Specifying, designing and developing processes, products and services: Part 2 of 2

What Are We Talking About?

A number of the essential terms associated with this module suffer from a variety of radically different definitions, interpretations and explanations which do not assist a ready understanding of the underlying concepts. This can be a particular problem when you try to apply these terms to what your own organisation does, or to your own experience as an individual.

For the same reason, we avoid use of the term "product realisation" (introduced in ISO9000:2000), and we have not followed the explanation of "the process approach" offered by at least one of the major certification bodies which calls "Management Responsibility" a process, which it patently is not.

For clarity, we have repeated some of the explanations given in Part 1:

> **Process**: "*set of related tasks **trigger**ed by an event and intended to achieve an **objective**". It uses **resources** and is subject to **influences**.*
>
> **Product**: "*goods or services which are produced or provided by an organisation for the benefit of another organisation or person.*" Literally, a "product" is "*something that is produced*".
>
> **Customer**: "*an organisation or person that receives a product from another organisation or person.*"

And we reinforce the distinction between i) what is generated by "internal" processes, and ii) the "deliverable" which an organisation produces for its customers, by avoiding (for "internal" processes) the ISO9000:2000 definition of a "product" (the "*result of a process*").

So we use the term "**Product**" for a "deliverable" (goods and services sold or provided to a third party) in the way that most individual consumers use the term, and as commonly thought of when considering what an organisation receives from its suppliers.

In both cases, however, it is useful to consider the:

> **Output**: that which is "*put out*", and other
> **Outcome**(s): that which "*comes out*" or "*happens*", as a "*consequence*" or "*result*" of some event or action.

We also emphasise the potential confusion which can arise from the "traditional" definition of a process which has the "transformation of an input" as an essential component. An obvious example shows how this does not always work in practice…

Most business people would agree that "*Storing goods in a warehouse*" is a typical process for many manufacturing companies. They would, we imagine, also agree that the worst possible outcome from that process would be for the goods to be "transformed" – you want them to come out looking and working exactly the way they did when they went in.

In this example, the objective is something like to "*keep the boxes dry for a couple of weeks until the customer can take delivery*". So the goods are moved into safe storage, their precise location recorded, the temperature etc controlled, and their despatch perhaps organised by an email to the warehouseman. This would, we contend, make sense to anyone (and especially to the customer).

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Fortunately, a number of other definitions of a "*process*" found on the Internet confirm this more practical view:

- *"A series of actions, changes, or functions bringing about a result"*
- *"A series of inter-related activities that result in an outcome"*
- *"A generic method of doing something, involving steps or operations which are usually ordered and/or interdependent"*
- *"A collection of interrelated tasks, which solve a particular issue"*
- *"A series of events that produce change or development".*

Recognising each of these elements for a specific process is important for managing it, improving it, and for designing it in the first place (once the need for it has been established). Almost everything we do (and think) fits into this definition. But it remains a surprisingly difficult view for many to take.

Triggers

Using "*identification of an issue*" as an example of a "trigger", how many situations can you recall where someone receives notification of a problem (a delivery being wrong or late, or software not doing what it is supposed to do) and the initial response is to jump to a conclusion, sometimes not even understanding the message or asking any questions? Assumptions are one of the most common "influences" on how a process operates, and on how successful it is. Managers in particular often interfere and do not allow a process evolve naturally and so provide the platform for continuous improvement.

"*Identifying a need for something to be done*" is what often initiates a process – or creates the need for one to be defined. People don't turn up for work on Monday morning or begin to work their way through a process because "something needs to be transformed" - they do it because an event triggers action, or they decide to take action because inaction might cause a problem. These triggers ("activators") can be **event based**, **time based** or **input based**.

A system review, for instance, is initiated by a time-based activator such as a date on a calendar, or perhaps because someone recognises that internal performance or external circumstances have changed. There is no other trigger. The so-called inputs don't trigger the system review and they aren't transformed - the original data still exists. On the other hand, in a manufacturing process, the original (raw) material does not exist at the end of the process since it has (literally) been transformed. In the "system review" process, new data (information, knowledge) is generated.

