
2. theory
3. research design
4. data collection
5. data analysis
6. answers/ knowledge

Wheel of science – not a logistical sequence of steps, a way to defend conclusions; logic.

Empirical research questions are often asked in **the context of decision-making** and design, 'how to', can only be answered using observations,

<u>Decision making process:</u>

1. problem & need analysis – how big is the problem? what are its causes?
2. find & design options – which option have been used by others?
3. ex ante options evaluation – can we expect the option to work?
4. choice
5. implementation – did we do as planned? *(process evaluation)*
6. ex post choice evaluation – did the selected option have the expected outcome? *(outcome evaluation)*

All these questions are <u>empirical questions</u>, that can be descriptive or explanatory:

a. **Explanatory (causal) –** why do some people start smoking? what are consequences? did out policy reduce smoking? *(outcome evaluation)*
b. **Descriptive –** how many people smoke? which policies have been used thus far to reduce smoking? did tobacco companies do what they promised to do? *(process evaluation)*

Confirmation bias = myside bias = cherry picking → search for, analyze and recall information in a way that confirms preexisting beliefs, while giving disproportionately less consideration to alternative interpretations, affects what we think is true extreme case: conspiracy theories

3 types of confirmation bias
Information → reasoning → conclusions *(bias in remembering)*
Examples: psychology: halo and horn effects

Why is confirmation bias so strong?

- **Limitations** in humans, relying on 'heuristics'
- **Wishful thinking**
- **Consistency** (between initial evidence and new evidence)

Consequences:

- Mistakes in knowledge
- Bad decisions

Avoiding by:

- Systematic data gathering, being aware of what can go wrong - Explicit and complete reasoning
    1. Clarify your pre-existing beliefs *(theory)*
    2. Clarify the procedures you will use to test these beliefs *(methods)*
    3. Stick to these procedures!

Normative questions: Should we allow euthanasia for demented people? To what extent should we reduce the autonomy… ?
Conceptual questions: What is democracy? What is intellectual efficiency?
Predictive questions – We are not looking for causes, not causal, but also not simply descriptive.

Where do empirical questions come from?

A. Curiosity
B. Science (follow up existing theories and puzzles, if this is true, maybe that is true too)
C. Decision making (try to solve problems) – 'how to' questions can be broken up into descriptive and explanatory (causal) research questions.

After this unit, you will be able to...
explain what is meant with empirical research and which steps can be taken according to the wheel of science;
differentiate between induction and deduction;

recognize and explain the steps that can be taken in the decision making process; explain the relationship between systematic decision making and systematically answering empirical questions;
formulate a relevant research question in the context of a specific phase in a decision making process;
recognize and mention examples of confirmation bias; explain how systematic empirical research helps avoiding the confirmation bias.

Key terms:
Research question
Design and (cycle of) decision-making
Problem & need analysis
Ex ante evaluation
Process evaluation
Ex post evaluation (effect / impact research)
Wheel of science / empirical cycle
Deduction
Induction
Confirmation bias

Topic 2 – What are clear research questions?

Video Lectures

Formulating clear empirical research questions by clarifying the units of analysis and the variables.
Example of clear empirical research question: Does the level of integration in society affect the amount of criminal behavior among young people (in Western societies)?
Units: young people; variables: the level of integration & criminal behavior
~~Unclear: What is the effect of the police on the amount of crime? Does the concept intercultural policing explain the level of crime in Dutch cities?~~

Units of analysis – objects the research question is about, people, countries, identifying variables: if unit is known, ask 'what characteristic does the unit have? → variable
Variables – possible characteristics (attributes) of these units, identifying units: if variable is known, ask 'what or who is characterized by this variable? → unit

Different types of research questions:

1. normative – what should be the case, should we, is it justifiable, not asking for legal facts, cannot be answered using observation only (Is the introduction of the death penalty acceptable?)
2. conceptual – what does it mean, what is, cannot be answered using observations, often just based on agreement (what do we mean with death penalty?)
3. empirical (FULLY ANSWERED USING OBSERVATION):

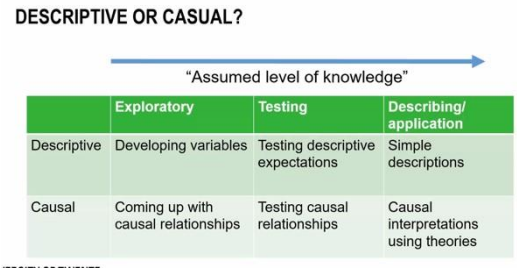
a. descriptive – about description (Which countries still have the death penalty? How many people were legally executed between 2000 and 2012 in the US?)
b. explanatory – about causes and effects (Does the introduction of the death penalty lead to a reduction of crime? Why did some countries abolish the death penalty, while other countries still have it?) Many explanatory questions have <u>two</u> variables, however not all questions with two variables are causal:

- ex. Do countries with a large Muslim population more frequently have the death penalty than countries with other religious majorities? It is descriptive question)
- Why did some countries abolish the death penalty, while other countries still have it? (explanatory with 1 variable)

Good research question:

1. <u>Context</u> – will your answers be relevant for theory or for practical problems?
   a. Practical problems, political problems, social problems (in Problem & need analysis: How big is the problem? What are its causes and consequences? In Find & design options: Which options have been used by other? In Implementation: Did we do as planned?)
   b. Theoretical questions, puzzles, existing research (A more general or new question? A better theory? Better/more data? Better technique for analyzing the data?

2. <u>Causal or not</u>? – describe or explain
   a. Description → descriptive questions
   b. Causes and effects → explanatory or causal questions



3. <u>Variable/units/setting</u> – UTOS scheme – ex. Does the level of integration in society affect the amount of criminal behavior among young people (in Western societies)? a. Units (of analysis)
   b. Variables (treatments and observations) -in most cases there are two variables
   c. Setting (time and place)

4. <u>Answerable?</u>
   a. Have preliminary answers been developed/tested?

After this unit, you will be able to... *identify units, variables (with their attributes / values) and settings in clearly formulated descriptive and explanatory empirical research question;*
distinguish empirical questions from normative questions and from questions about concepts; differentiate between explanatory empirical questions from descriptive empirical questions. ***Key terms:***
Research question
Normative
Conceptual
Empirical
Explanatory
Descriptive
Unit (of analysis)
Variable (attributes / values)
Setting

Topic 3 – What are data?

Book

Ecological fallacy – erroneously basing conclusions about individuals solely on the observation of groups OR drawing conclusions about lower level units (ex. Individuals) solely on the basis of aggregate data (ex. Regions) is not necessarily correct.

All variables are different. All variables are composed of attributes, but attributes of a given variable can have a variety of different relationships to one another.
Variables are used to describe units.
Ex. Age (of a human being) has attributes or values between 0 and 120.

Variable → a complete and mutually exclusive set of attributes/values:

- Complete – if the variable applies to a unit, a unit is always characterized by one of its attributes/values (What is the age of John?)
- Mutually exclusive – similar, if a variable applies to a unit, it is characterized by only one of its attributes/values. (Is Mary rich or nice? – attributes not mutually exclusive, can be both. Is John male or female? *(Mutually exclusive)*

Attributes or values?
The words 'values' and 'attributes' refer to the same thing, however:

1. ***'values'*** is more often used to refer to 'numerical' attributes *(age or weight)*
2. '***attributes'*** is more often used to refer to 'non-numerical' attributes *(colors, religions)*

Levels of Measurement:

A. **Dichotomy/ Dummy – two attributes only** (legally married? Yes/no)
B. **Nominal Measures** – a variable whose attributes have only the characteristics of exhaustiveness and mutual exclusiveness – in other words, a level of measurement describing a variable that has attributes that are merely different, as distinguished from

ordinal, interval or ratio measures. Ex. Gender, state of birthplace, we can say about two people that they are either the same or different. **=** [1] **(Jan and Andy earn different amounts)**

C. **Ordinal measures –** a level of measurement describing a variable with attributes we can logically rank-order along some dimension. Represent relatively more or less of the variable Ex. Socioeconomic status, composed of the attributes high, medium, low. Ex. Ranking in a running contest of long distance runners (we do not say anything about the times). In addition to saying whether two people are the same or different in terms of ordinal variable, we can also say one is more than the other, more conservative, more religious, older, and so forth. In physical sciences: hardness of materials, we do not say how hard in absolute terms, we can only say how hard in relative terms, which materials it is harder than and which softer than, distance is not known. **> < (Jan earns more than Andy)**

D. **Interval measures** – a level of measurement describing a variable whose attributes are rank-ordered and have equal distances between adjacent attributes. Ex. Fahrenheit temperature scale, because distance between 17 and 18 is the same as that between 89 and 90. When comparing two people in terms of an internal variable, we can say they are different from one another (nominal), and that one is more than another (ordinal). In addition, we can say "how much" more in terms of the scores themselves. We cannot say twice as much! **+ - (Jan ears $40,000 more than Andy)**

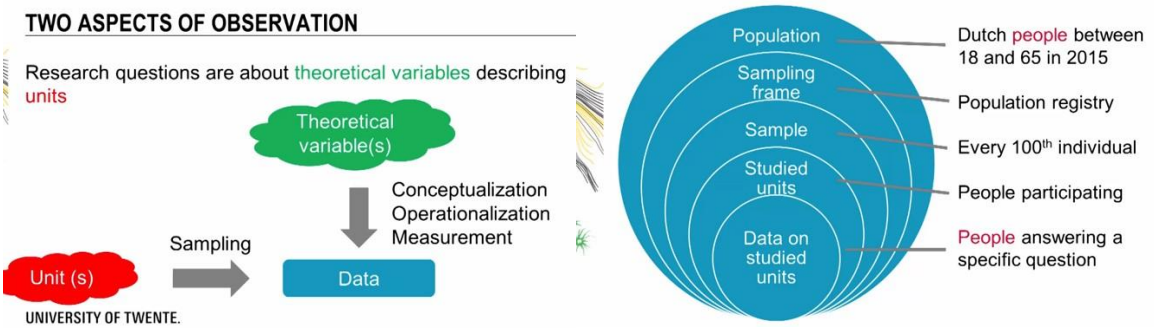
E. **Ratio measures –** a level of measurement describing a variable with attributes that have all the qualities of nominal, ordinal, and interval measures and in addition are based on a true zero point. Ex. Age, length of residence in a given place, number of organizations belonged to, number of times attending religious services during a particular period, number of times married, and number of Arab friends. **% * (Jan earns twice as much as Andy)**

Video Lectures

To understand ecological fallacy. **UoA** and **UoO** are often of the same "type" (people).

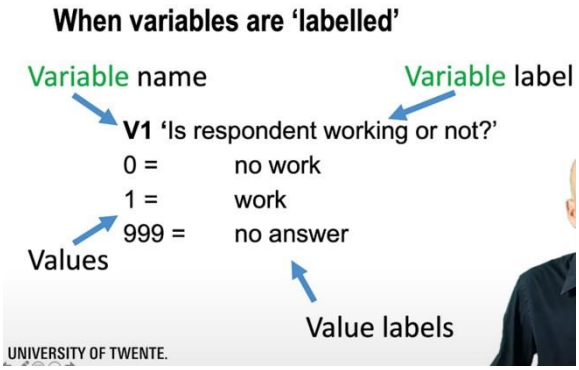
Ex. Municipalities (units of analysis) as observed by council clerks (units of observation). Diversity of musical tastes of married couples (units of analysis), but individual partner is unit of observation.

Units of analysis – units we are interested in
Units of observation – units we get data from



Data matrix – all data that you collected
Codebook – describes the meaning of variables and values used in the data matrix:

1. Sampling procedure
2. Way the data were cleaner
3. Materials used when asking a question 4. Etc. etc.



Values or attributes?
Example:

- Gender – attributes (nominal, dichotomous)
- Age – many values

(A variable has at least 2 values/attributes)

Variables: exhaustive and mutually exclusive
Rule 1. Every unit should have a value of the variable (exhaustive (=complete) set of categories)
Rule 2: Every unit should have only ONE value of a variable (mutually exclusive categories)

After this unit, you will be able to...
recognize the units of analysis and the units of observation in a study;
tell how mixing up units of analysis and units of observation may sometimes lead to the ecological fallacy;
identify variables with their attributes / values used in a study;
determine if the attributes / values of a variable are complete (a.k.a. exhaustive) and mutually exclusive;
differentiate between different levels of measurement; explain what a data matrix looks like.
Key terms:
Unit(s) of analysis

Unit(s) of observation
Ecological fallacy
Variable (attributes / values)
Mutually exclusive
Exhaustive / Complete
Dichotomy (dummy variable)
Nominal measure
Interval measure
Ordinal measure
Ratio measure

Topic 5 – Sampling

Book

Non-probability sampling – any technique in which samples are selected in some way not suggested by probability theory. Examples include reliance on available subjects as well as purposive (judgmental), snowball and quota sampling.

1. **Purposive sampling** – a type of nonprobability sampling in which the units to be observed are selected on the basis of the researcher's judgment about which ones will be the most useful or representative.
2. **Snowball sampling** – often employed in field research, whereby each person interviewed may be asked to suggest additional people for interviewing.
3. **Quota sampling** – units are selected for a sample on the basis of prespecified characteristics, so that the total sample will have the same distribution of characteristics assumed to exist in the population being studied

Informant – someone who is well versed in the social phenomenon that you wish to study and who is willing to tell you what he or she knows about it. Not to be confused with a respondent.

Probability sampling – the general term for samples selected in accordance with probability theory, typically involving some random-selection mechanism. Specific types of probability sampling include EPSEM, PPS, simple random sampling and systematic sampling.
- EPSEM (Equal Probability of Selection Method) – a sample design in which each member of a population has the same chance of being selected for the sample

Element – that unit of which a population is composed and that is selected for a sample.
Elements are distinguished from units of analysis, which are used in data analysis
Population – the theoretically specified aggregation of the elements in a study
Study population – the aggregation of elements from which a sample is actually selected

Random selection – a sampling method in which each element has an equal chance of being selected independently of any other event in the selection process.
Sampling unit – that element or set of elements considered for selection in some stage of sampling
Parameter – the summary description of a given variable in a population

Representativeness – the quality of a sample of having the same distribution of characteristics as the population from which it was selected. By implication, descriptions and explanations derived from an analysis of the sample may be assumed to represent similar ones in the population. Representativeness is enhanced by probability sampling and provides for generalizability and the use of inferential statistics.

Simple random sampling – a type of probability sampling in which the units composing a population are assigned numbers. A set of random numbers is then generated, and the units having those numbers are included in the sample
Systematic sampling – a type of probability sampling in which every (number) unit in a list is selected in the sample

Video Lectures

When sampling? If not all units mentioned in our research question can be studied, we need to sample. Studying a smaller set of units with the aim to say something about all units.

Sampling process:
Population → Sampling frame → Sample → Interviewed sample → Data

The relationship between sampling frame and sample is called *sampling*. Might be disturbed by sampling error & bias.
Between *population and sampling frame* there might be *registration errors* (list is incomplete)
The relationship between *sample and interviewed sample* is *change/disturbed in non-response and refusals*. (Nonresponse bias)

Response rate = interviewed sample size/sample size (we want high response rate) The relationship between interviewed sample and data is disturbed because of item nonresponse, sensitive questions are not answered by everyone.

Non-probability sampling:

1. Convenience
2. Purposive
3. Snowball sampling
4. Quota

Ex. Opt-in survey of some newspaper – selected units do not necessarily reflect the population.
The sample is probably biased. Sample size relatively unimportant
You want to develop a new concept. The population is unknown/sampling frame is not available, you can study only a very small number of units. Non-probability sampling does not allow for generalizations to a larger populations of units, however it enables the construction of variables *(empirical conceptualization)* to be used in research, or the construction of theories *(exploratory research*).
Example: interview a few recent immigrants you happen to know: **convenience sampling.** You can even ask whether these people know other recent immigrants: **snowball sampling.** Outcome of this research: a 'list of problems' recent immigrants may encounter.

Probability sampling

1. Simple
2. Stratified random sample – divide the population in separate groups, which you call strata, i.e. various universities in London. Every university is represented by a box and you put the pieces of paper with the names of the students in the box of the university where they are registered. Next you select a simple random sample of pieces of paper from each box. All these pieces of paper together form your sample. An advantage of this method is that you make sure that you have enough subjects from every stratum in your sample. Disadvantage is that you need a sampling frame and that you need to know to which stratum each respondent belongs.
3. (Multi-stage) cluster sampling – identify a large number of clusters within your population, i.e. the various educational programs in London in which the students are enrolled, imagine every program is represented by a bucket and you put the pieces of paper with the names of students in the buckets of the programs in which they are enrolled, next you randomly pick a number of buckets, say 10 then you select all pieces of paper within these buckets, that's your sample. Good choice if you do not have a good sampling frame or if drawing a simple random sample would be very expensive.

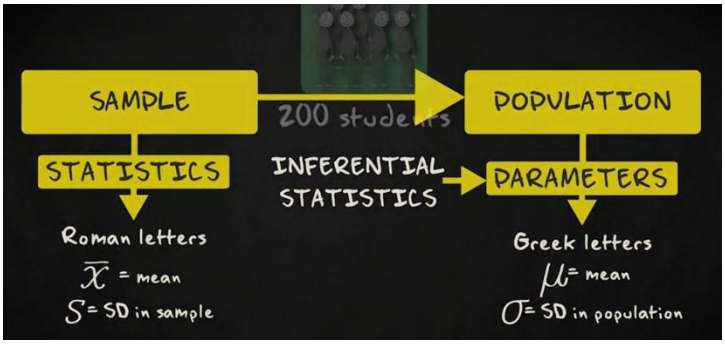
Ex. Simple random sample from the population registry. Selected units reflect the population
No bias. Sample size affects sampling error

We always make sampling mistakes! Two types:

1. **Sampling bias (sampling invalidity**) – not being typical for the population. Studying the wrong group of people. Not every person is equally likely to be included in the sample (convenience sample-approaching people on the street). Ex. 'how many people in the Netherlands currently support the EU?' and you use snowball sampling, interviewing only friends, friends' friends.
2. **Sampling error (sampling unreliability)** – a consequence of sample size and characteristics of the population, compare sample size 5 and sample size 400!

Univariate analyses – compute modes, means, standard deviation
Bivariate analyse – compute Pearson'r R, regression analyses
All numerical summaries resulting from these computations are fully based on your sample and are called statistics.

The methods for summarizing sample data are called **descriptive statistics.**



Inferential statistics refers to methods used to draw conclusions about a population based on data coming from a sample.
For inferential statistics not every sample is appropriate. What you want is a representative sample. So, draw a simple random sample, each subject has the same chance of being selected.

Because of possible bias (undercoverage, sampling bias, nonresponse bias) the estimation will be biased due to systematic under- or over- representation of certain group! **Response bias** – systematic misrepresentation of responses

After this unit, you will be able to... *differentiate between non-probability sampling and probability sampling; give examples of sampling methods;*
explain the relationship between the population, sampling frame, and sample for probability sampling;
explain the consequences of sampling error, sampling bias, and non-response; compute the response rate.

Key terms: *Population*
Sampling frame
Non-probability sampling
Probability sampling
Simple random sampling
Representativeness/representative sample
Sampling error
Sampling bias
Non-response
Response rate

Topic 6 – Conceptualizing constructs

Book

Concept – a family of conceptions, such as "chair", representing the whole class of actual chairs
Direct observables – physical characteristics (sex, height, skin, color) of a person being observed and/or interviewed
Indirect observables – characteristics of a person as indicated by answers given in a selfadministered questionnaire
Constructs – level of alienation, as measured by a scale that is created by combining several direct and/or indirect observables

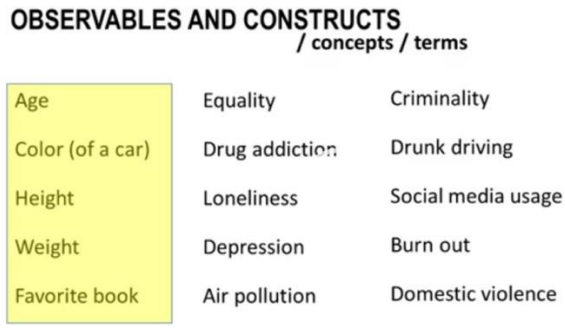
Conceptualization – the mental process whereby fuzzy and imprecise notions (concepts) are made more specific and precise.

Indicator – an observation that we choose to consider as a reflection of a variable we wish to study. Thus, for example, attending religious services might be considered an indicator of religiosity
Dimension – a specifiable aspect of a concept. "Religiosity", for example, might be specified in terms of a belief dimension, a ritual dimension, a devotional dimension, a knowledge dimension, and so forth.

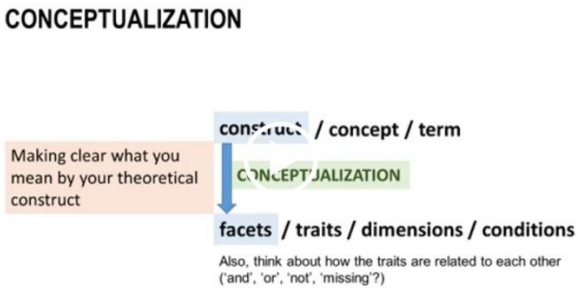
Cognitive interviewing – testing potential questions in an interview setting, probing to learn how respondents understand or interpret the questions

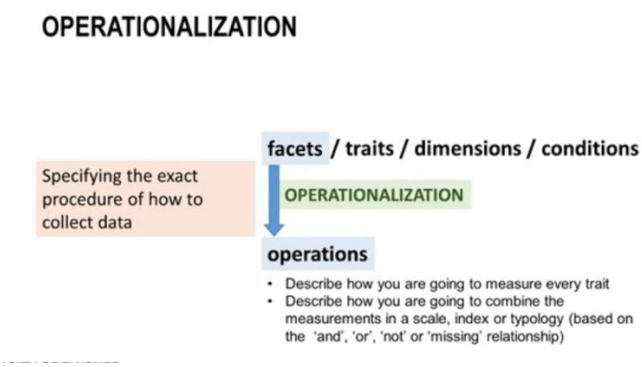
Index – a type of composite measure that summarizes and rank-orders several specific observations and represents some more-general dimension
Scale – a type of composite measure composed of several items that have a logical or empirical structure among them. Examples of scales include the Bogardus social distance
Typology – the classification (typically nominal) of observations in terms of their attributes on two or more variables. The classification of newspaper as liberal-urban, liberal-rural, conservative-urban, or conservative-rural would be an example.

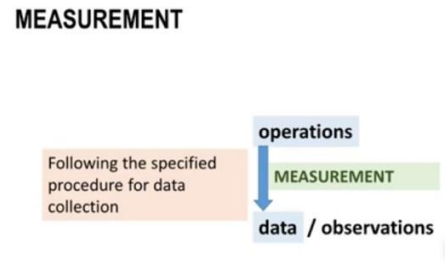
Video Lectures



More complicated set of variables are called constructs, also called concepts and terms.
Conceptualization → operationalization → measurement







<u>Four types of relationship between terms & facets:</u>
And: Necessary & Sufficient conditions
Not: Typologies
Or: Family resemblance
Missing: A set of similar variables

Many concepts seem to be simple: concepts not constructs!

1. The amount of money on a bank account
2. The amount of energy produced by a windmill
3. A person or individual

Four examples of constructs:
And: Bachelor -> dichotomy
Not: Gender -> typology
Or: democracy -> dichotomies or indices (ordinal/scale)
Missing: Personality (combination of constructs)

Everyone uses constructs all the times.
"In the 21st century most states are democratic"

1. Units

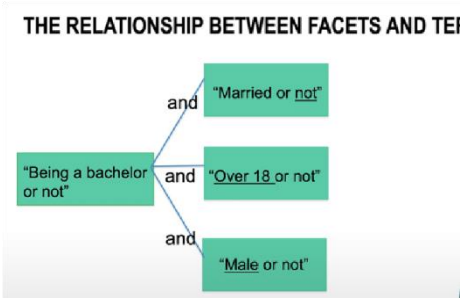
2. Variable
3. Setting (temporal)

States/democratic are constructs!

More examples of constructs:

- Violence
- Ethnocentrism
- Intelligence
- Personality

(Constructs can refer both to units and to variables)

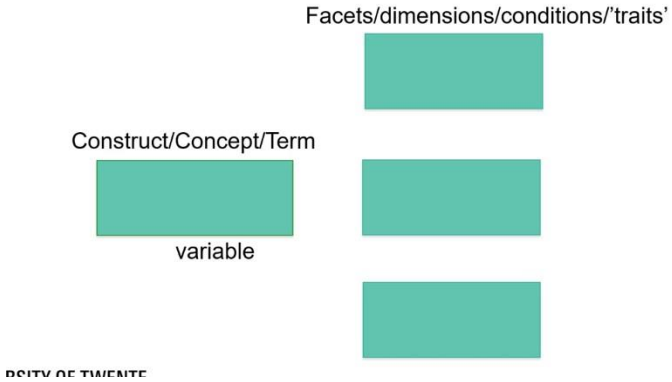


(And relationship) You are a bachelor: if you are not married, over 18 and male!
AND: a set of necessary and sufficient conditions (all facets are necessary). If we have information about the three facets, we can tell (the set of facets is sufficient)

Summary:
Relationship between facets and terms
And: necessary and sufficient conditions
Not: creating (matrix) typologies
Or: family resemblance (sufficient conditions)
Missing: just a set of 'somehow related variables' (ex. Personality)

Dimensions in concepts
Some concepts have independent dimensions.

Constructs consist of 'facets'
So, every concept can be seen as consisting of various dimensions/conditions/traits. Many words use to describe the underlying variable we are interested in.



Traits or types?
Personality:

1. As a set of (five) (unrelated) traits, or
2. As a set of types (often based on dichotomous traits)

Measuring 'theoretical constructs':
Conceptualization → operationalization → measurement
Constructing, indices (index), typologies and scale is very important aspect of these relationship.

Some theoretical variables are relatively simple: (**direct or indirect**) **observables.** Example: gender, age – measured by on simple question.

Other theoretical variables are complex, consisting of various dimensions or aspects: constructs, we cannot measure it by 1 question.
Examples of constructs:

1. Being a bachelor (not married, male, above 18); you need all 3 questions to know whether this person is bachelor or not.
2. Level of democracy
3. Level of centralization
4. IQ
5. Mathematical abilities

Conceptualization – making clear what you mean with the theoretical construct. Its possible dimensions or aspects, and its attributes (values). (ex. Mathematical abilities, with various 'aspects', to add, subtract, multiply etc.) Concepts are set of traits and dimensions. Criterions:

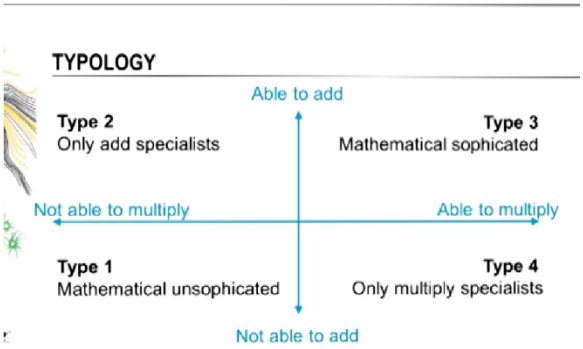
- Is it clear enough to tell what a unit is?
- Is it possible to measure the concept?
- Does it help to create meaningful theories that stand tests?

Operationalization – the construction of the exact procedures (in the context of some data collection method) to be used for data collection (ex. Formulating specific questions (items, indicators) measuring mathematical abilities)

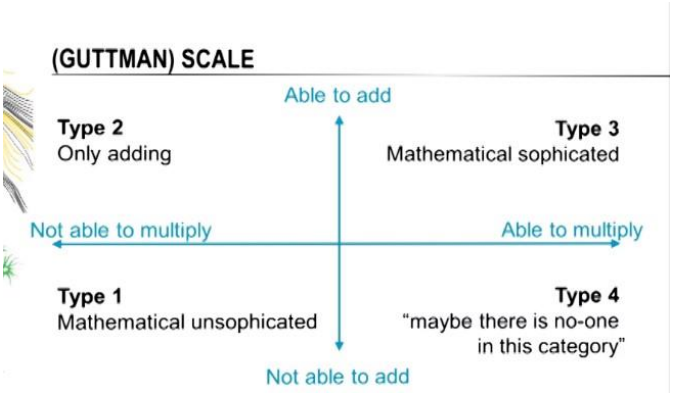
Content validity – if all aspects of a construct are included in the operationalization (ex. Mathematical abilities: include not only addition and multiplication)

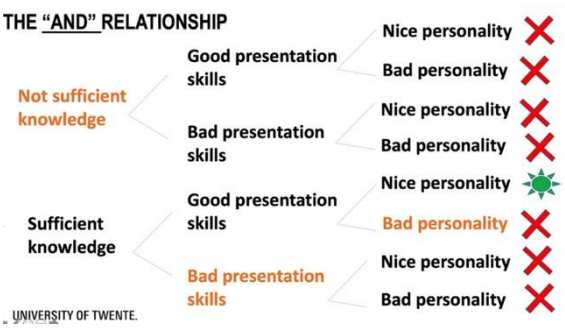
Combining indicators into one construct (3 ways) Ex. Using answers to 60 mathematical questions

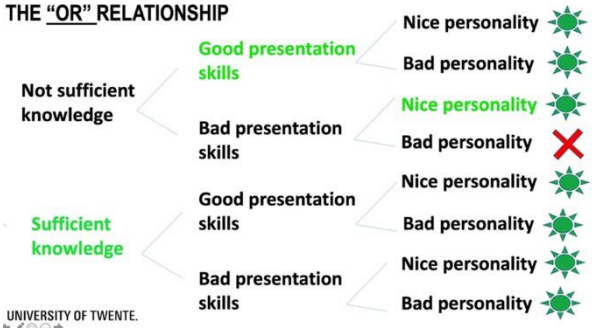
- Index – creating an ordinal variable by adding up answers (ex. Number of correct answers)
- Typology – creating a nominal variable, by using the intersection of two or more variables (ex. Correct answers to adding, correct answers to multiplication)

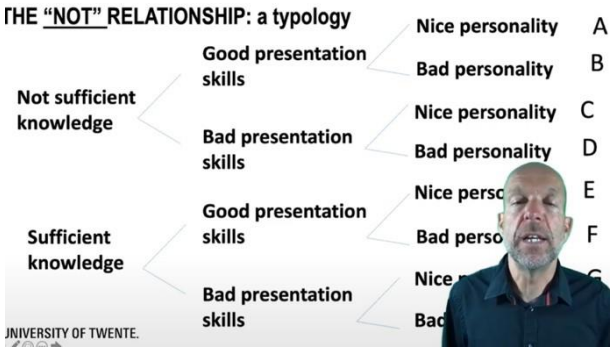


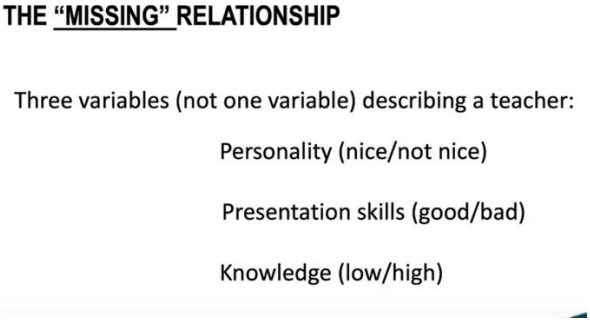
- Scale – similar to index, creating an ordinal variable by combining answers, after checking the empirical relationships between the answers and sometimes by taking into account these relationships











After this session, students will be able to *distinguish constructs from observables;*
identify constructs in academic research questions and theories as variables, a set of variables or as a unit of analysis;
explain the relationship between "conceptualization", "operationalization" and "measurement";
conceptualize a construct using the various relationships between traits; explain how composite measures are used to measure a single construct; distinguish composite measures as either a typology, index or scale.

Key terms:
Construct / concept / term
Dimension / facet / trait
Conceptualization
Operationalization
Measurement
Types
Typology
Index
Scale

Topic 7 – Operationalization and data collection

Video Lectures

Data collection methods:

- survey
- diary methods
- interviews
- Coding documents
- Physical measures
- Focus group recordinfs

Classifying data collection methods:

- Primary and secondary data
- From obtrusive to unobtrusive methods – if the process of measurement affects the observations, this is called 'obtrusive', is not a dichotomy, range of less to more obtrusive methods
- Verbal and non-verbal methods (non-verbal observing behavior) :
  a. data based on or using natural language are called 'verbal'. Language can be misunderstood, misinterpreted. Verbal methods can be both unobtrusive and obtrusive. Ex. Survey or listening to people near coffee machine (nonobtrusive)

EXAMPLES OF DATA COLLECTION METHODS

	Mostly unobtrusive	Mostly obtrusive
Non-Verbal	Observation of behavior	Physical measures
Verbal	Coding documents	Survey Open interviews Focus group analysis

b. Open interviews: non standardized questions are asked to a sample of (units of observation) to say something about a population of (units of analysis)
c. Focus group analysis: data collection method in which a non-random sample of units of observation discuss a topic the researches introduces.

Measuring a theoretical concept.

<u>Sources of operationalizations:</u>

- existing measurement instruments in
  a. articles and books about the topic
  b. books with operationalizations (scales, indices) • thinking, creativity

Operationalization of constructs consist of a set of indicators. Ex. One of the sub-test of the WAIS IQ scale is based on finding similarities between words. This is an operationalization of "Abstract verbal reasoning"

Content validity – if all aspects of a construct are included in the operationalization. This is an aspect of measurement validity. Ex. IQ ("Abstract verbal reasoning" and many other aspects)
Triangulation – using at least two different operationalizations (often in the context of different data collection methods) to measure the same theoretical concepts for the same units
Measurement – following a specified procedure (in the context of some data collection method) in order to het 'observations', 'data'.

STORING DATA

• data matrix:
  a. rows (1,2,3,4 -> units)
  b. columns (Gender, Year -> variables)

Steps in survey research:

0. Are survey data available (if yes, stop)
1. Selecting (the type of) survey (web, paper etc.)
2. Designing and selecting survey questions
3. Designing the questionnaire
4. Questionnaire testing
5. Interviewer training
6. Survey administration, checking response

7. Data cleaning and storage

Meta data is 'data about data'. It is a description of the data. Meta data explains how the data were collected, processed, and published and answers questions regarding every facet of the documented data. Is becoming more standardized and searchable.

Drawbacks of using existing data & doing secondary data analysis?

- Validity? (but can you do better?)
- Old data? (did the world change very much?)

After this unit, you will be able to...

explain the relationship between "conceptualization", "operationalization" and "measurement";
recognize various data collection methods;
tell whether a data collection method is more or less obtrusive and more or less (non)verbal;
differentiate primary data from secondary data and know when to use either one of them;
operationalize a construct.

Key terms:
Conceptualization
Operationalization
Measurement
Data collection
Data collection method
Primary data
Secondary data
(Un)obtrusive research
(Non)verbal measurement

Topic 8 – Two aspects of data quality

Book

Reliability – that quality of measurement methods that suggest that the same data would have been collected each time in repeated observations of the same phenomenon. In the context of a survey, we would expect that the question "Did you attend religious services last week?" would have higher reliability than the question "About how many times have you attended religious services in your life?". This is not to be confused with validity.
Validity – a term describing a measure that accurately reflects the concept it is intended to measure. For example, IQ would seem to be a more valid measure of your intelligence than the number of hours you spend in the library. Though the ultimate validity of a measure can never be proved, we may agree to its relative validity on the basis of face validity, criterionrelated validity, content validity, construct validity, internal validation and external validation.

- Internal validity – conclusion about cause and effect justified? Can we rule out alternative explanations/confounding variables?

- External validity – generalize to other settings? (a.k.a ecological validity)

Face validity – the quality of an indicator that makes it seem to be a reasonable measure of some variable. That the frequency of attendance at religious services is some indication of a person's religiosity seems to make sense without a lot of explanation.
Criterion-related validity – the degree to which a measure relates to some external criterion. Also called predictive validity. It is correctly related to conceptually related indicators? Ex. Did you vote in the last general election? Checked by using the actual voting records. Use both a survey and psychological measures to see whether they observe the same level of empathy

A. concurrent
B. predictive
C. postdictive

Construct validity– the degree to which a measure relates to other variables as expected within a system of theoretical relationships. Is it correctly related to other theoretically related variables? Ex. Assessing different operationalizations of 'obesities': BMI, Body Adiposity Index, Waist circumference etc. Which one is the best?
Content validity – the degree to which a measure covers the range of meanings included within a concept. Does it cover all aspects of the content?
Criterion-related validity, construct validity and content validity – are all called together construct validity!

Video Lectures

Understanding mistakes in measurement:

- (un)reliability
- Validity (bias)

Even when we observe the right set of units, observation may be imperfect: we make mistakes. Two types of observation mistakes:

- **random errors - reliability**
- **systematic errors** (systematic bias or measuring the wrong construct) - **validity**

Measurement reliability: the absence of random error (does everyone know what this means and have an opinion about this?)
Measurement validity: no systematic error, (on average) measure what you intend to measure

Reliability example: Every individual steps on the scale 10 times. Use three different scales (= three operationalizations). Assess the operationalizations using the reliability. Do I get the same weight on every step? For example, for 10 observations for one scale, I get 80kg – it is reliable, but what is my true weight? 77 kg is my true weight, so it is not valid! (only hypothetical)!.

Assessing the reliability – lack of reliability is a problem!

- stability – use the same operationalization several times, asking the same question 15 times to the same person, only small differences between observations

a. test-retest reliability – asking the same question in the beginning and the end of a survey
b. inter-rater reliability – asking several observers to rate/characterize/observe the same object

- consistency – use and compare similar operationalizations, it the items measure more or less the same thing, we expect the answers to be related, strong relationship between variables (items)

Assessing the measurement validity
Validity of an operationalization cannot be observed directly, because the 'true' value is unknown. Very difficult to measure.

- measurement validity – does the measure reflect what is supposed to reflect?
- validity of research (strength of your conclusions)

Accurate observation:

- **precise (grams is better than kilos)**
- **reliable**
- **valid**

After this session, you will be able to... *differentiate between the reliability and validity of a measurement instrument; explain why the quality of a measurement instrument depends on its (intended) use; explain how the two aspects of measurement reliability (stability and consistency) can be assessed;*
explain why measurement validity cannot be observed directly and how various methods (content, construct and criterion-related validity) are used to assess measurement validity.

Key terms:
Measurement instrument
Reliability
Random error
(Measurement) Validity
Systematic error
Data collection bias
Construct validity
Content validity
Criterion-related validity

Topic 9 – Displaying univariate data

Book

Univariate analysis – the analysis of a single variable for purposes of description. Ex. Frequency distributions, averages, and measures of dispersion
Frequency distribution – a description of the number of time the various attributes of a variable are observed in a sample

Center of distribution: (measures of central tendency):

- mode – value that occurs most frequently, often used if a variable is measured on a nominal or ordinal level, i.e. pie chart
- median – middle value of your observation when they are ordered from the smallest to the largest
- mean – sum of all the values divided by the number of observations, more sensitive to outliers!!

Summarizing data → **frequency table** (NOMINAL/ORDINAL)

- pie chart (see percentage, but not specific numbers)
- bar graph – specific numbers but not percentage, better for high number of categories!

Quantitative data: (INTERVAL/RATIO)

- histogram (similar to bar graph) – bars in histogram touch each other, it represents continuous scale, there are equal intervals! • boxplot

After this unit, you will be able to...
explain what is meant with univariate data;
display one single variable (univariate analysis) using a frequency table, a bar chart, or a histogram, using R;
display data in univariate plots, using R; display the mean, minimum and maximum; <-- in unit 4, remember summary()?
correctly interpret these displays;
make an informed choice between the various ways to display a single variable given the measurement level of the variable;
use mutate() in R to adjust data, so that you are able to correctly display the variables; use case_when() to recode variables.
Key terms:
Univariate analysis
Frequency table
Bar chart
Histogram

Topic 10 – Summarizing ratio variables

Book

Continuous variables – a variable whose attributes form a steady progression, such as age or income. Thus, the ages of a group of people might include 21,22,23,24 and so forth and could even be broken down into fractions of years
Discrete variables – a variable whose attributes are separate from one another, or discontinuous as in the case of gender or religious affiliation. In other words, there is no progression from male to female in the case of gender

Video Lectures

Measures of variability:

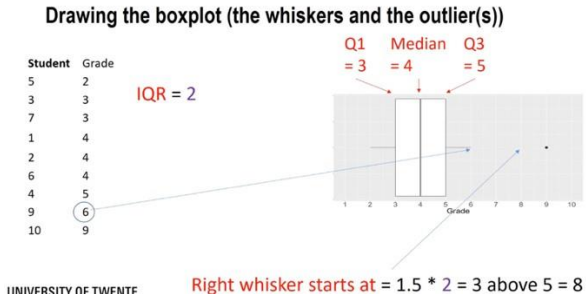
- variance – larger variance = larger variability, the more the values are spread out around the mean
- standard deviation – average distance of an observation from the mean, measure of dispersion, larger standard deviation = larger variability

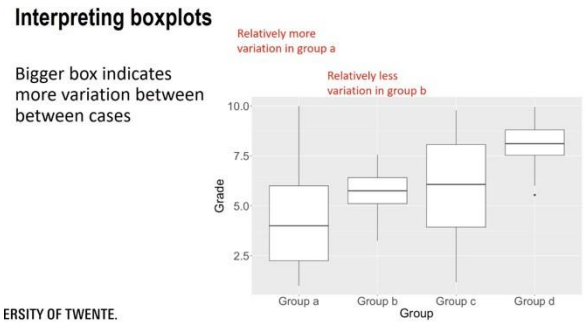
formulas are almost the same, but for standard deviation you add square root!

Four groups of students, four teaching methods, one exam → tukey **boxplot**

Comparing distributions in groups

In box there is median, Q1 and Q3, interquartile range (IQR) = difference between Q1 and Q3
Whiskers are max 1.5IQR long. If there are no observations at 1.5IQR, the whiskers end at the largest observation within that range





The box represents 50% of the observations.

After this unit, you will be able to...

understand the difference between dichotomies, nominal, ordinal, interval and ratio variables;

summarize variables using measures of central tendency and spread; display and interpret variable characteristics using a box plot.

Key terms:

Mode
Mean
Median
Quartile
Interquartile range

Box plot
Outliers
Standard deviation
Variance

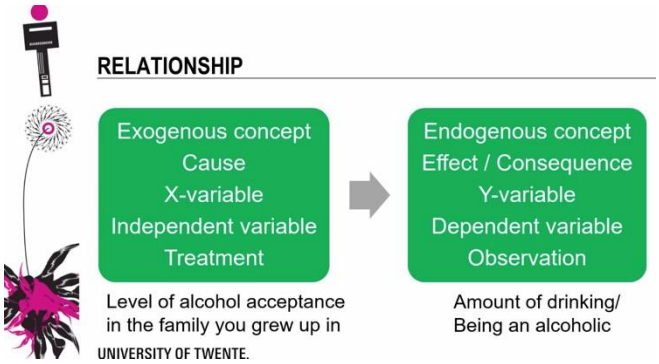
Topic 11 – Causality and bivariate causal hypotheses

Video Lectures

Causal explanation

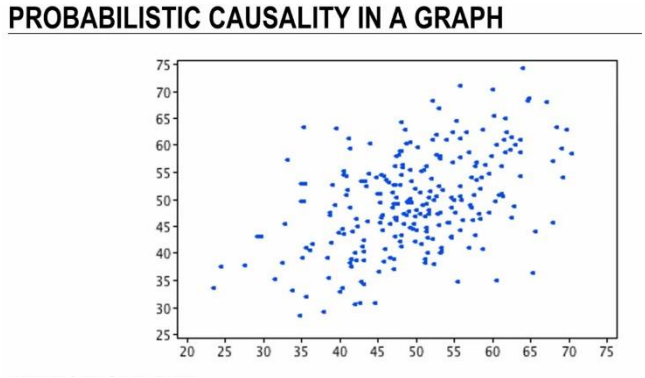
Three different, yet related questions:

1. Why did you become an alcoholic? (reasons) – story: abuse -> insecure -> drinking -> made mistakes -> drinking.
2. Why did this person become an alcoholic? (suppose the person died). Answering the question using knowledge about 'why things generally happen' = existing knowledge applied to a specific case
3. Why do people become alcoholics? Thinking about possible causes. Explanation as formulating and testing a relationship between a cause and a consequence.



Deterministic: If … then "always"

Probabilistic: If … then "relatively more/less often" -> measurement error, parsimonious models: omitted variables



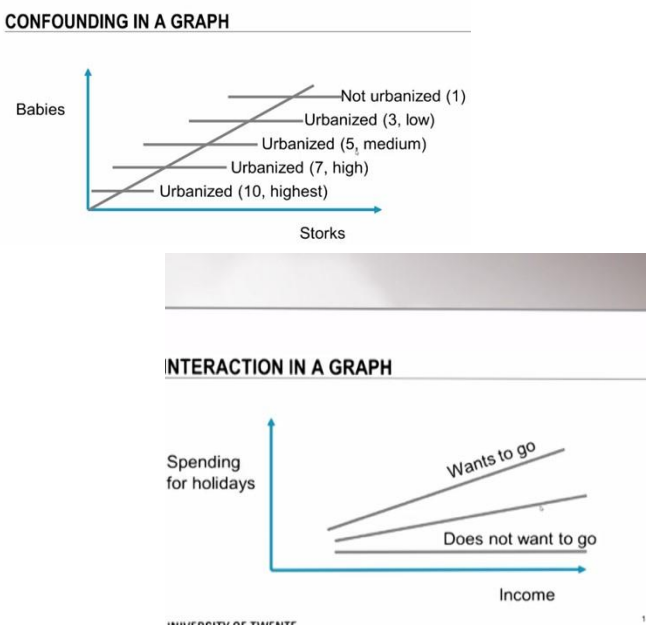
3 aspects of causality:

1. X precedes Y in time **(correct time order)** – the independent variable precedes the dependent variable, ex. The effect of alcohol acceptance during childhood and drinking behavior
2. X and Y are correlated **(association)** – ex. If alcohol acceptance during childhood is equal among alcoholics and non-alcoholics

3. There is no third variable accounting for the association **(non-spuriousness).**

Relationship can be spurious or seriously biased because of:

a. Explanation/confounding -



b. Specification/interaction/modification -

Causality is not just correlation!

Time order problems:

- Problems may occur when behavior and attitudes are measured at the same time. Behavior may change (reported) attitudes. Ex. Do you like him because you are dancing together, or are you dancing together because you like him?
- Measuring both variables at the same time may produce reverse causation. Ex. Does a happy childhood make you happier now?

How to check time order? Collect data at different points in time. Ex. Interrupted time series design pre test → pre test → treatment → post test → post test

Bivariate associations – between variables with various levels of measurement Dichotomy and nominal variables are more easily displayed in tables.

After this unit, you will be able to...

explain that causal statements play a big role when trying to answer an empirical explanatory research question; explain what is meant with the three basic implications of a bivariate causal statement: cause precedes consequence, cause is associated with consequence, and there is no third variable producing the observed relationship; distinguish linear from non-linear (causal) relationships between variables; explain why relationships are often probabilistic and not deterministic.

Key terms:
Theory
Causality
Association (between variables)
Linear relationship
Non-linear relationship
Spurious relationship
(causal) hypothesis
Time order
Bivariate
Probabilistic
Deterministic
Dependent variable (endogenous concept)
Independent variable (exogenous concept)
Reverse causation
Sign (aka direction) (of a causal relationship)

Topic 12 – Visualizing and analyzing bivariate relationships

Bivariate analysis – the analysis of two variables simultaneously, for the purpose of determining the empirical relationship between them. The construction of a simple percentage table or the computation of a simple correlation coefficient are examples.
Contingency table – a format for presenting the relationship among variables as percentage distributions; typically used to reveal the effects of the independent variable on the dependent variable. For nominal and ordinal variables
Multivariate analysis – the analysis of the simultaneous relationships among several variables. Examining simultaneously the effects of age, gender, and social class on religiosity is an example.

Scatterplot → quantitative variables

After this unit, you will be able to...
differentiate between bivariate and univariate graphs and tables (and you know when to use what kind of display);
create a scatterplot (using statistical software and by hand) with the independent variable on the X-axis and the dependent variable on the Y-axis;
create a contingency table (using statistical software and by hand) with the independent variable in the columns, the dependent variables in the rows, and column percentages in the cells; interpret results that are displayed in scatterplots and contingency tables.
Key terms:
Bivariate analysis
Contingency table
Scatterplot
Regression line
Strength (of a bivariate relationship)

Direction (of a bivariate relationship)
Linear relationship

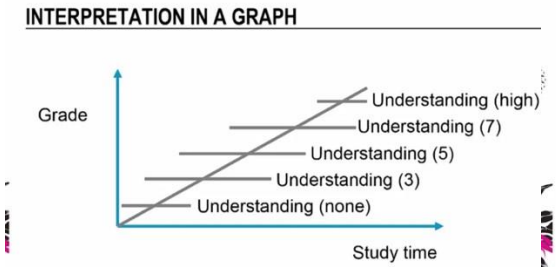
Topic 13 – Causality and the effect of third variables

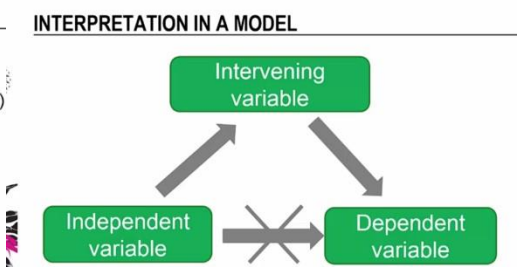
Video Lectures

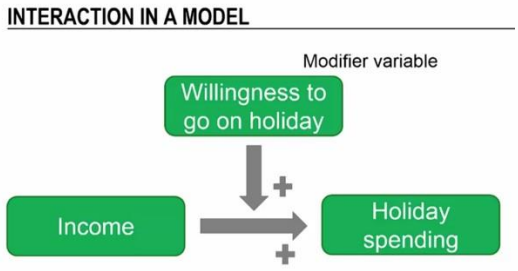
Testing bivariate hypothesis is checking:

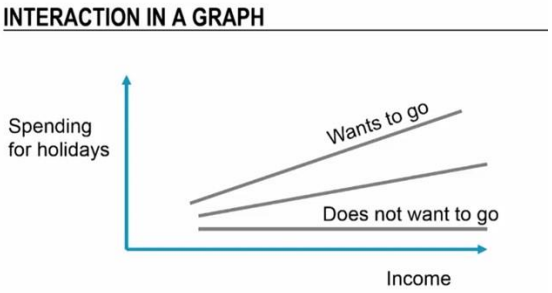
- time order of cause and effect
- correlation/association
- effect of third variables
  a. theorizing about the effect of third variables
  b. formulating a trivariate hypothesis
  c. testing the trivariate hypothesis

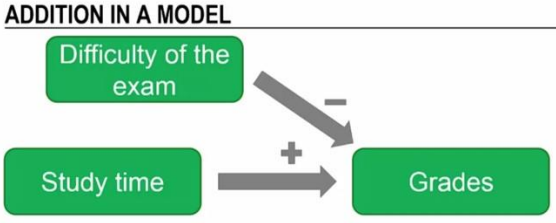
After the introduction of the third variable, the bivariate relationship disappears/ changes/ remains the same and the test variable is related to the other variables.

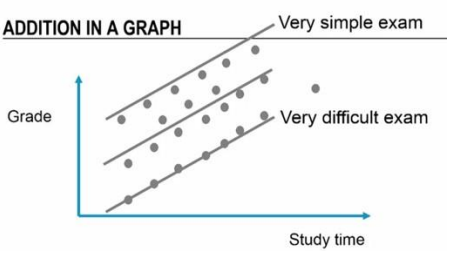












The Hawthorne experiments (1924-1932) as an example of explanation/confounding.
Working conditions -> productivity
Initial RQ: what is the effect of working conditions on the productivity of individual employees (in the departments of the Hawthorne Works)?

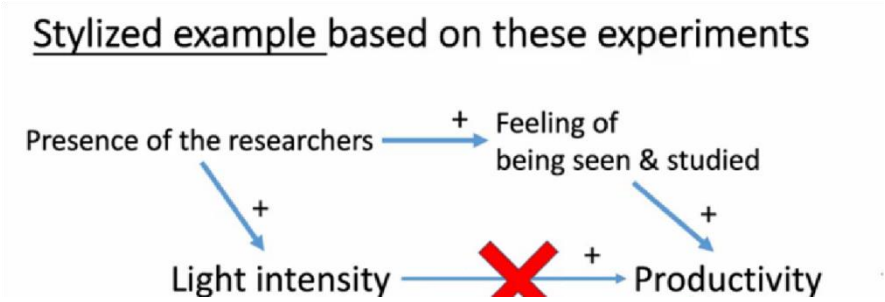
What do we mean with working conditions?

- Light intensity
- Length of the working day
- Breaks or not, or length of breaks
- Payment, bonus system etc.

Causality
Suppose we expected that (within a reasonable range) relationship light intensity -> productivity is positive This implies:
AFTER increasing the light intensity, productivity will go up.. (**time order**)
Thus, creating a positive **association** between the intensity and productivity.

Actual results in the study

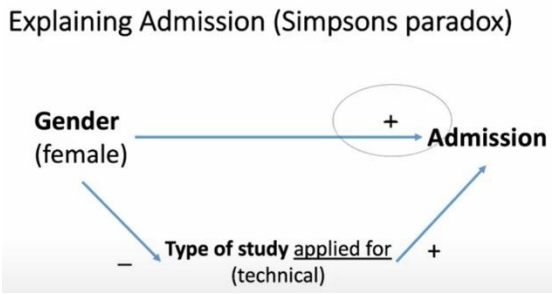
- Changes in productivity were inconsistent
- Some of the changes were only temporary
- This made the researchers to think about other factors playing a role in explaining productivity



Conclusions:

- Many factors play a role when studying causes and effects, and we need to think clearly about what to expect
- Not only social factors play a role, but the research process itself too
- The story shows the importance of thinking about 'confounding'

Simpsons Paradox (interpretation)



After this unit, you will be able to...

explain how to analyse the effect of a third dichotomous variable on a bivariate relationship between two dichotomous variables (a trivariate relationship) using the elaboration model;
differentiate between various elaboration models, including: full or partial explanation, interpretation, specification, addition, and replication;
tell what type of 'third' variable is associated with these elaboration models: confounding variable, moderator or integration variable, intervening variable.

Some key terms discussed in previous units will be revisited:

Theory; Causality; Linear relationship; (causal) hypothesis; Bivariate; Dependent variable (endogenous concept); Independent variable (exogenous concept) In addition you will learn some ***new key terms****:*

Trivariate
Addition
Explanation (effect of a third variable; aka confounding)
Confounding variable
Specification/interaction/moderation
Moderator (interaction variable)
Intervening variable

Topic 14 – Research design for testing causal hypotheses

Book

	Cross-Sectional	Longitudinal		
		Trend	Cohort	Panel
Snapshot in time	X			
Measurements across time		X	X	X
Follow age group across time			X	
Study same people over time				X

FIGURE 4-6
Comparing Types of Study Design.

Cross-sectional study – a study based on observations representing a single point in time
Longitudinal study – a study design involving data collected at different points in time

- trend study – a type of longitudinal study in which a given characteristic of some population is monitored over time
- cohort study – a study in which some specific subpopulation, or cohort, is studied over time, although data may be collected from different members in each set of observations
- panel study – data are collected from the same set of people (the sample or panel) at several points in time

a. panel mortality – the failure of some panel subjects to continue participating in the study

pretesting – the measurement of a dependent variable among subjects before they are exposed to a stimulus representing an independent variable
posttesting – the remeasurement of a dependent variable among subjects after they've been exposed to a stimulus representing an independent variable

experimental group – in experimentation, a group of subjects to whom an experimental stimulus is administered
control group – a group of subjects to whom no experimental stimulus is administered and who resemble the experimental group in all other respects. There is comparison of both groups at the end of experiment, points to the effect of the experimental stimulus.

Double-blind experiment – an experimental design in which neither the subjects not the experimenters know which is the experimental groups and which is the control

Randomization – a technique for assigning experimental subjects to experimental and control groups randomly
Matching – in connection with experiments, the procedure whereby pairs of subjects are matched on the basis of their similarities on one or more variables, and one member of the pair is assigned to the experimental group and the other to the control groups.

Internal validity – refers to the possibility that the conclusions drawn from experimental results may not accurately reflect what went on in the experiment itself
External validity – refers to the possibility that conclusions drawn from experimental results may not be generalizable to the real world.

Video Lectures

3 groups of research design for testing causal relationships:

- **cross sectional research design** (aka Correlational) – variables are measured at one moment in time
  a. can sometimes exclude time order problems
  b. can be used to collect data on confounders (third variables)
  c. weak in internal validity (reverse causation / third variable), however strong in external validity (sampling)
  d. the effect of many independent variables cannot be studied in other types of research designs
- **interrupted time series** – studying the same units and variables over time (longitudinal research) in which at one point in time the group receives a treatment (a change in the independent variable)
  a. is the actual treatment reflecting the theoretical construct?
  b. It may work now, for this set of units and in this setting but it may not work of another time, for other units in another setting
  c. Internal validity – the composition of the group changes
  d. When is the change big enough to say that treatment worked?
- **classical experiments** (also known as randomized experiment) – comparable groups of units are constructed using random assignment in which the treatment (independent variable) is manipulated differently across groups to see whether the outcome (dependent variable) becomes different across groups (extension of interrupted time series, random assignment = identical). a. Not always feasible

b. Require relatively simple hypotheses

TESTING A CAUSAL RELATIONSHIP

	Cross sectional	Interrupted time series	Experiment
Association	√	√	√
Time order		√	√
No third variable			√

distinguish between:

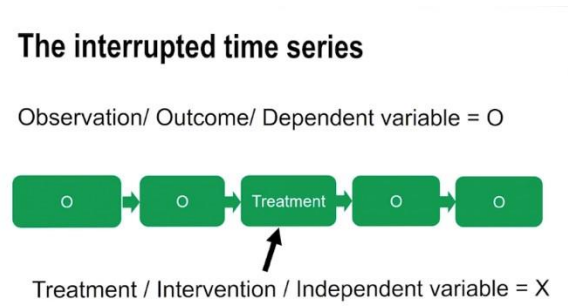
1. research design – the way of answering an explanatory (causal) research question in a convincing way, experiment, cross sectional study etc.
2. a data collection method – survey observation
3. the aim or context of the research, ex-post evaluative

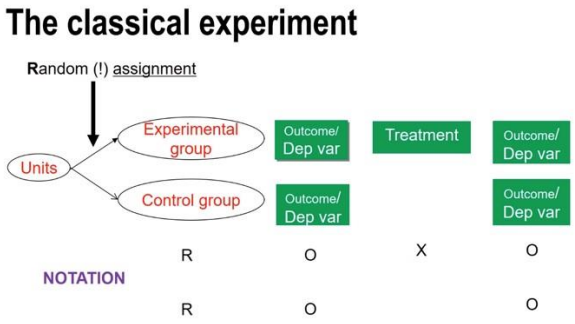
4. type of data (qualitative or quantitative)

(assessing) Validity in causal research:

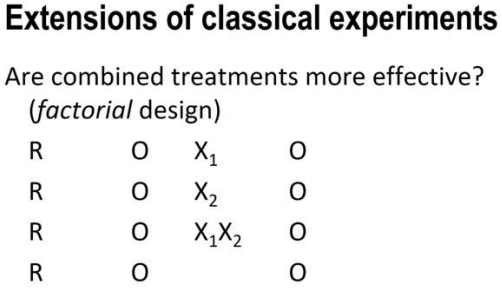
- Statistical conclusion validity **(correlation)** → correct conclusions drawn in the study itself
- Internal validity (is the **time order** between the measured variables correctly established? Is the relationship **spurious**)
- Measurement validity and reliability (measuring the variables and units appropriately. Referring to the theoretical construct intended) → generalization & inference to theory/population/other cases • External validity

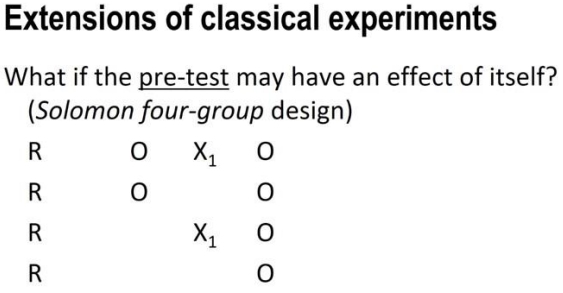
Measurement bias produces reverse causation – Measuring both variables at the same time, we don't know whether dependent variable is dependent variable, and when we switch X with Y.





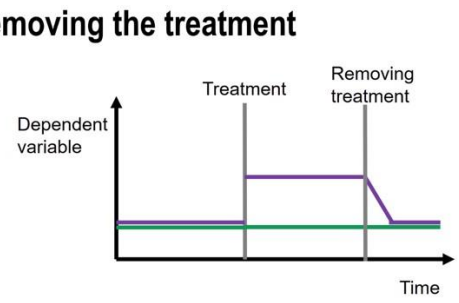
R = group created by random assignment N = comparison group not created by random assignment





Does the effect persist after removing the treatment?

R	O	X_1	O	O	~~X_1~~	O	O
R	O		O	O		O	O



->

Does it matter *when* the treatment is given?
Or: what if you cannot withhold the treatment?
(*stepped wedge* design)

R	O	X_1	O		O		O
R	O		O	X_1	O		O
R	O		O		O	X_1	O

After this unit, you will be able to…

explain in what way studies with a correlational (cross-sectional) design, an interrupted timeseries design and an experimental design differ in their ability to test bivariate causal relationships;
assess the internal validity of the three basic research designs (correlational, interrupted time-series, experiments);
describe basic features of a classical experiment (including: random assignment, posttest, pretest, treatment, placebo, and observation); explain the basic idea of a double blind experiment; use standard research design notation (R, N, X, O).

Key terms:

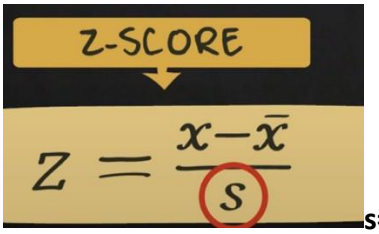
Correlational research / Cross-sectional research
Longitudinal research
Interrupted time series design
(Classical) experiment
Quasi-experimental design
Experimental group
Control group
Double-blind experiment
Random assignment (denoted by R)
Posttest
Pretest
Treatment (denoted by X)
Observation (observing the dependent variable in the context of an experiment, denoted by O)
Placebo
Internal validity
External validity

Topic 15 – Distributions and Z-scores

Video Lectures

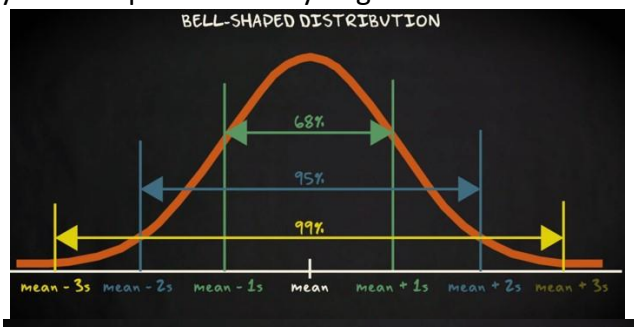
Z-score = number of standard deviations removed from the mean. Useful to compare different distributions.

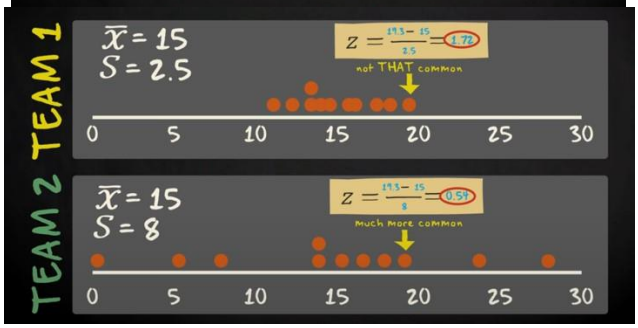
Recoding original scores into z-scores → **standardization** (replace the original scores by standard deviations from the mean) + easy to see whether a specific score is relatively common or exceptional it enabled comparing variables that are different.



s=standard deviation

Negative z-scores represent values below the mean, positive above the mean If you add up all z-scores you get 0.





(0.54 standard deviations removed from the mean)

<u>Effects of using z-scores for interval and ratio variables:</u>

1. standardizing variables using z-scores changes the center of the variable to 0.
2. The standard deviation of a standardized variable is always 1.
3. Standardization does NOT change of the distribution of the variable in any way, if it is oddly shaped, it stays oddly shaped

After this unit, you will be able to...
summarize ratio variables using measures of central tendency and spread (again); explain how standardizing variables works and why you would want to apply this; use the standard deviation to compute z-scores in order to standardize variables with different variances;
use statistical software to compute the standard deviation, variance and mean of variables,
use statistical software to add variables with standardised values to the dataset.
Key terms
(standard deviation and variance, again) distributions
z-scores/ standardized values

Topic 16 – Normal distribution

Empirical rule 68%-95%-99.7%

Standard normal distribution is standardized, mean of 0 and standard deviation of 1. It is curve that results when any normal curve is converted to standardized scores
Normal distribution are unimodal and symmetrically distributed with a bell-shaped curve, however it can take on any values as its mean and standard deviation (for example mean might be 1000, and standard deviation 20)
Standard normal distribution is a specific type of normal distribution!

3 characteristics of an approximately normal distribution curve:

1. it has a bell shape
2. the mean and median are equal
3. 68% of the data falls within 1 standard deviation
4. Population mean determines the location of the distribution!

After this unit, you will be able to...
differentiate between a normal distribution and a standard normal distribution; interpret a standardised normal distribution (using rules of thumb for percentages). ***Key terms:***
Normal distribution
Standardised normal distribution;

Topic 17 – First steps towards inference: certainty about means

Video Lectures

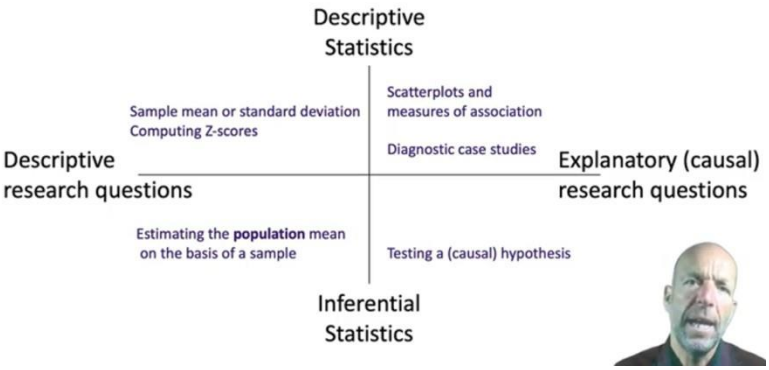
Parameter – a number that describes the data from a population **Statistic** – a number that describes the data from a sample

	SAMPLE	POPULATION	
MEAN	$\bar{x}$	μ	
STANDARD DEVIATION	s	σ	
	STATISTIC	PARAMETER	

Larger standard deviation in population, there is larger spread of the normal distribution.

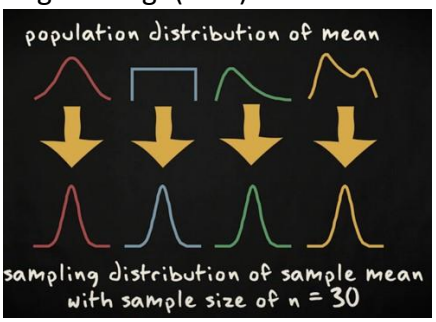
What is statistical inference?

Inferential vs descriptive statistics



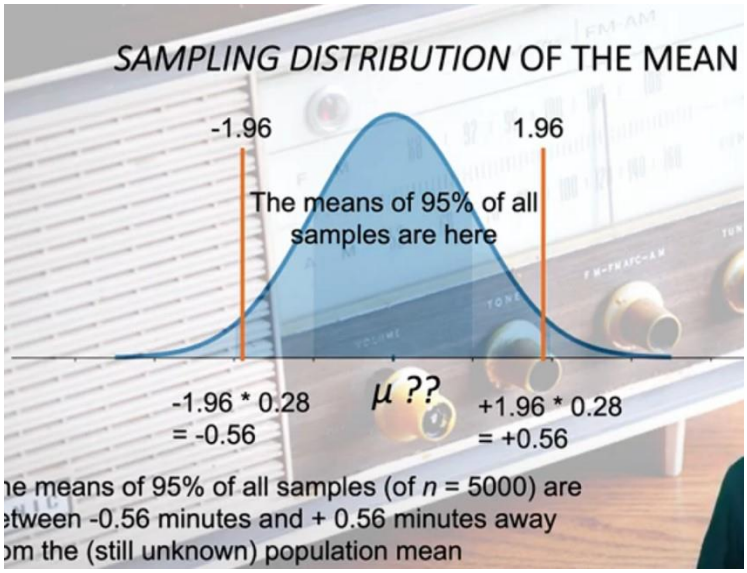
Sample distribution – for one single sample
Sampling distribution – for lot of samples, of population.

CENTRAL LIMIT THEOREM – <u>the sampling distribution of sample mean is approximately normal (provided that n is sufficient large).</u> Even if the variable of interest is not normally distributed in population. No matter how a variable is distributed in the population the sampling distribution of the sample mean is always approximately normal, as sample size is large enough(>30).



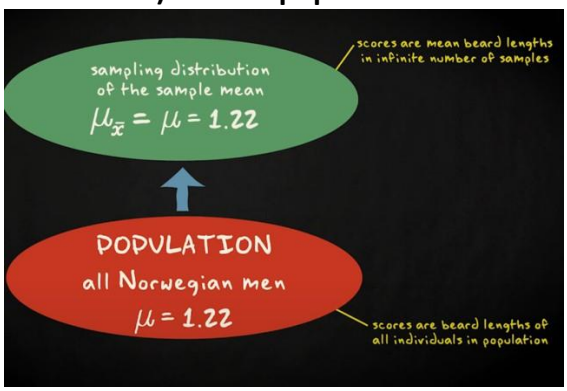
With random samples with a substantial n from a population, the sampling distribution will be approximately normal, irrespective the shape of the population distribution. Mean of the sampling distribution is identical to the mean of population. Standard deviation depends on the sample size n (bigger sample size, smaller standard deviation).

Bigger population standard deviation, bigger standard deviation of the sampling distribution.



(standard deviation from population)

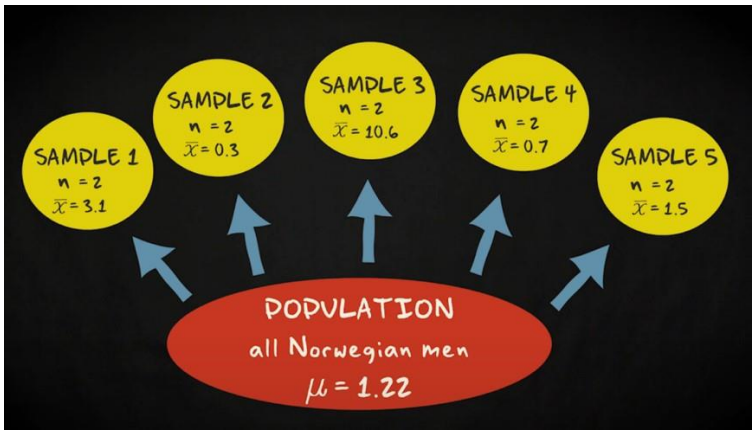
Sampling distribution – is the link that helps researchers to draw conclusions about a population on the basis of only one sample
If you draw a simple random sample from a population it is very unlikely that the sample is strongly differ from the population form which it is drawn. **Mean of samples (sampling distribution) = mean population**



Standard deviation of sampling distribution:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

The larger the variability in the population (<u>larger standard deviations</u> of populations) the larger the variability of the sample means.
However, <u>larger sample size</u>, the lower standard deviation of the sampling distribution


SAMPLE 1
n = 2
$\bar{x}$ = 3.1
SAMPLE 2
n = 2
$\bar{x}$ = 0.3
SAMPLE 3
n = 2
$\bar{x}$ = 10.6
SAMPLE 4
n = 2
$\bar{x}$ = 0.7
SAMPLE 5
n = 2
$\bar{x}$ = 1.5
POPULATION
all Norwegian men
μ = 1.22

VS


SAMPLE 1
n = 1000
$\bar{x}$ = 1.19
SAMPLE 2
n = 1000
$\bar{x}$ = 1.24
SAMPLE 3
n = 1000
$\bar{x}$ = 1.20
SAMPLE 4
n = 1000
$\bar{x}$ = 1.20
SAMPLE 5
n = 1000
$\bar{x}$ = 1.23
POPULATION
all Norwegian men
μ = 1.22
∞
number of samples
sampling distribution of the sample mean
mean =
population mean =
1.22

bell-shaped population distribution
∞
number of samples
distribution of sample means
is bell-shaped with a mean
equal to the population mean
sampling distribution
of the sample mean

After this unit, you will be able to... *differentiate between population statistics and sample statistics; explain what is meant with 'inference';*
explain what a sampling distribution of the mean is and how the shape of this distribution is related to the population distribution (using the central limit theorem). ***Key terms:***
Statistic
Parameter
Sample distribution Population distribution
Sampling distribution Inference
Central limit theorem

Summary 2: Organisation Theory

CHAPTER 1 – An overview

Main features of an organization:

- goals have to be set
- key areas of responsibility that are necessary to achieve the goals have to be identified
- pressures from the environment have to be identified and responded to -> subsequent changes in the organisation goals
- culture of the organization is necessary (including the standards of behaviour and attitudes towards work that reflect the values and necessary attitude)
  = successful establishment, correct organisation theory and design

Organization is a consciously managed and coordinated social entity with an identifiable boundary, which functions on a continuous basis to achieve a set of goals

- Managed and coordinated =involving management hierarchy in decision-making
- Social entity = people interacting with each other
- Identifiable boundary = distinguishing members from non-members

The interaction patterns that people follow in an organization are deliberately channelled in directions which promote the organization's interests, which means that interaction patterns have to be coordinated and the results of that interaction have to be monitoring.

Organizational structure - the degree of complexity, formalization and centralization in an organization

- *complexity* means the extent of differentiation within the organization, includes the degree of specialization and division of labour
- *formalisation* means the degree to which an organisation relies on rules and procedures to direct the behaviour of employees
- *centralization* means where the responsibility for decision-making authority lies
  - centralized: just a few executives, or even one person, make the relevant decisions
  - decentralized: a greater number of people are involved in decision-making

Organization Theory - the discipline that studies the structure and design of organizations

Organization design - the construction and change of an organization structure to achieve the goals

Organisational behaviour - the study of the way in which individuals and teams behave in the workplace

System - a set of interrelated and interdependent parts which interact to produce a unified outcome

- *closed system* is self-contained system that has no interaction with its environment

Doesn't exist solely closed-system organization apart from utopian communities or self-contained religious groups. Even those are only temporarily closed

- *open system* is a dynamic system that interacts with and responds to the environment

Characteristics of an open system:

- environment awareness means that the organization constantly interacts with its environment
- feedback means that the system adjust to information from the environment
- cyclical character (consists of cycles of events)
- tendency towards growth
- steady state means that the system is unchanged over long periods of time
- movements towards growth and expansion (sophisticated system)
- subparts are in balance and able to adapt to the environment
- equifinality is the ability to reach the same state by a variety of paths

Organizational life cycle - the pattern of predictable change through which the organization moves from start-up to dissolution

Life cycle stages:

1. Entrepreneurial stage: the formation stage
    - uncertain goals
    - high creativity and managerial input
    - maintaining a steady supply of resources such as capital and labour
2. Collectivity stage: the stage continues the innovation of earlier stage
    - organization's mission is clarified
    - communication and structure within the organization remain informal
    - high commitment, long hours of work
3. Formalization-and-control stage: stabilization of the operation of the organization
    - formal rules and procedures are introduced
    - decision-making is clarified
    - efficiency and stability become more important
4. Elaboration-of-structure stage: reaching a large size and bureaucracy
    - searching for new products and growth opportunities
    - structure becomes more complex and elaborated
    - decision-making is decentralized
5. Decline stage: demand for its products or services shrinking
    - new opportunities searching

- conflict promoted by shortage of resources and disagreements over strategy
- making decisions become more centralized
- the organization ceases to exist

Organization theories:

- positivism: an assumption that the world may be known and improved by extending knowledge through research
- normative: developing theories which may be applied across a wide range of situations
- critical theory: an approach to studying organizations which concentrates on their perceived shortcomings and deficiencies
- postmodernism: an approach to studying organizations which emerged from European philosophical origins and rejects traditional approaches to studying organizations

CHAPTER 2 – The evolution of Organisation Theory

Before the Industrial Revolution:

- farmers and labourers were hunting and forming their own food making own supplies
- manufacturing was done in people's homes using hands tools or basic machines
- almost fully self-sufficient

People worked for themselves not for a wage. In 1820 only 20% of U.S. population dependent on wage

After the Industrial Revolution:

- mass production appeared = low-skilled workers, repetitive tasks, high-tech and new machinery on the production
- modern industrial structure = departmentalization, division into workers, managers and general managers, working for wages, management control – supervisor)

Basic principles of modern organizations:

1. division of labour = breaking down tasks into simple components, repetition and specialization
2. bureaucracy = hierarchy, written rules and laws, formal selection procedures - selection of employees who fit in
3. rational system perspective = goal specification and formalization

CLASSICAL PERSPECTIVE 1900 – 1930

- closed system perspective (without considering the impact of environment)

- managerial problems such as disciplining labourers, enhancing efficiency and controlling labour unrest

Gold: to organize jobs as efficiently as possible (to minimize inputs and maximize output)

Frederick Taylor and *scientific management*

Frederick aimed to improve efficiency of factory work organizing work at the lowest level of the organization.

