

## 6

### **Managing the product development process**

Product development management in the food system is complex, long term and capital intensive. It is total company management involving every function in the company – so it is managing either a microcosm of the company or an integration of the company functions. For a major innovation, the company may set up a new venture company or division; or a new group of people may form a new company. At this time when many new companies are being formed on the innovations of information technology and biotechnology, it is interesting to speculate on new venture companies in the food industry and the basis of their new innovations. But at the present time, it is the large multinational food companies that dominate product development at all levels in the food industry, and it is management of product development in these companies that is the main basis for innovation in the food industry. There are many small food companies that are also involved in product development on a small scale. Management of product development in the food industry varies from a group in the small company sitting around a kitchen table to the multinational food company with large R&D laboratories, small-scale production development plants and product development teams in many countries. The basic principles of product development management are the same in large and small companies, but often more difficult to apply in the large company because of rigid hierarchies.

The framework for management in the food industry is the PD Process, and the recognition of management at the different stages.

## 6.1 Principles of product development management

Several principles of product development management have been identified (Souder, 1987; Ganguly, 1999). Relative importance does change but the basic principles are robust and are useful as a basis for product development management. They can be grouped under basic philosophy, understanding, abilities and organisation of the company as shown in Fig. 6.1.

### 6.1.1 Basic philosophy and understanding

- Belief in product development as a major business strategy.
- Understanding emerging worldwide technologies, in-depth knowledge of technologies.
- Understanding the transformation of technologies into want-satisfying products, intimate understanding of changing consumer needs.
- Developing a creative climate, creating spontaneous teamwork.
- Patience, realising that innovations take time, going through cycles of success and failure, and that management has to aid and direct them to the end of product success.
- Recognising the need for skills in systematic decision making and risk-taking.

These are still essential elements in product development that have continued to demonstrate their significance over a great diversity of situations and times, not to mention fashions! Unless management, especially top management, believes that product development needs knowledge of technology and consumer, and of their optimum relationship, then product development will stumble. Having recognised these basic knowledge needs, they have also to recognise that there needs to be a creative atmosphere and time to reach product success. Lastly they have to believe that the success of product development depends on their decision making, its quality and timeliness (Lord, 2000).



Fig. 6.1 Basic principles of product development management.

### 6.1.2 Abilities

- Systematic selection of best projects, using information sharing and group decision making, creating idea generation and evaluation with all people involved in product development, setting decision processes based on the product development goals.
- Careful analysis of the customer's level of sophistication and the product designer's level of technical sophistication, creating collaborative roles between product design and consumer/market research, educating product designers on consumer needs and wants, educating marketing on technical possibilities and problems.
- Finding and coordinating the resources and knowledge for product development, upgrading knowledge to make use of new technology, nurturing methods for new technologies, selection of technology with fit to present or planned future company technology, predicting costs of adoption of new technology in finances and company organisation.
- Elimination of disharmony between R&D and marketing groups, making open communication an explicit responsibility of every employee, using joint R&D/marketing task forces.
- Reducing complexity and problems, breaking large projects into manageable stages, identifying and eliminating mild problems before they become major.

Management at all levels needs to have the abilities to recognise the path of the project and to coordinate the knowledge, resources and people to follow the path efficiently and effectively to product success. There is a great deal spoken about multidisciplinary, cross-functional, inter-functional, intra-functional, integrated product development, but basically product development needs to be recognised as a many-faceted process which can only be achieved by collaboration between people with different knowledge and skills. It cannot be enclosed in specialist or functional boxes such as marketing or production (Harris and McKay, 1996). Management needs to understand the meaning of company collaboration and to have the ability to put into action a multifaceted product development project based on collaboration.

### 6.1.3 Organisation

- Design of product development organisation, ability to set the tone, posture and prevailing attitudes towards product development, creating an organisation to fit the needs of members and of customers, encouraging responsibility and creating multidirectional communication.
- Cost-effective project management, selecting the method that relates to the problem, for example incremental innovation using commercial line management, technical innovation using technical management, major innovation using separate project management or a new product committee.
- Flow management during the project, organising the timely transfer and flow of product prototypes and knowledge, encouraging the skills and knowledge

for the evolving technology and keeping team members involved to greater and lesser extent throughout the project.

- Product development budgeting techniques, understanding the changing cost/time ratios between projects and within projects, the financial analysis of the different stages of the PD Process to identify the costs and their possible improvements, the financial controls needed for the different cost/time ratios.

Management has to design the organisation for product development in the company, both for the overall new product programme and for the individual project. There needs to be coordination among projects to have the optimum use of people and resources, as well as planning and control for the individual project so that it flows towards the final product launch without stumbling too often. Radical innovations are never straightforward linear progressions through the project; there is often recycling especially during the earlier stages, but these returns to earlier stages in the project need to be managed.

### ***Think break***

In your company.

1. What is the basic philosophy of product development management?
2. Describe the understanding of technology changes and consumer needs changes.
3. How are these changes affecting product development?
4. Has your company the abilities to develop new products related to these changes?
5. If not, what new abilities need to be found? How could this be done?
6. What are the organisational methods used by your company?
7. Do they ensure effective and efficient product development?
8. If not, what changes need to be made in the organisational methods?

## **6.2 People in product development management**

It is important to recognise that there are different layers of management. The different levels of management can be identified as directors, chief executives, product development managers and project leaders, although the actual titles of the managers may be different from this in the individual companies (see Fig. 6.2). The directors are at the business strategy level, the chief executive at the product/innovation strategy level, the product development manager at the new product programme level and the project leader at the level of the individual

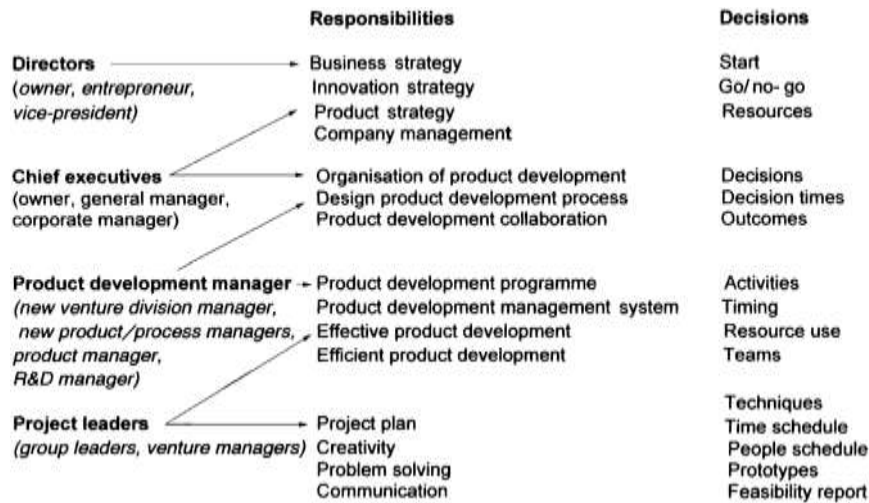


Fig. 6.2 Levels of PD management.

project as shown in Fig. 6.2. All of these different levels have their own basic philosophy and understanding, abilities and responsibilities, but they need to be coordinated into the whole product development management.

The interwoven nature of responsibilities should be noted; people may have individual responsibilities at their level of management, and also joint responsibilities at higher levels. There is no clear demarcation of responsibility in product development because it has to be collaborative management.

### 6.2.1 Directors

Directors on the Board of the company have their vision for future growth of the enterprise, commitment to product development as a method of ensuring company growth, understanding of the knowledge and skills needed for product development, provision of resources for product development. They need to have the abilities for: incorporating innovation into the business strategy, analysis and decision making, intelligent risk-taking, selecting and directing a chief executive with the knowledge and skills for the innovation strategy that they have developed. They need an understanding of the company's technological and marketing environments, the competitors' innovative strategies and multi-industry evolution, the company's structural and cultural context, and the company's resources and capabilities. The Board sets the overall innovation strategy and the philosophy for product development, gives appropriate allocation of resources and makes the major decisions in the development. As with most business activities, product development is most successful when it starts from the top.

### **6.2.2 Chief executives**

Chief executives have commitment to the organisational role of product development, understanding the needs of product development, recognising the knowledge and skills for product development, recognising the product development process as it relates to their company. They need the abilities:

- to develop the structure in which product development operates;
- to organise a management system for product development;
- to integrate all the functional areas taking part in product development;
- to develop a clear product strategy and a product development programme;
- to set clear goals;
- to indicate the decisions to be made at different parts of the product development processes, and make decisions with careful analysis.

They need to be able to define the long-term company development strategy and assess the strategic importance of new company initiatives and their relation to the present core capabilities (Cooper, 1998). They are responsible for effective portfolio management, making strategic choices of markets, products and technologies that the business will invest in (Cooper *et al.*, 1999). The chief executive develops a positive environment, actively supporting, leading and directing product development on a continuous basis, and providing integrating communication between different groups, usually the functional departments of marketing, production, R&D and finance, with product development. Since product development spans many disciplines, it should not get locked into one image – marketing, production or R&D.

### **6.2.3 Product development managers**

Product development managers have commitment to the company's PD Process and integration of the skills and knowledge for this process, understanding of the customer and consumer needs and wants, knowledge of present and emerging technologies, understanding of the company and the external environment. They need the abilities to:

- identify the outcomes necessary for each stage of the PD Process for the chief executive's and Board's decision making;
- identify the time and other constraints on the project;
- identify and find the resources for the product development;
- encourage the creative and technical achievements of the people involved in product development;
- analyse and make the decisions.

They need to be able, with top management, to obtain/maintain support for new initiatives, to define the company's strategies for the new initiatives, and to cooperate with the project leaders in defining projects. Product development managers integrate the various projects into an overall product development programme. They set with the project managers the timing of stages in the PD

Process, plan and control the resources so that they are available at the correct time and are of the right quality, analyse the results of the development and make decisions for further stages. They need to be aware, guide and be available when necessary, to help the creativity and the problem solving. Every company needs a person who is responsible for new products and is recognised as this. This person must have product development knowledge and skills as well as management knowledge and skills. There needs to be a balance between the innovation development and the management. Over-management can stifle innovation, but uncontrolled product development may lead to inappropriate products, inefficient product development and time/cost overruns – in other words commercial failure.

#### **6.2.4 Project leader**

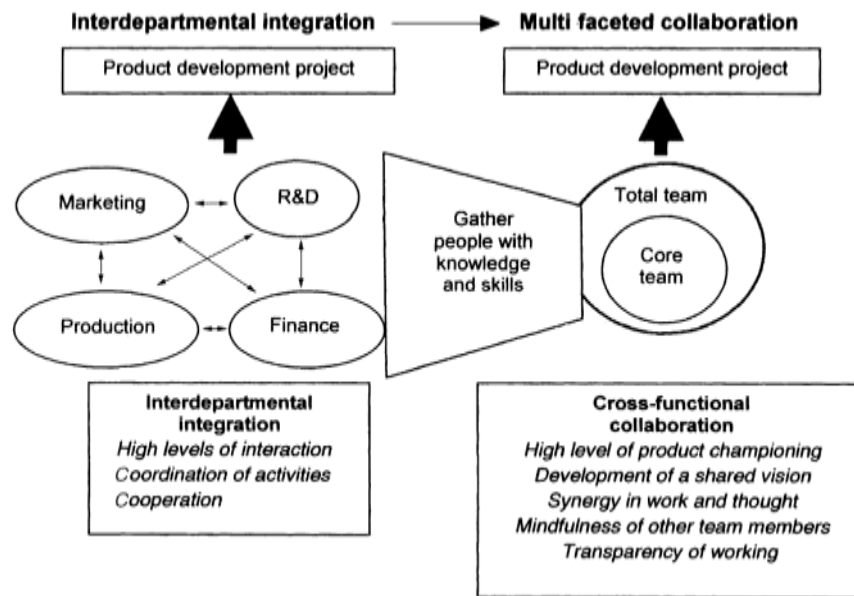
Project leaders understand the consumer and market as well as the PD Process and the product; recognise and foster innovative, creative, problem-solving skills; and understand integration of people with different skills and philosophies. They need the abilities to:

- drive the project to a successful conclusion;
- identify the outcomes for each stage of the PD Process and important sections in the individual stages;
- relate the outcomes to the activities in the project;
- choose the techniques for the activities that relate to the knowledge and skills of the team, and the resources available.

They have the capacity to develop the business strategy for the new product as well as to define the technical/marketing development, and to build the organisational structure for the development. The project manager is leading a team of people who are skilled in different disciplines – consumer research, marketing, product design, processing development, production and finance. Although the project manager may not have an in-depth knowledge in all areas, there is a need for basic knowledge in each area and the ability to see the interrelationships between them. The project leader is responsible for ensuring that the project progresses smoothly, meets all interim objectives and targets on time and within budget, and makes sure that the necessary resources are available when and where they are required. They also are the primary channel of communication between the project team, senior management and external organisations (Jones, 1997).

#### **6.2.5 Important factors in management levels**

There are three important factors to recognise in these four different types of management. Firstly there is a need for *championing*: strategic championing at the directors/top management level, organisational championing at the product development manager level, and product championing at the project leader



**Fig. 6.3** Comparison of integration and collaboration in product development (Source: After Jassawalla and Sashittal, 1998).

level. Secondly, *decision making* needs to be spread throughout the three groups and to be clearly defined. There is a need for decision making at all levels and not only at top management level. There is nothing more restrictive in product development than all decisions having to be made by one person; also it tends to slow development because there is endless reporting and decision making. Decision making is a collaborative activity between all levels of management. Thirdly, *collaboration* is an active aim of product development management. Collaboration is much more than cross-functional integration, it is the active working together of people from different disciplines, different functional departments, and different levels of management in product development, all with common aims for product development as shown in Fig. 6.3.

