

PRODUCT DESIGN SPECIFICATION DEFINITION

The product design specification (PDS) is a document created during the problem definition activity very early in the product realization process. It lays the groundwork for all engineering design activities and ensures that all relevant factors are accounted for and all stakeholders are heard from. The PDS comprises your quantitative statement of what you want to design prior to starting to design it. In other words, the specifications of the PDS should be largely independent of any specific embodiment of your product, so multiple solution concepts are possible.

The purpose of the PDS is to ensure that your design actually addresses your customer needs. This is essential if your product is to succeed.

Begin by defining your *customer needs*, which are stated in the language of the customer, then converts those needs to *engineering specifications*.

Each specification may consists of a *metric*, a *weighting of importance*, *units*, a *marginal value*, and an *ideal value*. The *metric* is something that you can measure. The *weighting of importance* is scaled from 1, for low importance, to 5, for essential. *Units* correspond to your measurement; for example, mm for length or degrees C for temperature. The *marginal value* states the value, or range of values, for the metric that you feel the customer would be able to tolerate. The *ideal value* states the target for the metric that you hope your team can meet.

The PDS should consider the following information:

1) MARKET ISSUES

a) Potential customer base

- i) Who will buy this product? Why?
- ii) Have you listed all potential classes of customers?
- iii) Can we tap into a new segment of the market? How?

b) Market constraints on product.

- i) Who is buying this type product? Why?
- ii) What is currently selling?
- iii) What is currently not selling?

c) Expected product competition (These will be benchmarked!)

- i) If you were a customer, which of the competing products would you buy? Why?
- ii) What is the market share of each competing product?
- iii) What are the strengths of each competing product? Can we incorporate them?
- iv) What are the weaknesses of each competing product? Can we design around them?

d) Target product price -- OEM and MSRP

e) Target production volume and market share.

- i) Is there a market for this product? How do you know?
- ii) Is the potential market sufficiently large to justify investment in a new product?
- iii) Is the new product sufficiently better than the competition to gain customer acceptance?
- iv) How do we capture sufficient market share to justify the investment?

f) Expected product distribution environment.

- i) How will the packaged product be treated in shipping, storage, and on the shelf?
- ii) Are adequate shipping facilities available?
- iii) Will installation require a professional?

2) CAPABILITY ISSUES

a) Company constraints on product design, manufacture, and distribution.

- i) What are our manufacturing capabilities?
- ii) Should we manufacture ourselves or outsource? Why?
- iii) Should we manufacture locally in the USA or locate manufacturing in another country? Why?

b) PRP schedule requirements -- time to market.

- i) When should we have this product to market to capture maximum market share?
- ii) How much time should we allocate to design?
- iii) How much time do we need to implement a manufacturing process?

3) PRODUCT DESIGN & PERFORMANCE ISSUES

a) Expected product quality standards and requirements.

- i) What are the current aspects of quality in competing products?
- ii) What constitutes the highest levels of quality in this product? Why?
- iii) What are the highest levels of quality we are able to attain? Are they adequate? Why?

b) Expected product size and weight -- the voice of the customer!

c) Expected product aesthetics -- the voice of the customer!

d) Expected product ergonomic requirements -- the voice of the customer!

- i) Which user/operator features are desirable in this product? Why?
- ii) What are the problem areas for users/operators? Why? Can we design around them?

e) Expected product performance requirements -- the voice of the customer!

- i) Expected product shelf life.
- ii) Expected product service life.

- iii) Expected product power requirements.
- iv) What performance do you need? Why?
- v) How many function? Why?
- vi) What is the basis for your judgments?

f) Expected product reliability standards and requirements.

- i) What level of reliability can we expect when this product is manufactured? Is this adequate? Why?

g) Expected product safety requirements.

- i) Potential sources of product liability litigation.
- ii) Potential operator hazards.
- iii) Potential manufacturing and assembly hazards.
- iv) Potential for abuse.
- v) Potential hazards for small children, the elderly, and the handicapped.

h) Expected product service environment.