He initiated a movement oriented to achieve the "one best way" jobs should be done by systematizing and standardizing jobs:

- equal division of responsibility between managers and workers
- shift in power from worker to manager
- managed production as a science
- deskilling of work
- centralization of decision-making
- manager's responsibility was to train and motivate and workers (using punishments)

Henry Fayol and *the 14 principles of organization*

Henry developed principles for the whole management to identify the functions which a manager should perform:

1. Division of labour, specialisation
2. Authority must equal responsibility
3. Discipline (obeying and respecting rules)
4. Unity of command (only one superior for the group of employees)
5. Unity of direction (same tasks for one departments)
6. Subordination of individual interests to the general interests (no individual interests)
7. Remuneration (fair wages)
8. Centralization
9. Scolor chain (communication should follow the line of authority)
10. Order (people and materials should be in the right place at the right time)
11. Equity (being kind in fair)
12. Stability of tenure or personal (replacement has to be available to fill vacancies)
13. Initiative by employees
14. Espirit de corps (team spirit for the harmony)

Max Weber and *bureaucracy*

Weber created the "ideal type" organization structure based on:

- division of labour

- clear authority hierarchy
- formal selection procedures (finding best employees for the job)
- detailed rules and regulations
- impersonal relationship
- employment decisions based on merit
- career tracks
- separation of members' organizational and personal lives

Ralph Davis and *rational planning perspective*

- development of clear goals
- plan to achieve these goals is identified
- the structure of organization is contingent on the organization's objectives

NEOCLASSICAL PERSPECTIVE 1930 – 1960

- closed system perspective
- managerial problems such as motivating people, strengthening commitment, coordination and planning

Elton Mayo and the *Hawthrone Studies*

Elton considered the individual and social context realizing that employees have social and psychological needs

- responded to the way employees wear treated in scientific management so that human/social element became more important in the workplace (for example, interrelationship between co-workers and group work)
- social factors became as important as financial factors for productivity
- individual workers considered as part of a group

Douglas MC Gregor and Theory X and Theory Y

- Assumptions of managers according to the Theory X about the nature of human beings:
  - employees dislike work and are lazy
  - employees must be coerced, controlled or threatened with punishment to achieve goals
  - employees display little ambition without an appropriate incentive system

Assumptions lead to the authoritarian management style

- Assumptions of managers according to the Theory Y about the nature of human beings:
  - work is natural as play
  - employees can be ambitious, self-motivated, exercise self-control and take responsibility
  - employees want to do well at work

Assumptions lead to the management style based on climate of trust and employee development

Socio-technical Systems

As the result of a great number of strikes new system appeared. Employees' work lacked challenge and opportunity to advancement, so sociotechnical system was an attempt to make work more interesting and challenging by improving the quality of working life:

- job design principles were developed
- involving workers in decision-making
- multidisciplinarity of group (different disciplines working together)
- autonomous work groups (workers were provided with responsibilities)

Human Relations School

Efficiency in Human Relations School stay as important as in the classical school (early management theories)

- closed system perspective
- social aspect of work was next to the efficiency and productivity levels
- most managers were aware of the influence that human behaviour had on organizational outcomes

UNMANAGEABLE ORGANIZATIONS 1950 – 1970

- very large and complex organizations with a great number of hierarchy levels
- no focus on customers and environment, still a closed-system perspective
- strict management control
- a lot of strikes
- complex bureaucracies
- lifetime employment

The Peter Principle - promotion until incompetence

Peter researched large organizations and suggested that people get promoted on the regular basis until they become incompetent. So the decision was to move managers horizontally by giving them longer job titles

Parkinson's law

Parkinson proposed a number of laws relating to organizations:

- work expands to fill the time available for its completion
- expansion of the number of administrators compared with workers
- time spend on any item on the agenda is in inverse proportion to its importance

Herbert Simon and *satisficing decision making*

Simon studied decision-making in complex organizations and noted that:

- there is no possibility to fully processed all the information available in their organization
- rational decision-making was replaced by satisfying decision-making which was good enough

March - *garbage can of choices*

March observed the process of decision-making in complex and large organisations and noted that:

- organization had problems with coordinating the flow of information in constantly changing external environment
- garbage can of choices means that decision-making process was unlikely rational

MORDEN ORGANIZATION THEORY 1960 -1980

- open system perspective (considering the environment, understanding the outside influence)
- managerial problems such as coping with the complexities of scale and scope - different products, markets, technologies and countries, determining the best structural form

Contingency Theory

- open system approach
- there is no best way to organize a company
- the structure of an organization is contingent which means that structure depend on outside pressures that can be identified and analysed
- improving organizational effectiveness instead of efficiency

Contingency factors:

- environments (stable or dynamic)
- strategy (to be as efficient as possible/to increase production outcomes/to be more Innovative or creative)
- technology (division of labour/non-routine work, the level of specialization, autonomy)
- size (large or small organizations)

POSTMODERN THEORIES 1980 – today

- managerial problems such as coping with competition from low-wage countries, variety of goals, flexibility, innovativeness, quality, ..
- effectiveness instead of efficiency
- configurations of different systems
- power and politics (decision making is for the people with power)
- culture becomes important
- criticism (assumption that organisations of classical school are arenas of exploitation - poor work conditions, low quality)

- equality (organizations depend on actions of individuals (the meaning of equality was redefined))
- social construction of reality (interpretations and perceptions for employees and managers differ)

Symbolic-interpretive perspective:

- concerns more with behavioural than structural issues
- concentrates on relationships between people and different interpretations of the language
- realization that business researchers are lacking knowledge of psychology, anthropology and other behavioural disciplines

Peter and Waterman's *"In search of Excellence"*

- culture had a significant impact on effectiveness (national and corporate culture is the key to the strength of the company)

Efficiency – reducing input and increasing output (produce as much as possible for less time)

CHAPTER 3 - Organizational effectiveness

Organisational Theory clarifies which organization structure will lead to, or improve, organizational effectiveness

Organization means collective of people

Organizational Effectiveness criteria:

1. overall effectiveness
2. productivity
3. efficiency
4. profit
5. quality
6. accidents
7. growth
8. absenteeism
9. turnover
10. job satisfaction
11. motivation
12. morale
13. control
14. conflict/cohesion
15. flexibility/adaptation
16. planning and goal-setting
17. gold consensus
18. internalization of organizational goals
19. role and norm congruence
20. managerial interpersonal skills

21. managerial task skills
22. information management and communication
23. readiness
24. utilization of environments
25. evaluation of external entities
26. stability
27. value of human resources
28. participation and shared influence
29. training and development emphasis
30. achievement emphasis

All 30 criteria cannot be relevant to every organization, and certainly some are more important than others.

Organizational effectiveness - the degree to which organization attains its short and long-term goals, the selection of which reflects strategic consistencies, the self-interest of the evaluator and the life stage of the organization.

- *The goal attainment approach* states that an organization's effectiveness should be judged by whether it has achieved what it sets out to achieve

(Goal attainment approach is probably the most widely used approach to measure effectiveness)

For goal attainment approach to be viable measure of effectiveness:

- organization must have goals
- goals must be explicit, sufficiently clear and widely known
- goals should be of a manageable number and should reflect areas important to the organization
- there must be general consensus on these goals
- progress towards goals must be measurable and there should be a time limit attached to them

Drawbacks of the approach:

- in the large company's goals varies according to the person who is setting them
- the difference between goals that the company sets officially and real ones
- the difference orienting of short-term and long-term goals
- goals that are compatible to each other because of the diversity of interests within organization

Organizations exist to achieve goals - the problem lie in their identification and measurement.

- *System approach* states that an organization's effectiveness should be judged on its ability to acquire inputs, process them, distribute the outputs, and maintain stability and balance between the various subsystems of the organization

System approach implies that:

- organizations are made up of interrelated subparts
- if any of these subparts performs poorly, it will negatively affect the performance of the whole system
- management should maintain good relations with all the consistencies

- vacancies created must be filled, outdated technology replaced etc.
- mechanism produces goods and services in the repetitive cycles

Drawbacks of the approach:

- not all process variables are easy to measure
- hard to understand is the whole system improving or not

System approach increases the managers awareness of the interdependence of organizational activities and of the need for continuous improvement and that such improvement takes time

- *Strategic-consistencies approach* - an organization's effectiveness is determined by how successfully it satisfies the demands of those consistencies in its environment from which it requires support for its continued existence

Strategic-consistencies approach implies:

- the organization becomes a "political arena" in which vested interests compete for control over resources in order to satisfy environmental demands

Political arena - the organization has a number of important consistencies, each with different degrees of power and each trying to have its demands satisfied

- managers pursue a number of goals and that those selected represent a response to those interest groups that control the resources necessary for the organization to survive

Examples of consistencies: shareholders, employees, customers, locals, suppliers..

Drawbacks of the approach:

- separating the strategic consistencies from the larger environment is difficult, especially in quickly changing world
- approach also assumes that an organization's basic goal is survival, which may not be the case in many situations

It is important for managers to understand who it is that survival depends upon. If management knows whose support it needs if the organization is to maintain its health, it can modify its preferred ordering of goals as necessary to reflect the changing power relationships with is strategic consistencies

- *The balanced scorecard approach* – technique to evaluate effectiveness which seeks to balance the various demands in the organization with its capabilities

Making the balanced scorecard approach operative:

- all organizations must have access to finance and hence they have financial demands and constraints
- it is important how the product or service contributes to creating value for customers
- concentration on what the company must do internally to meet the customer's expectations
- searching for ability to develop and introduce new products of value to customers and clients

Drawbacks of the approach:

- the utility may be limited if what is chosen to be measured is not important
- organizations long-term survival depends on having sufficient slack of resources in order to avoid crisis

Approach involves reasonably wide range of managers and stakeholders in the process of nominating what is important for their organization

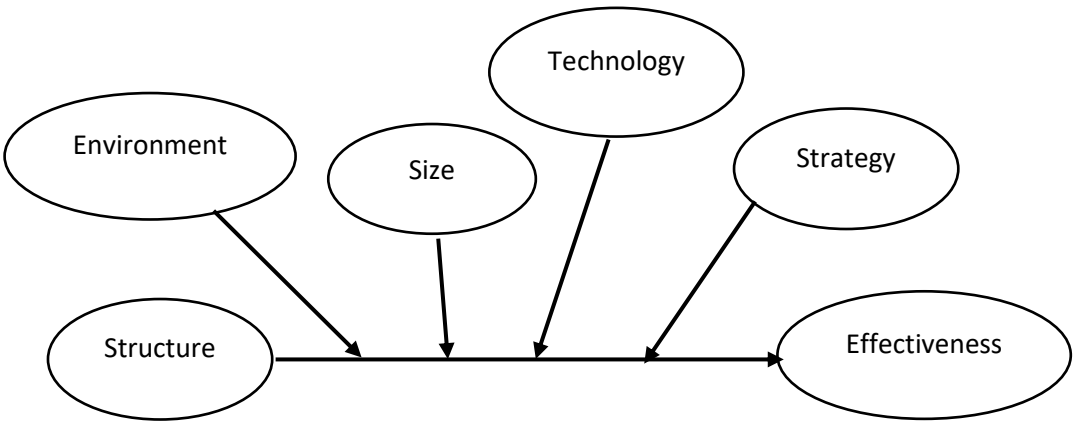
VALUE TO MANAGERS:

- *Goal attainment approach*
  - managers ensure that goals of the organization are SMART = specific, measurable, achievable and time-bound
  - managers ensure that input is received from all those who have a major influence on formulating and implementing the official goals
  - managers observe the behaviour of organization managers
  - managers reduce the degree of incompatibility between goals
  - managers ensure the organization pursue both short and long-term goals
  - managers realize that goals have to change over time, they are not fixed purpose

- *System approach*
  - focused on continuous improvements
  - managers are aware of the interdependence of organizational activities
  - approach is applicable where end goals are not clear or measurable
  - system is efficient as organization work in repetitive cycles

- *Strategic consistency approach*
  - managers understand who it is that's why all depends upon
  - ghosts are ordered to make sure supports from the consistencies will be received
  - the system is efficient

The effectiveness of an organization structure is contingent upon the fit between the structure and various contingency variables (strategy, size, environment and technology)



CHAPTER 4 – Dimensions of organisation structure

The structure of an organisation refers to its overall dimensions, characteristics and areas of responsibility.

Organisational structure;

- complexity
- formalization
- centralisation
- coordination

COMPLEXITY

- *Horizontal differentiation* - the degree of differentiation among units based on the orientation of members, the nature of the tasks, their education and training (refer to the number of departments of the organisation)

Types of horizontal differentiation:

- By task or function

+ efficiencies similar specialities with common skills, knowledge, orientations

- poor communication

- By product or service

+ specialisation in particular products, experts in their industry, being close to customers

- duplication of function

- By location geography

+ effective handling of specific regional issues

- duplication of functions, being isolated from other areas

- By customer or client

+ close to customer demands and expectations

- duplication of functions, limited view on organisational goals

- By process customer project flow

+ efficient flow of work activities

- only usable for a certain type of products

Benefits from the division of labour (horizontal differentiation):

- physical limitations (for one person to perform all required tasks it will take months of full-time effort)

- solve limitations of knowledge (the greater the skill levels required, the more likely the jobs will be highly specialised)
- efficiency (skills and knowledge of a task increase through repetition and concentration)
- simplify training (it is easier and less costly to train workers to undertake specific and repetitive tasks)
- workers undertake tasks that they are good at
- areas of responsibilities are clearly defined

- *Vertical differentiation* - the number of layers of management

The more levels exist between top management and lover management workers:

- the greater the potential for communication breakdown
- the more difficult it is to coordinate the decisions of managerial personal
- the more likely that political and power plays will slow decision-making

Many layers of hierarchy -> tall organisation

Only a few levels of hierarchy -> flat organisation

The span of control - the number of subordinates that a manager can supervise effectively

A large number of subordinates -> wide span of control -> flat organisation

Only a few subordinates -> narrow span of control -> tall organisation

Spatial dispersion - the extent to which the organisation facilities and personnel are spread over a wide geographical area

Layers of management:

1. Top management - sets the strategic direction of the organisation
2. Middle management - implements the plants of senior management + supervise lover level management
3. Lower level management - completes day-to-day tasks of supervising the production of goods and services

The higher the complexity, the greater amounts of attention management must give to dealing with problems of communication, coordination and control, and the maintenance of the organisation itself.

FORMALIZATION - the degree to which jobs and procedures within the organisation are standardized

Formalized organizations are plenty of rules and procedures which determine:

- what is to be done
- when it is to be done
- how it should be done

Work is standardized -> strict procedures are followed to run the process, problems are standard, for solving them standard solutions are used.

The greater the professionalization of a job, the less likely it is to be highly formalised.

Formalisation techniques:

- Selection (choosing employees that will fit into the organisation)
- Role requirements (task requirements are explicit and defined in great detail)
- Rules, procedures and policies
- Rules state a particular and specific required behaviour pattern
- Procedures - a series of interrelated sequential steps that employees follow to accomplish tasks
- Policies - guide employees in decision making in order to show a direction to the goals
- Socialisation (adaptation process by which individuals learn the values, norms, expected behaviour patterns for the job and the organisation)
- Training (the program used to teach employees preferred job skills, knowledge and attitudes, as well as to introduce employees into organisation's objectives, history, rules and policies)
- Rituals (essentially communal activities like informal lunches, drinks, sports activities. Rituals can extend to the style of clothes and company songs)

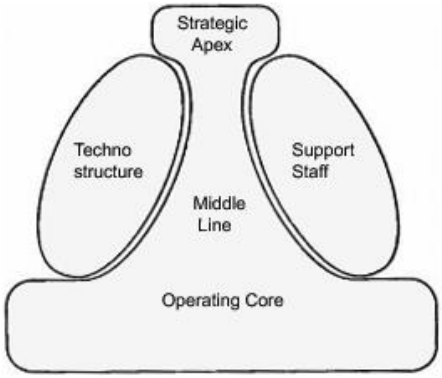
CENTRALISATION - the degree to which decision-making authority is centralised at the top

Centralisation of decision making:

- a comprehensive perspective is needed to choose actions that will benefit the whole organisation
- improved efficiency by controlling financial decisions and avoiding special interests
- helps survive in times of crisis

Decentralisation of decision making:

- avoid information overload for managers
- avoid the need to process information through all vertical hierarchy making the response to changes faster
- more detailed input in decision making
- ability to have the input of different specialists in decision-making process
- motivate employees by allowing them to participate in the decision-making process
- developes decision-making skills in lower-level management



COORDINATION - the process of integrating the objectives and activities of the separate units of the organisation in order to achieve organisational goals efficiently

- Programmed coordination includes planning, goal setting, scheduling, timetabling, sequencing, developing various types of standard operating procedures
- Individual coordination includes coordinating the work of others, especially when unusual circumstances demand a unique solution to a problem
- Informal coordination - coordination of employees among themselves on a day-to-day basis, which includes discussions, formal/informal meetings, emails, telephone calls, casual talks

ORGANISATION DESIGN OPTIONS

Configuration - a complex clustering of elements that are internally cohesive and where the presence of some elements suggests the reliable occurrence of others

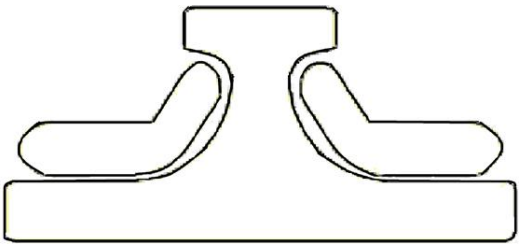
Common elements in organisations:

1. Operating core - employees, who perform the basic work related to the production of products and services
2. Strategic appex - top-level managers, who are charged with the overall responsibility for the organisation
3. Middle line - managers, who connect the operating core to the strategic appex
4. Technostructure - analysts who have responsibility for developing the programs, procedures and rules, which standardise the work of the organisation
5. Support stuff - people who feel the stuff units that provide indirect support services for the organisation

There are five distinct design configurations and each one is associated with the domination by one of the five basic parts.

THE SIMPLE STRUCTURE (Strategic appex is dominant)

Features of the simple structure:



- Low in complexity
- Little formalisation
- Authority centralised in a single person (usually owner)
- Flat organisation (few levels of hierarchy)
- Only strategic apex and operating core

Strengths and weaknesses:

+ simplicity of the structure

+ fast decision making

+ operations are flexible and require little cost to maintain

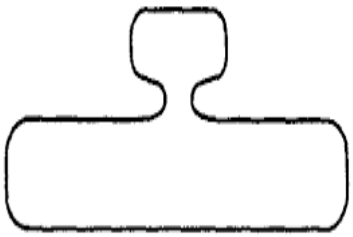
+ accountability is clear

+ goals are clear

-applicable only to small organisations

-power is concentrated in one person, who could be in lack of managerial skills etc.

-organisation's decision making centre is irreplaceable



The simple structure is effective when the number of employees is small, informal communication is generally effective and the cost of production is low.

THE MACHINE BUREAUCRACY (Technostructure is dominant)

Features of the machine bureaucracy:

- Highly routine operating core
- Functional departments
- Formalised rules and regulations
- Centralised authority
- Standardisation

Strengths and weaknesses:

+ ability to perform highly standardised activities in a highly effective manner

+ economies of scale

+ minimalisation of duplication of personnel and equipment

+ simplifies the way people communicate as they have the same background

+ requires less talented and less costly middle and lower level managers

-poor at adapting to change

-subunit conflicts in the process of setting goals and transfer of knowledge

The machine bureaucracy is effective when matched with large size, a stable environment and a technology that permits standardised routine work

THE DIVISIONAL STRUCTURE (middle management is in control)

Features of the divisional structure:

- A set of autonomous self-contained units, each typically configured as a machine bureaucracy
- Each division has the divisional manager responsible for its performance
- Managers hold strategic and operating decision-making authority in relations to their businesses
- Divisions have support services
- Divisional general managers are answerable to the senior managers in the head office

Examples of machine bureaucracy

MASS PRODUCTION FIRMS:

- CAR AND STEEL INDUSTRIES
- BANKS
- INSURANCE COMPANIES
- POST OFFICES
- AIRLINES
- RAILWAYS

Strengths and weaknesses:

+ clear accountability and responsibility for their performance of each division

+ Head Office staff is focused on the long-term problems

+ strategic decision-making is done at headquarters

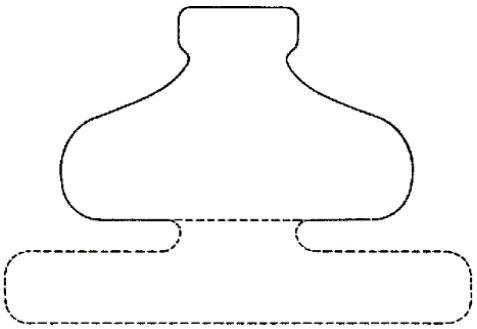
+ trained and qualified general managers

+ a loss of one division will have a minimal effect on the entire organization

-duplication of activities and resources, which leads to increasing costs and reducing efficiency

-it is hard to make cooperation between divisions as well as coordination of personnel

The structure is necessary because of the product or market diversity. With increasing size of the organisation it becomes more and more relevant to make divisionalisation. To make the structure applicable environment has to be neither very complex nor very dynamic, as well as technology must be divisible.

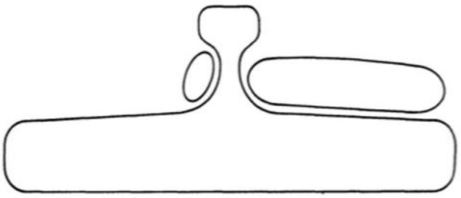


THE PROFESSIONAL BUREAUCRACY (operating core is in charge)

Features of the professional bureaucracy:

- highly trained specialists in the operating core
- decentralisation of decision making
- support staff focused on serving the operating core
- structure is high in complexity
- many rules and regulations

Strengths and weaknesses:



+ ability to perform specialised tasks

+ autonomy helps to do managers' jobs effectively

-conflicts between subunits, because employees place their interests over organisation's ones

-difficulties with adapting to changes

-limitations on the complexity of work that can be carried out

-difficult to set strategic priorities as there is no clear strategic appex

The professional bureaucracy is most efficient when a complex and stable environment exists.

Examples of professional bureaucracy

- HOSPITALS, SCHOOLS, UNIVERSITIES
- MUSEUMS, LIBRARIES
- SOCIAL SERVICE AGENCIES
- ENGENEERING DESIGN FIRMS
- MANAGEMENT CONSULTANCIES

THE ADHOCRACY (dominant -?)

Features of the adhocracy:

- high horizontal differentiation
- low vertical differentiation

- intensive coordination
- great flexibility
- responsiveness
- few rules and regulations
- decision-making is decentralized
- little standardization and formalization
- no technostructure

Strengths and weaknesses:

+ ability to respond quickly to change and innovation

+ ability to facilitate the coordination of diverse specialists

+ ability to be creative

-no clear boss-subordinate relationships

-inefficient configuration

-vulnerable design

The adhocracy is applicable only under certain circumstances. Structure is used to solve non-routine problems, where environment will be dynamic and complex.

Is often used as temporary structure.

CHAPTER 5 – Strategy

Strategy - the adoption of courses of action and the allocation of resources necessary to achieve the organization's goals (+determination of the basic long-term goals)

Strategy is one of the fundamental influences on the way organisation is managed

Tactics/tactical decisions (≠ strategy) are day-to-day decisions associated with implementing plans and operating the expertise

Two approaches how an organisation can determine its strategy:

- *Planning mode* - views strategy as a plan or explicit set of guidelines developed in advance
  - starts with identifying the direction, then develops a systematic and structured plan to get there
  - rationality plays a significant role to create a well-thought-out process
- *Evolutionary mode* - views strategy as a pattern in a stream of significant decisions that evolves over time
  - acknowledges the unpredictable process involved in strategy formation

Environmental factors and organisational capabilities -> strategy -> structure

Levels of strategy:

- Corporate level strategy (more than one line of businesses)
  - defines the nature of businesses in which the film should operate
  - defines the role of each businesses in the organisation
- Business level strategy
  - defines the way to compete in each of our businesses
  - for the small organisations in only one line of activity or the large organisations that avoided diversifications

STRATEGY-STRUCTURE RELATIONSHIP

- Miles and Snow's four strategic types:

They classified organisations into 1 of 4 strategic types based on the rate at which they changed their products and markets

1. *Defenders* - organisations whose strategy is to produce a limited set of products directed at a narrow segment of the total potential market

   - fight aggressively to prevent competitors from taking market share or customers from them - aggressive pricing or production of high-quality products
   - ignore developments and trends outside their current areas of interests
   - intensive learning oriented towards costs and other efficiency issues

Features:

- high horizontal differentiation and normalization
- highly specialised tasks, division of labour
- centralised control and decision making
- formal hierarchy for communication and coordination

2. *Prospectors* - organisations whose strategy is to find and exploit new product and market opportunities

- innovations are more important than high profitability

- develop and maintain the capacity to survey a wide range of environmental conditions, trends and then introduce new products based on their research

Features:

- flexibility
- standardization and routinisation
- decentralisation
- formalization is low
- lateral and vertical communication

Examples: internet biotechnology companies, magazine publishers, fashion companies, advertising agencies

3. *Analysers* - organizations whose strategy is to move into new products or markets only after their viability has been proven
- minimisation of risks, adaptation of only proven innovations
- maximisation opportunity for profit

Features:

- flexibility and stability
- parts of organisation - manufacturing and distribution have high levels of standardization, routinization and automatization
- parts of organisation - marketing and product development are adaptive and flexible

Examples: mass market fashion and retailers

4. *Reactors* - organisations that follow inconsistent and unstable patterns (one of the other three strategies is pursued improperly)
- respond inappropriately, perform poorly
- are reluctant to commit themselves to specific strategy
- lack of response mechanisms with which to face a challenging environment

Strategy is the result of management mistakes

- Porter's competitive strategies:

Porter suggests 3 strategies for organisations, the choice of which has to develop on the organization's strengths and competitor's weaknesses

1. *Cost leadership strategy* aims to achieve the lowest cost within an industry
- high in complexity, high in formalisation and high in centralisation
- efficiency of operations
- economies of scale and minimalisation of overheads
- technological innovations
- low-cost labour
- preferential access to raw materials

2. *Differentiation strategy* aims to achieve a unique position in an industry in ways that are widely valued by buyers
- low in complexity, low in formalisation and low in centralisation
- flexibility
- high quality/extraordinary service/innovative design/technological capability/unique brand image

3. *Focus strategy* aims at cost advantage or differentiation advantage in a narrow segment
- special focus for selected segment of industry (product variety, type of buyers, distribution channel,..) with the goal to develop a narrow segment of market

4. *Stuck in the middle* organisations are unable to gain a competitive advantage through one of varieties strategies and are unlikely to achieve long-term success

- Bartlett and Ghoshal's strategy and globalisation:

	Low pressure for local responsiveness	*High pressure for local responsiveness*

High pressure to reduce costs	*Global strategy* is adapted where a product can be sold in most markets with very little modification. Strategy is to lower costs by selling common products on a global basis. Examples: motor vehicle manufacturers and oil companies	*Transnational strategy* attends to achieve maximum local responsiveness while achieving world wild economies of scale. Firms are considered as stateless with no obvious country of location (rarely found in practice)
High pressure to reduce costs	*International strategy* requires firms to transfer valuable skills and product knowledge to overseas markets. Research and development is centralised in a home market, but manufacturing, distribution and marketing is carried out locally. Head office maintains tight control over key technologies. Examples: McDonald's, Microsoft and Nestlé	*Mutidomestic strategy* aims to achieve maximum local responsiveness with products customised to meet local conditions. Organisation has to be close to the customers. Examples: building material companies, service industries (banks)

THE INDUSTRY STRUCTURE RELATIONSHIP

Industry -> strategy -> structure

Industry - an important factor influencing strategy, which differs in terms of growth possibilities, regulatory constraints, barrier to entry, capital requirements, product life cycle, long-term prospects, technologies..

	High capital requirements	*Low capital requirements*
High product innovation rate	A type - large organisation with limited number of competitors. High in complexity and decentralisation, procedures are standardised. Examples: telecommunication firms, aerospace	B type - small firm with task specialisation and formalization (lower than D), high product innovation. Examples: Computer Software manufacturers, magazine publishers

Low product innovation rate	C type - large organisation with limited competitors. High in complexity, procedures are standardised, less decentralized than a type Examples: metal and mining, appliance manufacturers	D type - small firm high task specialisation and formalization. Low product innovation Examples: retail building materials sales, bicycle manufacturers

CHAPTER 6 - Organisation size

Organisation size - the total number of employees in the organization

Peter Blau: there is an increase in complexity of organization as size increases, but the rate of increase diminished once a certain size is reached.

Size is one of the most important conditions affecting the structure of organization

Increase in size -> increase in complexity, differentiation, specialization and formalisation (+ decentralization)

SIZE-STRUCTURE RELATIONSHIP

- Size and complexity

Size affects complexity at a decreasing rate in government organizations (for business firms it is questionable)

Size generates differentiation, whereas increasing differentiation also generates increasing size

Size has strong effect on vertical differentiation, it is dominant predictor of vertical differentiation, explaining between 50% and 59% of the variance

Size and horizontal differentiation has relationship in the way that increasing size increases the division of labour, but a decreasing rate

- Size and formalisation

Increase in size increases the level of formalisation (more rules and regulations)

If a small firm is a subsidiary of a larger firm, we can expect the former to have higher formalisation than its size alone would dictate.

- Size and centralisation

When organisation increases in size, some activities or parts of organisation remain centralised, where is became more decentralized

(Decisions anyway have to be made in accordance with the desires of top management)

Organisation with less than 1500 employees tend to be labelled as small

Once in organisation has approximately 2000 members, it is considered as large one and adding employees would have a minimal impact on its structure

Common problems to most large organisations:

- the growth of bureaucracy, environment changes faster than the rules and regulations, leading to misfit between what organisation is actually doing and what the environment is demanding
- the need to gather and process information and turn it into knowledge (there is a significant amount of data, that in themselves are of little use, it has to be processed)
- the need to adapt to changing technologies and product life cycles
- extended time frames for action (it can take a long time to realise that the change is required as well as determine if change is working or not)
- knowing where profits are being made and costs incurred (it is difficult to allocate costs and revenues to individual products)
- difficulty in managing over a wide geographic area (as most large organisations operate in different markets and regions, they have difficulties with employing people from different cultures, adapting products and services to suit local conditions and maintaining control over operations that are far away from the head office
- bounded rationality (it is impossible for one person or even a group of people to fully understand all that is going on)

Several structural solutions can be applied to these problems that can contribute to the efficient management:

- divisionalisation, when organisation is divided into small manageable parts their own goals, management, staff and facilities
- outsourcing parts of organisation by letting other firms to undertake some operations
- finding a balance between what's this season's centralise and decentralize
- structuring to facilitate change - reduce power distance, support new ways of recognising and solving problems, respond to current and future needs
- ensuring that important tasks have someone responsible for them
- physically separate those areas of the organisation which undertake different types of work

SMALL BUSINESSES

- minimal degree of horizontal, vertical and spatial differentiation
- low formalization
- high centralisation (usually one owner)
- have small influence over their environments

The reasons leading to downsizing:

- increased competition, which means that all in an industry must strive to match the lowest cost producer
- computerisation and automation, which means that fever people can do an equivalent amount of work
- technological obsolescence, which means that new technologies and Innovations reduce the need for technicians
- declining profitability
- information technology and meddle management. By the increasing use of IT many middle managers no longer have meaningful work, as controlling, coordinating and decision-making could be done without them
- the realisation that size itself doesn't bring advantages – poor adaptation to change
- changes in strategy
- changes in structure
- the rise of outsourcing (it is easier and cheaper to purchase goods and services from specialist companies than produce them)

Benefits from downsizing:

- lowered overheads
- Less bureaucracy
- faster decision making
- smoother communication
- great entrepreneurship (more innovative behaviour on the part of management)
- Increased productivity

CHAPTER 7 - Technology

Technology - the information, equipment, techniques and procedures required to transform inputs into outputs (include physical processes as well as mental concepts which are part of the information required to complete tasks)

- Joan Woodward's research

Her research was the first major attempt to view organisation's structure from technological perspective.

The research is manufacturing based, so it is applicable only to manufacturing industries, which represent less than a third of all organizations.

Three types of technologies:

1. Unit production - technology where units are custom-made and work is non-routine (small-batch production)

- the least technological complexity
- low vertical differentiation
- moderate span of control
- low proportion of administrative and support staff personnel
- high proportion of skilled workers
- low overall complexity
- low formalization
- low centralisation

Examples: locomotives, turbines for hydroelectric installations, special purpose vehicles)

2. Mass production - large-batch or mass-produced technology, routine in nature

- moderate technological complexity
- moderate vertical differentiation
- the highest span of control
- moderate proportion of administrative and support staff personal
- low proportion of skilled workers - high division of labour
- high overall complexity
- high formalisation, clear line of authority
- high centralisation

Examples: refrigerators, motor cars

3.Process production- highly controlled standardized and continues processing technology

- the highest technological complexity
- the highest vertical differentiation
- the lowest span of control
- the highest proportion of administrative and support staff
- high proportion of skilled workers
- low overall complexity
- low formalization
- low centralisation

Examples: oil production, chemical refiners

- Perrow's contribution

Perrow concentrated on knowledge technology to operationalise technology in more general way.

Hence Perrow's model is applicable to all types of work in all nature of industries.

Dimensions of the knowledge technology:

1. Task variability - the number of exceptions encountered in performing a task

High predictability -> low task variability -> few exceptions

2. Problem analysability - the type of search procedures followed to find successful methods for adequately responding to task exceptions, from well-defined and analysable to ill-defined

- Craft technology (non-routine) contains difficult problems but with a limited set of exceptions
    - moderate formalization
    - low centralisation
    - moderate-wide span of control
    - coordination and control is accomplished through trainings and meetings

Examples: custom tailoring, furniture restoring, work of performing artists

- Non-routine technology contains many exceptions and difficult to analyse problems
    - low feminization
    - low centralisation
    - moderate-narrow span of control
    - coordination and control is accomplished through group meetings

Examples: strategic planning, research activities

- Routine technology contains few exceptions and easy to analyse problems
    - high formalization
    - high centralisation
    - wide span of control
    - coordination and control is accomplished through planning and rigid rules

Examples: motor cars, fast food

- Engineering technology (routine) contains a large number of exceptions, which can be handled in a relational and systematic manner
    - low formalization
    - high centralisation
    - moderate span of control

- coordination and control is accomplished through reports and meetings

Examples: construction of buildings, work of accountants

- Thompson's contribution

1. Long-linked technology (routine technology)- a fixed sequence of connected steps: sequentially interdependent tasks

Input -> A -> B -> C -> D -> Output

- High level of coordination between activities
- High uncertainty
- Vertical differentiation
- Standardization
- Moderate complexity
- Moderate formalization

Examples: mass-production, aeroplane journey

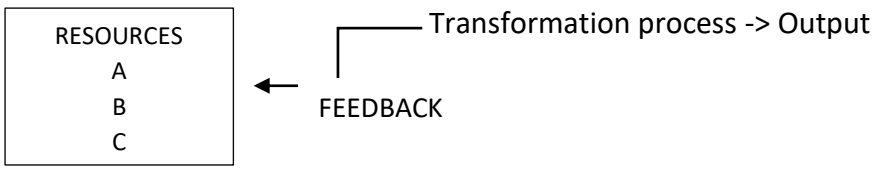
2. Mediating technology (routine technology)- the process of linking together different clients in need of each other's services: pooled interdependence

Client A -> Transformation process-> Client B

- Reducing variability in client expectations and behaviour
- High uncertainty
- Standardizing transactions
- Low complexity
- High formalization

Examples: banks, employment agencies, telephone companies, retail stores, insurance companies, post offices

3. Intensive technology (non-routine) - the utilization of a wide range of customized responses, depending on the nature and variety of the problems: reciprocal interdependence



- Flexibility of response
- Uncertainty
- Availability of a variety of resources
- High complexity
- Low formalization

Examples: hospitals, universities, research laboratories, consulting firms, military teams

- Galbraith 's contribution

He considered that as task uncertainty increased, so did the amount of information that had to be processed among decision makers in order to achieve the desired level of organisational performance.

The amounts of information and how this information was processed, became the major determinant of the structure of the organisation.

The processes of transformation - from input to output - has different levels of uncertainty.

Uncertainty is the difference between the amounts of information required to perform a task and the amount of information already processed by the organisation.

General strategies for handling uncertainty:

1. Rules and regulations
2. Hierarchical referral
3. Goal setting

When handling uncertainty is no longer effective, the organisation can:

- reduce the need for information processing - low uncertainty

4. creation of slack resources (increase the time necessary to achieve the goal make stacks of inputs)

5. creation of self-contained tasks (reduce complexity by creating groups which have all the necessary resources to complete their tasks, reduce the need to coordinate and communicate with other groups)

- increase the capacity to handle information - high uncertainty

6. Investment in vertical information systems

7. Creation of lateral relations (create coordinating positions)

TECHNOLOGY AS A CONTINGENCY

Industry ⟹ size ⇔ technology ⟹ organisational structure

In smaller organizations the structure of operations is likely to be dominant by the production process, whereas in large organisations the impact of technology is not so powerful.

MANUFACTURING AND SERVICE TECHNOLOGIES

1. Service technology

- simultaneous production and consumption
- output to suit customers' needs
- customer is part of the production process
- intangible output
- Often labour-intensive

Examples: hairdressers, law firms, medical services, education providers, transport operators

2. Manufacturing technology

- goods can be produced for inventory and later consumption
- output is largely standardised
- few in the company interact with customers
- output is tangible
- generally high levels of capital investment

Examples: car producers, aircraft manufactories, mineral producers, software writing, book production

3.Combined product and service industries: fast food, real estate agents, pension plan providers, retail industries, car hire firms

TECHNOLOGY AND INFORMATION PROCESSING

Information technologies - a generic term covering the application of computerized information- processing techniques to organizational operations

- day-to-day operations (routine accounting tasks, inventory control, information storage, payroll calculations) are used to improve efficiency, particularly in the resource usage
- technologies that improve communication (email, internet, file sharing, teleconferencing) are essential for organization which have a wide geographic spread and a complex range of tasks to undertake
- control systems, that monitor and evaluate the performance of organization (stock management, monitoring bank balances, maintaining budgets, keeping the track of the cost)

- decision support system supports the intellectual process of planning and decision-making (calculating potential rates of return, generating a spreadsheet, scenario planning, quality control)
- codifying the knowledge, implies codification of knowledge and dissemination throughout the organization
- promotes innovations - provides opportunity for areas such as research, design and strategy be dispread, but still communicate with each other
- interorganisational systems - information exchange within organization

The influence of IT on structure

1. Extent of it usage

- decentralized decision-making
- non-routine work => more intensive use of it
- dynamic environment

2. IT and formalization

- more intensive use of it =>
    - increased formalisation
    - reduces routinalisation

3. Impact on communication and coordination

- more intensive use of IT =>
    - improved coordination
    - increased complexity
    - improved communication

4. Impact on middle managers

- more intensive use of IT in centralized organizations =>
    - reduction in the number of middle managers

- more intensive use of IT in decentralized organizations =>
    - increasment in the number of middle managers

5. Impact on decision-making

- decentralised decision-making on the lower-level of organization => more intensive use of IT
- centralized decision-making on higher-level of organizations => less intensive use of it

6. Impact on communication technologies

- more intensive use of it =>
    - dispersion of organizational activities
    - formation of networks and clusters
    - reduced the cost of coordination and integration

7. IT and size

Ability for smaller organizations work together in networks and clusters	<= intensive use of IT =>	Emergence of extremely large and complex organizations	=>	Division into smaller organizations that work together in networks

8. structure of IT department

- centralized decision-making within the organization => centralized decision-making in the department

TECHNOLOGY AND STRUCTURE

- technology and complexity
  routine technology -> low complexity
- technology and formalization
  routine technology -> high formalization
- technology and centralisation
  routine technology -> high formalization -> decentralization
  routine technology -> centralisation

CHAPTER 8 - Environment

Organizations exist within an environment which they must respond to.

Environment consists of factors outside and organizations boundaries.

- *General environment* embodies conditions that potentially have an impact on the organization
- *Specific environment* is the part of the environments that is directly relevant to the organization in achieving its goals (the part of the environment with which management will be concerned, because of the consistencies that can positively or negatively influence the organization's effectiveness)

Environment is changing because of the new competitors, new technologies, pressure by public groups, new customers, loss of major customers, unpredictable price changes - all these factors are called *environmental uncertainty*.

Some of the environmental uncertainties are easier to predict, some of them - impossible (accidents)

- Burns and Stalker's contribution:

They found out that the type of structure that existed in rapidly changing and they dynamic environments was significantly different from that in origins wit stable environments

1. *Mechanistic structure* is characterised by high complexity, formalisation and centralization. Job specialization - each worker only making a small contribution to the final output

Efforts are concentrated on improving technical processes rather than final output. Power and knowledge reside in the management hierarchy. Flow of information and communication is vertical

2. *Organic structures* are a relatively flexible and adoptive, with an emphasis on knowledge. Formalization is low, control-diverse, low complexity, decentralization.

Power and influence derives from knowledge and expertise, rather than position in the hierarchy. Communication is lateral between individuals whatever they are located.

Burns and Stalker believed that the most effective structure is one that adjusts to the requirements of the environment -> mechanistic design for stable and certain environments and organic one for turbulent environments

- Lawrence and Lorsch' contribution:

1. *Differentiation* – task regimentation, job specialisation and attitudinal differences held by individuals in various departments

In terms of different goal perspective, time frame and interpersonal orientation, different interest and points of you appeared

2. *Integration* – the quality of collaboration that exists among interdependent units or departments that are required to achieve unity of effort

Integration devices include rules and procedures, formal plans, the authority hierarchy and decision-making commities.

Lawrence and Lorsch perceived both the organization and the environment as having subparts: parts of the organization deal with parts of their environments.

The more turbulent, complex and diverse the external environment facing an organization, the greater the degree of differentiation among its subparts.

- Duncan's contribution:

1. First dimension - rate of change – some environments change only slowly, over time, when others are characterized by rapid change
2. Second dimension - environmental complexity - the greater the number of elements there are in an environment, the more complex the environment

The combination of a stable environment and low complexity leads to low on uncertainty for organizations

	Complex environment	*Simple environment*

Dynamic environment	High uncertainty- large number of unpredictable external elements => Structural elements: - decentralized, organic structure - many different departments - expensive integration mechanisms - extensive planning - extensive use of laundry spanners Examples: aerospace films, telecommunication and biotechnology companies	Moderate to high uncertainty- few environmental elements, but each changes often and unpredictably => Structural elements: - decentralized with an emphasis on teamwork - constant environmental monitoring by boundary spanners - high level of coordination in order to promote imitation and innovation - production facilities often mechanistic Examples: fashion clothing, music industry, computer games and television programming
Stable environment	Low to moderate uncertainty- large number of dissimilar external elements, which change only slowly => Structural elements: - centralised, formalized and mechanistic structure - differentiated into many departments to meet environmental elements - large number of boundary spanners - programmed coordination and use of planning for integration Examples: motor vehicle manufacturers, banks, oil companies, retail chains	Low uncertainty- small number of easily understood environmental elements, which change slowly Structural elements: - centralised, with high formalization mechanistic structure - few departments - coordination by programs and planning Examples: cement manufacturers, self-drink bottlers, breweries, bakeries

THE ROLE OF THE BOUNDARY SPANNER:

Boundary spanners- people who operate at the periphery of the organisation, performing organisational relevant tasks, and relating the organisation to elements outside it.

Boundary spanners make a great contribution to managing environmental uncertainty:

1. they have expertise in understanding and interpreting the environmental segment with they are concerned with
2. they filter and process environmental information into a form which is useful to their organisation and transmit this information through established channels

3. they protect the core from undue disruption by removing the need for it to interact directly with the environment
4. they represent their organisation to the environment

Dimensions of an environment:

- capacity- the degree to which an environment can support growth (availability to finance, customers, resource inputs and managerial skills)
- stability- the extent to which there is a little change in the environment
- complexity the degree to which environment is concentrated on just a few elements

POPULATION ECOLOGY APPROACH

Population ecology view- the environment selects certain types of organizations to survive and others to perish based on the fit between structural characteristics and the characteristics of their environment (The environment naturally select 'in' some organizations and select 'out' others)

Assumptions of population ecology:

- approach focuses on groups of population, not on individual organisations
- population-ecology defines organisational effectiveness as simply survival
- approach assumes that management has little impact on an organisation's survival
- carrying capacity of the environment is limited (there are only so many organisations that a given community size can absorb
- the existence of a three stage process ->

Variation-> Selection-> Retention

- Within any population of organizations there will be variations in organisational forms ->
    - Organisations that have a form that fits their environment are positively selected and survive ->
        - Selected organisational forms tend to emerge in populations that share common needs for economies of scale, technologies and control systems

Limitations to the population ecology view:

- ignores managerial motives and abilities
- has reduced application to large and powerful organisations as they can insulate themselves against failure
- public-sector organisations efficiency and adaptation are not effectiveness criteria

⇨ population ecology - a special theory applicable to small and powerless organizations

INSTITUTIONAL THEORY

Institutional theory - an approach which integrates an organisation's post actions and the social and environmental pressures on it to explain organisational practices

Theory proposes that organisations are influenced not only by their internal processes but also by the need to adapt to the institutional pressures in the external environment.

Institutional demands:

- Economic and technical demands - to show a profit, innovate and respond to change, respond to the laws and regulations from the government
- Social demands - to confirm the societal values, norms, expectations, practices of other organisations

RESOURCE-DEPENDENCE THEORY

Resource dependence theory- draws on the concept of the open system to promote the ways in which the organisation depends on the environment for its resources

Dependence on resources increases uncertainty for organizations. However, the direction of the uncertainty is generally predictable, its magnitude is not.

THE ENVIRONMENT-STRUCTURE RELATIONSHIP

Some organisations are much more dependent on the environment and certain sub environments than are others. This dependency creates vulnerability for the organizations, which managers attempt to minimise.

Dynamic environment has more influence on structure than a static environment does.

- Environment and structure's complexity

High environment uncertainty leads to a greater complexity

- Environment and structure's formalization

Stable environment leads to high formalization (there is a minimal need for rapid response)

Dynamic environment leads to low formalization of boundary activities while maintaining a relatively high formalization within other functions

- Environment and structure's centralisation

The more complex the environment, the more decentralized is the structure

CHAPTER 9 - Power-control

Power control – view states that an organisation structure, at any given time, is to a large extent the result of those in power, who select a structure that will maintain and enhance their control.

Power is necessary in order to move the organization towards its goals, it is essential component of organizational life.

Each contingency explains only some of the variations in organizational part, but power – control view can explain others.

- Strategic choice by John Child:

Environment, technology, size and strategy limit the choices that managers have (however there is opportunity for managers to make choices favourable to themselves).

1. Decision makers have more autonomy than that implied by those arguing for the dominance of environmental, technological and other forces. Managers can select from among a wide range of viable alternatives which all accommodate the needs of the environment and technology.
2. Organizational effectiveness should be constructed as a range instead of a point.
3. Organizations often have the power to manipulate and control their environment.
4. Perception and evaluation of events are an important intervening link between environments and the actions of organizations (ability to define the threats provides a strong power base)

Rationality – the belief that decisions are goal – directed and consistent.

1. A few assumptions according to rational choices:
2. Rational decision making assumes that decisions regarding structure are made by those charged with the responsibility for making the decisions.
3. Perfect understanding of the problem, no emotional attachment to any particular outcome.
4. It ignores the possibility that others in the organization besides the management might have the power to influence structural decisions.
5. Decision makers always act in the best interest of organization, there are no better alternatives.

Non-rationality – process of decision making that does not follow the principles of logical deduction and decision optimization. Nonrationality does not imply that decisions are random and ill – informed. There is a range of possible outcomes that are acceptable.

Choice making is reflected by self-interest, ideologies, believes, fashion and experience of management.

Modern management techniques aim to merge the interest of the decision makers using reward systems and socialisation.

Coalition – the individual who make up the organization coalesce into groups with familiar interests or values. Coalitions reinforces the political nature of organizations and even plays a part in deciding what is considered rational and what is not.

Dominant coalition – the group within the organization with the power to influence the outcome of decisions and structure (usually senior management / owner of the small organization).

Power – an individual's capacity to influence decisions authority the right to act, or to command others to act, towards the attainment of organizational goals.

Authority contributes to an individual's power, however it is not necessary to have authority to wield power, because one can move horizontally inward towards the power core without moving up the hierarchy (but in general those hire in the hierarchy have greater power those lower down).

Legacy systems – the existing systems, rules, procedures, responsibilities and ways of doing things that are accepted within the organization. The existence of legacy systems leads to large organizations being slow to change, reflect past practices rather than current needs.

Power can be acquired by holding:

1. Hierarchical authority (right to reward and punish workers)
2. Control of resources and ability to reduce uncertainty. A resource must be both scarce and important to organization, because then its supply creates uncertainty to organization and increases the power of those who can reduce uncertainty.
3. Network centrality – the degree to which a position in an organization allows an individual to integrate other functions or reduce organization dependencies.

Power control thesis - an organisation's structure is to a large extent the result of those in power selecting a power that will maintain and enhance their control.

Five areas within organisation where structure creates political arenas:

1. position in hierarchy (status =influence)
2. resource allocation
3. interdepartmental coordination. Relationships between departments are part of organisational life, but this department can really differ from each other, so procedures need to be set and territory defined.
4. Responsibility exceeding out authority. A principle of sound management is that authority should always equal responsibility.
5. structural change - redefining authority and power.

Political tactics are used in the way of:

- Building coalitions based on liking, trust and respect.
- Defining the nature or problems, which will became the main area for political activity as those who define the problem are closer to the decision making.
- Enhancing legitimacy and expertise (reputation).
- Making preferences explicit but keeping power implicit
- Expanding networks of influence

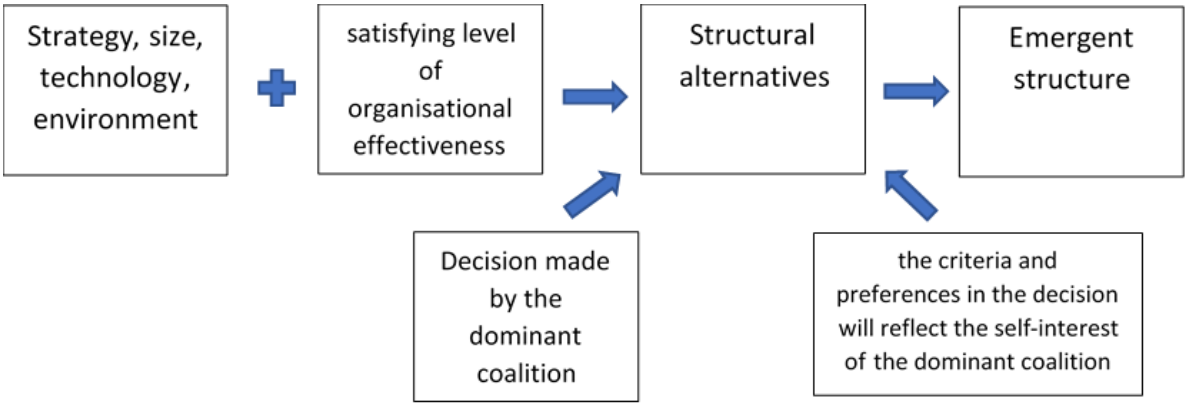
The higher a person is in management, the more likely he / she is to use politics as part of their job.

Organizational slack – a cushion of excess resources that enables an organisation to adjust to environmental change -> opportunity to respond to environmental change without changing the organisation.

The less slack an organisation has, the greater the pressure to optimise organisation structure and tighter the decision parameters will be.

Thus, those in power will select technologies and environments that will facilitate their maintenance of control - stable environments and routine technology.

POWER-CONTROL VIEW ON CONTINGENCY FACTORS AND STRUCTURE.



Decrease in the degree of complexity => increase in the level of control

Increase in degree of formalisation => increase in the level of control

Increase in centralization => increase in the level of control

Module 2: Business Operations Management

! Disclaimer: always check what you need to study corresponds with the content of the summaries, courses can be changed which could cause changes in study material for your exams

This module consists of four courses and a project. The summary for Probability is also usable for Statistics I in module 3. Below you find information about which courses you have this module, and about the summaries for this module. If you made a summary for a course this module you can sent them to education@stress.utwente.nl and depending on how many summaries we have for this course you will receive compensation for your work.

Courses

- Operations Management
- Quantitative Modelling
- Purchasing and Supply Management
- Probability
- Operations Management simulation game (Project)

Summary 1

Course: Operations Management part one*
Book: Slack, N, Brandon-Jones, A., Johnston, R. (2019, 9th edition). *Operations Management*, Pearson.
Chapters: 1, 2, 3, 5, 6, 7, 8, 10, 11
Year the summary was received: 2019/2020

Summary 2

Course: Operations Management part two*
Book: Slack, N, Brandon-Jones, A., Johnston, R. (2019, 9th edition). *Operations Management*, Pearson.
Chapters: 13, 14, 15, 16, 17, 18
Year the summary was received: 2019/2020

Summary 3

Course: Quantitative Modelling*
Book: B.W. Taylor III (2015, 12th ed.). *Introduction to Management Science*, Pearson.
Chapters: 1, 2, 3, 4, 5, 8, 13
Year the summary was received: 2016/2017

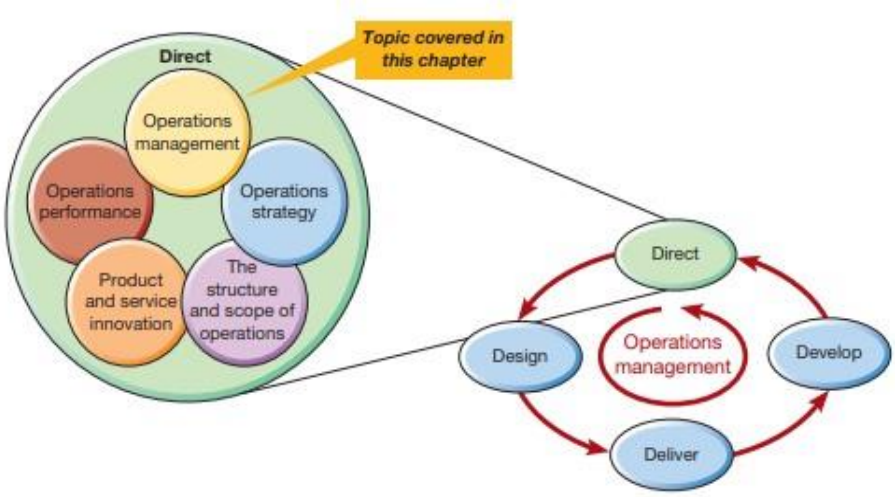
Summary 4

Course: Purchasing and Supply Management
Book: Cousins, Lamming, Lawson, Squire (2008). *Strategic supply management*, Pearson.
Chapters: 4, 6, 7, 8, 13, 14, 16, 18, 19 + slides
Year the summary was received: 2023

* There is another summary available on www.stress.utwente.nl

Summary 1: Operations Management part one

Chapter 1 – Operations management



1. **What is operations management?** – the activity of managing the resources that create and deliver services and products
    - Operations function – part of organization, responsible for this activity
    - All organizations have operations that produce some mix of services and products
    - Operation managers (not called like this in every organization) – the people responsible for managing some or all of the resources that comprise operations function
    - Activities of operations function for various types of organizations:

Internet service provider	Fast food chain	International aid charity	Furniture manufacturer
Maintain and update hardware Update software and content Respond to customer queries Implement new services Ensure security of customer data	Locate potential sites for restaurants Provide processes and equipment to produce burgers etc. Maintain service quality Develop, install and maintain equipment Reduce impact on local area, and packaging waste	Provide aid and development projects for recipients Provide fast emergency response when needed Procure and store emergency supplies Be sensitive to local cultural norms	Procure appropriate raw materials and components Make sub-assemblies Assemble finished products Deliver products to customers Reduce environmental impact of products and processes

2. **Operations in the organization –** operations function is one of the three main functions of every organization:
    - **The marketing (including sales) function** – which is responsible for communicating the organization's services and products to its markets in order to generate customers' requests

- **The product/service development function** – which is responsible for coming up with new and modified services and products in order to generate future customers' requests
- **The operations function** – which is responsible for the creation and delivery of services and products based on customers' requests

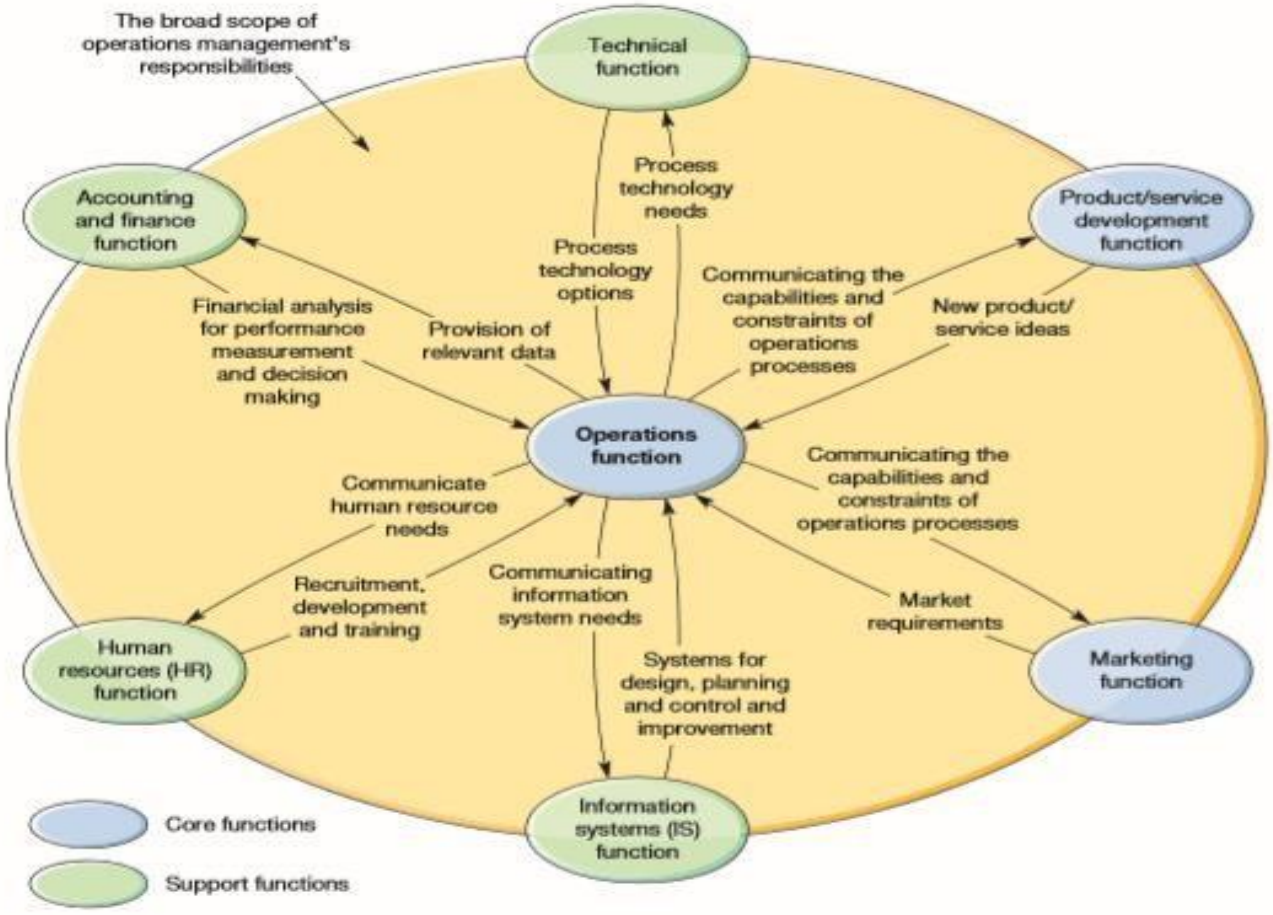
There are also support functions that helps main (core) functions to operate effectively – accounting, finance, technical, HR, IT.

! No clear division between functions in practice!

The book -> treats operations functions as comprising all the activities necessary for the daytoday fulfilment of customers' requests within the constraints of environmental and social sustainability – incl. sourcing services and products from suppliers and delivering services and products to customers

Relationship between operations function and other core and support functions:

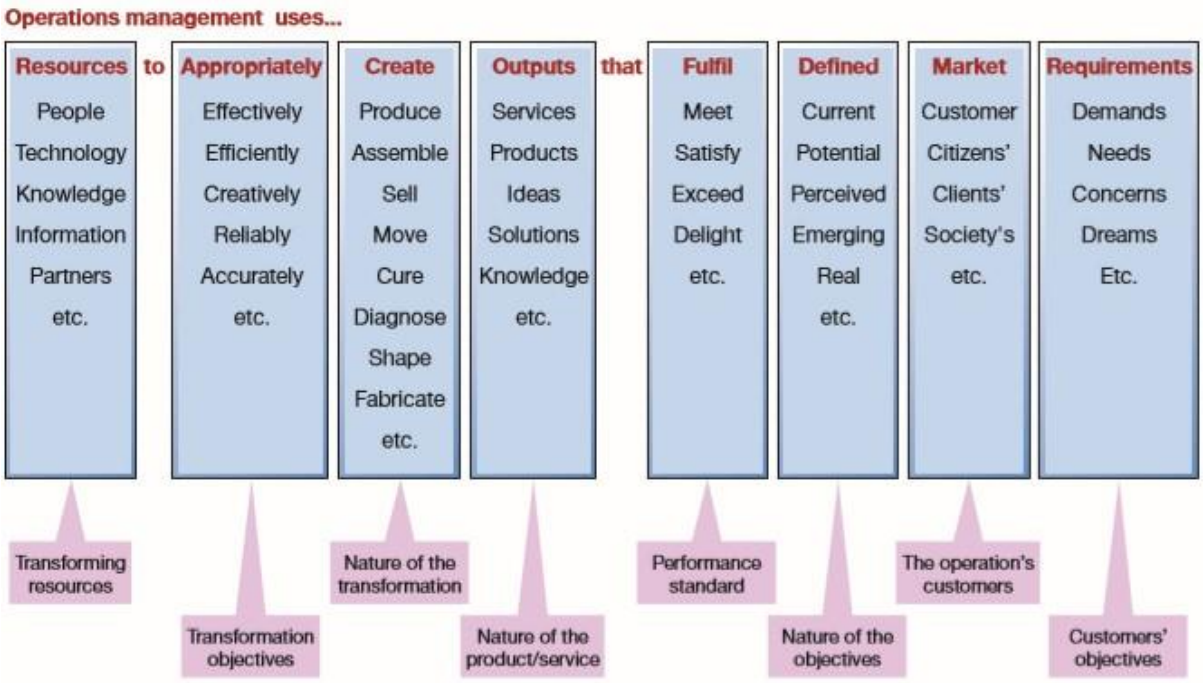
*Operations managers need to cooperate with other functions to ensure effective org. performance



3. Why is OM important to all types of organizations?

- Visualizing operations activity in every type of organizations – small or large, service or manufacturing, public or private, profit or non-profit.

- Operations management uses resources to appropriately create outputs that fulfill defined market requirements.
- The essential nature and purpose is common is every organization but there are issues to consider when it comes to smaller or organizations that aims to maximize something else than profit.



4. OM in the smaller organizations

- Large organizations may have the resources to dedicate individuals to specialized tasks but smaller ones often cannot, so people may have to do different jobs as the need arises but sometimes decision making is affected by overlapping of roles of these individuals
- Smaller organizations may have advantages as well – Torch box example – opportunity of being flexible and agile, in what is still a dynamic market.

5. OM in not-for-profit organizations

- Operations decisions almost the same as those in for-a-profit organizations
- Strategic objectives may be more complex and involve a mixture of political, social, economic or environmental objectives
- There may be a greater chance of operations decisions being made under conditions of conflicting objectives

6. The new operations agenda

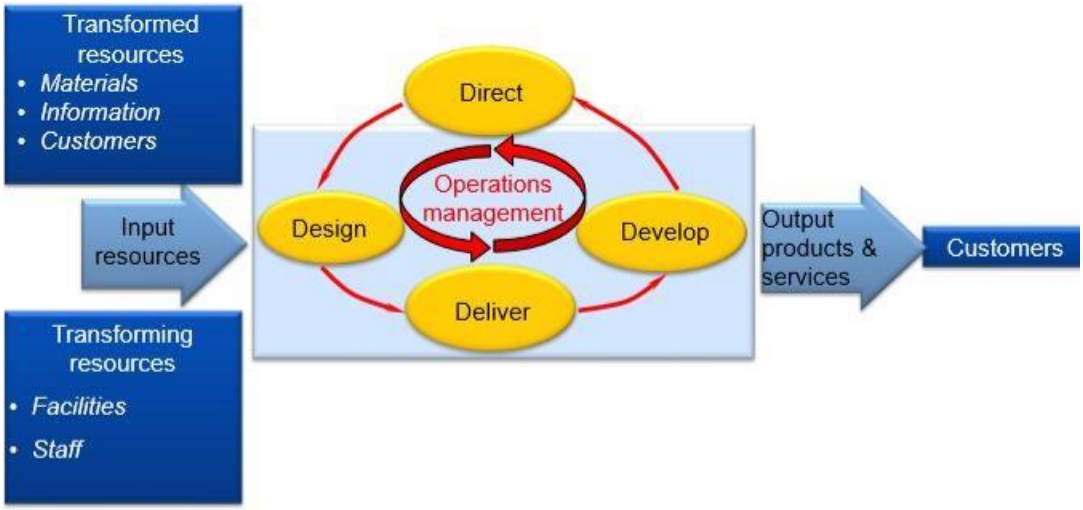
- Changes in business environment -> challenges faced by operations managers
  - **New technologies** – changing so fast in both manufacturing and service industries, so their effect cannot exactly be predicted only a few years in the future; likely to have radical effect on operating practices in almost all types of operation
  - **Different supply arrangements** – Markets have become more global, often meaning a demand for a higher variety, or customized products and services.

Globalized markets are opening up new options in how operations source input goods and services. While bringing opportunities for cost savings, a bigger supply market also brings new problems of long supply chains, supply vulnerability, reputational risk

- **Increased emphasis on social and environmental issues –** operations have to change the way they create their products and services, and be more transparent about it

• Operations management is at the forefront of coping with, and exploiting, developments in business and technology

7. **What is the input-transformation-output process? –** all processes have inputs of transforming and transformed resources that they use to create products and services



Inputs to the process

• One set of inputs to any operation's processes are transformed resources, the ones being treated, transformed or converted in the process. Usually mixture of:

- **Materials**
- **Information ➢ Customers**

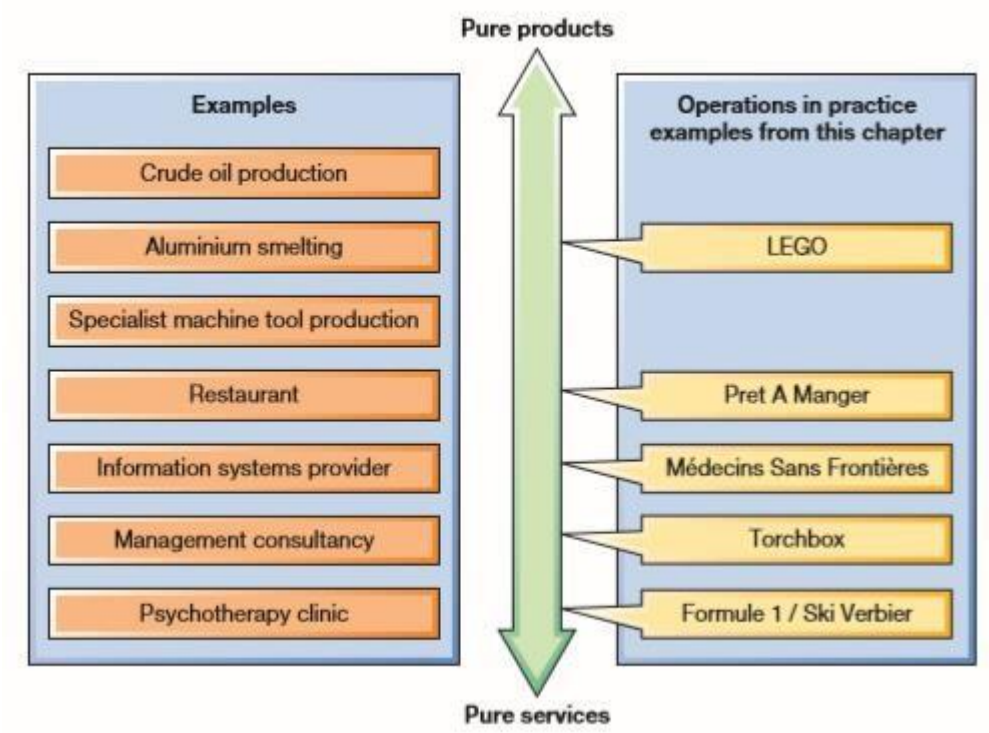
Predominantly processing inputs of materials	Predominantly processing inputs of information	Predominantly processing inputs of customer
All manufacturing operations	Accountants	Hairdressers
Mining companies	Bank headquarters	Hotels
Retail operations	Market research company	Hospitals
Warehouses	Financial analysts	Mass rapid transports
Postal services	News service	Theatres
Container shipping line	University research unit	Theme parks
Trucking companies	Telecoms company	Dentists

• The other set of inputs are the transforming resources, they act upon the transformed resources. There are two types of building blocks of all organizations:

- **Facilities –** the buildings, equipment, plant and process technology of the operation
- **Staff –** the people who operate, maintain, plan and manage the operation

Outputs from the process

- Products – tangible, services – intangible
- Most operations produce both products and services



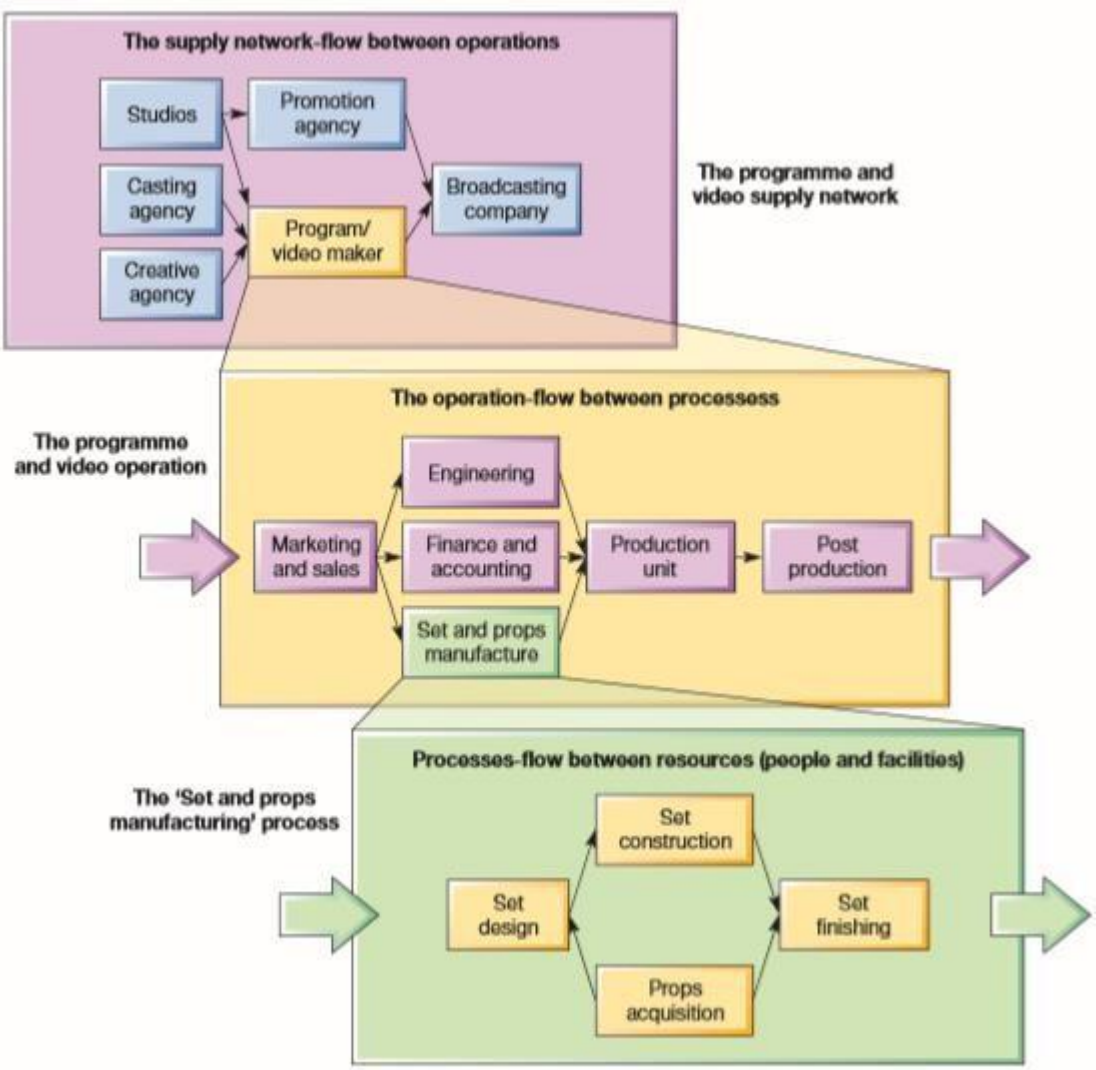
- **Product or service?** – Sometimes difficult to distinguish between both. We would argue that all operations are service providers which may create and deliver products as part of the offering to their customers. This is why OM is important to all organizations – whether they see themselves as manufacturers or service providers is not of much importance.
- **Servitization –** a term that indicates how operations, which once considered themselves exclusively producers of products, are becoming more service-conscious.
- **Subscription services** – an operation's customers will pay a usually fixed amount each agreed time period – month or year, for which they receive a pre-agreed service (e.g. - Netflix)
- **Customers –** Although customers may be an input to many operations (see earlier), they are also the reason for their existence. If there are no customers, there will be no operation. Different customer groups may want different things from an operation, even if they want the same product or service (more in Ch. 3)
- **B2B(business to business) and B2C(business to customer) –** serving individual customers and serving other businesses is very different, that's why understanding customer needs is always important (whether customers are individuals or businesses)

8. What is the process hierarchy?

- A 'process' is an arrangement of resources and activities that transform inputs into outputs that satisfy (internal or external) customer needs. They are the 'building blocks' of all operations, and they form an 'internal network' within an operation. Each process is, at the same time, an internal supplier and an internal customer for other processes. This 'internal customer' concept provides a model to analyze the internal activities of an operation and suggests that the effectiveness of the whole operation can be improved by treating internal customers with the same degree of care as external customers.

Operation	Some of the operation's processes
Airline 	Passenger check-in assistance, baggage drop, security/seat check, board passengers, fly passengers and freight around the world, flight scheduling, in-flight passenger care, transfer assistance, baggage reclaim, etc.
Department store 	Source merchandise, manage inventory, display products, give sales advice, sales, aftercare, complaint handling, delivery service, etc.
Police service 	Crime prevention, crime detection, information gathering/ collating, victim support, formally charging/detaining suspects, managing custody suites, liaising with court/justice system, etc.
Ice cream manufacturer 	Source raw materials, input quality checks, prepare ingredients, assemble products, pack products, fast-freeze products, quality checks, finished goods inventory, etc.

- A process perspective can be used in three levels: the level of the operation itself, the level of supply network, the level of individual processes
- **"Hierarchy of operations" or "process hierarchy"** - many different "levels of analysis", moving upwards from small to larger processes, right up to the huge supply network that describes a whole industry

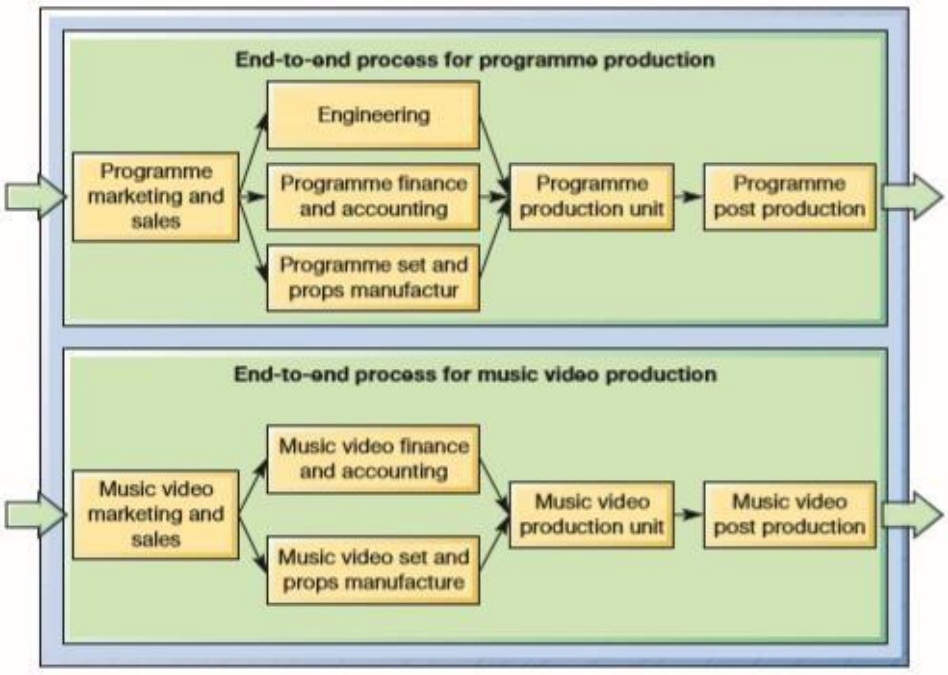


- **Operations management is relevant to all parts of the business** because all parts manage processes, so all parts have an operations role and need to understand OM principles
- **!**Distinguish between two meanings of operations
  - 'Operations' – as a function, meaning the part of the organization which creates and delivers services and products for the organization's external customers
  - 'Operations' as an activity, meaning the management of the processes within any of the organization's functions

Table 1.4 Some examples of processes in non-operations functions

Organizational function	Some of its processes 	Outputs from its processes 	Customer(s) for its outputs 
Marketing and sales	Planning process Forecasting process Order taking process	Marketing plans Sales forecasts Confirmed orders	Senior management Sales staff, planners, operations Operations, finance
Finance and accounting	Budgeting process Capital approval processes Invoicing processes	Budgets Capital request evaluations Invoices	Everyone Senior management, requesters External customers
Human resources management	Payroll processes Recruitment processes Training processes	Salary statements New hires Trained employees	Employees All other processes All other processes
Information technology	Systems review process Help desk process System implementation project processes	System evaluation Systems advice Implemented working systems and aftercare	All other processes in the business

- **Business processes** - whenever a business attempts to satisfy its customers' needs it will use many processes, both in its operations and in its other functions. Each of these processes will contribute some part to fulfilling customer needs. So customer needs for each product are entirely fulfilled from within what is called an 'end-to-end' business process. These often cut across conventional organizational boundaries.

