3

Product Performance and Specification

3.1 Introduction

A new product development process starts with a requirement statement, that is, a description of the required product functions and their related performance standards. This involves defining the product performance and constraints. Once this is done, we can derive a set of specifications that form the basis for the production of the product. In Chapter 1 we defined desired and predicted performance and in Chapter 2 we indicated that a product is a complex object that can be decomposed into several levels. As a result, we have a hierarchy of performance and specification and these are interlinked. In this chapter we discuss product performance and specification and their links in general and then focus on reliability performance and specification.

The outline of the chapter is as follows. We start with a discussion of requirements and constraints in Section 3.2. Sections 3.3 and 3.4 look at performance and specification in general and the links between them are discussed in Section 3.5. In Sections 3.6 to 3.8, we look at product performance and specification in stages I through III of the new product development process model proposed in Chapter 2. In Section 3.9, we integrate the discussion of Sections 3.6–3.8 and describe the overall process for decision making regarding performance and specification in new product development.

3.2 Requirements, Preferences and Constraints

In this section we discuss several issues that are relevant in order to understand product performance and specification.

3.2.1 Requirements

According to the Oxford Dictionary (1989):

Requirement, n. That which is required or needed; a want, need.

There are many different kinds of requirements in new product development. Requirements provide the basis for defining the need for a new product and for evaluating alternative options for a new product in the front-end phase. Requirements guide the designers towards correct design options, and provide the basis for verification and selection of potential design options during the design and development phases of the new product development. A guide on how to specify dependability requirements is given in IEC 60300-3-4. Gershenson and Stauffer (1999) suggest the following taxonomy for requirements:

Customer requirements: These requirements express the customers' expectations related to the product attributes (e.g., the fuel consumption of a car engine must be low).

Corporate requirements: These are business related requirements and may be related to all aspects of the product life cycle (e.g., the sales of new engines must exceed a certain figure to achieve the desired returns on investment) of concern to the different groups within the manufacturing firm (engineers, managers, marketers, etc.).

Regulatory requirements: These requirements are related to safety/health, environmental/ecological, disposal and/or political issues, and are often imposed by governmental agencies (e.g., the emission level must meet the new standards). This is further discussed in Chapter 10.

Technical requirements: Technical requirements include engineering principles, material properties and physical laws (e.g., the cylinder material must withstand a certain pressure and temperature). These requirements are usually found in handbooks and manuals.

All these requirements have to be addressed.[1] Another term that is important in the context of new product development is the following:

Functional requirements: According to Lin and Chen (2002):

> "This consists of a function and a requirement. A function states 'to do what' and the requirement is defined by a performance measure imposed either by a preference or a bound."

They define two types of requirement:

Type 1: A performance measure and a related preference

Type 2: A performance measure and a related constraint/bound

We will discuss performance in the next section and look at constraints and preferences in this section.

3.2.2 Preferences

The preferences identify what performance the different stakeholders (e.g., customers, corporate representatives) desire from the product, i.e., what performance the product should have.

[1] Gershenson and Stauffer (1999) use the term "customer requirements" to denote the four requirements stated above.

According to Prudhomme et al. (2003), preferences are not sufficient to characterize the needs of different stakeholders in the new product development process. They also use "flexibility" to indicate the degree of willingness to modulate the preferences (desired performance) for a given performance measure.[2]

Preferences are also linked to "prioritizing" the requirements according to the importance to customers and/or the different groups within the manufacturing firm. This is needed for trading different performance measures or assessing the overall "value" of alternative solutions for comparison purposes.[3]

3.2.3 Constraints

A constraint is a bound that restricts the range of a variable. In the new product development process there are various kinds of constraints – financial constraints (ability to raise funds for the new project), resource constraints (manpower available), time constraints (new product must be launched by some specified date) to name a few.

In the context of product design, Suh (2001) defines a constraint as a bound on either (1) a single external or internal product property, or (2) the relationship between two or more product properties and identifies two types of constraints: (i) input constraints that are identified at the onset of the new product development process, (e.g., constraints on size, weight, materials, cost) and (ii) system constraints that arise as the development progresses (e.g., the choice of a particular electronic part in one sub-system may impose constraints on the temperature generation in another part of the system).

