EVERYTHING CAN BE IMPROVED.

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Supplier Selection

Supplier Selection is presented in the following topic areas:

- **Product/Service Requirements**
  - **Internal Design Reviews**
  - **Identifying Requirements**
- **Supplier Selection Planning**
  - **Supplier Comparison**
  - **Potential Suppliers Evaluation**
  - **Supplier Selection**

Internal Design Reviews

It is important to recognize that a design is intended to satisfy customer needs. This is where it all starts. The customer is often a mixture of both internal and external users. The internal customer provides the strategic and product requirements of the company and the external customer provides their specific product requirements.

Examples of internal customers and their requirements are detailed below:

Internal Customer	Requirements
Sales	Cost and quantity
Quality	Reliability and quality levels
Top management	Profit and gross margin
Manufacturing	Manufacturability requirements
Service	Serviceability requirements

Internal Design Reviews (Continued)

Examples of external customers and their requirements are illustrated below:

External Customer	Requirements
End user	Quality characteristics
Dealers, distributors	Service, storage, and delivery
Regulatory agencies	Safety, emissions

Design inputs (i.e. customer quality characteristics) may start out being vague such as "timeliness" and "fits in your pocket." On the other hand, they may be very well defined, such as, 24 hours a day, 7 days a week, or emergency service within 1 hour, or 1x3x4 inches.

The early process/product definition phase is often referred to as the design concept phase. During this phase, quality characteristics (ideas) are turned into written process or product design specifications. One quality tool used to translate customer ideas into design specifications is quality function deployment (QFD).

Both ISO 9001:2015[4] and ISO/TS 16949:2009[5] require a company to control design inputs related to the product, including applicable statutory and regulatory requirements. The company shall identify, document, and review their selection for adequacy. Furthermore, incomplete, ambiguous, or conflicting requirements shall be resolved with those responsible for imposing the requirement.

It would be impractical (as well as almost impossible) for the design procedure to provide all details in developing the design specification. Usually, the design procedure includes a design input checklist that is reviewed for each item.

Internal Design Reviews (Continued)

Refer to the design input considerations below:

Design Input Considerations

Customer drawings	**Market research results**
Customer contract	**Tooling, gages, fixtures, facilities**
Quality system requirements	**Training requirements**
Subcontractor requirements	**Sales (volume) projections**
Regulatory issues	**Serviceability requirements**
Statutory issues	**Manufacturability requirements**
Safety requirements	**Competitive analysis**
Product performance requirements	**Quality requirements**
Reliability requirements	**Price, cost, gross margin**
Warranty, repair, return history	**Design goals**
Design FMEA results	**Special product characteristics**
Product assurance requirements	**Special process characteristics**
Assumptions	**Bill of materials**

Each area of the checklist is reviewed to develop the design specification. An essential success factor is ensuring that the design specifications are quantified with a tolerance. An inability to quantify a design specification usually means that the requirements are not well understood. Additionally, some areas may need to be determined later. Both of these issues create risks in the design process.

Internal Design Reviews (Continued)

Design specifications may be developed with an iterative approach, in phases, or in stages. An example of the sequence of design specifications development is:

- **System**
- **Subsystem**
- **Module (printed circuit board, software, etc.)**
- **Component or material**

Once the design specification phase starts to take shape, a design review should take place. A design review is usually considered mandatory when the design specification (concept phase) is complete, or complete enough to assign engineers to the task of making the design specifications real hardware prototypes.

The design process is usually identified with product (versus process) designs. However, the exact same approach can be easily identified with process designs (development). Manufacturers can use the same process for introducing a new part or process into manufacturing. A company can use the design process to implement either ISO 9001:2015[4] or ISO/TS 16949:2009[5] in their organization. Obviously, in this last case, a process is being designed (or developed).

A design review is a documented, comprehensive, and systematic examination of the design progress to ensure it is capable of fulfilling the design inputs and the design specification. The review communicates design project status, progress, results, and changes, and also identifies potential and real areas of risk. The design review process is established by management policy or customer specifications, or both.

Often a product design requires trade-offs between conflicting aspects of reliability, maintainability, cost, weight, ease of manufacture and performance. The final decision on a product design, therefore, depends heavily upon the experience of members of the design team.

Both ISO 9001 and ISO/TS 16949 state that systematic reviews of design and development are to be held at suitable stages to evaluate the capability to fulfill requirements, identify problems, and propose follow-up actions.

Internal Design Reviews (Continued)

The membership and responsibilities of a typical design review committee are shown in Table 4.1. This is a representative committee only. The membership and responsibilities in a design review will vary considerably, based on the type of review under consideration. The participants will come from marketing, manufacturing, engineering, purchasing, quality, reliability, tooling and other management functions. The size of the review committee varies, dependent upon the complexity of the product.