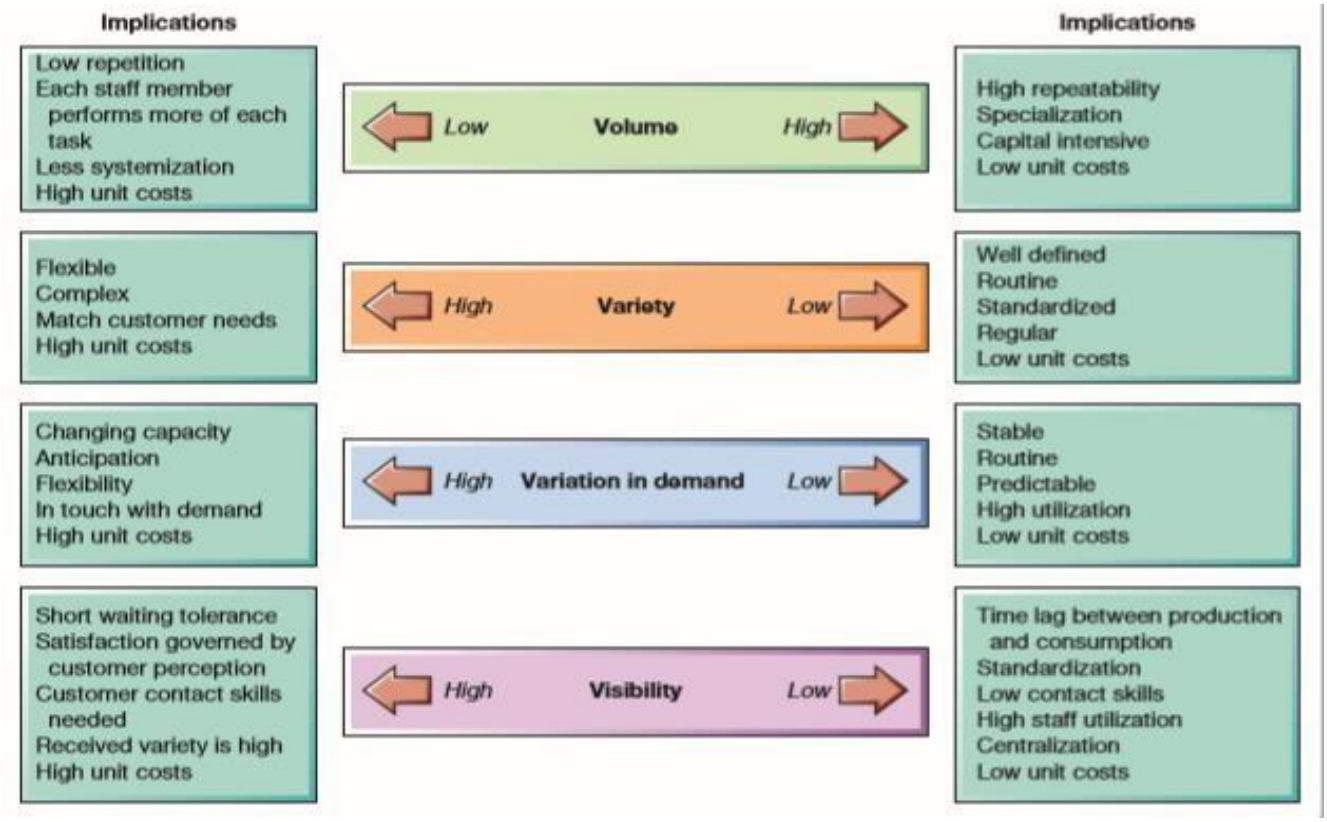


9. How do operation and processes differ? - Operations and processes can be characterized by the 4 Vs

- The **volume** of their output
- The **variety** of their output

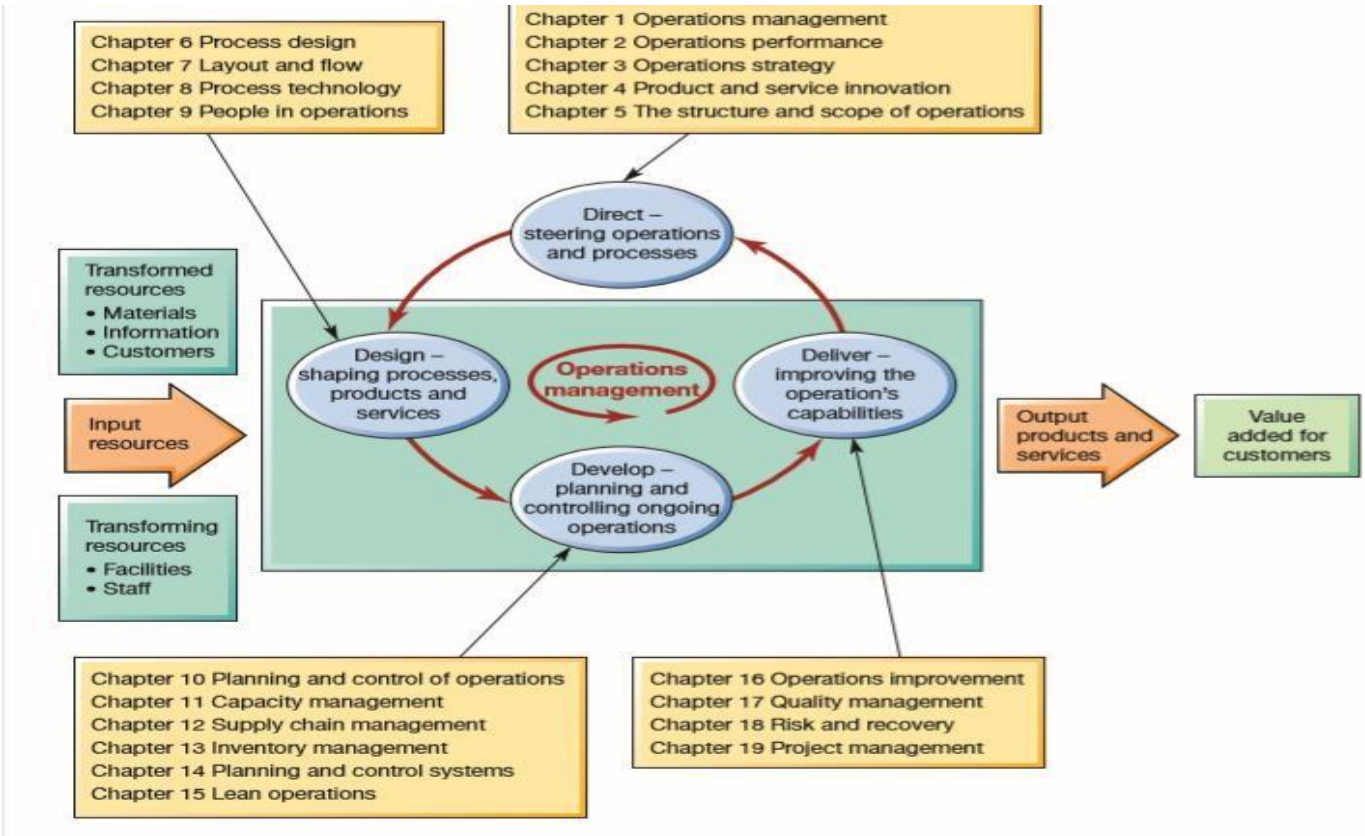
- The **variation** in the demand for their product
- The degree of **visibility** that the creation of their output has for customers – can be mixed – both high and low within the same operation – e.g. airport

- **Implications of thee four Vs of operations processes –** operations and processes can reduce their costs by increasing volume, reducing variety, variation in demand and visibility; and can increase their costs the other way around

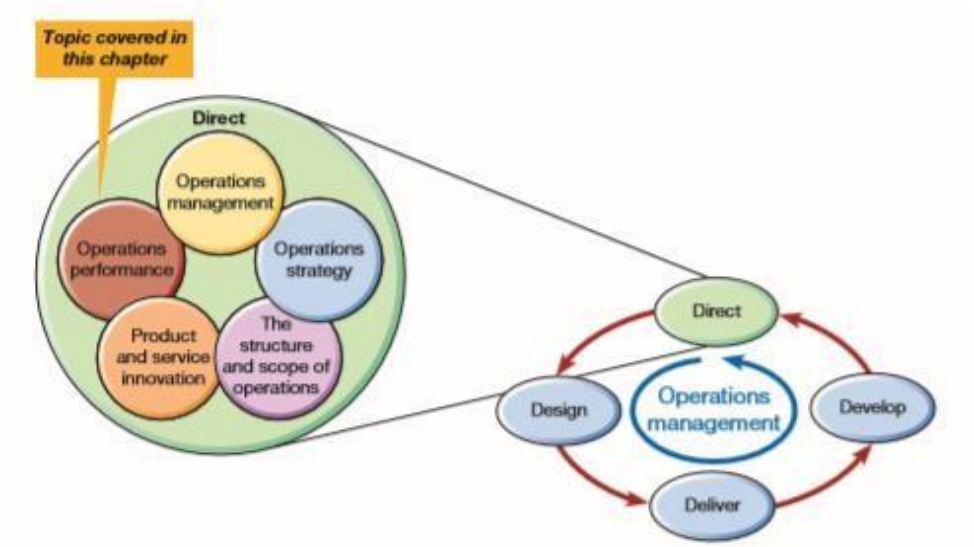


10. What do operations managers do? - We classify operations management activities under the four headings: direct, design, deliver and develop

- **Directing** the overall strategy of the operation. A general understanding of operations and processes and their strategic purpose and performance, together with an appreciation of how strategic purpose is translated into reality, are prerequisites to the detailed design of operations and process.
- **Designing** the operation's resources and processes. Design is the activity of determining the physical form, shape and composition of operations and processes in line with the services and products that they create.
- Planning and control process **delivery.** After being designed, the delivery of services and products from suppliers and through the total operation to customers must be planned and controlled.
- **Developing** process performance. Increasingly it is recognized that operations managers, or any process managers, cannot simply routinely deliver services and products in the same way that they always have done. They have a responsibility to develop the capabilities of their processes to improve process performance.


Chapter 6 Process design
Chapter 7 Layout and flow
Chapter 8 Process technology
Chapter 9 People in operations
Chapter 1 Operations management
Chapter 2 Operations performance
Chapter 3 Operations strategy
Chapter 4 Product and service innovation
Chapter 5 The structure and scope of operations
Direct – steering operations and processes
Transformed resources
• Materials
• Information
• Customers
Design – shaping processes, products and services
Operations management
Deliver – improving the operation's capabilities
Input resources
Output products and services
Value added for customers
Develop – planning and controlling ongoing operations
Transforming resources
• Facilities
• Staff
Chapter 10 Planning and control of operations
Chapter 11 Capacity management
Chapter 12 Supply chain management
Chapter 13 Inventory management
Chapter 14 Planning and control systems
Chapter 15 Lean operations
Chapter 16 Operations improvement
Chapter 17 Quality management
Chapter 18 Risk and recovery
Chapter 19 Project management

Chapter 2 – Operations performance

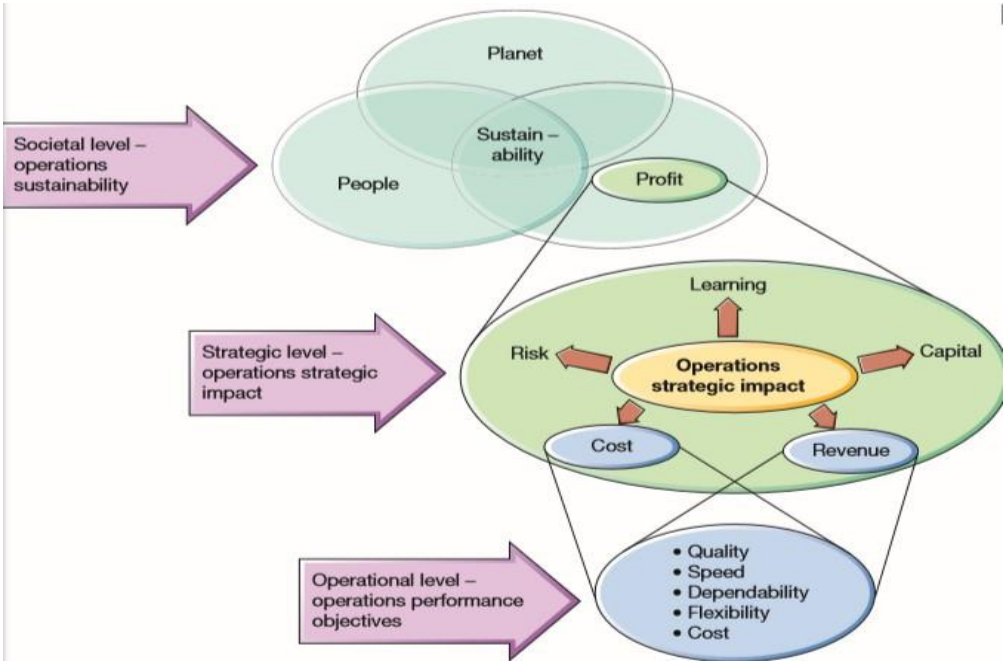


1. Why is operations performance vital in any organization? - operations management is being able either to 'make or break' any business – not just because the operations function is large and, in most businesses, represents the bulk of its assets and the majority of its people, but because the operations function gives the power to compete by providing the ability to respond to customers and by developing the capabilities that will keep it ahead of its competitors in the future. But when things go wrong in operations, the reputational damage can last for years. Operations management can 'make' the organization in several ways. First, operations management is concerned with doing things better – better quality, better service, better responsiveness, better reliability, better flexibility, better cost, and better use of capital invested in facilities. And it is this focus on 'better', on improvement, that can potentially make operations

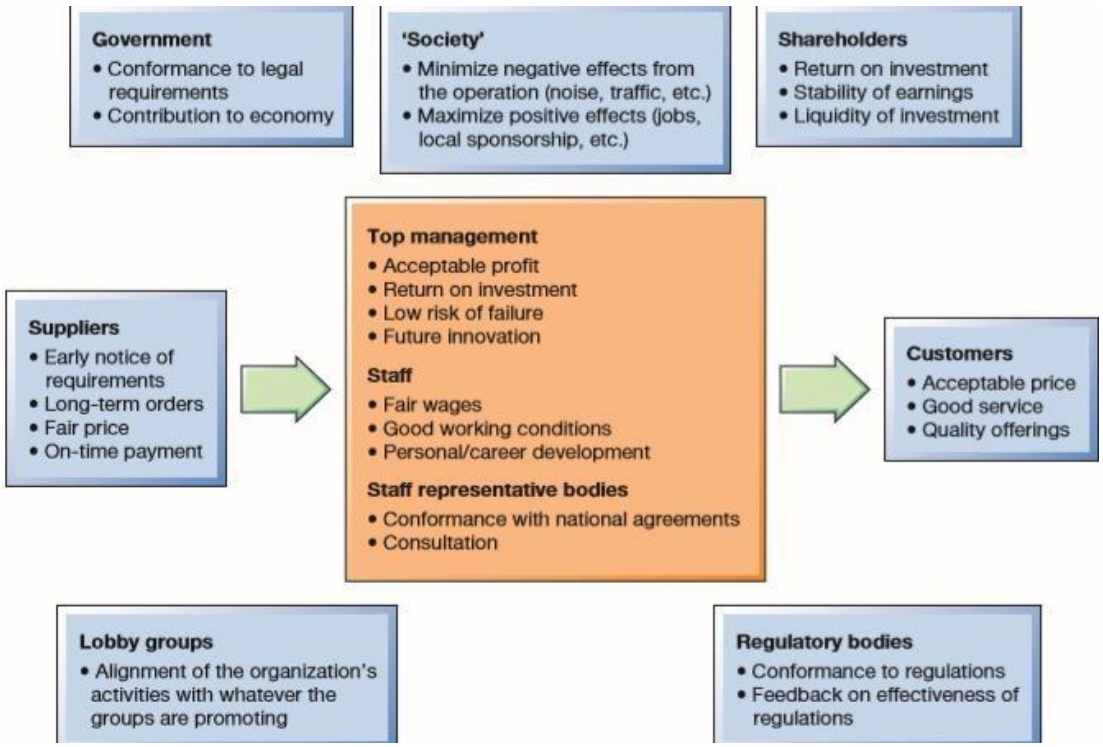
the driver of improvement for the whole organization. Second, through the continual learning that can come from its improvement activities, operations management can build the 'difficult to imitate' capabilities that can have a significant strategic impact. Third, operations management is very much concerned with 'process', with how things are done. And there is a relationship between process and outcome. Good operations management is the best way to produce good products and services.

• **Performance at three levels –** performance is not a straightforward concept. First, it is multi-faceted in the sense that a single measure can never fully communicate the success of something as complex as an operation. Several measures will always be needed to convey a realistic overview of the various aspects of performance. Second, performance can be assessed at different levels:

- The broad, societal level, using the idea of the 'triple bottom line'.
- The strategic level of how an operation can contribute to the organization's overall strategy.
- The operational level, using the five operations 'performance objectives'.



2. How is operations performance judged at a societal level? - The decisions that are made within any operation and the way it goes about its day-to-day activities will affect a whole variety of 'stakeholders'. Stakeholders are the people and groups who have a legitimate interest in the operation's activities. Some stakeholders are internal, for example the operation's employees; others are external, for example customers, society or community groups and a company's shareholders. Some external stakeholders have a direct commercial relationship with the organization, for example suppliers and customers; others do not, for example industry regulators. In not-for-profit operations, these stakeholder groups can overlap.



- **Corporate social responsibility (CSR) –** the idea that operations should take into account their impact on a broad mix of stakeholders. (Marks and Spencer, the UK-based retailer: *'Corporate Social Responsibility…is listening and responding to the needs of a company's stakeholders. This includes the requirements of sustainable development. We believe that building good relationships with employees, suppliers and wider society is the best guarantee of long-term success. This is the backbone of our approach to CSR.*')
- **The triple bottom line -** One common term that tries to capture the idea of a broader approach to assessing an organization's performance – **TBL or 3BL,** aka **'people, planet and profit'**. It is a straightforward idea: organizations should measure themselves not only on the economic profit they make for their owners but also on the impact they have on society and the ecological impact on the environment. The influential initiative that has come out of this triple bottom line approach is that of 'sustainability'.

  ➢ **The social bottom line (People**) – the social account, measured by the impact of the operation on the quality of people's lives

  Customer safety from products and services
  Employment impact of an operation's location independently
  Employment implications of outsourcing
  Repetitive or alienating work
  Staff safety and workplace stress
  Non-exploitation of developing country suppliers

  ➢ **The environmental bottom line (Planet)** – the environmental account, measured by environmental impact of the operation. Environmental sustainability - the extent to which business activity negatively impacts the natural environment.

  Recyclability of materials, energy consumption, waste material generation
  Reducing transport-related energy
  Noise pollution, fume and emission pollution
  Obsolescence and wastage
  Environmental impact of process failures
  Recovery to minimize impact of failures.

  ➢ **The economic bottom line (Profit)** – the economic account, measured by profitability, return on assets, etc., of the operation

  Cost of producing products and services
  Revenue from the effects of quality, speed, dependability and flexibility
  Effectiveness of investment in operations resources ✓ Risk and resilience of supply
  Building capabilities for the future.

  *We will build on these 'economic bottom line' issues in the next section on judging operations performance at a strategic level.

3. How is operations performance judged at a strategic level?

Figure 2.4 Operations can contribute to financial success through low costs, increasing revenue, lowering risk, making efficient use of capital, and building the capabilities for future innovation

Profit = **the revenue** the organization secures from its customers in exchange **- the costs** of producing products and services

- **Operations management affects costs** - the efficiency with which an operation purchases its transformed and transforming resources, and the efficiency with which it converts its transformed resources, will determine the cost of its products and services
- **Operations management affects revenue** - High-quality, error-free products and services, delivered fast and on time, where the operation has the flexibility to adapt to customers' needs, are likely to command a higher price and sell more than those with lower levels of quality, delivery and flexibility

  ➢ **Net promoter score (NFS) –** measuring the level of customer satisfaction by asking customers how likely they are to recommend a company, service or a product from 1 to 10 scale**.** 1- 6 – detractors; 7-8 – passives; 9-10 – promoters**.** **NFS = promoters - detractors**

- **Operations management affects the required level of investment -** Producing more output with the same resources (or sometimes producing the same output with fewer resources) affects the required level of investment.
- **Operations management affects the risk of operational failure -** Well-designed and run operations should be less likely to fail. They are more likely to operate at a predictable and acceptable rate without either letting customers down or incurring excess costs. And if they ever do suffer failures, well-run operations should be able to recover faster and with less disruption (this is called resilience)
- **Operations management affects the ability to build the capabilities on which future innovation is based -** accumulation of process knowledge (learning from previous

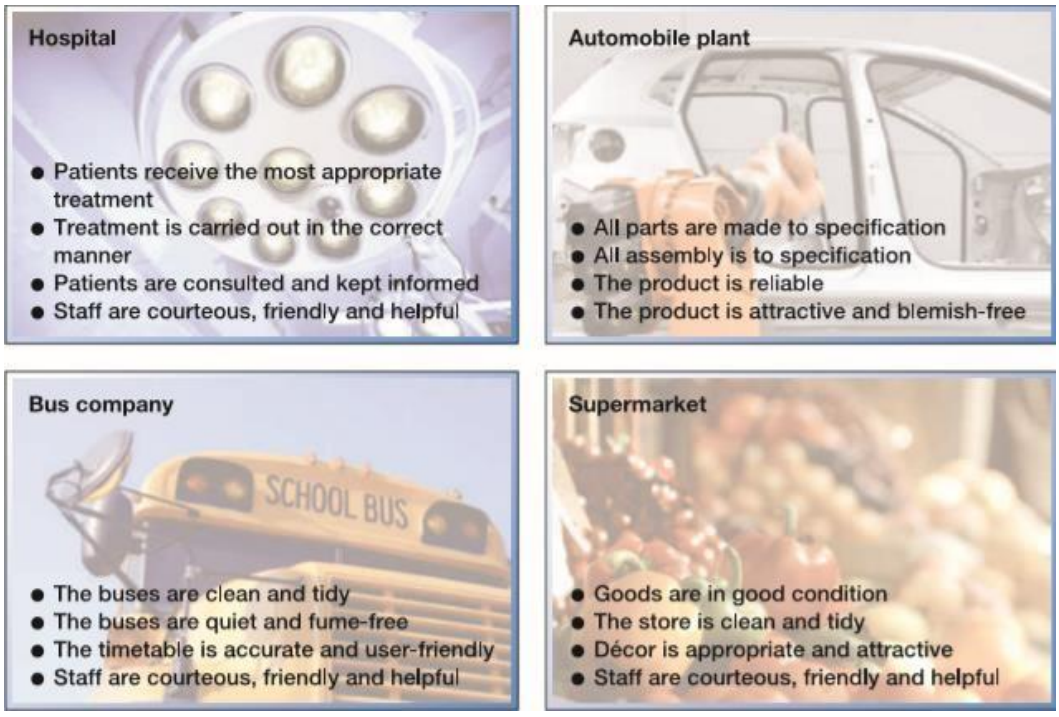
experience) can build into the skills, knowledge and experience that allow the business to improve over time. But more than that, it can build into what are known as the 'capabilities' that allow the business to innovate in the future.

4. How is operations performance judged at an operational level? - running operations at an operational day-to-day level requires a more tightly defined set of objectives. These are called operations 'performance objectives'. There are five of them and they apply to all types of operation – quality, speed, dependability, flexibility, cost

- **Quality advantage – being right -** it is clearly a major influence on customer satisfaction or dissatisfaction. A customer perception of high-quality products and services means customer satisfaction and therefore the likelihood that the customer will return.

➢ **Quality inside the operation -** When quality means consistently producing services and products to specification it not only leads to external customer satisfaction, but makes life easier inside the operation as well

✓ **Quality reduces costs -** The fewer mistakes made by each process in the operation, the less time will be needed to correct the mistakes and the less confusion and irritation will be spread ✓ **Quality increases dependability**

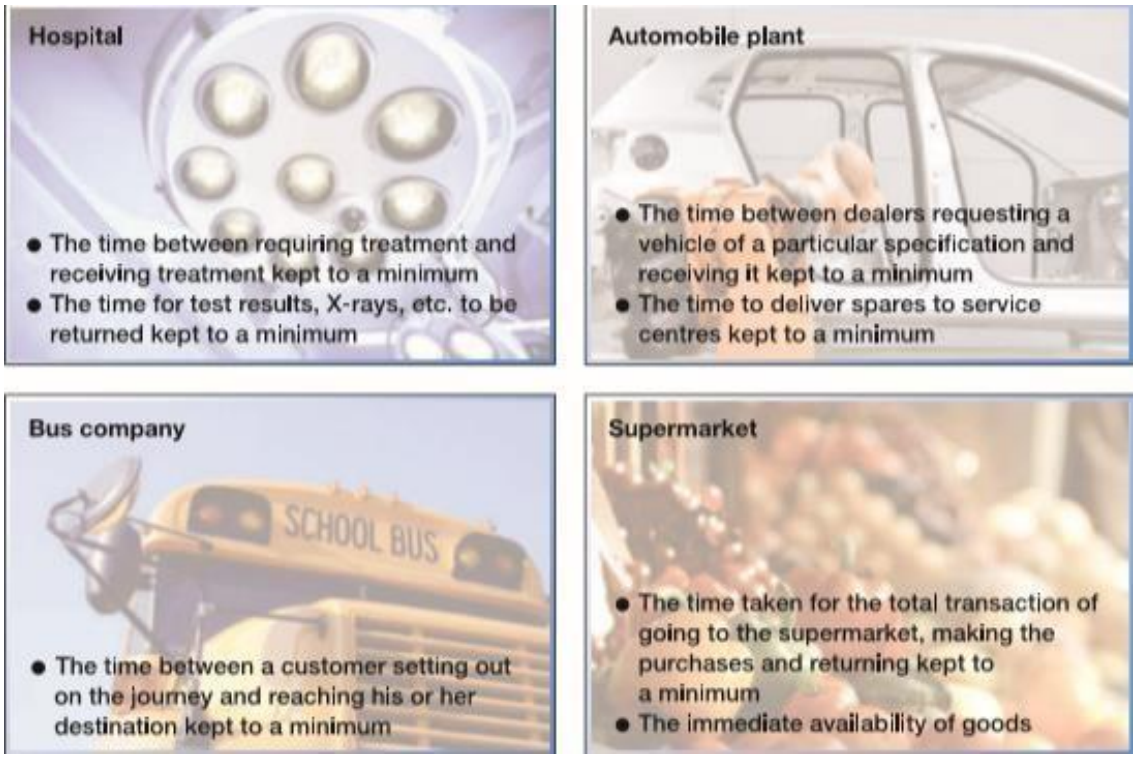


- **Speed advantage – being fast -** the elapsed time between customers requesting products or services and their receiving them

- **Speed inside the operation** - . Fast response to external customers is greatly helped by speedy decision making and speedy movement of materials and information inside the operation

  Speed reduces inventories

  Speed reduces risks

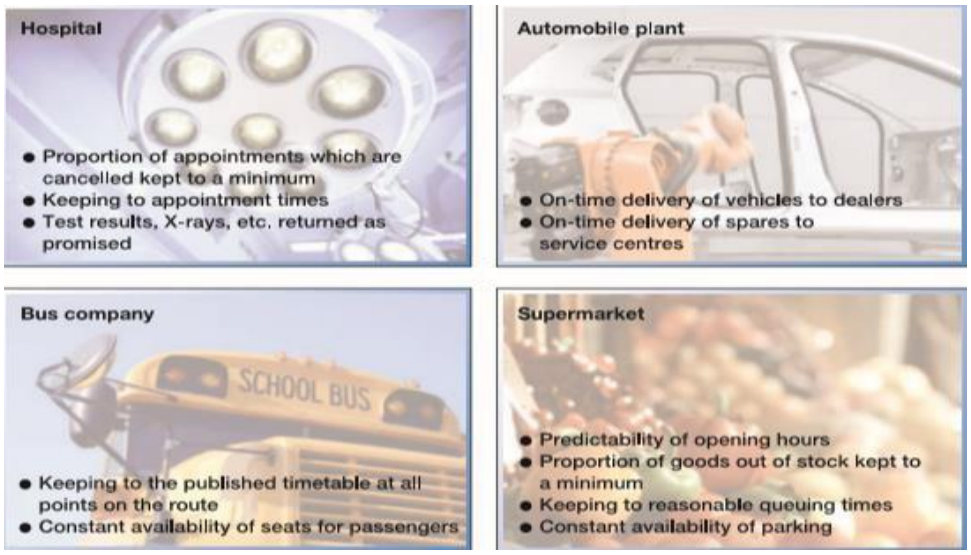


- **Dependability advantage – being on time -** doing things in time for customers to receive products or services exactly when they are needed, or at least when they were promised
  - **Dependability inside the operation -** internal customers will judge each other's performance partly by how reliable the other processes are in delivering material or information on time. Operations where internal dependability is high are more effective than those which are not

    Dependability saves time

    Dependability saves money - Ineffective use of time will translate into extra cost

    Dependability gives stability - the disruption caused to operations by a lack of dependability goes beyond time and cost. It affects the 'quality' of the operation's time. If everything in an operation is always perfectly dependable, a level of trust will have built up between the different parts of the operation. There will be no 'surprises' and everything will be predictable. Under such circumstances, each part of the operation can concentrate on improving its own area of responsibility without having its attention continually diverted by a lack of dependable service from the other parts



- **Flexibility advantage – being able to change -** changing what the operation does, how it is doing it, or when it is doing it. Four types of requirement:

  product/service flexibility – the operation's ability to introduce new or modified products and services

  mix flexibility – the operation's ability to produce a wide range or mix of products and services

  volume flexibility – the operation's ability to change its level of output or activity to produce different quantities or volumes of products and services over time

  delivery flexibility – the operation's ability to change the timing of the delivery of its services or products

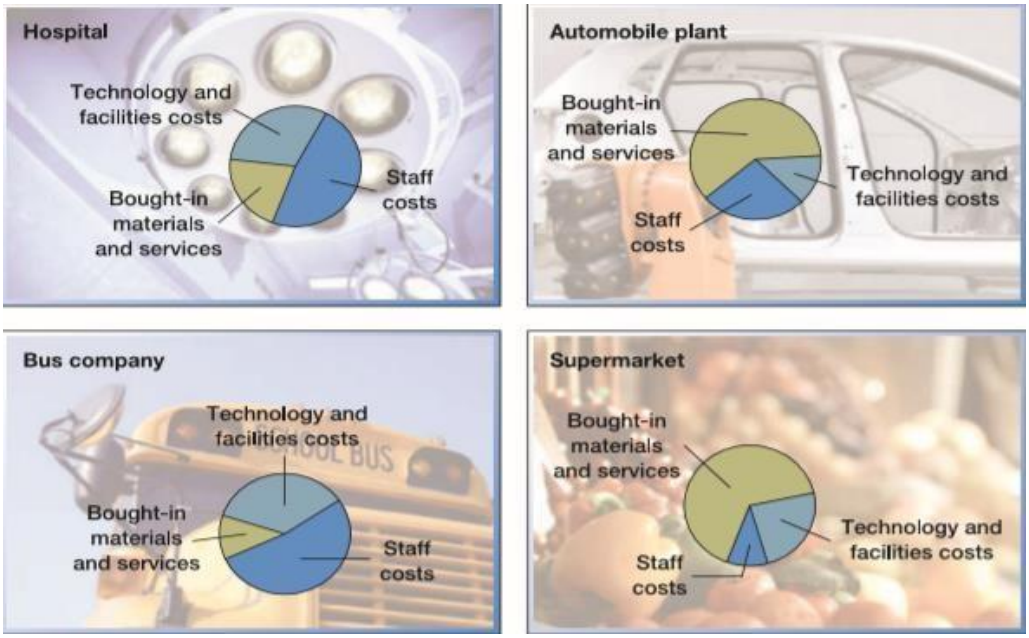
  - **Mass customization -** one of the beneficial external effects of flexibility is the increased ability of operations to do different things for different customers. So, high flexibility gives the ability to produce a high variety of products or services. Normally high variety means high cost. Furthermore, high-variety operations do not usually produce in high volume. Some companies have developed their flexibility in such a way that products and services are customized for each individual customer. Yet they manage to produce them in a high volume, mass production manner which keeps costs down
  - **Agility -** a combination of all the five performance objectives but particularly flexibility and speed; means responding to market requirements by producing new and existing products and services fast and flexibly.
  - **Flexibility inside the operation**

    Flexibility speeds up response

    Flexibility saves time

    Flexibility maintains dependability

- **Cost advantage – being productive** - to the companies that compete directly on price, cost will clearly be their major operations objective. The lower the cost of producing their goods and services, the lower can be the price to their customers. Even those companies which do not compete on price will be interested in keeping costs low. Every euro or dollar removed from an operation's cost base is a further euro or dollar added to its profits



- **Keeping operations costs down** - All operations have an interest in keeping their costs as low as is compatible with the levels of quality, speed, dependability and flexibility that their customers require. The measure for this is called **productivity** - the ratio of what is produced by an operation (its output) to what is required to produce it (its input):
  Single + multi factor:

$$\text{Productivity} = \frac{\text{Output from the operation}}{\text{Input to the operation}}$$

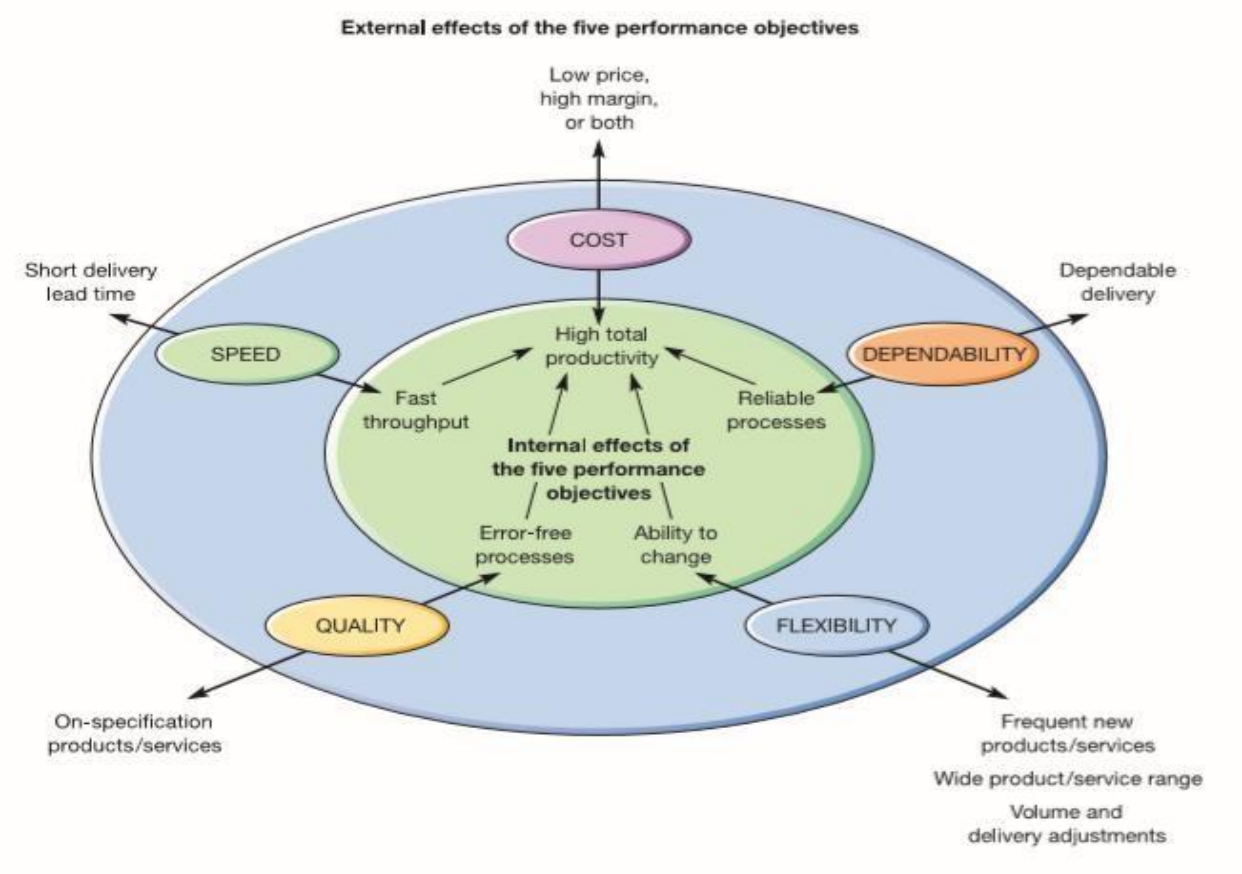
$$P_s = \frac{O}{I_i}, P_m = \frac{O}{\sum_i I_i}$$

=

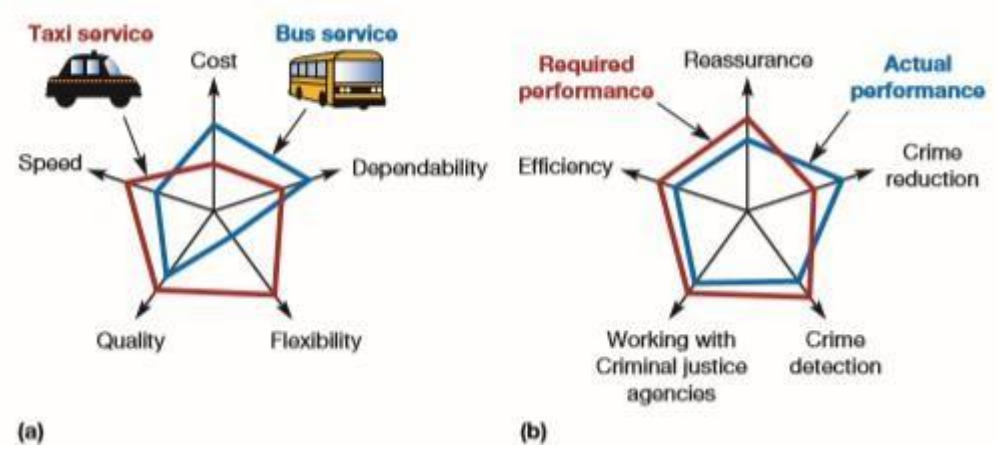
Where O=output; I=input; i=factor considered

Note: $\sum_i I_i = \sum_{i=1}^{n} I_i = (I_1 + I_2 + I_3 + \cdots + I_n)$

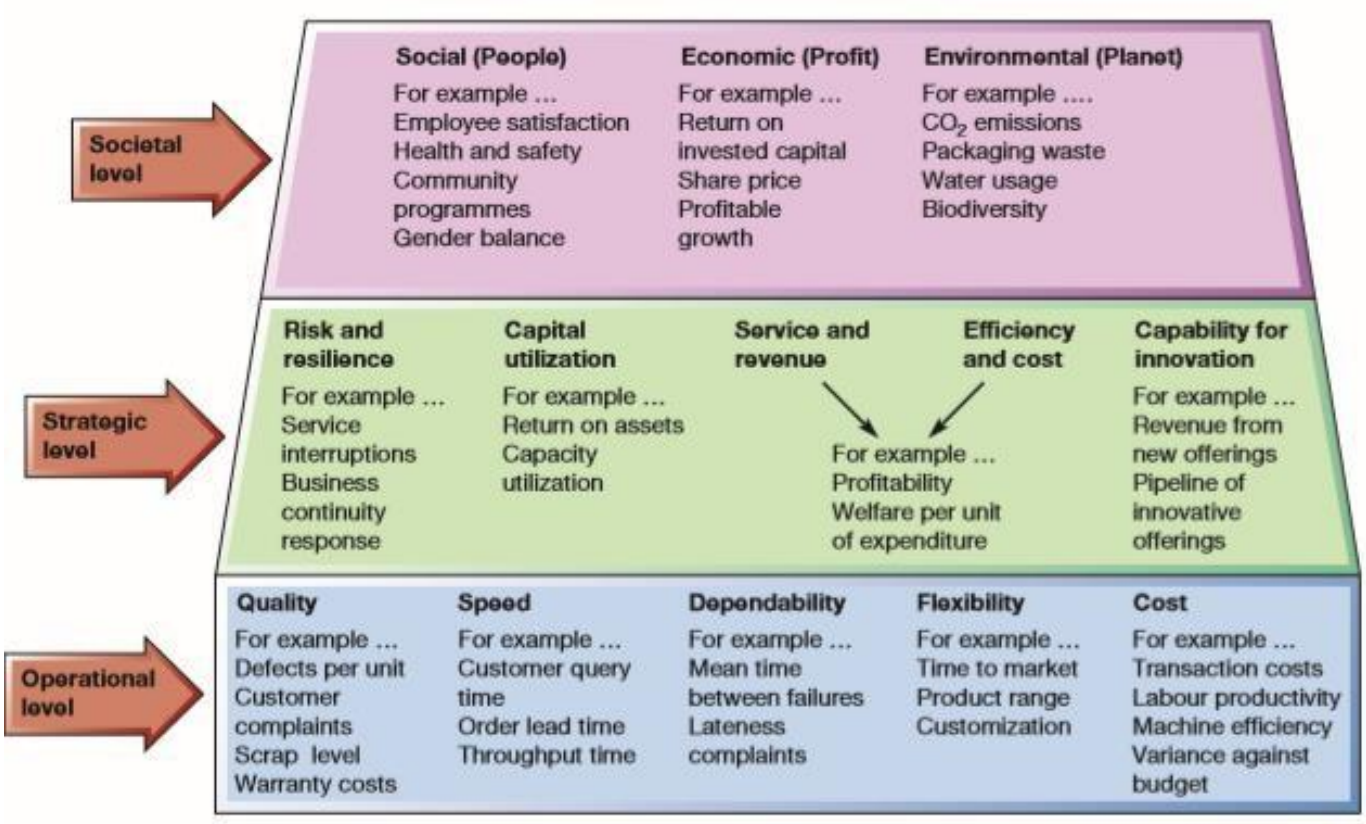
- **Cost reduction through internal effectiveness** - each of the various performance objectives has several internal effects, but all of them affect cost,
  so one important way to improve cost performance is to improve the performance of the other operations objectives



- **The polar representation of performance objectives** - A useful way of representing the relative importance of performance objectives for a product or service is because the scales which represent the importance of each performance objective have the same origin

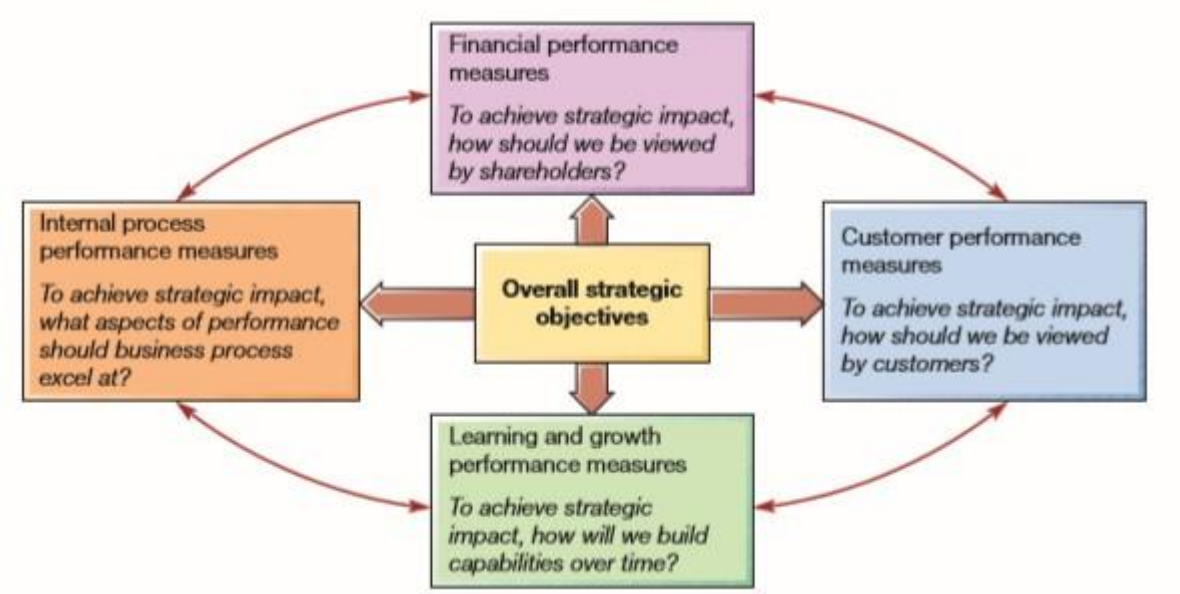


5. How can operations performance be measured?



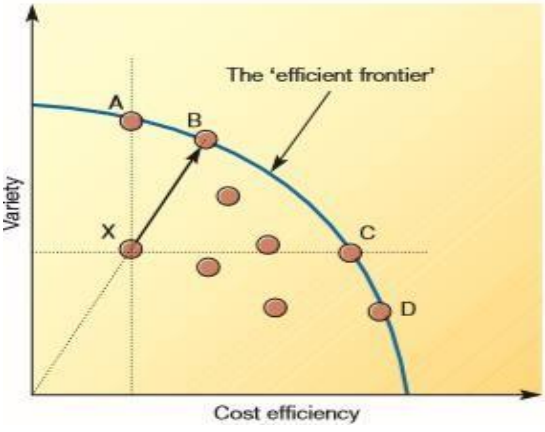
- **The balanced scorecard approach -** attempts to bring together the elements that reflect a business's strategic position, including product or service quality measures, product and service development times, customer complaints, labour

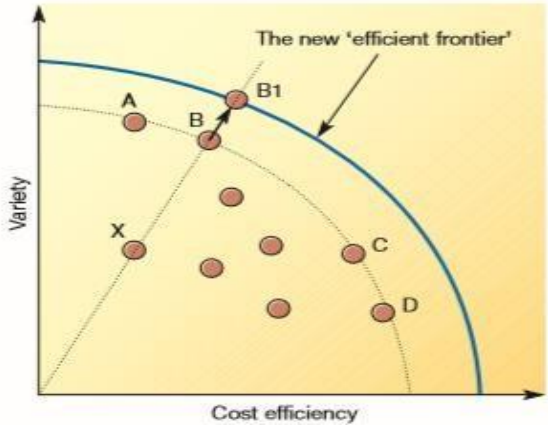
productivity, and so on. At the same time it attempts to avoid performance reporting becoming unwieldy by restricting the number of measures and focusing especially on those seen to be essential. The advantages of the approach are that it presents an overall picture of the organization's performance in a single report, and, by being comprehensive in the measures of performance it uses, encourages companies to take decisions in the interests of the whole organization rather than sub-optimizing around narrow measures.



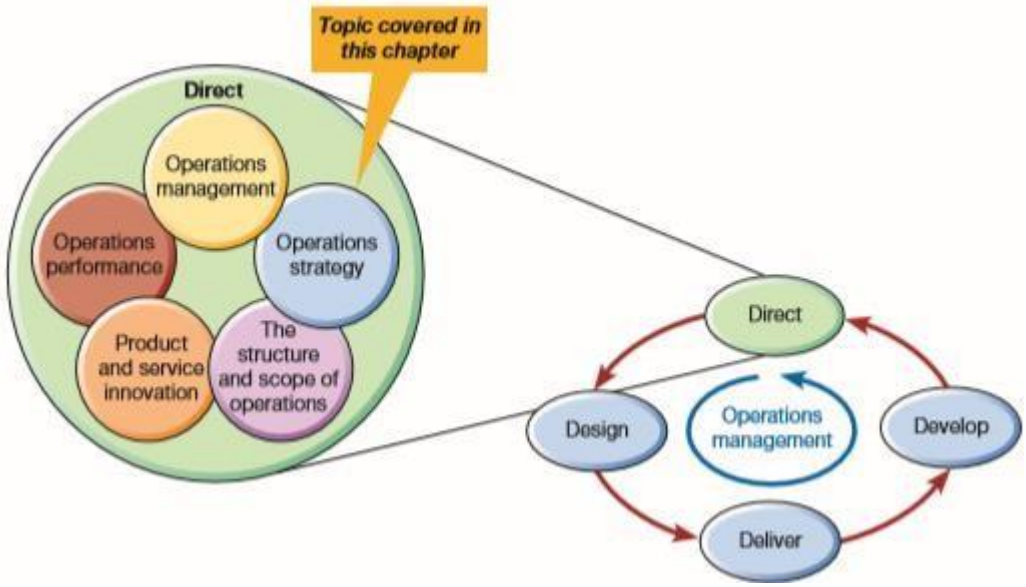
6. **How do performance objectives trade off against each other? –** Trade-off s are the extent to which improvements in one performance objective can be achieved by sacrificing performance in others.

    - **Trade-offs and the efficient frontier** - The 'efficient frontier' concept is a useful approach to articulating trade-offs and distinguishes between repositioning performance on the efficient frontier and improving performance by overcoming tradeoffs





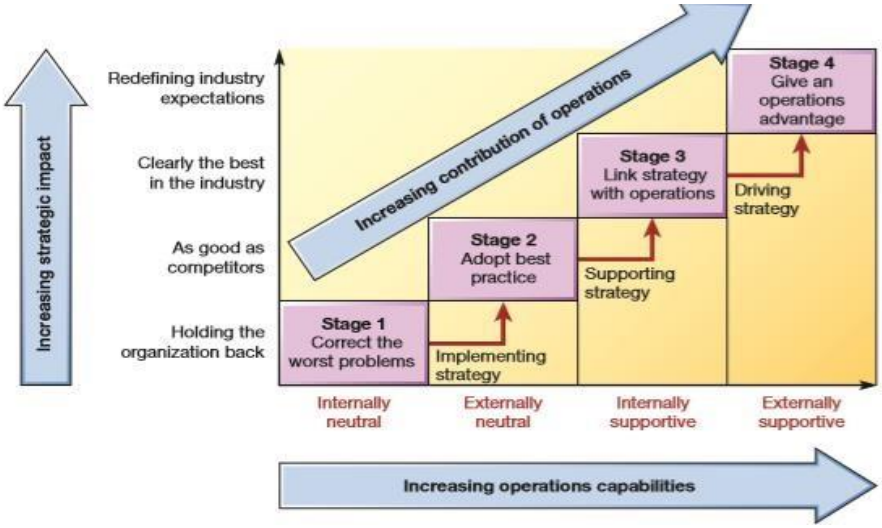
Chapter 3 – Operations strategy



1. **What is strategy and what is operations strategy?**
    - **Strategy –** total pattern of decisions and actions that move the influence the long-term direction of the business
        - Setting broad objectives that direct an enterprise towards its overall goal.
        - Planning the path (in general rather than specific terms) that will achieve these goals.
        - Stressing long-term rather than short-term objectives.
        - Dealing with the total picture rather than stressing individual activities.
        - Being detached from, and above, the confusion and distractions of day-to-day activities.
    - **Operations strategy** – pattern of decisions and actions that shape the long-term vision, objectives and capabilities of the operation and its contribution to the overall strategy of the business
        - **Content** – the specific decisions and actions that set the operations role, objectives and activities
        - **Process –** the method that is used to make the specific 'content' decisions
    - **Operations ≠ Operational**
        - Operations – the resources that create products and services, and it's clear that they have a real strategic impact
        - Operational is the opposite of 'strategic' – meaning day-to-day, detailed and often localized
2. **Using operations strategy to articulate a vision for the contribution of operations –** the vision of an operation is a clear statement of how operations intend to contribute value for the business. It's not a statement of what the operation wants to **achieve** (those are the objectives), but rather an idea of what it must **become** and what contribution it should make. A common approach to summarizing operations contribution - **Hayes and Wheelwright's four stages model.**
    - **Stage 1 : Internal neutrality**
        - The poorest level of contribution by the operations function

- Holding the company back from competing effectively
- Inward looking and reactive with very little positive to contribute towards competitive process
- Its goal is to be ignored
- Attempts to improve by avoiding making mistakes

- **Stage 2 : External neutrality**
  - The first step of breaking out of stage 1 for operations function is to begin comparing itself with similar companies or organizations in the outside market
  - Measuring itself against its competitors' performance and trying to implement the best practice
- **Stage 3 : Internally supportive**
  - This stage operations are among the best in their market
  - They achieve this by gaining a clear view of the company's competitive or strategic goals and supporting it by developing appropriate operations resources
  - Internally supportive by providing a credible operations strategy
- **Stage 4 : Externally supportive**
  - The company views the operations function as providing the foundation for its competitive success
  - Operations look to the long term
  - Forecasts likely changes in markets and supply
  - Develops the operation-based capabilities which will be required to compete in future market conditions
  - Operations are innovative, creative and proactive and are driving the company's strategy by being one step ahead of competitors



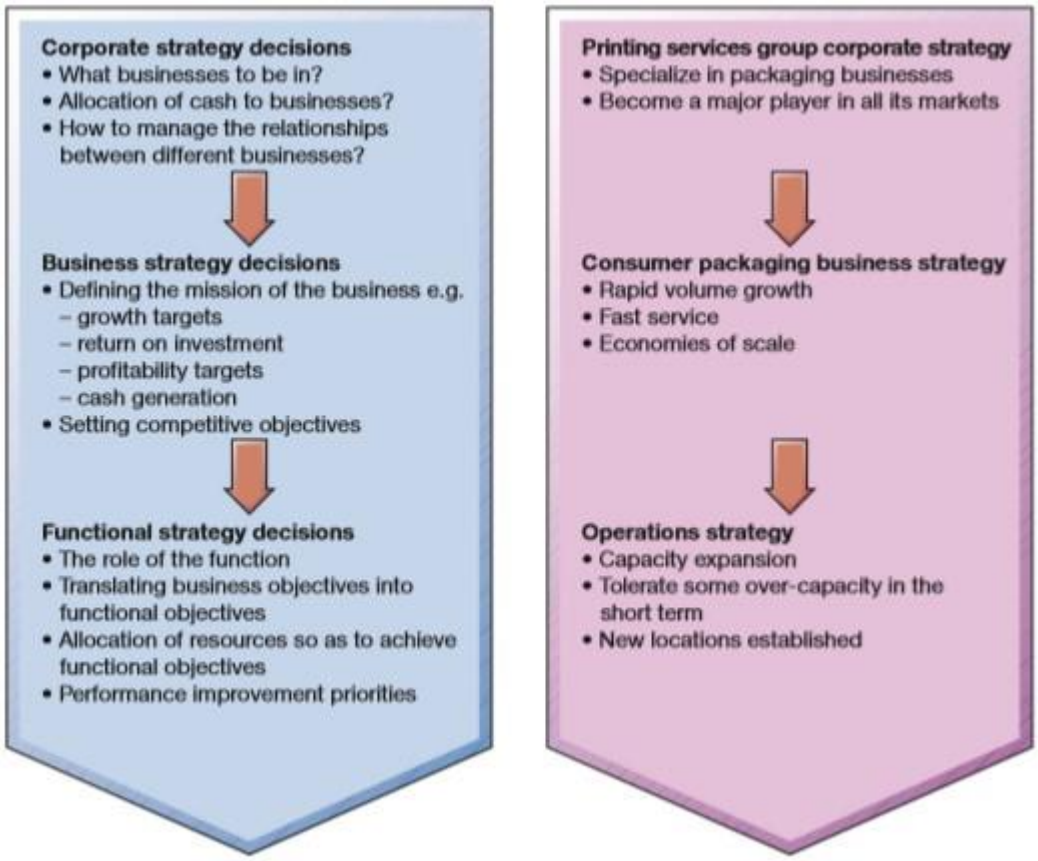
3. The four perspectives on operations strategy

- **Top - down perspective** - Operations strategy should align with what the whole group or business wants
- **Outside-in perspective** - Operations strategy should translate the enterprise's intended market position so as to provide the required objectives for operations decisions

- **Bottom-up perspective** - Operations strategy should learn from day-to-day activities so as to cumulatively build strategic capabilities
- **Inside-out** perspective - Operations strategy should develop the business's resources and processes so that its capabilities can be exploited in its chosen markets

➢ None of these four perspectives alone gives the full picture of what operations strategy is. But together provide some idea of the pressures that go to form the content of operations strategy.

4. **Top-down perspective -** How does operations strategy align with the business strategy?
   - Identifies three related levels of strategy – corporate, business and functional
     - **Corporate strategy** – position the corporation in its global, economic, political and social environment
     - **Business strategy** – each business unit sets out its individual mission and objectives within the corporate group
     - **Functional strategies** – need to consider what part of which function should play in contributing to the strategic objectives of the business



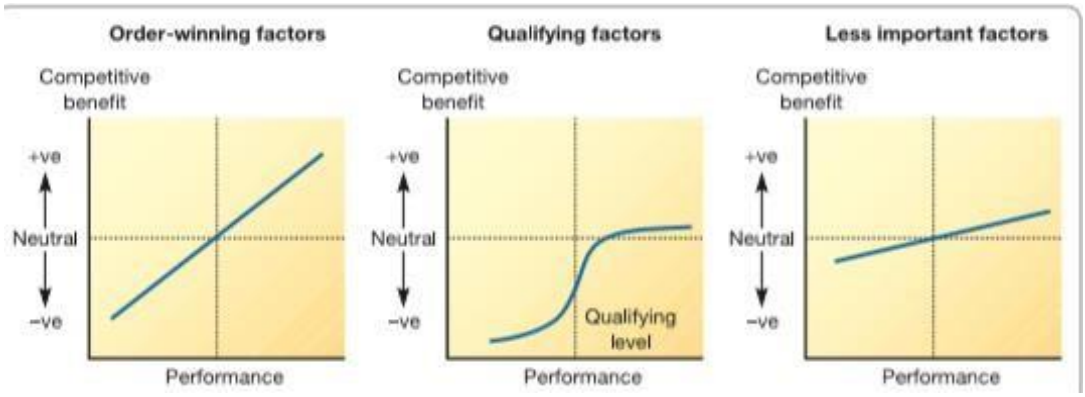
- **Correspondence and coherence** –
  - ➢ **Correspondence** – clear, explicit and logical connection:

    between each functional strategy and the business strategy
    between a functional strategy and the decisions taken within the function
  - ➢ **Coherence** – the choices made across or within functions should not pull it in different directions

  All decisions should complement and reinforce each other in the promotion of the business's and the operation's objectives.
- **Business model and operating model**
  - **Business model –** implemented plan by a company to generate revenue and make a profit or fulfil its social objectives
  - **Operating model –** high-level design of the organization that defines the structure and style which enables it to meet its business objectives

5. **Outside-in (market) perspective –** How does operations strategy align with the market requirements? – organizations compete in different ways, so the operations function should therefore respond by providing the ability to perform in a manner that is appropriate for the intended market position
   - **How market requirements influence operations strategy performance objectives -** Operations seek to satisfy customers through developing their five performance objectives – quality, speed, dependability, flexibility and cost

- **Order winners, qualifiers and less important factors -** a useful way of determining the relative importance of competitive factors is to distinguish between 'order-winning' and 'qualifying' factors
    - **Order winners -** directly and significantly contribute to winning business; regarded by customers as key reasons for purchasing the product or service. Raising performance in an order-winning factor will either result in more business or improve the chances of gaining more business
    - **Qualifiers -** aspects of competitiveness where the operation's performance has to be above a particular level just to be considered by the customer
    - **Less important -** do not influence customers in any significant way; may be of importance in other parts of the operation's activities



- **The impact of product/service differentiation on market requirements –** if an operation differentiates its services based on different customer segments, it will need to determine the performance objective for each segment

	Retail banking 	Corporate banking 
Products	Personal financial services such as loans and credit cards	Special services for corporate customers
Customers	Individuals	Businesses
Range of services offered	Medium but standardized, little need for special terms	Very wide range, many need to be customized
Changes to service design	Occasional	Continual
Delivery	Fast decisions	Dependable service
Quality	Means error-free transactions	Means close relationships
Volume per service type	Most services are high volume	Most services are low volume
Profit margins	Most are low to medium, some high	Medium to high

Competitive factors		
Order winners	Price	Customization
	Accessibility	Quality of service
	Ease of transaction	Reliability/trust
Qualifiers	Quality	Ease of transaction
	Range	Price
Less important		Accessibility

Internal performance	Cost	Flexibility
objectives	Speed	Quality
	Quality	Dependability

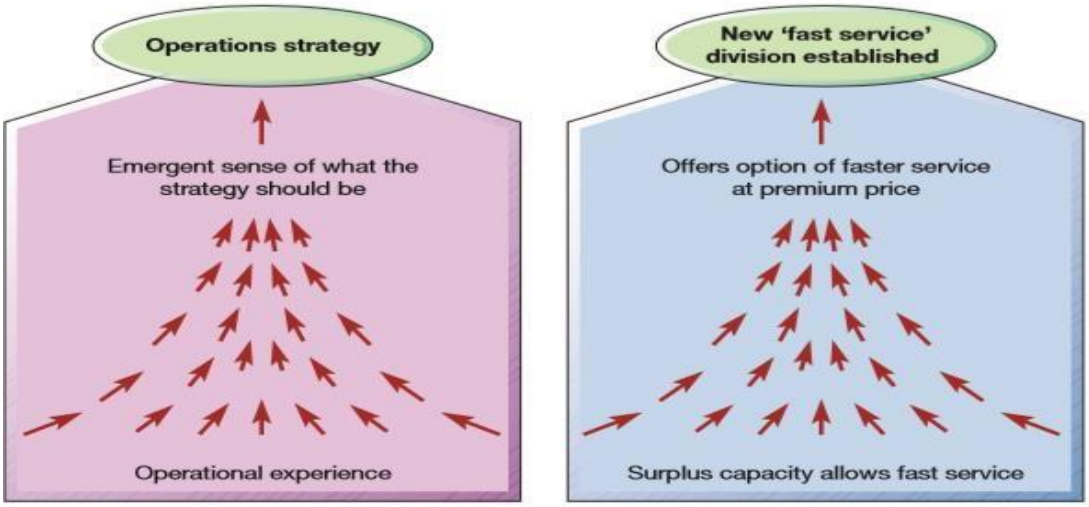
- **The impact of product/service life cycle on market requirements -** one way of generalizing the behavior of both customers and competitors is to link it to the life cycle of the products or services that the operation is producing
    - **Introduction stage –** When a product or service is first introduced, it is likely to be offering something new in terms of its design or performance, with few competitors offering the same product or service. The needs of customers are unlikely to be well understood, so operations management needs to develop the flexibility to cope with any changes and be able to give the quality to maintain product/service performance
    - **Growth stage –** As volume grows, competitors may enter the growing market. Keeping up with demand could prove to be the main operations preoccupation. Rapid and dependable response to demand will help to keep demand buoyant, while quality levels must ensure that the company keeps its share of the market as competition starts to increase
    - **Maturity stage -** Demand starts to level off. Some early competitors may have left the market and the industry will probably be dominated by a few larger companies. So operations will be expected to get the costs down in

order to maintain profits or to allow price cutting, or both. Because of this, cost and productivity issues, together with dependable supply, are likely to be the operation's main concerns.

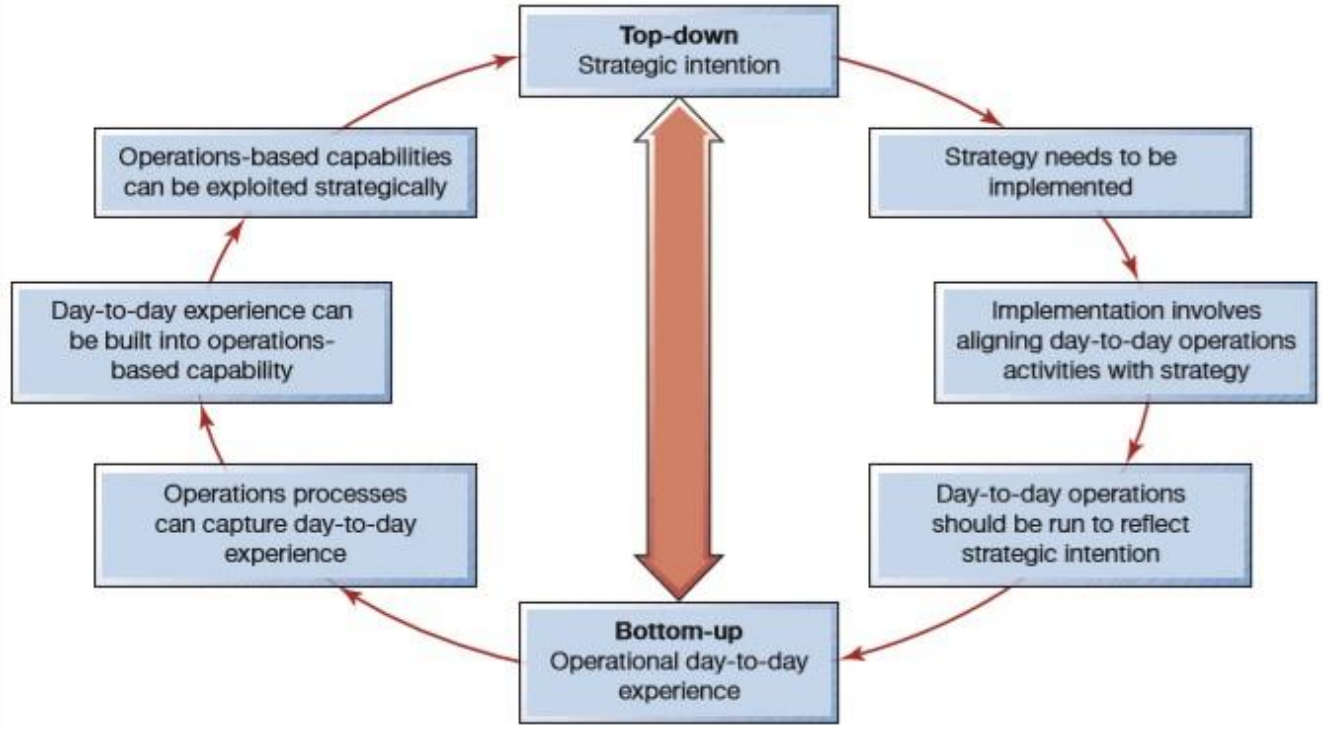
- **Decline stage -** After time, sales will decline with more competitors dropping out of the market. There might be a residual market, but unless a shortage of capacity develops, the market will continue to be dominated by price competition. Operations objectives continue to be dominated by cost

Sales volume	Introduction into market	Growth in market acceptance	Maturity of market, sales level off	Decline as market becomes saturated
Customers	Innovators	Early adopters	Bulk of market	Laggards
Competitors	Few/none	Increasing numbers	Stable numbers	Declining number
Likely order winners	Product/service specification	Availability	Low price Dependable supply	Low price
Likely qualifiers	Quality Range	Price Range	Range Quality	Dependable supply
Dominant operations performance objectives	Flexibility Quality	Speed Dependability Quality	Cost Dependability	Cost

Bottom-up perspective – How does operations strategy align with operational experience? Businesses, when reviewing their strategies, consult the individual functions within the business about their constraints and capabilities and incorporate the ideas which come from each function's day-to-day experience.



- **The reinforcing effect of top-down and bottom-up perspectives of operations strategy -** both are often seen as being diametrically opposite ways of looking at operations strategy, but they are not. In fact they can be mutually reinforcing



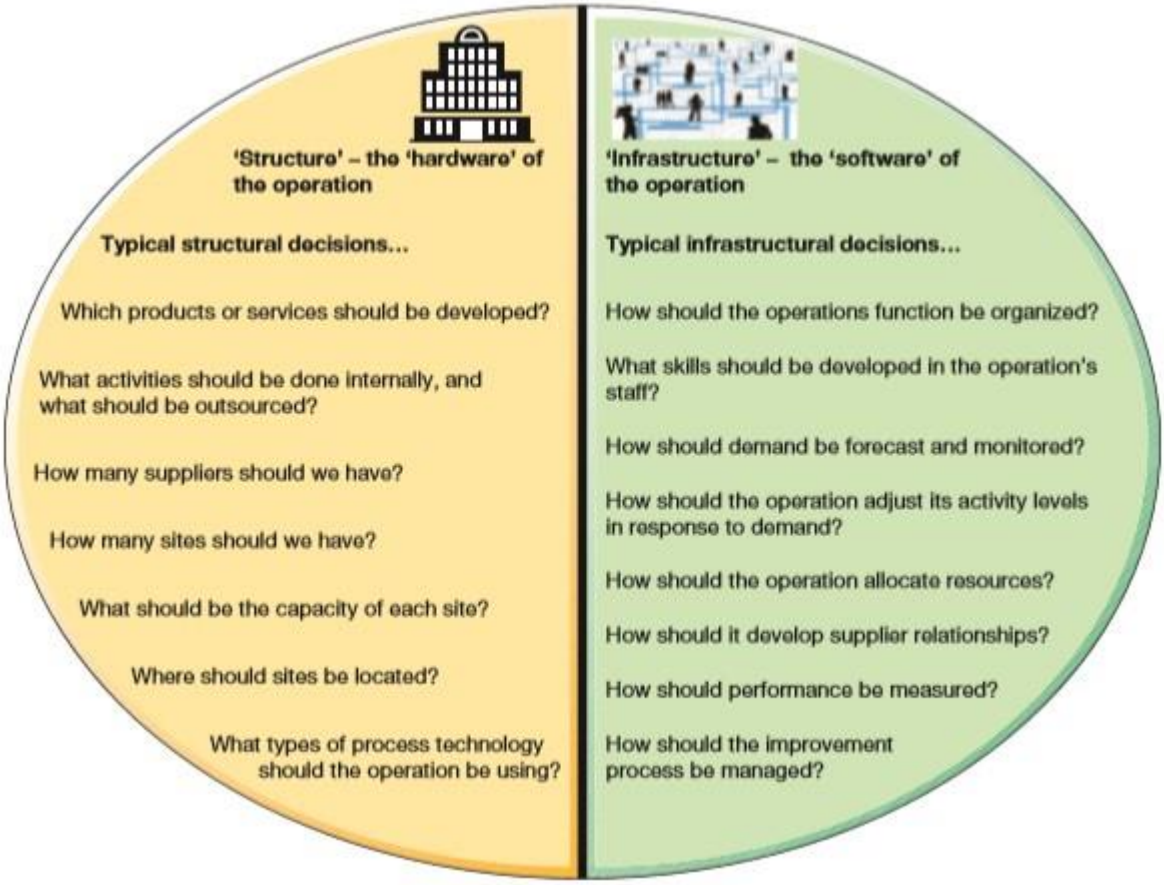
Inside-out perspective – How does operations strategy align with operations resources? -
Long-term competitive advantage can come from the capabilities of the operation's resources and processes, and these should be developed over long term to provide the business with a set of capabilities and competences

- **Understanding existing capabilities and competences –** What do we have and what can we do?
  - ➢ **Operation's intangible resources**
    Its relationship with suppliers and the reputation it has with its customers
    Its knowledge of and experience in handling its process technologies
    The way its staff can work together in new product and service development
    The way it integrates all its processes into mutually supporting whole
  - ➢ **Capabilities – tangible + intangible recourses and processes** ➢ **Constraints**
- **Strategic resources and sustainable competitive advantage**
  - **RBV (resource-based view)** - firms with an 'above-average' strategic performance are likely to have gained their sustainable competitive advantage because of the core competences (or capabilities) of their resources**:**
    They are scarce - ideal location, experienced engineers, proprietary software, etc.

They are not very mobile

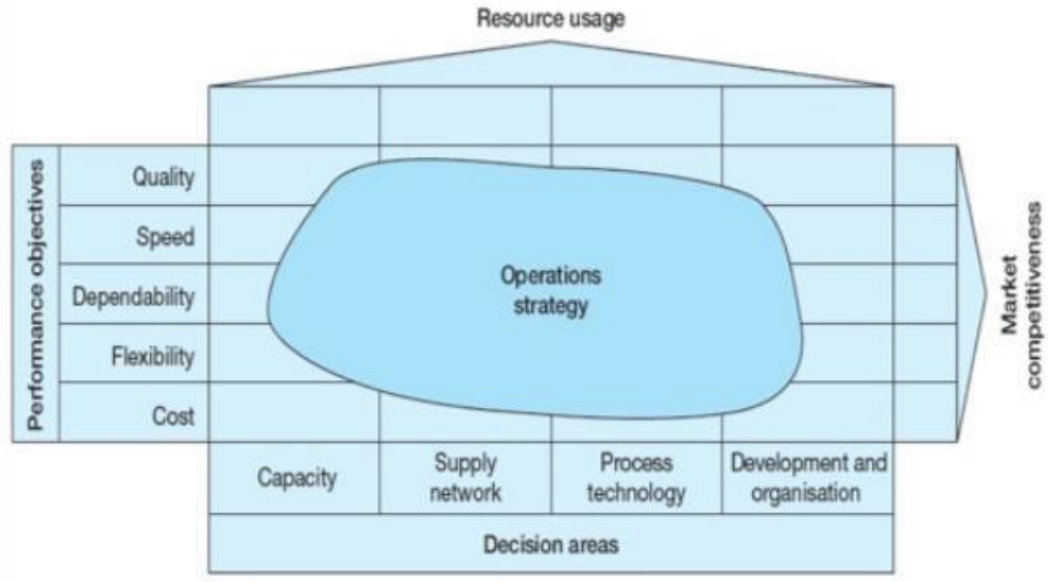
They are difficult to imitate or substitute for infrastructural decisions

- **Structural and**

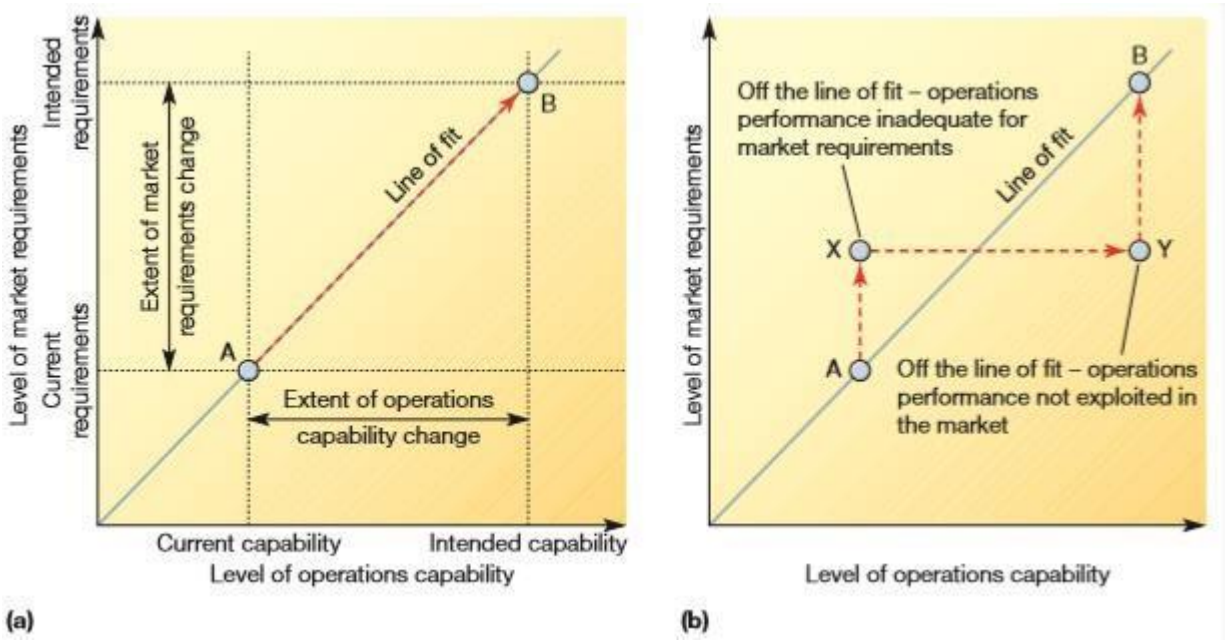


How are the four perspectives of operations strategy reconciled?