Thinking in "process" terms can be beneficial in many situations, and the logic can apply equally well at the task level. We have described a process as "*a sequence of … tasks…*", where a **task** can be defined as:

- *"a discrete activity or piece of work"*
- *"the smallest essential part of a job".*

A task is started when something triggers it; there is an objective to be achieved (otherwise why do it?) and it will almost certainly require resources and be subject to a variety of influencing factors. In many cases, completion of one task in a process may trigger the start of the next task. The outcomes from a process may be the aggregate of the outcomes from individual tasks. And the objectives of a task should always be aligned with the aims of the process, and each task should contribute to the creation of the "output".

Why Is It Important?

Prof. Jim Norton wrote in **Computing Business magazine:** (August/September 2006): "*A major concern for directors is to ensure that the key processes … are documented clearly… Such processes often cross organisational boundaries and are vital to the sharing of knowledge*."

Business processes are:

- How work gets done
- How you achieve objectives ("proactive")
- How you respond ("reactive")
- How you affect others (un)intentionally
- What have to be merged in a merger
- Widely misunderstood
- Confusingly defined and explained...

What Skills And Knowledge Are Required?

Module F3 (**Manage Business Processes**) of the National Occupational Standards for Management and Leadership gives a useful summary of the skills needed. Its "Outcomes of Effective Performance" state that you must be able to:

- Design processes that deliver outcomes based on business goals and aims.
- Identify and provide the resources you need.
- Take account of influences that may affect and shape how processes work.
- Link processes so that they interact across the organisation to form a complete system.
- Provide information and support for staff and other stakeholders involved.
- Define process responsibilities.
- Develop process measures that are affordable and provide enough information for people to decide how to manage the process.
- Establish and use effective methods to review and improve the process.

The "behaviours which underpin effective performance" are listed as:

- You keep people informed of plans and developments.
- You clearly agree what is expected of others and hold them to account.
- You take repeated or different actions to overcome obstacles and respond positively and creatively to setbacks.
- You comply with, and ensure others comply with, legal requirements, industry regulations, organisational policies and professional codes.
- You monitor the quality of work and progress against plans and take appropriate corrective action, where necessary.
- You focus personal attention on specific details that are critical to achieving successful results
- You identify systemic issues and trends and recognise their impact upon current and future work
- You take opportunities when they arise to achieve longer-term aims.

You need to know and understand the following:

- Principles and models of effective process management.
- How to define business processes.
- Types of business process measures and how to assess their suitability.
- The difference between process outputs and outcomes.
- How to assess process changes for risk and reward against their potential investment cost.
- How to carry out cost and benefit analysis.
- Types of analytical and problem-solving tools that you can use when developing business processes.
- How to measure the effect of changes in the business process.

Types of Process

What types of process are we considering in this module? All businesses are different - but perhaps not as different as they might like to think. Although there will be variations on a theme, only the core "getting and doing work" processes are likely to vary drastically, depending on whether you are manufacturing or distributing goods or providing a service. Marketing, recruiting staff, managing premises and so on are more likely to follow a familiar path irrespective of the product or service being provided. Even "running your business", that is, taking your business from where it is now to where you want it to be in say a year's time, is a process (or is it a "project"?)

This (or something very similar) is the key top level process for most organisations, and all other processes are sub-processes. The process of "running an organisation" typically consists of the following key elements:

Planning and Organising ("managing" the system)

Getting Work and Doing Work (the "core" processes)

Managing Resources ("supporting" the core processes)

Reviewing and Improving ("managing" the system).

A useful reference is the **Process Classification Framework (PCF)** was developed by the **American Productivity & Quality Center (APQC)** (see Sources). It organises operating and management processes into 12 enterprise level categories, including process groups and over 1,500 processes and associated activities (see Management systems).

One way to classify processes – and products – is to consider the frequency of product change. At one extreme is continuous production, such as a power station. At the other are projects that make a single, unique product, like building Terminal Five at Heathrow. Using this approach, there are five types of process:

Project: makes a single unit, usually tailored to individual specifications. The process has a lot of variety, needs to be flexible to accommodate new situations, requires a skilled workforce and adaptable equipment. Projects usually have high unit costs, but they are perhaps the most interesting to work with. Examples: developing software, designing a house, building a rail tunnel.

Job shop: makes small numbers of a wide range of products. Each product uses a different mix of resources - so there are usually some idle resources, while others can be so much in demand that bottlenecks form around them. The result is fairly high unit costs, and difficulties in

scheduling and keeping track of work. Examples: restaurants, general printers, furniture manufacturers.