Member	Review Phase					Responsibility
	I	II	III	IV	V	
Chairperson (of design function)	X	X	X	X	X	Calls and conducts reviews; issues all reports
Design engineer (of this product)		X	X	X	X	Prepares and presents the design approach
Independent design engineer		X	X	X	X	Reviews and verifies adequacy of design
Customer or marketing representative	X	X	X	X	X	Ensures that the customer's viewpoint is represented
Reliability manager or engineer	X	X	X	X	X	Evaluates the design for reliability
Materials/stress engineer		X				Verifies stress calculations and material usage
Human factors/safety engineer		X	X			Ensures product safety in use and manufacture
Manufacturing engineer			X	X	X	Ensures cost effective manufacture
Quality engineer or quality representative		X	X	X	X	Reviews inspection and test capabilities
Test engineer			X		X	Presents test procedures and results
Others						As required

Table 4.1 Membership and Responsibilities of a Design Review Committee

Internal Design Reviews (Continued)

Each review committee has a designated chairperson (not the design engineer) who has general management experience, design understanding, and technical knowledge of the various disciplines involved. The design review considers all important factors in the creation of a mature product design.

- **Are customer performance requirements met?**
- **Is the design as simple as possible?**
- **Are proven components and configurations used?**
- **Are manufacturing tolerances adequate?**
- **Is the manufacturing process capable?**
- **Are approved parts used in all practical cases?**
- **Are environmental requirements met?**
- **Are operational conditions considered?**
- **Are maintainability features present?**
- **Are there provisions for testing and inspection?**
- **Have potential failure modes been analyzed?**
- **Has a worst-case analysis been conducted?**

The design process goes through several phases. Examples of typical design phases and purposes are:

Design Phase	Purpose
Concept	Acquire and document design inputs
Design	Convert design inputs into documented specifications
Prototype	Convert design specifications into hardware
Pre-production	Pilot runs, capability analysis studies and confirmation
Deployment	Full production
Final	Determine the success of meeting the design inputs

Design reviews should be conducted at the end of each phase. It is important that relevant stakeholders attend the design review. There should be a consensus among the relevant stakeholders, experts, and independent reviewers that each phase has been successfully completed, and the project is ready to move forward.

Obviously, all items are not always simultaneously successfully completed. Any incomplete items must be addressed, along with new issues, and action items raised during the next design review. The formal closure of all items should be documented. A major component of design reviews is the qualification process, which includes verification and validation.

Identifying Requirements

The customer must take steps to insure that the supplier's quality program is adequate. Additionally, a customer must take steps to ensure that their own quality program is adequate.

Bossert (2004)[3] refers to the three Ps of evaluation:

Program: This judges the effectiveness of a supplier's efforts to provide an adequate product. Considerations are given to supplier's facilities, workspace. and number and types of employees.

Product: Evidence is gathered on the degree of product conformity to specification and design. It may be helpful to compare a large number of identical products for a lengthy time period.

Process: This involves the interaction of manufacturer management, workers, and machinery to provide a satisfactory end product. The following overall process elements are examined:

- **Are process performance goals set?**
- **Are there adequate procedures for attaining these goals?**
- **Are control procedures implemented?**
- **Are process performance goals achieved?**
- **Is improvement undertaken when a need is indicated?**

The best way to control and improve quality is to prevent nonconformity. Many of the following supplier principles determine the success of both the supplier and customer:

- **Control of quality management: Are there adequate planning, direction, and control in how products are measured and evaluated?**

- **Control of design improvement: Are specifications current as applied to the product? This is known as document control.**

- **Control of procurement: Do suppliers control the raw materials that go into the product?**

- **Control of material: Is the product material adequately identified, stored, issued, and used?**

- **Control of manufacture: Are processes adequately controlled to produce a conforming product? This will reduce waste and excessive variability.**

Identifying Requirements (Continued)

- **Control of acceptance: This is verification that the finished product meets the design intent. This can be referred to as an inspection and testing component.**

- **Control of measuring instruments: Measuring equipment must posses adequate precision, accuracy, and reliability.**

- **Use of quality information: Quality information should be directed towards the product and process. More importantly, it should be available on the production floor. (Bossert, 2004)[3]**

Russell (2014)[9] provides the following incomplete list of customer requirements:

- **Product description**
- **Product quantities**
- **Delivery due date**
- **Agreement on prices, rates, or fees**
- **Approval of products and procedures**
- **Approval of processes and equipment**
- **Adequate management systems**
- **Drawing and process data control**
- **Test specimen requirements**
- **Adequate record retention**
- **Age control requirements**
- **Notification of management changes**
- **Notification of nonconformances**
- **Product shelf life information**
- **Adequate identification and traceability**
- **Right of plant access as required**
- **Shipping requirements**
- **Labeling and packaging requirements**
- **Source/first article inspection requirement**
- **Certificate of conformance**
- **Certificate of compliance or analysis**
- **Financial terms and methods**
- **Sub tier supplier requirements**

Supplier Comparison

The CSQP student should note that a number of supplier measurements such as quality, timeliness, delivery, cost compliance, and subjective areas are reviewed in Primer Section VI. Russell (2014)[9] states that the following factors are important when comparing and evaluating suppliers.