Note that a preference may appear as a constraint in subsequent phases (e.g., the choice of a particular sub-system may subsequently result in spatial constraints).

3.3 Product Performance

3.3.1 Concept and Notions

According to the Oxford Dictionary (1989):

> *Performance,* n. The accomplishment, execution, carrying out, working out of anything ordered or undertaken; the doing of any action or work; working, action (personal or mechanical); spec. the capabilities of a machine or device, now esp. those of a motor vehicle or aircraft measured under test and expressed in a specification. Also used attrib. to designate a motor vehicle with very good performance.

A number of different definitions of performance can be found in the technical literature as illustrated by the following sample:

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[2] This is similar to differentiating between "demands" and "wishes," in much of the engineering design literature (see Roozenburg and Eekels, 1995).

[3] See Blanchard (2004) for further discussion.

- "Performance is the measure of function and behaviour - how well the device does what it is designed to do" (Ullman, 2003)
- "How well a product implements its intended functions. Typical product performance characteristics are speed, efficiency, life, accuracy, and noise" (Ulrich and Eppinger, 1995)
- "Product performance is described as the response of a product to external actions in its working environment. The performance of a product is realized through the performance of its constituent components" (Zeng and Gu, 1999)

As can be seen, these definitions imply that product performance is a measure of the functional aspects of the product. When talking about product performance, we must also bring in properties like form, durability, and price. As defined in Chapter 1, product performance is *a vector of variables*, where each variable is *a measurable property of the product or its elements*. The performance variables are concerned with both internal and external properties.[4] The performance variables can be:[5]

- Functional properties (e.g., power, throughput, fuel consumption)
- Reliability properties (defined in terms of failure frequency, mean time to failure, survival probability, etc.)
- Business properties (e.g., profit, return on investment)

The performance of a product depends on several factors. These include usage mode, usage intensity, usage environment, skills of the operator involved, and so on.

3.3.2 Types of Performance

In the context of new product development, we can define three different types of performance.

Desired Performance (DP)

From a consumer perspective, the desired performance is what the consumer expects from the product. For individual consumers, the desired performance is linked to consumer benefits, pleasure, and satisfaction. In the case of a car, the desired performance can be stated in terms of a maximum level for environmental pollution, minimum level for ride characteristics, and so on. If the consumer is a business, then the desired performance is linked to the business objectives. For example, in the case of an airline operator, the desired performance for a jet engine might be that its fuel efficiency is above some specified value, that is again linked to operating cost.

From a manufacturer perspective, desired performance forms the basis for new product development. The initial desired performance is established in the front-end

[4] As indicated in Section 2.2.2, a product can be decomposed into several levels starting from sub-system level down to component level. We can define performance at each level and Zeng and Gu (1999) state that the performance of a product is realized through the performance of its constituent components.

[5] Form (e.g., dimensions, shape, weight) can be viewed as a performance variable in some situations.

phase. Establishing the desired performance involves trade-offs between the desired performance and the following interacting factors (Zeng and Gu, 1999):

- Programme expense: Costs incurred in developing the product
- Development speed: Time from concept to launch/operation
- Production cost: The cost of manufacturing/constructing the product
- Economic performance: Revenue generated, and post-sale servicing expenses over the product life cycle

The desired performance that is arrived at will have direct implications for all four factors. However, as mentioned earlier, the desired performance is influenced by the following factors:

- Customer demands
- Technical feasibility
- Performance of earlier products
- Competitors' actions and competitive pressure
- Business economy
- Laws, standards, and directives

Predicted Performance (PP)

Predicted performance may be defined as "an estimate of an object's performance, obtained through analysis, simulation, testing, and so on." During the design phase, the manufacturer has to predict the performance of an object based on technical data from handbooks and catalogues.[6] During the development phase, the data obtained from limited testing forms the basis for predicting the performance of an object. Predicted performance of an object plays an important role in the decision making process, as will be discussed later in the chapter.