- **The operations strategy matrix –** operations strategy should articulate between operations objectives and the means of achieving them



- **The 'line of fit' between market requirements and operations capabilities**
  - **Achieving 'alignment' –** This means achieving an approximate balance between 'required market performance' and 'actual operations performance'. The diagonal line in represents a line of fit with market requirements and operations capabilities in balance
  - **Achieving 'sustainable' alignment –** It is not enough to achieve some degree of alignment to a single point in time. Equally important is whether operations processes could adapt to the new market conditions
  - **Improving overall performance –** If the requirements placed on the organization by its markets are relatively undemanding, then the corresponding level of operations capabilities will not need to be particularly high. The more demanding the level of market requirements, the greater will have to be the level of operations capabilities.



- **Importance-performance matrix to determine operations strategy improvement priorities – ex:** 'how important are the competitive factors that characterize a product or service?' **not** 'what are the market requirements for our products and/or services?'
  - **Judging importance to customers –** take order winning, qualifying and less important and divide each category into three further points representing strong, medium and weak positions
  - **Judging performance against competitors** – a competitive performance standard would consist merely of judging whether the achieved performance of an operation is better than, the same or worse than that of its competitors

(a) Importance scale for competitive factors		
Rating	**Description**	
1	Provides a crucial advantage to customers	High
2	Provides an important advantage to customers	
3	Provides a useful advantage to customers	
4	Needs to be up to good industry standard	
5	Needs to be up to median industry standard	
6	Needs to be within close range of rest of industry	
7	Not usually important but could become so	
8	Very rarely considered by customers	
9	Never considered by customers	Low

(b) Performance scale for competitive factors		
Rating	**Description**	
1	Considerably better than similar organizations	Good
2	Clearly better than similar organizations	
3	Marginally better than similar organizations	
4	Sometimes marginally better than similar organizations	
5	About the same as similar organizations	
6	Slightly worse than the average of similar organizations	
7	Usually marginally worse than similar organizations	
8	Generally worse than most similar organizations	
9	Consistently worse than most similar organizations	Poor

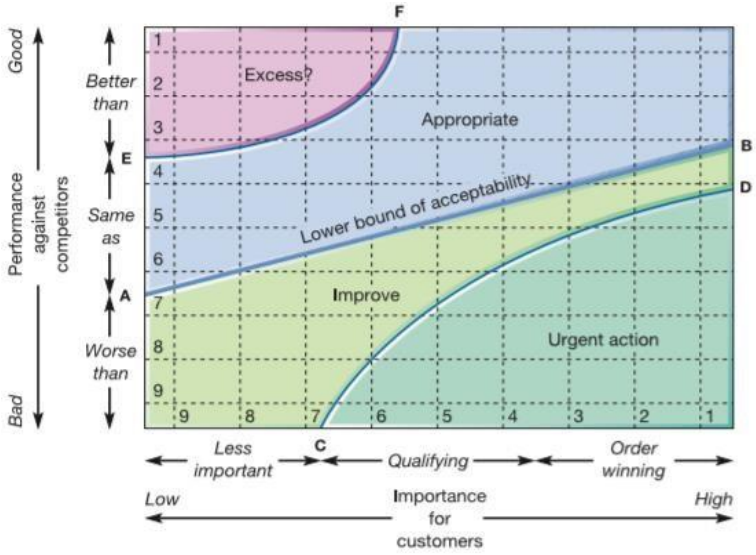
- **Priority zones**

The 'appropriate' zone – Competitive factors in this area lie above the lower bound of acceptability and so should be considered satisfactory.

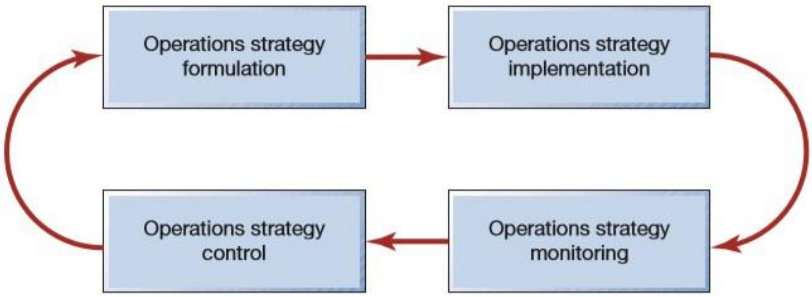
The 'improve' zone – Lying below the lower bound of acceptability, any factors in this zone must be candidates for improvement**.**

The 'urgent-action' zone – Important to customers but performance is below that of competitors; the factors must be considered as candidates for immediate improvement.

The 'excess?' zone – Factors in this area are 'high performing', but not important to customers. The question must be asked whether the resources devoted to achieving such a performance could be used better elsewhere.

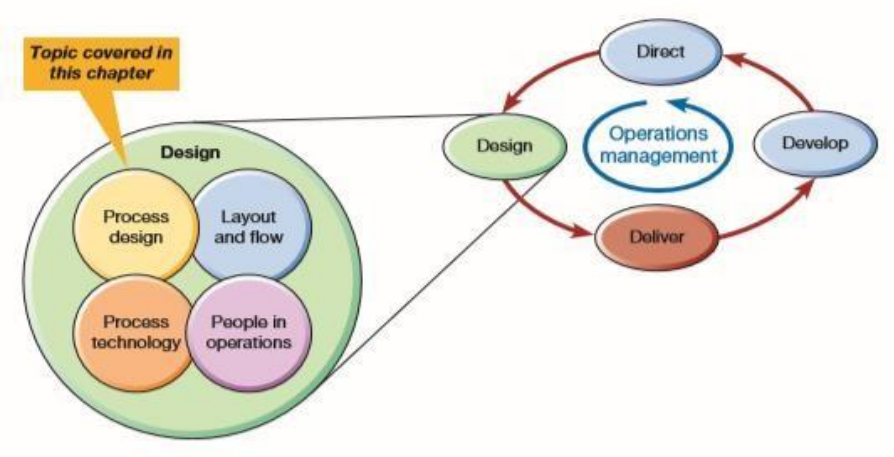


9. How can the process of operations strategy be organized?

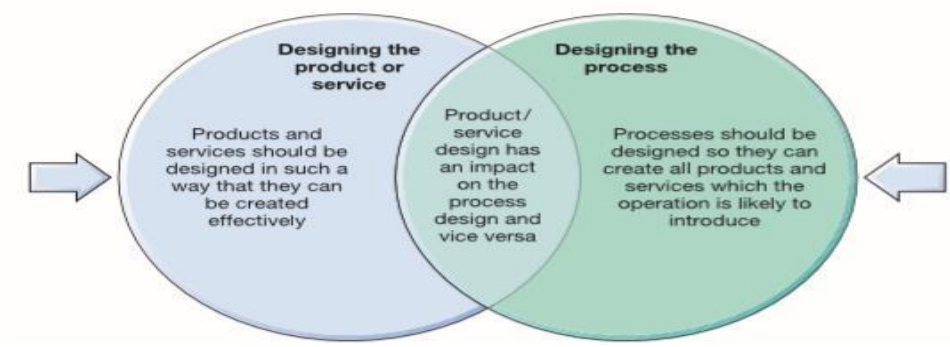


- **Operations strategy formulation -** the process of clarifying the various objectives and decisions that make up the strategy, and the links between them. What should it try to achieve:
  - Is operations strategy comprehensive?
  - Is operations strategy coherent?
  - Does operations strategy have correspondence? ➢ Does operations strategy identify critical issues?
- **Operations strategy implementation**
  - **Clarity of strategic decisions –** easier to define the intent behind the strategy, the few important issues that need to be developed to deliver the intent, the way that projects be led and resourced, who will be responsible for each task, etc.
  - **Motivational leadership –** needed to bring sense and meaning to strategic aspirations, maintain a sense of purpose over the implementation period, and, when necessary, modify the implementation plan in the light of experience ➢ **Project management**
- **Operations strategy monitoring -** should be capable of providing early indications by diagnosing data and triggering appropriate changes in how the operations strategy is being implemented, each part of the plan of implementation has to be monitored to ensure that planned activities are indeed happening. Any deviation from what should be happening can then be rectified through some kind of intervention in the operation
- **Operations strategy control** - the evaluation of the results from monitoring the implementation. Activities, plans and performance are assessed with the intention of correcting future action if that is required

Chapter 6 – Process design



1. **What is process design?**
    - To design – to conceive the looks, arrangement and workings of something before it is created; a conceptual exercise – delivers solution that will work in practice
    - Understanding design objectives
    - Activity which shapes the physical form and purpose of both products and services and the processes that produce them.
    - More likely to be successful if the complementary activities of product or service design and process design are coordinated.



2. **What should be the objectives of process design?**
    - The whole point of process design – to make sure that the performance of the process is appropriate for whatever it is trying to achieve

Operations performance objective	Typical process design objectives	Some benefits of good process design
Quality	Provide appropriate resources, capable of achieving the specification of product of services Error-free processing	Products and services produced to specification Less recycling and wasted effort within the process
Speed	Minimum throughput time Output rate appropriate for demand	Short customer waiting time Low in-process inventory
Dependability	Provide dependable process resources Reliable process output timing and volume	On-time deliveries of products and services Less disruption, confusion and rescheduling within the process
Flexibility	Provide resources with an appropriate range of capabilities Change easily between processing states (what, how, or how much is being processed?)	Ability to process a wide range of products and services Low cost/fast product and service change Low cost/fast volume and timing changes Ability to cope with unexpected events (e.g. supply or a processing failure)
Cost	Appropriate capacity to meet demand Eliminate process waste in terms of excess capacity, excess process capability, in-process delays, in-process errors, inappropriate process inputs	Low processing costs Low resource costs (capital costs) Low delay/inventory costs (working capital costs)
Sustainability	Minimize energy usage Reduce local impact on community Produce for easy disassembly	Lower negative environmental and societal impact

- **Micro process objectives**
  - **Throughput rate** (or flow rate) is the rate at which items emerge from the process, that is the number of items passing through the process per unit of time ➢ **Cycle time** is the reciprocal of throughput rate; it is the time between items emerging from the process. The term 'takt' time is the same, but is normally applied to 'paced' processes like moving-belt assembly lines. It is the 'beat' or tempo of working required to meet demand
  - **Throughput time** is the average elapsed time taken for inputs to move through the process and become outputs
  - The number of items in the process (also called the '**work-in-progress', or inprocess inventory**) as an average over a period of time
  - The **utilization** of process resources is the proportion of available time that the resources within the process are performing useful work

• **Standardization of process** – doing things in the same way; adopting a common sequence of activities, methods and use of equipment

➢ The extent to which process designs should be standardized – one of the most important process objectives, especially in large companies

- **Environmentally sensitive process design**
  - The sources of inputs to a product or service. (Will they damage rainforests? Will they use up scarce minerals? Will they exploit the poor or use child labour)
  - Quantities and sources of energy consumed in the process. (Do plastic beverage bottles use more energy than glass ones? Should waste heat be recovered and used in fish farming?)
  - The amounts and type of waste material that are created in the manufacturing processes. (Can this waste be recycled efficiently, or must it be burnt or buried in landfill sites?)
  - The life of the product itself. If a product has a long useful life will it consume fewer resources than a short-life product?
  - The end of life of the product. (Will the redundant product be difficult to dispose of in an environmentally friendly way?)

3. **How do volume and variety affect process design? –** different products or services with different volume–variety positions require different processes
   - **Process types -** The position of a process on the volume–variety continuum shapes its overall design and the general approach(process type) to managing its activities

➢ **Project processes**

Deal with discrete, usually highly customized products
Long timescale between completion of each item
Jobs have well-defined start and finish
Low volume and high variety
Activities – ill-defined and uncertain
Resources may have to be organized especially for each item

Complex process
Software design, movie production, most construction companies, large fabrication operations such as turbo generators manufacturers

➢ **Jobbing processes**

Low volumes and high variety
Operation's resources process series of items
Sometimes → One-offs never repeated
Complex, physically smaller products,
Work of made-to-measure tailors, many precision engineers such as specialist toolmakers, furniture restorers, printer producing tickets

➢ **Batch processes**

Similar to jobbing processes
Produce more than one item at s time
A wide range of volume and variety levels
Machine tool manufacturing, Production of special gourmet frozen goods, component parts which go into mass-produced assemblies

➢ **Mass processes**

High volume and relatively low variety
Operate for a long period of time
Repetitive and largely predictable
Frozen food production, automatic packing lines, automobile plants, TV factories

➢ **Continuous processes**

Higher volume and lower variety than mass processes
Operate for a long period of time
Inflexible, capital-intensive technologies with highly predictable flow
Water processing, petro technical refineries, electricity utilities, steel making, paper making

➢ **Professional services**

High-contact services, customers in the process
Customization
People-based rather than equipment-based
Management consultants, lawyer's practices, architects, doctors' surgeries, auditors, health and safety inspectors

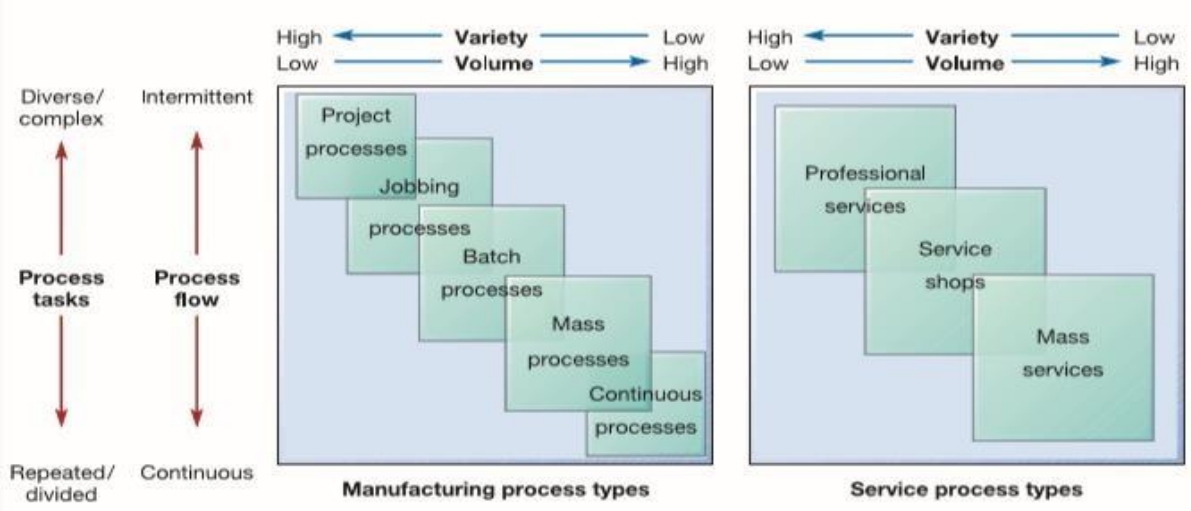
➢ **Service shops**

High levels of volume and variety
Customer contact, customization, staff discretion
Service provided via mixes of front- and back-office activities
Banks, hotels, high street shops, holiday tour operators, car rental companies, schools, most restaurants, hotels and travel agents

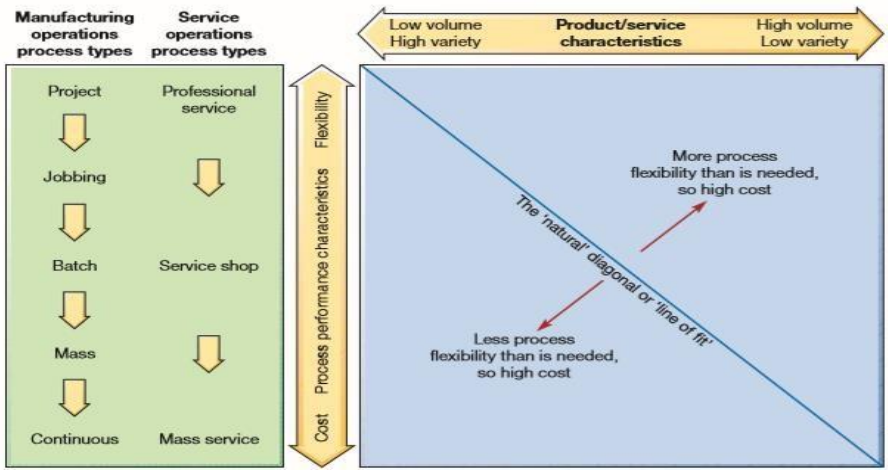
➢ **Mass services**

Customer transactions, limited contact time, little customization
Staff – defined division of labour, have to follow procedures

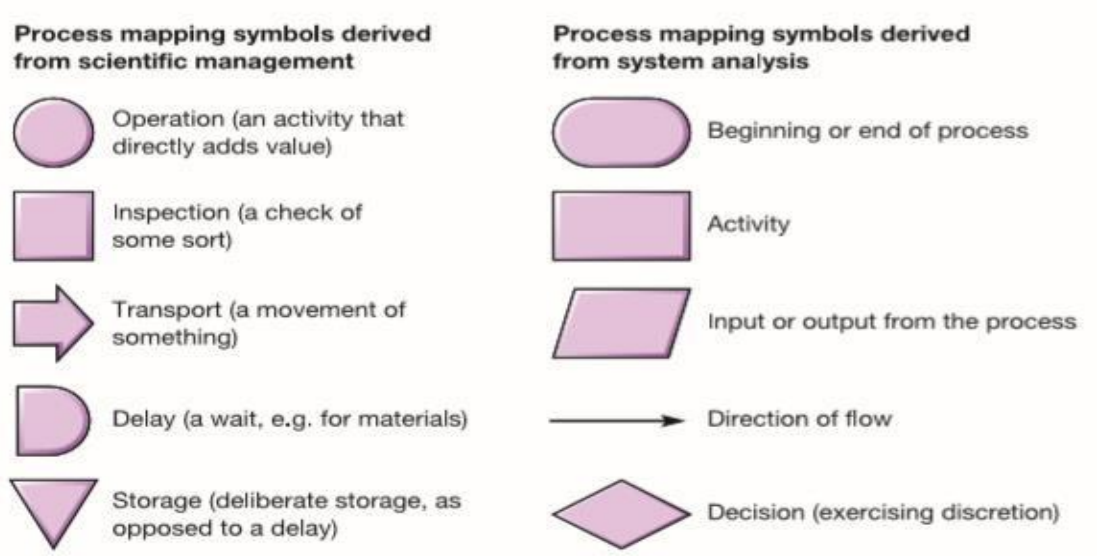
Supermarkets, a national rail network, airports, telecommunication service, library, TV station, police service, call centers



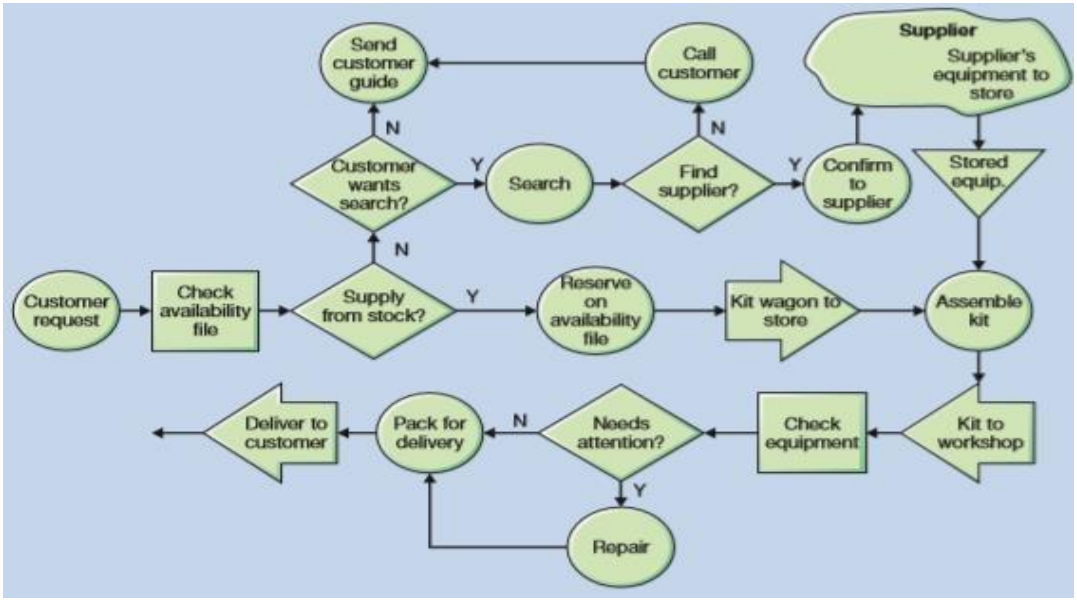
4. **The product-process matrix –** the most common method of illustrating the relationship between a process's volume-variety position and its characteristics
    - **Moving off the natural diagonal(line of fit) –** higher operating costs because the line represents the most appropriate process design for any volume-variety position



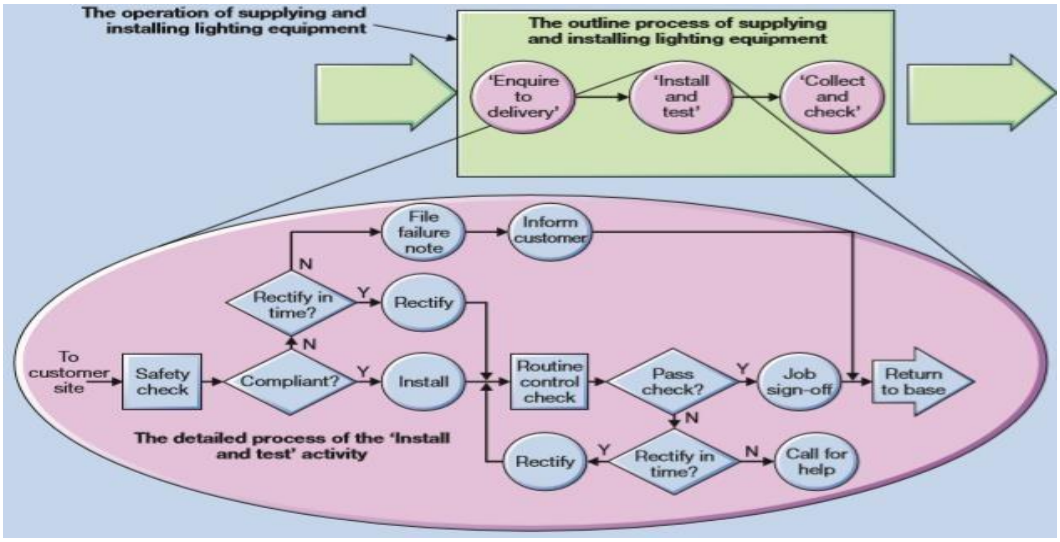
5. **How are processes designed in detail? -** After the overall design of a process has been determined, its individual activities must be configured. **Detailed design of a process** involves identifying all the individual activities that are needed to meet the objectives of the process, and deciding on the sequence in which these activities are to be performed and who is going to do them
    - **Process mapping**(blueprinting, analysis) – involves describing processes in terms of how the activities within the process relate to each other, using different techniques which identify different types of activity
        - **Process mapping symbols –** used to classify different types of activity which takes place during the process



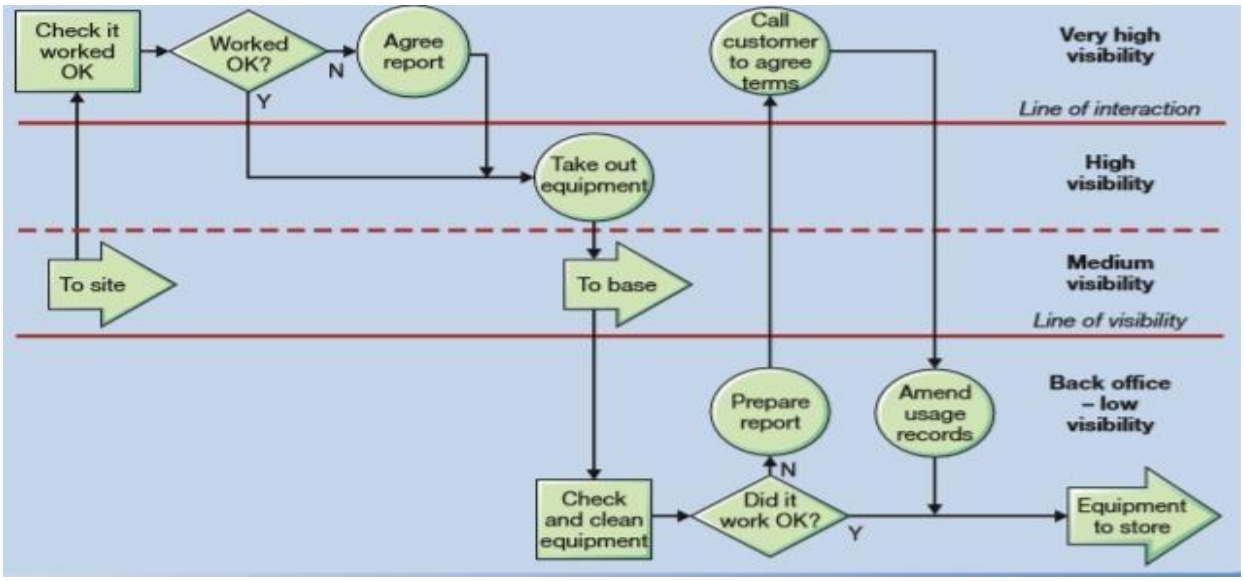
- Example



- **Different levels of process mapping –** because drawing detailed maps for a large process can be complex



- **Process visibility –** mapping processes to make the degree of visibility of each part of the process obvious



- **Throughput time, cycle time and work-in-progress**

- **Little's law -** the average number of things in the system is the product of the average rate at which things leave the system and average time each one spends in the system

Throughput time (TT) = work-in-progress (WIP) x cycle time (CT)

Work-in-progress (WIP) = Throughput time (TT) x Throughput rate (TR)

E.g. 10-minute wait = 10 people in the system x 1 minute per person

Need people/staff = work content/cycle

- **Throughput efficiency**

%Throughput efficiency = (Work content/Throughput time) x 100

- **Value-added throughput efficiency**

Value-added throughput efficiency = work content needed / throughput time

- **Workflow -** the automation of procedures where documents, information or tasks are passed between participants according to a defined set of rules to achieve, or contribute to, an overall business goal

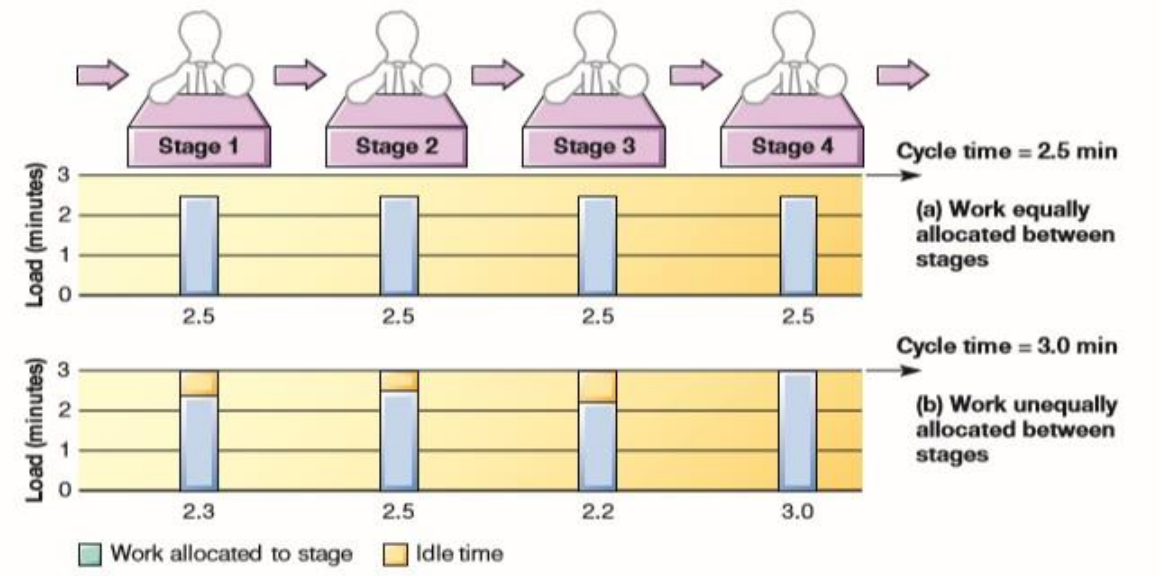
  Analysis, modelling, definition and subsequent operational implementation of business processes

  The technology that supports the processes

  The procedural (decision) rules that move information/documents through processes

  Defining the process in terms of the sequence of work activities, the human skills needed to perform each activity and the appropriate IT resources

- **Process bottlenecks -** the activity or stage where congestion occurs because the workload placed is greater than the capacity to cope with it; it will dictate the rate at which the whole process can operate



➢ **Balancing work time allocation**

Karlstad Kakes (KK) is a manufacturer of speciality cakes, which has recently obtained a contract to supply a major supermarket chain with a speciality cake in the shape of a space rocket. It has been decided that the volumes required by the supermarket warrant a special production process to perform the finishing, decorating and packing of the cake. This line would have to carry out the elements shown in Table 6.2.

Table 6.2 The individual tasks that make up the total job of the finishing, decorating and packing of the cake

Task a: De-tin and trim	Task d: Clad in top fondant	Task g: Apply blue icing
Task b: Reshape	Task e: Apply red icing	Task h: Fix transfers
Task c: Apply base fondant	Task f: Apply green icing	Task i: To base and pack

Figure 6.11 shows the precedence diagram for the total job. The initial order from the supermarket is for 5,000 cakes a week and the number of hours worked by the factory is 40 per week. From this:

$$\text{The required cycle time} = \frac{40 \text{ hours} \times 60 \text{ minutes}}{4{,}000}$$

$$= 0.48 \text{ minutes}$$

$$\text{The required number of stages} = \frac{1.68 \text{ minutes (the total work content)}}{0.48 \text{ minutes (the required cycle time)}}$$

$$= 3.5 \text{ stages}$$

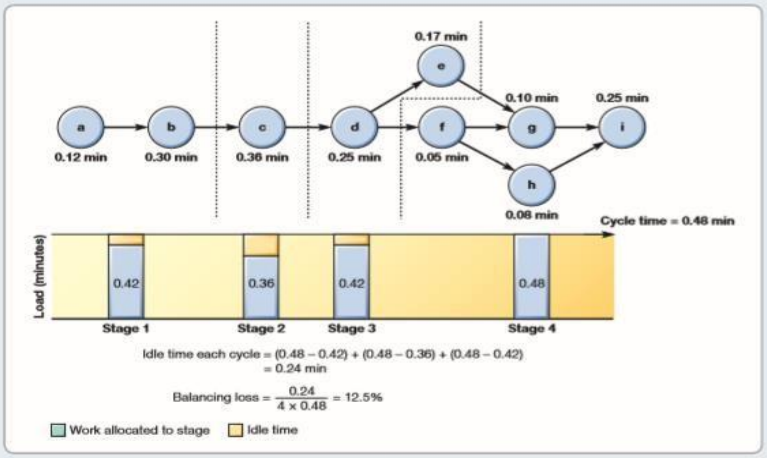
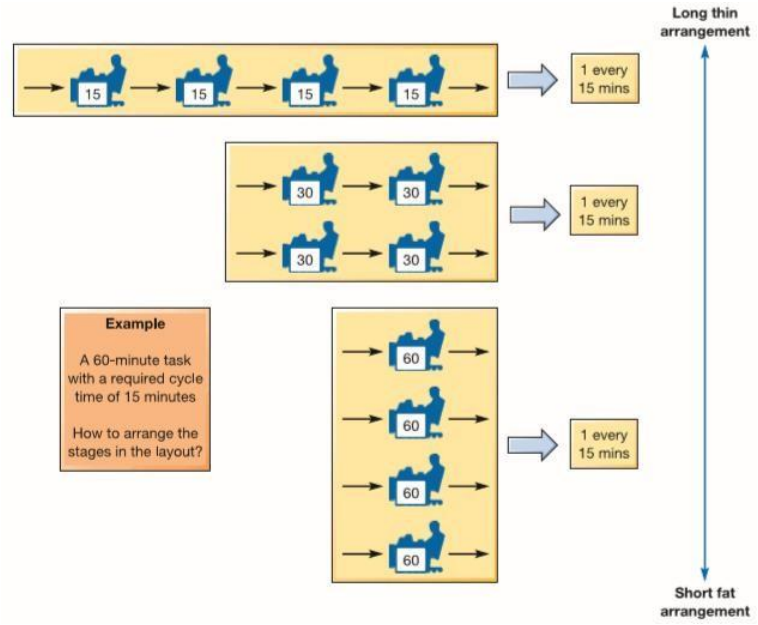


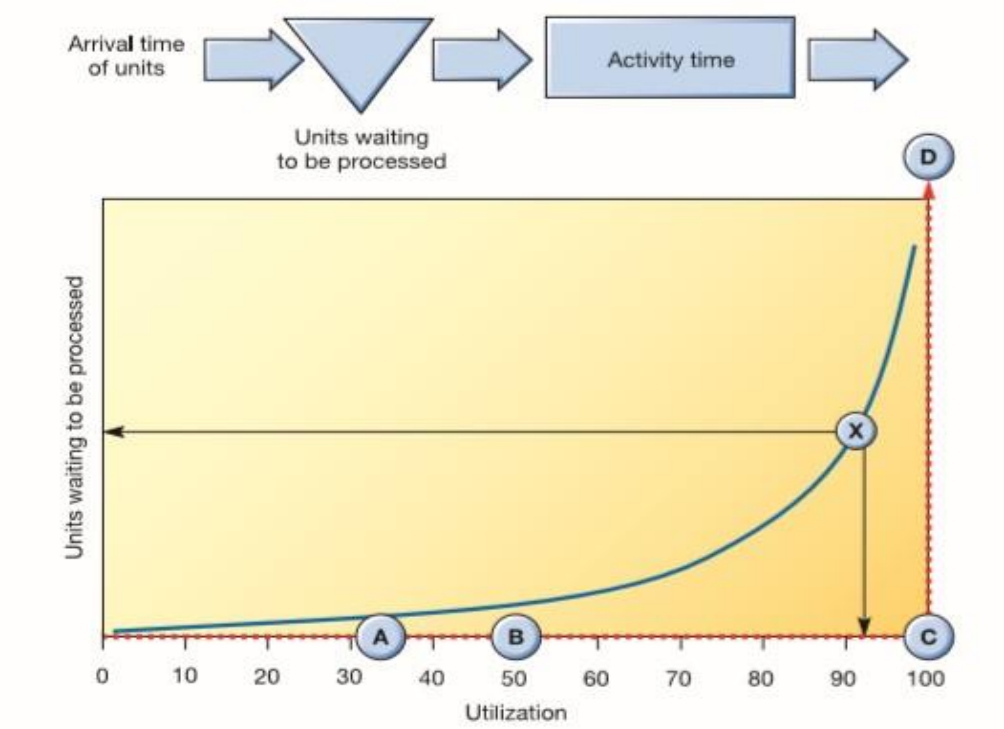
Figure 6.11 Precedence diagram for Karlstad Kakes with allocation of tasks to each stage

- **Arranging the stages -** All the stages necessary to fulfil the requirements of the process may not be arranged in a sequential 'single line' ('long' means the number of stages and 'fat' means the amount of work allocated to each stage)

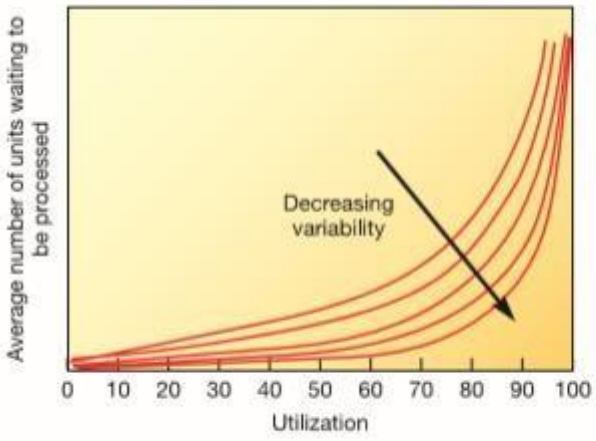
- **The advantages of the long thin arrangement include:** Controlled flow of items, Simple handling, Lower capital requirement, More efficient operation
- **The advantages of the short fat arrangement include:** Higher mix flexibility , Higher volume, Higher robustness, Less monotonous work



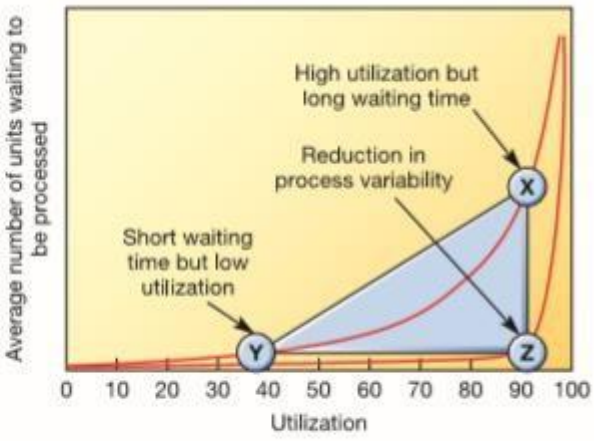
- **Low volume-high variety processes**
- **The effects of process variability** - Variability has a significant effect on the performance of processes, particularly the relationship between waiting time and utilization
    - Variability in the demand for processing at an individual stage within the process, usually expressed in terms of variation in the inter-arrival times of items to be processed
    - Variation in the time taken to perform the activities (that is, process a unit) at each stage



- accept long average waiting times and achieve high utilization (point X);
- accept low utilization and achieve short average waiting times (point Y)
- reduce the variability in arrival times, activity times, or both, and achieve higher utilization and short waiting times (point Z)

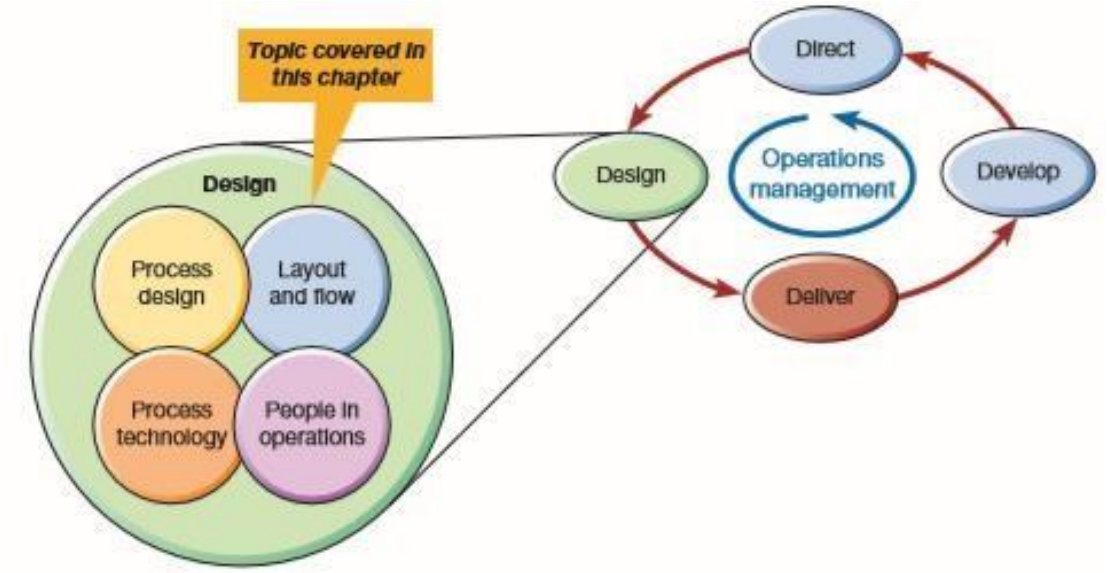


(a) Decreasing variability allows higher utilization without long waiting times

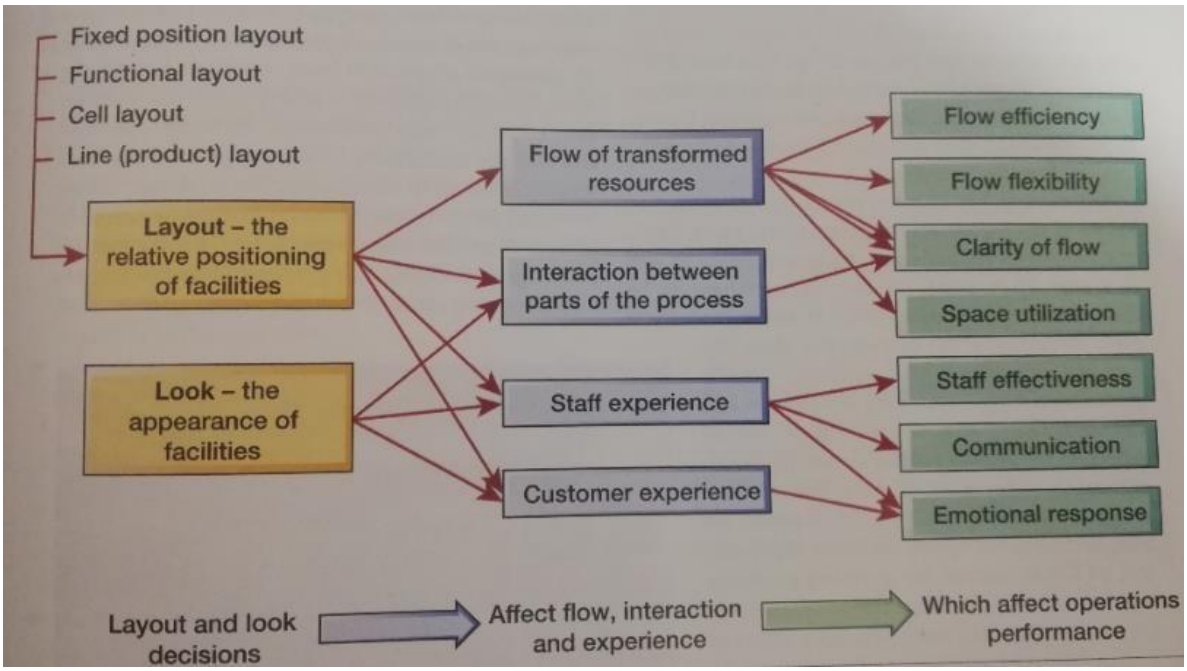


(b) Managing process capacity and/or variabiltiy

Chapter 7 – The layout and look of facilities



1. What is layout and how can it influence performance? - 'layout' of an operation or process means how its transforming resources are positioned relative to each other, how its various tasks are allocated to these transforming resources and the general appearance of the transforming resources. if done badly, it can lead to over-long or confused flow patterns, customer queues, long process times, inflexible operations, unpredictable flow, high costs and a poor response for whoever is within the operation, whether they are customers or staff

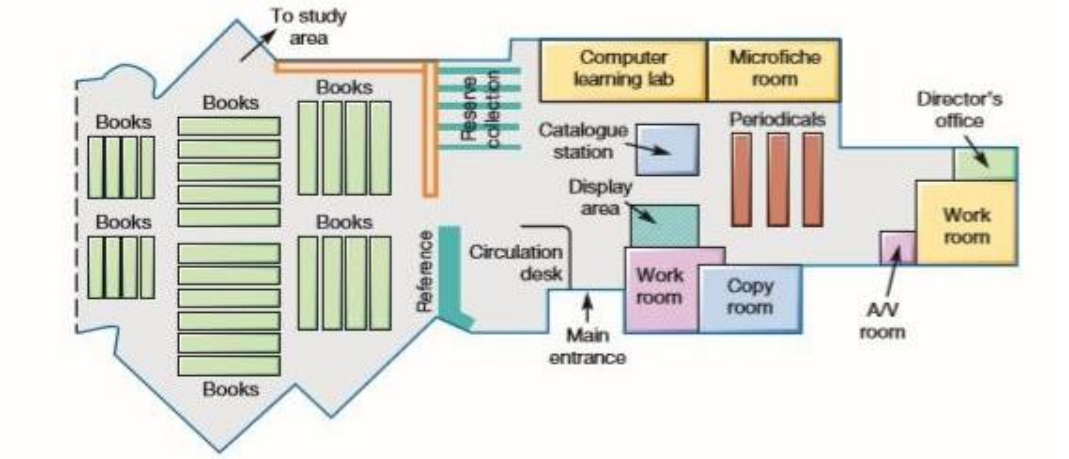


- **What makes a good layout? –** depends on the strategic objectives of the operation, but there are some general objectives, relevant to all operations:
    - **The flow of transformed resources –** the route taken by transformed resources as they progress through operation or process is governed by how its transforming resources are positioned relative to each other

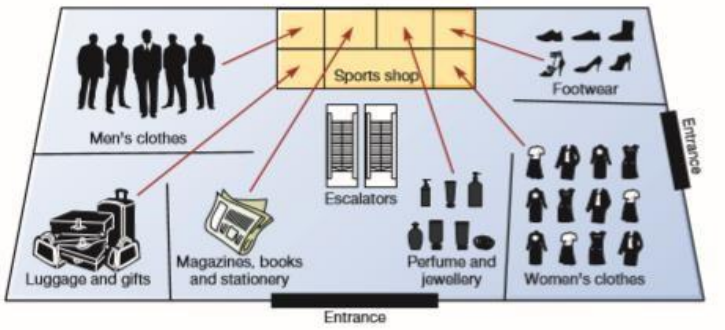
- **The interaction between part of the process –** the individual facilities can suffer or benefit from being positioned close to each other
- **Staff experience –** an obvious prerequisite for any layout in any type of operation is that it should not constitute any physical or emotional danger to staff
- **Customer experience –** in high-visibility operations – banks, retail shops – the layout and the look of an operation can help to shape its image and the general experience of customers

2. What are the basic layout types used in operations?

- **Fixed-position layout –** the transformed resources do not move between the transforming resources - the recipient of the processing is stationary and the equipment, machinery, plant and people who do the processing move as necessary, because the product or the recipient of the service is too large to be moved conveniently, or it might be too delicate to move, or perhaps it could object to being moved
  - **Motorway construction –** the product is too large to move
  - **Open-heart surgery –** patients are too delicate to move
  - **High-class service restaurant –** customers would object to being moved to where food is prepared
  - **Shipbuilding –** the product is too large to move
  - **Mainframe computer maintenance –** the product is too big and probably also too delicate to move, and the customer might object to bringing it in for repair
- **Functional layout -** similar resources or processes are located together, because it is convenient to group them together, or that the utilization of transforming resources is improved. It means that when products, information or customers flow through the operation, they will take a route from activity to activity according to their needs. Different products or customers will have different needs and therefore take different routes
  - **Hospital** – some processes (for example, X-ray machines and laboratories) are required by several types of patient; some processes (for example, general wards) can achieve high staff and bed utilization
  - **Machining the parts which go into aircraft engines** – some processes (for example, heat treatment) need specialist support (heat and fume extraction); some processes (for example, machining centers) require the same technical support from specialist setter– operators; some processes (for example, grinding machines) get high machine utilization as all parts which need grinding pass through a single grinding section
  - **Supermarket** – some products, such as tinned goods, are convenient to restock if grouped together. Some areas, such as those holding frozen vegetables, need the common technology of freezer cabinets. Others, such as the areas holding fresh vegetables, might be together because, that way, they can be made to look attractive to customers
  - **Library** - has different types of user with different traffic patterns

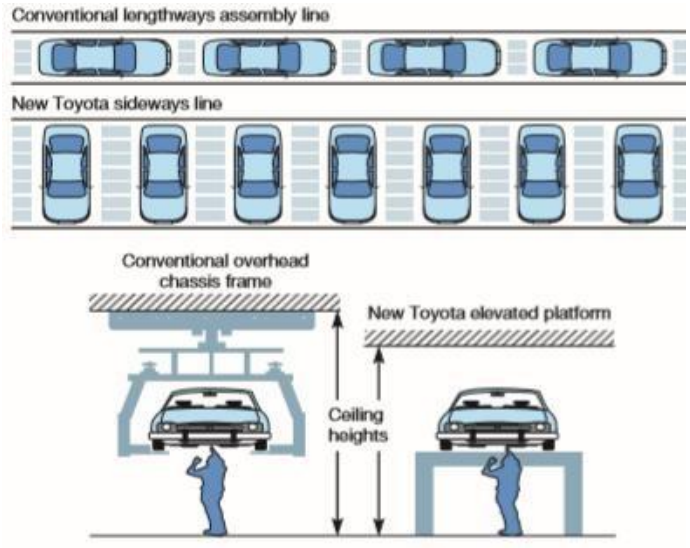


- **Cell layout -** where the transformed resources entering the operation are pre-selected (or preselect themselves) to move to one part of the operation (or cell) in which all the transforming resources, to meet their immediate processing needs, are located. The cell itself may be arranged in either a functional or line
    - **Some computer component manufacture**– the processing and assembly of some types of computer parts may need a special area dedicated to the manufacturing of parts for one particular customer who has special requirements, such as particularly high- quality levels.
    - **'Lunch' products area in a supermarket** – some customers use the supermarket just to purchase sandwiches, savory snacks, cool drinks, yoghurt, etc., for their lunch. These products are often located close together so that customers who are just buying lunch do not have to search around the store.
    - **Maternity unit in a hospital** – customers needing maternity attention are a well-defined group who can be treated together and who are unlikely to need the other facilities of the hospital at the same time that they need the maternity unit

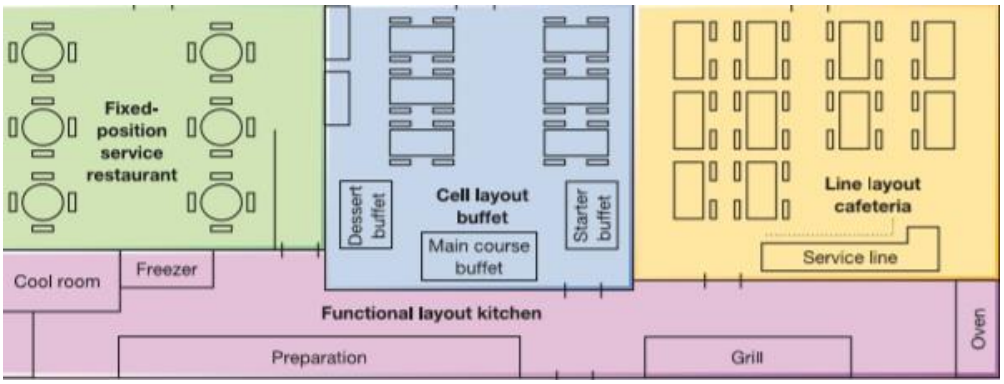


- **Line/product layout -** locating the transforming resources entirely for the convenience of the transformed resources- each product, piece of information or customer follows a prearranged route in which the sequence of activities that are required matches the sequence in which the processes have been located
    - **Automobile assembly –** almost all variants of the same model require the same sequence of processes
    - **Mass-immunization program –** all customers require the same sequence of clerical, medical and counselling activities

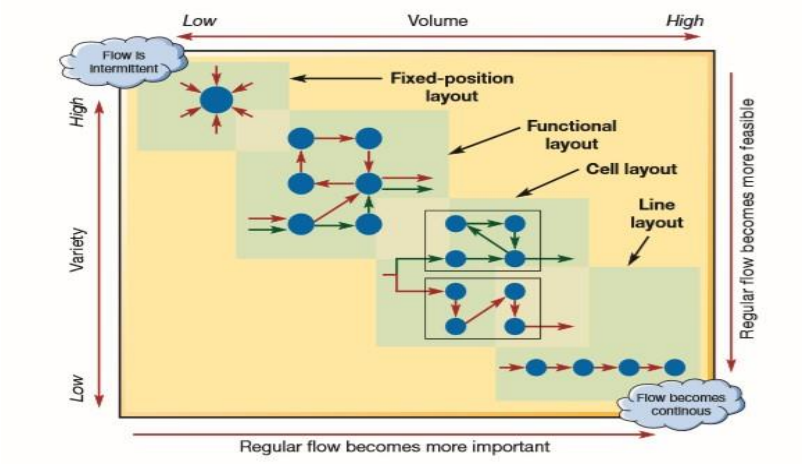
- **Self-service cafeteria –** generally the sequence of customer requirements (starter, main course, dessert and drink) is common to all customers, but layout also helps control customer flow



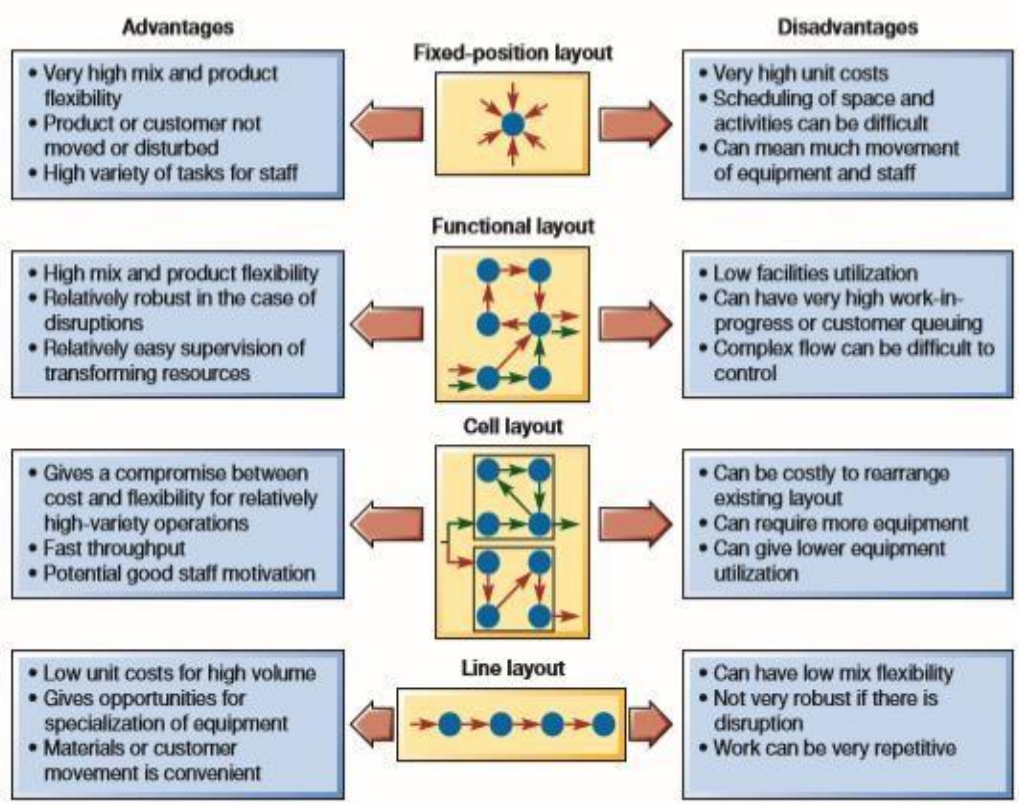
- **Mixed layouts -** Many operations either design themselves hybrid layouts which combine elements of some or all of the basic layout types, or use the 'pure' basic layout types in different parts of the operation



- **What type of layout should an operation choose?**



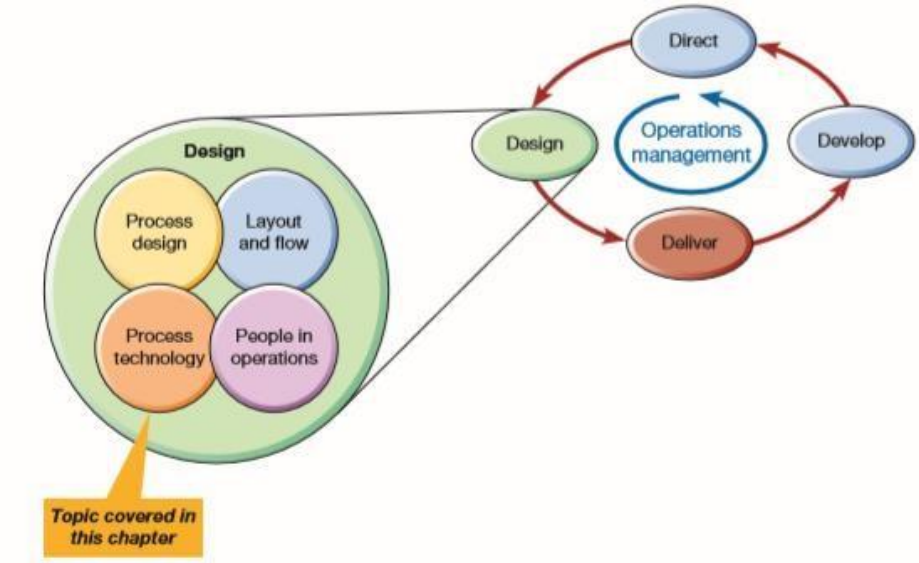
igure 7.8 Different process layouts are appropriate for different volume–variety ombinations



➢ **cost analysis -** different types of layouts have different fixed and variable costs which determine the appropriateness of layout for varying volume-variety characteristics

3. **How does the appearance of an operation affect its performance? -** the aesthetics of a layout (in other words, what it looks and feels like) is also important, particularly when customers experience the inside of an operation, as in high-visibility operations
    - **The effect of workplace design on staff –** layouts take into consideration the aesthetic appearance of the workplace and type of facilities available to staff
    - **The effect design on customers – servicescapes –** layouts should include consideration of the look and feel of operation to customers and/or staff
4. **Several layout design techniques**
    - **Fixed position –** resource location analysis
    - **Functional layout** – flow charts and relationship charts
    - **Cell layout** – product flow analysis
    - **Product layout** – assembly line balancing techniques

Chapter 8 – Process technology



1. **What is process technology and why is it getting more important?**
   - **Definition -** the machines, equipment, and devices that create and/or deliver products and services
   - Without **process technology** many of the products and services we all purchase would be less reliable, take longer to arrive and arrive unexpectedly, only be available in a limited variety, and be more expensive.
   - **Process technology** has a very significant effect on quality, speed, dependability, flexibility and cost
   - **What is new in new technologies?**
     - **New technologies often have increased capabilities**
     - **New technologies can increasingly be applied in all types of operation**

   • **Process technology and transformed resources** (materials, information, customers) ➢ **Material-processing technologies**

   include any technology that shapes, transports, stores, or in any way changes physical objects - machines and equipment found in manufacturing operations, also includes trucks, conveyors, packing machines, warehousing systems and even retail display units
   it is the initial forming and shaping of materials at the start, and the handling and movement through the supply network, that have been most affected by technology advances

   ➢ **Information-processing technologies – Information technology (IT)**

   includes any device which collects, manipulates, stores or distributes information
   advantage was that it increased both reach and richness
   provide opportunities for process innovation
   - ✞ those involving some form of analytical capability – algorithmic decision making, AI, data mining

- those involving communication or connectivity – block chain
- those capable of processing visual information – augmented reality (AU)

➢ **Customer-processing technologies**

the human element of service is being reduced, with customerprocessing technology used to give an acceptable level of service while significantly reducing costs

There are three types of customer-processing technologies.

- **Customers create service using technology –** active interaction technology- automobiles, telephones, Internet bookings and purchases, fitness equipment and cash machines (ATMs)
- **Passive interactive technology -** 'processes' and controls customers by constraining their actions in some way - aircraft, mass transport systems, moving walkways and lifts, cinemas and theme parks
- **Hidden technologies -** track customers' movements or transactions in an unobtrusive way - security monitoring technologies in shopping malls or at national frontier customs areas

➢ **Integrating technologies**

Some technologies process more than one type of resource - materials, people and customers.

Electronic point-of-sale (EPOS) technology, for example, processes shoppers, products and information

- **How should operations managers manage process technology?**
  - **First –** understand the technology to the extent that they are able to articulate what it should be able to do – understanding its implications
  - **Second –** evaluate alternative technologies, particularly as they affect the operations they manage, and share in the decisions of which technology to choose
  - **Third –** manage – develop, plan and implement – the technology so that it can reach its full potential in contributing to the performance of the operations as a whole

2. **Understanding the potential of new process technology -** knowing enough about the principles behind the technology to be comfortable in evaluating some technical information, capable of dealing with experts in the technology, and confident enough to ask relevant questions
   - **What does the technology do which is different from other similar technologies?**
   - **How does it do it? That is, what particular characteristics of the technology are used to perform its function?**
   - **What benefits does using the technology give to the operation?**

- **What constraints or risks does using the technology place on the operation?**

- **Emerging technologies – assessing their primary capabilities**
  - ➢ **General perception of new technologies**

    Stage 1 – technology trigger – technology exist only theoretically or it has only a prototype

    Stage 2 – peak of the inflated expectations – technology is implemented by some more adventurous operations

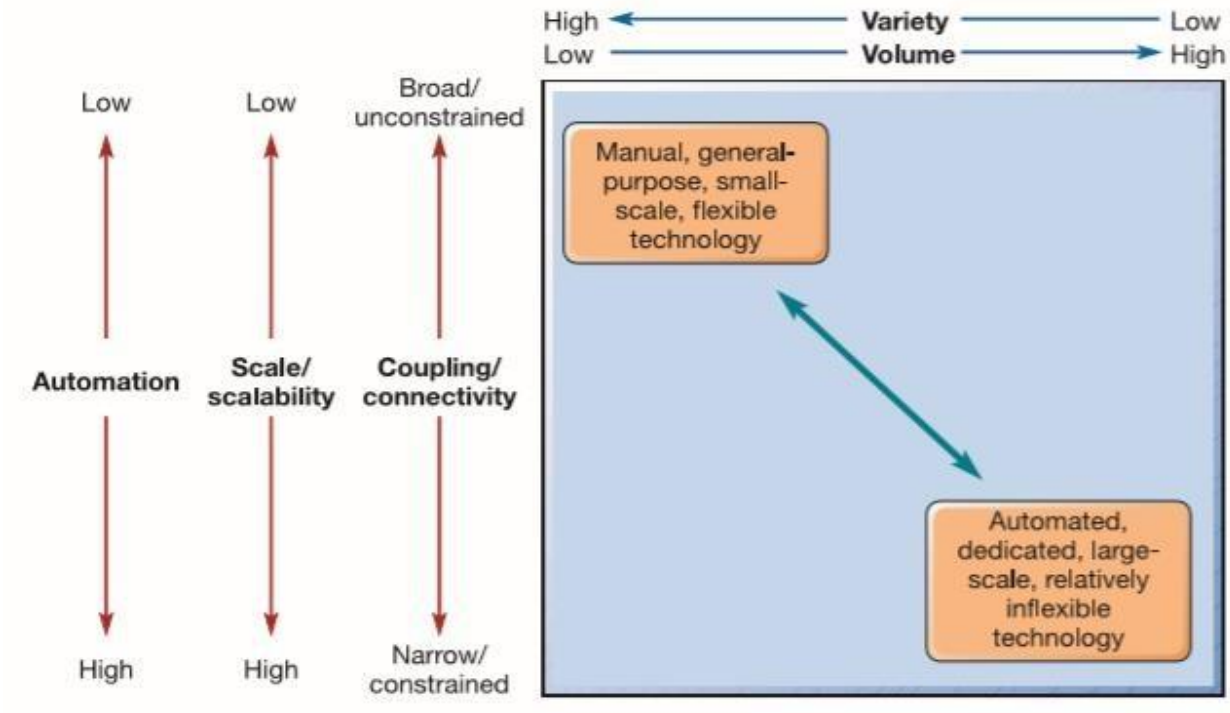
    Stage 3 – trough of disillusionment – backlash → disappointment and disillusionment with the technology

    Stage 4 – slope of enlightenment – problems are slowly solved and its potential is understood

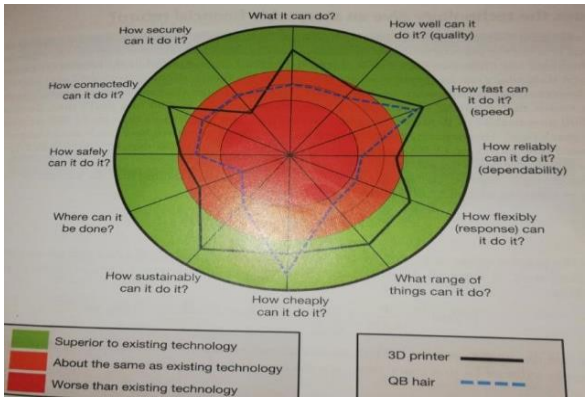
    Stage 5 – plateau of productivity – the technology becomes widely adopted

- **Classifying technologies by their primary capabilities**
  - **Technologies that can think, or reason**
  - **Technologies that can see, or sense**
  - **Technologies that can communicate, or connect**
  - **Technologies that can move objects**
  - **Technologies that can process materials**
  - **Technologies with more than one primary capability**

3. **How are process technologies evaluated?**
   - **Does the technology fit the processing task for which it is intended?**
     - **The degree of automation of the technology**
     - **The scale/scalability of the technology**
     - **The coupling/connectivity of the technology**



How does the technology improve the operation's performance?



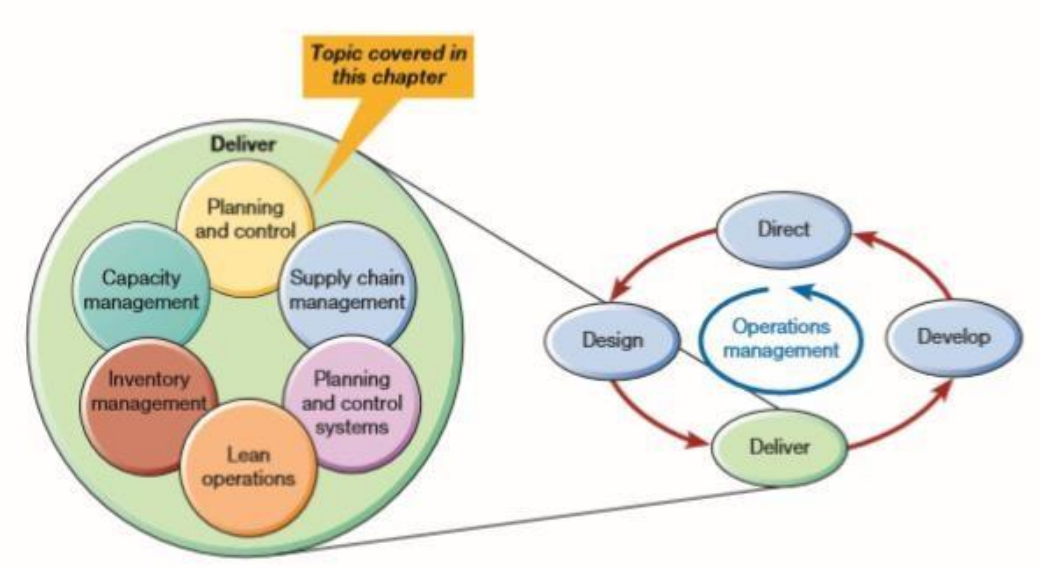
- **Does the technology give an acceptable financial return?**

The rate of interest assumed (10 per cent in our case) is known as the discount rate. More generally, the present value of €x in n years' time, at a discount rate of r per cent, is:

$$€\frac{x}{(1+r/100)^n}$$

4. **How are new process technologies developed and implemented? -** Implementing process technology means organizing all the activities involved in making the technology work as intended.
    - **Technology planning in the long term – technology road mapping (TRM) -** approach that provides a structure that attempts to assure the alignment of developments (and investments) in technology, possible future market needs, and the new development of associated operations capabilities
    - **Resource and process 'distance'** - implied by the technology implementation, will indicate the degree of difficulty
    - **Customer acceptability – may be a barrier to implementation in customerprocessing technologies**
    - **Anticipating implementation problems -** It is necessary to allow for the adjustment costs of implementation

Chapter 10 – Planning and control



1. **What is planning and control? -** concerned with the activities that attempt to reconcile the demands of the market and the ability of the operation's resources to deliver - provides the systems, procedures and decisions which bring different aspects of supply and demand together • **The difference between planning and control – not clear division but:**
    - **Planning -** what activities should take place in the operation; when they should take place; what resources should be allocated to them
    - **Control -** understanding what is actually happening in the operation; deciding whether there is a significant deviation from what should be happening; (if there is deviation) changing resources in order to affect the operation's activities.

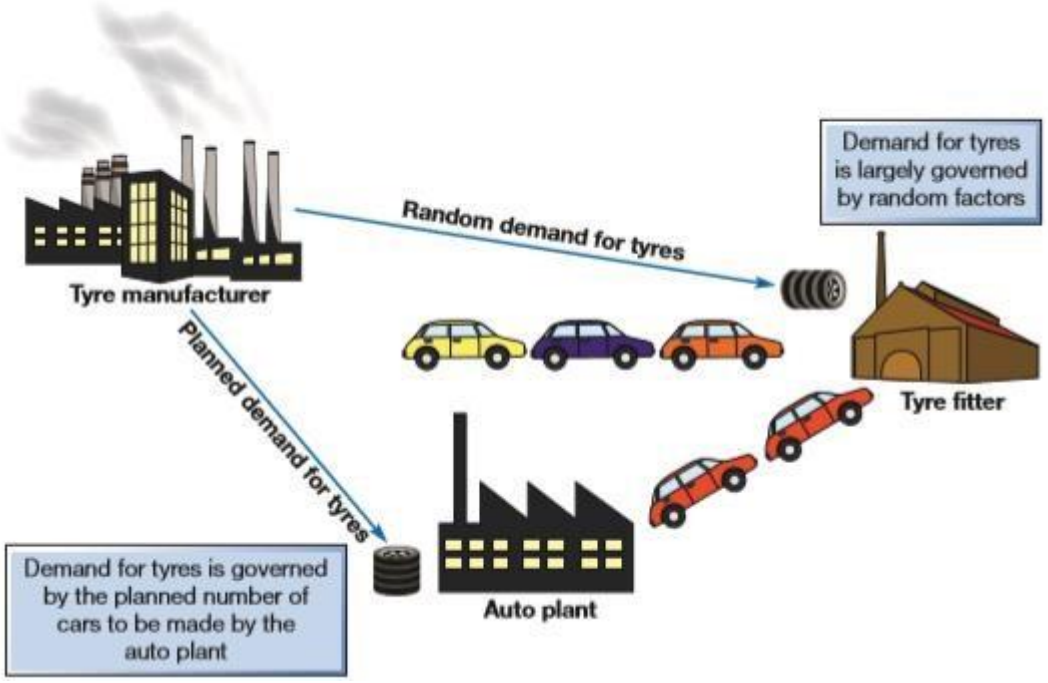
- **Long-, medium-, and short-term planning and control**

The volume-variety effect on planning and control

Volume	Variety	Customer responsiveness	Planning horizon	Major planning decision	Control decisions	Robustness
Low	High	Slow	Short	Timing	Detailed	High
↓	↓	↓	↓	↓	↓	↓
High	Low	Fast	Long	Volume	Aggregated	Low

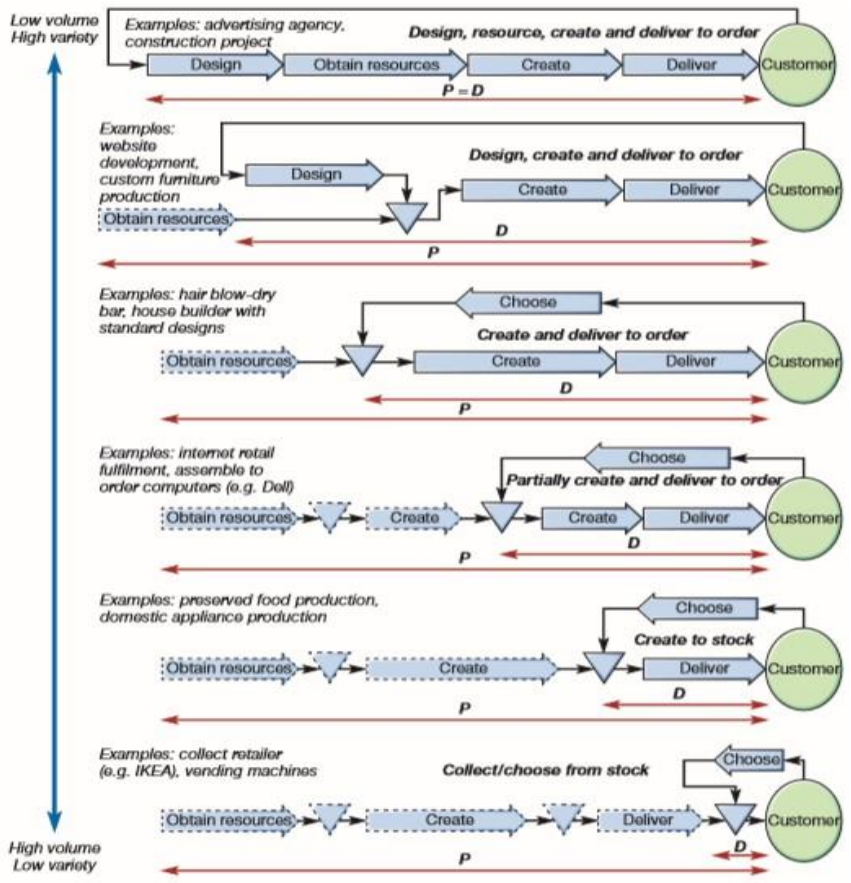
***robustness - vulnerability to serious disruption if one part of the operation fails**

2. **How do supply and demand affect planning and control?**
   - **Uncertainty in supply and uncertainty in demand → separately make planning and control more difficult, both → extremely difficult**
   - **Dependent demand planning and control -** largely concerned with how the operation should respond when demand has occurred**; Independent demand planning and control** → makes 'best guesses' concerning future demand, attempts to put the resources in place which can satisfy this demand, and attempts to respond quickly if actual demand does not match the forecast.

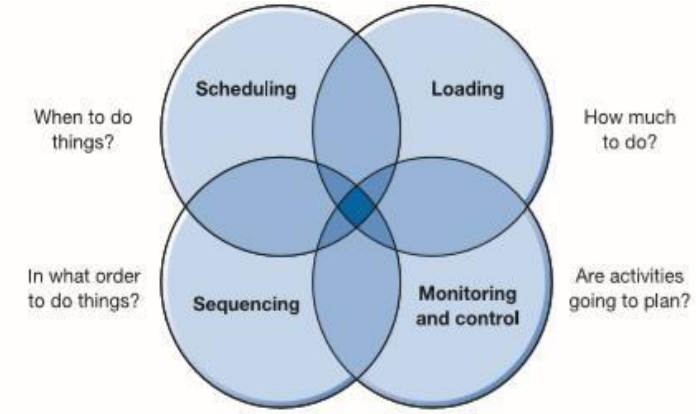


Responding to demand – vary depending how much work is done before the demand is known

P:D ratios – the total length of time customers have to wait between asking for the service or product and receiving it, called the demand time, D, and the total throughput time from start to finish, P; by reducing their P:D ratio operations reduce their degree of speculative activity and also reduce their dependence on forecasting (although bad forecasting will lead to other problems)



3. **What are planning and control activities? -** requires the reconciliation of supply and demand in terms of volumes, timing and quality



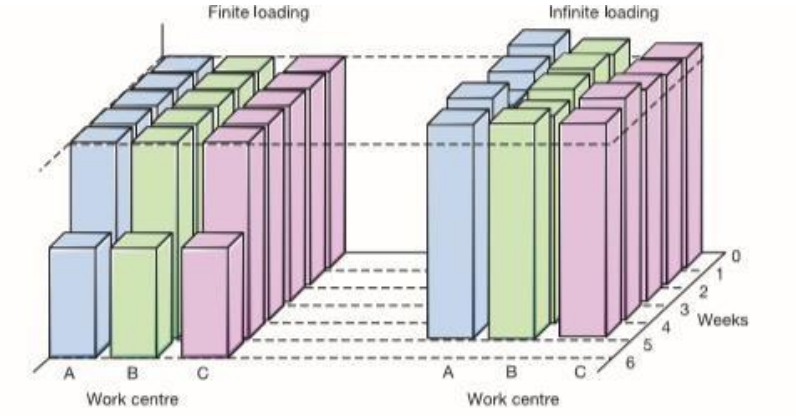
Loading - the amount of work that is allocated to a work center

➢ **Finite loading -** approach which only allocates work to a work center (a person, a machine, or perhaps a group of people or machines) up to a set limit- the estimate of capacity for the work center (based on the times available for loading). Work over and above this capacity is not accepted. Relevant for operations where**:**

it is possible to limit the load
it is necessary to limit the load
the cost of limiting the load is not prohibitive

➢ **Infinite loading -** an approach to loading work which does not limit accepting work, but instead tries to cope with it. Relevant for operations where:

it is not possible to limit the load
it is not necessary to limit the load
the cost of limiting the load is prohibitive



• **Sequencing -** whether the approach to loading is finite or infinite, when work arrives, decisions must be taken on the order in which the work will be tackled. The priorities given to work in an operation are often determined by some predefined set of rules, some of which are relatively complex

- **Physical constraints -** jobs that physically fit together may be scheduled together to reduce waste
- **Customer priority -** although giving a high level of service to some customers, may erode the service given to many other. This may lower the overall performance of the operation if work flows are disrupted to accommodate important customers.