Cross-functional collaboration includes an equal stake and responsibility for the outcomes, and a willingness to understand the other people's viewpoints so that they can be blended to give higher levels of combined knowledge in the product development. Such collaboration involves synergy in thought and action, which leads to outcomes from the product development exceeding the capabilities of the individual participants in the PD Process (Jassawalla and Sashittal, 1998). Collaboration can be hard to achieve in radical innovation where uncertainty leads to tensions between people, with different functional groups blaming the others for delays, poor product qualities and increased costs. It is much easier in incremental product development where the risks of failure are much less and many activities become routine. Stage-specific collaboration is more likely to lead to new product success, rather than integrating all functions during all four stages of the PD



Process, with the three functions – R&D, manufacturing and marketing – playing the central role in turns (Song *et al.*, 1998).

### **Think break**

Are you a manager? If yes, answer the questions directly. If no, answer the questions as related to your manager.

1. For what area of product development are you (or the manager) responsible?
2. Identify your responsibilities.
3. How do these relate to the responsibilities of the manager above you?
4. How do these responsibilities relate to your abilities? Do you need more abilities or improved abilities? How could you attain these?
5. How do you relate to other areas of product development, other people in product development?
6. Would these relations improve with a top management decision to have collaboration as a basic company philosophy?

## **6.3 Designing the PD Process**

The PD Process is the framework to build up both product development projects and the product development programme. The selection of activities in the PD Process depends on the knowledge and skills in the company, knowledge easily available outside the company, the risks involved through lack of knowledge, the importance of the product development for the future of the company, and most important the level of innovation.

### **6.3.1 The effects of knowledge and skills on the PD Process**

Knowledge and skills in the company, and also the company's philosophy on product development, affect the choice of activities and therefore the structure of the PD Process. If the company is not able to do consumer research, it may do personal research with the retailer, food service buyer, their family and friends. If the company does not have formulation skills, it will take a formula from the ingredient supplier. If the company does not have process engineering skills, it will buy a turnkey processing line from an equipment supplier. Or if there are no innovation skills in the company, then it will acquire another company! Some company managers are conservative and some want excitement, some are risk takers and some are fearful of risk; these differences cause differences in the PD Process used in the company. Some companies bring new products through to market as quickly as possible, missing activities such as business analysis and test marketing, as they are prepared to live with failures; other companies include all activities so as to

reduce their risk of failure in the market. So the PD Process is specific to the company and its knowledge, skills, and philosophy.

### 6.3.2 Level of innovation and the PD Process

A comparison of the PD Processes for radical and incremental changes is shown in Table 6.1. The sequence of the activities varies, for example in the incremental change there is generally a linear sequence in the PD Process, but in the radical innovation, there is often recycling of activities. The incremental product changes can be developed and marketed according to a standard PD Process with strong involvement of the functional departments such as marketing and production. The radical innovation uses generalised

**Table 6.1** Differences in the PD Process for platform and derivative products

Radical innovations (new platform products)	Incremental changes (derivative products)
<b>Stage 1: Product strategy development</b>	
Probing problems with consumers	Consumers setting attributes
Focused project objectives	Clear schedules and time goals
Developed product concept	General product concept
New product design specifications	Standard product design specification
New market probing studies	Market surveys
<b>Stage 2: Product design and process development</b>	
Building product attribute measures	Refining product attribute measures
Product/process interrelationship studies	Product formulation
Pilot plant studies	Process improvement
Frequent product testing	Strategic product testing
<b>Stage 3: Product commercialisation</b>	
Design of new production method	Adaptation of production
Design of new quality assurance	Adaptation of quality assurance
Commissioning of new plant	Minor plant changes
New marketing strategy	Improvement of marketing strategy
Detailed business and market analysis	Setting market and financial targets
<b>Stage 4: Launching and post-launch evaluation</b>	
Rolling launch or pre-launch test market	National launch
Continuous market analysis	Assessing if market targets met
Continuous financial analysis	Assessing if financial targets met
<b>Overall management</b>	
Project milestones to control	High importance of speed
Long-term commitment of capital	Short-term commitment of capital
Long-term commitment of human resources	Short-term commitment of human resources

Source: From Earle and Earle, *Building the Future on New Products*, © LFRA Ltd, 2000, by permission of Leatherhead Food RA, Leatherhead, UK.

activities because creativity and problems in the project are difficult to predict.

For the radical innovation, there is a need to develop technical and market knowledge in the first two stages of the product development process and to include product/market testing and business analysis in the product commercialisation stage. In the initial stages:

- product concepts are developed with the consumers;
- product designers make some models or simple prototypes of possible products and ask the consumers to evaluate them;
- further product concepts are developed; and
- evaluated by marketing and processing technologists to see if any are possible for commercialisation.

Later in the PD Process, early versions are marketed quickly on a small scale, obtaining the user feedback and making modifications before expanding the market. Usually for the radical innovation, the company's resource commitments are made at sequential times in the PD Process, and not at the beginning of the project as for incremental products (Mullins and Sutherland, 1998).

In the incremental product projects, a great deal of the knowledge is already in the company, so there is less need for new research in building the direction of the project (Earle and Earle, 2000). The product concept can be developed by a marketer and a product designer, evaluated by consumers to check that no mistakes have been made, and the product specifications written in the standard form for this type of product. A national launch usually targets the total market.

Between the extremes of radical and incremental changes, major product changes can need different types of PD Processes. If major changes in product, market and production are being made, they can be similar to the PD Process for radical innovations. If the major change is marketing related, for example a positioning change, the PD Process is similar to the incremental PD Process with an emphasis on the marketing change; if production related, such as a new process, it is an incremental PD Process with an emphasis on technical development.

### **6.3.3 Other factors in designing the PD Process**

Other factors to be considered in designing the PD Process framework for the company are: place in the food system, environment, technology, marketing and company resources. Primary production, industrial and consumer food product development have differences in their PD Processes, which will be described in Chapter 7. There may be strong societal and political constraints on product development that need to be included in the PD Process; obviously food regulations limit the processing and the raw materials, but religious requirements are also often important; or it can be recycling of packaging or other environmental problems. If these are not included in an early part of the PD Process, a great deal of time and money can be wasted. Technology in processing, distribution and marketing has also to be considered – what is

standard, what is new? (Earle and Earle, 2000). With the large multinational food companies, there is often a requirement for fast processing and large-scale equipment. This means that the product design, and the process development, start in the first stage of the PD Process with the consumer research, and then develop together. In recent years there has been a great deal spoken about concurrent engineering in other industries (Tomiyama, 1998), developing the product and the production methods in parallel. In the food industry it is crucial that the product design and the process development are interwoven from early in product concept development and product design. For the smaller companies using simpler equipment, it can be possible to do a significant amount of product design on 'kitchen' size equipment before building up the process.

#### **6.3.4 Using and changing the PD Process**

The company, often through experience, has found the important activities for their industry and business – although sometimes this is not so much by careful analysis after product development projects are completed, but by copying the actions of competitors or the industry in general or the latest fashion. Selecting both the activities and also intensity of work in each activity needs to be based not on 'we have always done it that way' or 'the industry does it that way' but on what is needed to achieve the target aims and outcomes. Selection of the activities involves:

- reason for the activity;
- resources needed;
- outcomes expected;
- timing of activities;
- controls for measurement of progress (Gruenwald, 1988).

The PD Process is not a static framework but needs to be evaluated regularly so that it can be updated for the new knowledge and skills in the company, the new directions chosen for the company and the changing environment. The use of some novel activities in the PD Process leads to the competitive edge of the company. But the PD Process always has a basic framework, which has been built up by experience and is only slowly changed. Top management can instigate new strategies and therefore new PD Processes for product development but this needs exceptional entrepreneurial skills, sustained commitment to new products for company growth and an acceptance of risk taking (Gruenwald, 1988). Without making drastic changes, top management can send the right signals to the organisation for evaluation and necessary change to the PD Process, for communication between different people to recognise changes, and for a dynamic organisation that can cope with change in the PD Process (O'Connor, 1996).

The management of the PD Process varies from company to company. Some companies put the framework on the internal communication network and expect product development staff to consult it; other companies set out a rigid PD Process with the activities and often the techniques identified as to what is to be done in all projects.

**Think break**

Does your company have a PD Process framework?

1. Discuss how the PD Process framework:
  - (a) recognises the company's philosophy, knowledge and skills,
  - (b) adapts to innovation level, type of technology, marketing, environment, food regulations,
  - (c) identifies the activities for each of the four stages of the PD Process
  - (d) puts these activities into parallel or sequential positions,
  - (e) shows the necessary collaboration between people and departments.
2. What changes could be made to your company's PD Process framework that would make product development more effective and efficient in your company?

(If your company does not have a PD Process framework, design one using the above criteria.)

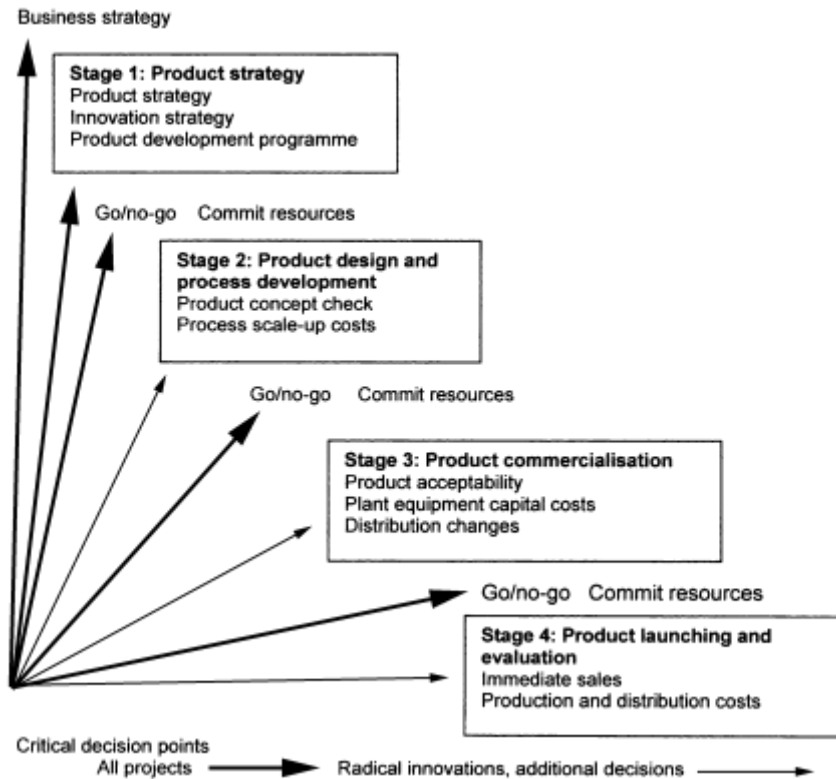
## **6.4 Establishing key decision points and the decision makers**

Many people make decisions in product development at all levels – from the top management and the Board of Directors, who decide on the overall project and its resources, to the process worker, who decides on the detail of production for the new product, and the salesperson, who decides the factors that they think will encourage the customer to buy the product. All the decisions follow on from decisions made by other people, and are linked with other decisions. This interrelationship between decisions is not always recognised in the company and therefore important decision making is not identified. The top management receives a report that is based on the knowledge and decisions of middle management or perhaps of a product approval committee, and then makes its decision on this report combined with other knowledge it may have. The decision made by top management determines the project for the project leader, whose decisions determine how the project is to be organised. Decisions and the knowledge used to make them are the foundation stones for product development; poor decisions based on inaccurate knowledge lead to product failures, and good decision making based on sound knowledge leads to product success.

### **6.4.1 Top management's decisions**

Top management and often the directors on the company Board handle the critical decisions between the stages. Basically there are two decisions:

- Do we go on or stop the product development?
- What resources does the company put into further development?



**Fig. 6.4** Critical decision points for directors and top management.

During Stage 1: Developing the product strategy, there are another three critical acceptance decisions – does the company accept the product strategy, the innovation strategy and the product development programme?

In the first stages of product development, Urban *et al.* (1987) identified the important top management decisions as: commit company to new products, approve PD Process and budgets, product portfolio and market strategy. Before product design, there was a review of market entry strategy and then after product design, review and commit to test, followed by go/no-go decision and review launch plan. They noted that after launch the important decisions were approve one- and five-year plans and finally approve strategy to ‘milk’ or ‘rejuvenate’. The general critical decision points for top management are shown in Fig. 6.4, and some additional decisions for radical innovations are shown within Stages 2, 3 and 4. Because of uncertainties in radical and some major product changes, there can be changes in the product concept during design, changes in processing which need design and building of new equipment, changes in the storage conditions which alter the distribution method, and changes in the target market which need product or marketing alterations. These

uncertainties need to be recognised at the beginning and the additional critical decision points they introduce included in the PD Process. In incremental new products, it is unlikely for top management to be involved in decision making within stages unless there are unusual problems that could for example cause disharmony with company ethics or cause time and costs overruns.