The following factors influence the predicted performance (in levels II and III of stage I; see Figure 2.4): (1) choice of design properties, (2) choice of models used for prediction, and (3) the quality of the data used in the prediction.

As physical testing starts at levels III and II of stage II, additional factors that influence the predicted (or estimated) performance (component level through product level) include: (1) test environment (normal versus accelerated testing, environmental testing), (2) test duration, and (3) methods used to analyse the test data.

Actual Performance (AP)

The actual performance of the product in the field is dependent on several manufacturing factors, such as quality control, production process capability, materials used, and quality of components supplied by vendors. The performance is also influenced by several customer related factors, such as usage intensity, usage environment, and maintenance of the product. Even storage and transport can, in some instances, influence product performance in the field. Therefore, the actual performance will vary from item to item as no two items will have exactly the same actual performance.

[6] An object can represent either the product, or some sub-system, assembly, module or component of it.

3.4 Product Specification

According to the Oxford Dictionary (1989):

> *Specifications,* n. A detailed description of the particulars of some projected work in building, engineering, or the like, giving the dimensions, materials, quantities, etc., of the work, together with directions to be followed by the builder or constructor; the document containing this.

Many different definitions of specification can be found in the technical literature as illustrated by the following sample:

- "A document stating requirements" (ISO 9000)
- "A specification is a means of communicating in writing the requirements or intentions of one party to another in relation to a product, service, a procedure or test. A specification may be written by the product supplier, the user, the designer, the constructor or by the manufacturer. [...] A specification may define general characteristics or it may be specific. [...] A specification consists of two parts, the first defines requirements, and the second defines the means by which compliance with requirements can be demonstrated." (BS 5760-4)
- "A specification (singular) consists of a metric and a value. The product specifications (plural) are simply the set of the individual specifications." (Ulrich and Eppinger, 1995)
- "The technical requirements for the system and its elements are documented through a series of specifications [...] top level specification leads into one or more subordinate specifications [...], covering applicable subsystems, configuration items, equipment, software, and other components of the system." (Blanchard and Fabrycky, 1998)
- "A specification is usually a document that prescribes, in a complete, precise, and verifiable manner, the requirements, constraints, expected behaviour, or other characteristics of a product or system." (Kohoutek, 1996)
- "The Product Design Specification (PDS) is a detailed listing of the requirements to be met to produce a successful product or process. The specification should say what the product must do, not what it must be. Whenever possible the specification should be in quantitative terms, and when appropriate it should give limits within acceptable performance lies." (Dieter, 1991)
- "In a design process, design requirements are represented by design specifications. Based on the specifications, candidate product descriptions are generated. Design specifications are the formulation of design requirements, which manifest themselves as a set of desired product descriptions or product performances." (Zeng and Gu, 1999)

As can be seen, the scope and focus of these definitions vary considerably. However, what they have in common is that a specification can be viewed as a means of stating the characteristics of a product at some stage in a development process. The Oxford Dictionary (1989) defines a specification as a document describing a process in detail, subsequent to development of the process. Others, like Dieter (1991), view the specification as a document that states the desired characteristics of a product or process prior to its development, a view shared by Zeng and Gu (1999). On the other hand, Ulrich and Eppinger (1995) and Blanchard (2004) define the specification as a document initially serving as input to the design process, but being refined as the design proceeds through different design phases. The initial specification of Blanchard (2004) is the system specification, and the final is the product, process and materials specification.

We define the specification of an object (product or system, sub-system, and down to part level) as:

> A set of statements about an object derived during the pre-development stage to achieve some desired performance.

The specifications for the three phases of stage I (pre-development stage) are different and there is a close link between performance and specification at each phase.

Note. In this book we use the terms *performance* and *specification* in singular form. The performance and the specification will, however, generally consist of a long list of statements.

3.5 Performance and Specification Relationships

There are two kinds of relationships between performance and specification as indicated in Figure 3.1.