1	Immediate resuscitation	Patient in need of immediate treatment for preservation of life
2	Very urgent	Seriously ill or injured patients whose lives are not in immediate danger
3	Urgent	Patients with serious problems, but apparently stable conditions
4	Standard	Standard cases without immediate danger or distress
5	Non-urgent	Patients whose conditions are not true accidents or emergencies

- **Due date (DD) -** work is sequenced according to when it is 'due' for delivery, irrespective of the size of each job or the importance of each customer

Jobs	Processing time	Start	Finish	Due	Late
2	2	0	2	8	0
1	6	2	8	10	0
4	3	8	11	13	0
3	8	11	19	15	4
5	9	19	28	23	5

Total time in process: 2 + 8 + 11 + 19 + 28 = 68
Average time in process: 68 / 5 = 13.6
Total lateness: 4 + 5 = 9
Average lateness: 9 / 5 = 1.8

Jobs are sequenced by due dates

- **Last in, first out (LIFO)** - method of sequencing usually selected for practical reasons
- **First in, first out (FIFO)**

Jobs	Processing time	Start	Finish	Due	Late
1	6	0	6	10	0
2	2	6	8	8	0
3	8	8	16	15	1
4	3	16	19	13	6
5	9	19	28	23	5

Total time in process: 6 + 8 + 16 + 19 + 28 = 77
Average time in process: 77 / 5 = 15.4
Total lateness: 1 + 6 + 5 = 12
Average lateness: 12 / 5 = 2.4

Jobs are sequenced by order of arrival

- **Longest operation time (LOT)** - advantage of occupying work centers for long periods, keeps utilization high**;** does not take into account delivery speed, reliability or flexibility
- **Shortest operation time (SOT) –** when operations become cash constrained

Jobs	Processing time	Start	Finish	Due	Late
2	2	0	2	8	0
4	3	2	5	13	0
1	6	5	11	10	1
3	8	11	19	15	4
5	9	19	28	23	5

Total time in process: 2 + 5 + 11 + 19 + 28 = 65
Average time in process: 65 / 5 = 13
Total lateness: 1 + 4 + 5 = 10
Average lateness: 10 / 5 = 2

Jobs are sequenced by processing times

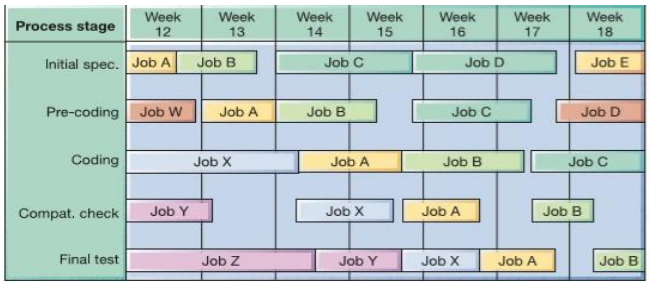
- **Judging sequencing rules**

Meeting ‘due date’ promised to customer (dependability)
Minimizing the time the job spends in the process, also known as ‘flow time’ (speed)
Minimizing work-in-progress inventory (an element of cost)
Minimizing idle time of work centers (another element of cost)

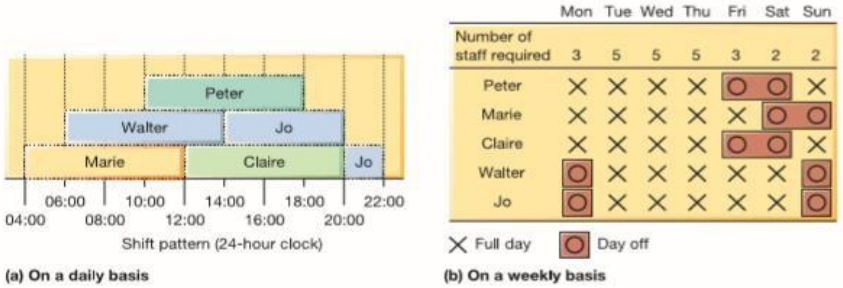
- **Scheduling -** some operations require a detailed timetable showing at what time or date jobs should start and when they should end
  - **The complexity of scheduling**
    Number of possible schedules =
    (n!)^m n -number of jobs **m -** number of machines
  - **Forward**(starting work as soon as it arrives) **and backward** (starting jobs at the last possible moment to prevent them from being late) **scheduling**

Advantages of forward scheduling	Advantages of backward scheduling
High labour utilization – workers always start work to keep busy	Lower material costs – materials are not used until they have to be, therefore delaying added value until the last moment
Flexible – the time slack in the system allows unexpected work to be loaded	Less exposed to risk in case of schedule change by the customer
	Tends to focus the operation on customer due dates

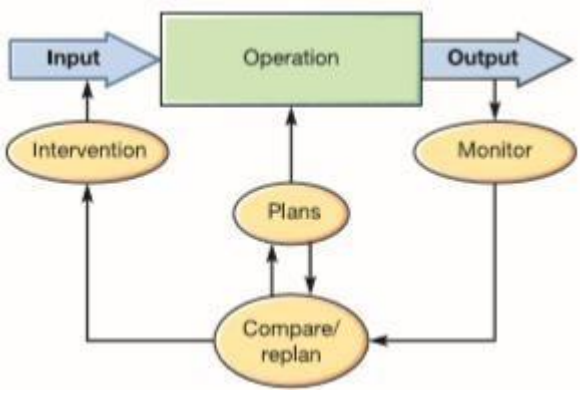
  - **Gantt charts -** provide a simple visual representation both of what should be happening and of what actually is happening in the operation; can be used to ‘test out’ alternative schedules



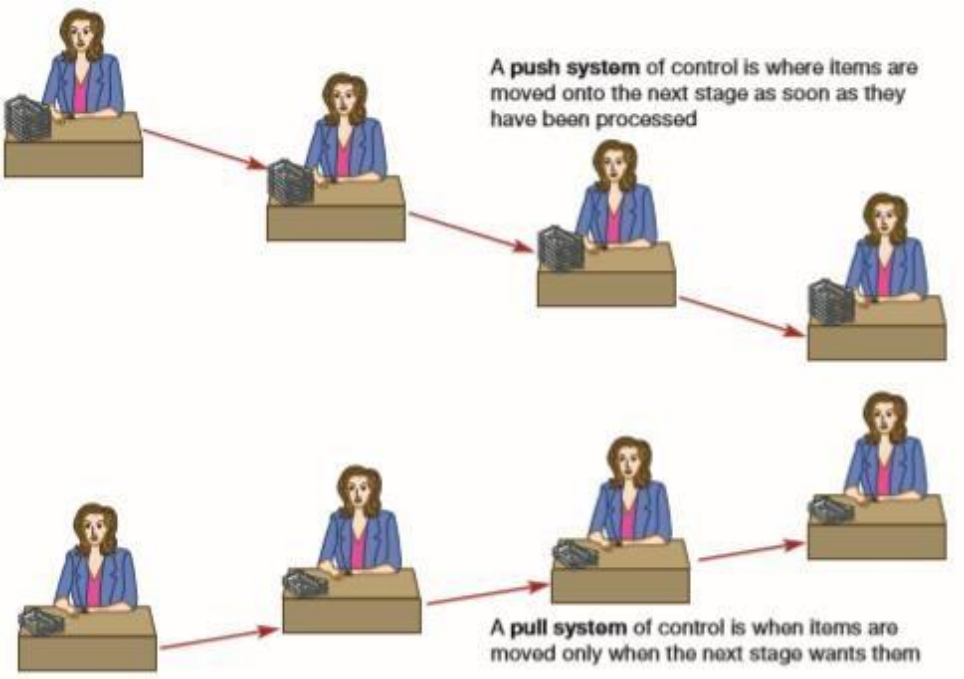
  - **Scheduling work patterns -** sufficient numbers of people are working at any point in time to provide a capacity appropriate for the level of demand at that point in time; staff roistering



- **Monitoring and control -** about checking whether the planned activities (loading, sequencing & scheduling) actually take place as should



- **Push and pull control**



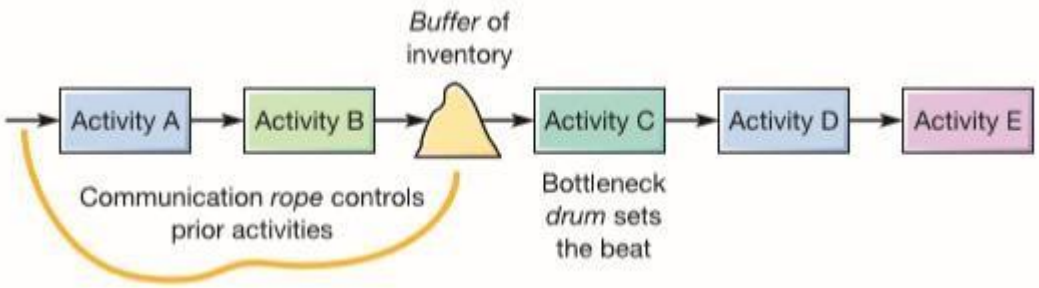
***pull control reduces the build-up on inventory between processes and stages**

- **Drum, buffer, rope -** is an idea that helps to decide exactly where in a process control should occur

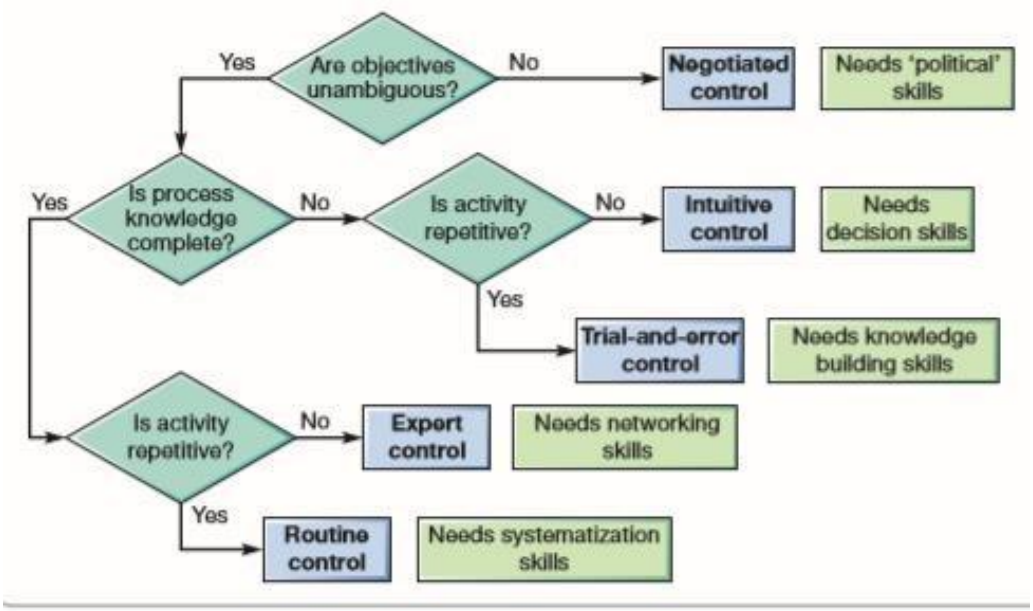
  Drum – the bottleneck

  Buffer – makes sure that the 'drum' always has something to work on

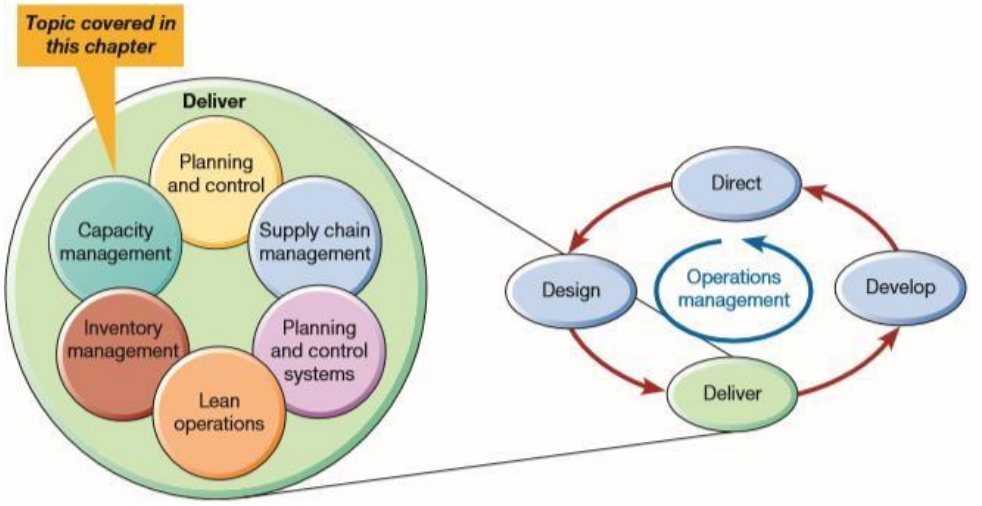
  Rope – creates form of communication between the bottleneck and the input



- **Controlling operations is not always routine**
  - **Expert control**
  - **Trial-error control**
  - **Intuitive control**
  - **Negotiated control**

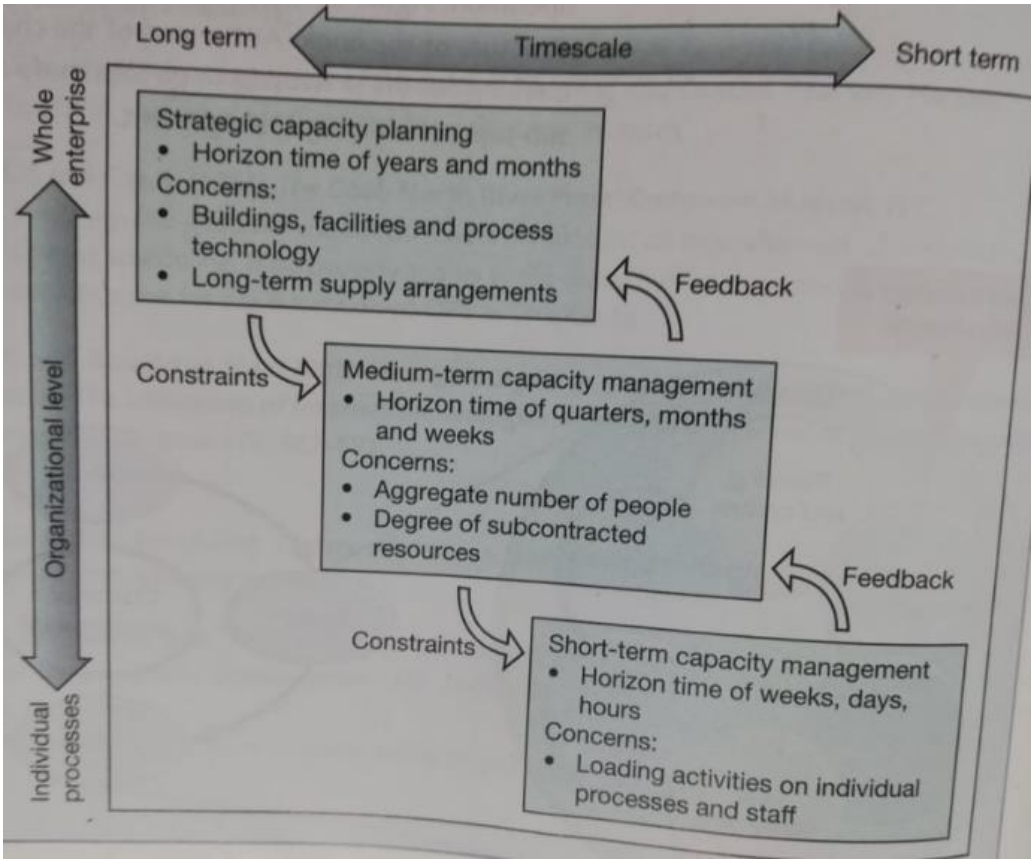


Chapter 11 – Capacity management



1. What is capacity management? - the activity of understanding the nature of demand for products and services, and effectively planning and controlling capacity in the short term, medium term and long term

➢ **Capacity** is the maximum level of value-added activity over a period of time that the process or operation can achieve under normal operating conditions

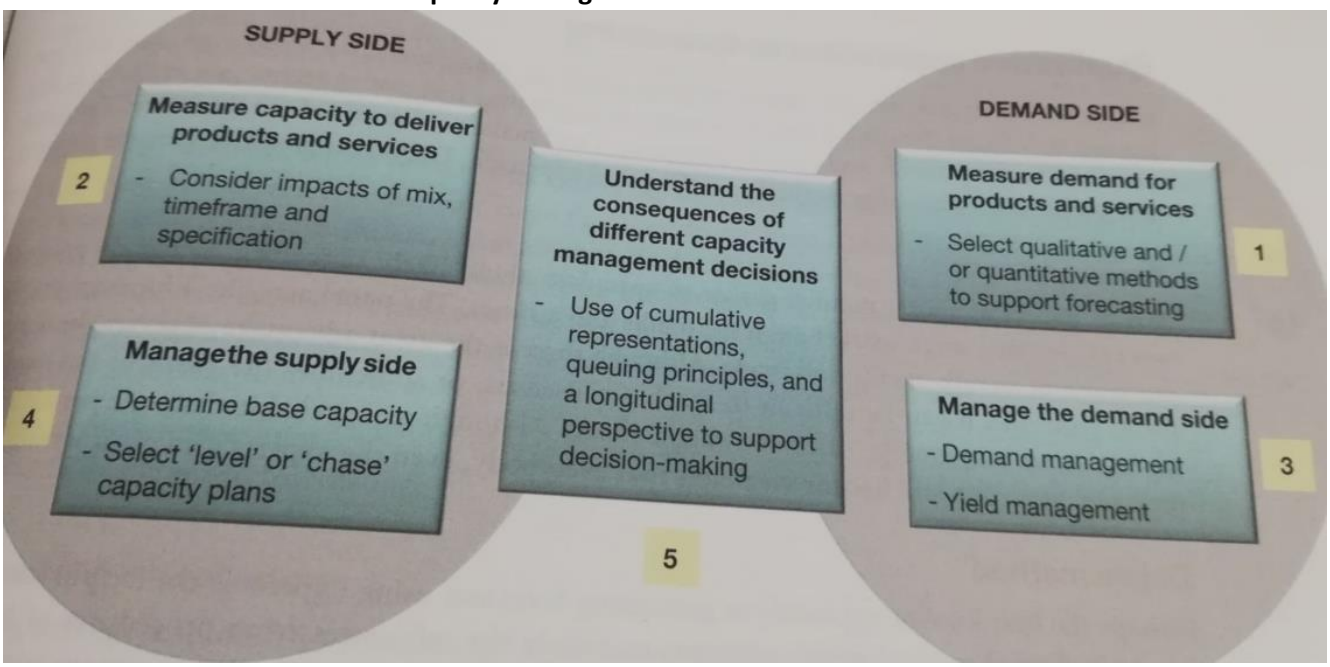


- **Aggregate demand and capacity -** making overall, broad capacity decisions, but is not concerned with all of the detail of the individual products and services offered;

different products and services are bundled together in order to get a broad view of demand and capacity

- **Capacity management performance objectives**
  - **Costs** will be affected by the balance between capacity and demand. Capacity levels in excess of demand could mean under-utilization of capacity and therefore high units cost.
  - **Revenues** will also be affected by the balance between capacity and demand, but in the opposite way. Capacity levels equal to or higher than demand at any point in time will ensure that all demand is satisfied and no revenue lost.
  - **Working capital** will be affected if an operation decides to build up finished goods inventory prior to demand. This might allow demand to be satisfied, but the organization will have to fund the inventory until it can be sold.
  - **Quality** of goods or services might be affected by a capacity plan that involves large fluctuations in capacity levels, by hiring temporary staff, for example. The new staff and the disruption to the routine working of the operation could increase the probability of errors being made.
  - **Speed** of response to customer demand could be enhanced either by the buildup of inventories (allowing customers to be satisfied directly from the inventory rather than having to wait for items to be manufactured) or by the deliberate provision of surplus capacity to avoid queuing.
  - **Dependability** of supply will also be affected by how close demand levels are to capacity. The closer demand gets to the operation's capacity ceiling, the less able it is to cope with any unexpected disruptions and the less dependable its deliveries of goods and services could be.
  - **Flexibility,** especially volume flexibility, will be enhanced by surplus capacity. If demand and capacity are in balance, the operation will not be able to respond to any unexpected increase in demand.

A framework for capacity management



2. **How is demand measured?**
    - **Qualitative approaches to forecasting** – panel approach, delphi method, scenario planning
    - **Quantative approaches to forecasting –** time series analysis, moving-avarage forecasting, exponential smoothing, seasonality in forecasting, causal models
    - **Making forecasts useful for operations managers**
    - **Better forecasting or better operations responsiveness?**

3. **How is capacity measured?**

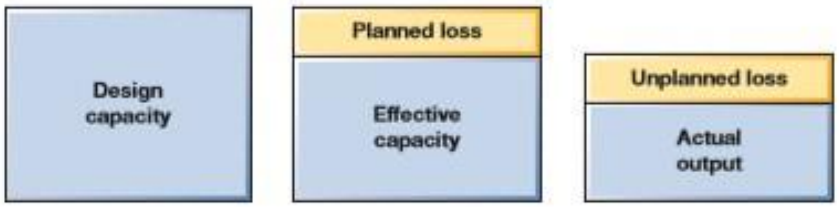
Operation	Input measure of capacity	Output measure of capacity
Air-conditioner plant	Machine hours available	**Number of units per week**
Hospital	**Beds available**	Number of patients treated per week
Theatre	**Number of seats**	Number of customers entertained per week
University	**Number of students**	Students graduated per year
Retail store	**Sales floor area**	Number of items sold per day
Airline	**Number of seats available on the sector**	Number of passengers per week
Electricity company	Generator size	**Megawatts of electricity generated**
Brewery	Volume of fermentation tanks	**Litres per week**

The effect of activity mix on capacity measurement – how much an operation can do depends on what it is being required to do

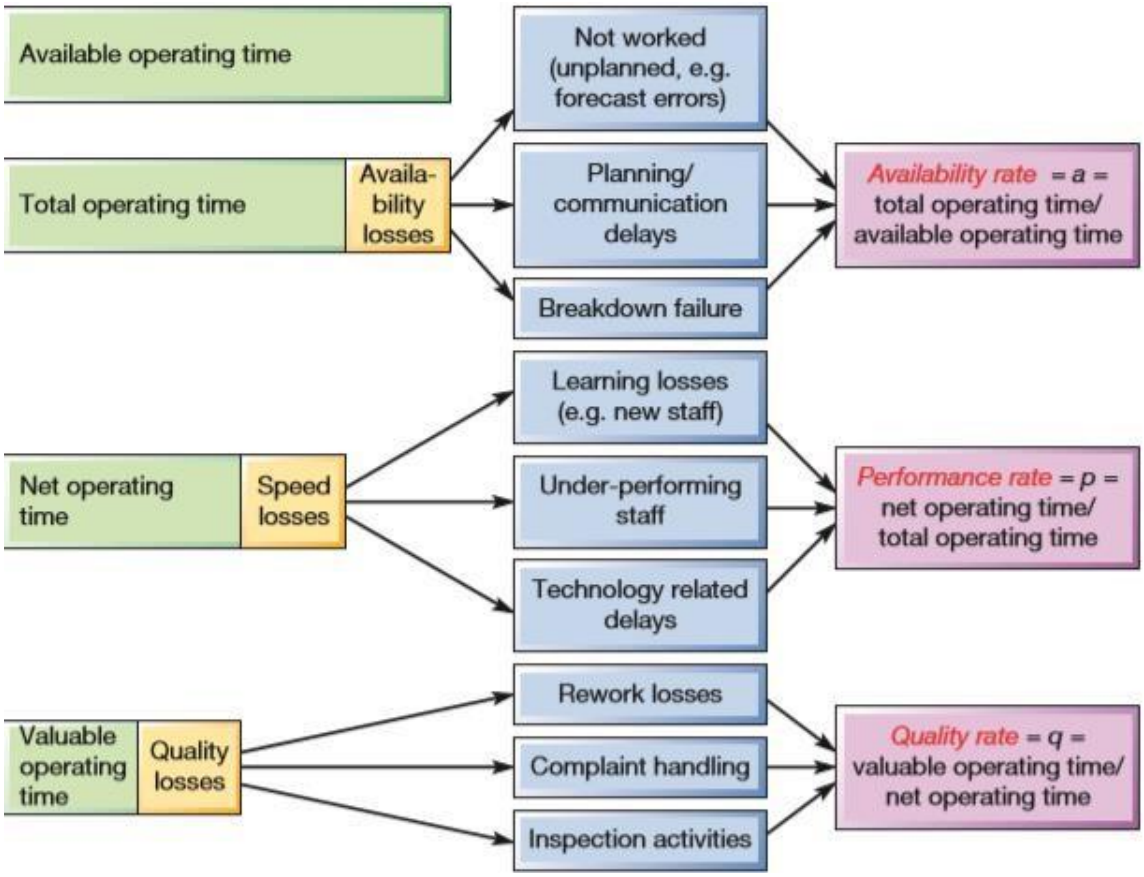
- **The effect of time-frame on capacity measurement -** Capacity is the output that an operation can deliver in a defined unit of time
    - **Design capacity** – the theoretical capacity of an operation that one of its technical designers had in mind when they commissioned it
    - **Effective capacity – the capacity of an operation after planned losses are accounted for**
    - **Actual output –** the capacity of an operation after both planned and unplanned losses are accounted for. The ratio of the output actually achieved by an operation to its design capacity, and the ratio of output to effective capacity, are called, respectively, the utilization and the efficiency of an operation:

$$\text{Utilization} = \frac{\text{Actual output}}{\text{Design capacity}}$$

$$\text{Efficiency} = \frac{\text{Actual output}}{\text{Effective capacity}}$$

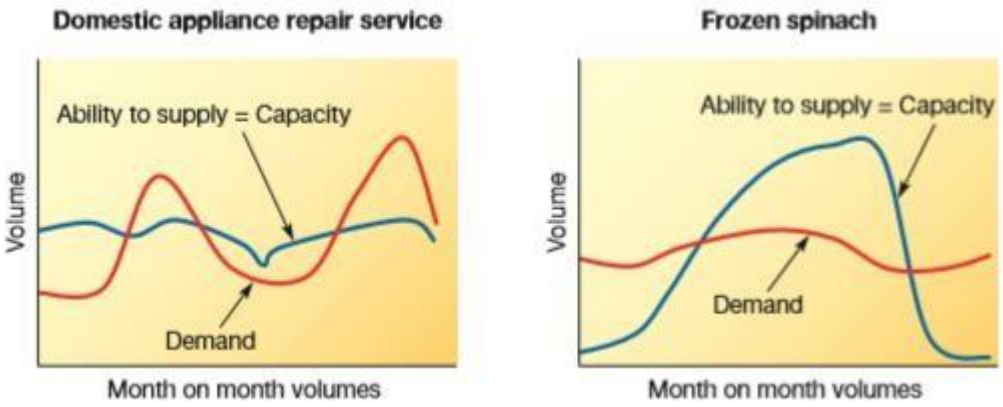


- **Capacity leakage -** can be assessed by calculating overall equipment effectiveness (OEE)



The effect of specification on capacity management - important task is to distinguish between the 'must do' elements of the service that should not be sacrificed and the 'nice to do' parts of the service that can be omitted or delayed in order to increase capacity in the short term

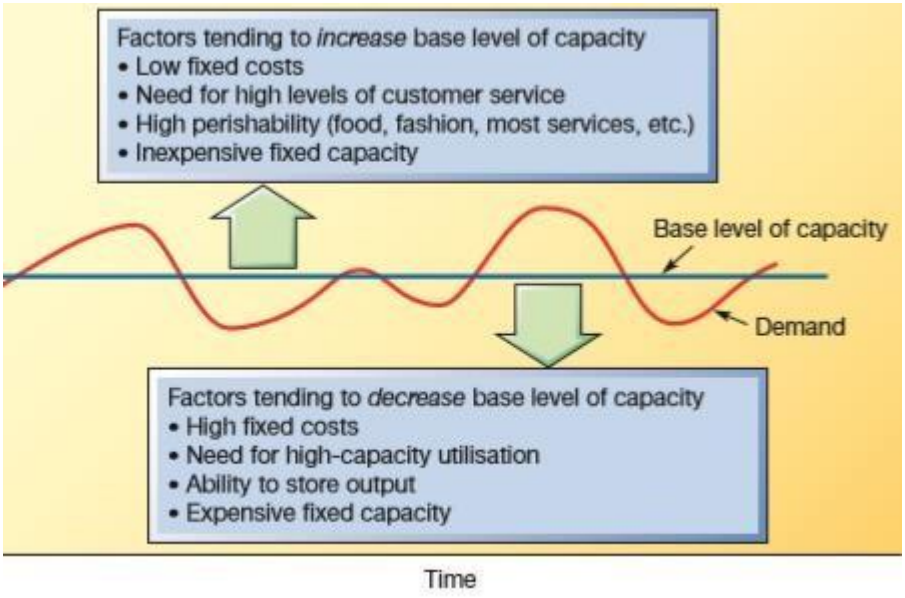
- **Understanding the changes in capacity**



4. **How is the demand side managed? -** the objective is to change the pattern of demand to bring it closer to available capacity, by either stimulating off-peak demand or by constraining peak demand. There are a number of methods for achieving this:
   - **Price differentials -** adjusting price to reflect demand
   - **Scheduling promotion -** varying the degree of market stimulation through promotion and advertising in order to encourage demand during normally low periods
   - **Contraining customer access -** customers may only be allowed access to the operation's products or services at particular times
   - **Service differentials -** allowing service levels to reflect demand (implicitly or explicitly), allowing service to deteriorate in periods of high demand and increase in periods of low demand
   - **Creating alternative products or services -** new products or services should meet three criteria: (a) they can be produced on the same processes, (b) they have different demand patterns to existing offerings, and (c) they are sold through similar marketing channels

   - **Yield (profit)**
   - **management** - a collection of methods, which can be used to ensure that an operation maximizes its potential to generate profit. Useful when:
     - **capacity is relatively fixed;**
     - **the market can be fairly clearly segmented;**
     - **the service cannot be stored in any way;**
     - **the service is sold in advance;**
     - **the marginal cost of making a sale is relatively low**

5. **How is the supply side managed?**
   - **Setting base capacity -** The most common way of managing capacity is to decide the 'base level' of capacity and then adjust it periodically up or down to reflect fluctuations in demand
     - **Operation's performnce objectives-** Base levels of capacity should be set primarily to reflect an operation's performance objectives



- **Perishability of the operation's outputs -** When either supply or demand is perishable, base capacity will need to be set at a relatively high level because inputs to the operation or outputs from the operation cannot be stored for long periods.
- **The degree of variability in demand or supply -** Variability, either in demand or capacity, will reduce the ability of an operation to process its inputs. That is, it will reduce its effective capacity. The greater the variability in arrival time or activity time at a process, the more the process will suffer both high throughput times and reduced utilization

- **Level capacity plan -** the capacity is fixed throughout the planning period, regardless of the fluctuations in forecast demand
  - the same number of staff operate the same processes and should therefore be capable of producing the same aggregate output in each period
  - Where non-perishable materials are processed, but not immediately sold, they can be transferred to finished goods inventory in anticipation of sales at a later time
  - **Advantages** - can achieve the objectives of stable employment patterns, high process utilization, and usually also high productivity with low unit costs
  - **Disadvantages** - can also create considerable inventory which has to be financed and stored
- **Chase (demand) capacity plan -** the opposite of a level capacity plan is one which attempts to match capacity closely to the varying levels of forecast demand
  - much more difficult to achieve than a level capacity plan, as different numbers of staff, different working hours and even different amounts of equipment may be necessary in each period
  - adopted by operations that are not able to store their output, such as customer processing operations or manufacturers of perishable products
  - There are a number of different methods for adjusting capacity, although they may not all be feasible for all types of operation

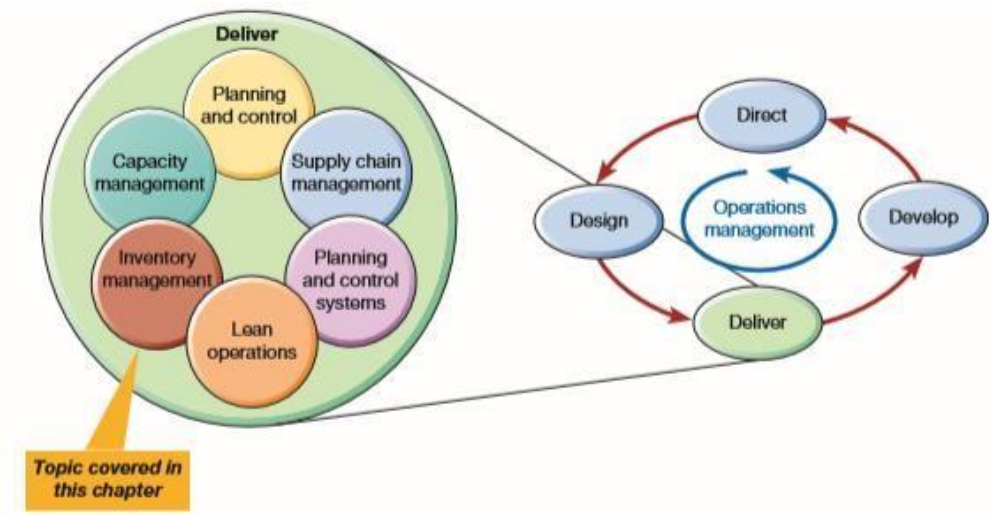
Method of adjusting capacity	Advantages	Disadvantages
Overtime – staff working longer than their normal working times	Quickest and most convenient	Extra payment normally necessary and agreement of staff to work can reduce productivity over long periods
Annualized hours – staff contracting to work a set number of hours per year rather than a set number of hours per week	Without many of the costs associated with overtime the number of staff time available to an organization can be varied throughout the year to reflect demand	When very large and unexpected fluctuations in demand are possible, all the negotiated annual working time flexibility can be used before the end of the year
Staff scheduling – arranging working times (start and finish times) to vary the aggregate number of staff available for working at any time	Staffing levels can be adjusted to meet demand without changing job responsibilities or hiring new staff	Providing start and finish (shift) times that both satisfy staffs' need for reasonable working times and shift patterns as well as providing appropriate capacity can be difficult
Varying the size of the workforce – hiring extra staff during periods of high demand and laying them off as demand falls, or hire and fire	Reduces basic labour costs quickly	Hiring costs and possible low productivity while new staff go through the learning curve. Lay-offs may result in severance payments and possible loss of morale in the operation and loss of goodwill in the local labour market
Using part-time staff – recruit staff who work for less than the normal working day (at the busiest periods)	Good method of adjusting capacity to meet predictable short-term demand fluctuations	Expensive if the fixed costs of employment for each employee (irrespective of how long he or she works) are high
Skills flexibility – designing flexibility in job design and job demarcation so that staff can transfer across from less busy parts of the operation	Fast method of reacting to short-term demand fluctuations	Investment in skills training needed and may cause some internal disruption
Subcontracting/outsourcing – buying, renting or sharing capacity or output from other operations	No disruption to the operation	Can be very expensive because of subcontractor's margin and subcontractor may not be as motivated to give same service, or quality. Also a risk of leakage of knowledge
Change output rate – expecting staff (and equipment) to work faster than normal	No need to provide extra resources	Can only be used as a temporary measure, and even then can cause staff dissatisfaction, a reduction in the quality of work, or both

6. How can operations understand the consequences of their capacity management decisions?

- **Using cumulative representations to make capacity management decisions**
- **Using queuing principles to make capacity management decisions**
- **Using longitudinal perspective to make capacity management decisions**

Summary 2: Operations Management part two

Chapter 13 – Inventory management



1. **What is inventory? -** the accumulations of materials, customers or information as they flow through processes or networks
    - **Physical inventory (stock) -** the accumulation of physical materials such as components, parts, finished goods or physical (paper) information records
        - Minimizing them can release large quantities of cash
        - Reducing them too far can lead to customers' orders not being fulfilled
    - **Databases -** stores for accumulations of digital information, such as medical records or insurance details
        - ➢ critical for storing digital information and while storage may be inexpensive, maintaining databases may not be
2. **All processes, operations and supply networks have inventories**
    - **Inventories are often a result of uneven flows -** If there is a difference between the timing/the rate of supply and demand at any point in a process or network then accumulations (inventories) will occur
    - When the rate of supply exceeds the rate of demand - inventory increases;
    - When the rate of demand exceeds the rate of supply - inventory decreases
    - if an operation or process can match supply and demand rates, it will also succeed in reducing its inventory levels
    - most organizations must cope with unequal supply and demand, at least at some points in their supply chain
    - **Inventories of information**
        - Can be stored because of uneven flow (as materials and people) or
        - Can be stored because the operation needs to use the information to process something in the future (inventory of information has turned from a transformed resource into a transforming resource, because it is being used to transform other information rather than being transformed itself)

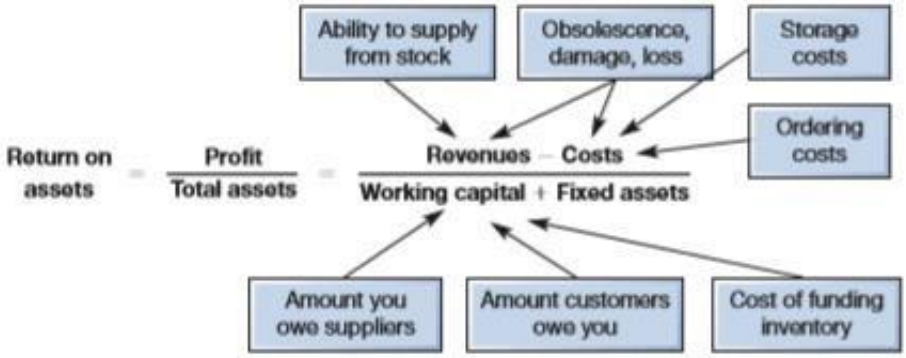
3. Why should there be any inventory?

	'Inventories'		
	Physical inventories 	Queues of customers 	Digital information in databases 
Cost	Ties up working capital and there could be high administrative and insurance costs	Primarily time cost to the customer, i.e. wastes customer's time	Cost of set-up, access, update and maintenance
Space	Requires storage space	Requires areas for waiting or phone lines for held calls	Requires memory capacity. May require secure and/or special environment
Quality	May deteriorate over time, become damaged or obsolete	May upset customers if they have to wait too long. May lose customers	Data may be corrupted or lost or become obsolete
Operational/ organizational	May hide problems (see the chapter on 'lean' – Chapter 15)	May put undue pressure on the staff and so quality is compromised for throughput	Databases need constant management; access control, updating and security

- **Why?**
  - **Physical inventory is an insurance against uncertainty**
  - **Physical inventory can counteract a lack of flexibility**
  - **Physical inventory allows operations to take advantage of shortterm opportunities**
  - **Physical inventory can be used to anticipate future demands –**
  - **Physical inventory can reduce overall costs ➢ Physical inventory can increase in value ➢ Physical inventory fills the processing 'pipeline'**
  - **Queues of customers help balance capacity and demand**
  - **Queues of customers enable prioritization**
  - **Queuing gives customers time to choose**
  - **Queues enable efficient use of resources**
  - **Databases provide efficient multi-level access**
  - **Databases of information allow single data capture**
  - **Databases of information speed the process**
- **Reducing physical inventory**
- **The effect of inventory on return on assets**

Reason for holding inventory	Example	How inventory could be reduced
As an insurance against uncertainty	Safety stocks for when demand or supply is not perfectly predictable	• Improve demand forecasting • Tighten supply, e.g. through service level penalties
To counteract a lack of flexibility	Cycle stock to maintain supply when other products are being made	• Increase flexibility of processes, e.g. by reducing changeover times (*see* Chapter 15) • Using parallel processes producing output simultaneously (*see* Chapter 6)
To take advantage of relatively short-term opportunities	Suppliers offer 'time-limited' special low-cost offers	• Persuade suppliers to adopt 'everyday low prices' (*see* Chapter 12)
To anticipate future demands	Build up stocks in low-demand periods for use in high-demand periods	• Increase volume flexibility by moving towards a 'chase demand' plan (*see* Chapter 11)
To reduce overall costs	Purchasing a batch of products in order to save delivery and administration costs	• Reduce administration costs through purchasing process efficiency gains • Investigate alternative delivery channel that reduce transport costs
To fill the processing 'pipeline'	Items being delivered to customer	• Reduce process time between customer request and dispatch of items • Reduce throughput time in the downstream supply chain (*see* Chapter 12)

- **Inventory governs the operation's ability to supply its customers.** The absence of inventory means that customers are not satisfied with the possibility of reduced revenue.
- **Inventory may become obsolete as alternatives become available, or could be damaged, deteriorate or simply get lost.** This increases costs (because resources have been wasted) and reduces revenue (because the obsolete, damaged or lost items cannot be sold).
- **Inventory incurs storage costs (leasing space, maintaining appropriate conditions, etc.).** This could be high if items are ha.
- zardous to store (for example, flammable solvents, explosives, chemicals) or difficult to store and require special facilities (for example, frozen food).
- **Inventory involves administrative and insurance costs.** Every time a delivery is ordered, time and costs are incurred.
- **Inventory ties up money, in the form of working capital,** which is therefore unavailable for other uses, such as reducing borrowings or making investments in productive fixed assets (we will expand on the idea of working capital later).
- **Inventory contracts with suppliers can dictate the timing of when suppliers need to be paid.** If they require paying before the operation receives payment from its customers (as is normal), the difference between the amount the operation owes suppliers and the amount suppliers owe the operation adds to working capital requirements.



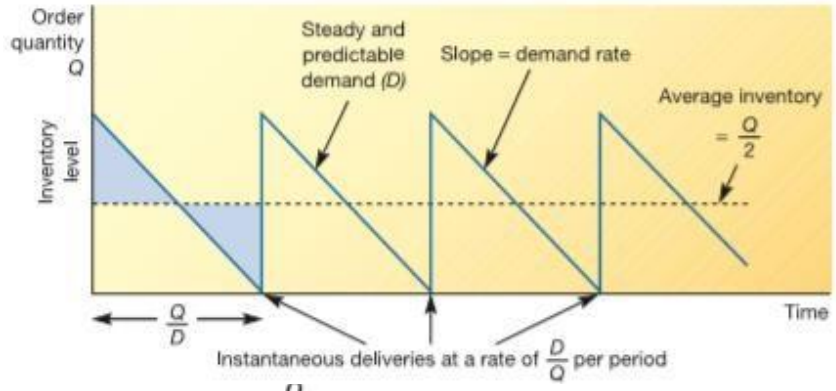
- **Day-to-day inventory decisions**
  - **How much to order –** Every time a replenishment order is placed, how big should it be (sometimes called the volume decision)?
  - **When to order –** At what point in time, or at what level of stock, should the replenishment order be placed (sometimes called the timing decision)?
  - **How to control the system –** What procedures and routines should be installed to help make these decisions? Should different priorities be allocated to different stock items? How should stock information be stored?

4. How much to order? The volume decision

- **Inventory costs**
  - Cost of placing an order
  - Price discount costs
  - Stockout costs
  - Working capital costs
  - Storage costs
  - Obsolescence costs

- Operating inefficiently costs

- **Inventory profiles -** visual representations of the inventory level over time



The average inventory $= \frac{Q}{2}$ (because the two shaded areas in Fig. 13.5 are equal)

The time interval between deliveries $= \frac{Q}{D}$

The frequency of deliveries = the reciprocal of the time interval $= \frac{D}{Q}$

- **The economic order quantity (EOQ) formula**

  ➢ **EOQ approach -** attempts to find the best balance between the advantages and disadvantages of holding stock

$$\text{Holding costs} = \text{Holding cost/unit} \times \text{Average inventory}$$
$$= C_h \times \frac{Q}{2}$$
$$\text{Ordering costs} = \text{Ordering cost} \times \text{number of orders per period}$$
$$= C_o \times \frac{D}{Q}$$

So, total cost is:

$$C_t = \frac{C_h Q}{2} + \frac{C_o D}{Q}$$

The rate of change of total cost is given by the first differential of C_t with respect to Q:

$$\frac{dC_t}{dQ} = \frac{C_h}{2} - \frac{C_o D}{Q^2}$$

The lowest cost will occur when $\frac{dC_t}{dQ} = 0$, that is:

$$0 = \frac{C_h}{2} - \frac{C_o D}{Q_o^2}$$

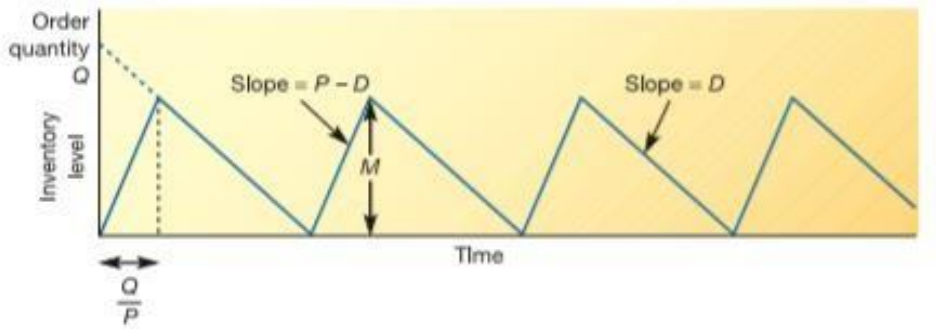
where Q_o is the EOQ. Rearranging this expression gives:

$$Q_o = \text{EOQ} = \sqrt{\frac{2C_o D}{C_h}}$$

When using the EOQ:

$$\text{Time between orders} = \frac{\text{EOQ}}{D}$$
$$\text{Order frequency} = \frac{D}{\text{EOQ}} \text{ per period}$$

- **Gradual replacement – the economic batch quantity (EBQ) model**



$$\text{Maximum stock level} = M$$

$$\text{Slope of inventory build-up} = P - D$$

Also, as is clear from Figure 13.8:

$$\text{Slope of inventory build-up} = M \div \frac{Q}{P}$$

$$= \frac{MP}{Q}$$

So:

$$\frac{MP}{Q} = P - D$$

$$M = \frac{Q(P - D)}{P}$$

$$\text{Average inventory level} = \frac{M}{2}$$

$$= \frac{Q(P - D)}{2P}$$

As before:

$$\text{Total cost} = \text{Holding cost} + \text{Order cost}$$

$$C_t = \frac{C_h Q(P - D)}{2P} + \frac{C_o D}{Q}$$

$$\frac{dC_t}{dQ} = \frac{C_h(P - D)}{2P} - \frac{C_o D}{Q^2}$$

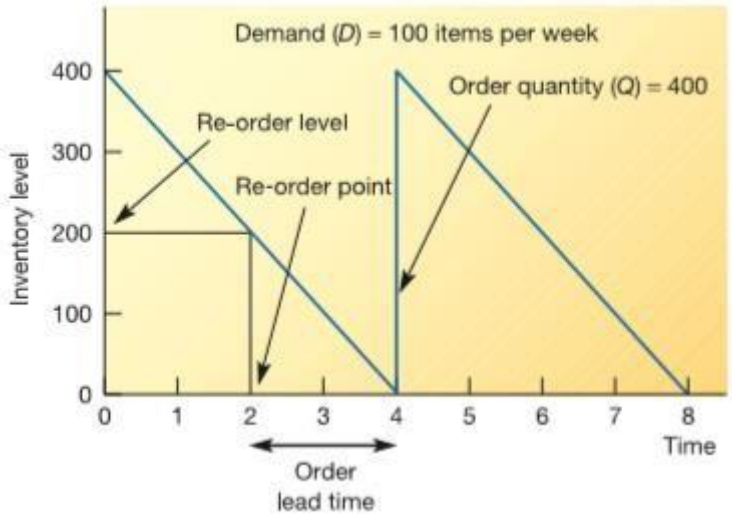
Again, equating to zero and solving Q gives the minimum cost order quantity EBQ:

$$\text{EBQ} = \sqrt{\frac{2C_o D}{C_h(1 - (D/P))}}$$

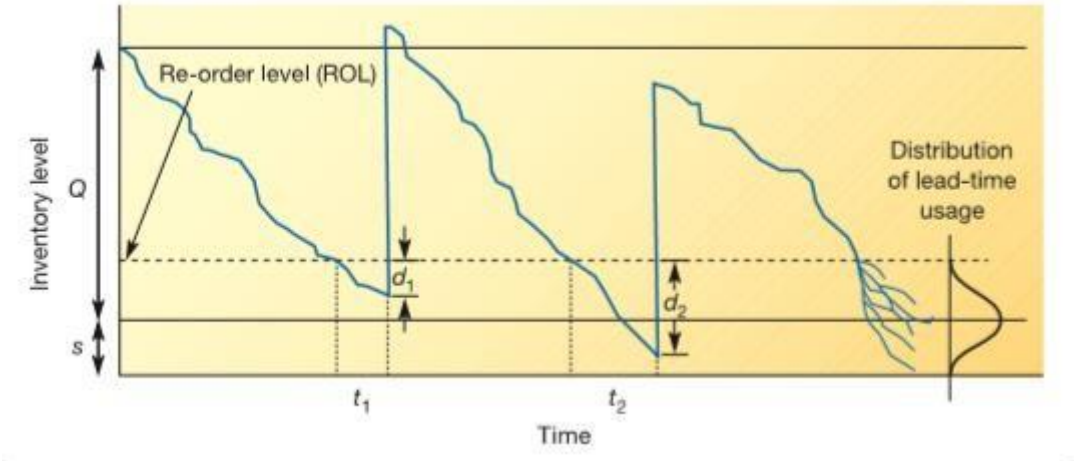
- **Responding to the criticisms of EOQ**
  - **Cost of stock**
  - **Using EOQ models as prescriptions**
  - **Should the cost of inventory be minimized?**

5. When to place an order? - The timing decision

- When we assumed that orders arrived instantaneously and demand was steady and predictable, the decision of when to place a replenishment order was selfevident. An order would be placed as soon as the stock level reached zero. This would arrive instantaneously and prevent any stockout occurring.
- If replenishment orders do not arrive instantaneously, but have a lag between the order being placed and arriving in the inventory, we can calculate the timing of a replacement order



- In most cases both demand and the order lead time are likely to. In these circumstances it is necessary to make the replenishment order somewhat earlier than would be the case in a purely deterministic situation. This will result in, on average, some stock still being in the inventory when the replenishment order arrives. This is **buffer (safety) stock.** The earlier the replenishment order is placed, the higher will be the expected level of safety stock (s) when the replenishment order arrives. But because of the variability of both lead time (t) and demand rate (d), there will sometimes be a higher than average level of safety stock and sometimes lower.



- **Continuous and periodic review**

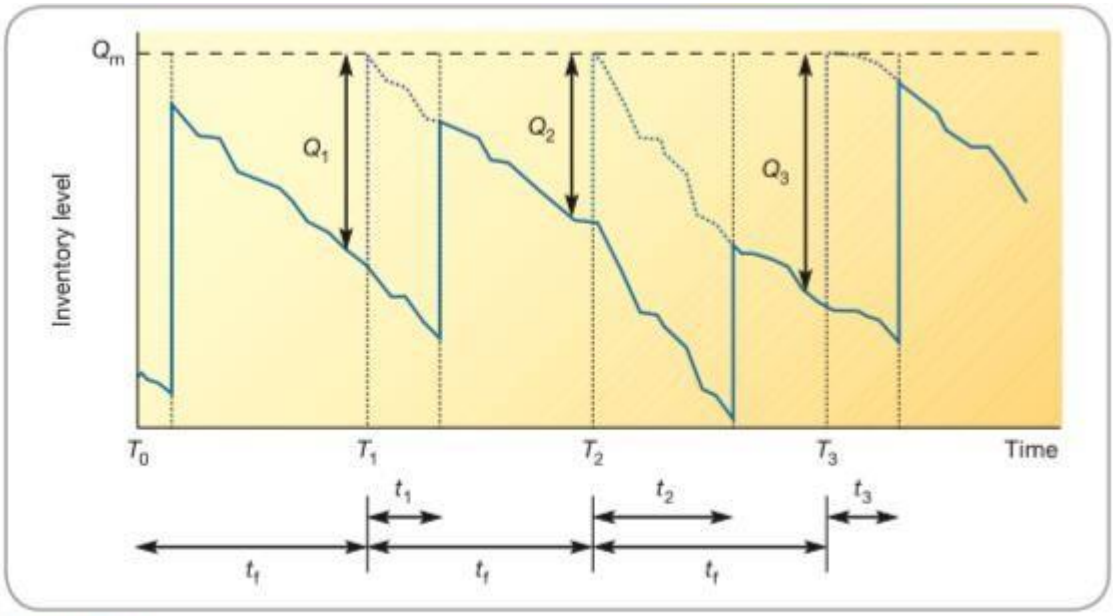


Figure 13.13 A periodic review approach to order timing with probabilistic demand and lead time

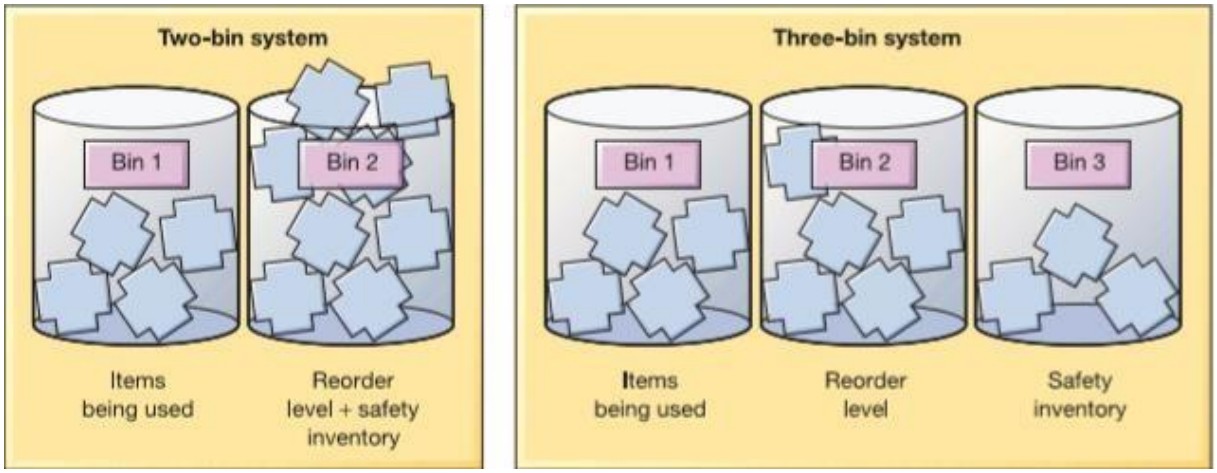
- **The time interval -** The interval between placing orders, t1, is usually calculated on a deterministic basis, and derived from the EOQ.

$$\text{EOQ} = \sqrt{\frac{2C_oD}{C_h}} = \sqrt{\frac{2 \times 2{,}000 \times 25}{0.5}} = 447$$

The optimum time interval between orders, t_f, is therefore:

$$t_f = \frac{\text{EOQ}}{D} = \frac{447}{2{,}000}\text{ years}$$
$$= 2.68 \text{ months}$$

- **Two-bin and three-bin systems -** When the first bin empties that is the signal to order the next re-order quantity.



6. How can inventory be controlled?

- **Inventory priorities – the ABC system – Pareto law (80/20 rule)**
  - **Class A items** are those 20 per cent or so of high usage value which account for around 80 per cent of the total usage value.
  - **Class B items** are those of medium usage value, usually the next 30 per cent of items which often account for around 10 per cent of the total usage value.
  - **Class C items** are those of low usage value which, although comprising around 50 per cent of the total types of items stocked, probably only account for around 10 per cent of the total usage value of the operation.
- **Measuring inventory**

A small specialist wine importer holds stocks of three types of wine, Chateau A, Chateau B and Chateau C. Current stock levels are 500 cases of Chateau A, 300 cases of Chateau B and 200 cases of Chateau C. Table 13.9 shows the number of each held in stock, their cost per item and the demand per year for each.

Table 13.9 Stock, cost and demand for three stocked items

Item	Average no. in stock	Cost per item (£)	Annual demand
Chateau A	500	3.00	2,000
Chateau B	300	4.00	1,500
Chateau C	200	5.00	1,000

$$\text{The total value of stock} = \sum(\text{average stock level} \times \text{cost per item})$$
$$= (500 \times 3) + (300 \times 4) + (200 \times 5)$$
$$= 3{,}700$$

The amount of *stock cover* provided by each item stocked is as follows (assuming 50 sales weeks per year):

$$\text{Chateau A, stock cover} = \frac{\text{Stock}}{\text{Demand}} = \frac{500}{2{,}000} \times 50 = 12.5 \text{ weeks}$$

$$\text{Chateau B, stock cover} = \frac{\text{Stock}}{\text{Demand}} = \frac{300}{1{,}500} \times 50 = 10 \text{ weeks}$$

$$\text{Chateau C, stock cover} = \frac{\text{Stock}}{\text{Demand}} = \frac{200}{1{,}000} \times 50 = 10 \text{ weeks}$$

The *stock turn* for each item is calculated as follows:

$$\text{Chateau A, stock turn} = \frac{\text{Demand}}{\text{Stock}} = \frac{2{,}000}{500} = 4 \text{ times/year}$$

$$\text{Chateau B, stock turn} = \frac{\text{Demand}}{\text{Stock}} = \frac{1{,}500}{300} = 5 \text{ times/year}$$

$$\text{Chateau C, stock turn} = \frac{\text{Demand}}{\text{Stock}} = \frac{1{,}000}{200} = 5 \text{ times/year}$$

To find the average stock cover or stock turn for the total items in the inventory, the individual item measures can be weighted by their demand levels as a proportion of total demand (4,500). Thus:

$$\text{Average stock cover} = \left(12.5 \times \frac{2{,}000}{4{,}500}\right) + \left(10 \times \frac{1{,}500}{4{,}500}\right) + \left(10 \times \frac{1{,}000}{4{,}500}\right)$$
$$= 11.11$$

$$\text{Average stock turn} = \left(4 \times \frac{2{,}000}{4{,}500}\right) + \left(50 \times \frac{1{,}500}{4{,}500}\right) + \left(50 \times \frac{1{,}000}{4{,}500}\right)$$
$$= 4.5$$

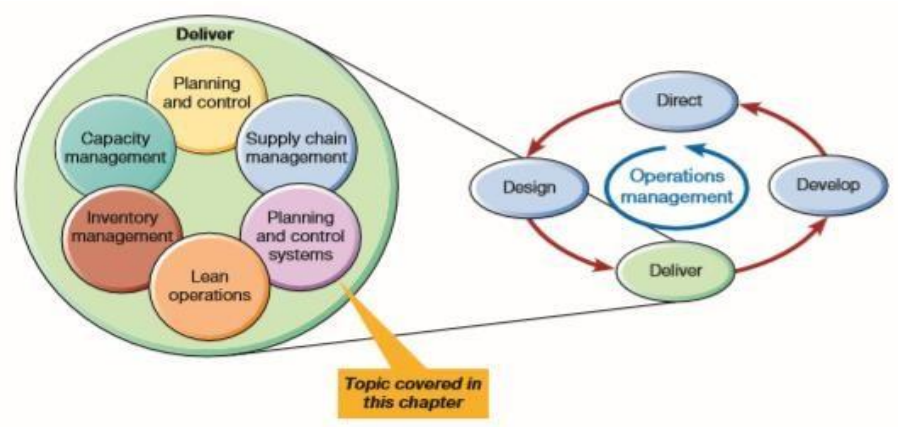
- **Inventory information systems**
  - **Updating stock records**
  - **Generating orders**
  - **Generating inventory reports**
  - **Forecasting**

- **Common problems with inventory systems**

Opening stock level + Receipts in – Dispatches out = new stock level

  - **keying errors** – entering the wrong product code;
  - **quantity errors** – a miscount of items put into or taken from stock;
  - **damaged or deteriorated inventory** not recorded as such, or not correctly deleted from the records when it is destroyed;
  - **the wrong items being taken out of stock**, but the records not being corrected when they are returned to stock;
  - **delays** between the transactions being made and the records being updated;
  - **items stolen from inventory** (common in retail environments, but also not unusual in industrial and commercial inventories)

Chapter 14 – Planning and control systems

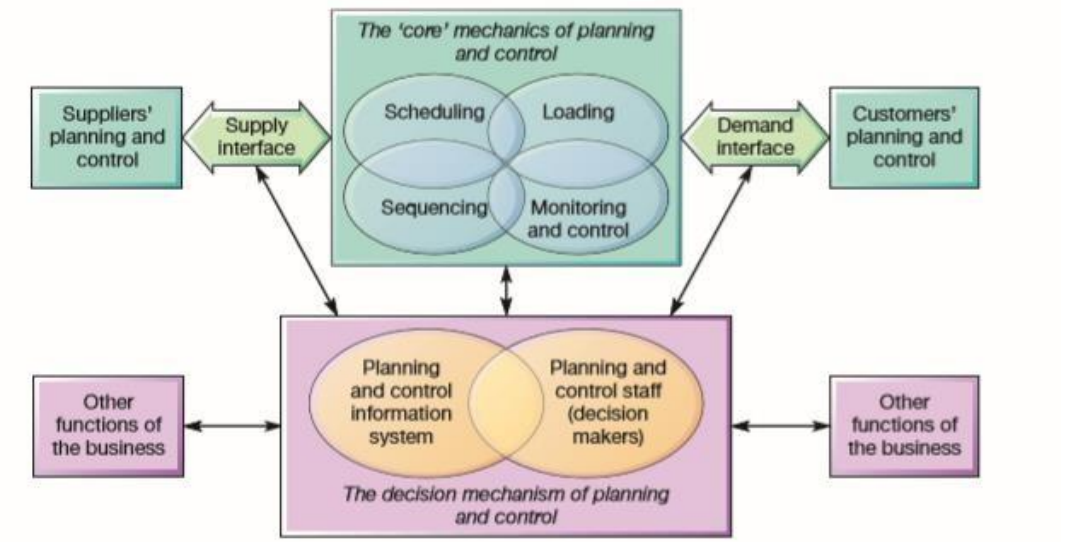


1. What are planning and control systems?

- The **activity** of **planning and control** is concerned with managing the ongoing allocation of resources and activities to ensure that the operation's processes are both efficient and reflect customer demand for products and services
- **Planning and control activities** are distinct but often overlap
- **Planning** determines what is intended to happen at some time in the future, while **control** is the process of coping when things do not happen as intended
- **Planning and control SYSTEMS** are the information-processing, decision support and execution mechanisms that support the operations planning and control activity

➢ These systems can differ but they tend to have a number of common elements (It is important that all these elements to be effective in their own right and work together):

a customer (demand) interface that forms a two-way information link between the operation's activities and its customers; ✓ a supply interface that does the same thing for the operation's suppliers;
a set of overlapping 'core' mechanisms that perform basic tasks such as loading, sequencing, scheduling, and monitoring and control;
a decision mechanism involving both operations staff and information systems that makes or confirms planning and control decisions;



2. **How does the system interface with customers? -** the way customers' interact with the business on a day-to-day basis is called the 'customer interface' or sometimes 'demand management'**;** activities - customer negotiation, order entry, demand forecasting, order promising, updating customers, keeping customer histories, postdelivery customer service and physical distribution
    - **Customer interface defines the customer experience -** it needs to be managed like any other 'customer- processing' process, where the quality of the service, as the customer sees it, is defined by the gap between customers' expectations and their perceptions of the service they receive

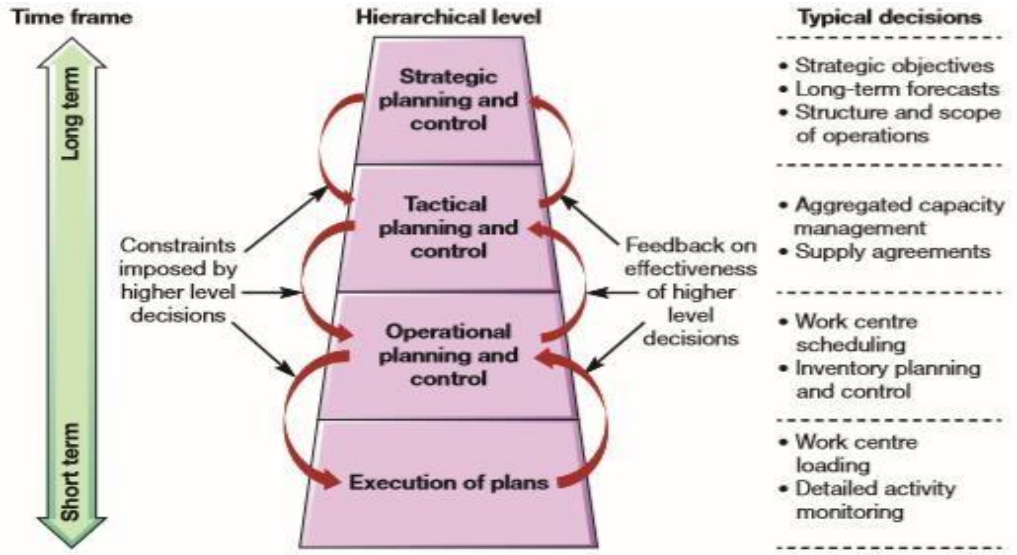
- **The customer interface should reflect the operation's objectives -** this part of the planning and control system cannot operate effectively without clear priorities derived from the operation's strategic objectives
    - It may have to prioritize one type of customer over another
    - It may have to encourage some types of customer to transact business more than other (possibly less profitable) types of customer
    - It will almost certainly have to trade off elements of customer service against the efficiency and utilization of the operations resources

- **The customer interface acts as a trigger function -** what is triggered will depend on the nature of the business
    - **'resource-to-order' -** keep relatively few of their own resources within the business, but rather hire them in when the nature of the job becomes evident ; the customer interface triggers the task of hiring in the relevant equipment (and possibly labour) and purchasing the appropriate materials
    - **'produce-to-order' –** when the nature of demand slightly more predictable, it would be likely to have its own equipment and labour permanently within the operation; accepting a job would only need to trigger the purchase of the materials to be used in the construction

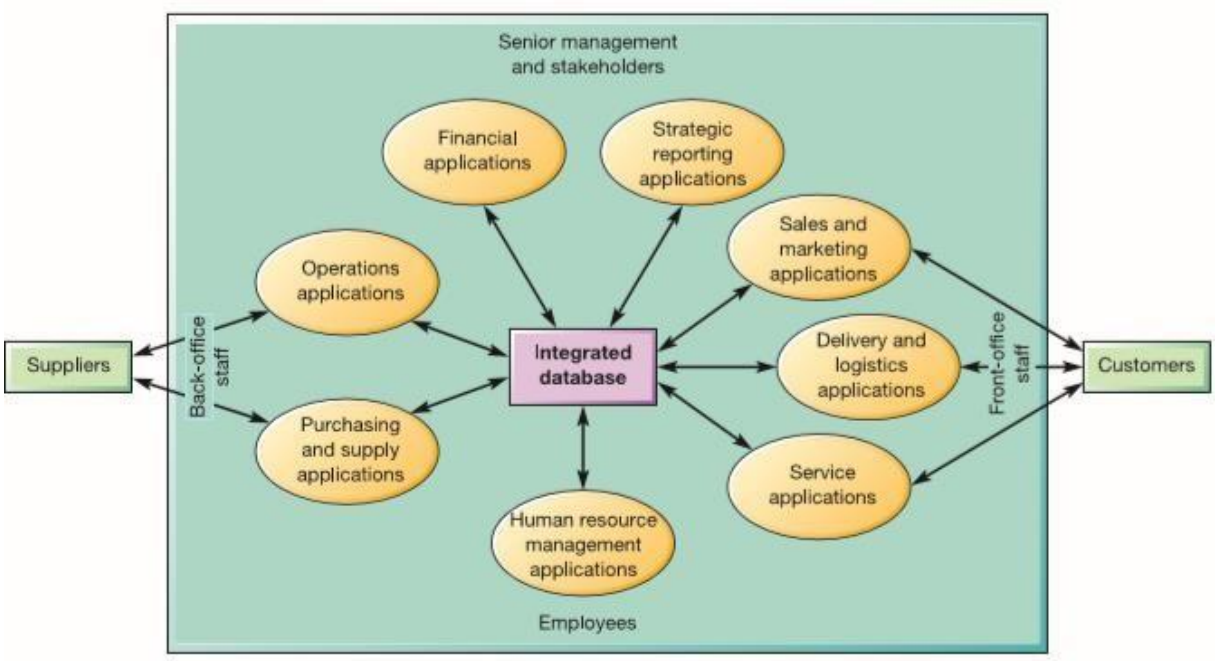
- **'produce-ahead-of-order'-** if demand is high, customers may place requests before the process started or during the process; the customers will form a backlog of demand and must wait; the company is taking the risk of holding stocks

3. **How does the system interface with suppliers? -** supplier interface is concerned with managing the supplier experience to ensure appropriate supply;

4. **Hierarchical planning and control -** recognizes difficulties in planning and control activities and tries to bring some order to the complexity by dividing up the many interrelated planning and control decisions into sub-problems to reflect the organizational hierarchy. So decisions at a high level link with decisions at lower levels in an effective manner. Decisions that are made at the higher level will of course impose some constraints on the lower level decisions. And the execution of detailed decisions at the lower level will provide the necessary feedback so that the quality of higher level decision making can be judged.



5. **Does the system integrate human with 'automated' decision making? - , humans are good at:**
    - **Flexibility, adaptability and learning.** Humans can cope with ambiguous, incomplete, inconsistent and redundant goals and constraints. In particular they can deal with the fact that planning and control objectives and constraints may not be stable for more than a few hours.
    - **Communication and negotiation.** Humans are able to understand and sometimes influence the variability inherent in an operation. They can influence job priorities and sometimes processing times. They can negotiate between internal processes and communicate with customers and suppliers in a way that could minimize misunderstanding.
    - **Intuition.** Humans can fill in the blanks of missing information that is required to plan and control. They can accumulate the tacit knowledge about what is, and what may be, really happening with the operation's processes.
6. **What is enterprise resource planning (ERP)? -it automates and integrates core business processes such as customer demand, scheduling operations, ordering items, keeping inventory records and updating financial data. It helps companies to 'forward-plan' these types of decisions and understand all the implications of any changes to the plan.** The basis of the foundation concept for ERP is called materials requirements planning (MRP)
    - MRP - a process that helps companies make volume and timing calculation
7. **How did ERP develop into the most common planning and control system?**
    - The latest and the most significant development of the original MRP philosophy
    - The (now) large companies which have grown almost exclusively on the basis of providing **ERP** systems include **SAP and Oracle**.
    - The original MRP became popular in 1970s
    - Manufacturing resource planning (MRP II) expanded out of MRP during the 1980s because of technology innovation
    - **ERP systems** - allow decisions and databases from all parts of the organization to be integrated so that the consequences of decisions in one part of the organization are reflected in the planning and control systems of the rest of the organization. ERP is the equivalent of the organization's central nervous system, sensing information about the condition of different parts of the business and relaying the information to other parts of the business that need it. The information is updated in real time by those who use it and yet is always available to everyone connected to the ERP system. Also, the potential of Internet-based communication has provided a further boost to ERP development. Many companies have suppliers, customers and other businesses with whom they collaborate who themselves have ERP-type systems. An obvious development is to allow these systems to communicate. However, the technical, as well as the organizational and strategic, consequences of this can be formidable. Nevertheless, many authorities believe that the true value of ERP systems is only fully exploited when such web-integrated ERP (known by some people as 'collaborative commerce', or ccommerce) becomes widely implemented.



8. The benefits of ERP

- Because software communicates across all functions, there is absolute visibility of what is happening in all parts of the business.
- The discipline of forcing business-process-based changes is an effective mechanism for making all parts of the business more efficient.
- There is better 'sense of control' of operations that will form the basis for continuous improvement (albeit within the confines of the common process structures).
- It enables far more sophisticated communication with customers, suppliers and other business partners, often giving more accurate and timely information.
- It is capable of integrating whole supply chains including suppliers' suppliers and customers' customers.

9. ERP changes the way companies do business

- If, as most businesses find, their current processes do not fit with a ERP package, they can do one of two things
  - they could change their processes to fit the ERP package
  - they could modify the software within the ERP package to fit their processes
  - both of these options involve costs and risks
- Why do most companies invest in ERP?
  - the attraction of turning the company's information systems into a 'smooth-running and integrated machine'
  - sometimes businesses have to invest just to stand still - *' even if we gain no significant advantage by investing in ERP, we will be placed at a disadvantage by not investing in it because all our competitors are doing so '*

10. Web-integrated ERP - the most important justification for embarking on ERP is the potential it gives the organization to link up with the outside world - it is much easier for an operation to move into Internet-based trading if it can integrate its external Internet systems into its internal ERP systems.

11. **Supply chain ERP -** The step beyond integrating internal ERP systems with immediate customers and suppliers is to integrate all the ERP and similar systems along a supply chain. Of course, this can never be straightforward and is often exceptionally complicated. If the ERP system of one operation within a supply chain fails for some reason, it may block the effective operation of the whole integrated information system throughout the chain.

12. **How should planning and control systems be implemented? -** Implementing this type of systems will necessarily involve crossing organizational boundaries and integrating internal processes that cover many, if not all, functional areas of a business • The particular challenges of IT implementation

    ➢ there is a high failure rate for IT projects (often cited as between 35 and 75 per cent, although the definition of 'failure' is debated)

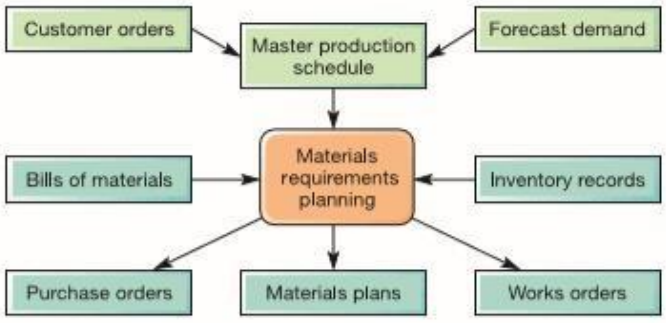
    ➢ there is extensive agreement that the most common reasons for failure are connected in some way with managerial, implementation or organizational factors - one of the main issues was the degree of alignment and integration between a firm's overall IT strategy and the general strategy of the firm

- '**function IT'** - it facilitates a single function or task - computer-aided design (CAD), spreadsheets and simple decision support systems
    ➢ can be adopted with or without any changes to other organizational structures
- **'enterprise IT' -** extends across much of or even the entire organization;
    - will need potentially extensive changes to the organization
    - the most common (and problematic) enterprise IT systems are ERP systems
- **'network IT'** - facilitates exchanges between people and groups inside and/or outside the organization; it does not necessarily predefine how these exchanges should work - simple email is a network IT
    - has brought significant changes to how operations and supply networks function, but the changes are not imposed by the technology itself; rather they emerge over time as people gain experience of using the technology;
    - the challenge with this type of technology is to learn how to exploit its emergent potential
- Implementation critical success factors **(CSFs) -** should be managed to increase the chances of a successful implementation
    ➢ CSFs are those things that the organization must 'get right' in order for the ERP system to work effectively

Strategic CSFs	Tactical CSFs
• Top management commitment and support – strong and committed leadership at the top management level is essential to the success of an ERP implementation • Visioning and planning – articulating a business vision to the organization, identifying clear goals and objectives, and providing a clear link between business goals and systems strategy • Project champion – the individual should possess strong leadership skills as well as business, technical and personal managerial competences • Implementation strategy and time frame – implement the ERP under a time-phased approach • Project management – the ongoing management of the implementation plan • Change management – this concept refers to the need for the implementation team to prepare formally a change management programme and be conscious of the need to consider the implications of such a project. One key task is to build user acceptance of the project and a positive employee attitude. This might be accomplished through education about the benefits and need for an ERP system. Part of this building of user acceptance should also involve securing the support of opinion leaders throughout the organization. There is also a need for the team leader to negotiate effectively between various political turfs. Some authorities also stress that, in planning the ERP project, it must be looked upon as a change management initiative, not an IT initiative	• Balanced team – the need for an implementation team that spans the organization, as well as one that possesses a balance of business and IT skills • Project team – there is a critical need to put in place a solid, core implementation team that is composed of the organization's 'best and brightest' individuals. These individuals should have a proven reputation and there should be a commitment to 'release' these individuals to the project on a full-time basis • Communication plan – planned communication among various functions and organizational levels (specifically between business and IT personnel) is important to ensure that open communication occurs within the entire organization, as well as with suppliers and customers • Project cost planning and management – it is important to know up front exactly what the implementation costs will be and dedicate the necessary budget • IT infrastructure – it is critical to assess the IT readiness of the organization, including the architecture and skills. If necessary, infrastructure might need to be upgraded or revamped • Selection of ERP – the selection of an appropriate ERP package that matches the businesses processes • Consultant selection and relationship – some authorities advocate the need to include an ERP consultant as part of the implementation team • Training and job redesign – training is a critical aspect of an implementation. It is also necessary to consider the impact of the change on the nature of work and the specific job descriptions • Troubleshooting/crises management – it is important to be flexible in ERP implementations and to learn from unforeseen circumstances, as well as be prepared to handle unexpected crises situations. The need for troubleshooting skills will be an ongoing requirement of the implementation process

Supplement to Chapter 14 – Materials requirements planning (MRP)

1. **MRP** - an approach to calculating how many parts or materials of particular types are required and what times they are required
    - this requires data files which, when the MRP program is run, can be checked and updated
    - the first inputs to MRP are customer orders and forecast demand – MRP performs its calculations based on the combination of these two parts of future demand
    - all other requirements are derived from, and dependent on, this demand information



2. **Master production schedule (MPS) - forms the main input to MRP and contains a statement of the volume and timing of the end products to be made**
    - drives all the production and supply activities that eventually will come together to form the end products
    - It is the basis for the planning and utilization of labour and equipment
    - it determines the provisioning of materials and cash
    - should include all sources of demand, such as spare parts, internal production promises, etc
3. **The MPS record**
    - time-phased records of each end product, which contain a statement of demand and currently available stock of each finished item
    - Using this information, the available inventory is projected ahead in time. When there is insufficient inventory to satisfy forward demand, order quantities are entered on the master schedule line.