Senior management needs to review the right information at the right time to make the right decision. It also needs to make its decisions quickly, so that the project is not delayed while people wait for decisions. If the project is allowed to proceed to prototype product or to product commercialisation before the top management decision, it may be too late to stop the project even though it will need more development and therefore more resources. But management must not get directly involved in 'fighting fires' on products that are late or have problems. By this time most of the major decisions have been made by other people, and the real impact of top management involvement is minimal. The decision makers at this stage are the technical and marketing people who have the knowledge to solve the problems. If major problems occur, the project leader is responsible for reviewing the project and for devising a solution that can then be reviewed by top management, who make the decision to proceed or kill the project. Several important aspects for top management reviews are (McGrath *et al.*, 1992):

- to provide a clear and consistent process for making major decisions on new products and improvements;
- to empower project teams to execute a project plan;
- to provide the link for applying product strategy to product development;
- to provide measurable checkpoints to monitor progress;
- to establish milestones that emphasise a sense of urgency.

For all these critical decisions by the directors and senior management there is a need for knowledge, much of which is in the outcomes of the various stages within the PD Process. If the critical decisions and the knowledge needed to make these decisions are clearly identified by top management, during design of the PD Process framework at the beginning of the individual projects, the product development team knows what information it has to produce and in what form. There also needs to be a warning system in place for resource or time overruns or difficult problems impeding progress in the project.

#### **6.4.2 Product development manager's decisions**

The product development manager, the person responsible for the product development programme, also has decisions to make. He or she is responsible for the administrative framework of the product development programme, deciding on the activities, the schedules and the budgets, and most important the integration of different product development projects that are running in parallel. He or she decides on the workload forecasts, the standard of product development performance of the team and individuals, the efficiency expected

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of the PD Process (Gruenwald, 1988). In particular, a product development manager has to decide how and when to involve the company's functional groups in the PD Process, and very importantly how the consumer needs are related to the product. The product development manager leads the coordination between the consumers and the development team, and helps the project leaders to integrate technical and business perspectives. He or she is responsible for the development of new skills and knowledge, as well as bringing in outside consultants and other sources of knowledge (Burgelman and Maidique, 1988). Some important decisions of the product development manager in Stage 1: Product strategy development are:

- aim, outcomes and constraints for the individual projects;
- depth of activity in developing the product concept and the product design specifications;
- accuracy needed in the market predictions;
- amount of product design and other technical development;
- time schedule for the activities;
- resources available for each of the activities;
- involvement of the functional departments in developing and evaluating the product concept and the product design specifications, and in predicting the market and technical success;
- communication methods with the team members and among them;
- recognition of lack of skills and knowledge for the later stages and planning of involvement of outside knowledge sources and of education of team members.

The product development manager has to decide how to produce the outcomes for Stage 1, but has also to look ahead to later stages so that the necessary basis for them is laid during this stage. The later stages have similar types of decisions and these become more complex as the costs of the development and the opportunity for a large failure increase. It is very important that the product development manager ensures that decisions by the top management and by the project leaders are made at the right time. Otherwise the project can lose its urgency and the time to market extends. It is important when technical and marketing decisions are proving difficult that resources are organised by the product development manager to solve the problems without delay.

### **6.4.3 Project leader's decisions**

The project leader has also decisions to make so as to achieve the outcomes set by top management within the time and budget structure of the product development manager. Firstly the project leader has to decide with more senior management on the aim, outcomes and constraints of the project. The project leader selects techniques for the activities identified by the product development manager, which are within the capabilities of the team members or outside agencies, and which will produce the product with the qualities needed by the



consumer. The project leader decides how to do this within the resources and the time allowed so that the project remains on schedule. The project leader decides the balance between the effectiveness and the efficiency of the product development, that is balancing the quality of the product development and the time and resources used (see Fig. 6.10 on page 295). This is very difficult decision making, especially for the young project leader. There needs to be help from more senior management. Nothing is worse than senior management telling the project leader to produce the ideal product but not allocating the resources to attain it, or to give them a project known to be a problem without the knowledge to start solving it. The project leader's most important organisational decision is the product development project plan with the activities, resources, time, and the communication and control during the project. The project plan with its predicted timing and use of resources is the basis for decisions that determine the efficiency of the product development; the project leader using it to make the decisions on overruns of time and resources.

Few product development projects, except for simple incremental product changes, can be predicted accurately – either the direction of the design and development or the outcomes in the results. So the project leader is continuously making decisions during the project on the relationships between:

- product and the consumer needs;
- product and the company;
- process, distribution and marketing;
- production and marketing functions.

These decisions are made not only with the core product development team but also with the wider team in the functional departments and in outside organisations. These decisions are extremely important to the quality of the research and need to be recognised reasonably early before the project becomes confused and disorganised.

### ***Think break***

1. For product development in your company, outline the PD Process for each of the following:
  - (a) product improvements,
  - (b) new product introductions,
  - (c) process improvements,
  - (d) new process introductions.

If your company does not have PD Processes, design them for the company. Identify the individuals or groups who are responsible for the product strategy and the product development programme, and for go/no-go decision making at the end of Stages 1, 2, 3 and 4 in the PD Process

2. Select a recent project, which was a radical product innovation, and identify the critical decisions, where they occurred in the project and who were the decision makers. Identify decisions and decision makers in:
  - (a) the go/no-go decisions,
  - (b) decisions that led to final product qualities, product image, product features and uses
  - (c) decisions that led to production method, distribution method, marketing strategy, costs and pricing,
  - (d) decisions on the project efficiency, in achieving timing and costs.

## 6.5 Establishing outcomes, budgets and constraints

Decision making is the key framework for product development, but knowledge fills out the framework to give the live project. Knowledge is brought into the framework, and also created within the framework so that the decisions can be made. But knowledge has a cost; increasing the knowledge adds to the cost of a project. In product development, the intelligent and systematic balancing of knowledge and costs is fundamental to successful product development. Others might say it is the balancing of the costs of product failure against project costs. In product development, there is a need to define outcomes (the collected and created knowledge) and the budget (the costs) at the beginning of the project, and also to reconsider these at the completion of the four stages and at any other critical point in the PD Process. Conditions change throughout the individual projects and there is a need for top management to reconsider the outcomes and the budgets at the same time as permission for the project to proceed to the next stage is given.

### 6.5.1 Defining outcomes

At the end of each stage of the PD Process, the top management requires for its two outcomes:

- product form to that stage of development;
- report on which to base its decisions.

The product form will develop in the project from a product concept, to product design specifications to prototype products, to commercial product, to final launched product. The report can vary from many pages with detailed knowledge to a one page executive summary, dependent on what top management feels it needs to know. The areas listed in the reports in Table 6.2 are important areas of knowledge in product development for decision making but the top management may not wish to see any details, especially in incremental product development where there is not a great risk of making wrong predictions. Some of these critical decisions may be made by the middle management before the final executive

**Table 6.2** Outcomes (knowledge needs) for decision making

Outcomes (knowledge needs)	<i>Decisions</i>
<b>Stage 1: Product strategy development</b>	
Product/innovation strategies	<i>Strategies acceptance</i>
Product development programme	<i>Programme acceptance</i>
Project aim, objectives and constraints	<i>Project acceptance</i> <i>Resources for initial investigation</i>
Product design specifications (or product concept)	<i>Product idea acceptance</i> <i>Resources for product design, process development</i>
Product report: <ul style="list-style-type: none"> <li>• technical feasibility</li> <li>• marketing suitability</li> <li>• consumer acceptance</li> <li>• project costs, risks</li> </ul>	<i>Timing of programme</i> <i>Harmony with business</i>
<b>Stage 2: Product design and process development</b>	
Final prototype product	<i>Acceptance as new company product</i>
Feasibility report <ul style="list-style-type: none"> <li>• target consumers</li> <li>• product qualities</li> <li>• processing method</li> <li>• marketing strategy</li> <li>• predicted sales</li> <li>• predicted costs</li> <li>• project costs, risks</li> </ul>	<i>Resources for commercialisation</i> <i>Total company involvement</i> <i>Harmony with business</i>
<b>Stage 3: Product commercialisation</b>	
Commercial product	<i>Acceptance as new product into product mix</i>
Commercial report <ul style="list-style-type: none"> <li>• production plan</li> <li>• distribution plan</li> <li>• marketing plan</li> <li>• financial plan</li> <li>• risk analysis</li> <li>• capital investment</li> <li>• human resources</li> <li>• effect on company</li> <li>• effect on society</li> </ul>	<i>Launch agreement</i> <i>Capital investment</i> <i>Acceptance into company organisation</i>
<b>Stage 4: Product launch and evaluation</b>	
Marketed product	<i>Long-term acceptance into product mix</i>
Final evaluation report <ul style="list-style-type: none"> <li>• product quality and position</li> <li>• production and distribution efficiency</li> <li>• costs against targets</li> <li>• sales against targets</li> <li>• indicative return on investment</li> <li>• effect on company</li> <li>• market acceptance</li> <li>• society acceptance</li> </ul>	<i>Feedback to future business strategy</i> <i>Future product development</i> <i>Resources for future product development</i>

Source: From Earle and Earle, 1999, by permission of Chadwick House Group Ltd.

summary is prepared for the chief executive and the directors. A summary of the knowledge and a decision direction is made by the middle management for top management. In simple incremental product development, the Board may have set an overall budget for the product development programme; the decisions on the product concept acceptance and the resources for the individual projects are made by the middle management.

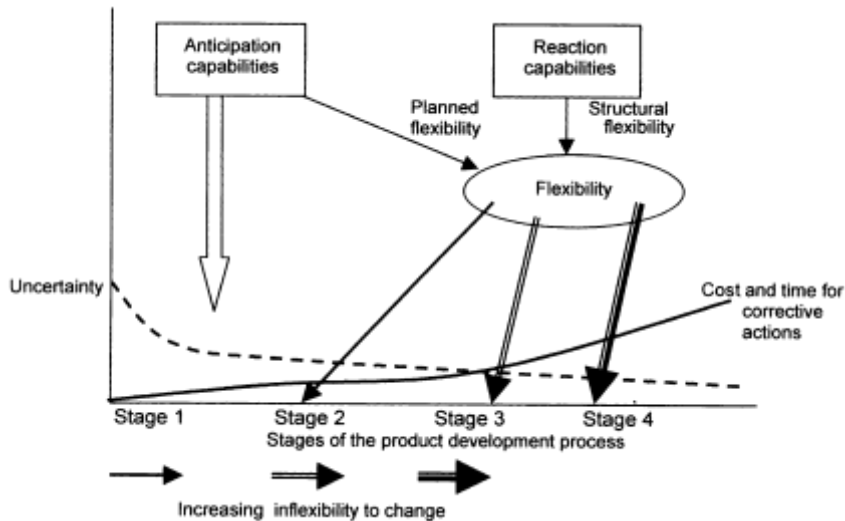
There is no question that the decisions about the product/innovation strategies and the product development programme are set by top management, but it is also important that middle managers, and even the project leaders in large projects, are involved in deciding on the knowledge needed in the outcomes. Only they have the detailed understanding and skills to know what knowledge is really needed, and what knowledge can be created with the capabilities of the company and available outside sources. The final decision is by top management but the knowledge basis for it is from the collaboration of all the people in the product development group (Jassawalla and Sashittal, 1998). Strategic planning for new products and new product selection are the most critical issues in product development management (Scott, 2000). It is important to align the business strategies with the technology strategies. This can be difficult where the technology strategy may be very long term, say 10 years, and the business strategy is shorter, usually 5 years. So the strategic knowledge outcomes are not set in concrete but are studied yearly, and are designed so that they anticipate, but are also reactive to, change.

The linking at all levels of management of anticipation and reaction are important in the early stages of the PD Process: project plan, product concept, product and process specifications, product design choices and process design choices. There needs to be recognition (Verganti, 1999) of both:

- anticipation capabilities – the capabilities to anticipate information into the early phase of product development;
- reaction capabilities – the capabilities to introduce changes late in the PD Process at low cost and time, to cope with unexpected constraints and opportunities.

The early decisions, and their related desired outcomes identified in the early stages of the PD Process, play a central role in the further development of the product development project. This is why there has been much emphasis in recent years on spending more resources on the ‘fuzzy’ front end, so that the future development of the project can lead more surely to product success. But, especially in the innovative and long-term projects, it is not possible to anticipate everything that is going to happen. In aiming for integrated product development performance (that is shortest time to market and optimum product quality) with new product lines and new product platforms, Verganti (1999) found that companies used different mixes of anticipation and reaction between the extremes:

- Detailed approach. Companies devote great efforts in the early stages to reduce uncertainty about downstream constraints and opportunities, and tend



**Fig. 6.5** Anticipation and reaction capabilities in product development  
(Source: After Verganti, 1999).

to keep reaction to a minimum. They try as far as they can to anticipate what is going to happen.

- Postponing approach. In this fully reactive approach, companies simply start the implementation of product development without anticipating knowledge about downstream opportunities and constraints.

Other companies aim at reducing the probability of running into serious unexpected events, through selective anticipation of critical areas and reactive capabilities that can handle inevitable late corrections at low cost and time. The ratio of anticipation to reaction depends very much on the company philosophy on risk-taking but also on the level of innovation of the project.

There is a need to combine anticipation of decisions/outcomes with planning of the ways to react to new knowledge developed in the PD Process, so necessary changes can be introduced late in the PD Process without too much cost in resources and time. Because making changes in the later stages is more costly in time and resources, there needs to be a balance in anticipation and reaction in the early decision-making as shown in Fig. 6.5.