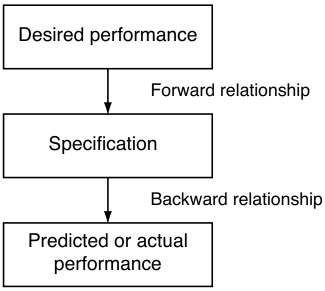

Figure 3.1. Two relationships linking performance and specification

Forward Relationship (Desired Performance to Specification): The desired performance outlines what is to be achieved in the new product development process. The specification describes how this performance can be achieved (using a synthesis process involving evaluation of alternative solutions to select the best solution), with the desired performance as input to the process. Thus, the specification becomes a function of the desired performance. Often there are several alternative solutions yielding the same desired performance. This results in several specifications (defining alternative solutions) so that the forward relationship is one-to-many. This relationship plays an important role in stage I.

Backward Relationship (Specification to Actual Performance): The predicted performance (of a product to be built to a stated specification) or the actual performance (of prototype or products released for sale), will, in general, differ from the desired performance used in the formulation of the specification. The predicted or actual performance can be viewed as a function of the specification. Note that this is a one-to-one relationship since a given specification leads to a unique actual performance of the product. This relationship plays an important role in stages II and III.

Note. The actual performance is affected by several uncertain factors beyond the control of the manufacturer. In this case, we need to define performance in a statistical sense so that the expected (or average) actual performance is related to the specification through a one-to-one relationship.

3.6 Performance and Specification in Stage I

Stage I involves three levels and we need to deal with performance and specification at each level. These are linked as indicated in Figure 3.2. In this section we discuss each level separately.

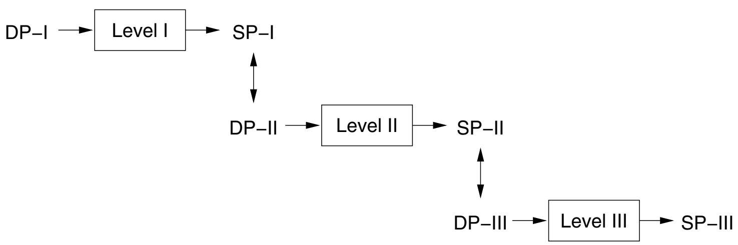

Figure 3.2. Performance and specification in stage I

3.6.1 Phase 1

The starting point of phase 1 (stage I, level I in Figure 2.4) is the recognition of a need (e.g., lower warranty costs, reverse declining sales) or opportunity (advances in technology, new market) for a new product as discussed in Section 2.5. The generation and screening of ideas, and understanding the customer requirements (often referred to as "requirements capture"[7]) are important for defining the desired performance DP-I in phase 1.

[7] See Cooper et al. (1998) for a model of the requirements capture process.

DP-I: The desired performance of the new product is defined from an overall business perspective. The performance of the product is viewed in terms of business objectives and business strategy and is defined through a number of elements, such as, market share, sales, revenue, return on investment, customer satisfaction, and so on, that define the overall business performance.

SP-I: The specification defines the product attributes (e.g., various functional features, such as speed of CPU, size of memory, and weight in the case of a notebook computer), product support (e.g., warranty, technical support) and other variables (e.g., customer satisfaction, reputation), and so on. As indicated earlier, there can be several SP-Is that can achieve the DP-I. Generating the different SP-Is is linked closely to idea and concept generation.

PP-I: Not all SP-Is will achieve the defined DP-I. We need to use models to determine whether or not an SP-I will achieve the desired DP-I. The model output is the predicted performance PP-I for a given SP-I. This needs to be compared with the defined DP-I to evaluate whether or not the SP-I under consideration will result in the DP-I being achieved. As a result, deriving SP-I is an iterative process that requires iterating back if the evaluation indicates a mismatch between DP-I and PP-I. If not, we move to phase 2 (level II). This process is shown schematically in Figure 3.3.