	Week number								
	1	2	3	4	5	6	7	8	9
Demand	10	10	10	10	15	15	15	20	20
Available	20	10	0	0	0	0	0	0	0
MPS	0	0	10	10	15	15	15	20	20
On hand	30								

Demand - sales orders and any forecasts
Available - how much inventory of this item is expected to be in stock at the end of each weekly period
On hand - opening inventory balance
MPS - how many finished items need to be completed and available in each week to satisfy demand

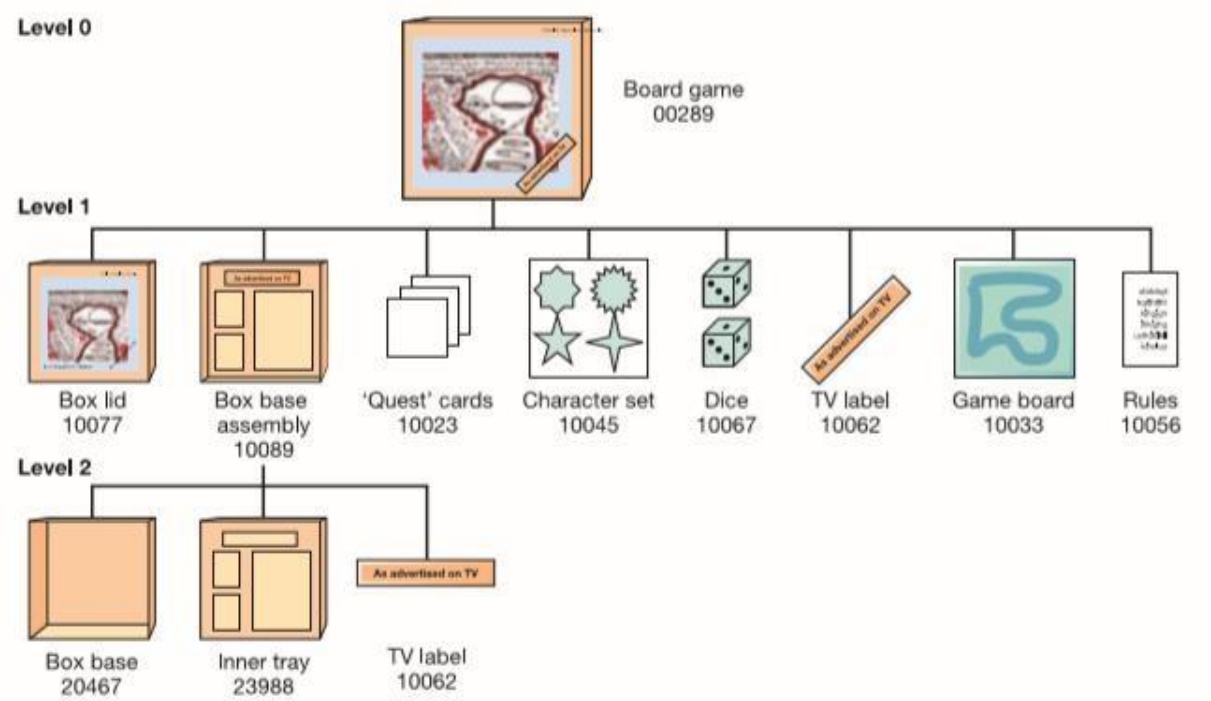
4. **Chase or level MPSs**
    - Level scheduling involves averaging the amount required to be completed to smooth out peaks and troughs; it generates more inventory than the previous 'chase' MPS.

	Week number								
	1	2	3	4	5	6	7	8	9
Demand	10	10	10	10	15	15	15	20	20
Available	31	32	33	34	30	26	22	13	4
MPS	11	11	11	11	11	11	11	11	11
On hand	30								

5. **Available to promise (ATP) -** The MPS provides information to the sales function on what can be promised to customers and when delivery can be promised
    - ATP line in the MPS shows the maximum that is still available in any one week, against which sales orders can be loaded

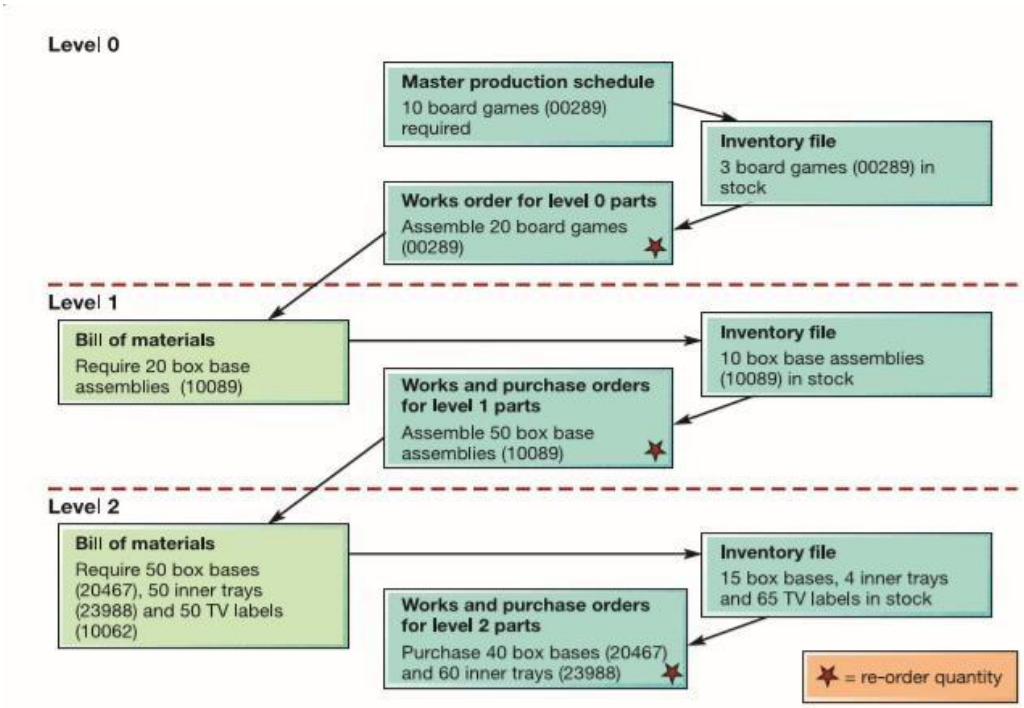
	Week number								
	1	2	3	4	5	6	7	8	9
Demand	10	10	10	10	15	15	15	20	20
Sales orders	10	10	10	8	4				
Available	31	32	33	34	30	26	22	13	4
ATP	31	1	1	3	7	11	11	11	11
MPS	11	11	11	11	11	11	11	11	11
On hand	30								

6. **The bill of materials (BOM) – the information needed on what parts are required for each product**



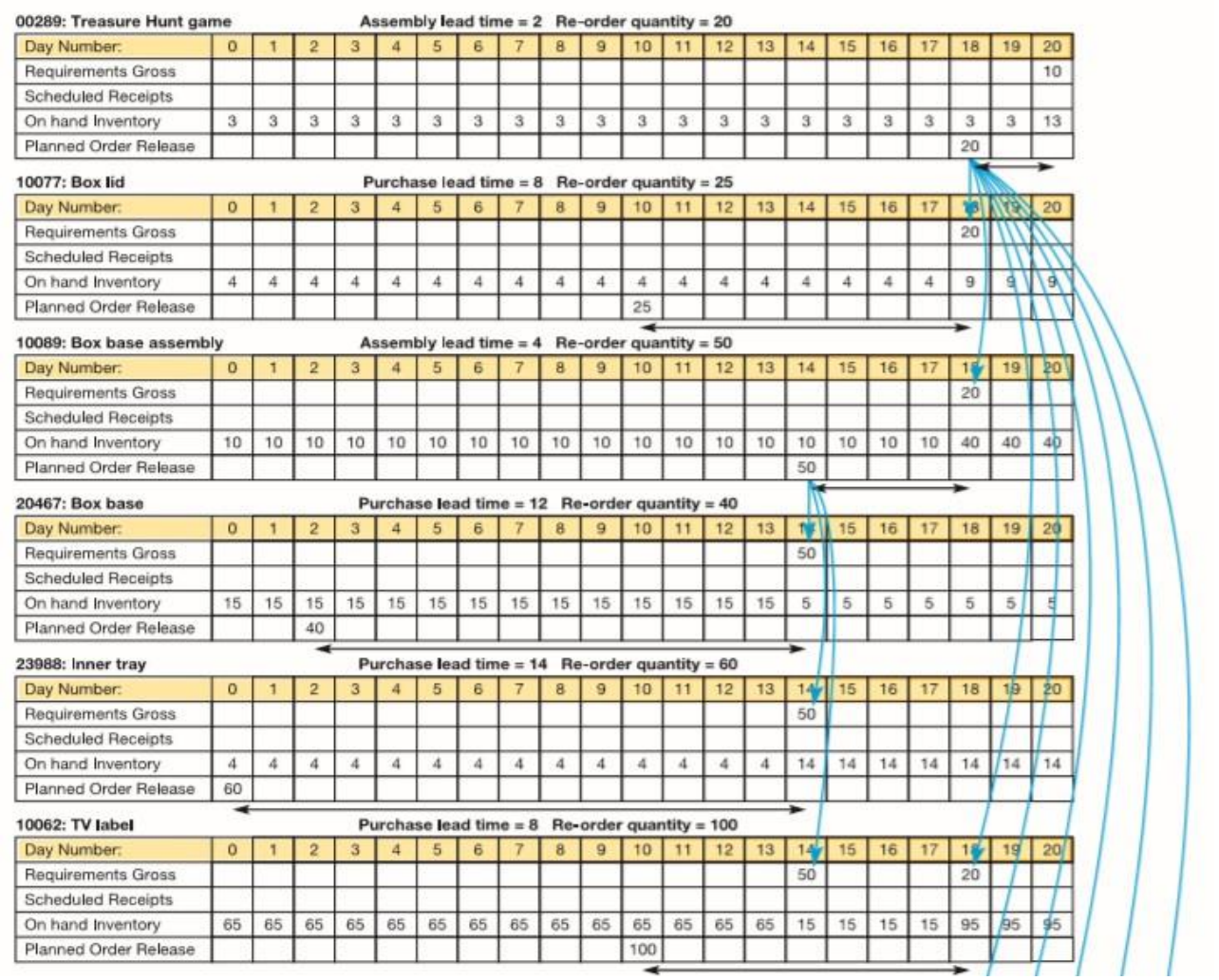
Part number: 00289 Description: Board game Level: 0			
Level	**Part number**	**Description**	**Quantity**
0	00289	Board game	1
. 1	10077	Box lid	1
. 1	10089	Box base assy	1
. . 2	20467	Box base	1
. . 2	10062	TV label	1
. . 2	23988	Inner tray	1
. 1	10023	Quest cards set	1
. 1	10045	Character set	1
. 1	10067	Die	2
. 1	10062	TV label	1
. 1	10033	Game board	1
. 1	10056	Rules booklet	1

7. **Inventory records -** MRP calculations need to recognize that some required items may already be in stock. So, it is necessary, starting at level 0 of each bill, to check how much inventory is available of each finished product, sub-assembly and component, and then to calculate what is termed the 'net' requirements, that is the extra requirements needed to supplement the inventory so that demand can be met. This requires that three main inventory records are kept:
    - **the item master file -** contains the unique standard identification code for each part or component;
    - **the transaction file -** keeps a record of receipts into stock, issues from stock and a running balance;
    - **the location file -** identifies where inventory is located;
8. **The MRP netting process**



9. **Back scheduling - In addition to calculating the volume of materials required, MRP also considers when each of these parts is required, that is the timing and scheduling of materials**
    - takes into account the lead time (the time allowed for completion of each stage of the process) at every level of assembly
    - using the lead-time information, the program is worked backwards to determine the tasks that have to be performed and the purchase orders that have to be placed

Part no.	Description	Inventory on hand day 0	Lead time (days)	Re-order quantity
00289	Board game	3	2	20
10077	Box lid	4	8	25
10089	Box base assy	10	4	50
20467	Box base	15	12	40
23988	Inner tray	4	14	60
10062	TV label	65	8	100
10023	Quest cards set	4	3	50
10045	Character set	46	3	50
10067	Die	22	5	80
10033	Game board	8	15	50
10056	Rules booklet	0	3	80



00289: Treasure Hunt game — Assembly lead time = 2 Re-order quantity = 20

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																					10
Scheduled Receipts																					
On hand Inventory	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	13
Planned Order Release																			20		

10077: Box lid — Purchase lead time = 8 Re-order quantity = 25

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			20		
Scheduled Receipts																					
On hand Inventory	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	9	9	9
Planned Order Release											25										

10089: Box base assembly — Assembly lead time = 4 Re-order quantity = 50

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			20		
Scheduled Receipts																					
On hand Inventory	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	40	40	40
Planned Order Release															50						

20467: Box base — Purchase lead time = 12 Re-order quantity = 40

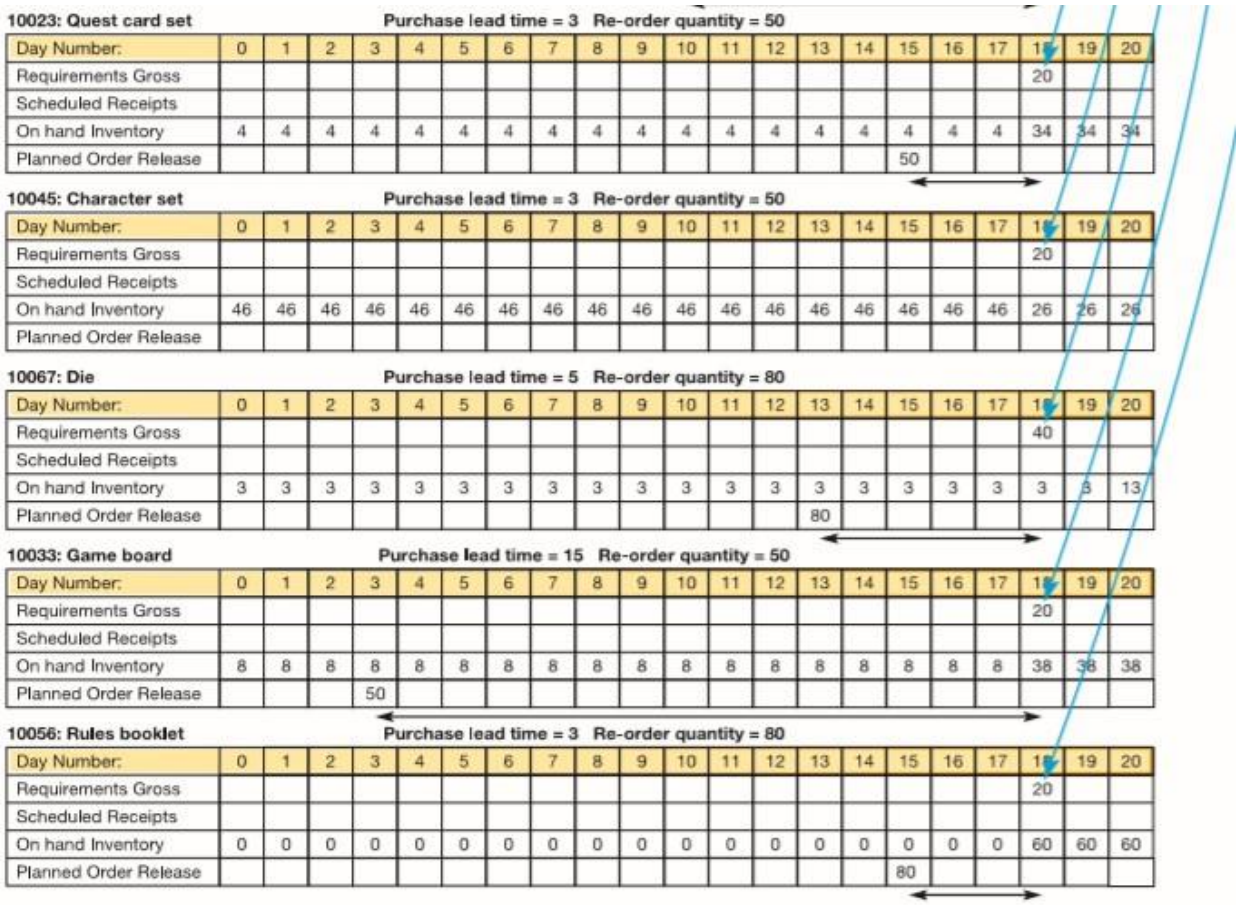
Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross															50						
Scheduled Receipts																					
On hand Inventory	15	15	15	15	15	15	15	15	15	15	15	15	15	15	5	5	5	5	5	5	5
Planned Order Release			40																		

23988: Inner tray — Purchase lead time = 14 Re-order quantity = 60

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross															50						
Scheduled Receipts																					
On hand Inventory	4	4	4	4	4	4	4	4	4	4	4	4	4	4	14	14	14	14	14	14	14
Planned Order Release	60																				

10062: TV label — Purchase lead time = 8 Re-order quantity = 100

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross															50				20		
Scheduled Receipts																					
On hand Inventory	65	65	65	65	65	65	65	65	65	65	65	65	65	65	15	15	15	15	95	95	95
Planned Order Release											100										



10023: Quest card set — Purchase lead time = 3 Re-order quantity = 50

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			20		
Scheduled Receipts																					
On hand Inventory	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	34	34	34
Planned Order Release																50					

10045: Character set — Purchase lead time = 3 Re-order quantity = 50

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			20		
Scheduled Receipts																					
On hand Inventory	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	26	26	26
Planned Order Release																					

10067: Die — Purchase lead time = 5 Re-order quantity = 80

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			40		
Scheduled Receipts																					
On hand Inventory	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	13
Planned Order Release														80							

10033: Game board — Purchase lead time = 15 Re-order quantity = 50

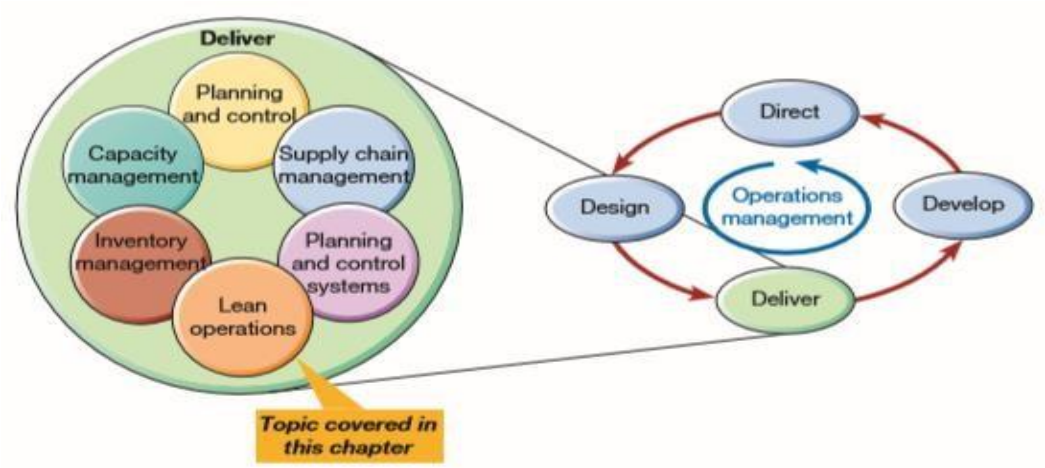
Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			20		
Scheduled Receipts																					
On hand Inventory	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	38	38	38
Planned Order Release				50																	

10056: Rules booklet — Purchase lead time = 3 Re-order quantity = 80

Day Number:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Requirements Gross																			20		
Scheduled Receipts																					
On hand Inventory	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60
Planned Order Release																80					

10. **MRP capacity checks -** three planning routines to check production plans against the operation's resources at three levels:
    - **Resource requirements plans (RRPs)** involve looking forward in the long term to predict the requirements for large structural parts of the operation, such as the numbers, locations and sizes of new plants.
    - **Rough-cut capacity plans (RCCPs)** are used in the medium to short term, to check the MPSs against known capacity bottlenecks, in case capacity constraints are broken. The feedback loop at this level checks the MPS and key resources only.
    - **Capacity requirements plans (CRPs)** look at the day-to-day effect of the works orders issued from the MRP on the loading individual process stages.

Chapter 15 – Lean operations

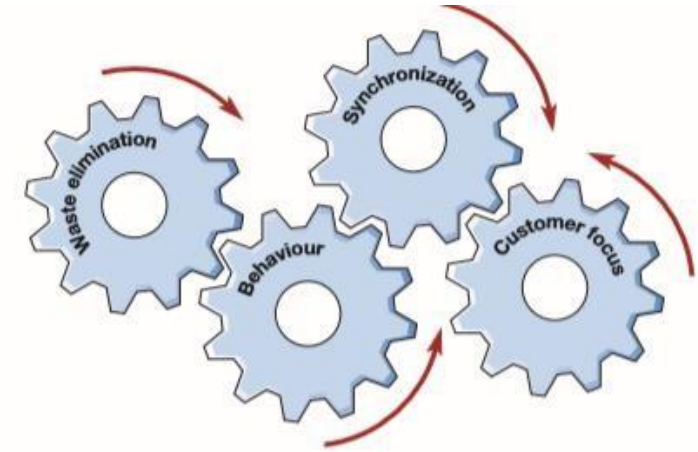


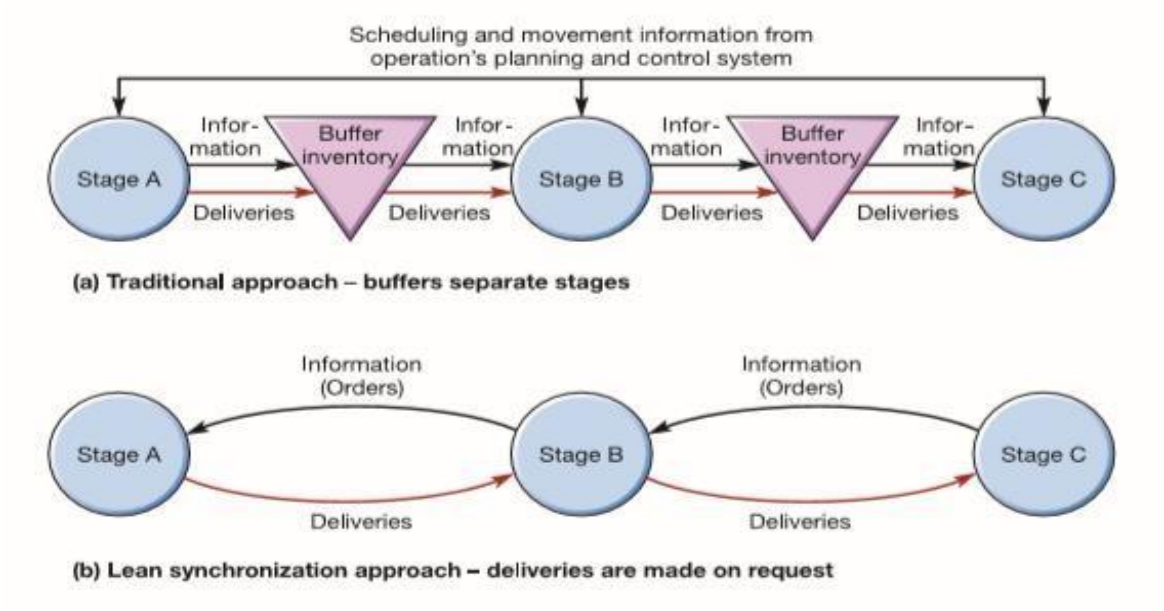
1. **What is lean? -** to achieve a flow of materials, information or customers that delivers exactly what customers want (perfect quality), in exact quantities (neither too much nor too little), exactly when needed (not too early nor too late), exactly where required (in the right location) and at the lowest possible cost
    - a concept that is almost synonymous with terms such as 'just-in-time' (JIT), the 'Toyota Production System' (TPS), 'stockless production' and 'lean synchronization'
    - results in items flowing rapidly and smoothly through processes, operations and supply networks
2. **Three perspectives of lean - defining lean is not entirely straightforward! In many ways lean can be viewed as three related, but distinct things:**
    - **Lean is a philosophy of how to run operations –** It is a coherent set of principles that are founded on smoothing flow through processes by doing all the simple things well, on gradually doing them better, on meeting customer needs exactly and (above all) on squeezing out waste every step of the way. Three key issues define the lean philosophy:
        - the involvement of staff in the operation
        - the drive for continuous improvement
        - **the elimination of waste**
    - **Lean is a method of planning and controlling operations –** Many lean ideas are concerned with how items (materials, information, customers) flow through operations and how operations managers can manage this flow. Uncoordinated flow causes unpredictability, and unpredictability causes waste because people hold inventory, capacity or time, to protect themselves against it. So lean planning and control uses several methods to achieve synchronized flow and reduce waste. Above all it uses 'pull' control (in contrast to MRP, which relies on 'push' control). This is usually achieved using some sort of **kanban** system. In addition the other lean planning and control methods which promote smooth flow include levelled scheduling and delivery, and mixed modelling.
    - **Lean is a set of tools that improve operations performance –** The 'engine room' of the lean philosophy is a collection of improvement tools and techniques that are the means for cutting out waste. There are many techniques that could be termed 'lean techniques' and, again, many of them follow on naturally and

logically from the overall lean philosophy. What is just as important to understand is how the introduction of lean as a philosophy helped to shift the focus of operations management generally towards viewing the improvement as its main purpose. In addition, the rise of lean ideas gave birth to techniques that have now become mainstream in operations management.

3. **How lean operations consider flow**

- **Traditional approach -** assumes that each stage in the process will place its output in an inventory that 'buffers' that stage from the next one downstream in the process. The next stage down will then (eventually) take outputs from the inventory, process them and pass them through to the next buffer inventory
  - These buffers are there to 'insulate' each stage from its neighbors making each stage relatively independent so that if, for example, stage A stops operating for some reason, stage B can continue, at least for a time.
  - The larger the buffer inventory, the greater the degree of insulation between the stages
  - This insulation has to be paid for in terms of inventory or queues and slow throughput times because products, customers or information will spend time waiting between stages in the process.
  - The main argument against this approach - when a problem occurs at one stage, the problem will not immediately be apparent elsewhere in the system. The responsibility for solving the problem will be centered largely on the people within that stage, and the consequences of the problem will be prevented from spreading to the whole system.
- **Lean synchronization approach -** Exposure of the system to problems can both make them more evident and change the 'motivation structure' of the whole system towards solving the problems. Lean sees accumulations of inventory, be they product, customer or information inventories, as a 'blanket of obscurity' that lies over the system and prevents problems being noticed. There are four interrelated ideas that 'mesh' with each other to form a logical chain:
  - First, between each stage, it is the downstream 'customer' stage that signals the need for action. It is the customer who, in effect, 'pulls' items through the process. The starting point of the lean philosophy is a customer focus.
  - Second, this customer 'pull' encourages items to flow through the process in a synchronized manner (rather than dwelling in inventory).
  - Third, the smooth synchronized flow and resulting reduction in inventory affect the motivation to improve because stages are no longer decoupled.
  - Fourth, the increased motivation to improve exposes waste and encourages its elimination





4. How lean operations consider inventory

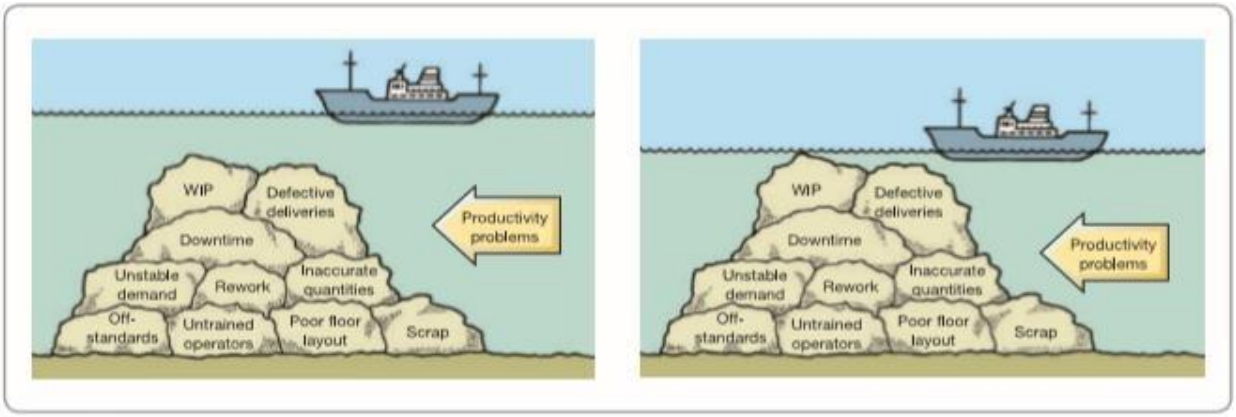
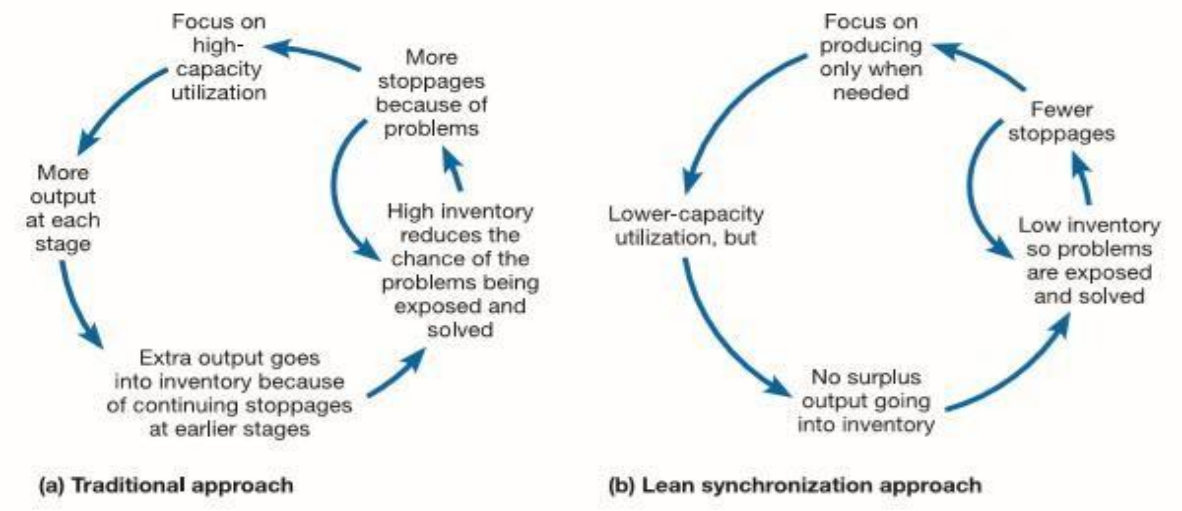


Figure 15.4 Reducing the level of inventory (water) allows operations management (the ship) to see the problems in the operation (the rocks) and work to reduce them

5. How lean operations consider capacity utilization



6. **How lean operations consider the role of people - ' basic working practices' used to implement the 'involvement of everyone' principle:**
    - **Discipline** – Work standards that are critical for the safety of staff, the environment and quality must be followed by everyone all the time
    - **Flexibility –** It should be possible to expand responsibilities to the extent of people's capabilities. This applies as equally to managers as it does to shop-floor personnel. Barriers to flexibility, such as grading structures and restrictive practices, should be removed
    - **Equality –** Unfair and divisive personnel policies should be discarded. Many companies implement the egalitarian message through to company uniforms, consistent pay structures which do not differentiate between fulltime staff and hourly rated staff, and open plan offices.
    - **Autonomy –** Delegate responsibility to people involved in direct activities so that management's task becomes one of supporting processes. Delegation includes giving staff the responsibility for stopping processes in the event of problems, scheduling work, gathering performance monitoring data and general problem solving.
    - **Development of personnel –** Over time, the aim is to create more company members who can support the rigors of being competitive
    - **Quality of working life (QWL) –** This may include, for example, involvement in decision making, security of employment, enjoyment and working area facilities.
    - **Creativity –** This is one of the indispensable elements of motivation. Creativity in this context means not just doing a job, but also improving how it is done, and building the improvement into the process.
    - **Total people involvement –** Staff take on more responsibility to use their abilities to the benefit of the company as a whole. They are expected to participate in activities such as the selection of new recruits, dealing directly with suppliers and customers over schedules, quality issues, delivery information, spending improvement budgets, and planning and reviewing work done each day through communication meetings.

7. **How lean operations consider improvement -** If the aims are set in terms of ideals which individual organizations may never fully achieve, then the emphasis must be on the way in which an organization moves closer to the ideal state. The Japanese word for continuous improvement is **kaizen,** and it is a key part of the lean philosophy.
8. **How does lean eliminate waste -** the most significant part of the lean philosophy is its focus on the elimination of all forms of waste. Waste - any activity that does not add value.
    - **causes of waste – muda, mura, muri**
        - **Muda** - activities in a process that are wasteful because they do not add value to the operation or the customer. The main causes of these wasteful activities are likely to be poorly communicated objectives (including not understanding the customer's requirements), or the inefficient use of resources. The implication of this is that, for an activity to be effective, it must be properly recorded and communicated to whoever is performing it.
        - **Mura -** means 'lack of consistency' or unevenness that results in periodic overloading of staff or equipment. So, for example, if activities are not properly documented so that different people at different times perform a task differently, then not surprisingly the result of the activity may be different. The negative effects of this are similar to a lack of dependability.
        - **Muri -** means absurd or unreasonable. It is based on the idea that unnecessary or unreasonable requirements put on a process will result in poor outcomes. The implication of this is that appropriate skills, effective planning, accurate estimation of times and schedules will avoid this 'muri' overloading waste. In other words, waste can be caused by failing to carry out basic operations planning tasks such as prioritizing activities (sequencing), understanding the necessary time (scheduling) and resources (loading) to perform activities.

      When a process is inconsistent (mura), it can lead to the overburdening of equipment and people (muri) which, in turn, will cause all kinds of non-value-adding activities (muda).
    - **types of waste**
        - ➢ **waste from irregular flow**
            - waiting time
            - transport
            - process inefficiencies
            - inventory
            - wasted motion
        - ➢ **waste from inexact supply**
            - over-production or under-production
            - early or late delivery
            - inventory
        - ➢ **waste from inflexible response**
            - large batches
            - delays between activities
            - more variation in activity mix than in customer demand
        - ➢ **waste from variability**
            - poor reliability of equipment

defective products or services

- **Looking for waste (and kaizen opportunities) – the 'gemba walk'**
  - **Gemba –** 'the actual price' where something happens - if you really want to understand something, you go to where it actually takes place. Only then can a true appreciation of the realities of improvement opportunities be gained.
  - **'The gemba walk'** (The Western idea of 'Management by Walking Around' is similar.) **-** managers should regularly visit the place where the job is done to seek out waste
- **Eliminating waste through streamlined flow**

➢ **examining all elements of throughput time - value stream mapping :**

It uses a broader range of information than most process maps.
It is usually at a higher level (5–10 activities) than most process maps.
It often has a wider scope, frequently spanning the whole supply chain.
It can be used to identify where to focus future improvement activities.

➢ **Adopting visual management -** one of the lean techniques designed to make the current and planned state of the operation or process transparent to everyone, so that anyone can very quickly see what is going on. it can:

act as a common focus for team meetings;
demonstrate methods for safe and effective working practices;
communicate to everyone how performance is being judged;
assess at a glance the current status of the operations
understand tasks and work priorities;
judge your and others' performance;
identify the flow of work, namely what has been and is being done;
identify when something is not going to plan;
show what agreed standards should be;
provide real-time feedback on performance to everyone involved;
reduce the reliance on formal meetings;

Functions of visual management:

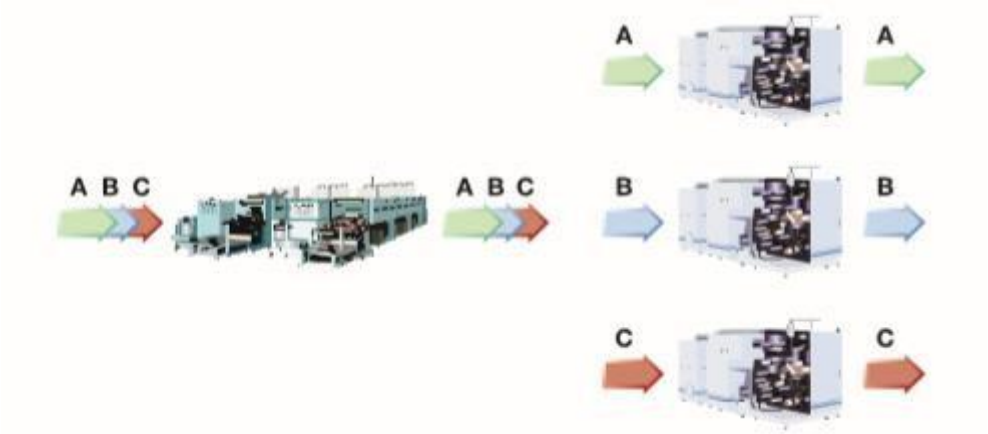
- ✞ To act as a communication mechanism.
- ✞ To encourage commitment to agreed goals.
- ✞ To facilitate co-operation between team members.

➢ **Using small-scale simple process technology -** using several small units of process technology (for example, machines) rather than one large unit. Small machines have several advantages over large ones:

First, they can process different products and services simultaneously

The system is also more robust. If one large machine breaks down, the whole system ceases to operate. If one of the three smaller machines breaks down, the system is still operating at two-thirds effectiveness.

Small machines are also easily moved, so that layout flexibility is enhanced, and the risks of making errors in investment decisions are reduced.



- **Eliminating waste through matching supply and demand exactly**
  - **Using pull control -** production is being triggered only by real customer demand
  - **Using kanbans** (means card of signal from Japanese) - called the 'invisible conveyor' that controls the transfer of items between the stages of an operation. In its simplest form, it is a card used by a customer stage to instruct its supplier stage to send more items. Kanbans can also take other forms. In some Japanese companies, they are solid plastic markers or even colored ping pong balls.

    Purposes:

    It is an instruction for the preceding process to send more.

    It is a visual control tool to show up areas of overproduction and lack of synchronization.

    It is a tool for kaizen (continuous improvement). Toyota's rules state that 'the number of kanbans should be reduced over time'.
- **Eliminating waste through flexible processes -** responding exactly and instantaneously to customer demand implies that operations resources need to be sufficiently flexible to change both what they do and how much they do of it without incurring high cost or long delays

  ➢ **reducing changeover times**

  Measure and analyze changeover

  Separate external and internal activities

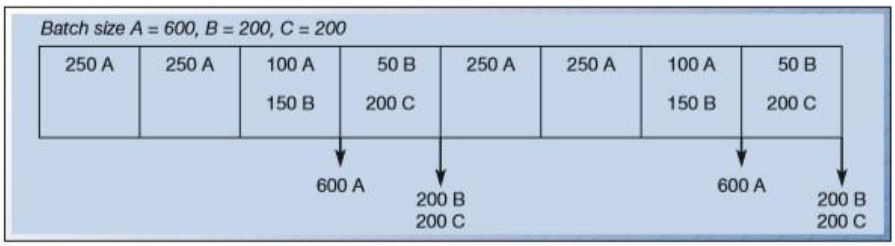
  Convert internal to external activities

  ✞ Pre-prepare activities or equipment instead of having to do it during changeover periods.

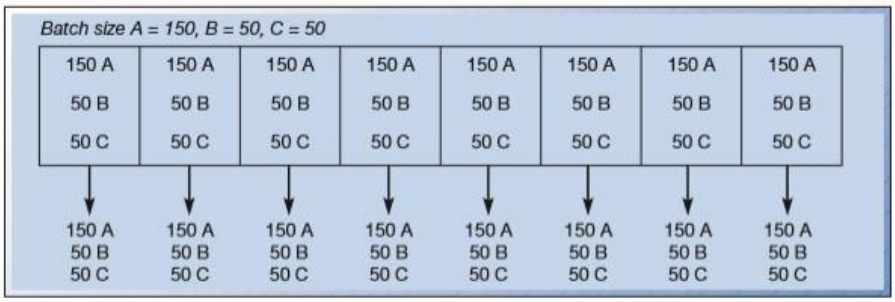
- ✞ Make the changeover process intrinsically flexible and capable of performing all required activities without any delay.
- ✞ Speed up any required changes of equipment, information or staff, for example by using simple devices.

✓ Practice changeover routines

- **Eliminating waste through minimizing variability**
  - **Levelling product or service schedules -** keeping the mix and volume of flow between stages at an even rate over time

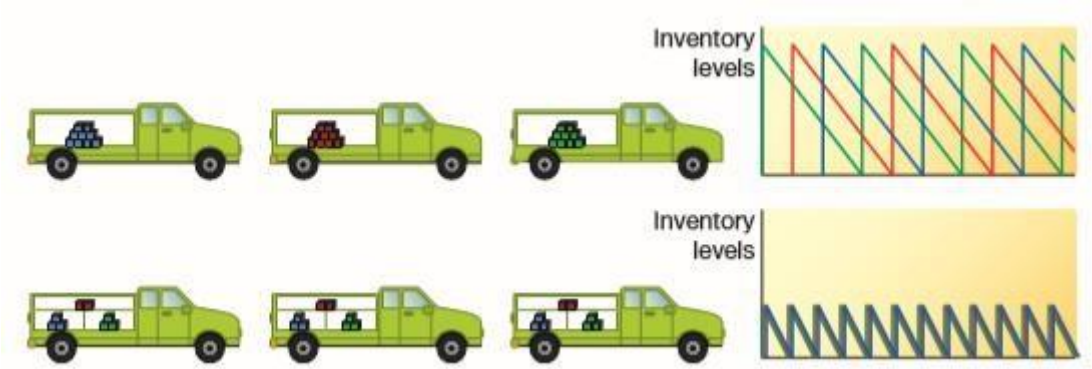


(a) Scheduling in large batches

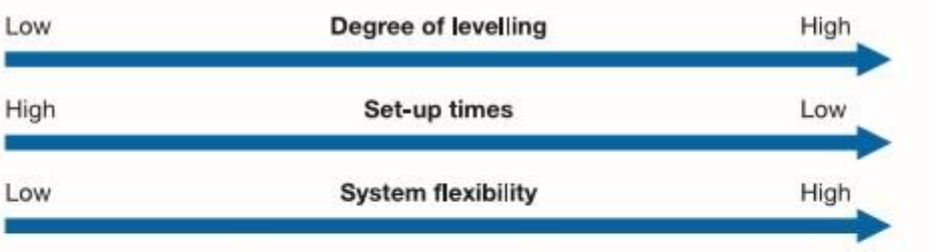


(b) Levelled scheduling

  - **Levelling delivery schedules**



  - **Adopting mixed modelling**



Large batches, e.g.	Small batches, e.g.	Mixed modelling, e.g.
200 A 120 B 80 C	5 A 3 B 2 C	A A B A B C A B C A

- **Keeping things simple – the 5Ss**
  1. **Sort (seiri) -** Eliminate what is not needed and keep what is needed.
  2. **Straighten (seiton) -** Position things in such a way that they can be easily reached whenever they are needed.
  3. **Shine (seiso) -** Keep things clean and tidy; no refuse or dirt in the work area.
  4. **Standardize (seiketsu) -** Maintain cleanliness and order – perpetual neatness.
  5. **Sustain (shitsuke) -** Develop a commitment and pride in keeping to standards.

➢ **Adopting total productive maintenance (TPM) -** aims to eliminate the variability in operations processes caused by the effect of breakdowns.

9. **How does lean apply throughout the supply network? -** To make a supply chain lean means more than making each operation in the chain lean. A collection of localized lean operations rarely leads to an overall lean chain. Rather one needs to apply the lean philosophy to the supply chain as a whole. Yet the advantages from truly lean chains can be significant.
   - **Lean supply chains are like air traffic control systems -** attempts to provide continuous, 'real-time visibility and control' to all elements in the chain

10. **How does lean compare with other approaches?**
    - **Lean and the theory of constraints**
      - **TOC -** recognize the significance of capacity constraints to the planning and control process
      - **OPT (optimized production technology) -** identifying the location of constraints, working to remove them, then looking for the next constraint, an operation is always focusing on the part that critically determines the pace of output
    - **The five steps of TOC**
      1. **Identify the system constraint –** the part of a system that constitutes its weakest link; it could be a physical constraint or even a decision-making or policy constraint.

2. **Decide how to exploit the constraint –** obtain as much capability as possible from the constraint, preferably without expensive changes. For example, reduce or eliminate any non-productive time at the bottleneck.
3. **Subordinate everything to the constraint –** the non-constraint elements of the process are adjusted to a level where the constraint can operate at maximum effectiveness. After this, the overall process is evaluated to determine if the constraint has shifted elsewhere in the process. If the constraint has been eliminated, go to step 5.
4. **Elevate the constraint –** 'elevating' the constraint means eliminating it. This step is only considered if steps 2 and 3 have not been successful. Major changes to the existing system are considered at this step.
5. **Start again from step 1.**

	Theory of constraints	Lean synchronization
Overall objectives	To increase profit by increasing the throughput of a process or operation	To increase profit by adding value from the customers' perspective
Measures of effectiveness	• Throughput • Inventory • Operating expense	• Cost • Throughput time • Value-added efficiency
Achieve improvement by...	Focusing on the constraints (the 'weakest links') in the process	Eliminating waste and adding value by considering the entire process, operation or supply network
How to implement	A five-step, continuous process (see above) emphasizing acting locally	Continuous improvement emphasizing the whole supply network

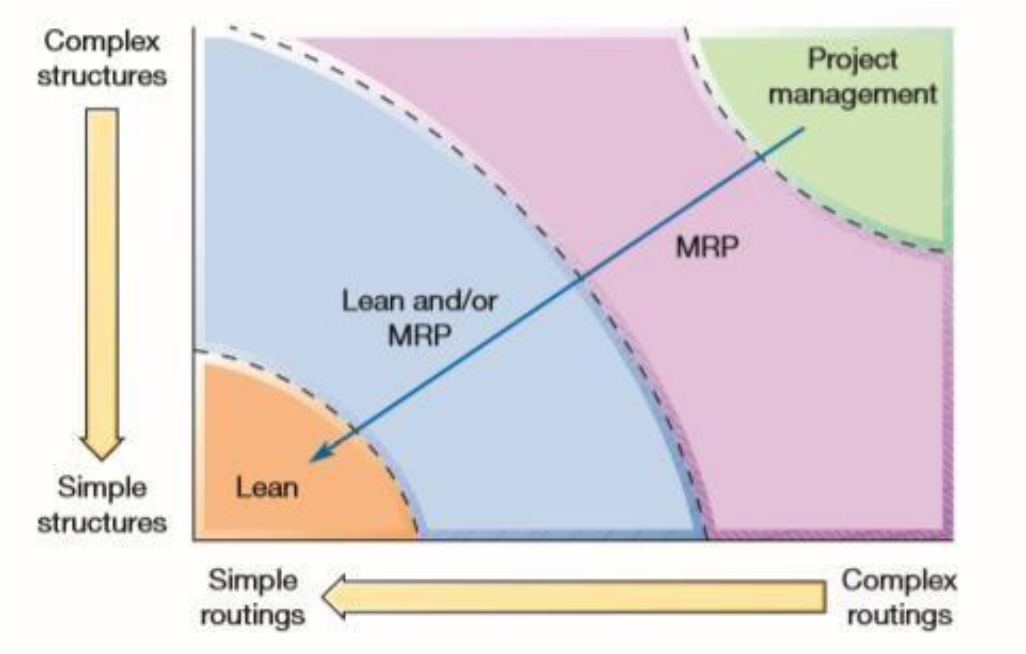
- **Lean and MRP**
  - ➢ **Lean**

    encourages a 'pull' system of planning and control

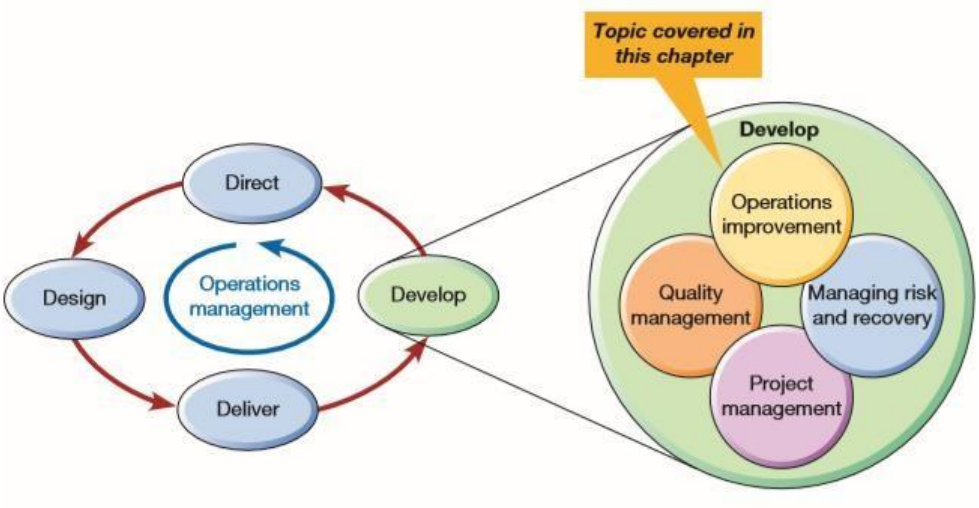
    aims which are wider than the operations planning and control activity
  - ➢ **MRP**

    encourages a 'push' system of planning and control

    essentially a planning and control 'calculation mechanism' ***The two approaches can reinforce each other in the same operation, provided their respective advantages are preserved.***
- **When to use lean, MRP and combined systems**

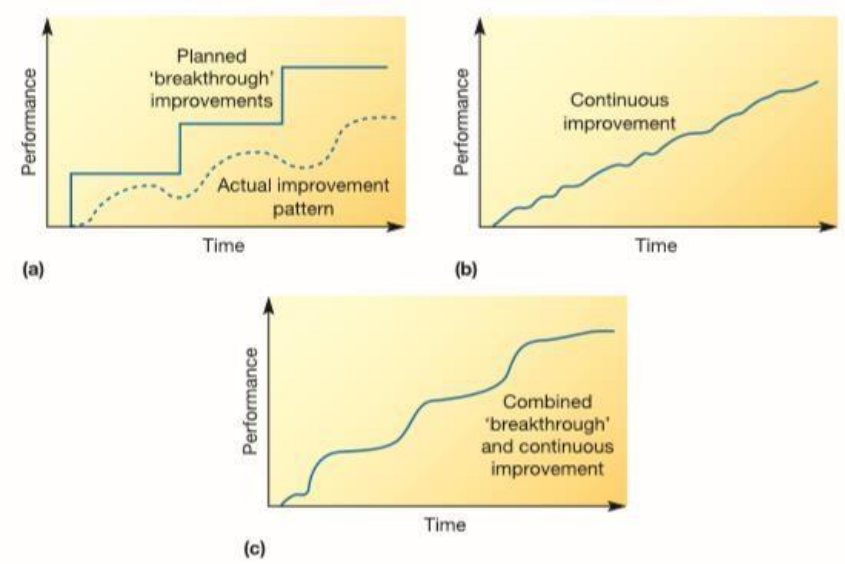

Complex structures
Simple structures
Project management
MRP
Lean and/or MRP
Lean
Simple routings
Complex routings

Chapter 16 – Operations improvement



1. **Why is improvement so important in operations management? -**
   Performance improvement is the ultimate objective of operations and process management
2. **Why the focus on improvement?**
   - **There is a perceived increase in the intensity of competitive pressures**. In fact economists argue about whether markets are really getting more competitive. As far as improvement is concerned it does not matter; there is a perception of increased competitive pressure, and certainly the owners of operations (shareholders or governments) are less likely to tolerate poor returns or value for money.
   - **The nature of world trade is changing**. Economies such as China, India and Brazil are emerging as both producers and consumers of products and services. This has had a number of effects that have impacted more developed economies. It has introduced cost pressures in countries with relatively expensive labour and infrastructure costs; it has introduced new challenges for global companies, such as managing complex supply chains; and it has accelerated demand for resources (materials, food, energy), pushing up (or destabilizing) prices for these commodities.
   - **New technology has both introduced opportunities to improve operations practice and disrupted existing markets**. Look at how operations in the music business have had to adapt their working practices to downloading and music streaming.
   - **The interest in operations improvement has resulted in the development of many new ideas and approaches to improving operations which have, in turn, focused attention on improvement.** The more ways there are to improve operations, the more operations will be improved.
   - **The scope of operations management has widened from a subject associated largely with manufacturing to one that embraces all types of enterprise and processes in all functions of the enterprise.** Because of this extended scope, operations managers have seen how they can learn from each other, even if their operations and processes seem, at first glance, different.

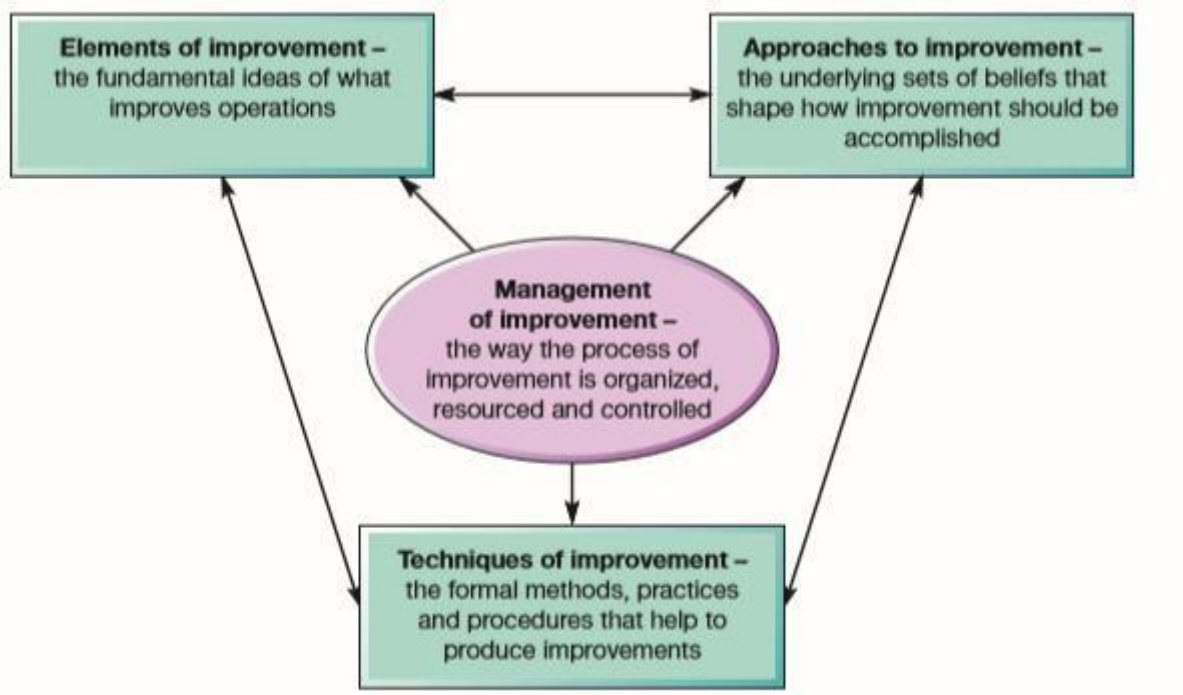
3. **The Red Queen effect -** Those firms that have improved their competitive position have improved their operations performance more than that of their competitors. Where improvement has simply matched that of competitors, survival has been the main benefit.
4. **Radical or breakthrough change -** a philosophy that assumes that the main vehicle of improvement is major and dramatic change in the way the operation works
5. **Continuous or incremental improvement (kaizen) -** adopts an approach to improving performance which assumes many small incremental improvement steps. It is not the rate of improvement that is important; it is the momentum of improvement. It does not matter if successive improvements are small; what does matter is that every month some kind of improvement has actually taken place.



6. **Exploitation and exploration**
   - **Exploitation -** the activity of enhancing processes (and products) that already exist within a firm.
     - The focus is on creating efficiencies rather than radically changing resources or processes.
     - Its emphasis is on tight control of the improvement process, standardizing processes, clear organizational structures and organizational stability.
     - The benefits tend to be relatively immediate, incremental and predictable; likely to be better understood by the firm and fit into its existing strategic framework
   - **Exploration -** concerned with the exploration of new possibilities
     - associated with searching for and recognizing new mindsets and ways of doing things
     - involves experimentation, taking risks, simulation of possible consequences, flexibility and innovation
     - The benefits are principally long term but can be relatively difficult to predict; any benefits or discoveries that might come may be so different from what the firm is familiar with that it may not find it easy to take advantage of them

7. **Organizational 'ambidexterity' -** means the ability of a firm both to exploit and explore as it seeks to improve; to be able to compete in mature markets where efficiency is important, by improving existing resources and processes, while also competing in new technologies and/or markets where novelty, innovation and experimentation are required. *if existing processes are improved over time, there may be less motivation to experiment with new ideas*

8. **The structure of improvement ideas**



9. **What are the key elements of operations improvement**

- **Improvement cycles**

➢ **PDCA cycle (Deming cycle)**

P (for plan) stage - involves an examination of the current method or the problem area being studied. This involves collecting and analyzing data so as to formulate a plan of action which is intended to improve performance.

D (for do) stage - the implementation stage during which the plan is tried out in the operation. This stage may itself involve a mini-PDCA cycle as the problems of implementation are resolved.

C (for check) stage - the new implemented solution is evaluated to see whether it has resulted in the expected performance improvement.

A (for act) stage - the change is consolidated or standardized if it has been successful. If the change has not been successful, the lessons learned from the 'trial' are formalized before the cycle starts again.

➢ **DMAIC ('De-Make') cycle (Six Sigma circle) -** follows a more 'experimental' approach

(D) Defining the problem or problems, partly to understand the scope of what needs to be done and partly to define exactly the

requirements of the process improvement. Often at this stage a formal goal or target for the improvement is set.

(M) Measurement stage - involves validating the problem to make sure that it really is a problem worth solving, using data to refine the problem and measuring exactly what is happening.

(A) Analyze – established measurements can be analyzed; seen as an opportunity to develop hypotheses as to what the root causes of the problem really are.

(I) Improving the process - Ideas are developed to remove the root causes of problems, solutions are tested and those solutions that seem to work are implemented, formalized and results measured.

(C) Control - The improved process needs then to be continually monitored and controlled to check that the improved level of performance is sustaining.

Although it is the last point about both cycles that is the most important – the cycle starts again.

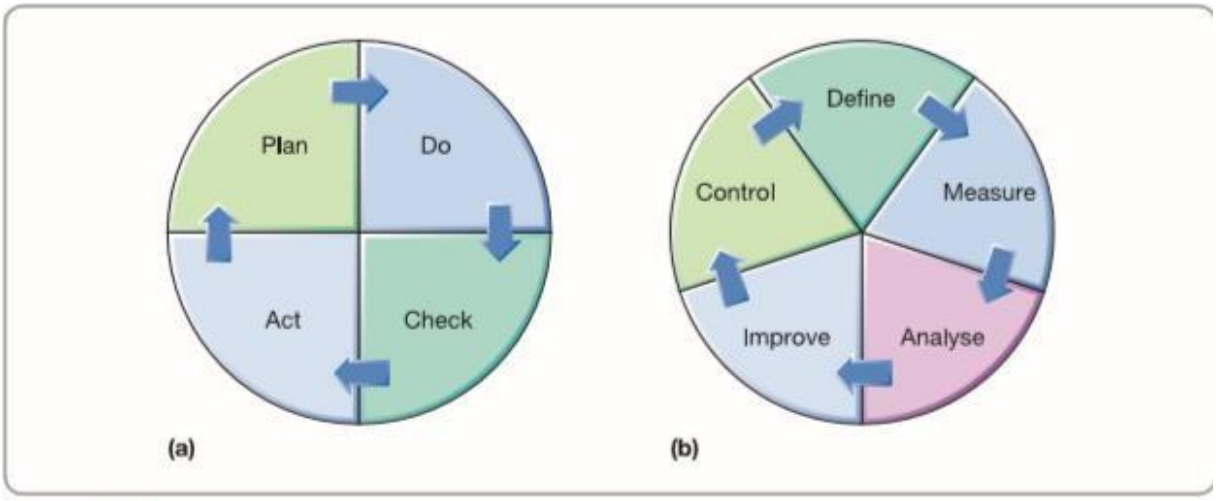
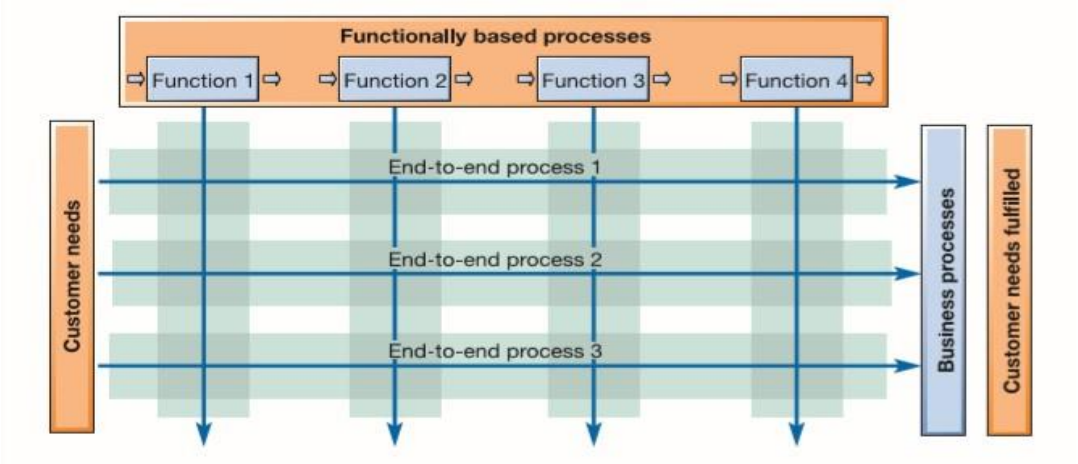


Figure 16.4 (a) The plan–do–check–act, or 'Deming', improvement cycle; and (b) the define–measure–analyse–improve–control, or DMAIC, Six Sigma improvement cycle

- **A process perspective**
  - improvement can be focused on what actually happens rather than which part of the organization has responsibility for what happens
  - if improvement is described in terms of how processes can be made more effective, those messages will have relevance for all the other functions of the business in addition to the operations function. • **End to end processes**



- **Evidence-based problem solving -** Underlying the use of techniques is an emphasis on the scientific method, responding only to hard evidence, and using statistical software to facilitate analysis.
- **Customer centricity -** involves the whole organization in understanding the central importance of customers to its success and even to its survival. Customers are seen not as being external to the organization but as the most important part of it; ***balancing between what customers would like and what the operation can afford (or wants) to do.
    - ➢ **Voice of the customer (VOC) -** capturing a customer's requirements, expectations, perceptions and preferences in some depth; done as part of new service and product development as part of quality function deployment (QFD)
- **Systems and procedures -** 'the organizational structure, responsibilities, procedures, processes and resources for implementing quality management.' It should 'define and cover all facets of an organization's operation, from identifying and meeting the needs and requirements of customers, design, planning, purchasing, manufacturing, packaging, storage, delivery and service, together with all relevant activities carried out within these functions. It deals with organization, responsibilities, procedures and processes. Put simply it is good management practice.'
- **Reduce process variation -** a potentially useful method of identifying improvement opportunities is to try and identify the sources of random variation in process performance
- **Synchronized flow -** items in a process, operation or supply network flow smoothly and with even velocity from start to finish
- **Emphasize education/training -** techniques of improvement and business and organizational context of improvement should be fully understood by everyone engaged in the improvement process
- **Perfection is the goal -** By an 'absolute target' one literally means the theoretical level of perfection, for example zero errors, instant delivery, delivery absolutely when promised, infinite flexibility, zero waste, etc. Of course, in reality such perfection may never be achievable.
- **Waste identification -** arguably the most significant part of the lean philosophy

- **Include everybody -** individual creativity and effort from all staff represent a valuable source of development
- **Develop internal customer-supplier relationships -** stressing that each process in an operation has a responsibility to manage these internal customer–supplier relationships; done primarily by defining as clearly as possible what their own and their customers' requirements are by defining what constitutes 'error-free' service – the quality, speed, dependability and flexibility required by internal customers.

10. What are the broad approaches to improvement?

- **Total quality management (TQM) as an improvement approach -** puts quality (and indeed improvement generally) at the heart of
  everything that is done by an operation
  - Meeting the needs and expectations of customers. ●
  - Improvement covers all parts of the organization (and should be group based).
  - Improvement includes every person in the organization (and success is recognized).
  - Including all costs of quality.
  - Getting things 'right first time' that is designing in quality rather than inspecting it in.
  - Developing the systems and procedures which support improvement.
- **Lean as an improvement approach -** aims to meet demand instantaneously, with perfect quality and no waste ➢ Customer-centricity.
  - Internal customer–supplier relationships
  - Perfection is the goal
  - Synchronized flow
  - Reduce variation
  - Include all people
  - Waste elimination
- **Business process re-engineering (BPR) -** All work should be examined for whether it adds value for the customer and, if not, processes should be redesigned to eliminate it
  - Rethink business processes in a cross-functional manner which organizes work around the natural flow of information (or materials or customers).
  - Strive for dramatic improvements in performance by radically rethinking and redesigning the process.
  - Have those who use the output from a process perform the process. Check to see if all internal customers can be their own supplier rather than depending on another function in the business to supply them (which takes longer and separates out the stages in the process).
  - Put decision points where the work is performed. Do not separate those who do the work from those who control and manage the work.
- **Six Sigma** (the specification range of any part of a product or service should be +/- 6 the standard deviation of the process) **-** 'A disciplined methodology of defining, measuring, analyzing, improving, and controlling the quality in every one of the company's products, processes, and transactions – with the ultimate goal of virtually eliminating all defects'

1. Measuring performance

A defect – is a failure to meet customer-required performance (defining performance measures from a customer's perspective is an important part of the Six Sigma approach).

A defect unit or item – is any unit of output that contains a defect (that is, only units of output with no defects are not defective; defective units will have one or more than one defect).

A defect opportunity – is the number of different ways a unit of output can fail to meet customer requirements

Proportion defective – is the percentage or fraction of units that have one or more defects.

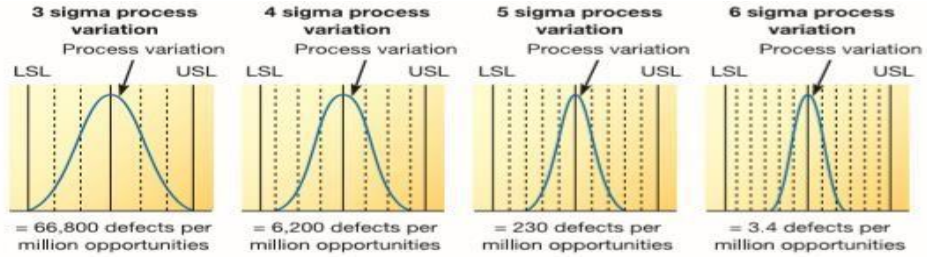
Process yield – is the percentage or fraction of total units produced by a process that are defect-free (that is, 1 − proportion defective).

Defect per unit (DPU) - is the average number of defects on a unit of output (the number of defects divided by the number of items produced).

Defects per opportunity – is the proportion or percentage of defects divided by the total number of defect opportunities (the number of defects divided by (the number of items produced × the number of opportunities per item).

Defects per million opportunities (DPMO) – is exactly what it says, the number of defects which the process will produce if there were 1 million opportunities to do so.

The Sigma measurement is derived from the DPMO and is the number of standard deviations of the process variability that will fit within the customer specification limits.



An insurance process checks details of insurance claims and arranges for customers to be paid. It samples 300 claims at random at the end of the process. It finds that 51 claims had one or more defects and there were 74 defects in total. Four types of error were observed: coding errors, policy conditions errors, liability errors and notification errors.

$$\text{Proportion defective} = \frac{\text{Number of defects}}{\text{Number of units processed}}$$

$$= \frac{51}{300} = 0.17 \text{ (17\% defective)}$$

$$\text{Yield} = 1 - \text{proportion of defectives}$$

$$= 1 - 0.17 = 0.83 \text{ or (83\% yield)}$$

$$\text{Defects per unit} = \frac{\text{Number of defects}}{\text{Number of units processed}}$$

$$= \frac{74}{300} = 0.247 \text{ (or 24.7) DPO}$$

$$\text{Defects per opportunity} = \frac{\text{Number of defects}}{\text{Number of units processed} \times \text{Number of opportunities}}$$

$$= \frac{74}{300 \times 4} = 0.062 \text{ DPO}$$

$$\text{Defects per million opportunities} = \text{DPO} \times 10^6$$

$$= 62{,}000 \text{ DPMO}$$

Customer-driven objectives – Six Sigma is sometimes defined as 'the process of comparing process outputs against customer requirements'. It uses a number of measures to assess the performance of operations processes. In particular it expresses performance in terms of defects per million opportunities (DPMO).

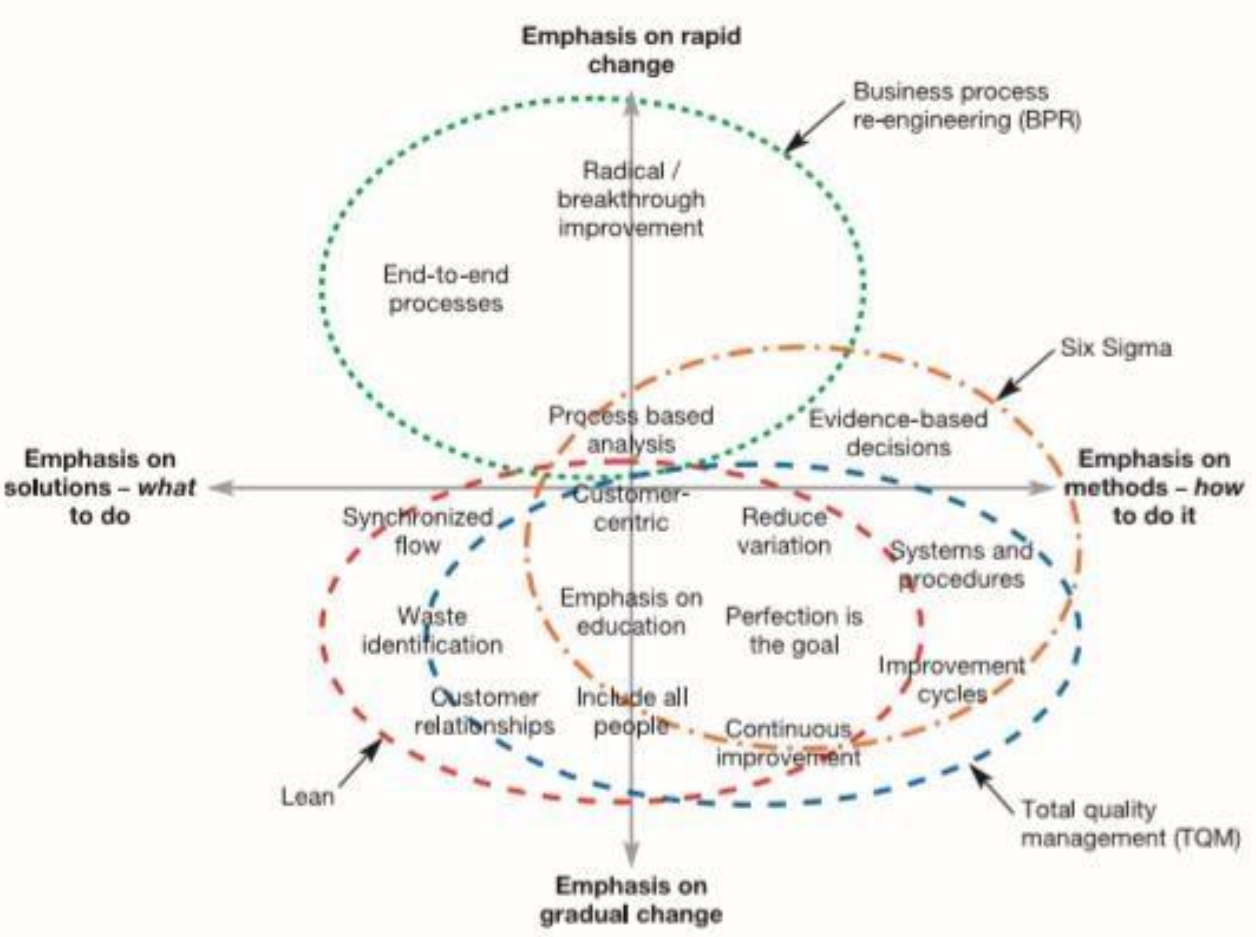
Use of evidence – Although Six Sigma is not the first of the new approaches to operations to use statistical methods, it has done a lot to emphasize the use of quantitative evidence. Structured improvement cycle – The structured improvement cycle used in Six Sigma is the DMAIC cycle.

Process capability and control – Not surprisingly, given its origins, process capability and control is important within the Six Sigma approach.

Process design – Latterly Six Sigma proponents also include process design in the collection of elements that define the Six Sigma approach.

Structured training and organization of improvement – The Six Sigma approach holds that improvement initiatives can only be successful if significant resources and training are devoted to their management.

- **Differences and similarities**



- **Lean Sigma -** a combination of lean methods and Six Sigma concepts; attempts to build on the experience, methods and tools that have emerged from the several decades of operational improvement and implementation using lean and Six Sigma approaches separately. Lean Sigma includes the waste reduction, fast throughput time and impact of lean with the data-driven, rigor and variation control of Six Sigma. Some organizations also include other elements from other approaches – e.g. the continuous improvement and errorfree quality orientation of TQM.

11. What techniques can be used for improvement?

- **Scatter diagrams -** provide a quick and simple method of identifying whether there is evidence of a connection between two sets of data: for example, the time at which you set off for work every morning and how long the journey to work takes
- **Process maps (flow charts) -** can be used to give a detailed understanding prior to improvement, they highlight problem areas where no procedure exists to cope with a particular set of circumstances
- **Cause-effect diagrams -** effective method of helping to search for the root causes of problems. They do this by asking what, when, where, how and why questions, but also add some possible 'answers' in an explicit way. They can also be used to identify areas where further data is needed. Cause–effect diagrams (which are also known as Ishikawa diagrams) have become extensively used in improvement programs.
- **Pareto diagrams -** distinguish between the 'vital few' issues and the 'trivial many'. It is a relatively straightforward technique which involves arranging items of information on the types of problem or causes of problem into their order of importance.
- **Why-why analysis -** starts by stating the problem and asking why that problem has occurred. Once the reasons for the problem occurring have been identified, each of the reasons is taken in turn and again the question is asked why those reasons have occurred, and so on. This procedure is continued until either a cause seems sufficiently selfcontained to be addressed by itself or no more answers to the question

  'Why?' can be generated.

12. How can improvement knowledge be managed?

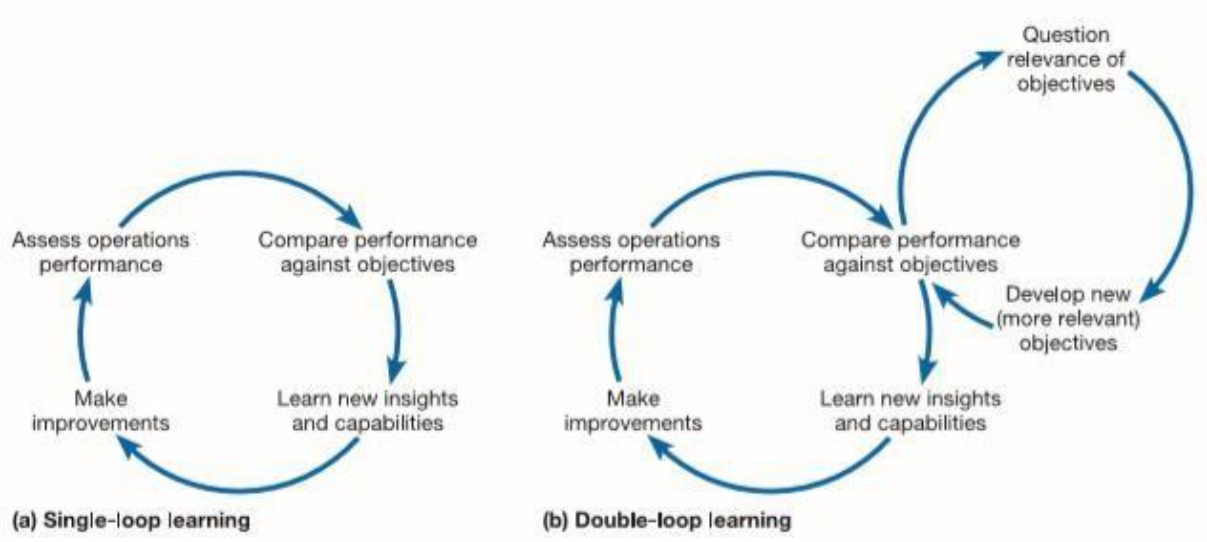
- **Why does the improvement need organizing? -** Improvement does not just happen. It needs organizing and it needs implementing. It also needs a purpose that is well thought through and clearly articulated.
- **How can organizational culture affect improvement? -** A receptive organizational culture that encourages a constant search for improved ways to do things nurtures improvement. At the same time the organization's view of improvement is an important indication of its culture.
- **Sourcing improvement ideas -** 'imitation can be strategic seems almost blasphemous in the current scholarly climate', it can ' be strategic and should be part of the strategic repertoire of any agile firm' . 18 In fact,
  'imitation can be a differentiating factor and has the potential to deliver unique value '. Three 'strategic types' of imitators:
  - **The pioneer importer –** is an imitator that is the pioneer in another place (another country, industry, or product market). This is what Ryanair did in Europe when it imported the Southwest model.
  - **The fast second –** is a rapid mover arriving quickly after an innovator or pioneer, but before they have had an opportunity to establish an unassailable

lead, and before other potentially rival imitators take a large share of the market.