Batch processing: makes larger batches of similar products on the same equipment. Bigger batches give smoother operations and lower set-up costs, but higher inventory costs as finished goods are stored until needed. Batch processing is useful for medium volumes of products, with less product variety and customising. Examples: clothing manufacturers, buses, bottling plants.

Mass production: as in an assembly line that makes large numbers of a single product, such as computers, cars or washing machines. Mass production processes use specialised equipment to make a standard product, with easy scheduling and control. Examples: processing photographs, newspaper printing, "white goods".

Continuous flow: used for high volumes of a single product such as bulk chemicals, oil and paper. (The process is different to assembly lines as the product emerges as a continuous flow rather than discrete units.) Such processes use highly specialised equipment that can work for 24 hours a day with virtually no changes or interruptions. Examples: petrol refineries, electricity supply, paper mills, police service.

Developing a New Process

In practice, how often do you develop a new process? Start up companies will certainly need to do this, and a manufacturing company will do so when they introduce a new product line or method of production, but in many other situations you are more likely to be reviewing and improving an existing process. The principles are the same in all cases.

"**Developing a new process**" is, of course, a process. It involves the following tasks:

PREPARATION
- Consider the reason why you want a new process (are you reacting to a problem, or is it part of a new development? Are there other ways to achieve the same result – such as revising an existing process, training staff, making more or different resources available?)
- Agree how it fits with your overall structure and plans
- Identify the influences and constraints which may affect how it can work
- Identify the skills and knowledge required
- Identify the other resources required
- Gather together as much relevant knowledge as possible

DEFINITION
- Involve and communicate with all those who will be affected
- Decide on a "process owner" (to be "accountable" for the success of the process)
- Clarify the objectives of the process
- Identify the (intended) outcomes
- Define the "scope" (where it starts and ends, and the boundaries)
- Decide how success will be measured
- Define the "normal" sequence of events first
- Then cater for the "what ifs" and exceptional conditions
- Be clear who will be responsible for each task
- Specify who else may be involved in a task

IMPLEMENTATION
- Inform and train all those who will be involved
- Review progress and adjust if necessary.

Understand the Properties & Characteristics of a Process

A process is not just a list of activities. It can be identified or characterised in a number of different ways, such as by the event which initiates it, by how you name it or by the value it adds to what is "processed". All these elements may be relevant to a degree for any process.

Although there may be a desire to get a description of the activities down on paper or a flowchart sketched out as quickly as possible, you will benefit from taking a moment or two to think how the following properties and attributes can be defined for the process in question. It will help you to understand the process better as well as prompting you to assess whether it is achieving what it sets out to do.

It is important to consider the value added by each process, so techniques like Value Stream Mapping are useful as a way to visualise the current "as-is" state and a possible (improved) future state.

Objectives and Scope

What is the process designed to achieve? The **objective**(s) of the process may seem obvious, but it is likely that some of the higher level objectives of the business also need to be considered. So, satisfying a need for material is the obvious aim of Procurement, but there may also be underlying objectives to minimise stockholding or to develop a closer relationship with certain key suppliers. Supply chain management has for example been revolutionised through thinking "differently" and by the judicious application of technology. A supporting process such as this should always be designed to help meet the objective of the production process.

Which area(s) of your operation does the process cover? Defining the **scope** of a process spells out the extent of its application – for example, it may be restricted to a specific project or to a product group.

Influences and Constraints

"Influences" are factors which shape or constrain the process, such as:

- Objective(s) of the process / the organisation
- External standards and legislation
- Internal policies and values
- Risks and critical success factors
- The need (or desire) to measure performance
- Stakeholder expectations
- Assumptions
- The need to make best use of available resources
- Customer requirements and expectations
- The need to manage the outcomes from the process.

With a process-based approach to management systems design, you will need to understand how these external influences and constraints apply to each process – this will require a good understanding of the standards, laws and regulations as well as the ability to interpret them in relation to a specific process.

Do not forget to consider the assumptions you may (perhaps unthinkingly) make when defining the process, and the assumptions made by the people working in the process.