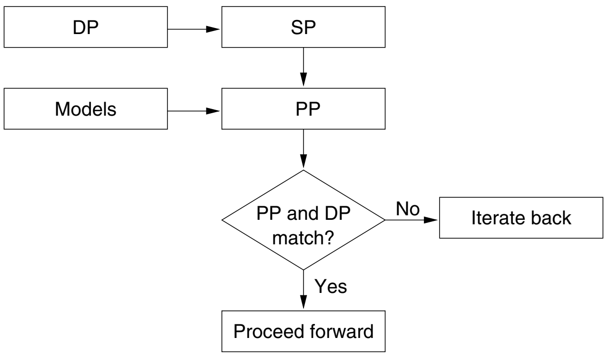

Figure 3.3. Iterative process for deriving SP

If no SP-I results in a match between PP-I and DP-I, then we either need to revise the DP-I or terminate the project. In the traditional new product development literature this evaluation is the main activity in the front-end phase and has received a lot of attention. The front-end activity is completed when a business either commits to the funding and launch of an new product development project, or decides not to do this.[8]

[8] Khurana and Rosenthal (1998) provide an extensive bibliography concerning the front-end of new product development.

Constraints

There are many different types of constraints that need to be taken into account when making decisions regarding DP-I and SP-I. Some of these are financial (e.g., limit on the funds available), resource (e.g., limits on technical and marketing manpower), technology (e.g., limits with respect to capabilities), and so on.

3.6.2 Phase 2

If the decision at the end of phase 1 is "proceed forward", then SP-I is communicated to the design team involved with phases 2 and 3 (levels II and III of stage I). The objective of phase 2 is to link product attributes to product characteristics that form the basis for designing the product.

DP-II: This is essentially SP-I from phase 1. However, it can include other elements that the design engineer might regard to be relevant in deriving SP-II.

SP-II: This defines the product characteristics. The starting point for the design team is to look at alternative system architectures for the product. Once this is done, we need to identify the relevant characteristics for the design process. The relevant characteristics (defined as technical statements) are scientific and technical in nature (e.g., product reliability to ensure a certain level of customer satisfaction or expected warranty cost to be below a specified value). Note that we may consider several variants of the product (each with different characteristics) to achieve the defined DP-II.

PP-II: A set of technical statements defining an SP-II might not ensure that it achieves the specified DP-II. As in phase 1, we use models to obtain a predicted performance PP-II for an SP-II and then we evaluate SP-II by comparing with DP-II. In other words, deriving SP-II is an iterative process as indicated in Figure 3.3.

Constraints

In addition to the constraints from phase 1, new technical constraints may arise. These could include, for example, whether the products use existing platforms or not; use of existing technologies or not; in-house versus out-sourcing of design and manufacture, and so on.

3.6.3 Phase 3

Phase 3 (stage I, level III) is involved with detail design of the product that will yield the desired product characteristics. A product can be viewed as a system that can be decomposed into many different sub-levels (ranging from sub-system down to component) as indicated in Section 2.2.3.

Functional Analysis

Functional analysis is a useful tool for allocating requirements (desired performance) that can be assigned to "technical" functions as the design evolves.[9] Function trees and functional block diagrams are frequently used to support the functional analysis.

The hierarchical nature of requirements (desired performance) and design options (specification) in a design process can be described as follows:[10]

- A function F_j at sub-level j (to level III in phase 3) and its related desired performance DP_j is attainable by a design option (solution) DS_j which is defined by specification SP_j.
- DS_j is bounded by constraints C_j.
- On the next lower hierarchical sub-level $j + 1$, the design option DS_j requires n_{j+1} solution specific functions, $F_{j+1,1}, F_{j+1,2}, \ldots, F_{j+1,n_{j+1}}$.
- Desired performances $DP_{j+1,1}, DP_{j+1,2}, \ldots, DP_{j+1,n_{j+1}}$ and constraints $C_{j+1,1}, C_{j+1,2}, \ldots, C_{j+1,n_{j+1}}$ are then allocated to these n_{j+1} functions.

As a result, the functions, requirements (desired performance) and solutions (specifications) evolve in a hierarchical manner, as illustrated in Figure 3.4.