- **The come from behind –** is a late entrant or adopter that has deliberately delayed adopting a new idea. Samsung did this with its chip-making business, by using its manufacturing capability and knowledge to halve the time it takes to build a semiconductor plant. Then Samsung established a lead over competitors by exploiting its strength in key technical, production and quality skills.

- **Benchmarking -** 'the process of learning from others' and involves comparing one's own performance or methods against other comparable operations. Types of benchmarking:
  - **Internal benchmarking** is a comparison between operations or parts of operations which are within the same total organization.
  - **External benchmarking** is a comparison between an operation and other operations which are part of a different organization.
  - **Non-competitive benchmarking** is benchmarking against external organizations which do not compete directly in the same markets.
  - **Competitive benchmarking** is a comparison directly between competitors in the same, or similar, markets.
  - **Performance benchmarking** is a comparison between the levels of achieved performance in different operations.
  - **Practice benchmarking** is a comparison between an organization's operations practices, or way of doing things, and those adopted by another operation.

- **Improvement as learning -** it is crucial that improvement is organized so that it encourages, facilitates and exploits the learning that occurs during improvement. This requires us to recognize that there is a distinction between **single- and double-loop learning**

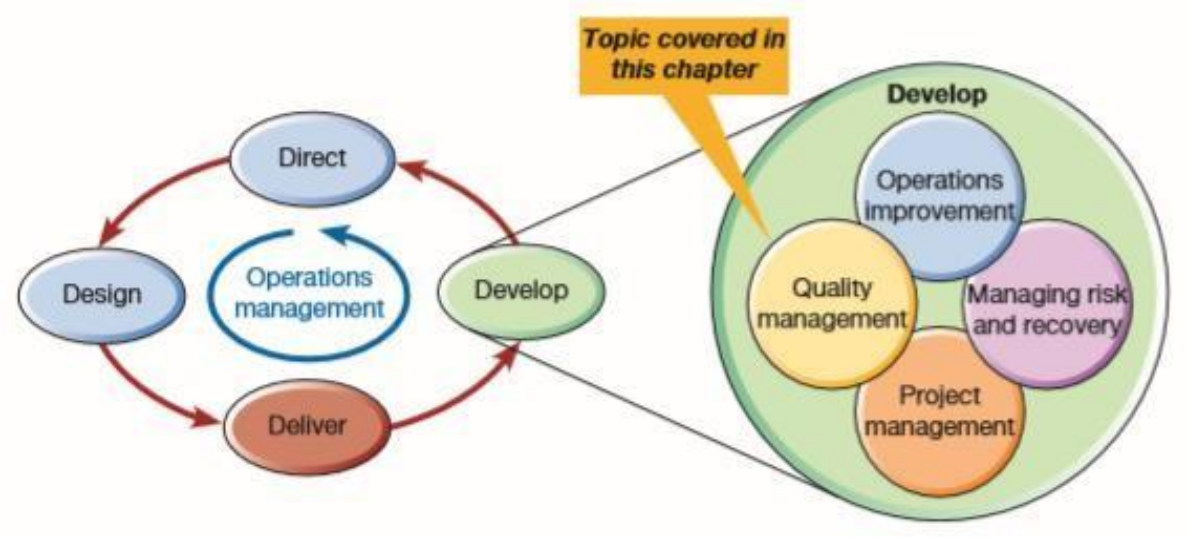


- **Some key implementation issues**

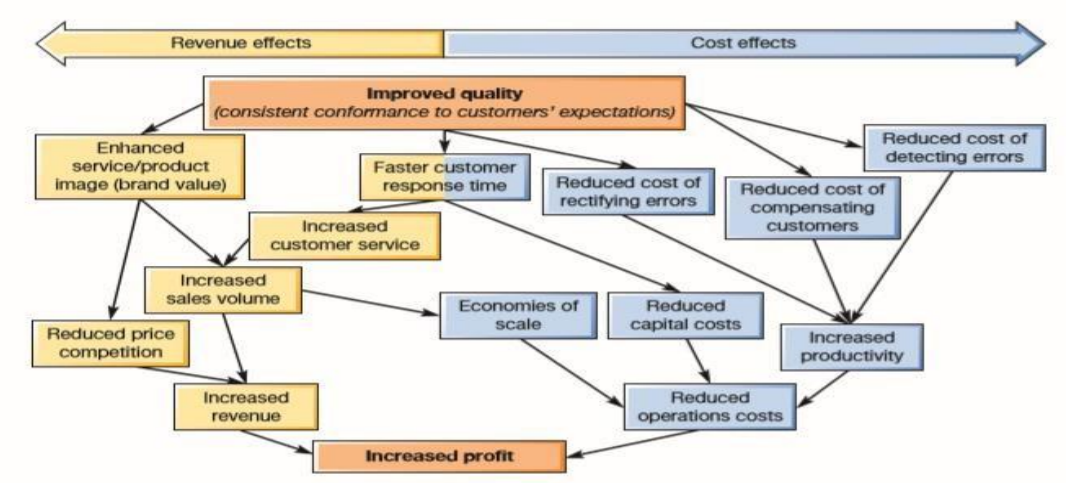
➢ **Top-management support - top management must:**

understand and believe in the benefits of the improvement approach;
communicate the principles and techniques of improvement;
participate in the improvement process;
formulate and maintain a clear 'improvement strategy'

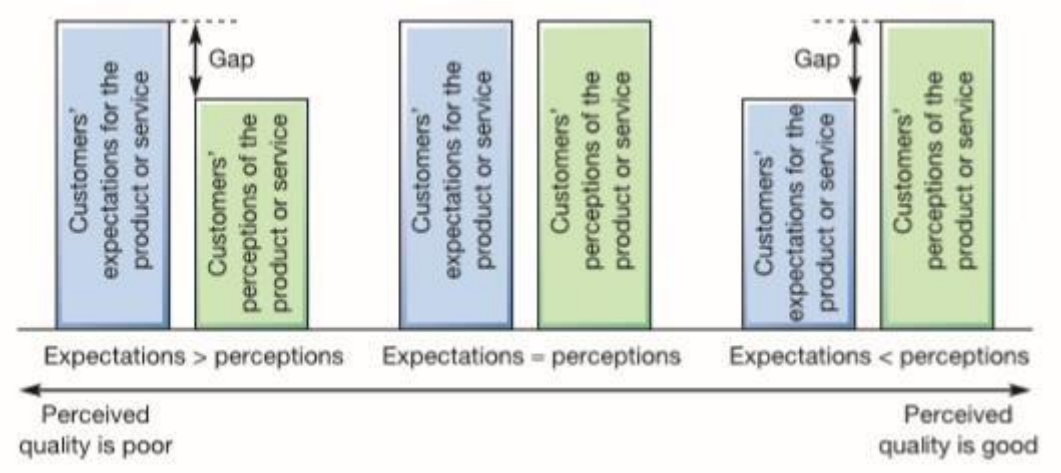
- **Senior managers may not fully understanding the improvement approach -** understanding in detail what each approach means must be the first step in deciding whether it is appropriate
- **Avoid excessive 'hype' -** Most new ideas have something to say, but jumping from one fad to another will not only generate a backlash against any new idea, but also destroy the ability to accumulate the experience that comes from experimenting with each one. Avoiding becoming an improvement fashion victim is not easy.



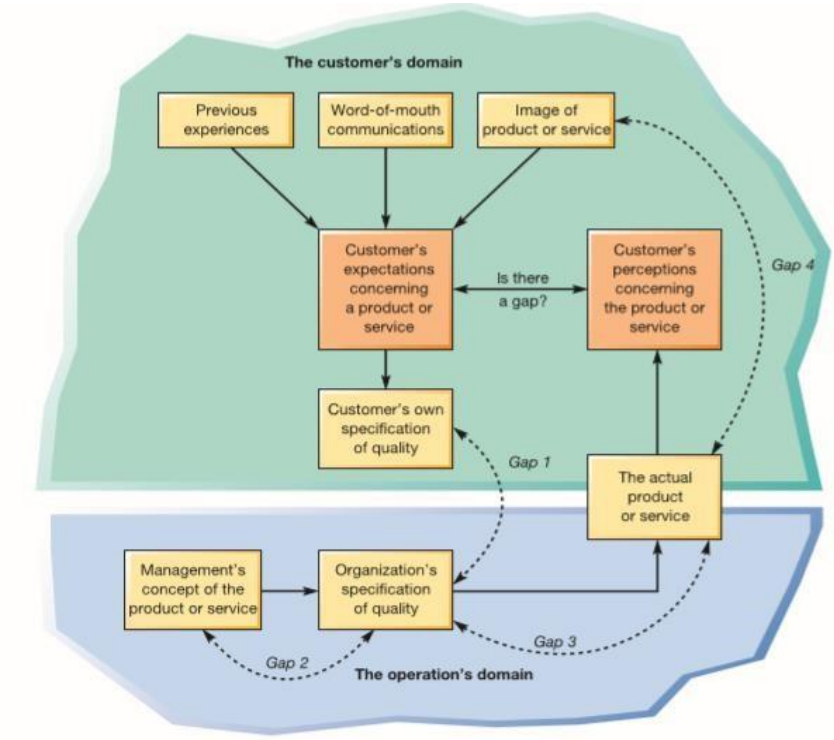
1. What is quality and why is it so important?



- **The operation's view of quality –** the consistent conformance to customers' expectations
- **Customer's view of quality –** quality needs to be understood from a customer's point of view because, to the customer, the quality of a particular service or product is whatever he or she perceives it to be
- **Reconciling the operation's and the customer's views of quality -** the degree of fit between customers' expectations and customer perception of the service or product

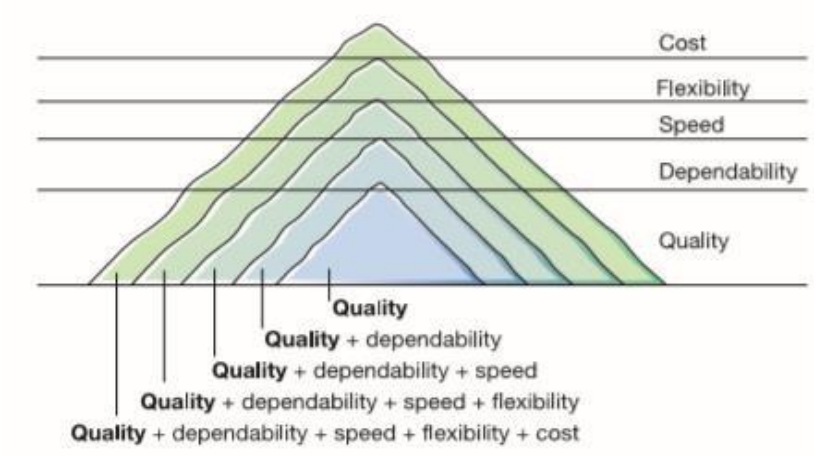


- **How can quality problems be diagnosed?**
  - Gap 1:The customer's specification–operation's specification gap
  - Gap 2: The concept–specification gap
  - Gap 3: The quality specification–actual quality gap
  - Gap 4: The actual quality–communicated image gap



The sandcone theory - the sand is analogous to management effort and resources. Building a stable sandcone needs a stable foundation of **quality** upon which one can build layers of **dependability, speed, flexibility and cost**. Building up improvement is a cumulative process, not a sequential one. Moving on to the second priority for improvement does not mean dropping the first, and so on. According to the theory, the first priority should be **quality**, since this is a precondition to all lasting improvement. Only when the operation has reached a minimally acceptable level in **quality** should it then tackle the next issue - internal **dependability**. Moving on to include **dependability** in the improvement process will actually require further improvement in quality. Once a critical level of **dependability** is reached, enough to provide some stability to the operation, the next stage is to

improve the **speed** of internal throughput. But again only while continuing to improve **quality** and **dependability** further. Soon it will become evident that the most effective way to improve **speed** is through improvements in response **flexibility**, which means changing things within the operation faster. Again, including **flexibility** in the improvement process should not divert attention from continuing to work further on **quality, dependability and speed**. Only then should **cost** be tackled head on.



- **Conformance to specification -** providing a service or producing a product to its design specification; seen as the most important contribution that operations management can make to the customer's perception of quality

2. What steps lead towards conformance to specification? • Step 1 – define the quality characteristics

Quality characteristic	Automobile (material transformation process)	Bank loan (information transformation process)	Air journey (customer transformation process)
Functionality – how well the service or product does its job	Speed, acceleration, fuel consumption, ride quality, road-holding, etc.	Interest rate, terms and conditions	Safety and duration of journey, onboard meals and drinks, car and hotel booking services
Appearance – the sensory characteristics of the service or product: its aesthetic appeal, look, feel, etc.	Aesthetics, shape, finish, door gaps, etc.	Aesthetics of information, website, etc.	Decor and cleanliness of aircraft, lounges and crew
Reliability – the consistency of the product's or service's performance over time	Mean time to failure	Keeping promises (implicit and explicit)	Keeping to the published flight times
Durability – the total useful life of the service or product	Useful life (with repair)	Stability of terms and conditions	Keeping up with trends in the industry
Recovery – the ease with which problems with the service or product can be resolved	Ease of repair	Resolution of service failures	Resolution of service failures
Contact – the nature of the person-to-person contact which might take place	Knowledge and courtesy of sales staff	Knowledge and courtesy of branch and call centre staff	Knowledge, courtesy and sensitivity of airline staff

- **Step 2 – decide how to measure each characteristic -** taking a very general quality characteristic and breaking it down, as far as one can, into its constituent elements
  - **Variable measures -** those that can be measured on a continuously variable scale (for example, length, diameter, weight or time)
  - **Attribute measures -** assessed by judgment and are dichotomous, that is they have two states (for example, right or wrong, works or does not work, looks OK or not OK

Quality	Automobile		Airline journey	
characteristic	Variable	Attribute	Variable	Attribute
Functionality	Acceleration and braking characteristics from test bed	Is the ride quality satisfactory?	Number of journeys which actually arrived at the destination (i.e. did not crash!)	Was the food acceptable?
Appearance	Number of blemishes visible on car	Is the colour to specification?	Number of seats not cleaned satisfactorily	Is the crew dressed smartly?
Reliability	Average time between faults	Is the reliability satisfactory?	Proportion of journeys which arrived on time	Were there any complaints?
Durability	Life of the car	Is the useful life as predicted?	Number of times service innovations lagged competitors'	Generally, is the airline updating its services in a satisfactory manner?
Recovery	Time from fault discovered to fault repaired	Is the serviceability of the car acceptable?	Proportion of service failures resolved satisfactorily	Do customers feel that staff deal satisfactorily with complaints?
Contact	Level of help provided by sales staff (1 to 5 scale)	Did customers feel well served (yes or no)?	The extent to which customers feel well treated by staff (1 to 5 scale)	Did customers feel that the staff were helpful (yes or no)?

Step 3 – set quality standards – the level of quality which defines the boundary between acceptable and unacceptable

- **Step 4 – control quality against those standards**
  - **Where in the operation should it check that it is conforming to standards? -** before a particularly costly process, prior to 'difficult to check', immediately after a process with a high defective rate, before potential damage or distress might be caused, and so on
  - **Check every product and service or take a sample? –** a sample may be more practical because:

    It might be dangerous to inspect everything

    Checking everything might destroy the product or interfere with the service.

    Checking everything can be time consuming and costly.

    100 per cent checking may not guarantee that all defects will be identified. Sometimes it is intrinsically difficult.

➢ **Type I and Type II errors -** using a sample to make a decision about quality does have its own inherent problems

Type I - occur when a decision was made to do something and the situation did not warrant it

Type II - occur when nothing was done, yet a decision to do something should have been taken as the situation did indeed warrant it

Table 17.3 Type I and Type II errors for a pedestrian crossing the road

	Road conditions	
Decision	Unsafe	Safe
Cross	Type I error	Correct decision
Wait	Correct decision	Type II error

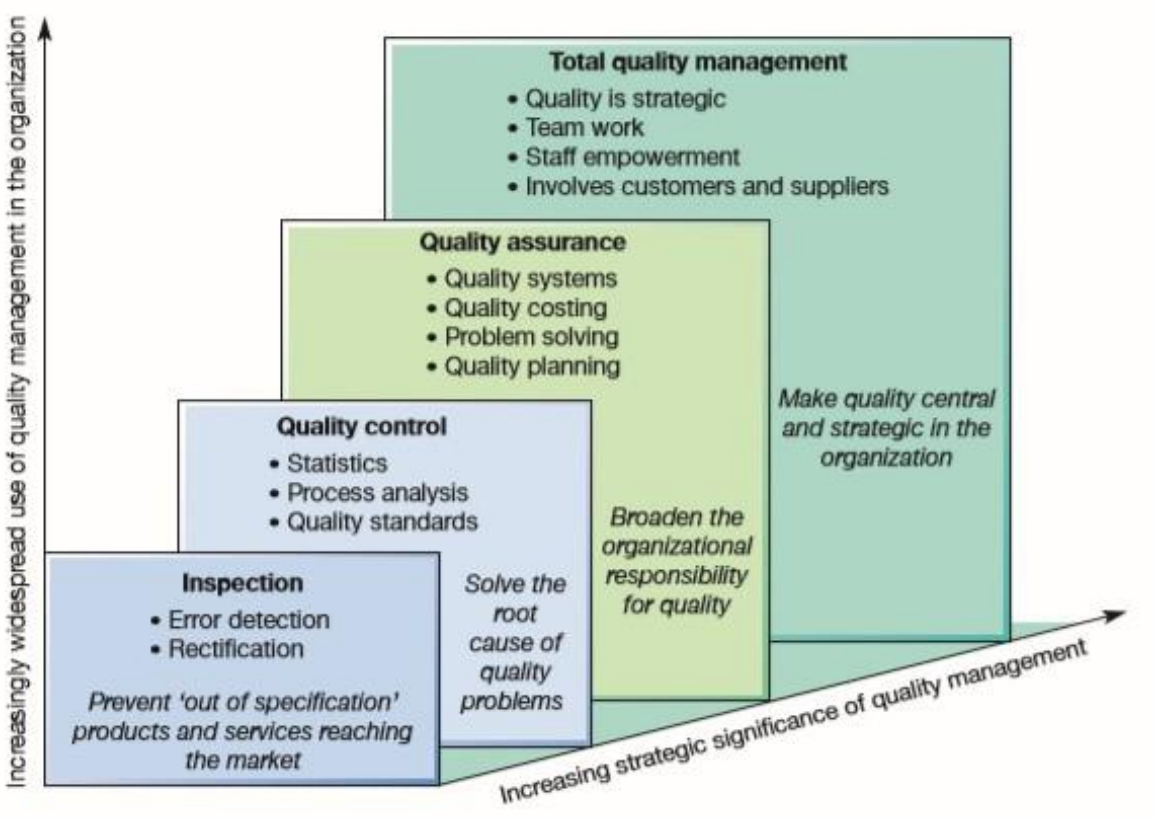
➢ **How should the checks be performed? -** The most common approach for checking the quality of a sample service or product so as to make inferences about all the output from an operation is called statistical process control (SPC)

✓ **SPC –** concerned with sampling the process during the production of the goods or the delivery of service. Based on this sample, decisions are made as to whether the process is 'in control'. A key aspect of SPC is that it looks at the variability in the performance of processes to check whether the process is operating as it should do

- **Step 5 and 6 – find and correct causes of poor quality and continue to make improvements –** there is an aspect of quality management that has been particularly important in shaping how quality is improved and the improvement activity made self-sustaining **– total quality management (TQM)**

3. What is total quality management (TQM)? - was one of the earliest of the current wave of management 'fashions'. Its peak of popularity was in the late 80s and early 90s.

- **TQM as an extension of previous practice**



- **What is TQM? -** an effective system for integrating the quality development, quality maintenance and quality improvement efforts of the various groups in an organization so as to enable production and service

at the most economical levels which allow for full customer satisfaction

- **Meeting the needs and expectations of customers**
- **Covering all parts of the organization**
- **Including every person in the organization**
- **Examining all costs which are related to quality, especially failure costs and getting things 'right first time'**
- **Developing the systems and procedures which support quality and improvement**
- **Developing a continuous process of improvement**

TQM means meeting the needs and expectations of customers – the importance of starting with an insight into customer needs, wants, perceptions and preferences. This can then be translated into quality objectives and used to drive quality improvement.

- **TQM means covering all parts of the organization -** everyone is a customer within the organization and consume goods or services provided by other internal suppliers, and everyone is also an internal supplier of goods and services for other internal customers
  - **Service-level agreements –** formal definitions of the dimensions of service and the relationship between two parts of an organization.

    the types of information network services which may be provided as 'standard'

    the range of special information services which may be available at different periods of the day

    the minimum 'uptime', that is the proportion of time the system will be available at different periods of the day

    the maximum response time and average response time to get the system fully operational should it fails

    the maximum response time to provide 'special' services, and so on

- **TQM means including every person in the organization -** Every person in the organization has the potential to contribute to quality, and TQM was among the first approaches to stress the centrality of harnessing everyone's potential contribution to quality
- **TQM means all costs of quality are considered**
  - **Prevention costs -** costs incurred in trying to prevent problems, failures and errors from occurring in the first place. They include such things as:

    identifying potential problems and putting the process right before poor quality occurs;

    designing and improving the design of products and services and processes to reduce quality problems;

    training and development of personnel in the best way to perform their jobs;

    process control through SPC
  - **Appraisal costs -** costs associated with controlling quality to check to see if problems or errors have occurred during and after the creation of the service or product. They might include such things as:

    the setting up of statistical acceptance sampling plans;

    the time and effort required to inspect inputs, processes and outputs;

    obtaining processing inspection and test data;

investigating quality problems and providing quality reports;
conducting customer surveys and quality audits

- **Internal failure costs** - failure costs associated with errors which are dealt with inside the operation. These costs might include such things as:
  - the cost of scrapped parts and material;
  - reworked parts and materials;
  - the lost production time as a result of coping with errors;
  - lack of concentration due to time spent troubleshooting rather than on improvement
- **External failure costs -** associated with an error going out of the operation to a customer. These costs include such things as:
  - loss of customer goodwill affecting future business;
  - aggrieved customers who may take up time;
  - litigation (or payments to avoid litigation);
  - guarantee and warranty costs;
  - the cost to the company of providing excessive capability (too much coffee in the pack or too much information to a client)

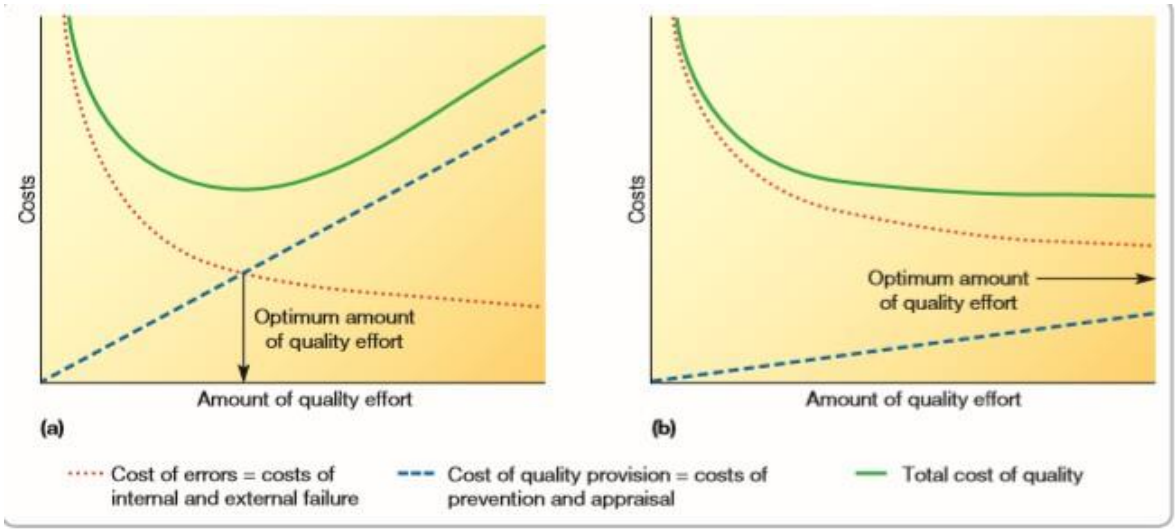


Figure 17.9 (a) The traditional cost of quality model, and (b) the traditional cost of quality model with adjustments to reflect TQM criticisms

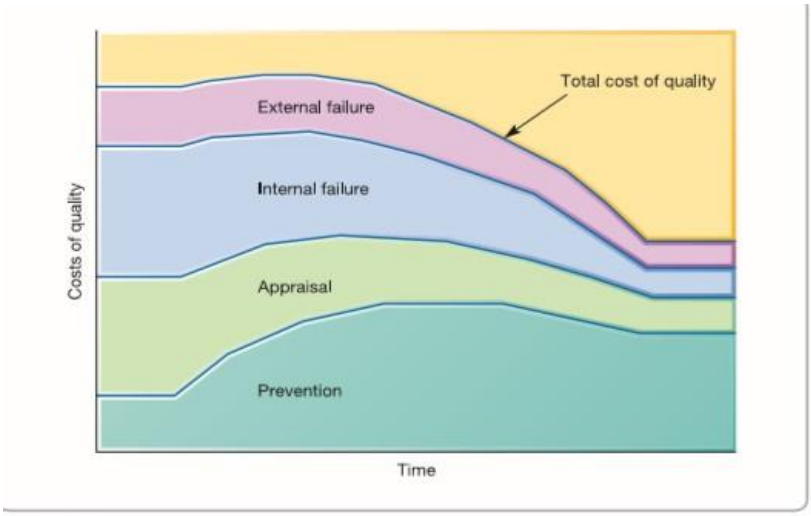


Figure 17.10 Increasing the effort spent on preventing errors occurring in the first place brings more than equivalent reduction in other cost categories

- **TQM means developing the systems and procedures which support quality and improvement**
  - ➢ **The ISO 9000 approach -** a family of standards compiled by the International Organization for Standardization (ISO), which is the world's largest developer and publisher of international standards, based in Geneva, Switzerland. According to the ISO, 'the standards represent an international consensus on good quality management practices. It consists of standards and guidelines relating to quality management systems and related supporting standards.'

    Quality management should be customer focused

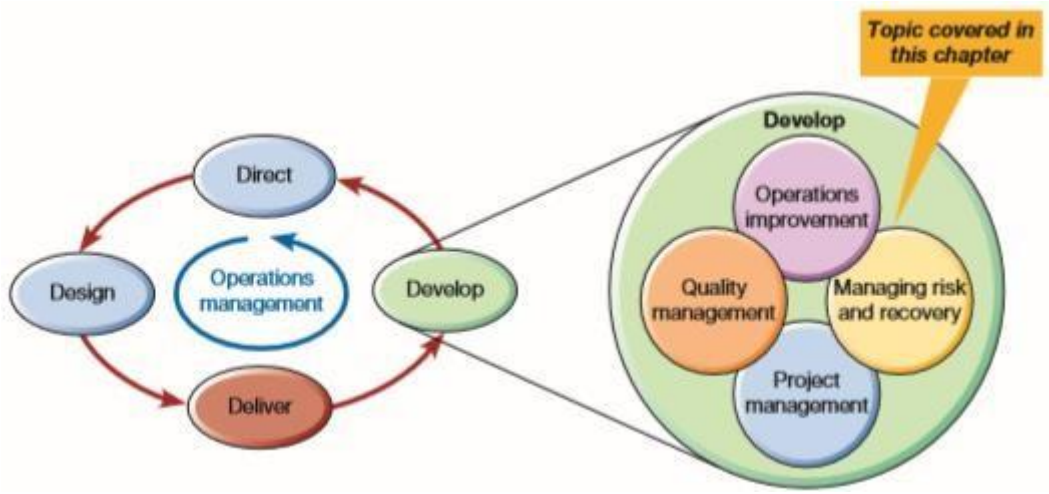
    Quality performance should be measure

    Quality management should be improvement driven

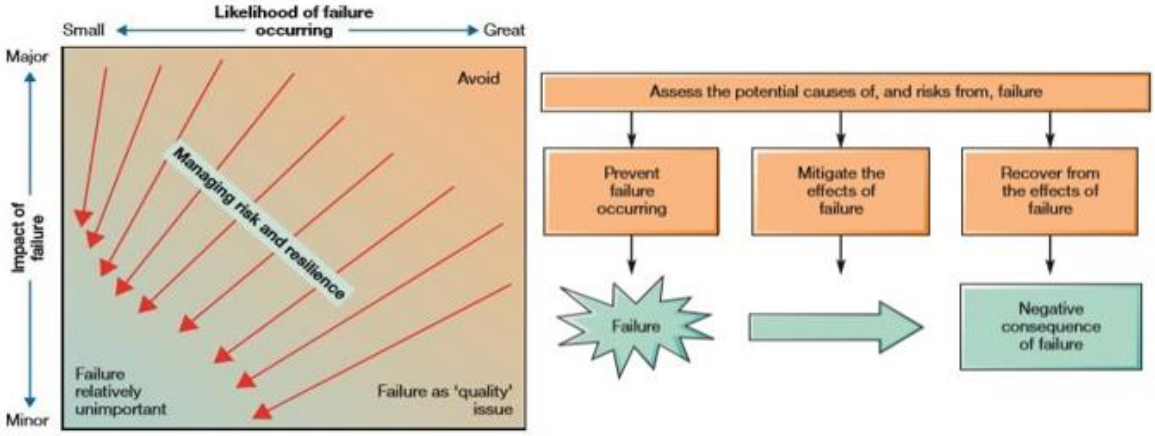
    Top management must demonstrate their commitment to maintaining and continually improving management systems

- **Quality awards**
  - **The Deming Prize**
  - **The Malcolm Baldrige National Quality Award**
  - **The EFQM Excellence Model**
  - **Self-assessment**
  - **Green reporting and ISO 14000**

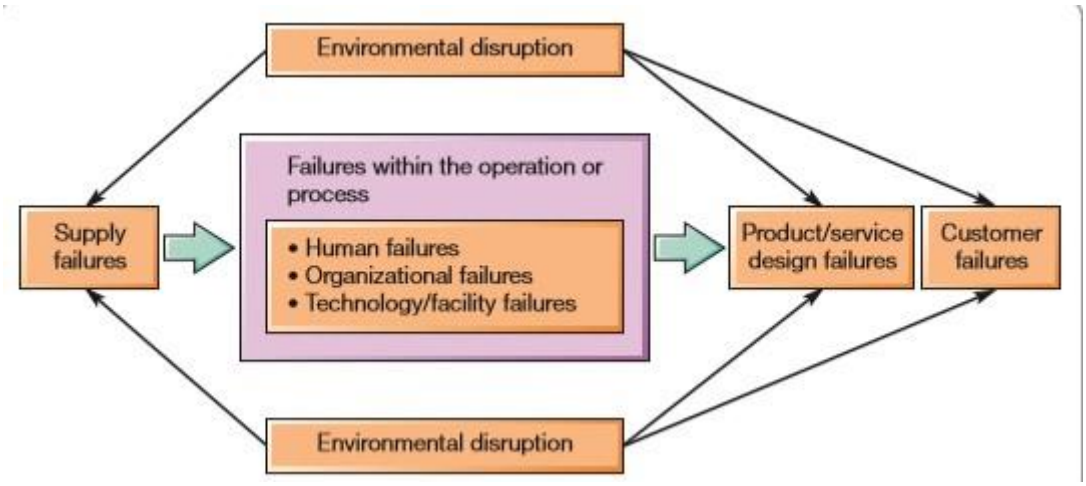
Chapter 18 – Managing risk and recovery



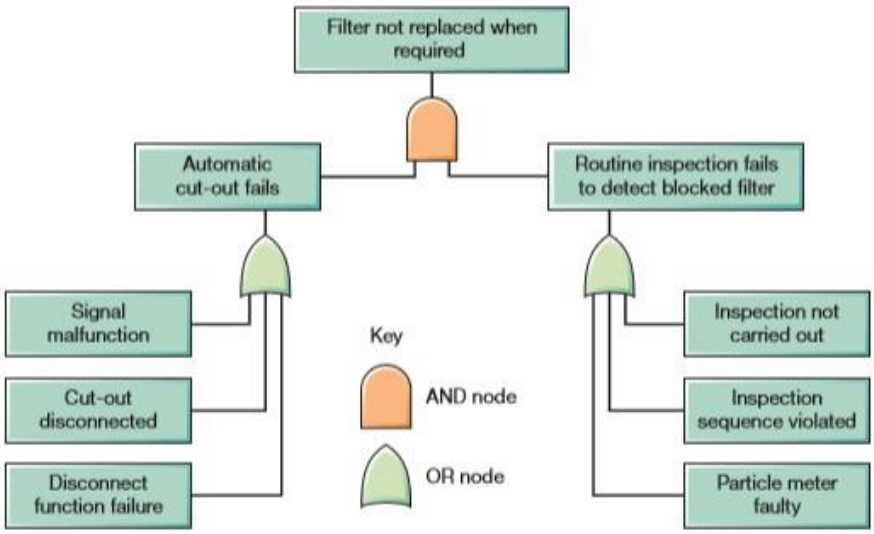
1. **What is risk management?** - identifying things that could go wrong, stopping them going wrong, reducing the consequences when things do go wrong, and recovering after things have gone wrong



2. **How can operations assess the potential causes and consequences of failure**
   - **Identify the potential causes of failure**
     - **Supply failure**
     - **Human failures**
     - **Organizational failure**
     - **Technology/facilities failures**
     - **Product/service design failures**
     - **Customer failures**
     - **Environmental disruption**
     - **E-security**



- **Post-failure analysis**
  - **Accident investigation –** where large-scale national disasters like oil tanker spillages and aircraft accidents are investigated using specifically trained staff. In many senses, the reason so much attention goes into examining these kinds of failures after the event is not only because of the damaging consequences of failure, but also because their infrequency makes it relatively hard to identify new sources of risks in advance of an event.
  - **Failure traceability –** where some adopt traceability procedures to ensure that all their failures are traceable. Any failures can be traced back to the process which produced them, the components from which they were produced, or the suppliers who provided them.
  - **Complaint analysis –** where complaints are used as a valuable source for detecting the root causes of failures of customer service. The prime function of complaint analysis involves analyzing the number and 'content' of complaints over time to understand better the nature of the failure, as the customer perceives it. Two key advantages of complaints are that they come unsolicited and they are often very timely pieces of information that can pinpoint problems quickly. However, managers should be aware that for every customer who does complain, there might be many who do not!
  - **Fault-tree analysis –** where a logical procedure starts with a failure or a potential failure and works backwards to identify all the possible causes and therefore the origins of that failure. Faulttree analysis is made up of branches connected by two types of nodes: AND nodes and OR nodes. The branches below an AND node all need to occur for the event above the node to occur. Only one of the branches below an OR node needs to occur for the event above the node to occur.



- **Likelihood of failure**

- **Failure rates (FR)** – how often a failure occurs

$$FR = \frac{\text{Number of failures}}{\text{Total number of products tested}} \times 100$$

$$FR = \frac{\text{Number of failures}}{\text{Operating time}}$$

A batch of 50 electronic components is tested for 2,000 hours. Four of the components fail during the test as follows:

Failure 1 occurred at 12:00 hours
Failure 2 occurred at 14:50 hours
Failure 3 occurred at 17:20 hours
Failure 4 occurred at 19:05 hours

$$\text{Failure rate as a percentage} = \frac{\text{Number of failures}}{\text{Number tested}} \times 100 = \frac{4}{50} \times 10 = 8\%$$

The total time of the test = 50 × 2,000 = 100,000 component hours

But:

one component was not operating 2,000 − 1,200 = 800 hours
one component was not operating 2,000 − 1,450 = 550 hours
one component was not operating 2,000 − 1,720 = 280 hours
one component was not operating 2,000 − 1,905 = 95 hours

Thus:

$$\text{Total non-operating time} = 1{,}725 \text{ hours}$$

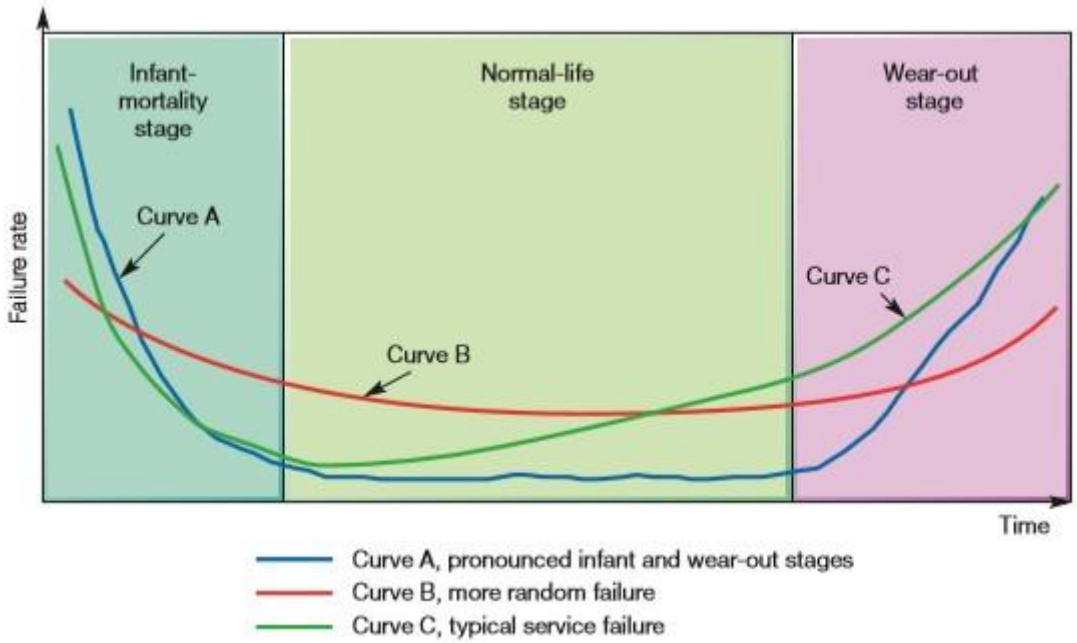
$$\text{Operating time} = \text{Total time} - \text{Non-operating time}$$

$$= 100{,}000 - 1{,}725 = 98{,}275 \text{ hours}$$

$$\text{Failure rate (in time)} = \frac{\text{Number of failures}}{\text{Operating time}} = \frac{4}{98{,}275}$$

$$= 0.000041$$

- **Bath-tub curves**



- **Reliability –** measures the ability to perform as expected over time

An automated pizza-making machine in a food manufacturer's factory has five major components, with individual reliabilities (the probability of the component not failing) as follows:

Dough mixer	Reliability = 0.95
Dough roller and cutter	Reliability = 0.99
Tomato paste applicator	Reliability = 0.97
Cheese applicator	Reliability = 0.90
Oven	Reliability = 0.98

If one of these parts of the production system fails, the whole system will stop working. Thus the reliability of the whole system is:

$$R_s = 0.95 \times 0.99 \times 0.97 \times 0.90 \times 0.98$$
$$= 0.805$$

- **The number of components -** The more interdependent components an operations or process has, the lower its reliability will be
- **Mean time between failures (MTBF) -** the reciprocal of failure rate (in time)

$$\text{MTBF} = \frac{\text{Operating hours}}{\text{Number of failures}}$$

In the previous worked example which was concerned with electronic components, the failure rate (in time) of the electronic components was 0.000041. For that component:

$$\text{MTBF} = \frac{1}{0.000041} = 24{,}390.24 \text{ hours}$$

That is, a failure can be expected once every 24,390.24 hours on average.

- **Availability –** the amount of available useful operating time

$$\text{Availability } (A) = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

Where:

MTBF = the mean time between failures of the operation

MTTR = the mean time to repair, which is the average time taken to repair the operation, from the time it fails to the time it is operational again

laser printer. Currently, the mean time between failures of the printer is 70 hours and its mean time to repair is six hours. Thus:

$$\text{Availability} = \frac{70}{70+6} = 0.92$$

The company has discussed its problem with the supplier of the printer, who has offered two alternative service deals. One option would be to buy some preventive maintenance (see later for a full description of preventive maintenance) which would be carried out each weekend. This would raise the MTBF of the printer to 90 hours. The other option would be to subscribe to a faster repair service which would reduce the MTTR to 4 hours. Both options would cost the same amount. Which would give the company the higher availability?

With MTBF increased to 90 hours:

$$\text{Availability} = \frac{90}{90+6} = 0.938$$

With MTTR reduced to 4 hours:

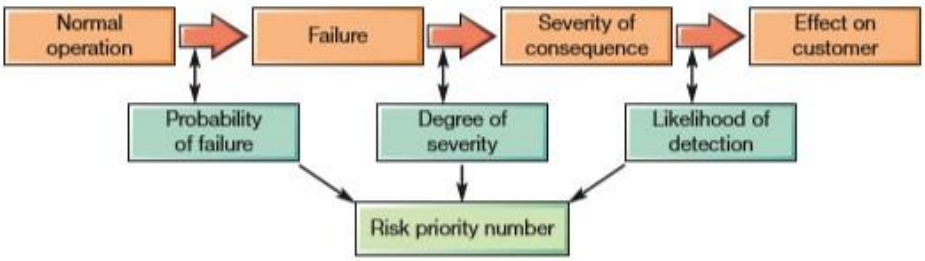
$$\text{Availability} = \frac{70}{70+4} = 0.946$$

Availability would be greater if the company took the deal which offered the faster repair time.

'Subjective' estimates

- **Non-evident failure estimation - n**ot all failures are immediately evident. Small failures may be accumulating for a while before they become evident, making objective and subjective estimation challenging

- **Failure mode and effect analysis (FMEA) –** identifies the factors that are critical to various types of failure as a means of identifying failures before they happen. It does this by providing a 'checklist' procedure built around three key questions for each possible cause of failure:
  - **What is the likelihood that failure will occur?**
  - **What would the consequence of the failure be?**
  - **How likely is such a failure to be detected before it affects the customer?**



Part of an FMEA exercise at a transportation company has identified three failure modes associated with the failure of 'goods arriving damaged' at the point of delivery:

- Goods not secured (failure mode 1)
- Goods incorrectly secured (failure mode 2)
- Goods incorrectly loaded (failure mode 3).

The improvement group which is investigating the failures allocates scores for the probability of the failure mode occurring, the severity of each failure mode, and the likelihood that they will be detected using the rating scales shown in Table 18.1, as follows:

Probability of occurrence

Failure mode 1	5
Failure mode 2	8
Failure mode 3	7

Severity of failure

Failure mode 1	6
Failure mode 2	4
Failure mode 3	4

Probability of detection

Failure mode 1	2
Failure mode 2	6
Failure mode 3	7

The RPN of each failure mode is calculated:

Failure mode 1 (goods not secured)	$5 \times 6 \times 2 = 60$
Failure mode 2 (goods incorrectly secured)	$8 \times 4 \times 5 = 160$
Failure mode 3 (goods incorrectly loaded)	$7 \times 4 \times 7 = 196$

Priority is therefore given to failure mode 3 (goods incorrectly loaded) when attempting to eliminate the failure.

3. How can failures be prevented? - 'Prevention', it is said, is better than 'cure', which is why failure prevention is such an important responsibility for operations managers

- **Redundancy -** having back-up systems or components in case of failure - doubling or even tripling some parts of a process or system. It can be expensive and is generally used when the breakdown could have a critical impact. **Types of redundancy:**
  - **Hot standby –** where both primary and secondary (back-up) systems run simultaneously. The data is copied to the secondary server in real time so that both systems contain identical information.
  - **Warm standby** – where the secondary system runs in the background to the primary system. Data is copied to the secondary server at regular intervals, so there are times when both servers do not contain exactly the same data.
  - **Cold standby –** where the secondary system is only called upon when the primary system fails. The secondary system receives scheduled da ta back-ups, but less frequently than a warm standby, so cold standby is mainly used for non-critical applications.

The effect of redundancy can be calculated by the sum of the reliability of the original process component and the likelihood that the back-up component will both be needed and be working:

$$R_{a+b} = R_a + (R_b \times P(\text{failure}))$$

Where:

R_{a+b} = reliability of component a with its back-up component b
R_a = reliability of a alone
R_b = reliability of back-up component b
$P(\text{failure})$ = the probability that component a will fail and therefore component b will be needed

An e-auction provider has two servers, one of which will come online if the first server fails. If each server has a reliability of 90%, the two working together will have a reliability of:

0.9 + [0.9 x (1-0.9)] = 0.99

- **Fail-safeing - Poka-yokes** are simple (preferably inexpensive) devices or systems that are incorporated into a process to prevent inadvertent mistakes by those providing a service as well as customers receiving a service.
- **Maintenance -** how organizations try to avoid failure by taking care of their physical facilities. The three basic approaches to maintenance:
  - **Run to breakdown maintenance (RTB) –** As its name implies, this involves allowing the facilities to continue operating until they fail. Maintenance work is performed only after failure has taken place. Failure in these circumstances is neither catastrophic nor so frequent as to make regular checking of the facilities appropriate.
  - **Preventive maintenance (PM) –** This attempts to eliminate or reduce the chances of failure by servicing (cleaning, lubricating, replacing and checking) the facilities at preplanned intervals.
  - **Condition-based maintenance (CBM) –** This attempts to perform maintenance only when the facilities require it.
- **Total productive maintenance (TPM) -** 'the productive maintenance carried out by all employees through small-group activities'.

  Goals of TPM:

  1. Improve equipment effectiveness by examining all the losses which occur.
  2. Achieve autonomous maintenance by allowing staff to take responsibility for some of the maintenance tasks and for the improvement of maintenance performance.
  3. Plan maintenance with a fully worked-out approach to all maintenance activities.
  4. Train all staff in relevant maintenance skills so that both maintenance and operating staff have all the skills to carry out their roles.
  5. Achieve early equipment management by 'maintenance prevention' (MP), which involves considering failure causes and the maintainability of equipment during its design, manufacture, installation and commissioning.

4. **How can operations mitigate the effects of failure? -** Even when a failure has occurred, its impact on the customer can, in many cases, be minimized through mitigation actions. Failure (or risk) mitigation means isolating a failure from its negative consequences.
    - **Failure mitigation actions**
        - **Mitigation planning –** the activity of ensuring that all possible failure circumstances have been identified and the appropriate mitigation actions identified. It is the overarching activity that encompasses all subsequent mitigation actions, and may be described in the form of a decision tree or guide rules. It is worth noting that mitigation planning, as well as an overarching action, also provides mitigation action in its own right.
        - **Economic mitigation –** includes actions such as insurance against losses from failure, spreading the financial consequences of failure, and 'hedging' against failure. Insurance is the best known of these actions and is widely adopted, although ensuring appropriate insurance and effective claims management is a specialized skill in itself. Hedging often takes the form of financial instruments, for example a business may purchase a financial 'hedge' against the price risk of a vital raw material deviating significantly from a set price.
        - **Containment (spatial) –** means stopping the failure physically spreading to affect other parts of an internal or external supply network.
        - **Containment (temporal) –** means containing the spread of a failure over time. It particularly applies when information about a failure or potential failure needs to be transmitted without undue delay.
        - **Loss reduction –** covers any action that reduces the catastrophic consequences of failure by removing the resources that are likely to suffer those consequences.
        - **Substitution –** means compensating for failure by providing other resources that can substitute for those rendered less effective by the failure. It is a little like the concept of redundancy that was described earlier, but does not always imply excess resources if a failure has not occurred.
5. **How can operations recover from the effects of failure? -** Failure recovery is the set of actions that are taken to reduce the impact of failure once the customer has experienced its negative effects. Recovery needs to be planned and procedures put in place that can discover when failures have occurred, guide appropriate action to keep everyone informed, capture the lessons learnt from the failure, and plan to absorb lessons into any future recovery. All types of operation can benefit from well-planned recovery.
    - **The complaint value chain -** helps to visualize the potential value of good recovery at different stages

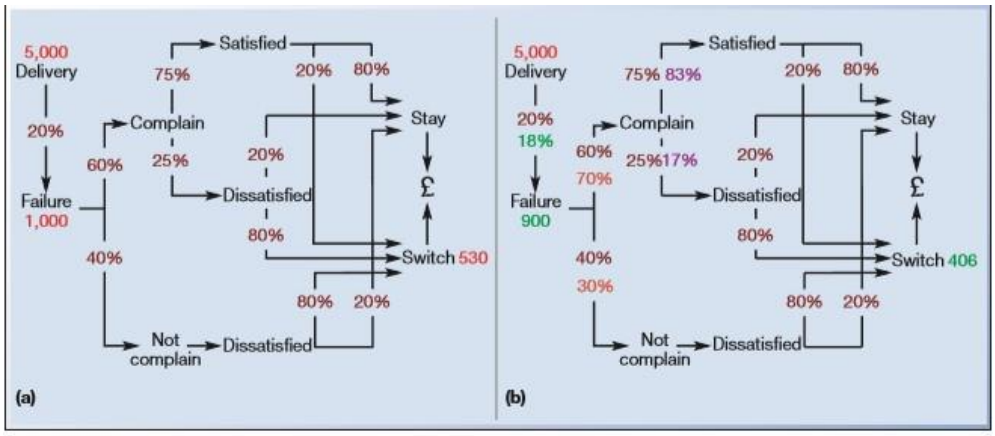
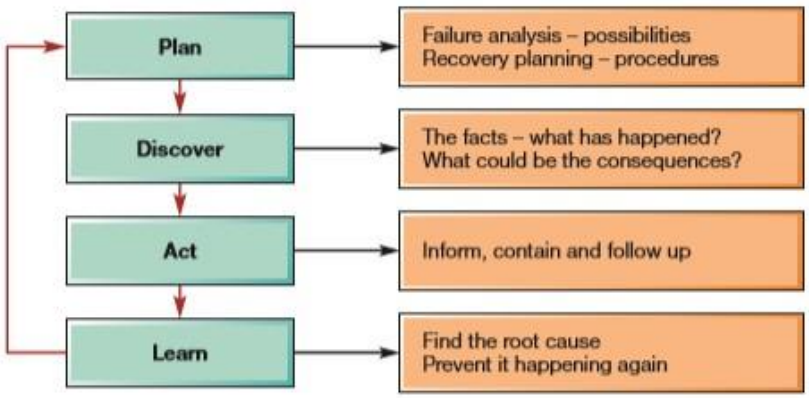


Figure 18.10 Complaint value chain: (a) initial value chain and (b) with small improvements to each step

- **Failure planning**



Summary 3: Quantitative Modelling

Chapter 1 – Management Science

Management science: a scientific approach to solving management problems.

Management science can be used in a variety of organisations to solve many different types of problems.

Management science encompasses a logical approach to problem solving.

The steps of the **scientific method** are:

1. Observation; problems can often be identified by a **management scientist** → a person skilled in the application of management science techniques.
2. Problem definition
3. Model construction
4. Model solution
5. **Implementation;** the actual use of a model once it has been developed.

Model: an abstract mathematical representation of a problem situation.

Variable: a symbol used to represent an item that can take on any value.

Parameters: are known, constant values that are often coefficients of variables in equations → usually remain constant during the process of solving a specific problem.

Data: pieces of information from the problem environment.

A model is a **functional relationship** that includes variables, parameters and equations.

Formula for profit:

- $Z = Px - Cx$

→ Z = profit, P = Price, C = Costs.

Business analytics: uses large amounts of data with management science techniques and modelling to help managers makes decisions.

Break-even analysis: is a modelling technique to determine the number of units to sell or produce that will result in zero profit.

- **Volume:** the level of sales or production by a company.
- **Fixed costs:** are independent of the volume and remain constant.
- **Variable costs:** depend on the number of items produced.

→ Total variable costs: vc_v

→ vc_v = variable costs per unit, v = volume sold

Total cost (TC): equals the fixed costs (c_f) plus the variable costs per unit (vc_v) multiplied by volume (v).

→ $TC = c_f + vc_v$

Profit: the difference between total revenue (volume multiplied by price) and total cost.

→ Total revenue = vp

→ Total profit = total revenue – total cost

$= vp – (c_f + vc_v)$

$= vp – c_f - vc_v$

Break-even point: the volume (v) that equated total revenue with total cost where profit is zero.

Sensitivity analysis: sees how sensitive a management model is to changes.

- In general, an increase in price lowers the break-even point, all other things held constant.
- In general, an increase in variable costs will increase the break-even point, all other things held constant.
- In general, an increase in fixed costs will increase the break-even point, all other things held constant.

Break-even volume formula:

→ $v = c_f / (p – c_v)$

- A **deterministic** techniques assumes certainty in the solution.
- **Probabilistic** techniques assumes uncertainty in the solution.

Decision support system (DSS): a computer-based information system that a manager can use to assist in and support decision making.

Chapter 2 – Linear Programming: Model Formulation and Graphical Solution

Objectives of a business frequently are to maximise profit or minimise cost.

Linear programming: a model that consists of linear relationships representing a firm's decisions, given an objective and resource constraints.

Decision variables: are mathematical symbols that represent levels of activity.

Objective function: a linear relationship that reflects the objective of an operation → always consists of either maximising or minimising some value.

Model constraints: a linear relationship that represents a restriction on decision making.

A linear programming model consists of decision variables, an objective function and constraints.

Nonnegativity constraints: restrict the decisions variables to zero or positive values.

→ $x \geq 0$

Feasible solution: does not violate any of the constraints

→For example: $25 \leq 40$ is correct

Infeasible problem: violates at least one of the constraints

→For example: $50 \leq 40$ is not correct

Graphical solutions are limited to linear programming problems with only two decision variables.

The graphical method provides a picture of how a solution is obtained for a linear programming problem.

Constraint lines are plotted as equations.

The feasible solution area is an are on the graph that is bounded by the constraint equations.

Optimal solution: the best feasible solution.

The optimal solution point is the last point the objective function touches as it leaves the feasible solution area.

Extreme points: corner points on the boundary of the feasible solution area.

Optimal extreme point: the extreme point the objective function touches last as it leaves the feasible solution area.

Constraint equations are solved simultaneously at the optimal extreme point to determine the variable solution values.

Slope: is computed as the 'rise' over the 'run'.

→ $y = a + bx$

Sensitivity analysis: is used to analyse changes in model parameters

Multiple optimal solutions: can occur when the objective function is parallel to a constraint line.

A slack variable is added to a $\leq$ constraint to convert it to an equation (=)

→ $x_1 + x_2 \leq 100$ (for example)

→became: $x_1 + x_2 + s_1 = 100$ (for example)

→ s_1 = slack variable

Slack variable: represents unused resources

→The ultimate instance of unused resources occurs at the origin, where $x_1 = 0$ and $x_2 = 0$

A slack variable contributes nothing to the objective function value.

Slack variables can only have nonnegative values because negative resources are not possible.

→ $x_1, x_2, s_1, s_2 \geq 0$

The three types of linear programming constraints are, $\leq$, $\geq$, =

The optimal solution of a minimisation problem is at the extreme point closest to the origin → the optimal point is always the last point it touches in the feasible solution area.

Surplus variable: represents an excess above a constraint requirement level.

A surplus variable is subtracted from a $\geq$ constraint to convert in to an equation (=).

→ $x_1 + x_2 \geq 100$ (for example)

→became: $x_1 + x_2 - s_1 = 100$ (for example

→ s_1 = surplus variable.

Alternate optimal solutions: are at the endpoints of the constraint line segment that the objective function parallels.

Multiple optimal solutions provide greater flexibility to the decision maker

Infeasible problem: has no feasible solution area; every possible solution point violates one or more constraints

Unbounded problem: the objective function can increase indefinitely without reaching a maximum value.

The components of a linear programming model are:

- An objective function
- Decision variables
- Constraints

Proportionality: means the slope of a constraint or objective function line is constant

- The terms in the objective function or constraints are **additive**.
- The values of decision variables are continuous or **divisible.**
- All model parameters are assumed to be known with **certainty.**

Chapter 3 – Linear Programming: Computer Solution and Sensitivity Analysis

Simplex method: a procedure involving a set of mathematical steps to solve linear programming problems.

Marginal value: the dollar amount one would be willing to pay for one additional resource unit.

Sensitivity analysis: the analysis of the effect of parameter changes on the optimal solution.

Sensitivity range: for an objective coefficient is the range of values over which the current optimal solution point will remain optimal.

Chapter 4 – Linear Programming: Modeling Examples

Summary of Linear Programming Model Formulation Steps:

1. **Define the decision variables**

How many of each type to produce

2. **Define the objective function**

Maximise/minimise profit

3. **Define the constraints**

The resources available, including processing time, budget and shipping capacity

Standard form: requires all variables to be to the left of the inequality and numeric values to the right.

Double-subscripted variable: is simply another form of variable name.

Balanced transportation model: supply equals demand such that all constraints are equalities.

Unbalanced transportation model: supply does not equal demand, and one set of constraints is $\leq$

DEA linear programming model: a linear programming application that compares a number of service units of the same type, such as banks, hospitals, restaurants and schools, based on their inputs and outputs

→ The decision variables are defined as a price per unit of each output and each input. These are not the actual prices that inputs and outputs would be valued at. They are referred to as implicit prices or opportunity costs.

Efficiency: value of the outputs/value of the inputs

→ If the objective function equals 1: efficient

→ If the objective function is less than 1: inefficient

→ It is not possible to be more than 100% efficient: thus, the efficiency of the school must be less than or equal to 1 → value of the outputs/value of the inputs ≤ 1

Chapter 5 – Integer Programming

Three basic types of integer linear programming models:

1. **Total integer model:** all the decision variables are required to have integer solution values.
2. **0-1 integer model:** all the decision variables have integer values of zero or one.
3. **Mixed integer model:** some of the decision variables (but not all) are required to have integer solutions.

$X_1 + X_2 \leq 1$ → Reflects the contingency that either the (for example) swimming pool or the tennis centre can be constructed, but not both.

Integer: it is not possible to invest in a fraction of something or to purchase one part of a thing.

Chapter 8 – Project Management

Project planning:

- **Objectives:** a detailed statement of what is to be accomplished by the project, how it will achieve the company's goals and meet the strategic plan, and an estimate of when it needs to be completed, the cost, and return.
- **Project scope:** a discussion of how to approach the project, the technological and resource feasibility, the major tasks involved, and a preliminary schedule; it includes a justification of the project and what constitutes project success.
- **Contract requirements:** a general structure of managerial, reporting and performance responsibilities, including a detailed list of staff, suppliers, subcontractors, managerial requirements and agreements, reporting requirements and a projected organisational structure.
- **Schedules:** a list of all major events, tasks, and sub schedules, from which a master schedule is developed.
- **Resources:** the overall project budget for all resource requirements and procedures for budgetary control.
- **Personnel:** identification and recruitment of personnel required for the project team, including special skills and training.
- **Control:** procedures for monitoring and evaluating progress and performance, including schedules and cost.
- **Risk and problem analysis:** anticipation assessment of uncertainties, problems and potential difficulties that might increase the risk of project delays and/or failure and threaten project success.

Return on investment (ROI): a measure used to evaluate projects calculated by dividing the dollar gain minus the dollar cost of a project by the cost.

→ ROI = (Gain from project – cost of project) / cost of project → Percentage/ratio

A project team typically consists of a group of individuals selected from other areas in the organisation, or from consultants outside the organisation, because of their special skills, expertise and experience related to the project activities → most important member: project manager.

Scope statement: includes a project justification and the expected results → Statement of Work (SOW) is a similar planning document

Work breakdown structure (WBS): an organisational chart that breaks down the project into modules for planning.

Responsibility assignment matrix: a table or chart that shows who is responsible for project work

Steps of developing a schedule:

1. Define the activities that must be performed to complete the project
2. Sequence the activities in the order in which they must be completed

3. Estimate the time required to complete each activity
4. Develop the schedule based on the sequencing and time estimates of the activities

Gantt chart: a graph or bar chart with a bar for each project activity that shows the passage of time.

Slack: the amount of time an activity can be delayed without delaying the project

Project control: the process of making sure a project progresses toward successful completion.

- **Time management:** the process of making sure a project schedule does not slip and that a project is on time
- **Cost management:** often closely tied to time management, because of the time-cost trade-off occurrences mentioned previously.
- **Performance management:** the process of monitoring a project and developing timed status reports to make sure that goals are being met and the plan is being followed.

Critical Path Method (CPM): used a single activity time estimate, and in the network, activities were nodes.

Project Evaluation and Review Technique (PERT): used multiple activity time estimates, and in the network, activities were lines between nodes.

Advantage of CPM/PERT over the Gantt Chart is the use of a network (instead of a graph) to show the precedence relationships between activities.

Dummy activity: shows a precedence relationship but no passage of time

The critical path: is the longest path through the network; it is the minimum time in which the network can be completed.

ES (earliest start time): the earliest time an activity can start → ES = Maximum

EF (earliest finish time): the earliest start time plus the activity time estimate → EF = ES + t

LS (latest start): the latest time an activity can start without delaying the critical path time → LS = LF – t

LF (latest finish): the latest start time minus the activity time estimate → LF = Minimum

Forward pass: is used to determine earliest times

Backward pass: is used to determine latest times

You can also determine the critical path by seeing for which activities ES = LS or EF = LF → the critical path is the one containing those activities with zero slack

Slack = S = LS – ES

S = LF – EF

Shared slack: total slack available for combination of activities

Beta distribution: a probability distribution whose shape is based on 3 time estimates

Three time estimates for each activity:

- **Most likely (M):** time that would most frequently occur if the activity were repeated many times
- **Optimistic (A):** the shortest possible time within which the activity could be completed if everything went right
- **Pessimistic (B):** the longest possible time the activity would require to be completed, assuming that everything went wrong.

→ Provide an estimate of the mean and variance of a beta distribution

Mean (expected time): $T = (A + 4M + B) / 6 \rightarrow \mu$

Variance: $V = ((B – A) / 6)^2 \rightarrow \sigma^2$

→ The project variance is the sum of the variances of the critical path activities

Z value: $Z = (x - \mu) / \sigma$

Project crashing: shortens the project time by reducing critical activity times at a cost

→ Crash costs per week: total crash cost / total crash time

Chapter 13 – Queuing Analysis

Queuing analysis: the probabilistic analysis of waiting lines

Operating characteristics: average values for characteristics that describe the performance of a waiting line system.

Queue: waiting line

Queue discipline: the order in which waiting customers are served

Calling population: the source of customers; may be infinite or finite

The arrival rate (λ): the frequency at which customers arrive at a waiting line according to a probability distribution

→ The arrival rate λ is most frequently described by a Poisson distribution

Service rate (μ): the average number of customers who can be served during a time period

→ Can often be described by the negative exponential distribution

Customers must be served faster than they arrive, or an infinitely large queue will build up → $\lambda < \mu$

Assumptions of the basic-single-server model (M/M/1 Model):

1. An infinite calling population
2. A first-come, first-served queue discipline
3. Poisson arrival rate
4. Exponential service times

Single-server waiting line system; general service times (M/G/1 Model)

- Constant, rather than exponentially distributed service times, occur with machinery and automated equipment.
- Constant service times are a special case of the single-server model with undefined service times
- In the constant service time model, there is nog variability in service times; $\sigma = 0$

In a **finite queue**, the length of the queue is limited

The basic single server model must be modified to consider the finite queue system. Note: the service rate does not have to exceed the arrival rate ($\mu > \lambda$), in order to obtain steady-state conditions. The resulting operating characteristics, where M is the maximum number in the system, are as follows → check paper

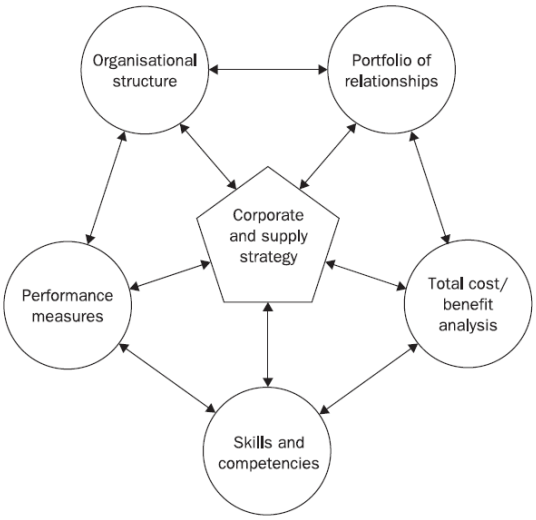
With a **finite calling population,** the customers from which arrivals originate are limited

In **multiple-server models**, two or more independent servers in parallel serve a single waiting line.

- c = number of serves
- $c\mu$ = the mean effective service rate for the system, which must exceed the arrival rate
- $c\mu > \lambda$: the total number of servers must be able to serve customers faster than they arrive

Summary 4: Purchasing and Supply Management

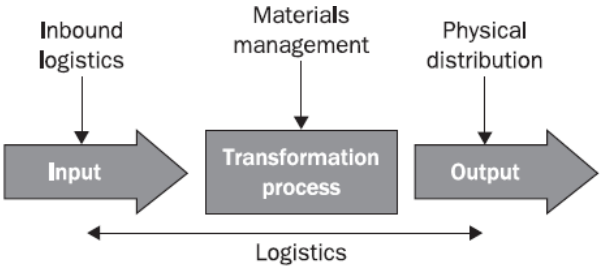
Ch 1



To explain and teach the main principles and concepts of supply management → **Strategic supply wheel**. It illustrates that managers and academics school not consider any one element in isolation. The elements are **interrelated**. The wheel would fall apart without the centre part, which is the development of supply policy and strategy. It concerns the **5 key elements** of supply management: *performance measurement, skills and competences, organisational structure, relationship portfolios, and cost-benefit modelling*. **Supply management** is ensuring that the enterprise is supplied with what it needs so that it can provide what it sells to its market. By the early 80's, western firms focussed on their **Supply structure.** Which are the activities of their suppliers, grouped conceptually into an imaginary 'supply chain' in the search for opportunities to achieve quick savings via price reduction strategies. When we say: "the saving goes straight to the 'bottom line', we can also say: "the saving contributes to the operating profit".

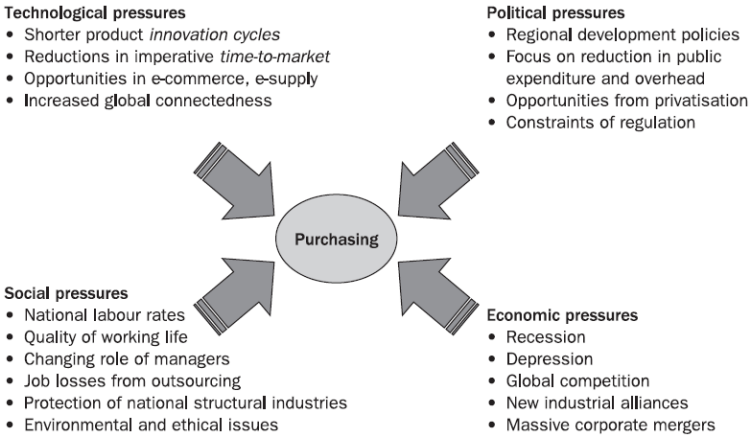
Ch2

Strategy is *an integrated set of choices positioning a firm in an industry to earn superior financial returns over the long run*. Logistics originate from the army. Logistics in the business only began to get attention in the 50's. It expanded the business's scope and became the forerunner to formal purchasing departments. The new specialised logistic functions, challenged the departmental boundaries (=fragmented approach). It led to friction: accounting minimises stock, production maximises stock, marketing wants flexibility. Today **logistics** is *the entire process of material and products moving into, through, and out the firm*. Initially **logistics** was *the management of the firm's inputs as they are acquired or 'enter' the enterprise*. **Inbound logistics** covers the movement of material, components and products received from suppliers. **Materials management** is the movement of components and materials within the factory or firm. **Physical distribution (or outbound logistics)** is the movement of finished goods outward from the end of the assembly line, and through the shipping department to the end customer. Emerging of MRP. Throughout 70s purchasing was seen more administrative than strategic. And played a passive role in its own silo. In the 80s the term supply chain management emerged and purchasing became more recognised (think of Porter). Focus was on efficiency, but became effectiveness. Emerging of ERP and JIT.

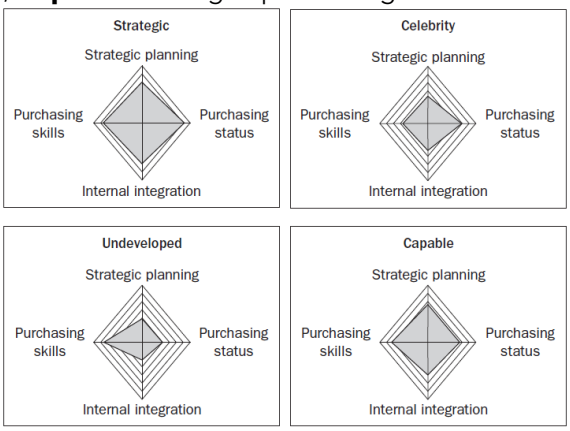


The realisation that the strategic management of supply could save substantial money has led firms to invest in it. Purchasing is differentiated in: **purchasing operations**, which is *day-to-day buying activities* and **purchasing strategy**, which is *the specific actions of the function to achieve its goals.* However, only if the activities and strategies of the purchasing function are aligned with the overall strategies of the firm, *purchasing can be a strategic function*. When a small number of key suppliers who are responsible for large parts of the end-product is identified → those suppliers have been assigned a *supply base* with roles (e.g. mega, first-tier, tier-half). Supply management is not only concerned with the *input* but also with the *transition and management process of goods and services*. It aims for higher competitiveness by tackling purchasing prices and saving costs in process.

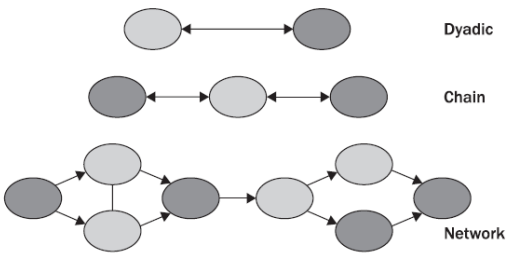
Drivers of purchasing evolution → **PEST: Political, Economic, Social, Technological**.



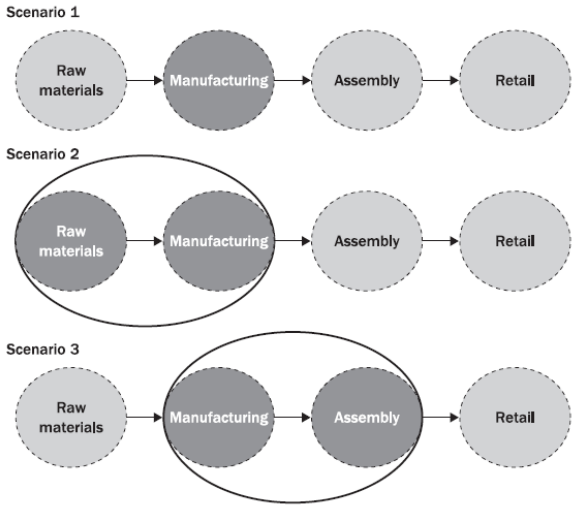
Political has influenced focus and structure of industries and organisations. Industrial economic sectors moved from specification to lowest total cost: *Most Economically Advantageous Tender (MEAT).* Also privatisation is known in Political. Economic has to do with costs an Cost to consumer. Chinese market is cheap which limited other companies to raise their Cost To Consumer. Which can lead to price pressures back to the suppliers or outsourcing etc..
Social has led to Purchasing employment acquiring a higher status. This also includes low-wage production etc.
Technological in terms of websites for customers, programs to display spendings of a firm.
There are three types of 'purchasing strategies': Purchasing function *(contribute to)* ***implementing*** *competitive strategy,* ***supports*** *strategy (by aligning purchasing's functional strategy with firm's overall strategy) and* ***drives*** *the strategy (by providing the firm with a long-term competitive advantage).*
4 stages to help managers assess their current position and identify the type of changes: 1) **passive**: purchasing reacts to requests from other functions 2) **independent**: purchasing adopts latest techniques & practices, but strategic direction is independent, "professional purchasing" 3) **supportive**: support the competitive strategy, "purchasing is essential" 4) **integrative**: purchasing's strategy is fully integrated in firm's competitive strategy, trying to be one step ahead of competitors.
4 Types of purchasers: **Strategic**, **Celebrity**, **Undeveloped**, **Capable.** *Strategic*: purchasing is integrated (Stage4), heavily involved in strategy and are highly regarded by top management. *Celebrity*: high regard but low skill level and involvement in strategy, 'emperor without clothes', focus on (low-level) operational issues. *Undeveloped: (Stage2)* Are the laggards of the purchasing function. High skills, but low status and integration. Doesn't have strategic influence (yet).
Capable: (Stage3) high skill, but moderate status integration and influence on strategy. Steps to become strategic: develop skills, engage with rest of the firm, integrate those two.



← ways of looking at a supply structure



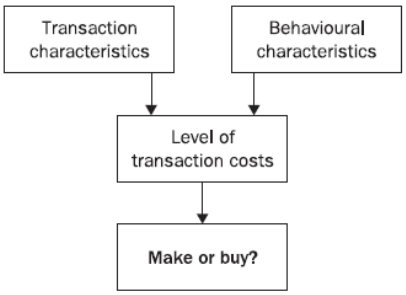
Ch 3



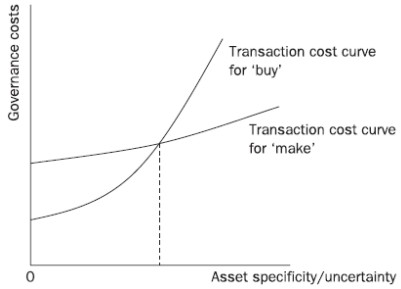
Make vs buy is the decision whether to manufacture of to buy the materials/elements…

The big circles determine the boundaries of a firm in a supply chain. In scenario 1 it is limited to manufacturing.

The theory of **Transaction Cost Economics** has the following assumptions: *bounded rationality, opportunism (those are behavioural assumptions), asset specificity, uncertainty (those are transaction assumptions)*

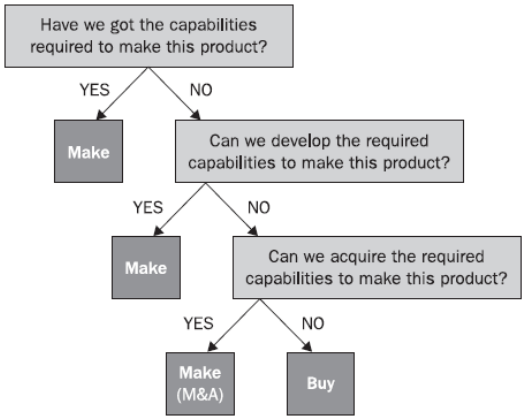


Asset specificity refers to the transferability of an asset within an exchange relationship. Specialised assets are risky because the full value cannot be transferred to a different supplier if the contract is prematurely terminated. There are two types of *uncertainties*: *behavioural* uncertainties and *environmental* uncertainties The basic understanding of TCE is that firms must make investments to transact with each other. These investments are relationship specific, and their value in another relationship is appreciably lower. The 'hold-up problem' is the situation where to parties can work efficiently together but refuse to do so because they don't want to give the other party increased bargaining power and thus reduce their own profits.



← is a transaction costs curve for make-buy. There are critics on TCE. 1) It doesn't address the limitations of firms. TCE assumes that the capabilities required for production pre-exist or can be developed equally in all firms. However, capabilities are not spread evenly across firms. 2) TCE is a theory of cost minimisation, not of value maximisation.

The capability approach is associated with the resource-based view (RBV). RBV assumes resources to be heterogeneous and endowed with different levels of efficiency. *Superior resources* enable firms to produce at lower cost or better satisfy customer demand and are considered primary. 3 criteria for the RBV: *imperfect imitability, imperfect substitutability and imperfect mobility*.



Imitability refers to the extent that firms can duplicate or substitute the resources and capabilities of competing firms. Resources are only imperfectly imitable if firms that do not have them cannot obtain them. Resources can be inimitable because of *unique historical conditions, causal ambiguity (=dubbelzinnigheid) and/or social complexity*. *Temporal opportunities* is when resources are (or were) developed in a way that is no longer available. When the *link between resources* is not fully understood, rival firms can't easily imitate the combination of resources for a competitive advantage. Resources can also be inimitable if they are socially complex.

Non-substitutable is when resources can substitute one another.

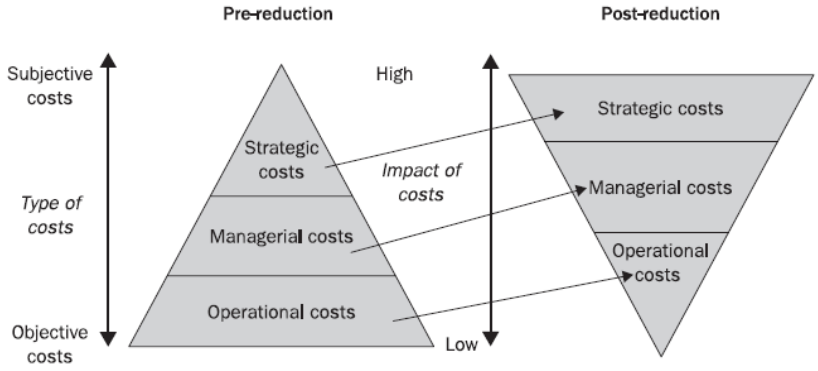
Immobile refers to those commodities that can't be priced or traded on the open market, such as reputation or loyalty. Those cannot be traded (moved) between firms.

