

ME170

Term Design Project Tools

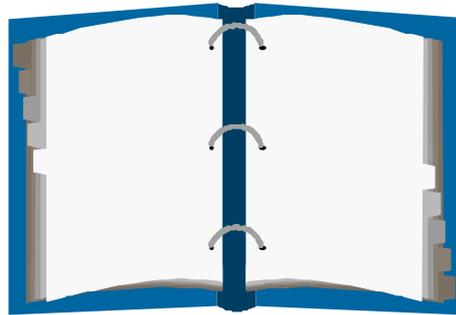
Product Design Specification (PDS)

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Product Design Specification (PDS)



The PDS is a structured document defining the agreed requirements to be met by all aspects of the enterprise to achieve a successful new model or product

Inter-Departmental Communication?



What Marketing Requested



What Sales Ordered



What Engineering Designed

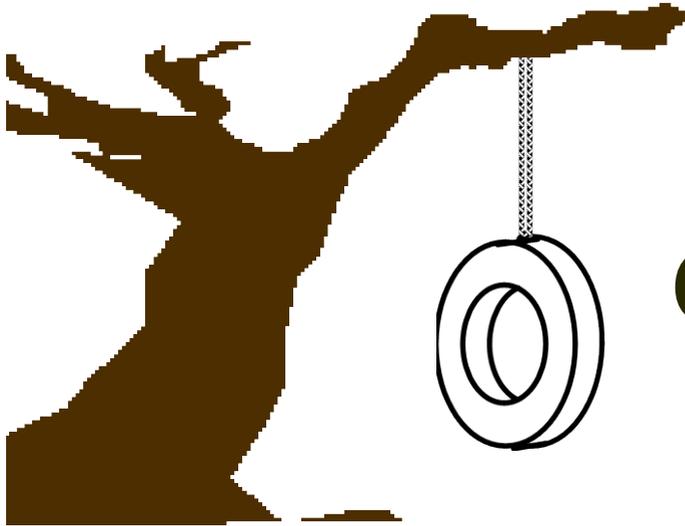


What was Manufactured



What was Installed

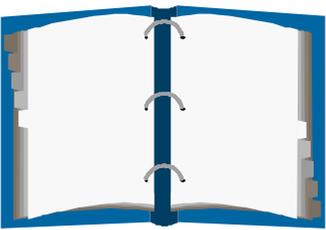
|| Goal of PDS - Unifying Document



**What the
Customer
Wanted!**

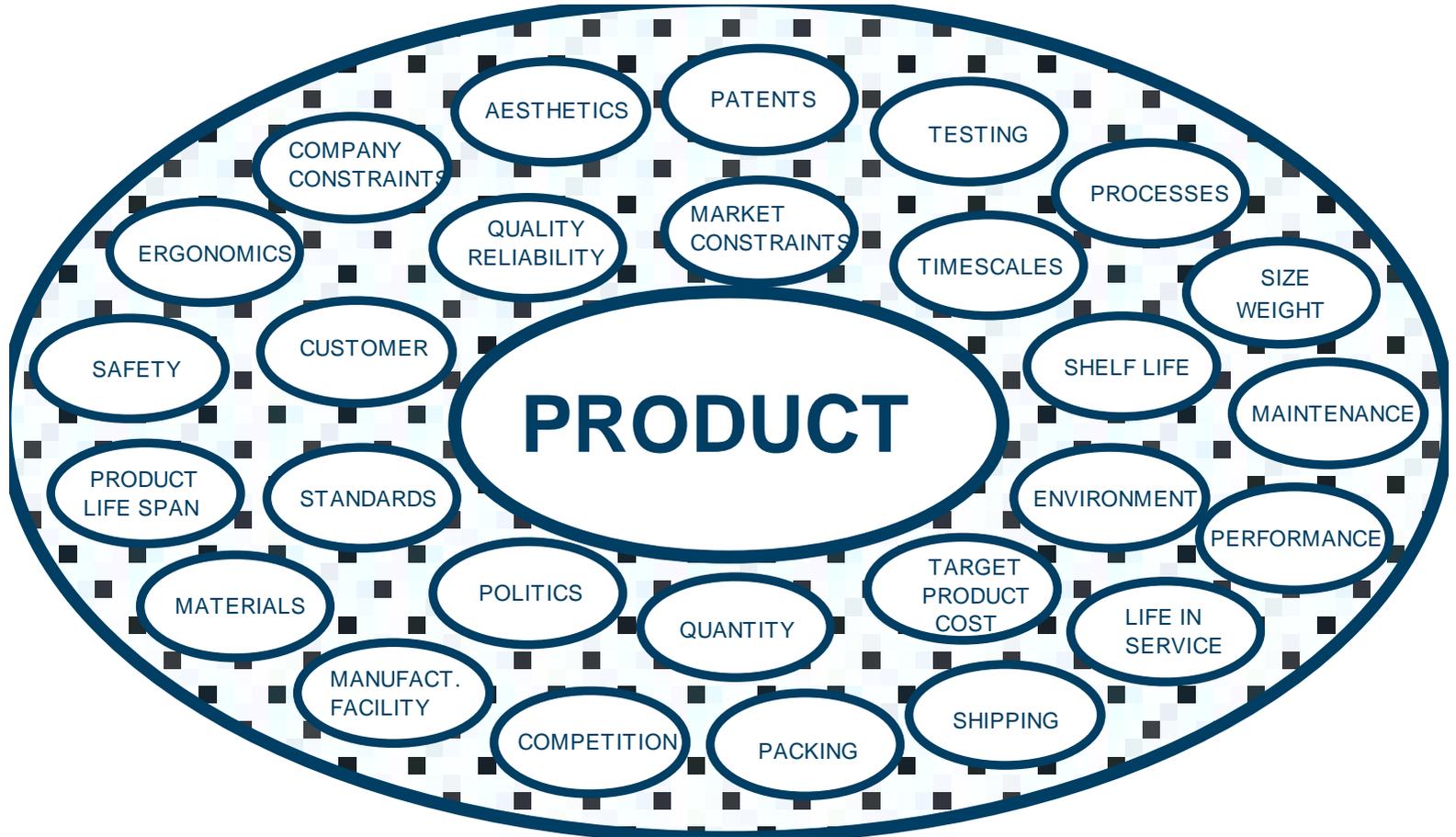
**What the Customer Wants = What Marketing Requests = What Sales Orders =
What Engineering Designs = What is Manufactured = What is Installed**

Role of the PDS



- ◆ **The PDS is the basic reference source - If used properly, and combined with effective product reviews, it may be used as the main control mechanism for the product development activity.**
- ◆ **The PDS evolves and changes - multidisciplinary team structure assists immediate awareness of changes to the PDS by all areas of the business.**
- ◆ **Preparation of the PDS should be a disciplined activity involving all areas of the business. The following Primary Elements (a.k.a. the 'Design Boundary') provide useful triggers:**

The Design Boundary





1. Performance

Clearly, the performance demanded or likely to be demanded should be fully defined:

- Speed - how fast, how slow
- How often, continuously or discontinuously
- Loadings likely - electrical, hydraulic, pneumatic
- Precision - accuracy, repeatability, resolution
- Tolerance of speed, rate of working etc.

The following should be guarded against:

- Ambiguities
- Over-specification

2. Environment

