3. With some consumers build simple product idea concepts for these product ideas.
4. Expand the product idea concepts with knowledge of the processing, marketing and the technical characteristics of the product. Select the two most promising product idea concepts with the consumers.
5. Finally with the consumer group, build product concepts for design of the two remaining products.

3.1.3 Product design specification

Building the product design specification from the product concept includes both research and design. Market research provides more details about the target market characteristics and size, the methods of marketing that might be used and the position of the product as compared with the competitors. The market study is progressing into consumer and retailer surveys in consumer marketing and customer surveys in industrial marketing. The technical research involves the searching of the scientific and technological literature, including patents, as a preliminary investigation into the possible products, processing and physical distribution. The designer is starting to create the products and often needs to make models so that ideas on the product characteristics can develop. The modelling can be on paper or computer, and some preliminary laboratory research makes the products on a small scale. Of course in incremental development, the basic product is already known and both the marketing and the technical research, and product model building are much less and indeed may not be done at all.

The product design specification has for a long time played an important part in design in other industries and now is considered the area that has a major effect on quickening development and ensuring product success. The use of computer techniques such as CAD (computer aided design), CAID (computer aided industrial design), CAM (computer aided modelling), especially with more modern versions, has given the opportunity to design on the computer and to present the product ideas on the computer to other project members and even to consumers. The computer designs can be transferred into engineering design and linked to small-scale production units producing the experimental prototype for the consumer to discuss. Some of the newer tools in product design are shown in Table 3.3.

All of these new developments are changing industrial design and making it quicker. These techniques can be used for food packaging and for a structural food such as a loaf of bread and snacks. Snacks have already been designed using earlier CAD versions. Word descriptions of food product characteristics have been used in computer techniques such as conjoint analysis for a number of years to build and evaluate food product concepts (Moore *et al*., 1999). The question is how far can the food industry use computer design techniques in building up product concepts and product design specifications? Certainly the

Table 3.3 Tools at the cutting edge of product design

3D solid modelling software Describes both the exterior and interior of the product in three dimensions
Virtual-reality design tools Aid interaction of the computer models in a manner that resembles real life using stereoscopic eyewear which tracks with the computer
Rapid-prototyping Tests new design concepts with models using plastic materials such as polyamide/epoxy resins
Collaborative design tools Use an internal Net or the Internet so that people can design together.

Source: After Schmitz, 2000.

personal computer is being used actively in the product concept stage – Internet for desk research, software for interpretation of statistical market research, computer-based literature searches and databases (Hegenbart, 1997). Newer developments are the use of detailed product models of present and past products to use as an information base to design new products (Jonsdottir *et al*., 1998).

What are specifications for product design? The product concept states clearly the needs and wants of the consumer or customers, but it does not provide specific guidance for design of the product in technical terms. It is often subjective and leaves room for different interpretations. Product concept engineering interprets the consumers' product characteristics into measurable terms, metrics, which can be tested in the product prototypes to see if the design is meeting the specification. An individual specification consists of a metric and a value, for example protein content between 20 and 30%; or thickness between 0.1 and 0.2 cm, or an ideal target value with an acceptable range, for example, strength of onion flavour, 7, range 6.5 to 7.5 on a linear flavour scale. Metrics and their values should be:

- critical to the consumer;
- consumer-acceptable ideal value and range of values;
- practical and capable of being achieved.

The product design specification is a set of individual specifications. Too many metrics should not be included, as this will limit the area in which the designer works and cause problems with too much testing. Only the metrics recognised as important by the consumer, or needed for the consumer such as safety, or for food regulations, are usually included, but sometimes there may be specifications dictated by the process or the distribution. Also it is important to choose metrics that are achievable, for example it may not be possible to choose vitamin C as a metric because heat processing conditions needed to ensure a critical metric safety (microbiological) value, will destroy it. And metrics must be practical, for example there may be no measure for spicy hotness in a food so the acceptance of different levels in the new product have to be tested with consumers during design.

Choosing metrics and their values is simple if it is an incremental product or a copy of a competing product in the market. The metrics are already identified and the values can be chosen by competitive or company product benchmarking (Ulrich and Eppinger, 1995). With the radical innovation, there is not sufficient previous knowledge and there will be a need to continue the metric identification into later stages of design. As prototypes are developed and tested both technically and by the consumer, the metrics for the consumer-identified product characteristics are built. The design specification evolves to the product prototype specification at the end of the design process, so it does change, but care must be taken that critical metrics are neither dropped nor changed in value without consumer acceptance of the change. Factors sometimes causing changes in metrics are costs, availability or variability of raw materials and processes, new competing products, contradictions between product characteristics, difficulties in design. Nothing is black and white: usually various forms of grey have to be accepted.

Think break

1. Evaluate the two product concepts remaining after your work in the last Think Break, for marketing and production suitability. Make a checklist of all the important factors to consider in marketing and production and score the two product concepts.
2. Calculate a prediction of the possible sales volumes, prices and sales revenue for the two product concepts.
3. Do an evaluative comparison of the two product concepts and select the best product concept.
4. For the remaining product concept, write down the product benefits identified by the consumers and the other critical product characteristics you have so far identified. Suggest a metric for each product characteristic – this can be a physical, chemical, nutritional, sensory or microbiological metric.
5. What are the product characteristics for which you have not identified a metric? Can you create an empirical metric for them?
6. What are the raw material, processing and distribution requirements that need to be included in the product design specification?

3.1.4 Product feasibility and project plan

From the detailed knowledge, a more quantitative comparison can be made of the ideas for the new product. The consumer study gives in the product concept a comprehensive description of the product characteristics wanted by the target consumers who are more clearly identified. The market research gives an indication of the probable sales of the product, the position of the product in the market, the possible prices, promotion and market channels. The technical study describes the possible products, processes and the probable costs and time for development and production. By a qualitative evaluation of the suitability of the product concepts and a quantitative estimation of the profits and costs ratio, and by predictions of the probabilities of successful development and launching, the most suitable product concepts for development can be selected.

The various activities needed for the project are firstly developed in the outcomes and then in the building of the product design specification. They are all brought together and integrated in the **operational plan** for directing and controlling the project. For the plan:

- list all the major activities;
- place them in a logical sequence, noting activities that run in sequence, in parallel, and those that need to be integrated (**project logic flow plan**);
- time each activity from start to finish (**project scheduling plan**);
- identify the money, resource needs, personnel, for each activity (**project resource plan**);
- identify activities that are critical for time and resources (**critical path network**).

Review the network so that it meets the required launch date and is within the resources designated for the project (**project operational plan**).

3.2 Product design and process development

The themes for Stage 2: product design and process development, are integration, creativity, systematic planning and monitoring. Food product development is process-intensive, the characteristics of the product are highly constrained by the processing. Therefore the process and the product are developed together. This tight integration of process development and product design, called concurrent or simultaneous engineering, is becoming more important because of the time and cost constraints on getting the product to the market (Fox, 1993; Stoy, 1996). Jonsdottir *et al*. (1998), reviewing concurrent engineering in seafood companies, defined the overall goal of concurrent engineering as quality, cost, schedule, product user requirements and reduction of the time the product takes to reach the market. They emphasised the information technology applications in product models, in particular the knowledge of the product's functional and structural characteristics, and the development of a system model that secures the integration and reuse of knowledge in the different stages of the product development process. The concurrent design also integrates with marketing and production (Hollingsworth, 1995) as shown in Fig. 3.7. Often in incremental development, the production