← the resource-based view and the make-buy decision
The resource based view is an attempt to advance a reason for the existence and boundaries of the firm independent of the effects of opportunism. The make-buy decision depends on the extent to which the new undertakings are specific to current capabilities, and the costs of developing the necessary capabilities. RBV sees firms as entities that can combine their resources to produce efficiencies unavailable in the market. A firm has 3 choices: 1) try to develop the capabilities internally 2) acquire a firm that already possesses the capabilities 3) buy from external supplier. The choice is based on costs of development and acquiring the capabilities. Reasons why internal development may be costly:
- *Historical context:* Right place-right time syndrome
- *Path dependence*: Capabilities that are developed through a long learning process.
- *Social complexity:* Some capabilities are costly to develop because of social complexity.
- *Causal ambiguity:* Some capabilities are difficult to develop due to unclarity between the capability and the development
Several costs that can inform managers during the decision-making process:
- *Legal constraints:* Some firms are prevented from developing capabilities due to patents
- *Knock-on effects on value:* increase or decrease of firm's value after merge or acquisition (=overname)
- *Technology tie-in:* The capabilities desired at a time become redundant due to technological changes
- *Unwanted 'baggage': Firms may have difficulty in separating the desired capabilities from the company as a whole*

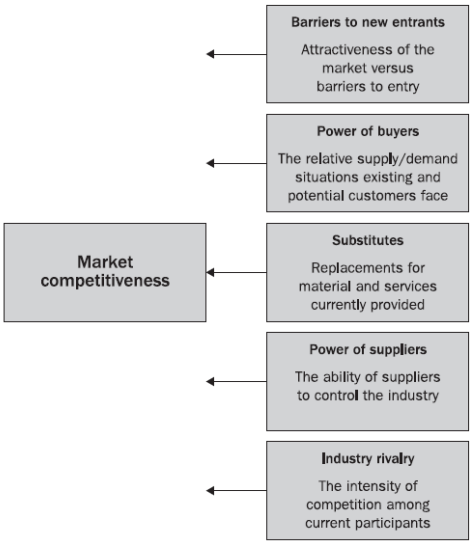
Ch4

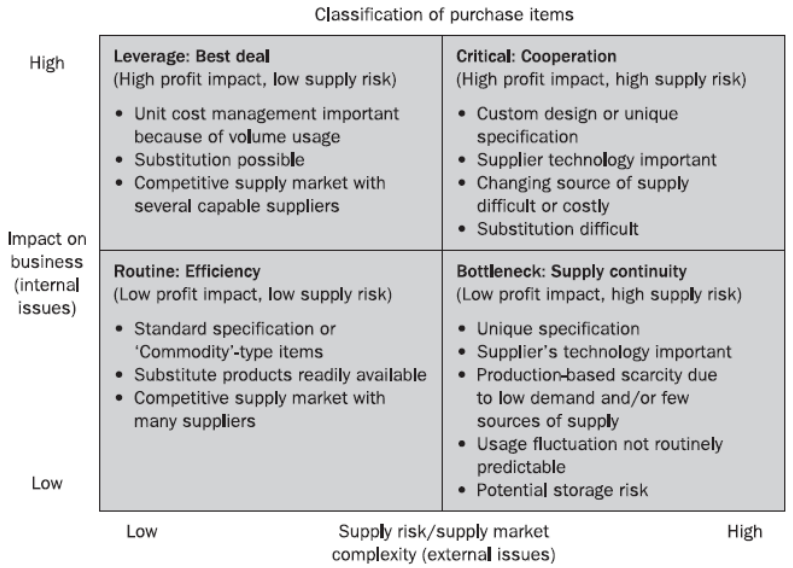
The move towards increased supplier integration in the 90s led to **supply base rationalisation** = working more closely with fewer suppliers. By reducing the number of suppliers, a firm can focus on managing resources. However due to this reduction the nature of the inter-firm relationship changes from relatively independent to dependent (few supply sources). When a firm's methods don't adapt to this → over-reliance on suppliers who can't collaborate more intensively.

We have 3 types of costs:
1) *operational* (day-to-day relationship)
2) *Managerial* (managing relationship)
3) *strategic* (high/low strategic risk)
Subjective = easy to measure, objective = difficult to measure → influence of costs on business →



Issues regarding those pyramids: The more subjective the costs, the more difficult they are to measure and therefore the less likely they are to be considered by the firm. Strategic costs post reduction increase by a large amount as the buyer firm becomes more dependent on a smaller number of suppliers, whereas operational costs decrease. The reduction seems successful short-term because it reduces costs and transaction costs, but in the medium to long-term it changes the nature of the buyer-supplier relationship from independent to dependent.
A **leverage strategy** focuses on reducing suppliers by having a key dominant supplier. **Supplier tiering** is restructuring the supply base into direct and indirect suppliers. So not changing the number of suppliers, but reorganising them in layers.
The **Kraljic product and service positioning matrix** is developed to help buyers formulate appropriate sourcing and competitive strategies. He identifies 4 key approaches.
Horizontal axis: Porter's 5 forces model (below) gives an indication to the factors causing rivalry (supply risk) in an industry.



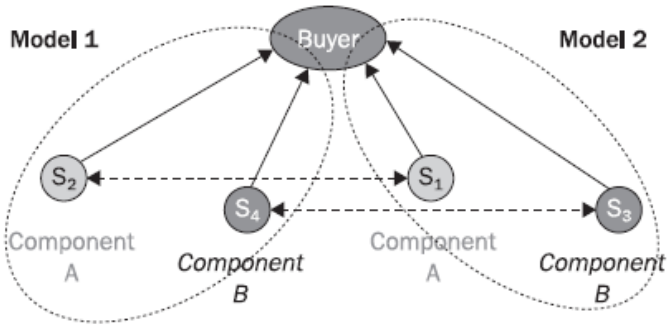


Vertical axis: Categorising products is difficult → ABC or 80/20 analysis by Pareto.
Kraljic stage 1 = vertical, stage 2 = horizontal

The Kraljic model offers buyer firms 4 strategies:
1) *routine* = aimed at a routine items, focus on efficiency; concerns products/services of low value/cost and low supply risk. Objective is to pay the most competitive or low-level temporary labour
2) *bottleneck* = aimed at bottleneck items, those can seriously affect the delivery of the product/service; low value; objective is to maintain supply continuity (e.g. long-term contracts)
3) *leverage* = aimed at leverage items, focus is to obtain the best deal possible, increase bargaining power; occurs when buyer perceives low market exposure yet high costs
4) *critical* = aimed at critical items, goal is cooperation, are the A product in ABC analysis, products of high supply risk and high impact on the business, focus on collaboration and mutual development.
4 sourcing categories: 1) *single sourcing* = one source, advantages: easier to exchange ideas, clear understanding of cost structures, generally long-term focus; disadvantages: buyer becomes too dependent on the supplier, may restrict possibilities to new tech of innovations → buyer's market position is jeopardised.
2) *multiple sourcing* = multiple sources, competition based on purchase price rather than total costs, play suppliers off against each other, would be 'Routine'; prices however can rise due to market collusion
3) *delegated sourcing* = making one supplier responsible for the delivery of an entire sub-assembly as opposed to individual part. Buyer delegates authority to a key supplier → first-tier supplier; goal is to work with one supplier, which works with other suppliers; advantages: reduce day-to-day transaction-costs with first-tier supplier, they exchange more detailed info, more dependent relationship; disadvantages: suppliers can become powerful and increase their prices, would be 'Leverage' but moving to 'Critical' in the medium term due to high dependency and switching

costs.

4) *parallel sourcing* = allows the buying firm to work on a single or sole-sourced basis with each component supplier within a product group while maintaining a multiple-sourced relationship → maintain price competition, reduce complacency and protect against capacity constraint issues while working closely with suppliers. Suppose a buyer makes two products, with two (same) components. Each supplier supplies into a separate product group (sole sourced), the buyer has alternative sources of supply if necessary (multiple sourced). This strategy makes comparisons easier.



Ch5

Main stages of supplier selection: 1) **initial supplier qualification** 2) **agree measurement criteria** 3) **obtain relevant information** 4) **make selection**

Stage 1: Goal is to identify suppliers who meet the requisite product and process standards and are capable of supporting the buyer's long-term objectives. Qualification helps to reduce the pool of potential suppliers to a more manageable number for detailed evaluation and selection. It is concerned with sorting rather than ranking. Information for qualification is usually obtained with surveys or requests for information.

Three types of requests for information:

1) Request For Quotation (RFQ) = a document issued when an organisation wishes to procure an item/product/service and makes the specifications available for competitive bids. Those bids aren't offers, more a request for price and availability. Is used when monetary value of the item is high and the firm has no existing supplier.

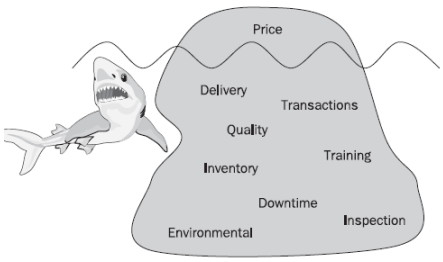
2) Request For Proposal (RFP) = a document issued when an organisation wishes to procure an item/product/service, but requires complete or partial design input from the supplier. Doesn't lead to an offer, but is a request of design, price and availability. Is used when the contract requires negotiation rather than competitive bidding.

3) Request For Information (RFI) is a document issued when an organisation wishes to collect more information regarding a product or supplier. Can include supplier's capacity or capability. RFI may lead to RFP or RFQ. Is used when the buyer has insufficient knowledge relating to a market or product to issue an RFP or RFQ.

Buyer firms usually wish to assess two categories: 1) **manufacturing capabilities** = Stocks of strategic assets that are accumulated through a pattern of investments over time and cannot be easily imitated, acquired by trade or substituted. 2) **financial viability** = Assess the long-term financial health of the suppliers. This is important for strategic items where the development of long-term relationships and investment in relationship-specific assets can make switching suppliers problematic.

Table 5.2 Criteria for supplier selection

Cost	*Quality*	*Delivery*	*Flexibility*	*Others*
Unit price	Quality system certification	On-time performance	Supplier flexibility	Financial risk analysis
Pricing terms	Quality circles	Lead-time		Ethical analysis
Exchange rates, taxes and duties	Continuous improvement	Delivery frequency		Environmental analysis
	ISO 9000 series	Minimum lot size		E-commerce capability
		Inbound delivery cost		Reputation
		Location		Diversity of ownership
				Innovation capability



Stage 2: Identifying relevant and appropriate selection criteria. There is need for criteria that are specific to the particular product purchases and that do not create unnecessary effort within a resource-constrained organisation. ←Iceberg model: price is immediately visible.

Those criteria are grouped in 5 competitive priorities. **1) Cost criteria:** unit price, are easy to compare because the data is objective and comparable. *Quantity discounts* can be important when timing the purchase. *Payment terms* refer to the length of time before payment is due. Longer payment terms have a positive effect on working capital and therefore are an important factor when comparing suppliers. Exchange rates will vary according to the location of each supplier. Supply strategists may consider the volatility of currencies as part of the supplier selection decision.
2) Quality criteria: Measuring supplier quantity *ex ante* (beforehand) presents an interesting management conundrum: how do you measure quality before delivery? For this there are criteria: for quality standards → **quality system certification** such as ISO 9000 certification. To measure attitude of management and workers → **quality circles** and **continuous improvement** techniques are used.
3) Delivery criteria: JIT-production; on-time delivery considers the variability of a supplier's delivery compared to the time agreed by the buyer. In this day and age, buyer firms seek to balance production in low-wage economies with the need to be flexible and responsive to their customers. The *location of the supplier, lead-time* and *inbound delivery costs* must be considered against any savings a low cost manufacturer may offer.
4) Flexible criteria: is the ability of the supplier to manage variation from the buyer firm without significant trade-offs with other competitive priorities. Two types: *volume* and *mix flexibility*. Latter is the ability of the supplier to change the mix or ordered products without significant penalties. Is especially important within agile or mass customisation environments.
5) Other criteria: *environmental measures*; *diversity of ownership* (minority groups);

innovation capabilities

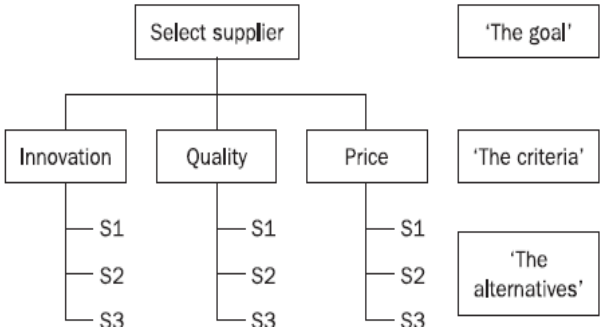
Table 5.3 Selection criteria for functional versus innovative products

Functional	*Innovative*
Cost	Flexibility
Delivery	Innovation capability
On time	Delivery
Cost	Location
Minimum lot size	Lead-time
Quality	
Environmental	
Diversity of ownership	

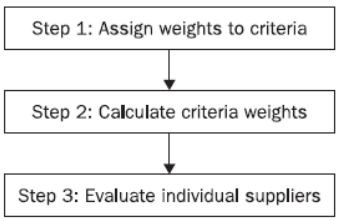
Functional products have a relatively stable, predictable demand with long life cycles. Require efficient suppliers that are concerned with cost and reliable delivery. Innovative products are characterised by lumpy, unpredictable demand with shorter life cycle. Require suppliers responsive to changes. So flexible, innovative and changes in delivery speed.

Stage 3: obtaining up-to-date and accurate information to compare suppliers across criteria. Sources of obtaining information: *information from suppliers* = RFP and/or RFQ; *supplier visits* = A team of the buyer visits the supplier(s), this is often referred to as 'socialisation'; *supplier performance measures* = suppliers can be evaluated against current performance

Stage 4: Models to make a final selection between suppliers should reflect the *impact on the business:* low value products → RFQ/RFP are sufficient, high value products → more complex selection involving multi-criteria decision-making models;
and should reflect *the market complexity:* products with few alternative sources of supply → comprehensive selection because of low substitution,
products with many alternative sources of supply → less comprehensive selection
This is applicable to the organisation's strategic items. → **multicriteria decision-making** (MCDM). The analytic hierarchy process technique → allows decision makers to weight criteria according to their importance. AHP is designed to handle tangible and intangible criteria.



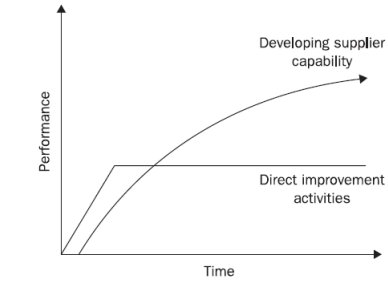
Process of **AHP** →
AHP is the process of thinking and choosing the criteria that is most interesting and not the mathematical mechanism

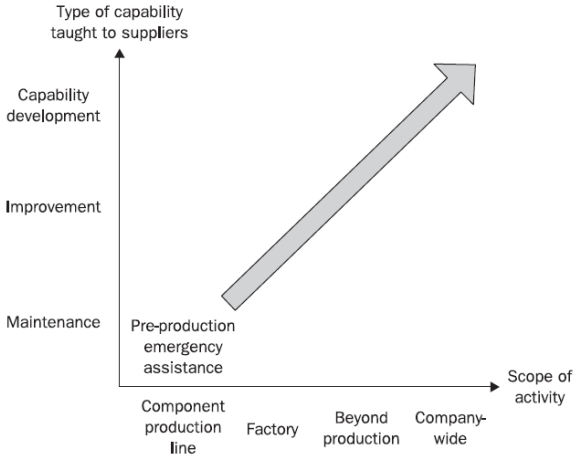


Steps in assigning weights: 1) develop pairs for the selected criteria 2) make a matrix
Calculate criteria weights by dividing each of the values in the matrix by their column total and then computing the row averages.
The next step is to compare each supplier against these criteria. Now with a separate matrix for each criteria. And lastly calculate the supplier weights by multiplying each criteria weight by the suppliers weight for that criterion, and end with a row total.
This system helps to provide a step-by-step approach where large quantities of seemingly conflicting data can be handled in manageable chunks.

Ch6

Supplier development = any effort of a buying firm with a supplier to increase its performance and/or capabilities and meet the buying firm's short and/or long-term supply needs. Range from **limited** to **extensive efforts**. Limited include informal supplier evaluation and performance improvement requests, extensive includes training for supplier's personnel and investment in the supplier's operation. **Advantage** of supplier development = buyer pressure can act as a catalyst for process change within suppliers.
Objectives of supp. devel.:
1) improving supplier's *operational performance* = short-term, working side-to-side, focus on bringing supplier performance up to the buyer firm's requirements, but limited input of the supplier and no full understanding of the underlying problem
2) Improving supplier's *capability to improve* = it is the buyer's attempt to transfer its in-house capabilities across into the supplier, this objective helps build commitment to change, reduces resistance and facilitates the transfer of knowledge from buyer – supplier, focus on managing the transition out of the supplier's organisation, but it requires large commitment of time and resources from the buyer and it is a slower process than objective 1, which might lead to frustration from the supplier. We can make a typology →



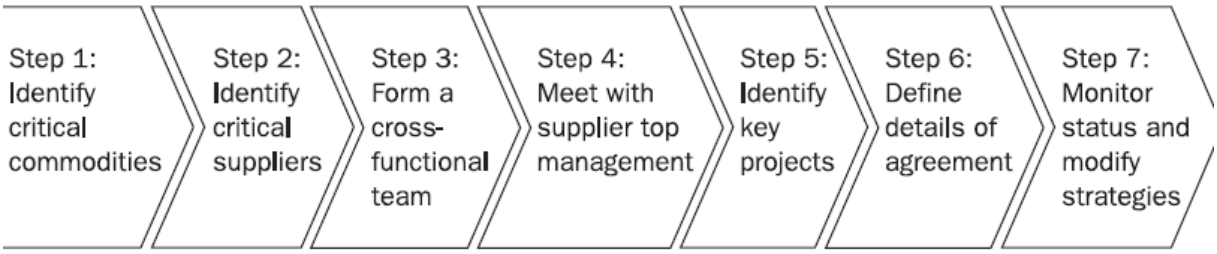


Supplier development strategies:
1) *competitive pressure* = a buyer firm applies competitive pressure on its suppliers, assuring the best-performing supplier is rewarded with the higher volumes, the remaining suppliers are motivated to improve, and the primary supplier is motivated to maintain.
2) *evaluation and certification systems* = a buyer firm assesses suppliers' quality, delivery, cost, technical an managerial capabilities, gives feedback to make suppliers aware of their performance and directions for improvement.
3) *incentives* = buyer firm provides range of incentives (prikkel) for supplier improvement.
4) *direct involvement* = through: • capital and equipment investments • partial acquisition of the supplier firm • investment of human and organisational resources
Strategy 4 is suggested to be the most effective one.

Activities which are used in supplier development: • buying from alternative suppliers to generate competition for current suppliers • evaluation of supplier performance • raising performance expectations • recognition and awards for outstanding suppliers • promises of increased present

an future business if supplier performance improves • training and education of supplier's personnel • site visits by buyer (customer) • integrated teams to reduce supplier waste and help solve problems • integrated tech roadmaps • provide access to CAD/CAM software • financial assistance

The supplier development **process:**



Step 1: Kraljic is useful here
Step 2: Not all supplier relationships require to engage in development activities. Make a selection on the following factors: amount of expenditure • suppliers of strategically important components • likely length of relationship, improving weakest supplier • the type of manufacturing or administrative processes used by suppliers
Step 3: Create an internal team with employees from all relevant areas → a consistent united front
Step 4: Is critical but difficult, an effective way of doing so is showing how supplier development would lead to greater profits/better quality. Here you set communication standards.
Step 5: Take a step back and assess the highest-priority improvements with the greatest impact on operational performance rather than assessing the 'hottest' items.
Step 6: Share the metrics so that both parties can use the same criteria to determine success/failure
Step 7: Measure and oversee progress and implementation.

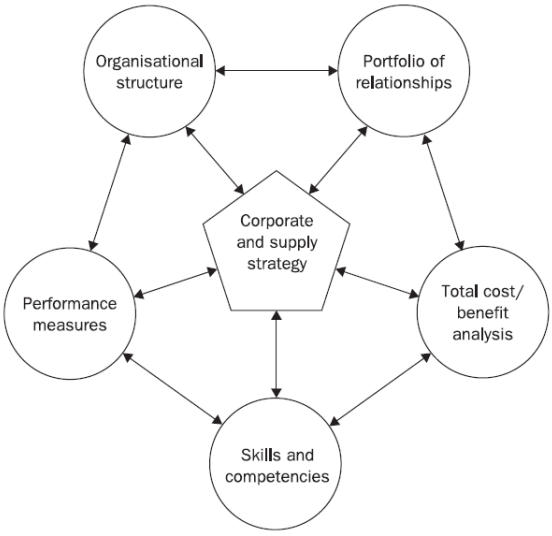
Barriers to supplier development:

Area	*Main issues*
Buyer-specific	■ Lack of buyer top management commitment ■ Too small purchases by the buyer firm spread across too many suppliers ■ Supplier not important enough to buyer ■ Overly ambitious expectations that go unrealised
Supplier-specific	■ Lack of supplier commitment ■ Lack of buying firm power creates supplier reluctance to participate ■ Insufficient supplier human resources ■ Insufficient supplier technical capabilities
Buyer–supplier interface	■ Lack of mutual trust ■ Ineffective communication of potential benefits ■ Insufficient inducements to the supplier ■ Supplier is reluctant to share cost/process information ■ Poor cultural alignment

Ch7

Approaches to strategy: **Process based approach** is linked to specific organisational processes that need to be in place in order to facilitate strategy implementation. Includes the development of appropriate skills and competencies and information systems. **Procedure based approach** concerns the organisational procedures that are needed to facilitate implementation of a strategy through the organisational systems. Includes use of performance measures and total cost-benefit analysis. **Policy based approaches** formulate the strategy itself.
The **supply wheel** shows the interrelationship between each of the strategic elements of the organisation. If you want to change one element, you have to change others because they are linked. The reason behind the supply wheel is making appropriate choices while the wheel stays in balance. It can be used to analyse the firm's strategic capabilities. It shows where the organisation is

(strategic analysis), where it wants to be (strategic choice), and put it into place (strategic implementation).

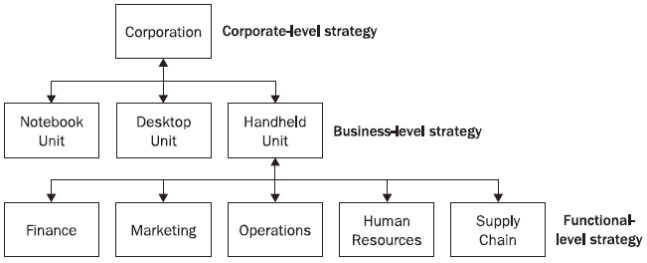


Corporate and supply strategy: It is essential that the policy of the firm is communicated through the supply process.
Skills and competencies & Organisational structure can be skipped for the exam

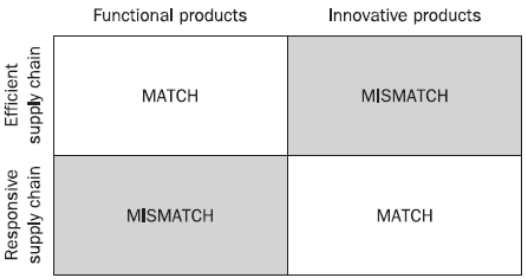
Strategic performance measures: are essential for the delivery of the strategy, align internal and external elements. Performance measures act as a signal and motivator.
Cost benefit analysis: Companies need to understand the costs of doing business. The benefits and costs must align with the central strategy within the model and produce a business case for following any of the various relationship approaches.
Portfolio of relationships: considers the types of relationship that the organisation operates. Relationships range from adversarial (transaction based) towards highly collaborative (strategically based).

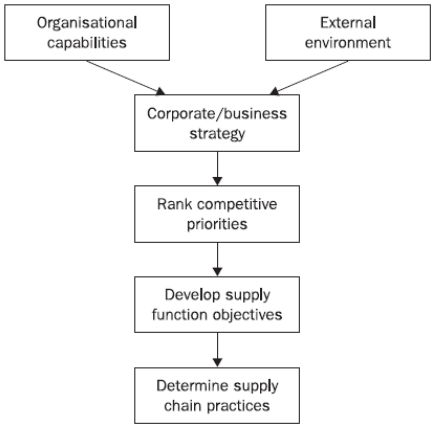
Ch8 corporate and supply strategy

Three important point when defining strategy:
1) *Strategy affects the scale and scope of an organisation's activities over the long term.*
2) *Strategy is about being responsive to changes in the external environment* = outside-in
3) *Strategy is about aligning activities with strategic resources and capabilities.* = inside-out
Three levels of strategy: **corporate** *what business are we in?;* **business** *how do we compete in our market?;* **functional** *how can our function support business and corporate-level strategies?* **Strategic alignment:** *Does our functional strategy support our business and/ or corporate strategy?* Has more to do with information sharing rather than it being capital intensive.



Supply chain strategy should support and facilitate corporate strategy. So supply chain and corporate strategy are **aligned.** This is especially important concerning the products. An organisation's **competitive priorities**: cost, quality, flexibility, delivery, innovation.





Usually two or three have the main focus, also because they are trade-offs.

The **content of strategy** examines the specifics of what was decided, whereas the **process of strategy** considers how such decisions are made within organisations.
← **Process of strategy**

Competitive priorities are generally developed by the operations/manufacturing function together with corporate planners.

Priority	*Description*	*Typical measurement criteria*
Cost	Supply, production and distribution of products at low cost	Total cost, pricing terms, exchange rates
Quality	Supply, production and distribution of products with high quality and performance standards	Product durability, performance reliability and conformance quality
Delivery	Supply and distribution of products on time and/or at short lead-time	Delivery speed, delivery reliability
Flexibility	Supply, production and distribution of different mixes and volumes of product with little or no impact on cost	Volume flexibility, mix flexibility
Innovation	Supply, production and distribution of new products	Supplier technological capability, speed of NPD

← Competitive priorities for supply
To make these applicable for Supply → **SMART analysis**:
Specific: explicit what to achieve
Measurable: Quantifiable
Achievable: Context specific & realistic
Relevant: Relevant to specific function
Time bound: Time-frame
Relevance of an objective is based on its weight. Last step is to move from objectives to specific practices. It is critical that strategy, not the best practice drives the implementation of supply chain practices.

Ch11

This chapter focusses on the performance measures of the supply wheel. The objective of a supply chain management **performance measurement system** is to aid in strategy implementation through a formal, systematic approach to monitoring and evaluating purchasing activities. The types of measures used hasn't drastically changed over time. Therefore they have become less useful. Performance measurement systems can be used to signal and influence people with tasks responsibility. But they should suit the needs and not be used in a sub-optimal way. These systems should spread the corporate strategy and its goals and expectations over different levels in the organisation to assure alignment between corporate and supply strategy. **Hierarchy** of performance measures →

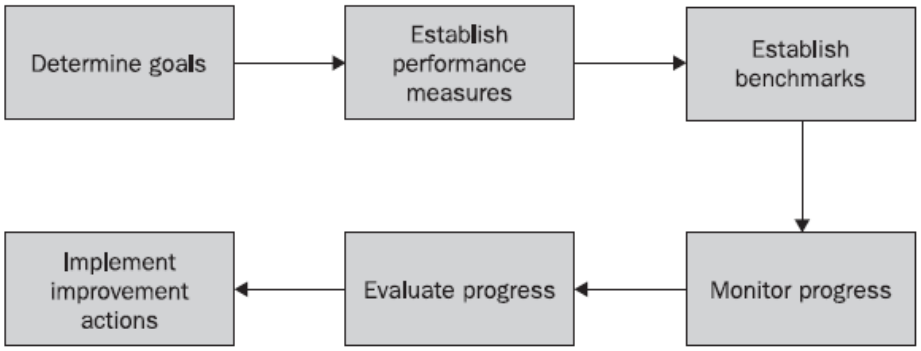
Benefits of measurement:
- *Improved decision making with easier planning, control and coordination*
- *Improved communication by being aware of Purchasing's contribution*
- *Improved visibility of activities*
- *Improved motivation and contribution when targets are related to success, employees see the value that they can add*

Problems with measurement:
- *Conflicting messages with unclarity of what is expected from the receiver or when the messages aren't directly related to the organisation's purpose → problems*
- *When measurement tools are designed for operational requirements instead of measurement*
- *It is useless when measures don't indicate progress → lack of goal congruence*

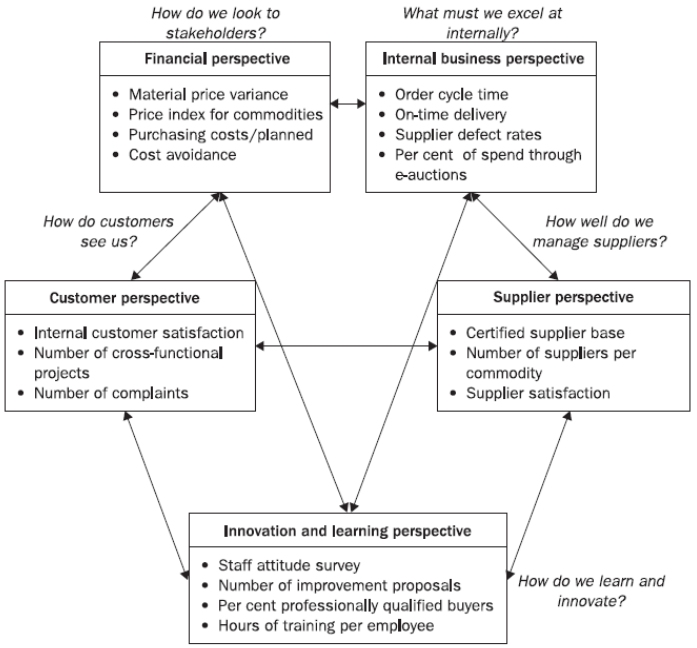
There are two dimensions to performance: **efficiency** and **effectiveness**. Efficiency is the relationship between the planned and actual sacrifices which are made to achieve agreed goals. Effectiveness is the extent to which a goal can be met, using a chosen course of action. **Price performance** is an element of purchasing efficiency, but can be very misleading because the real price might be vague due to discounts etc. and prices in different periods can't easily be compared. It is also difficult to say who is responsible for a drop in market price. Focussing too much on price performance/purchasing efficiency can be **counterproductive** and other important factors when determining the price can be overlooked. To assess performance, it is important to fully **identify the stakeholders** and **internal customers**. Performance measurement should also include the input of the different teams for their goals (bottom-up). This gives greater credibility. People **'closest to the action'**, those who do the jobs routinely know best what measure is relevant and effective. Objectives owned by those responsible for them are far more powerful motivators of performance.
A performance measurement is most effective when it assesses performance through the entire length of the supply chain (suppliers → customers)
Categories of performance measurement:
- *Cost:* Evaluates the efficiency and effectiveness of the purchasing spend. Specific performance

measurements: *total distribution cost; total inventory cost*.
• *Quality:* Is measured across three levels: 1) being manufacturing-related 2) being supplier related 3) being customer related. Specific performance measurements: *production quality, defects per supplier, customer returns*.
• *Time:* In time delivery of orders. Time is assessed on responsiveness to customer and the reliability of the delivery process. Specific measurements: *on-time deliveries, customer response time, backorder/stockout* (product availability)
• *Supplier performance:* The level and degree of information sharing, the number of buyer-vendor (=buyer-supplier) cost-saving initiatives, the extent of mutual assistance in problem-solving efforts. Also the degree of collaboration is measured.
• *Customer satisfaction:* Measuring the satisfaction of internal customers as well as external customers.

Stages in developing a purchasing performance measurement system:
1) *Determine goals to measure:* In other words, the critical areas. These goals should reflect the corporate- and business level strategy of the firm.
2) *Establish performance measures:* use SMART e.g. These should be not too few and not too many, focus on the long-term, therefore have power to influence behaviour.



3) *Establish standards for comparison:* Have something to compare results with. Three approaches: 1. Analysis of historical data (experience) 2. Planned performance (maintain a company-wide best perspective) 3. Competitive benchmarking (analyse competitors)
4) *Monitor progress*: Who are the users? What information is required? How frequent? How will date be collected?
5) *Evaluate progress*: Capture performance, and identify exceptions to what is planned.
6) *Implement improvement actions*: Correct the problems that are ought to be solved.
7) *The Purchasing Balanced Scorecard:* Perspectives: financial, customer, internal business processes, innovation and learning. A 5th perspective may be added: measuring supplier performance. →

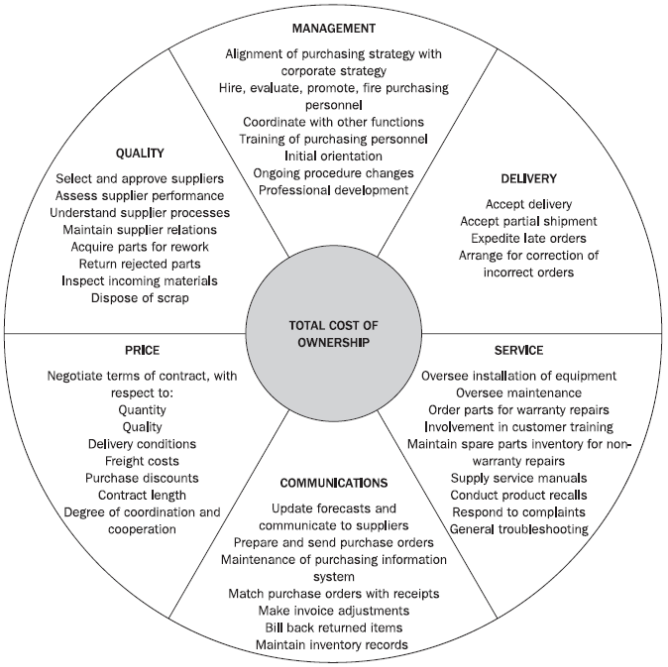


Ch12

This chapter focuses on total cost/benefit analysis of the supply wheel. A customer usually attributes a failure of a product to the manufacturer and not to the supplier. One dissatisfied customer statistically will tell ten other about the dissatisfaction. In order for the Balanced Scorecard to work, supply management needs to be seen as being strategic i.o. tactical. So to be seen as contributing.
A **price-focused approach** means that the customer wants to pay less than last time you bought the same product. Fixed costs are fixed. his leaves variable and profit to debate. But a reasonable amount of variable costs are in agreeance with supplier. This leaves profit. So profit margin is the only alternative. This can have

severe consequences on the med-term. A supplier's firm can *stay in the marketplace, leave the marketplace, go out of business*. A **business cycle effect** usually flow out of a price-focused approach by a customer. This is 'starting with many suppliers and a few buyers. Buyers have power to lower prices, suppliers reduce profit. Some suppliers leave to a more lucrative market. The market has changed to few suppliers and many buyers. Suppliers are now in a dominant position and push up the prices and with that profit.'

Total cost of ownership (TCO) considers all the costs involved in the company's supply chain. Six **categories of TCO**: *management, delivery, service, communications, price, quality*. Five **stages of procurement value chain**: *initial acquisition* (prior buying the product) , *reception* (process costs), *possession* (occur between receiving and utilisation), *utilisation* (costs of use), *elimination* (reuse costs). Three **main levels** of costs: *supplier level* (when a supplier is used), *order level* (when an order is placed) , *unit level* (utilisation and elimination phase)



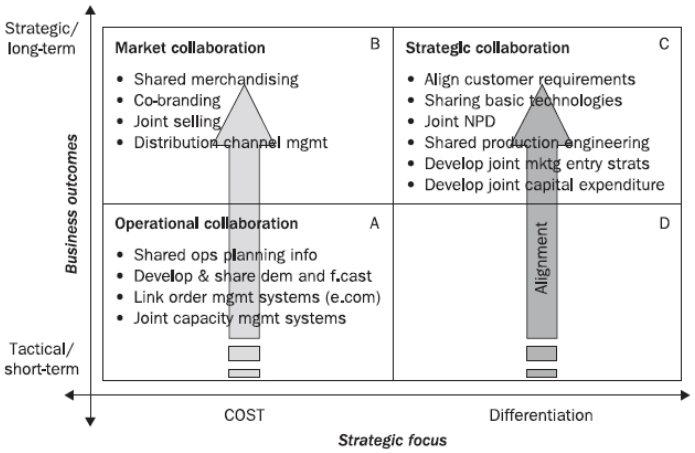
Ch13

This chapter focusses on portfolio of relationships of the wheel of science. The business of procurement is to achieve the best deal for your organisation.

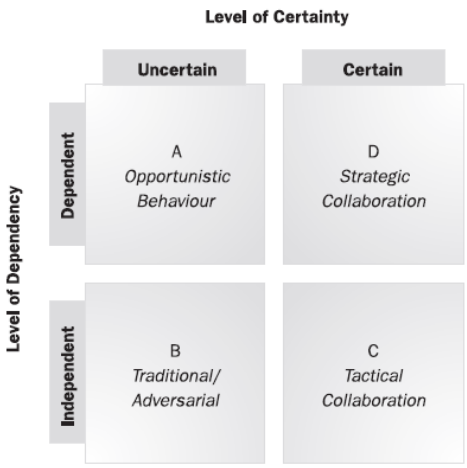
Relationships are processes, not things. *Relationships can be thought of as a process or course of action, which should be designed to deliver business outcomes.* The type of business outcome will dictate the level of relationship process or detail of course of action required to achieve it. They require input and an output. Processes need to be seen as efficient and effective. The objective of efficiency is here to allocate the minimum amount of resources to achieve the maximum amount of output. The complexity of output should fit the complexity of input. **Interfirm business relationships** are complex business processes that require resource allocation from the buyer and supplier to achieve a set of complex outputs. Lambert et al. refer to **Supply Chain Management (SCM)** as *the integration of business processes from end user through original suppliers that provides products, services , and information that add value for customers.* **Strategic supply management** are *specific strategies employed by the Purchasing function, Purchasing's role within those strategies and Purchasing as a strategic function within the firm.* The overall **consensus** between studies is that supply should be seen as 'strategic'. The key question to relationship management is: *How should a firm organise to manage its complex relationships?*

The **Strategic Focused Outcomes Model (SFOM).** →

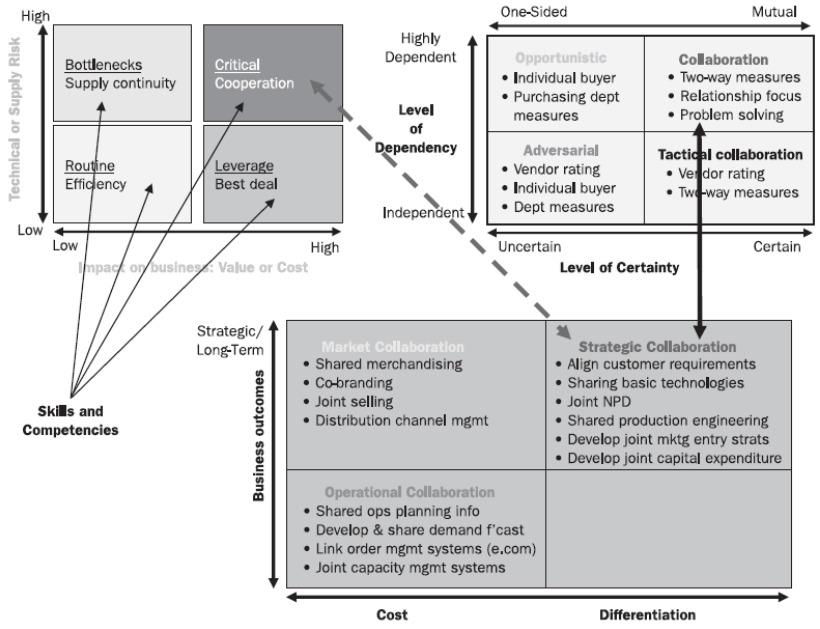
This model indicates which strategies should be followed dependent upon the strategic approach taken by the firm. The emphasis here is appropriateness and allocation of resources. The research behind this model indicates that a short-term strategy would only allow for what is termed 'operational collaboration'.



Strategic Relationship Positioning Model (SRPM) →
This model considers two key variables for the management of relationship. **Dependencies** are mechanisms that create a reliance on either the buyer/supplier or both. There are four **key dependencies**: economic, historic, technological, political. Interdependency happens when the buyer and supplier are relatively equally dependent on one another. This is a 'win-win' situation. But can at the same time be seen as 'lose-lose'. One-sided dependency is when one exploits another, this is time limited. Trust is a difficult word to use when talking about firms, so we use 'risk'. Four types of **uncertainty:** *contractual (How do you know standards are met by the other?), competence (How do you know the other has the needed capabilities?), goodwill (How willing is the other to give more effort than agreed on?) and political (What is the political risk of this cooperation?).*

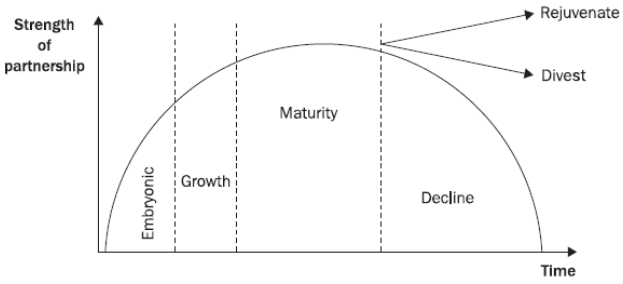


SRPM: adversarial = where the dominant partner will take advantage of the situation. **Opportunistic** = only when the dominant partner believes that they are in a position to sustain this additional value over time. **Tactical collaboration** = represent a significant level of collaborative activity. **Strategic collaboration** = when both parties focus on working the relationship for mutual gain. Those require large amounts of investment.

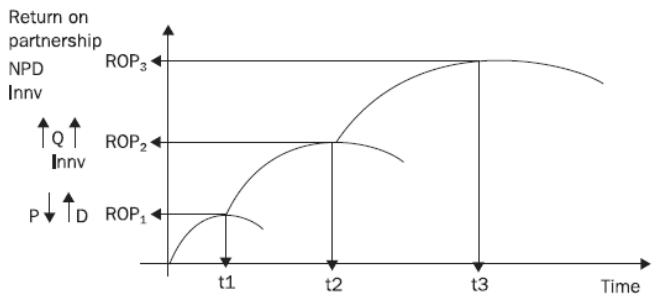


← alignment of strategies, relationships and skills. This model shows the interaction between the relationship focus, the type of product/service being purchased and the strategic nature of the supply function. The choice of the relationship approach/strategy should be based on focusing the appropriate relationship type to the outcomes required from the business transaction.

The partnership life cycle effect (below) shows how relationships operate through the three stages of the life cycle of a product.

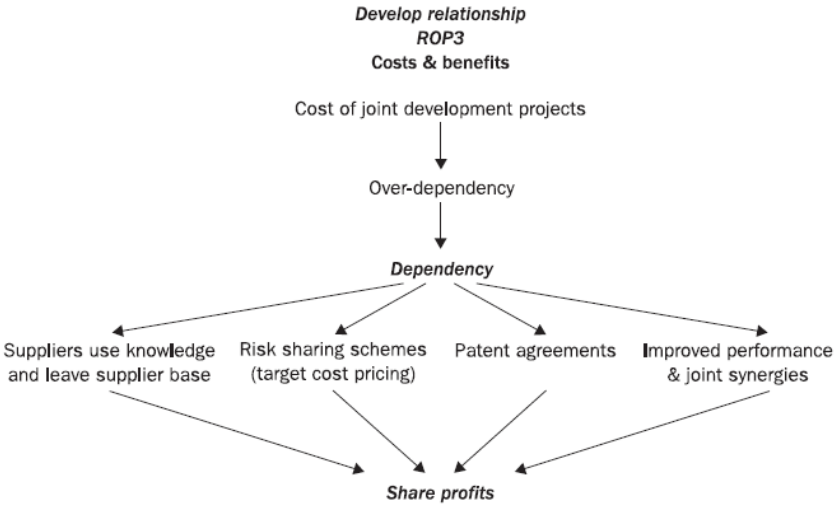


The partnership achievement and growth model (below) illustrates the expectations

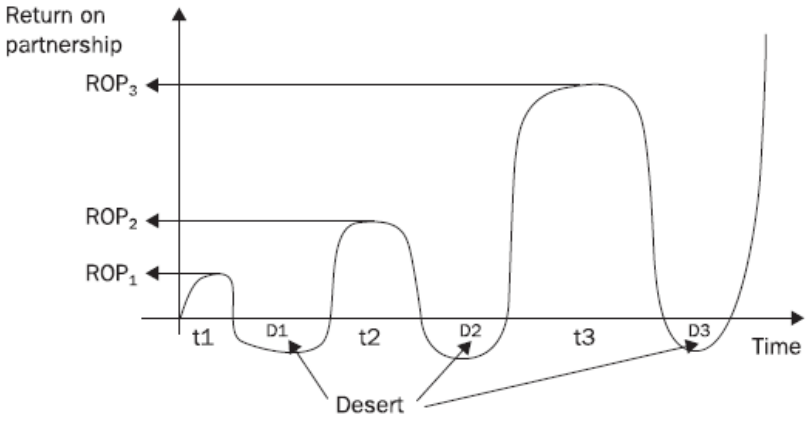


effect of relationship development. T1 is short-term, t2 is medium, t3 is long-term. ROP is **Return On Partnership**. In t1 the buyer and supplier ill set measurable benefits such as improvements in

pricing and delivery performance. In t2 the buyer and supplier have the opportunity to take a further decision: they could engender or rejuvenate the relationship to look at a wider sphere of deliverables, such as improvements in quality and possible joint innovation projects. At t3 the relationship reaches its mature stage, the levels of goodwill and competence trust have again been built up, communication systems are well aligned and now the partners have to make a decision to further develop the relationship or to leave it as it stands. In t3 the organisation should also make a decision about the types of sourcing strategies it may use to generate collaborative benefits. →



The partnership desert effect → shows how in the t1, t2 and t3 the parties receive the benefits from entering into relationships. The desert is where no returns/benefits are receive from the partnership approach. In t1 an initial return is realised which may be in the form of a price reduction. A period where no benefits are received follows: D1. This occurs during the growth stage of the relationship. As time progresses and the partners work more closely together, the ROP increases and the deserts become smaller. Many firms lose the drive for partnerships after hitting the first desert.



Implications for managing relationships:

1. The management of inter-firm relationships is complex, it is not sufficient simply to set up an agreement: action plans need to be followed to instigate change.

2. It is important to consider what a 'relationship is: a process that drives or facilitates changes in behaviour, positive/negative.

3. It is important to consider relationship at the level of the product or service and not at the level of the firm. The point is that firms need to consider strategically what they buy and then apply the appropriate relationship which will deliver the maximum value for their business.

4. Inter- and intra-firm relations. Relationship management should not begin with changing the way a firm manages its suppliers. It should start with how the buyer firm interacts with itself. It is vitally important that relationships are aligned internally first, before any attempts are made at changing existing inter-firm relationships.

5. Building a business case. There must be a business benefit from refocusing relationship approaches. Firms need to think through clearly what these benefits are, and also if the costs of getting them outweigh. It has certainly become apparent how few consider these important decision drivers. Firms tend to reduce supply bases with little cost knowledge move towards higher-dependency relationship without performance measurement or skill changes and so on. If a firm is going to adopt a different way of working then it must consider all of these aspects and build a business case for doing so.

6. Relationship strategies are dynamic; they need to be thought through and managed over time. At different stages they may require different people/skills to manage them. It is

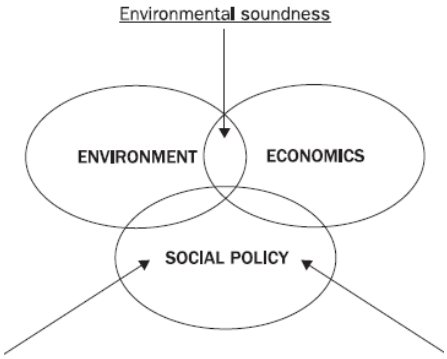
important that firms choose appropriate relationships to deliver the maximum value for their transaction. This can be achieved through manipulating and managing the dependency/certainty mix.

Ch14

Before the 90s, significant interest in environmental or ethical issues was limited to activists of Non-Governmental Organisations. Firms increasingly assessed their own environmental footprints and those of their suppliers. With ISO standards emerging with it. The popular press further highlighted environmental and ethical concerns. In the 70s it became clear that quality management could be self-financing. The question facing Operational managers and Supply managers in the early part of the twenty-first century is whether environmental and ethical concerns in the supply chain could also be self-financing. The difficulty for PSM is establishing the scope of their responsibility for activities in the operations of their direct and indirect suppliers. There are **two** good reasons for acting in a responsible way: *1) genuine concern for sustainability 2) improved risk management (avoiding penalties).*

When consumer suspect or discover that goods are not environmentally sound, they become disappointed. The 'customer satisfaction' and 'customer delight or excitement' are the necessary **conditions** to **encourage** repeat buying and personal recommendations. A supply managers perspective must include provision for potential problems elsewhere in his organisation supply network.

The environmental pressures that affect a business may come from sources inside or outside a firm. External/internal. Developing environmentally sound supply chain policies and strategies to address the related market needs therefore requires a clear understanding of each of the stakeholders' perspectives and priorities in a framework. **Corporate Social Responsibility** is an overarching term that encompasses many aspects of environmental and ethical performance.



For everyday sourcing decisions, firms need to develop policies and strategies for environmental and economic performance.

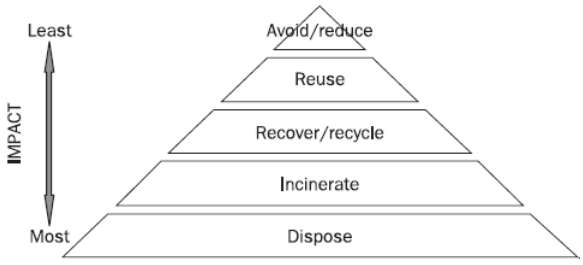
Environmental soundness is the degree to which the activities of a PSM complies with the framework of requirements their parent organisation has identified as its policy and strategy on the subject.

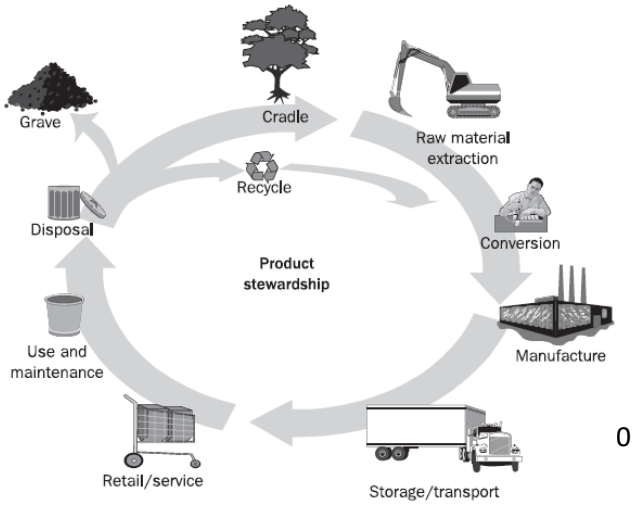
PSM's environmental concerns: • understanding of its pollution • policy on environmental soundness • strategy to minimise impact • a plan for working with environmental risks

Wally and Whitehead suggest a firm's goal should be to develop a strategy that internalises the external costs brough about by environmental pressures.

Environmental issues should be dealt with similarly to design, logistics etc. by integrating them into management. → **Total Quality Environmental Management (TQEM).**

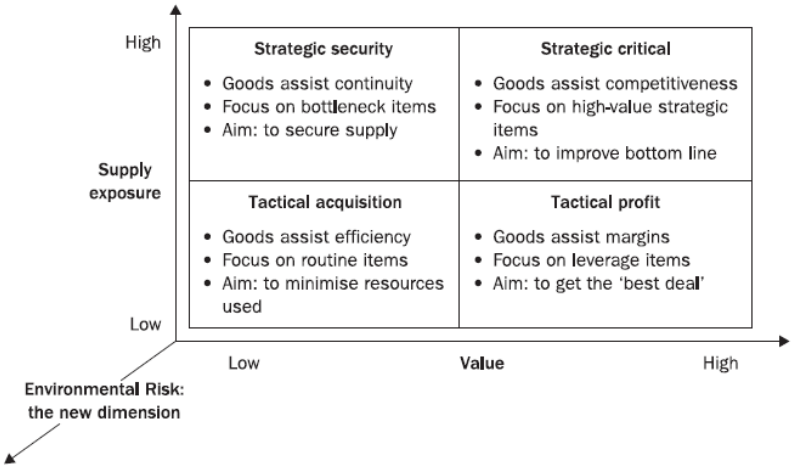
PSM could encourage their suppliers to examine the potential for pollution avoidance. → **improved resource productivity.** The **waste hierarchy** → **The product stewardship concept** (below)





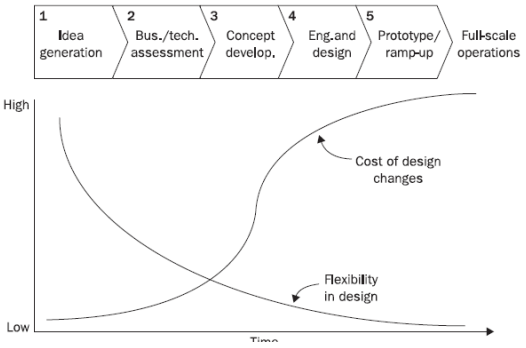
Risks for PSM:
1) Non-compliance with legislation/protocol: leads to fines, which leads to loss of goodwill
2) Bought-in liability: safe downstream passage of product through the supply chain, the product won't lead to more pollution when it is bought.
3) Security of supply: restricting availability of certain key items.
4) Resource productivity: is the total amount of materials directly used in the production process
5) Loss of competitive positioning: not being able to answer critical questions concerning environmental performance.

Implementation issues to successful green supply:
measuring environmental effectiveness: an environmental purchasing policy must be supported by open, credible, stated measurements which reflect the goals for it not to become side-lined.
supplier assessment: life-cycle inventory can be used to make an 'impact profile'. Kraljic approaches the market by classifying products based on: *the value added by the product line & the complexity of the market.*
strategy and senior management commitment: effective implementation of environmental goals requires that they are integrated with day-to-day activities, but also on the short-term when it comes to objectives. Once this has happened it is important to use the results to communicate performance to the stakeholders.



Ch15

New product development (NPD) is a key source of competitive advantage for firms. Suppliers are often one of the first ports of call in seeking to improve outcomes of NPD programmes. Various terms have been used to describe the practice, including **early supplier involvement (ESI),** supplier integration in new product development (SINPD), and collaborative product development (CPD). Supplier involvement, especially early in the life cycle enhance the NPD projects. Decisions made early in the development cycle have a significant impact on quality, cycle time and cost of the product. 80 per cent of the product cost is committed by the time the product is designed, involving the Procurement function early has vast scope for adding value to the process. As the design proceeds, engineering changes become more difficult and expensive to make. effective product management means involving all parties early, resolving conflict early, and through this achieving the consensus required to move the product quickly to market. The processes associated with 'best practice' in supplier involvement in new product development = a 'black box'.

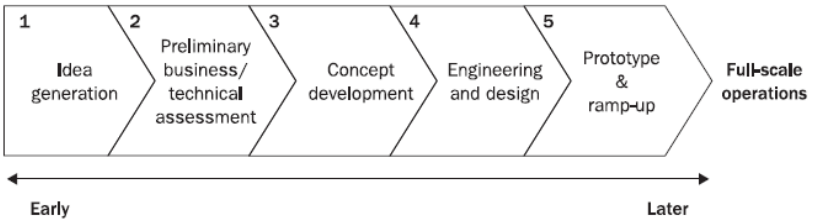


advantages of ESI:
at the product level: 1. *improved product quality;*
2. increased manufacturability of product;
3. reduced cycle time;
4. reduced development costs;
5. decreased product cost
at the organisational level: *1. Learning effects*

2. Access to new capabilities
3. Technology roadmapping (outlines the future directions for the supplier's product range)
4. Risk reduction

Disadvantages of ESI:
1. Early involvement is not always beneficial or appropriate. Not everyone is cooperative
2. Loss of bargaining power. ← when a supplier is 'locked in'
3. Leakage of key information. Supplier can trade with buyer's competitors.
4. Financial burden on manufacturing. ESI can place extra burden on keeping the costs low.
5. Locked into wrong technological trajectory. Accidentally choosing the wrong/slower tech.

Supplier selection criteria: *design and engineering capability; willingness to be involved in design; cultural compatibility with the buyer; ability to meet development schedule; willingness to co-locate design/engineering personnel; willingness to share cost and production information.* Also cultures can clash.



← The timing of supplier involvement
If supplier design expertise is **strong** and their potential impact on the final design **high**, then the **earlier** they should be included in the process. ('black box' suppliers e.g.)

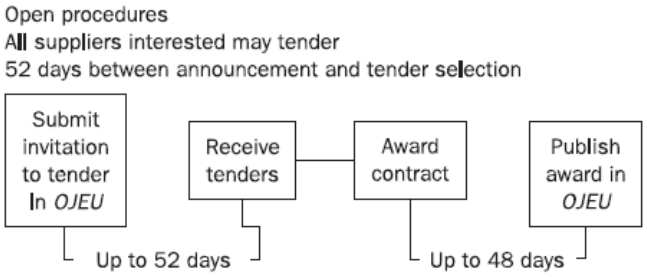
Types of involvement:
1) No supplier involvement
2) White box involvement: Supplier is **consulting**
3) Grey box involvement: the formal integration of the supplier into the buyer's NPD team, so **joint**
4) Black box involvement: **shifting** design responsibility to a trusted supplier

Ways to consider the *quality of the relationship* and *the way it's managed:*
1) Supplier selection procedures: selecting the right supplier
2) Degree of supplier responsibility for design: more responsible = more effectively goals are met
3) Communication processes between buyer/supplier:
4) IP agreements: Who owns what?
5) Alignment of buyer/supplier technologies: technology plans must be aligned currently and in the future
6) Project team structures: determine the work environment
7) Supplier membership on project teams = the biggest determinant of ESI success. Has to do with amount of trust.

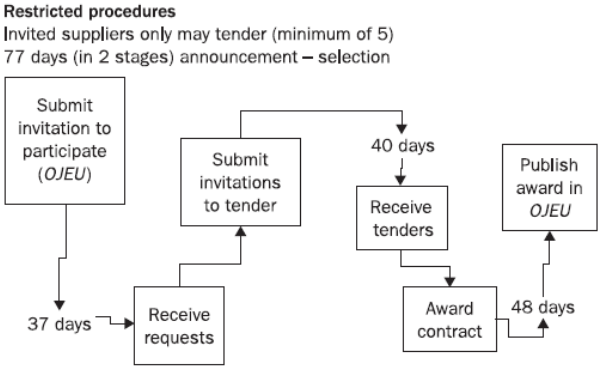
Ch16

Public procurement (Supplies, Services and Work directives) has to operate in a different manner, this is reflected both in its processes and in its organisation. For a private sector firm, competitive pressures are translated and transmitted to its purchasing and supply management activities as demands for cost reductions, timeliness and innovative solutions to next-customer requirements. A public body has no such. Public procurement employs **regulation.**
Utilities are water, electricity, bus, rail etc.
Gradually, the parts of everyday life that are serviced by government-run organisations have become fewer – with consumer choice steadily increasing.
Public sector procurement is driven by the need for efficiency, 'value for money' or 'best value',6 public scrutiny, national and regional regulation and legislation, and political expediency.
The European Union exists to support political and economic peace and development in the region. Several clauses dedicated to encouraging free competition in the public sector have been translated into nationally enforced regulations, via European Commission Directives. two basic purposes behind the procurement Directives: *ensure that those spending significant amounts of public funds explore the whole of the single market and thus have the best chance of getting value for money; to*

ensure that firms in member states throughout the EU get the chance of bidding for business throughout the whole market.
Determining when a purchase is a 'significant' level of spend is done by setting **thresholds** = financial levels above which the expenditure is deemed to be significant. Are set in euros and translated into other currencies for national law. But for global dealing, we have fixed exchange rates.
the Directives were developed to guide public procurers in **three separate types of contract**:
• supplies: where items or materials are to be bought or leased; • services: which may range from street cleaners to opera singers for public concerts; • works: buildings, bridges, roads, etc.
To reflect the fact that utilities might be public or private a special Directive was developed for what were initially called 'the excluded sectors'. Two further Directives were developed to deal with enforcement of the requirement: 'Compliance' and 'Remedies'. In March 2004, the EU adopted two new public procurement Directives: one for the public sector and one for utilities. Those were later replaced with the 2006 Public Contracts Regulations and the Utilities Directives by the 2006 Utilities Contract Regulations. The regulations ensure that purchasers keep to the spirit of the Directive in their contracting. Otherwise → penalties
Prior Indicative Notices' (PINs) are issued by public sector bodies when they wish to give advance notice to the market of future requirements.
Aggregation is that the thresholds apply to 'one-off' purchases and to a series of contracts with similar characteristics. Similar characteristics means 'Similar products and services, for a single or recurring need, available from the same or similar suppliers, bought in the same period and perhaps capable of being bought on the same contract'. When estimating the value of contracts for threshold purposes purchasers are required to aggregate the value of all purchases/lots of a like type and if the total value of contracts to be let within laid-down timescales exceeds the thresholds then all contracts must be let in accordance with the rules even though individual contracts may be below the thresholds. The Directives allow an organisation not to aggregate where it can show that the separate parts of the organisation are 'discrete operating units' or DOU. A DOU is defined as 'a part of a business which buys goods for its own purposes, has devolved authority to purchase those goods, and takes decisions independently.'
There however is concern about the Directives, two major: *that the stipulation of strict procedures would in some way compromise the 'professional' autonomy, skills and style of the purchasers; that the processes in the procedures would be cumbersome, time consuming and costly.*
Attestation enables organisations to develop acceptable (and thus 'owned') procedures that make sense in local terms (and perhaps terminology) while also ensuring that the requirements of the Directives are met. There are 5 **procedures**:
1) *open,* →
ITT = invitation to tender. In open procedures every supplier can bid. Disadvantage of it is that large numbers of bids must be sought for some contracts which can be expensive for both parties.
Advantage is that the contracting time scales re shorter than of other procedures.

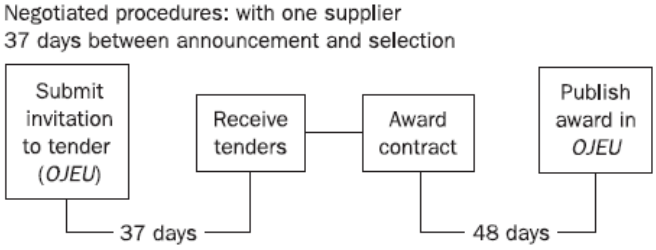


2) restricted, →
Allows the purchaser to short-list contractors that they deem competent and invite them to tender. the ITT is conducted in two stages. The first stage is an invitation to participate (ITP), published in the OJEU. Competition is called, and only suppliers that respond to this call can be considered. Five are selected minimum.



3) competitive dialogue, used by the public sector

when they cannot define their requirements in detailed terms or are not aware of what the market can offer in relation to their output requirements. This is a two-stage process that is available to the public sector for complex purchases where the requirements are expressed in output terms. There are three parts to the process. **Stage1** A contract notice is issued in the OJEU and applicants are requested to provide the qualifying information requested by the purchaser. Minimal three suppliers get to bid. Individual dialogues might then take place (not in Uitility). **Stage2** Final bid stage. The purchaser must then select a preferred bidder with whom they may agree other fine-tuning of the bid which may include changes to price but again the changes must not be significant.
4) negotiated (with/without call for competition), Without call → rules: urgency for reasons not due to the purchaser or reasons which were unforeseeable by the purchaser, in other words urgency due to reasons outside the control of the purchaser.
With call → used by the public sector when they have advertised under the open and restricted procedures and received only non-compliant or unacceptable bids or when the purchaser is unable to define their requirements to the level that would allow them to award the contract under the rules applicable to the open and restricted procedures. The purchaser must select a minimum of three suppliers



Above it with call for competition
5) dynamic purchasing system: Most suitable for purchase of standard products. Purchasers can respond to an open procedure. They are listed. When a purchaser wants to place a contract, it is published in the OJEU, other suppliers can bid electronically.

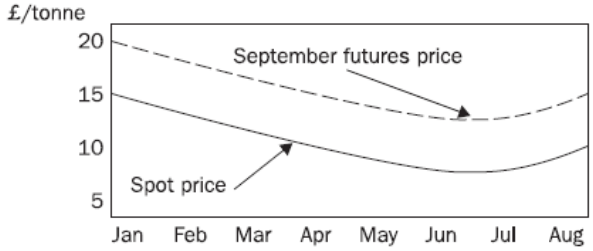
Some **criticism** on the Directives: • They don't help SMEs (small/medium-sized organisations) because of too high thresholds. • Large organisations set up operations to bid for local contracts.

Ch18

In business, the term **commodity** is used to refer to an item which is specified so closely, in terms of its form and quality, that it may be bought and sold purely on price; the price reflects the availability or scarcity and the level of demand.
The seller wants to differentiate its product. They can reduce the clarity of specification for the buyer by such differentiation – claiming that value has been added to this particular product or service, justifying a higher price. The buyer, meanwhile, is keen to pay the lowest price for the item and would like all competitive offerings to be the same, in order to compare them simply. So, commodities are materials and services which can be specified precisely and bought largely on the basis of price and availability. They are vitally important to the nations that produce them.
Types of commodity:
1) **Hard commodities:** metals → *base metals* (aluminium, zinc…) */precious metals* (gold, silver…)
2) **Soft commodities:** cocoa, white sugar, cotton, orange juice
3) More **straightforward** names: grains and seeds; meat and livestock; energy
open outcry = people who want to trade, do this in the same market building in which they shout to each other while using hand signals.
For an exchange to work there must be *sufficient liquidity* in the market – enough people who wish to buy and sell and enough of the commodity available to be traded. The *awareness* of a new item may be limited for a while and once its demand starts to soar, supply may be easily controlled, especially where barriers to entry are high in its production. To be a true commodity, the liquidity (availability for trade) of an item must be *quantifiable* (i.e. manageable lot sizes are agreed) and *quality stabilised* and *guaranteed*.
It is common practice to move buyers from one type of purchasing to another fairly frequently, whereas a commodity trader may expect to spend many years in one area, building a network and a rich experience or 'nose' for the market.
Four ways of dealing with price fluctuations that result in commodity markets:

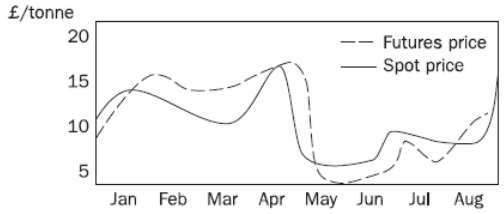
1) **Private deals:** Where an organisation knows the supply market well and relationships are good, it may be possible for private deals to be struck, thus avoiding the open market pressures, for both customer and supplier.
2) **Backward integration:** Backward integration may mean taking on a different industrial practice, since the separation of business activities from one another is largely influenced by the nature of those activities (financial dynamics, labour markets, resources bases, technologies, etc.).
3) **Opportunistic buying:** opportunistic buying may involve quick response or strategic planning. While the uncertainty over price may be removed in this way, other costs may be incurred; once again these may be sporadic or planned. For example buying winter fuel in summer. The danger might be that the reason for the good price is the imminent obsolescence of the item.
4) **Hedging on the future market:** Hedging comes in the form of buying and selling 'futures' – financial documents that are traded in their own market – linked to the commodity in question. It is to make sure to avoid the problems of paying more than they planned.
Simplified representation of the relationship between commodity price and futures price → "a perfect hedge".
Below: a more realistic representation between commodity price and futures price: → "complex hedging"

The spot price for the commodity and the related futures (with differing forward durations) change each day



In the simple representation, the spot and futures prices move together (in practice it is never this simple)

The futures market will be affected by different factors from those influencing the commodity price, in addition to the forward prospects



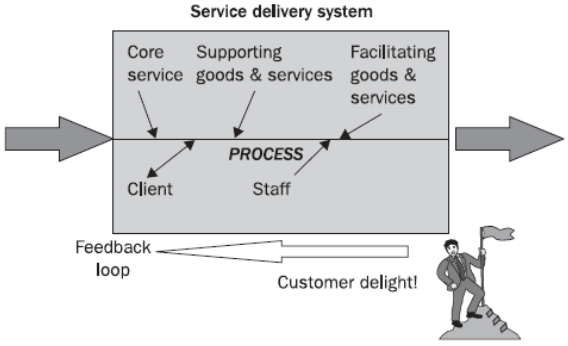
This complexity is inevitable and leads to the need for highly skilled and knowledgeable professional traders

spot price = the price that is to be paid for the delivery of the commodity on that day
Contango = the futures price > spot price
Backwardation = futures price < spot price
Long = owning not fully hedged futures or commodities
Short = selling commodities/futures in excess of what it actually owned
Arbitrage = buying in one market and selling in another to exploit different prices

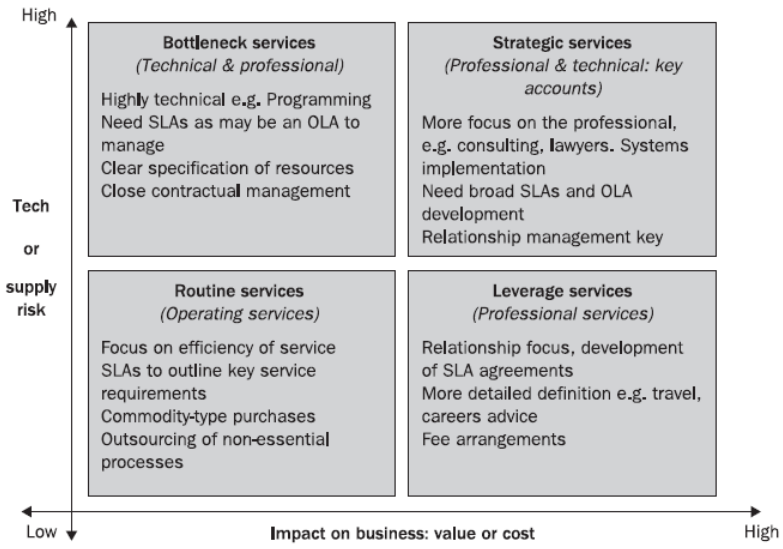
Bear = someone who speculates to expect a fall in prices
Bull = someone who speculates to expect a rise in prices

Ch19

Professional buyer firms are Firms that have consolidated their services within the responsibility of the Purchasing department have achieved significant cost savings as well as service-level improvements.
Service is any activity or benefit that one party can offer to another that is essentially intangible and does not result in ownership. Its production may or may not be tied to a physical product.
The goal in services should essentially be the same as that of buying manufactured items, namely, to gain the maximum amount of competitive advantage for the company.
Two words describe the **service interaction**: *expectations and perceptions. Expectations* refers to what the client thinks the service is going to deliver and *perceptions* refers to what the client perceives the service has delivered.
The **Service Delivery System** (SDS) is the means by which the service is provided. →
The SDS illustrates a range of key issues that the Purchaser needs to be aware of when managing a service contact. The

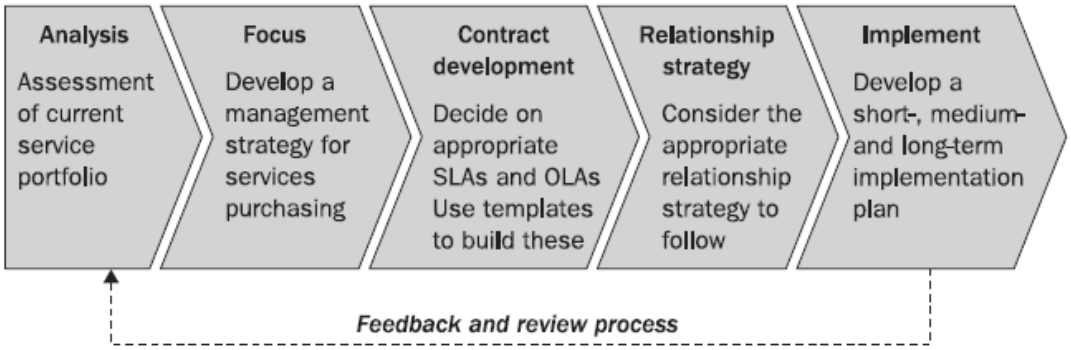


'**core service**' represents the basic service that is being provided, and this needs to be clearly defined.
The '**supporting goods and services**' refers to the services that support the core process. These are services that are necessary to support the day-to-day running of the business. '**Facilitating goods and services**' are seen as differentiators to the business. They provide services that make the process more enjoyable but are not necessary for its efficient delivery. '**Staff**' refers to the training of the staff that interacts with the client. This is important as it is these interaction points (or touch-points) that allow clients to form an understanding of the business. The SDS model contains a '**feedback' loop**. This aspect of the model provides information back to the provider on the client's experience of the service, and identifies opportunities for continuous improvement.
It is very complicated to define a measure that meets the firm's objectives. → The feedback loop feeds into what is known as the **Service Level Agreement (SLA)**. SLAs provide a mechanism for the buyer and supplier to measure the service being provided. SLAs are designed to guarantee the quality of service provided to the end customer. The SLA can be further enhanced with an **Operating Level Agreement (OLA)**. OLAs focus on the day-to-day management of a service delivery and tend to be extremely detailed, whereas the SLA outlines the overarching concepts involved within the delivery of the service itself. The OLA provides a further level of complexity in and around the relationship and defines the roles and responsibilities of the internal resources to allow the SLA to function optimally.
Three types of services:
1) **Professional services:** services provided by professional firms or individuals that tend to cover advice and management guidance. (lawyers/consultants). SLA works best here.
2) **Technical services:** services provided for technical support and knowledge exchange. (R&D/IT). Make best use of SLA supported by OLA.
3) **Operating services: (facilities management)** services that could be performed by the organisation itself but for reasons of economics or focus it has decided to outsource them. These are usually essential services that might be performed better by specialist organisations. Will use SLA and sometimes OLA as support.



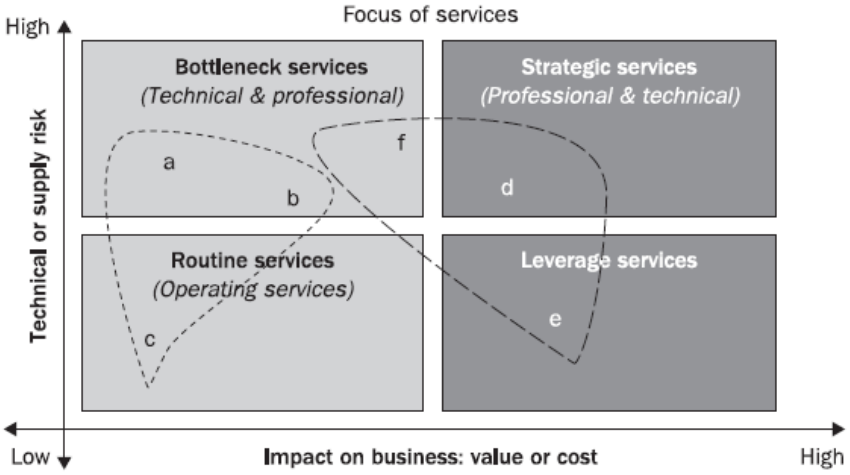
We redefine Kraljic's critical, bottleneck, leverage, and routine to strategic services, bottleneck services, routine services, and leverage services.
strategic services: services that are seen as having a high impact on the business; high cost and value but also high in terms of technical skills; 'strategically important', require SLA
Leverage services: service offerings that have a high value or cost, but are much more commodity focused; less technical; use SLA
Bottleneck services: apply predominately to what we defined as technical services, but also some highly technical professional services might fall into this category. Bottleneck services have the characteristic of being highly technical but are relatively low in terms of value or cost. Need for basic OLA and SLA.
Routine services: low-skill commodity-type services such as catering, security or cleaning contracts. The position of these services depends on the nature of the organisation and also on the type of service. SLAs are issued

Six stages in developing a strategy to manage services purchasing:



1) **Analysis:** identifying all of the services (non-traditional spend items) within the firm. This should be done via a firm-wide exercise where each budget or account centre reveals its spend on various outside services.

2) **Focus:** the buyer will position all of the services into the various segments of the model. The buyer can then also link up which services belong to which supplier. The buyer may decide to consolidate with one or other supplier or not. If not, then varying strategies will have to be applied to each service group.

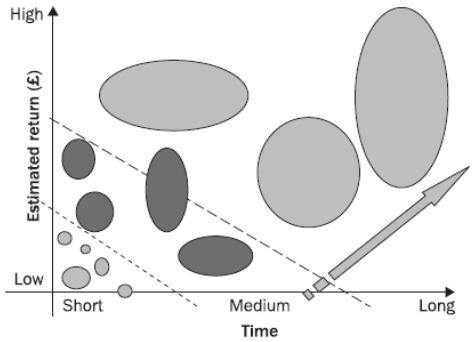


3) **Contract development:** the buyer must use the matrix to decide which SLAs and OLAs to apply and develop appropriate metrics for each. During this phase the buyer will need to focus on the internal management systems, measurement systems, and reward and penalty mechanisms.

4) **Relationship strategy:** what is the appropriate relationship approach to deliver the benefits to the firm?

5) **Implementation:** the practical aspects of managing the strategy. One approach is to divide the various activities that are required to manage the strategy into two areas: time and money. →

6) **Feedback:** the implementation plan and revisit the original model in an iterative manner. This process helps the buyer to develop a purchasing strategy for services procurement and to refine and develop it over time, being proactive as opposed to reactive to the external environment.



GO ROCK YOUR STUDIES

GOOD LUCK!