Flexibility in product development (the cost and time for late corrective actions in a project) may be seen as consisting of two major components: structural flexibility and planned flexibility. Structural flexibility is the reaction capability that unfolds through long-term practice, project after project; planned flexibility is the project-specific flexibility, built through decisions taken in the early phase of the particular project. Anticipation capability is the capability to identify, clearly and early, specific critical parts of the project and plan the trigger reaction measures to manage these critical parts of the project. Decision making

at the early stages of the PD Process is a balance of anticipating predicted outcomes and setting up possible reactions to uncertain outcomes later in the project. This balancing of the anticipation and reaction capabilities is related to the level of innovation of the project, and to the company's capabilities and resources.

Outcomes can be set in general strategic terms by the top management, but they have to be developed into much more specific outcomes by the product development manager and the project leader. Designers are given product design specifications and these are the blueprints for their development of a prototype product. Process development engineers are given product qualities from the designer's outcomes and design a process to produce these product qualities. Production engineers are given the production specifications from the process engineers' outcomes and have to design a production system. The different outcomes may be developing in sequence or in parallel. For example the marketing strategy development and the process/production development both start from the product prototype and its qualities, and end at the same time, as the production plan and the marketing plan. This integration of times for outcomes is very important so that there are no waiting periods in the project.

A problem is sometimes caused by ranking tangible outcomes higher than intangible outcomes, for example the process design before the consumer attitudes. Product development often goes astray because a great deal of time and money is spent on developing a technical product and process, only to discover that the product is not what the consumers or customers wanted. The technical product is a tangible outcome, the consumers' concept of their ideal product is intangible, but it is actually the true outcome.

***Think break***

In Table 6.2 are some of the outcomes required by top management to make decisions at critical points. The product development manager is required to produce these outcomes for top management, in turn the product development manager has to identify for the project leader, the specific outcomes from the activities in each stage.

1. For Stages 2 and 3 in the PD Process, identify the specific outcomes needed by the product development manager from the project leader to build up the outcomes needed by the top management.
2. Draw an outcome 'tree' to show the relationships between the two levels of outcomes – for top management and for the product development manager.
3. In some past product development projects in your company identify the critical outcomes for top management decision making. What outcomes were unimportant to the decision making of top management? Discuss how this could affect the identification of critical outcomes in future projects.

### 6.5.2 Setting the budget

Setting the budget for the product development programme and the individual projects is related to the outcomes desired and the resources of the company. The central figure in setting the budgets is the product development manager who discusses the project needs with the project leader and then negotiates for the budget with the top management. This is essentially a human relationship although it is clothed in quantitative terms such as predicted financial outcomes, costs and probability of success. In the radical innovation, these predictions can be inaccurate and the budget for the project is secured on, as Tighe said in 1998, the 'selling' of the project to the higher management based on a combination of estimates and confidence. For incremental product development, the predictions are more accurate and the decisions are more pragmatic. Essentially the product development budgets are competing with the budgets for the 'today' functions; either in the main company budget, or if product development is in a functional department/division, within its working budget. The project leader and even the product development manager can be looking for a sponsor, who could be someone on the company Board, in top management, in a functional department, or in a new venture corporation. For incremental product development, increasing a product line or re-positioning a product, the marketing manager is probably the most interested person in the outcome of the project. For process development, it will be the production and engineering managers. If the project is a radical innovation, going across the functional areas in the company, then it is at top management or Board level. In a budget presentation, the project is clearly defined as to:

- aim and outcomes and their relationship to the strategic direction of the company or the department;
- effects on profits, revenues; costs and the qualitative targets for the project.

In the presentation it is important to relate the outcomes of the project to the business and also to show how the resources sought in the presentation are to be used. The project budget needs to relate to the company strategies, plans and budgets, because the resource allocation is not only dependent on the project needs but also on its relationship to the overall company resources and the competing departmental and project needs.

Important resources needed by the project manager are:

- financial;
- expertise (people with the required knowledge and skills);
- equipment;
- raw materials;
- information.

For a company in a given environment, some or all of these resources may be in short supply, expensive or shared; there are limited resources for the project. In companies with a number of projects and project managers, competition for limited resources may add to resources allocation problems. The consequence of these situations, in terms of reaching the project outcomes on time, has to be

assessed and problem areas identified as early as possible. Bottlenecks are predicted and resolved before they become serious. Failure to identify such bottlenecks can result in missed deadlines, which are frequently associated with large cost penalties or lost market advantages.

Budgeting should not be complex. A straightforward approach is to take each activity and look at its resource requirement on a monthly basis and so build up a schedule of costs, personnel, equipment and raw materials. It is important for the project leader to analyse each activity to see if other techniques could be used that would be less costly, more within the present capability of the team, and yet still yield the desired quality and efficiency levels in the project. If the monthly expenditure is presented graphically as cumulative expenditure, critical areas for cash flow during the project can be identified. The capital expenditure is treated separately. One aspect to consider is the future use of the capital equipment; if the equipment is to be used only for one project, writing off this capital is an important point in determining the validity of the project.

One of the factors in helping the project team to product success is to give it a secure basis for development; this is largely based on the availability of finance. So all levels of management need to spend some time in the early stages predicting the costs for the project and the relationship of these costs to the company's availability of finance. They need to be involved in the decision to finance the project. The product development manager has to combine the resources detailed in the plans of the individual projects. The projects are integrated so that there is optimal use of resources, the specific resources are within the budgets of the different functional departments – R&D, marketing, production, and the finance required is within the overall budget predictions of the finance department. This can present a problem in some companies where departmental budgets are not specifically related to product development and only R&D is identified as product development. As is well known the main expenses are in product commercialisation and launching, and these costs need to be identified at the beginning of the project so that they are within the financial resources of the company or available from venture capital. The top management and the Board of Directors have to view the budget proposals for the product development programme and judge them within the strategies and resources of the company. It is not sufficient just to agree to the funds for one year, but the funds for future years need to have support. There also need to be contingency funds either to allow for rapid product development sparked by a change in the environment or to solve unforeseen problems that may have arisen.

***Think break***

In two recent product development projects in your company (one incremental and one radical innovation):

1. Identify the times in the PD Process when the need for resources was identified and when the resources were allocated.



2. What resource needs were identified – finance, people, equipment, raw materials, information? How were the resources found? Were there any other resources needed?
3. Who were the people who developed the budget proposal in these projects and who made the decision to guarantee the budget?
4. Were there any delays in the projects because of poor prediction of financial needs? Were there cost overruns?
5. Compare the resource management and financial control in both projects, and identify the difference between an incremental project and a radical innovation.

### 6.5.3 Setting the constraints

Product development does not occur in a vacuum! There is an environmental situation that sets the parameters and constraints for the project. All the layers of the environment – society, industry, market and company – limit or constrain the area of the project as can be seen in Fig. 6.6.

Parameters that need to be considered at the beginning and throughout the project are the needs and wants of the consumers, the processing and marketing technology available, the knowledge capability, the time and the resources. Some important company parameters are the business strategy, the innovation level, expertise, management style, location of plants and markets, distribution system, product development organisation and management. Some of the environmental parameters are local government, national government, industry

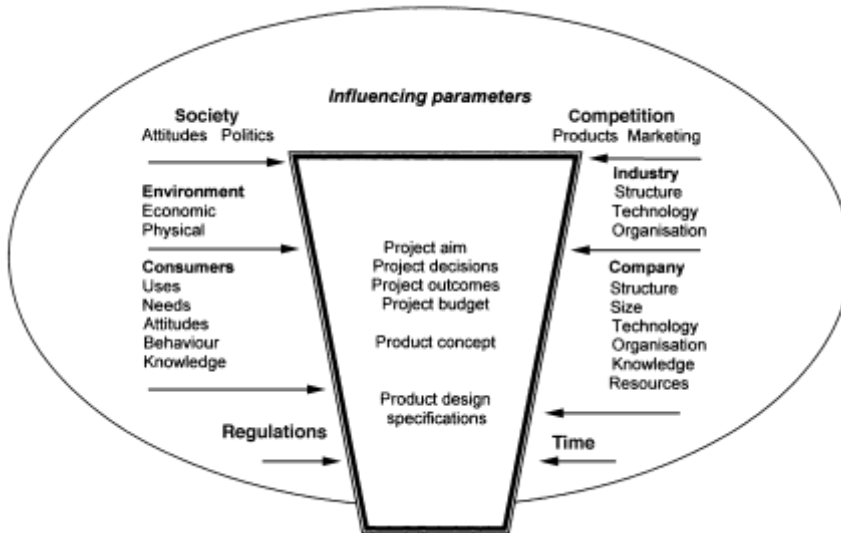


Fig. 6.6 Parameters that develop constraints in Stage 1 of the PD Process.

agreements, farmers' agreements, economic and technological status, business cycle as well as any social restrictions and attitudes.

Constraints caused by the different parameters are identified. Constraints can be set on the product, processing, marketing, finance, time and resources. These constraints are often quantitative, for example on the product there can be chemical composition, microbiological level, nutritional value, and a specific requirement such as the use/non-use of an ingredient. Some of the constraints important in product development projects are shown in Table 3.1 on page 100. Three important areas to develop constraints are the competitors, government regulations, user needs with their related societal attitudes (Holt, 1983). The company selects the important competitors, and the areas for competition, for example product technology, marketing, costs and prices, and the position of the new product as related to the competing products. Functional requirements or some other product quality may then be set according to the qualities of the competing products. These will then be part of the product design specifications and limit the area for design. Another important area to develop constraints on the design of the product is government regulations, both internal to the country and at entry to the country. These must be identified early in the project. There is little point in designing a canned fruit in syrup only to discover that there are high import duties related to the level of sugar in the product; or there is a quota on certain meat or dairy products into a country and these are already filled; or that only certain ingredients are allowed in bread; or there is a basic vitamin content if the label says vitamin-enriched. The government regulations need to be surveyed and the important parameters and constraints identified to avoid developing products that will violate the law. The very important area for setting constraints is the study of the user – what their needs, wants and fears are, and how these relate to the product design specifications; their attitudes to pollution, farming practices, environmental sustainability. Various factors may be constrained, for instance for a nutritional drink:

- product – nutritional, minimum percentage of protein, maximum percentage of fat;
- processing – minor adaptation of present production;
- marketing – existing distribution channels;
- financial – maximum level of investment in the project;
- company – two project members, one technical, one marketing; functional departments as support groups;
- food regulations – no preservatives, nutritional labelling required.

The parameters that can constrain product development are many and it is not possible to study them all when identifying constraints on the product development project. It is important to identify the critical constraints and not to have these constraints any tighter than is necessary to meet the parameters. One always needs to ask is this constraint valid? Is it necessary? If the constraints are very tight, then the opportunity for creativity is reduced. The constraints are important in the product screening and project evaluation, and are

used in building up the product concept and product design specifications. It is important that they are clear and as quantitative as possible.

Some parameters for the Mexican and US markets for tortillas are identified in Box 6.1.

### **Box 6.1 Mexican tortilla firms stage US bake-off**

Few things are more Mexican than the tortilla. But when it comes to making money off the ancient disks, most of the action today is north of the border. That's why two of Mexico's biggest food companies, Grupo Industrial Maseca SA (Gruma) and Grupo Industrial Bimbo SA have chosen the US as the main battleground for their fight to control the \$5 billion world tortilla market. So they're pitching their mass-produced, packaged tortillas to a foreign audience and honing their marketing skills for the day when Mexico's tortilla market joins the modern world.

#### **Mexico**

Mexicans eat 360 billion tortillas per year, 10 times the number of tortillas per capita as Americans. The market is overwhelmingly dominated by tortillerias, small businesses. More than 96% of all tortillas are sold in little shops licensed by the government. These outlets, many grinding tortillas on hand-powered conveyor belts, are virtual monopolies in their neighbourhoods, with a captive market that so far has resisted modern sales efforts. In part the reason is cultural: Mexicans like their staple fresh, hot off the press. But more importantly, Mexico subsidises small tortillerias with cheap prices on corn flour, making it possible to sell corn tortillas for less than the production cost. 'People stand in line for two to three hours for tortillas. It's worth it because they are so cheap.'

Thus, despite modern baking technology, companies such as Gruma and Bimbo simply are unable to make tortillas cheaply enough to compete with the small businesses, however inefficient they may be. Once tortilla subsidies are phased out, millions of Mexicans will buy their tortillas just like Americans do, in plastic bags in supermarkets. If Mexican companies could raise their packaged-tortilla sales to 20% of the Mexican market from 5%, they would match the tortilla output in the USA.

#### **USA**

There is a Mexican immigrant market but tortillas are also making in-roads among Anglo families. The US market is growing 10% per year in dollar terms, compared with just 2% for Mexico.

Gruma purchased Guerrero Foods, an East Los Angeles tortilleria founded by Mexican-Americans, in 1988. It works with Mission Foods, another

### **Box 6.1 (continued)**

Gruma operation. Guerrero's nemesis is La Tapatia, another family start-up, snatched by Bimbo last year.

Mission is the more upscale product, packaged with Mexican recipes in English on the back, for sale to Anglo supermarkets and institutional customers like PepsiCo Inc.'s Taco Bell unit. The play to national sympathies is obvious. Immigrant tortillas are packaged in bulky two-dozen, three-dozen and five-dozen, even 100-count bags, usually with a logo heavy on corncobs. Anglo tortillas are sold in slimmer packs with flashier logos; there are kid-size tortillas with green carton dinosaurs on the package, fat-free tortillas for the health conscious, and 'home-style' with lots of lard.

Bimbo has battle-hardened sales forces in the USA and the best distribution system in Mexico. Gruma's edge is its tortilla technology, with high speed mass production. In Los Angeles, it has the biggest tortilla factory in the world, runs three separate lines, one for institutional clients like Taco Bell, one for retailers and one for snack foods like tortilla chips. Gruma's R&D produce most of the industrial tortilla machinery used today. It also keeps down its raw material costs, because it mills its own flour in the USA and Mexico. Gruma is the biggest US player, with a 15% market share.