Financial stability: Review the financial reports of suppliers to ascertain their financial stability.

Management and employee capabilities: This entails an assessment fo key management personnel. This would include management interviews and organizational competitiveness. The history of workforce turnover and labor union activity should also be considered.

Process and technological capabilities: An evaluation should be made of the supplier's capabilities. This considers design strength, technology methods, and capital equipment. Additionally, there should be an assessment of the ability of a supplier to remain current with future technologies.

Cost structure: Understand the supplier's costs. This includes approximate values for direct and indirect expenses, overhead, production, and processing costs.

Supplier quality, security, safety, and environmental compliance: This review entails an indication of how the supplier adheres to:

- **Industrial standards**
- **Governmental standards**
- **National standards**
- **International standards**
- **Guidance standards**

Included in the above are a number of quality, security, safety, environmental, and socially responsible actions.

Production and scheduling systems: Are the supplier administrative operation controls adequate? A purchaser may need to know if the suppliers production, inventory, scheduling and delivery systems are adequate to anticipated needs. There may be a need for ship-to-stock (STS) and just-in-time (JIT) procurement.

Supplier sourcing strategy: Are there risks in the supplier's procurement system? If there are outsourced critical parts, the sub-supplier may need evaluation also.

Supplier Comparison (Continued)

Long term relationship potential: Is there sufficient alignment with the purchaser's goals to support a long term relationship? This could be very important.

The quality of materials and supplies determines the quality of the end product in many instances. As long as a company buys from the lowest bidder solely on price, an elaborate system of inventory management must be maintained. This system includes the inspection and staging of the material. Only approved material can be released to the process. Non-approved goods must be stored and returned with all the encompassing costs.

Today, companies are intensifying pressure to reduce idle inventory and maintain product quality. Increased cooperation between supplier and the end user is required. To make this feasible, the customer must rely on fewer suppliers and demand that quality standards be met with minimal or no incoming inspection. Involving suppliers in new product development, in self-administered audits and surveys, and creating long-term contracts are all directions to ensure greater supplier reliability.

Suppliers may be selected by either an internally developed rating system or by use of external certification models or some composite of the two.

Internal Supplier Evaluation Systems

Juran (1999)[6] describes the process of supplier evaluation as:

- **The evaluation of product samples**
- **The evaluation of the supplier's manufacturing processes**

Evaluation of the Supplier Through Product Samples

In this stage, the customer requests product samples from the supplier. Customer approval stages arise at each phase of the production process. A typical sequence would be as follows:

1. **Supplier creates a prototype that meets requirements**
2. **If prototype is accepted, additional production samples are produced**
3. **The customers tests the production samples**
4. **If acceptable, production is started**

Internal Supplier Evaluation Systems (Continued)

Evaluation of the Supplier's Processes

Juran (1999)[6] says there are three possible manufacturing process evaluation vehicles:

- **Prior product performance**
- **Process capability analysis**
- **Quality system review**

Prior Product Performance

This technique states that the best predictor of future product quality is past performance. Information is available from inside sources, other plants, or from government data banks.

Process Capability Analysis

In some situations, capability studies must be performed on various products to verify that the process is capable of meeting the specifications. The current AIAG PPAP (Production Part Approval Process) requirements state that process capability studies shall be submitted for identified product characteristics. An initial production index value $\geq$ 1.67 P_{pk} is required on these characteristics. An ongoing product capability of $\geq$ 1.33 P_{pk} must be maintained.

Quality System Reviews

A visit to the supplier's site may be required for this evaluation. The usual steps are:

- **Assemble available information on the supplier**
- **Collect pre-survey data from supplier**
- **Organize the survey team (comprised of quality audit specialists)**
- **On-site survey of supplier (Juran, 1999)[6]**

An on-site survey is dependent on the size and resources of the customer and on the dollar volume (or critical nature) of the supplier. Only the largest customer can afford to audit most of their suppliers. A minimum dollar volume may be needed before an on-site survey is conducted. A site visit may be necessary for only the most critical of parts.