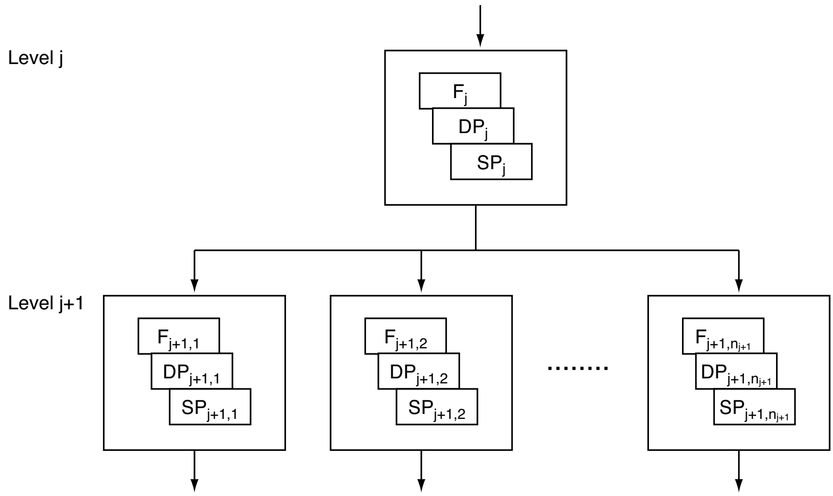

Figure 3.4. Hierarchy of functions, requirements, and solutions

Functional analysis is not only valuable for decomposing requirements from product level down to component level through functional decomposition (see Suh, 2001; Blanchard, 2004), but is also useful for:

[9] See Blanchard (2004); Fox (1993); Pahl and Beitz (1996); Pugh (1990); Suh (2001); Ullman (2003).

[10] For more details, e.g., see Suh (2001).

Modular design: To understand the functional relationships and interactions between components (Mikkola and Gassmann, 2003). Failure to take into account these relationships and interactions may result in tedious and costly trial-and-error iterations towards the end of new product development, even for non-modular designs.

Value analysis: To establish the "value" of components, and remove those not contributing to value (Miles, 1972).

Design storage and re-use: To store existing designs at different product levels based on function structures for re-use of the design knowledge (Hashim, 1993).

The performance and specification in phase 3 are:

DP-III: This is a collection of the desired performance for different objects at each of the sub-levels. Let DP-III$_j$, for $j \geq 1$, denote the desired performance of objects at sub-level j. The number of sub-levels needed, and the number of objects at each sub-level depend on the complexity of the product. At the first sub-level (corresponding to the product level) we have DP-III$_1$ $\equiv$ SP-II. As we move down the sub-levels, we have DP-III$_{j+1}$ $\equiv$ SP-III$_j$, for $j \geq 1$.

SP-III: This is a collection of specifications for different objects at each of the sub-levels. At the lowest sub-level, the specification is concerned with issues, such as geometrical shape, dimensions, tolerances, surface properties, and material. The end result is that all individual components and parts are fully specified and laid down in assembly drawings and parts lists.[11]

PP-III: This is a collection of the predicted performance for different objects at each of the sub-levels based on the specification for the object. This is needed to assess whether or not the specification selected will ensure the desired performance, using the iterative process indicated in Figure 3.3.

The models used are based on the various engineering sciences involved.

Note. The constraints get more detailed as we proceed through the different sub-levels.

3.6.4 Some Comments

1. The predicted performance (PP-I to PP-III) is obtained using models. Model building involves selecting the structure of the model and assigning numerical values to the parameters of the model. We can use many different types of models, since a model is a simplified (and approximate) representation of the relevant real world. Model building depends on the data and information that is available to the model builder. The data can vary from hard (technical data obtained from handbooks for models in level III) to soft (subjective data for models in level I).
2. The decision to iterate back (see Figure 3.3) depends on the match between DP and PP. In general, these are vectors as DP involves several elements. We need to define the criteria for deciding whether or not there is a match. One criterion

[11] See Pahl and Beitz (1996) for more on this.

would be the relative difference in the DP and PP for an element (as a fraction of the value of DP for the element) being less than some specified value. Another criterion would be that an element of PP must be either greater (e.g., efficiency of an engine) or smaller (e.g., noise level of the engine) than the corresponding element of the DP vector.

3.7 Performance in Stage II

Stage II is concerned with the performance of the physical object (component through to the final product) built to the detailed design specification given by SP-III. The building process starts with components and proceeds through various intermediate sub-levels (corresponding to sub-assembly, assembly, module, sub-system, etc.) and ending up with the final product. Since the performance is an estimate based on limited test data it is a predicted performance at levels II and III and this is shown schematically in Figure 3.5.