Analysts say that the future belongs to the tortilla-maker that can transfer US marketing practices to the home market.

Source: From Millman, 1996, reprinted by permission of the *Wall Street Journal*, 1996. Dow Jones & Company Inc. All rights reserved worldwide.

### **Think break**

In Box 6.1, there is a comparison between two markets and two companies in the tortilla industry.

1. Compare the parameters in the USA and the Mexican market affecting the development of 'commodity' tortillas, specialised consumer tortillas and institutional tortillas.
2. Identify the constraints that limit product development in the three product areas.
3. If the two companies were to consider entering the Mexican market when the corn flour subsidy was reduced by 50%, what constraints would each company have in developing tortillas?
4. What would be the major innovations for each company in product development?
5. What would be the major differences in the product development of the two companies?

## 6.6 Organising the PD Process

The PD Process, the decision-making, the outcomes, the budget and the project constraints are set and now someone has to start creating the product! There are two dimensions in carrying out the product development activities:

- PD Process capability;
- functional/technical knowledge and skills (expertise).

Companies have various degrees of functional excellence and technical know-how; but independent of these is the skill in organising, carrying out, maintaining and improving the complex business process of product development. McGrath *et al.* suggested in 1992 that companies could be graded on their product development capability according to these two dimensions. Companies tend to focus in one direction – technological superiority or business process capability, but the world-class companies are trying to increase their capabilities in both dimensions.

### 6.6.1 Identifying activities, knowledge and skills

The choice of activities is not only determined by the knowledge needed in the outcomes but also the resources and time available. The description of the activity defines the outcome expected, the timeframe to be met and the resources that can be used (Earle and Earle, 1999). The inputs and outputs of the activity are shown in Fig. 6.7, the people input and the physical input, which result in the necessary outcomes and decisions. Each activity has certain techniques chosen for it to achieve the desired outcomes.

**Activities** are often identified as product, consumer, technical (or processing), marketing and finance, but this does not give the integration that is necessary for product development. For example in Stage 2: Product design and process development:

- First main activity: initial prototype development.  
Specific sub-activities: modelling, product formulation, ball park processing experiments, protective packaging design, consumer panels.

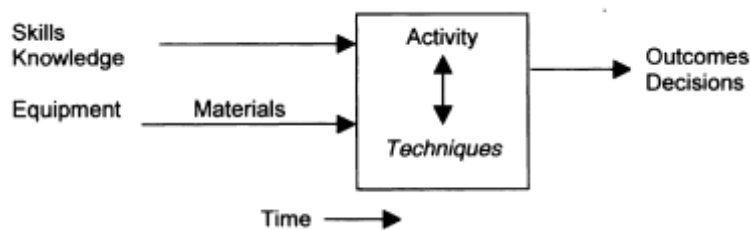
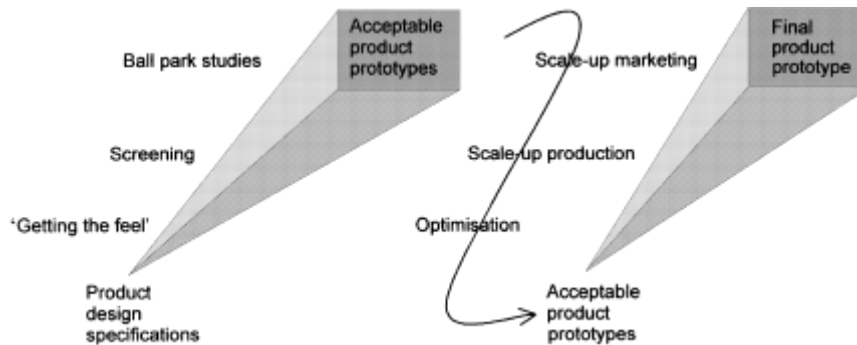


Fig. 6.7 The activity and its inputs and outputs.



**Fig. 6.8** Main activities in Stage 2: Product design and process development.

- Second main activity: developing the final prototype.  
Specific sub-activities: technical development, marketing strategy development, in-home consumer testing, production testing, market predicting, costing, finance analysis.

Figure 6.8 shows the main activities for developing the product prototypes and for developing the final prototype product. The sub-activities can usefully be grouped into development and testing as can be seen in Fig. 6.9. Design of the product and development of the process are interwoven with each other and with the technical, consumer and financial testing and analysis. The sub-activities can vary from project to project but the ones in Fig. 6.9 are common. Included in Fig. 6.9 are the possible techniques that can be used in these activities. It is important that the necessary activities in a project are identified and then techniques chosen to give the necessary knowledge. These must be within the capability of the company. There is often a tendency to keep on using the same techniques as it is simpler and easier for the project team, but they may not be the optimum for the project – they may be producing unnecessary knowledge or, what is worse, too little knowledge. The activities may be the same but there should be careful choice of techniques.

### **Think break**

1. In the initial activities of Fig. 6.9 – ‘getting the feel’, screening, ball park studies – the product design and the process development are conducted at the same time, and the techniques in the development are experimental designs. Study two recent product development projects in your company, and identify the activities and techniques used in developing the acceptable product prototypes and compare with the outline steps.
2. For future projects, would you change the activities in developing the acceptable product prototypes? What new techniques could be introduced in future projects?

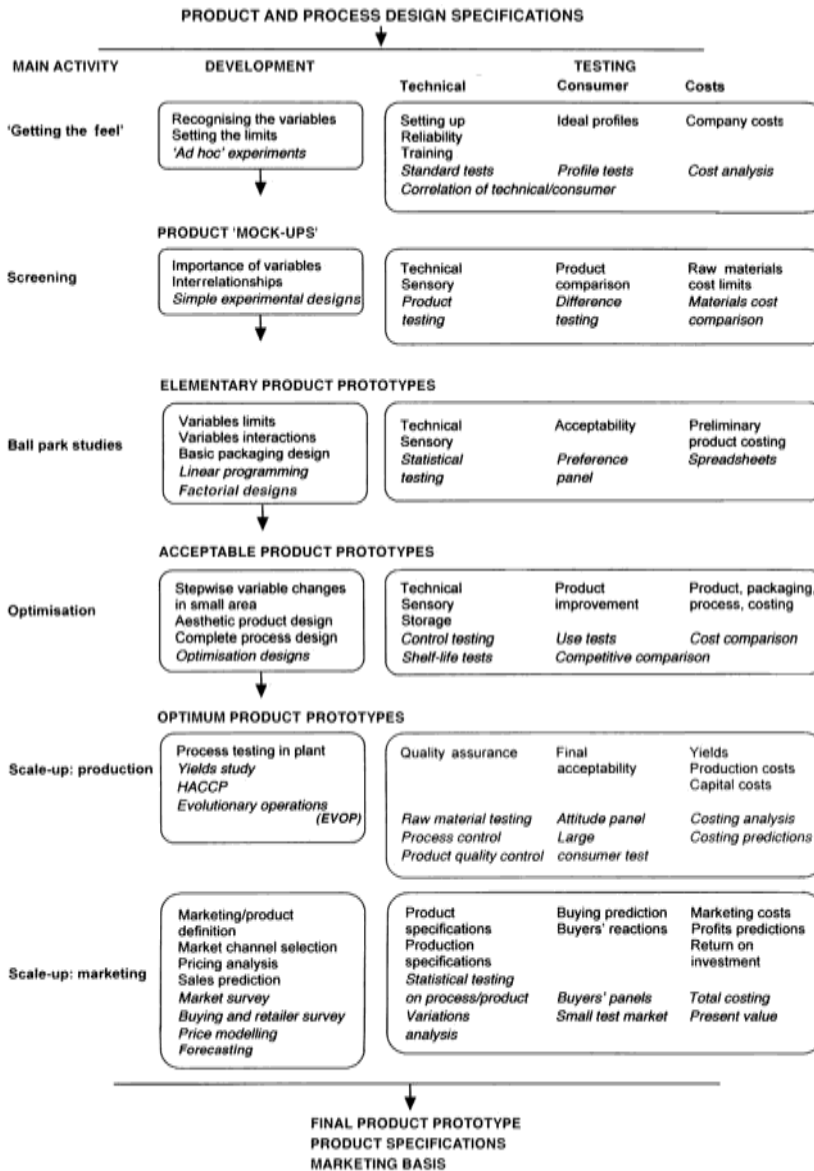


Fig. 6.9 Development and testing in product design and process development (Source: After Earle and Earle, 1999).

3. In the two company projects you are studying, how were the design and development integrated with the product testing? When was formal testing started?
4. In testing the product prototypes, what techniques were used? How accurate were the techniques in assessing the product qualities? Are there any new techniques that might improve the accuracy of selecting the acceptable product prototypes?

**Knowledge and skills** can be identified for activities and outcomes. There is a wide variety of skills from specialist skills such as in organising and moderating consumer focus groups and linear programming in product formulation through to generalist skills such as product design and project control. The important point is to identify the knowledge and skills needed for the activities and then identify the source of these skills. There is a basic level of knowledge inside the company, information can be brought from outside the company and used to create new knowledge, the company can create new knowledge through the activity, and also seek new knowledge through strategic research. The basic technical and marketing knowledge within the company may be tacit staff knowledge or explicit knowledge within the company records. This can be split into general knowledge and domain-specific knowledge, i.e. knowledge from general experience and education, and specific knowledge gained through working and education in the area(s) (Boston *et al.*, 1998).

There can be information sources outside the company such as literature, databases, patent information, catalogues, trade journals and of course the Internet. There is obviously a great deal of information available from these different sources, but knowledge is needed in the company to find it, refine it and present it in a usable form. Information has to be transformed into the knowledge needed for the activity; this is the most difficult part, which is often not recognised. Money and time are spent on setting up or contacting databases. But it is left to the stressed person organising the activity to change this into knowledge – is it a wonder that they often fall back on their own or other team members' tacit knowledge and do not use the information bases? The setting up of information bases means medium of presentation, format of presentation, location of delivery, management of delivery; timeliness, accuracy, relevance and cost must be considered – as related to the users of the information in product development (Boston *et al.*, 1998). Information technology can provide a means of collating and distilling meaningful and usable information across disciplines, which is useful as a basis for innovation, but also as a source of on-going relevant information (Ganguly, 1999).

Knowledge and skills can be brought into the company by employing new graduates or experienced people from other companies or from academic organisations. The present staff can be retrained to have the necessary skills. This all takes a great deal of forward planning based on the future product



development programme. It is not something that can be done when the project has come to a halt because of lack of specific knowledge or the ability to create new knowledge for the company.

Cooper (1999) identified seven 'blockers' to product development:

1. Ignorance.
2. Lack of skills.
3. Faulty or misapplied new product process.
4. Too confident.
5. Lack of discipline, no leadership.
6. Big rush.
7. Too many projects and not enough resources.

Three of these are lack of knowledge and skills, two are lack of time and resources, and one is lack of project discipline. The lack of knowledge and skills can be in the basic knowledge needed for the project and also in the method of organising the project. The activities needed for the outcomes and decisions cannot be identified, nor suitable techniques to be used in these activities. There is no excuse for this in incremental product development where activities are well recognised, but the important factor in this case is to keep up-to-date with the choice of techniques for the activities. Sometimes people may adopt a new software package for experimental designs but not know the underlying material changes that are occurring in the processing. For example they may be using an experimental design package that plans the experimentation and analyses the results but they may not understand the reactions that are causing the changes in colour, texture and flavour. Certainly in the radical innovation, the pathway may not be clear and there may be a need for significant experimentation before the product design specifications and the pathway for the rest of the project can be set. The radical innovation is entering unknown territory, but skilled knowledge in organising product development projects can keep the project from becoming lost.

### ***Think break***

1. Identify the tacit consumer knowledge that is in your company and the people who hold this knowledge. What are the codified sources of consumer knowledge and information available within the company and from sources outside? How does your company create consumer knowledge during the product development project?
2. Is the 'bark' of consumer knowledge within the company adequate for the company's incremental projects? If not, how could it be improved?
3. Identify people in your company who have knowledge in more than two areas of product development. What are their areas of knowledge and how do they integrate these? What are their positions in the company? When and how do they take part in the PD Process in your company?

4. Identify people either in your company or acting as consultants to the company, who have specialised knowledge in one discipline, activity or technique. When is their knowledge used in the PD Process? How is their knowledge integrated into the PD Process? Is there a need for more specialists – in what areas?

### 6.6.2 Responsibilities, resources and timing for activities

The kernel of the product development project is making things happen. It is important not only to plan activities but also to see that they occur effectively and efficiently, and are producing the correct new product at the right time and cost of resources. Product development is not a pyramid management activity, the person at the top of the pyramid taking all the responsibility, but for everyone in the project accepting responsibility. But to achieve the outcomes, they need to be given the resources and the time to complete their activities to the level required by the project. Everyone will have some critical activities, which they need to identify and nurture.

**Responsibility** is an important part of the management of product development. There needs to be clear definition of where responsibilities lie, from the critical decision making of top management to the outcome of the individual sub-activity of the individual project team member. Every part of the product development project can be crucial to the total effectiveness of the product, for example:

- poor optimisation of the flavour may cause an unattractive product to the consumer;
- selection of a variable raw material can cause production problems;
- low resources given by top management may cause lack of knowledge for controlling distribution;
- pressure on timing by marketing can lead to product failure in the marketplace.