All aspects of the product's likely environment should be considered & investigated - during normal use, mfg., storage, transportation, and display:

- **Temperature range**
- **Pressure range (altitude)**
- **Humidity**
- **Shock Loading (gravity forces)**
- **Dirty or Dusty - how dirty? - how clean?**
- **Corrosion from fluids - type of fluid?**
- **Noise levels**
- **Insects**
- **Vibration**
- **Type of persons who will use or handle the equipment - likely degree of abuse**

3. Service Life

- ***Should service life be short?*** - advantages in high product turnover creating more jobs, consumers like new products, lower cost alternatives possible, etc.
- ***Should service life be long?*** - advantages in high product image, consumers want 'high quality' now, ecology/resource wastage etc.
- ***How long, how short, and against what criteria?*** (i.e. hours, days of operation, distance travelled, no. of revolutions, no. of cycles.

4. Maintenance

Designed for maintenance free op.?

- Is it economic? Is it essential?
- Is the market into which the product will ultimately go, used to maintaining equipment?
- What would the customer/user expect?

Is regular maintenance desirable?

- Is it available?
- Specify ease of access/maintenance to the parts likely to require maintenance

What is the maintenance and spares philosophy of the company?

- Would consumable spares add revenue?
- Is a need for special tools likely, desirable, or unacceptable?

5. Target Costs

Target Design and Mfg. Costs

- Should be established from outset.
- Should be checked against existing products to avoid usual under-estimating
- If at any stage it is obviously unattainable then it may be necessary to compromise with other terms of the PDS, or abort the project.
- What is the likely investment required? Can the company afford to tool-up? what limit is there to this and over what period should tooling costs be recovered?