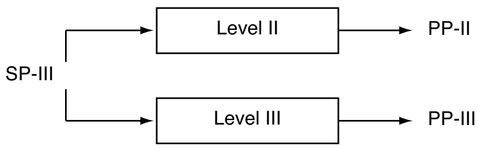

Figure 3.5. Performance in stage II

3.7.1 Phase 4

PP-III: The predicted performance in phase 4 (stage II, level III) is a set of the performance of objects (component through to product) involving test data as indicated in Figure 3.6.

If the desired performance of a component does not match that of an existing component, we need to carry out research and development to improve the performance. Similarly, if the predicted performance of an object (at an intermediate level) does not match the desired performance of the object, we need to carry out research and development involving a sequence of test–fix–test cycles. If the outcome of the research and development process is a success, we can move forward. If not, we need to iterate back.

At the end of the process, we have the predicted performance of the final product (or prototype) which gives an estimate of the product characteristics. If this matches the desired product characteristics ($DP\text{-}III_1$), it is released for field testing.

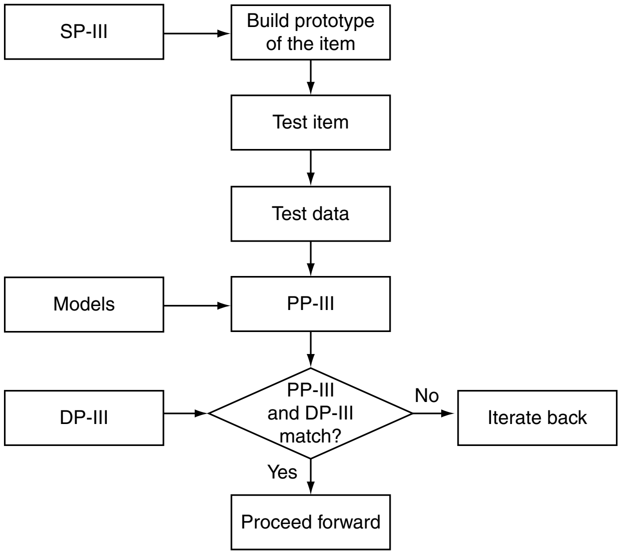

Figure 3.6. Evaluating PP-III in stage II

3.7.2 Phase 5

PP-II: In phase 5 (stage II, level II) the prototype is released to a small set of customers so that the performance of the product from the customer perspective can be assessed. Since the testing is limited, the inferences drawn yield a predicted value and hence we have the predicted performance PP-II. If this does not match the desired performance DP-II, then we iterate back. On the other hand, if there is a match, the specification SP-III is released for production of the product.

Comments

1. PP-II and PP-III in stage II are different from those in stage I. In stage I they are based on models using all the historical data available during design. In contrast, in level II they are based on the data generated by the tests carried out.
2. There are various forms of uncertainties that affect the outcome of the test as well as the data collection. As a result, the performance estimates based on the data can be either point estimates or interval estimates. This implies that in the evaluation process we can use either point or interval estimates.

3.8 Performance in Stage III

Stage III is concerned with the performance of the product produced (based on SP-III) in numbers that can vary from small (e.g., a few hundred in the case of airplanes) to large (e.g., several million in the case of cellular phones).[12] The performance in this stage is indicated in Figure 3.7.

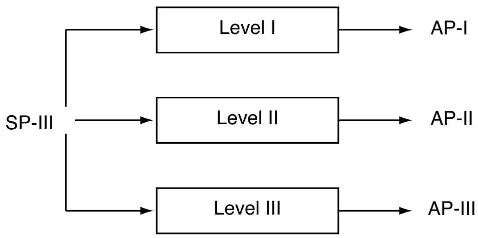

Figure 3.7. Performance in stage III

3.8.1 Phase 6

Phase 6 (stage III, level III) is about manufacturing of the product. Until the component production and assembly processes are fine-tuned, the performance of items will, in general, be lower than the performance of the prototype built in stage II. The production process is adjusted so that the performance matches the desired performance and this is referred to as process stabilization. Once this is achieved, full-scale manufacturing commences, and the product is launched to the market.