So responsibility needs to be identified early in the PD Process as shown in Fig. 6.2 and expanded in Table 6.3, and adhered to throughout the project.

These are management responsibilities but the responsibilities of the individuals in product development also need to be identified. The designer has responsibility not only for creating a product, but also to ensure cooperation with other company staff and also consumers in designing the product. The designer's responsibility does not stop with the product prototype but includes its integration into both marketing and production. The designer has responsibility for communication with the other product development team members to ensure the design fits with the other developments, particularly process development. The supervisor on the production line for the new product not only has the responsibility to produce the product to the specifications but also to see that yields and costs are met. They are responsible for ensuring that

**Table 6.3** Responsibilities in product development

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Top management

- Clear product strategy and product development strategies
- Prioritise projects objectively
- Acceptance of the product development programme
- Clear definition of decisions and outcomes at the critical points of the project
- Determine and make available the necessary resources
- Determine and ensure the personnel needed in product development
- Make timely, decisive and knowledgeable go/no-go decisions

Product development management

- Product development processes for different innovations
- Coordination of product development programme
- Allocation and timing of resources
- Identification of different activities and their outcomes
- Set standards for quality of activities
- Control times and outcomes for activities
- Education and training of project teams
- Measures and controls effectiveness and efficiency of the product development
- Revamps the PD Process regularly

Project leader

- Identification of techniques for different activities
  - Setting the standards for the different techniques
  - Encouraging the creativity in design
  - Problem solving
  - Communication in the team
  - Organising time and resources for the team
  - Controlling the team's activities to give the desired outcomes
- 

Source: From Earle and Earle, 1999, by permission of Chadwick House Group Ltd.

staff understand the process, process control and product qualities; as well as cooperation between production and quality assurance.

**Resources** needed for the project are identified, followed by the resources already present in the company and the resources that will have to be brought into the company. The core resources are the complementary assets and organisational capabilities of the company. The complementary assets owned by a company can include

- physical assets such as marketing channels and manufacturing capability;
- knowledge assets such as R&D, patenting and the linking of the buyers and the suppliers;
- psychological assets such as brand image, company image;
- power assets such as high market share and industry dominance (Taylor and Lowe, 1997).

The assets can be physical or functional such as R&D, company/retailer networks, and both technical and commercial knowledge. A company can have assets such as modern manufacturing technology, an understanding of the

market, a breadth of market coverage and skill in research and design. It is important that these assets are related not only to the product development programme but also at the level of the activity in the project. There is often non-recognition of these assets by the person at the activity level. Some functional assets such as marketing and R&D are crucially important to product development, and their interaction is vitally important. The assets do not have a value when standing alone; it is the range of assets used together that is important (Taylor and Lowe, 1997). Another important asset is the organisational capability of the company, not just as related to the product development project but the total company organisation – this is particularly important in the initial stages in developing product strategy and product development programmes, and also in product commercialisation and product launching.

It is important not only to identify the assets available as resources in product development, but also the assets that the company lacks:

- Lack of up-to-date technology may limit product development to incremental change.
- Lack of market strength makes it difficult to launch an innovative product.
- Lack of raw material sources can limit the product formulation.

**Timing** is of course crucial in product development. For over 40 years, planning aids such as critical path networks, Gantt charts, PERT diagrams, job progress bar charts have been used in planning and controlling projects and there is computer software which can be used (Gevirtz, 1994). But the important parts in planning timings are:

- setting the sequence of the activities;
- identifying the critical activities as regards timing.

It is important to identify the activities that can theoretically run side by side, that is in parallel, and the activities that must sequentially follow each other. Sometimes lack of resources may change the parallel activities because there are not the people to carry them out together. So the people resource, and also often the equipment, may change the theoretical sequencing in actual practice. But it is always useful to start with the theoretical, because that will be the fastest track for the project. It is important to realise that by changing the theoretical sequencing of activities, efficiency of the product development will be reduced. Because of its effect on timing, it may be decided to drop an activity and take the risk of lack of knowledge leading to product failure. So there is much balancing of effectiveness and efficiency in planning the timing of activities as shown in Fig. 6.10 (Duffy, 1998). The consumer and the markets pull the balance towards effectiveness, seeking the optimum product that satisfies their needs and wants; the company wants an efficient project that is completed in time and within costs. Product development (project leader and manager) is trying to balance the two wants!

The most important part in timing the activities is to identify the sequence of activities that are critical. If the time taken for these activities overruns, then the timing for the whole project overruns unless there is reduction of activities in

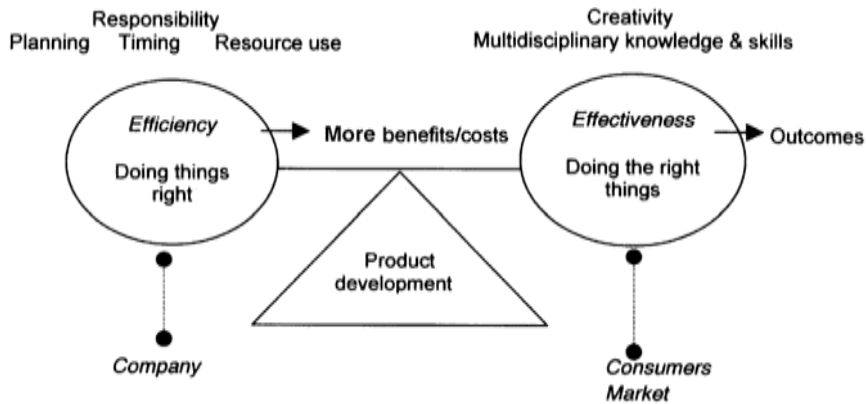


Fig. 6.10 Balancing effectiveness and efficiency (Source: After Duffy, 1998).

later stages. It is very important that care is taken with identifying and controlling the critical activities, early in the project, as losing time in Stage 1 can be very costly in the later stages and also may reduce the chance of success in later stages.

The main activities are split into the sub-activities (tasks) and the completion of each task is called an event (Meltzer, 1996). The length of each of these tasks is arguable, but they are usually measured in weeks. It is important that times for tasks are not too long as they become more difficult to control for timing, but again creativity in design does take time and is difficult to break down into short tasks.

It is important to monitor and maintain the time and resource schedule. Any changes are recorded and their effects on the launching date and also earlier stage completion dates predicted. There can be unanticipated problems such as difficulties in obtaining raw materials or equipment, technical difficulties in the design, patenting problems, competitor actions and even non-availability of top management for decisions. Their effects on the schedule need to be recognised immediately and the flow-on effects predicted. There may be a need to increase the people resources or to put pressure onto some suppliers to get the project back on a satisfactory schedule. Some pre-planning for possible problems needs to be allowed in the timing schedule.

### Think break

1. Contrast the responsibilities in your company, for product development, of functional managers including marketing and R&D, and of product development managers. How are these responsibilities integrated? And by whom?
2. In a product development project team in your company, compare the responsibilities of the project leaders and the team members. Do these responsibilities vary among project teams? What causes variations in

responsibilities among teams – differences in type of project, team leader, the composition of the team?

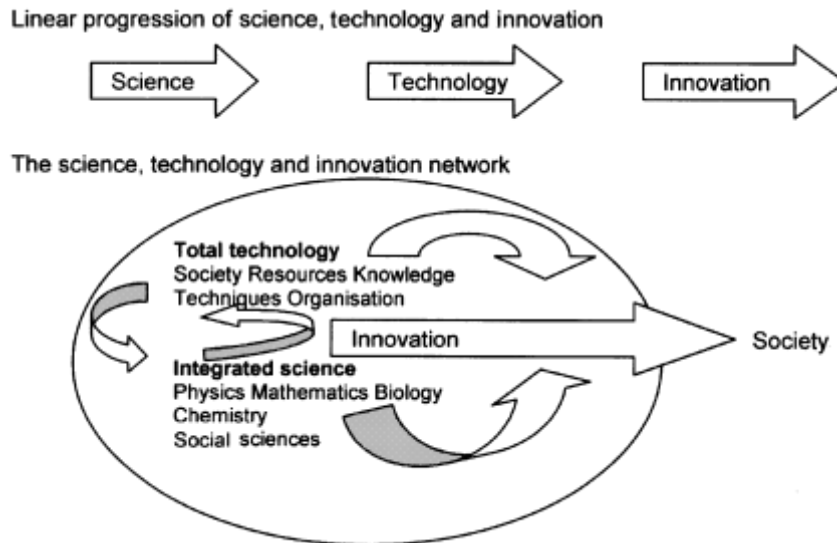
3. What is your company's balance between efficiency and effectiveness in product development projects? Does the balance vary between projects? If so, what is causing the variations?
4. What are the stumbling blocks in your company for increasing the efficiency of product development – lack of people, resources, and knowledge; over-ambitious projects; too many projects; faulty or misapplied PD Process; lack of discipline, no leadership?

**6.6.3 Personnel – internal and outsourcing**

People are the most important factor in product development. There are the core team members and there is the greater team, including support groups. A great variety of knowledge and skills is required and this needs to be integrated into a complex network supporting the product development. There is no question today that the linear progression from science to innovation has changed into an interdisciplinary relationship (Ganguly, 1999) as shown in Fig. 6.11.

There are four important factors in the network:

1. Integration of the sciences.
2. Integration of the technologies in the total technology.
3. Interaction of the science and technology continuously.
4. Interaction of the science and technology in innovation.



**Fig. 6.11** Relationships among science, technology and innovation.

The physical and mathematical sciences are part of all technology, in combination with chemistry and biology in process technology and with social sciences in total technology. The science can be developed separately but often is developed as part of the technology. Technology often cannot wait for the results of the basic science research but has to do the research to solve a basic technology problem. This is true in all areas, for example consumer research cannot wait for research in the social sciences but has to do the research now to solve the consumer problem. So basic research can be in technology as well as in science. Interaction also occurs in the other direction, basic science can come from a theoretical problem but often it comes from a problem identified in the science environment, which includes technology. The latter is often called strategic science, as it has a direction.

Therefore in the innovation process there is a continuous interaction between the development of the product and the science and technology. This interdisciplinary network, which vibrates backwards and forwards during the development, presents a very complex personnel management problem – in selection of people both outside and inside the company with the necessary knowledge, skills and creativity, and then coordinating them into a vibrant, interacting, communicating network. The company needs to have the ability to sustain a leading-edge competence over long periods (Ganguly, 1999), by selecting and educating staff, by careful selection of the outside personnel and building a relationship with them. Sometimes to solve a problem that has arisen, there may be a need to bring in an outside agency or consultant; but to be of value for the people in the network, the agency needs to have knowledge and understanding of the company. All this seems to fly in the face of the company's perceived need for secrecy in innovation, and has led to an increase in intellectual property agreements.

The networks can be inside the company and also connecting the company personnel to academics, technical consultants, research associations, consumer and market research companies, and innovation management consultants. There has been an increasing interaction of academic and government research with industrial research in companies, often encouraged by government organisations and grants. In all Western countries, the increasing need for these networks has been recognised because technology has been progressing so fast that it is difficult for companies to stay ahead. This also happened in the middle to the end of the nineteenth century in Scotland, during the Industrial Revolution, when the communication between academics and industrial technologists was not only close but their work was interrelated. In a time of fast innovation, academic research can get behind industrial research, and industry can be left with basic research problems, which cannot be solved in the time available. As the major problems cannot be solved, product development can make only small incremental changes; this can result in stagnation of the company and perhaps death. This stresses the importance of the interaction between the company research and external research to maintain the rate of innovation. Box 6.2 illustrates some academic and government research with possible applications.

### **Box 6.2 Application briefs from the *Journal of Food Science***

#### **Better rice formulated with vitamin A**

A process for enhancing the content of rice with retinyl palmitate, a particularly effective vitamin A precursor, was studied by researchers at the Department of Food Science and Technology at the University of Georgia. The process was donated in 1997 to the Program for Appropriate Technology in Health by the Coxes of Washington State, who owned the patent. Broken rice is milled into rice flour, combined with a binder and retinyl palmitate and other fortificants, and reformed into rice grains with the same texture as whole rice grains. These are blended with conventional long grained rice at a ratio of 99 : 1. The present study showed that the retinyl palmitate was quite stable under various cooking procedures. When stored at 23°C for 6 months, 85% of the retinyl palmitate was retained, but at 35°C there were extensive losses, 50% after 24 weeks. Under tropical conditions, this means either the use of controlled temperature storage or rapid turnover or increased levels of fortification to compensate for the loss.

#### **Reconfiguring the fatty acid profiles of dairy foods**

In 1970's it was found that by feeding cows a source of high oleic fatty acids, milk with higher levels of oleic acid can be produced. High oleic sunflower oil and canola grain are now available as cattle feed additives and make possible the commercial production of milk with higher levels of oleic acid. Researchers from the Universities of Florida and Virginia Tech have studied cheese making with this milk. By consuming calcium salts of high oleic sunflower oil containing 86% oleic acid, test animals produced milk in which the high oleic fatty acids in the milkfat increased from 26% to over 40%. Latin American white cheese (queso blanco) was made from the milk, and tested for firmness and for sensory differences from conventional cheese made by the same method. No differences were found in firmness, sensory testing showed no significant differences between the cheeses. Latin American white cheeses made with high oleic milk were similar to traditional cheeses.

Source: Reprinted from *Journal of Food Science* 65(5): iv, v. © Institute of Food Technologists, Chicago, Illinois, USA, 2000.

#### **Think break**

1. Identify outside agencies and people that your company has involved in product development over long periods of time, and the people in the company who work or liaise with these people. Show how they cooperate in the projects.