- i) What is the operating temperature range for this product?
- ii) What is the operating humidity range for this product?
- iii) Will the product be exposed to dirt or other contaminants?
- iv) Will there be any anomalies in power/fuel available for this product?
- v) How will the product be treated in service? What is the probability of injury?
- vi) What are the potential abuses of the product? What is the probability of injury for each mode of abuse?
- vii) What impact will the product have on its environment?

i) Expected product maintenance requirements.

- i) The general trend in consumer products is toward maintenance-free products.
- ii) If routine maintenance is required, can it be done by the owner/operator?
- iii) If professional maintenance is required, is there a network of conveniently located service centers? A training program will be required!

j) Possible off-the-shelf component parts.

- i) Which parts of this product be purchased instead of being made by us?
- ii) Is the quality and reliability of purchased parts adequate for this design?

k) Possible product materials.

- i) What are their strength requirements?
- ii) What are their rigidity/compliance requirements?
- iii) Is product weight of importance? Why?
- iv) Are there certain materials that more easily satisfy customer preference for color and finish?

l) Expected product recycling potential and expected disposal

- i) Does the disposal of this product constitute an environmental hazard?
- ii) Can parts of this product be effectively recycled by existing processes?

m) Manufacturing process requirements and limitations.

- i) Is protection from the environment necessary? In what way?
- ii) Is there a customer preference for a particular finish?
- iii) How do we minimize environmental impact?

n) Product packaging requirements.

- i) Can we use environmentally friendly packaging and packing materials?
- ii) How much packaging and packing materials are really necessary?
- iii) Applicable codes and standards to be checked.
- iv) Patents to be checked.
- v) Processes to benchmark.
- vi) Product part and prototype testing requirements.
- vii) Potential social and political ramifications.

Example (source: Stuart Pugh, *Total Design*, Addison Wesley, 1991)

Surveyor's Pole Stand. A surveyor's pole is used in land surveying for level and distance measurement. It is held vertically at a distance from a measuring device (a theodolite), which is operated by a surveyor. To allow the surveyor to operate independently, a self-supporting surveyor's pole is necessary.

The Product Design Specification (PDS) for the self-supporting pole is as follows:

Performance:	To be fixable in position within one minute. Its lower end to contact the ground, even when on irregular terrain. For use on soft or hard ground. The pole to be adjustable for angle so that it stands vertically on slopes up to 1 in 4.
Size:	Pole to be 2 m long and showing a "face" of 25 mm. A suitable base size could be X points on a circle not less than 600 mm in diameter. To fit in the trunk of an auto 1 m x 0.5 m x 0.5 m.
Cost:	Manufacturing cost plus \$20
Quantity:	Batches of 2000 – 5000 for domestic and international markets.
Maintenance:	Minimal (e.g., oiling allowed)
Finish:	Corrosion resistant to enable continued usage in environment specified.
Materials:	Light-weight – transportable – not easily damaged by impact.
Weight:	Five kilograms maximum.
Aesthetics:	Must present an image of robustness, reliability, and compactness.
Product life:	Twenty years.
Customer:	Surveyors in government and private sectors, domestic and international.
Standards/specifications:	To be checked.
Politics:	Not applicable.
Life in service:	Five years
Reliability:	Maximum 3% failure rate over service life.
Safety:	Should not have sharp projections; should be capable of being set up with gloved hands.
Environment:	Temperature range -20°C to 100°C; resistant to water, salt, dust, wind, ice, rocks, common solvents, oil, gasoline and the like; shock proof to 10 g wind speeds up to 25 mph.
Shelf life:	Five years.
Packing:	Standard pallets to appropriate ISO standards.
Time-scale:	Production to start nine months from specification date.
Testing:	Prototypes to be proven to meet PDS. No testing of production models (except for sampling).
Ergonomics:	Must be convenient to handle and store, easy to set up and dismantle, and be capable of set up by one person.
Competition:	To be analyzed.
Market:	Worldwide. Trends to be analyzed.
Patents:	To be checked.
Manufacturing facility:	Adequate capacity and suitable tools available.
Company constraints:	None at this stage.
Processes:	Batch production.