AP-III: This is the actual performance of the product released to customers, that is, in the field. It has the same elements as DP-III so that it corresponds to technical characteristics from component through to product.

3.8.2 Phase 7

In phase 7 (stage III, level II) the focus is on customer evaluation of the product performance in terms of product attributes that formed the basis for the initial purchase.

AP-II: This is the actual performance of the product viewed from the customer perspective. The performance is assessed using data from the field (e.g., warranty claims data, sale of spares for items no longer covered under warranty, customer complaints).

The assessment of the performance needs to be done with care taking into account the heterogeneity of consumers in terms of usage intensity, operating environment, due care, maintenance, and other factors. If the actual performance deviates from DP-II, we need to do root cause analysis to find out the cause. The most common cause is the variability in the components obtained from vendors and/or in the production process. Through effective quality control, we can ensure a reasonable match between AP-II and DP-II.

[12] This stage is not relevant when only a single custom-built item is produced.

3.8.3 Phase 8

Phase 8 (stage III, level I) is the final phase of the new product development model. Here we look at the product performance from the business perspective.

AP-I: This is based on the data (e.g., sales, warranty costs, return of investment) that is collected and analysed on a periodic basis (monthly, quarterly or yearly). This is compared with DP-I and if there is mismatch, we need to iterate back to phase 1 (stage I, level I) for appropriate actions.

3.9 Overall Process

The overall process for decision making with regard to product performance and specification is shown in Figure 3.8.

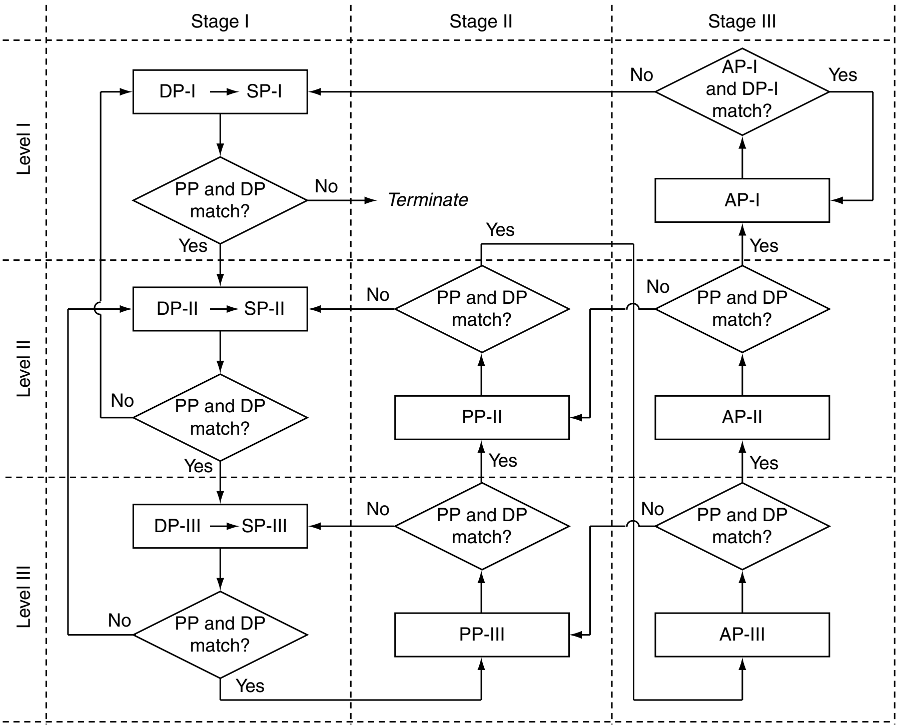

Figure 3.8. Overall process

3.10 Reliability Performance and Specification

Reliability performance and specification are a sub-set of the product performance and specification. They require concepts from reliability theory and these are discussed in Chapter 4. The remaining chapters deal with reliability performance and specification in more detail.