2. How could your company employ or educate its own personnel to take the place of the outside agencies? Would this improve the effectiveness and efficiency of product development in the company? How would you show top management the cost effectiveness of doing this?
3. The philosophy and practice of scientific research in universities during the last 100 years have been individualistic with freedom to choose but the philosophy of science and technology in industry is the creation of clusters of inter- and intra-disciplinary teams with a strategic direction (Ganguly, 1999). In the development of networks between academic institutions and commercial companies, how can these two philosophies be merged to give satisfaction to all the participants and ensure the forward-flow of research and development?
4. In small companies, there are only a few people in product development and they have only certain areas of knowledge. Examples are:
  - (a) Small company based on the technical invention of a co-extruder for dough and thick paste, the marketing skills are few. How could this company develop an outside network to overcome this lack of marketing skills?
  - (b) Small company formed because a need was recognised in the market for a high-protein drink for endurance athletes; it has little technical product and processing knowledge. How could this company develop an outside network to overcome this lack of technical skills?

## 6.7 Managing the PD Process

In managing the PD Process for a project, firstly the internal project management is identified and then the external agencies integrated into the internal team. The management for the project as it proceeds through the four stages, audits the outcomes and efficiency, and controls the project so that it is kept on track. The procedure is to lay down correctly the track for the project, and then ensure that the project is not slowed down by track unevenness or indeed goes off the rails and crashes.

### 6.7.1 Internal project management

Product development is people-driven, and therefore the most important aspect of managing for product development is to activate the product development team and to keep it going forward. This is the underlying energy that drives product development. By better managing and motivating people, the product development performance can improve markedly.

The **product development team** is a critical building block for the effectiveness and the efficiency of the project (Kuczmariski, 1996; Smith and Fowley, 2000). There needs to be the right mix of team members to give the knowledge for the activities and also the organisational capability for integrating the activities to create the knowledge for the required outcomes. These are

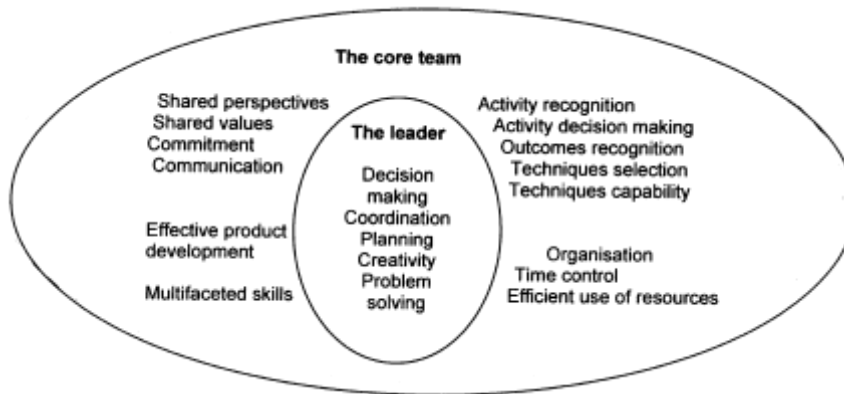


Fig. 6.12 The core product development team.

multifunctional teams and they need full-time leaders. They are often called cross-functional teams, comprising members from various functions and with complementary skills (Cooper, 1999). A truer description is a multifaceted team, having a variety of skills needed in a specific project, but not necessarily related to the functional departments. In the team, there is a need for a variety of expertise and experience, as well as different perspectives on product development. Utilising interdisciplinary project teams whose participants are involved at the onset of a project can greatly reduce development time and improve the probability of success (Gevirtz, 1994).

The actual mix depends on the company and the project. There may be a core team as shown in Fig. 6.12, and then a surrounding team or supporting groups. The core team conducts the activities but they are interacting continuously with the other members. People may move from the surrounding team as the project develops; for example in product design the person with marketing skills may be only an adviser, but in Stage 3: Product commercialisation will become a core team member. It is important that the knowledge and skills needed later in the project are identified, and people with these skills are included in the total team from the beginning.

As shown in Fig. 6.12, each member of the multifaceted team should share a common commitment to the project, with shared perspectives and shared values; being part of the team should be a responsibility that members are given by management. The team members need a mix of creativity and analytical problem-solving skills based on knowledge and experience. They are often individualistic because they have strong ideas on product development, but they need people skills to work in a team. This is not always easy to blend together but it can often be achieved with experience and good leadership.

The project leaders need skills in team-building and conflict resolution. They also need to be creative and good at problem solving; they need to be skilled product developers as well as organisers. In some incremental product development, organisation may be important; but as projects go towards radical

innovation, it is the innovative thinker who can bring the team to effective product development. It is the role of the project leader:

- to ensure that the project progresses smoothly, meeting all interim objectives and targets on time and within budget;
- to make sure that the necessary resources are available when and where they are required;
- to act as the primary channel of communication between the project teams, senior management and any external organisations involved (Jones, 1997).

There are several issues to consider in the coordination and management of new product development teams (Holahan and Markham, 1996; Scott, 2000):

- Team structure, team size, membership composition of teams.
- Team leader selection, team management, team control and evaluation.
- Team operations, inter- and intra-team coordination, communication systems, team member access to project databases.
- Team reward structures, team motivation.
- Team training in teamwork and conflict resolution.

The project leader's actions in team management are shown in Table 6.4. The leadership style of the project leader is important as it determines how project members perceive the working climate, learning possibilities and organisational

**Table 6.4** Project leader's team management

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**Setting up the project**

- Identify the activities in the project with the team and set up a coordinated project plan.
- Aid the team members in ensuring the appropriateness, accuracy and efficiency of the techniques they choose for the activities.
- Set up a time and resources schedule for the plan.

**Managing the team**

- Combine the knowledge and skills of the individuals into a combined group knowledge and skills.
- Lead the creativity and problem solving in the group.
- Ensure communication within the group.
- Organise resources for the project.
- Plan and keep the project on the time schedule by cooperating with the team.
- Continuously monitor the quality of the outcomes to ensure the project's effectiveness.
- Keep within budget.

**Team outside communicator**

- Communicate well with the functional departments.
  - Relate the group's aims and the outcomes from the group's activities with senior management.
  - Track overall time and achievement lines.
  - Be a strong group sponsor.
-

effectiveness of the PD Process. Employee-centred, relation-oriented leadership appears to lead to a positive work climate and a better learning atmosphere in the project, compared with production-centred and change-centred leadership. Supporting innovative learning requires a willingness of the leader to share responsibility and joint experimentation as well as focusing on team objectives. To assemble people in a work group and define work tasks is not sufficient to get synergetic effects – the team must find the climate supportive, trusting and challenging (Norrgrén and Schaller, 1999).

The core team has a combined aim and also a plan for the project. Teamwork is essential – members need to have shared values and shared knowledge. Continuous, open, communication leads to an effective and efficient team. Regular meetings are needed to update each other on the individual activities, analyse and compare the results, develop new ideas and keep the project on track. Ideas and results need to be shared and people must feel free to criticise constructively. This core team needs to stay close to the functional departments and to consumers, customers, raw material and equipment suppliers. It needs strong connections with organisations in the distribution chain, and other outside agencies such as consultants and research establishments. Product development is not a closed internal system and team members have to learn how to communicate with the outside and at the same time keep the new knowledge in the project confidential.

There are three important factors to consider in managing the team:

1. Education and training of the team.
2. Over-confidence of the team.
3. Cultural and societal background of the team.

**Education and training of the team** is important (Cooper, 1999). The team needs knowledge of the PD Process and also the general and specific knowledge needed for the various activities. Team members may be lacking in knowledge of the PD Process, its decisions, outcomes and activities. When people have neither education nor experience in product development, it is not sufficient to have a PD Process on the internal computer network to which they can refer. They need a training course on the PD Process in the company, with examples of past projects as illustrations. The project leader needs an advanced course on ensuring effectiveness and efficiency of the PD Process. The specific and the general knowledge varies according to the project and the person's part in the project, and therefore the educational level of the team members varies a great deal from the young scientist with a PhD to the process worker with many years of experience. If there is not the capability and knowledge for a particular activity such as market research, technical research or consumer research, either team members will need to have further education or the capability will have to be bought from outside.

**Over-confidence** can be a problem in managing product development (Cooper, 1999). There appears to be a tendency in some companies and with some product development personnel to say we do not need to do that activity –

we know it all. Sometimes this may be true, but many times it just shows a lack of knowledge. There appears to be little training, and indeed little research, in judging what knowledge is essential to a project, yet lack of knowledge combined with over-confidence is related to a high risk of failure. Any dropping of critical activities needs to be made in full awareness of the risks and costs involved. For incremental product change, there is often a situation in which:

- extensive tacit and explicit knowledge of the product category exists;
- the marketing strategy and plan need only minor changes from project to project;
- the production knowledge is known and in use within the company;
- the production capacity exists with little need for change to production method.

In this case, the team can consider dropping activities such as scale-up of processing, research for the market strategy and large-scale test marketing. But in radical innovation, where there can be little of this specific knowledge in the company, there can be real dangers in dropping activities such as business analysis before launch and test marketing of the new product with its new production and marketing methods.

The **cultural and societal environment** also affects the organisation and working methods of the product development team. There can be differences in the general society and also among different types of companies so that what is necessary for product development management in one environment may not be applicable in another. Souder's research in various countries in the world identified differences, for example in comparing the USA and Sweden. In the USA, the degree of commercial success was related, in both familiar and unfamiliar markets, to *marketing proficiency*, *development proficiency* and *customer service efficiency*. But three measures were significant for US unfamiliar products but not for US familiar products – *technical skill adequacy*, *R&D/marketing integration* and *project manager competency*. In the more innovative projects, there was a greater need for technical skills and for a strong interrelationship between the technical and marketing development. In these, usually large projects with a lot of unknowns, there was a need for innovative and adaptable project management. For Scandinavian product development, *R&D/marketing integration* and *project manager competency* were not related to product success for both familiar and unfamiliar products. This was probably because US-type integration processes and project manager roles may be relatively less important in Scandinavian companies, where collaboration among individuals may be more spontaneous, informal and internally motivated. Their relatively low importance is consistent with the egalitarian Scandinavian cultural emphasis on solidarity and cooperation (Souder and Jenssen, 1999). In comparing Japan and the USA, Souder and Song (1998) identified the greater Japanese belief in technical expertise in product development; which may be related to the culture – the Japanese culture emphasises the position of the technologist, the US culture places more emphasis on the manager. So in

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deciding on product development project management, it is important to recognise not only the level of innovation – incremental against radical innovation, but also the cultural background of both the company and the society surrounding it. Successful management of the product development project requires careful consideration of the company's internal and external environments. Practices that have proven successful in one company and one society may not be directly transferable to another company in another society.

The product development project needs to be managed in ways that promote the use and the development of each individual's knowledge and skills, and also encourage the coordination among the individuals. The means for managing this may vary from company to company, but they need to be researched so as to obtain the optimum capabilities for the company's product development.

### ***Think break***

1. Collaboration in the core project team gives a synergy which produces outcomes that exceed the capabilities of the individuals in the team (Jassawalla and Sashittal, 1998). Discuss the types of collaboration that you have observed in core product development teams and how these have affected both the efficiency of the project and the effectiveness of the outcomes.
2. From your experience, what characteristics of the core team and of the individuals affect the level of collaboration?
3. Collaboration between the core team and the supporting team in the functional departments gives a companywide thrust to product development. The level of this collaboration depends on company organisational factors such as the priority that senior management gives to product development and the level of autonomy afforded to participants in the PD Process. Discuss the level of collaboration in product development in your company, and how organisational change and also changes in the attitudes of individuals might raise the level of collaboration.

### **6.7.2 Integrating and managing the work of the outside agencies**

The second task is to integrate the work of the outside agencies into the product development project. There are two different groups – those providing knowledge to the company during the project and those providing systems for the commercial development and launching of the product. As shown in Fig. 6.13, outside agencies may provide consumer and market research, design of product and packaging, product testing and consulting in various areas. As the product development project progresses, more and more agencies can be brought in to provide contract processing, physical distribution, market distribution and marketing. The raw materials suppliers and the equipment suppliers fall within both the knowledge and systems acquisitions; they can be supplying knowledge

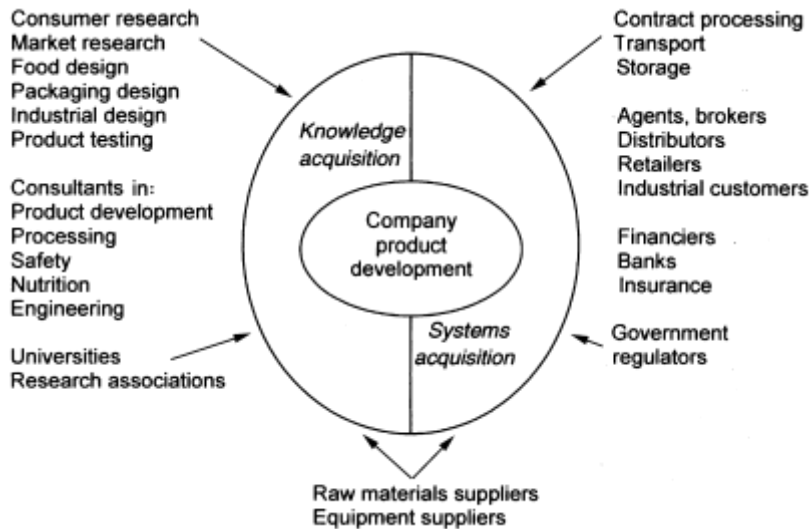


Fig. 6.13 External agencies and company product development.

on product qualities, formulation and processing conditions, but of course in the end hope to supply raw materials and equipment.