Target Retail Cost

- Is it compatible with competitors' products?
- Can sufficient profit be made? have mark-ups for others in the chain been established?

6. Competition

A thorough analysis of the competition must be carried out; e.g. parametric studies through a comprehensive literature search, trade shows etc, and detailed examination of *actual* products or systems.

- **It is very easy to "re-invent an inferior wheel"**
- **If the evolving PDS shows serious mismatches or deficiencies when compared with what already exists, then these must be fully understood.**

In order to stay in business, more and more companies are carrying out these sort of searches and parametric studies very thoroughly indeed.

7. Shipping

It is necessary to determine how the product is to be delivered:

- In bulk to the company's warehouse
- Directly to the retailer or retailer's warehouse
- Individually by mail order
- By land, sea, or air
- Home or overseas
- Type and size of truck
- Own distribution fleet, sub-contract, or retailer
- Pallet container (ISO), transit case (DoD)
- Shipping costs (may have effect on max. dimensions - particularly if relying on mail order)
- Provision of lifting points (eye bolts etc.)

8. Product Volume (Quantity)

Likely, and aimed for, annual sales in terms of product quantity, or volume, should be established. This will affect all aspects of the product design:

- **Shape, and style possible**
- **Method of construction - choice of manufacturing processes**
- **Method of assembly**
- **Tooling: a small number off could require very little tooling; a moderate number, cheap temporary tooling; and a large number off, permanent expensive tooling.**

9. Packing

According to the type of product being designed, some form of packaging for transport, storage, advertising, shelf stability etc. will be required:

- **This can be a significant percentage of the product cost - it must be considered and a target given.**
- **Type of packaging should be determined at the outset, perhaps through market survey, as it may well impose design limitations on the product.**
- **To what extent must packaging inhibit against environmental effects such as corrosion, shock-loading, etc?**

10. Manufacturing Facility

- Are we designing to fill an existing plant?
- Do we have excess capacity in specific areas? Should we try and utilize this capacity? Do we have an inflexible FMS?
- Are there plans for new plant and machinery? How might this effect the design of the product?
- Make-in or buy-out policy: is the product constrained to techniques with which the company is familiar or has facilities for.
- Are we to plan a completely new factory, or new assembly area perhaps, for this product?

11. Size

Maximum Size:

- Compactness and portability are common general requirements
- Some products are primarily selected on a basis of size (e.g. powerbooks)
- Beware of products growing during the design process - no longer fits space, access for maintenance difficult...

Minimum Size:

- Sometimes necessary when ergonomics are important - e.g. hand controls, VDU's, trunk etc.

Optimum Size:

- User preferences, perhaps obtained from survey data, should be specified.
- In some cases the size may be standard, and may be an essential requirement (e.g. kitchen units)

12. Weight

As with size, maximum, minimum, and/or Optimum may have to be considered in many product designs.

Weight is important when it comes to handling the product:

- By the user (portability)
- By the distributor (shipping costs)
- Handling on the shop floor (processing and assembly)
- During installation

Weight may be governed by limits on flooring or other supporting structures, where large structures are involved.

13. Aesthetics and Finish

- **Difficult to specify and, therefore, in many instances, is left to each designer - the complaints come later!**
- **Sales, manufacturing and others will always criticize a design once it exists - these opinions, and specific professional advice (i.e. from Industrial Designers) should be obtained.**
- **Color, shape, form and texture of finish should be specified where possible. So often the appearance just happens and strenuous efforts are made afterwards to make it look better.**
- **Remember, the customer sees it before he buys it; physical performance comes later.**

14. Materials

- **If special materials are necessary and known, they should be specified. Similarly, if company policy or market studies indicate specific materials these should be specified in the PDS.**
- **The converse is also true. If it is known that certain materials should not be used, they should be specified. For example: Toxic materials in most consumer products, ferrous materials in microwave cookers, untreated steels in food processing equ., etc.**

15. Product Life Span

- **Some indication of the life of a product as a marketable entity should be sought. Is it likely to remain in production for 2 or 20 years? This can often be based on recent historical data for the particular type of product.**
- **The answers in this area can effect the design approach, market promotion approach, tooling policy, manufacturing facility, make or buy decisions, etc.**