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You may also benefit by considering how people may influence the process as "suppliers". By this we do not (just) mean the people who provide the input(s) or raw materials, but also those who influence the operation of this process without perhaps having an actual "hands on" involvement. For example, board members and shareholders influence the top level "running the business" process (some would say that the stock market has an undue influence at the expense of customers).

Risks and Critical Success Factors

What has to happen (or not happen) for the process to be successful? This is equally relevant when you look at the business planning process as it is for identifying and assessing risks as required under both environmental and health and safety regulations.

Unexpected and unplanned side effects – perhaps on the environment, the community, your staff, your suppliers and even on other processes – may be crucial. A formal risk assessment will identify potential problems in areas such as health and safety and the environment.

Companies quoted on the London Stock Exchange are required by the Turnbull report to acknowledge, understand and act to control their operational risks. It recommends that they introduce and apply internal controls on how they operate, and disclose their policies on identifying and managing risk in their annual reports.

Resources Required

What resources are needed for the process to function properly? Resources can be physical, for example:

- manpower
- electricity
- premises
- equipment
- finance

or they can be in the shape of knowledge, skills and competencies.

People are obviously a key resource within any process which is not totally automated, and they are usually sufficiently important to be treated as something slightly more than "just" a human resource.

Characteristics such as technical knowledge, telephone skills and the ability to work under pressure are often as vital as physical resources. Identifying such requirements is essential, because you must ensure that the people whom you allocate to a process do in fact have the required competence, and this links to the wider issue of job specifications, staff induction processes and training.

Measures / Key Performance Indicators (KPIs)

"If you cannot measure it then you cannot manage it" is a mantra of management which can cause some misplaced effort and reaction. You need to be very sure that you are measuring something useful and meaningful. This requires high quality and relevant information, rather than large volumes of data, to enable timely intervention by management.

Measures such as the average time to respond to an incoming telephone call or the number of rejected parts per hundred may be useful and indicative of efficiency within a specific process, but the pressure to attain targets can often lead to shortcuts being taken in other areas which affect quality of service.

The whole question of targets and measures is a complex one. The UK government's attempt in 1999 to reduce waiting lists and times in the National Health Service (NHS) is a prime example. Did the processes become more efficient as a result, or were resources diverted to badly performing areas?

Were the criteria for selecting patients changed so that more "easy" cases were dealt with at the expense of those who otherwise would have been given priority? Was the objective of the process lost somewhere along the way?

As an example of measurement in action (or perhaps in question), ISO9001:2000 requires that "the organisation shall monitor information on customer satisfaction". What does "customer satisfaction" mean, and how (and when) should you gather information on it?

Research by **Martin O'Neill of Edith Cowan University** in Western Australia indicates that customers' perceptions of a visit to a tourist attraction changes over time, so the usefulness of a satisfaction survey may depend on its timing. And what if your customers are such that they do not stay around long enough for you to ask them anything?

Despite this, it is sensible to identify and apply (statistical) measures (performance indicators) to see how well the objectives of the process have been met. Does it do the job? How well does it do the job? "Opinion" is the alternative.

And once you have all this in place, how will you check that the process is being followed (method of audit), that the process is effective and efficient, and that possible improvements are identified and considered (method of review).

Beware, however, of using "measures" to build "league tables" which do not take account of the fact that normal variation dictates that i) performance varies over time (ref the use of "Control Charts") and ii) in any set of figures there must always be at least one at the top of the list, and at least one at the bottom of the list, and the position does not of itself imply "quality" (good or bad).

Identifying Requirements

Since one of the keys to staying in business is to "satisfy customer requirements", it is obviously essential to identify their needs and expectations in relation to the goods and services to be provided, as well as a range of other requirements relating to the product and its delivery. You make and deliver products to customers by means of a set of processes, and if your products are to be acceptable then your operations (your processes) must be effective and efficient.

You might expect that the paying customer is best placed to specify the characteristics of the required goods or services, although experience suggests that this is not always the case. Sometimes the customer does not know what is possible and so does not ask for it, and has to be guided through the requirements stage using your own, or even your suppliers, expertise.

The intended use of the product must be established where possible. The customer is not always the end user, and in some situations may not know who they may be. When you are making for stock rather than to order, you are in practice working to your own vision of a "customer", which must be based on market knowledge and past experience where possible.