16. Standards, Specifications, and Legal Aspects

- **Is the product to be designed to current international and/or national standards. If so these should be specified and copies obtained.**
- **It is much easier to design to a standard than to retrospectively attempt to modify semi-finalized designs to match such standards.**
- **Product liability relating to defects of specification, design, and manufacture are of increasing concern, as the product originators' liability increases.**

17. Ergonomics

- **All products have, to some degree, a man-machine interface.**
- **The likely nature of interaction of the product with man should be quantified where possible (For example: What heights, reach, forces and operating torques are acceptable).**



18. Customer

- **Specific and general information on customer likes, dislikes, preferences and prejudices should be understood and written down before the design starts.**
- **This may be obtained by discussion with potential or existing users, surveys, and examination of competitor's trends and specifications.**

19. Quality and Reliability

- It may be necessary to conduct special quality studies in the field to evaluate, plan and specify the required quality and reliability. It may be necessary to monitor quality assurance of suppliers, and insist on a particular minimum failure rate.
- Quality Measures - $\pm 6\sigma$, Defects per unit (DPU) or 'defects per million opportunities'
- In electronics, Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) are commonly quoted parameters.

20. Shelf Life

- **Must be specified and means to combat decay considered.**
- **Likely environmental conditions whilst in storage or on the retailer's shelf must be considered. Where possible the product should be capable of at least the typical required shelf life. Retailers do not like to have to cope with a lower than normal shelf life.**
- **In many cases it will be necessary to consider in the design ways of overcoming likely shelf life problems. (For example: Battery powered products may have non-removeable long lasting Lithium batteries or may require a simple means for the operator to insert after purchasing).**

21. Processes

- **Some companies will have their own preferred processes and specifications. Except in special circumstances, these should be used.**
- **If special processes are to be recommended they should be defined. (For example: special plating, flow soldering, surface mount processes etc.)**

22. Timescales

- **Lead times for concept designs, detail designs, prototyping, tool and die manufacture etc. should be determined, and made known to all, if an acceptable product development cycle time and product launch date is to be achieved (window-of-opportunity)**

23. Testing

- **Most products require some form of testing during manufacture, after manufacture, by the retailer or by the consumer, to verify the compliance with the product specification.**
- **Test procedures and specifications should be determined and added to the PDS. A new test facility may be needed, product design for rapid connection/disconnection to ATE may be required, or it may be necessary to supply retailers with special purpose equipment - these are some of the decisions that should be made prior to design.**

24. Safety

- **The safety aspect of the proposed design and its place in the market must be considered.**
- **Relevant safety standards and legislation covering the product type should be quoted and copies obtained (For Example: ISO 5724 'Safety requirements on Hospital Medical Electrical Equipment')**
- **Need for "Labelling" to give appropriate safety warnings should be established. Most electrical equipment requires this.**

25. Company Constraints

- **Is the product or project constrained by company practices? These constraints should be highlighted.**
- **Is the company constrained by its previous products? For example, is there a corporate product image that should be adhered to?**
- **Are there adequate in-house facilities and personnel for the research, design and development required?**

26. Market Constraints

- **Feed-back from the market place should be considered in terms of unacceptable conditions.**

***For example:* It is no good incorporating components from certain countries in products to be sold to Middle East countries; Patriotism can be very strong.**

- **Local and prevailing overseas opinions should be considered.**

27. Patents, Literature, and Product Data

- **All areas of likely useful information should be investigated and researched and in particular possible patent clashing should be known.**
- **If patents are known about, in detail, before the design starts, it is usually quite easy to avoid infringing them.**

28. Political and Social Implications

- ◎ Likely effect of the product upon the political and social structure of the markets or countries for which it is to be designed and manufactured should be considered.**
- ◎ Stability of the market, product features to avoid which may create social upset, and effect of consumer movements, are all issues that may need comment in the PDS.**

29. Disposal

- ◎ It is no longer possible to forget about the item after ownership has passed to the customer
- ◎ Non-biodegradable plastic packaging and items made from various materials present a problem of increasing magnitude - recyclability and ease of disposal have become major marketing/sales issues now.



PDS

Conclusion

- **These are the primary elements or 'triggers' to assist the preparation of a comprehensive PDS.**
- **The specification will be and should be subject to amendment and alteration with the passage of time and is, therefore, evolutionary.**
- **Upon completion of a design, the evolved specification provides the basic material for handbooks, sales and technical literature, and becomes the specification of the product itself (rather than the specification for its design).**