Whereas some legal restrictions on the use of materials and end use may be obvious, it is your responsibility to establish what restrictions if any there are in terms of manufacturing, delivery and use (which may depend on the country and the type of user).

You will have your own requirements to be satisfied, such as the required level of profit, brand and image development and reputation management as well as issues relating to Health and Safety, Security and Environment during production, delivery, usage and eventual disposal.

Whilst you should identify the value added by the process, you should also identify (potential) waste. Waste (Japanese: "muda") is the use of resources beyond those required to produce the product. **Taiichi Ohno** (the "father" of the Toyota Production System - qv) devised what is now known as the "**Seven Wastes**".

They are:

1. Overproduction and early production - producing over customer orders, producing unordered materials / goods.
2. Waiting - hanging around, idle time (time when no value is added to the product).
3. Transportation - handling more than once, delays in moving materials, unnecessary moving or handling.
4. Inventory - unnecessary raw materials in stores, work in process (WIP), & finished stocks.
5. Motion - movement of equipment or people that add no value to the product.
6. Over-processing - unnecessary processing, work carried out on the product which adds no value.
7. Defective items - which require rework or go to scrap.

Another seven wastes have been added to the list in more recent times:

8. Untapped human potential
9. Inappropriate systems
10. Wasted energy and water
11. Wasted materials
12. Service and office wastes
13. Waste of customer time
14. Waste of defecting customers.

Reducing these where they occur will obviously be beneficial – but it is better to anticipate and avoid them when the process is designed at the outset.

You also need to think about the "customers" or "stakeholders" of the process. This does not just mean the customer who is paying the bill, but also those who are affected by the performance of the process. Whose interests should be considered? As well as the obvious "customer", the following is a list of some of those who may be affected in one way or another:

- a supplier
- the local community
- the staff involved in the process
- staff involved in the next process down the line
- the end user (who may not be your customer in every case).

The production process may require rapid application development (for software), robust design (manufacturing), prototyping, pilot sites etc to manage the development and to test the product. The effect on other processes and products must be considered if you have limited capacity. All of which requires suitable planning before you commit time and resources to a project.

At a higher level, the use of modern software systems can now facilitate "enterprise" planning whereby an organisation can be managed holistically to link the tactical with the strategic to enable dramatic results to be achieved in taking "products" from concept to customer at lowest cost.

Product Design

You may be able to amend an existing product (as in the case of adapting existing training course) and this can help you to build on past experience and success. In software development, it is often beneficial to re-use existing code (and to develop code in a modular format so that it can be used again) rather than starting from a blank piece of paper. There needs to be a balance between pragmatism and innovation, and this will be driven partly by the corporate strategy and also by the expectations of the customers.

Just as goods can be produced as one-off orders, in small batches or in large scale production runs, so a service (such as a training course) can be a single customised presentation, a regular scheduled event or a "bundled" and intrinsic part of a software installation. A service can be an intrinsic part of a product (as in the installation of equipment) or can be discrete projects (as in delivery of a tailored training course). They do, however, closely resemble processes in as much as a standard service may have a generic outline but the detail may vary depending on the specific customer, the staff involved and other factors which may have an impact on each delivery.

At one extreme, the aim is to minimise variation each time the service is delivered, and on the other it is based on providing a customised service which recognises the characteristics of the specific situation and relies on those involved to make judgments and adapt the delivery to suit.

Dick Powell, director of product design consultancy **Seymourpowell Ltd** (www.seymourpowell.co.uk), sets out the essentials of product design on the **Design Council** website (see Sources below). Although this relates to new consumer products, many of the steps echo what should be done at least to some extent (but often isn't) when responding to a request for many types of goods and services. To summarise:

"*Product design typically involves a series of different phases, each one of which helps to build certainty and understanding as the focus of work narrows.*

Briefing: describes what is required. A brief can be complex, or not created until all influencing factors are better understood. Invariably, clients work with the design team to help put the brief together. Bringing designers in early improves the client's vision of what they could have alongside what they think they should have. Typically, the "brief" is a file containing a record of all of the relevant factors and documents. Briefing usually encompasses three main views:

Marketing (describes the anticipated product and its functionality)

- *"Must haves" and "wish list" of functions and features*
- *Any supporting research findings*

Technical

- *Restrictions on investment for new tooling, existing components to be reused*
- *Preliminary product specification covering performance, cost and intended manufacture, and standards that need to be respected*
- *Will clarify or key functional criteria that are likely to influence a future design*

Commercial (covers all aspects relating to sales and distribution)

- *ROI (Return on Investment), and sales planning (targets and forecasts)*
- *Key account needs*
- *Commercial implications for the new product in relation to other products*
- *(Normally would include documents and reports*)."

World class companies use regular "gate" reviews to ensure that the "product" still meets the original brief and indeed that the brief itself is still relevant. Typical design stages would include:

- Background research
- Strategic considerations
- Idea generation and innovation
- Concept design
- Concept development
- Design development
- Design of parts / specification / prototyping / tooling
- Production.

Verification and Validation of Processes and Products

These two terms ("verification" and "validation") can also cause problems of interpretation, especially when you refer to the definitions from ISO9000:2000:

Verification *is "confirmation, through the provision of objective evidence, that specified requirements have been fulfilled".*
NOTE 2 Confirmation can comprise activities such as

- *performing alternative calculations*
- *comparing a new design specification with a similar proven design specification*
- *undertaking tests and demonstrations*
- *reviewing documents prior to issue.*

Validation *is the confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled.*
NOTE 2 The use conditions for validation can be real or simulated.

By way of explanation:

Verification is a process to evaluate whether goods or a service comply with a regulation, specification, or other conditions defined at the start of a development process. Verification can take place at any appropriate stage during development or production.

Validation is a process to establish documented evidence that provides assurance that goods or a service accomplishes the intended requirements. This can involve acceptance and suitability tests with external customers.

So verification might be characterised as "looking back" to a preset requirement and "validation" as "looking forward" to a specific application.

Products

Validation of a product should demonstrate that it meets the needs and expectations of customers (and other interested parties). Validation may include testing, modelling, simulation and customer reviews. It should encompass:

- quality policy and objectives
- capability of equipment
- operating conditions for the product
- use / application of the product
- disposal of the product
- the product life cycle
- the environmental impact of the product.

When designing and developing products or processes, management should ensure that the organisation is not only capable of considering their basic performance and function, but all factors that contribute to meeting the product and process performance expected by customers and other interested parties. For example, you should consider life cycle, safety and health, testability, usability, user-friendliness, dependability, durability, ergonomics, the environment, product disposal and identified risks Timing is another key factor - is it the right time to launch the product, and do you have the resources available to satisfy the potential demand?

Processes

Process validation should be carried out at appropriate intervals to ensure timely reaction to changes impacting the process. Particular attention should be given to validation of processes:

- for high value and safety critical products
- where any deficiency in the product will only be apparent in use
- which cannot be repeated
- where verification of product is not possible.

You should ensure that you control product or process changes to ensure that they benefit the organisation and satisfy the needs and expectations of interested parties. Changes should be identified, recorded, evaluated, reviewed, and controlled in order to understand the effect on other processes and on customers and other parties.

Sources

ISO9000:2000 Quality management systems - Fundamentals and vocabulary

ISO9001:2000 Quality management systems – Requirements

Management Standards Centre (www.management-standards.org) (responsible for developing a new set of National Occupational Standards (NOS) for management and leadership)

American Productivity & Quality Center (APQC) Founded in 1977, APQC is a member-based non profit organisation serving approximately 500 organisations worldwide in all industries. (www.apqc.org).

The Design Council (www.designcouncil.org.uk/en/About-Design/Design-Disciplines/Product-design/)

This is one of four modules written in 2007-2008 by Peter Fraser of MandOS for the Chartered Quality Institute (CQI)'s Body of Quality Knowledge (BoQK). The BoQK (see www.thecqi.org/knowledge) is the framework that defines the current boundaries of knowledge of the quality profession in the UK. It acts as one of the foundations that defines the quality profession and provides the basis for regulation.

The categories of the BoQK are:

- Concepts of quality, its history and development
- Customers, suppliers, other stakeholders and markets
- Interactions of organisations and people
- Technologies and techniques
- Laws, standards, models, associations and professional bodies
- Corporate strategy.

The four modules are:

- **Specifying, Designing and Developing Processes, Products and Services**
- **Management Systems**
- **Elements of Corporate Strategy**
- **Evolution of Quality Thinking Post 1970**