Knowledge acquisition methods can vary from casual conversations to binding contracts. The outside agencies can come into the product development project for a one-off piece of work or they can be advising throughout the PD Process. The usual pattern of short-term contracts consists of:

- outline brief from the company;
- proposal from the outside agency;
- discussion and adaptation of proposal;
- contract agreement;
- research reporting;
- acceptance and coordination into product development project.

One of the problems in, say, employing a food designer either to design the basic product or to contribute aesthetic values to the product, is to give accurate descriptions of the consumer and their needs and wants, production/distribution limitations and price/cost limitations. The outline brief needs to include this information as well as the place of the new product in the company and the market. Otherwise there will be endless redesign and discussions to get the design the company will accept, ending in a frustrated designer and unhappy product development personnel. Another problem is with work that takes a long time, for example a research programme with a university that involves postgraduate students. Basically the project is a teaching process for them, and the company must not expect results that can be accepted immediately into the product development project; they will need further development to bring them

into the project. Also there are often teaching needs that require the students to do the R&D in a certain way, which is not the accepted procedure in the company. The company takes risks and cuts corners, which the university project cannot do if it is to be accepted academically. Using undergraduate or postgraduate students can be much cheaper than using company staff, but the company needs to realise the limitations, particularly of extended time.

How problems in building systems for the final stages of the PD Process can be solved by outside agencies is shown in Table 6.5. The list is not all-encompassing; many other problems arise; for example importing regulations and clearance of foods at entry will need a qualified person representing the company, the risk of loss of product or deterioration of product in transit will need insurance, and so on. This list is to bring attention to the many problems that have to be solved, and the systems/people that are available which the company can contract to use or actually buy. Little in the product development literature describes research in this area, but it is of course the most costly part of product development and can also have the greatest risk of failure.

The interrelationships between the company and the systems providers are commercial relationships and they are judged as usual by their effectiveness and efficiencies. Very often these relationships are already in place and it is a case of involving them with the new product. During the product commercialisation stage, they have to be brought into the discussions on the production, marketing or financial developments so the procedures cannot only be put in place but have

**Table 6.5** Some problems in building systems solved by outside agencies

Problem	Some solutions
Little knowledge of process	Buy a turnkey plant
Need to trial production	Use contract processor
No packaging line	Use contract packer
Process control inaccurate	Contract process control company
Microbiological safety	Contract microbiological laboratories
Need ISO 9001 QA (quality assurance)	Contract QA accredited auditors
No physical distribution	Contract international distribution company
No storage in market	Contract storage company
Poor control over distribution	Contract logistics expert
No marketing system in this area	Sell product to distributor Buy marketing company
Poor contact with retailers	Contract food broker, manufacturer's agent
No contact with media	Use advertising agency
Little knowledge of importing/exporting	Sell to exporter Use an export agent
Not enough working capital	Borrow from bank
Need investment capital to start	Loan from bank Agreement with venture capital company



the support of the outside agencies. There is a balancing of confidentiality on the product with the need to have strong cooperation. Where new agencies have to be sought, the procedures are much more complex, especially working in overseas markets, where there may not be knowledge of the distribution/marketing systems, culture or even the language. The primary producer can be a very long way from the consumer in the other country, and designing a fresh food for export to an overseas market can provide many headaches as the producer tries to work through a complex network of export agencies/import agencies/trading houses/auction markets/retailers. Reactions to products can take a long time – even years! The larger companies have built up subsidiary companies in the overseas countries, and may even have product development groups working in the country, so they have overcome the hurdles and can proceed with product development in a systematic way. Joint ventures and licensing operations can also overcome the problems in the new country.

Another problem is that foods are biological products, which can deteriorate with time. The distribution system looks suitable on paper but when the distribution development is taking place, there are discoveries of blocks in the system, for example slow unloading of cargo, changes from one container to another in using several airlines and bad vibrations in transport.

### ***Think break***

1. What are the major problems that your company has encountered during commercialisation and launching of a radical new product? What outside agencies has the company used to solve these problems?
2. How do you judge outside agencies providing marketing research, engineering consulting, packaging design and advertising design during commercialisation?
3. How are the distribution/wholesaling operations of marketing to the food service industry similar to and different from those of the food retailing industry? If you had been marketing to retailers, and had a line of new products designed for small family restaurants and takeaways, how would you design the distribution for these products?
4. What are some of the problems involved in exporting a new product into an overseas market? What investigations would you make to identify any import controls and also internal food regulations for the food product? What outside agencies could you use?

## **6.8 Company organisation for product development**

Organisation and organisational changes were a significant part of food company management in the 1980s and 1990s; this management structuring and restructuring affected product development. Companies bought or amalgamated

with other companies to obtain new brands and new products, and either brought together the product development and R&D groups in the two companies and then reduced the size, or dropped the product development group in one company. Then it was found that the various technologies in the conglomerate companies did not match, so they divested themselves of some areas and went back to their 'knitting' or core group. Other companies decided that they were only in marketing and sold off their processing plants and technologies; some decided that cost-cutting was the name of the game and divested or at least reduced their R&D departments. In all of this reorganising, the processing and marketing technologies were certainly split apart and in many cases were reduced, and product development was absorbed into one or the other. Today there is a need for a more dynamic management system that can grasp the idea of total technology and also be aware of changes occurring both technologically and in society.

There is no right or wrong structure for product development management. The place of product development will be determined for individual companies on the basis of:

- company strategies and objectives;
- industry environment;
- economic climate;
- company's existing product mix;
- level of technical orientation;
- level of market orientation;
- personnel involved;

and dare we say, the prevailing fashion in management!

### **6.8.1 Formal organisations**

On the whole, product development is a misunderstood or perhaps underrated profession. This often results in the product development function becoming an appendage rather than central to company strategic thinking. This in turn leads to product development becoming the domain of marketing or technical, mainly because senior management does not realise what it is and what it can do. Product development can be made to work with almost any organisation providing there is a commitment to product development from top management and a product champion, but the type of product development and its effectiveness and efficiency vary. Marketing tends towards incremental product changes, production to cost reductions and R&D to radical innovations.

#### *Technical*

'Technical' is often the home for product development: this may be R&D, production, laboratory or engineering as shown in Fig. 6.14. R&D is often the home for product development in large multifunctional food companies, as it is the base for new scientific and technological knowledge in the company, and also in primary production because of the long time needed to breed new plants

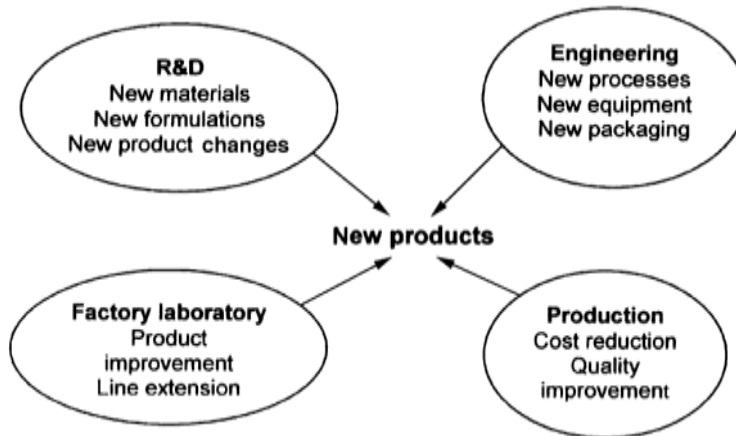


Fig. 6.14 Technical product development.

and animals. The first problem is whether to organise product development within the individual scientific disciplines or to have separate product development groups, in other words split the R from the D (Urban *et al.*, 1987). Within the scientific disciplines, there may be a lack of multidisciplinary research and it may be difficult to impose a tight time frame; the project group may have little real contact with the basic research, and none with consumers and production. A large multinational may try to get over this by having the incremental product development with the individual companies or areas, and the radical innovations in R&D. It is obviously a major problem as one sees the large companies cycling back and forth throughout the years.

Engineering is often the home in companies that are based on process development, especially food processing equipment systems. Process development is often strong in European food companies, because this can be an area for radical innovations. Usually the processes and the equipment are sold to food manufacturing companies, so there is not the same need for consumer input into product development. In the smaller companies, the laboratory or production can be the home for product development. The laboratory can be responsible for quality assurance and product development; product development usually emphasises incremental product improvements. Production controlled product development concentrates on raw material and processing changes, usually with the object of reducing costs, improving yields and improving quality. These are very general categories, and individual companies with different types of enthusiasts for product development can develop radical innovations from the laboratory of a small company.

#### *Marketing*

'Marketing' is also often the home for product development, especially in a strongly marketing-oriented company. There may be a product manager who is

responsible for a product area, both established and new products or there may be product managers who are responsible for the established products and a product development manager for the new products. The product development manager is responsible for coordinating all the market and consumer research, and the complete marketing mix for the product, and cooperating with the technical and production people in developing the product and producing it. Marketing also has problems in setting up an organisation for product development as is seen in Fig. 6.15 which outlines the development of the product development organisation in a fictional company 'Rainbow Products'.

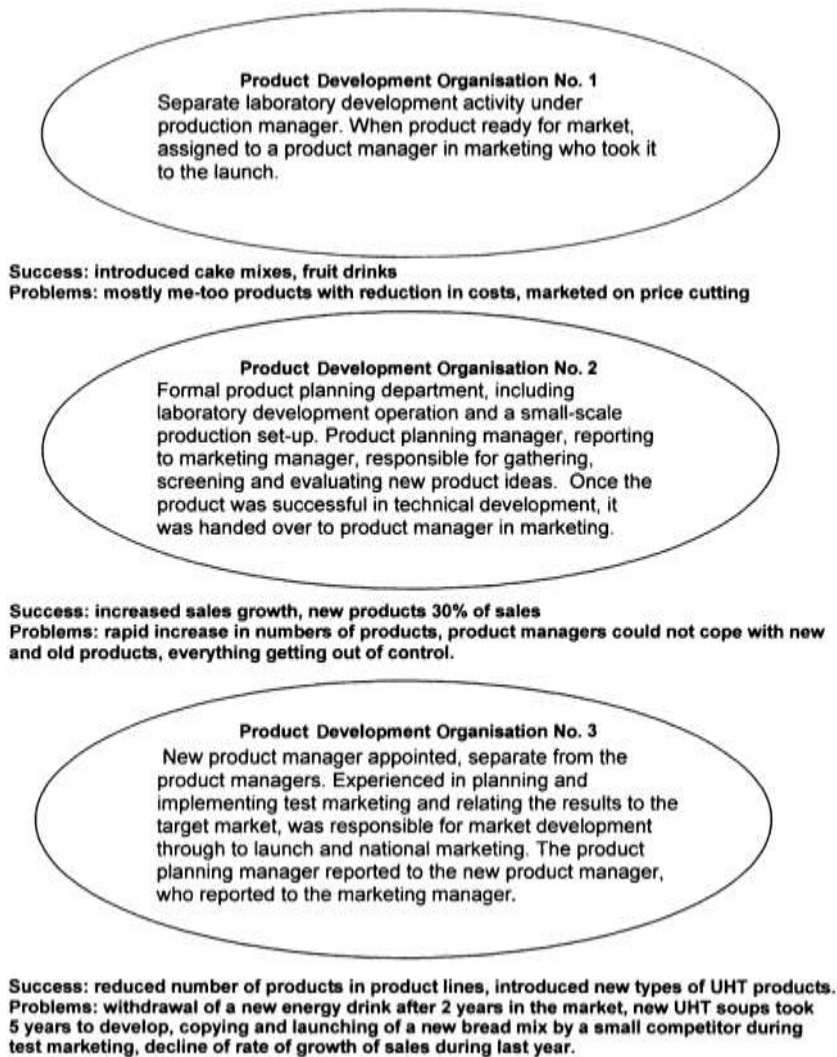


Fig. 6.15 Rainbow Products product development organisations.

The advantages of the product manager system are:

- familiarity with the product area;
- good connections with outside agencies such as advertising agencies, market researchers and retailers;
- real commitment to expanding the product area;
- involvement in all aspects of development;
- direct concern with day-to-day marketing.

Disadvantages of the product manager system for new products are:

- working under great pressure to produce short-term results for all products;
- difficulty in handling complex new products;
- little or no understanding of technological developments;
- difficulty in motivating people in other functional areas.

The product manager often has great difficulty in understanding the radical innovation and its relation to consumer needs and wants. Therefore they tend to produce minor product variations and product line extensions. This is also true when other people in the marketing department are responsible for product development.

### ***Think break***

Rainbow Products (Fig. 6.15), 20 years ago was an old-established company selling packaged consumer goods such as special flours, dried peas and beans, baking powder, peppers and spices, when the new general manager decided that the company should increase its range of packaged products. Gradually over the years it has marketed cake mixes, fruit drink powders, dried soups, bread mixes, hot chocolate drinks, health drinks, and recently has expanded into UHT soups and drinks. It has met several product development problems over the past years and reorganised its product development to overcome these problems.

You have been brought into Rainbow Products by the Chief Executive (who started product development when general manager). You have asked him and his staff some questions about their product development:

- Planning of products and go/no-go decisions: new product committee consisting of marketing manager (chairman), new product marketing manager, product planning manager and market researcher. Sometimes the Chief Executive sits in.
- PD Process generation, screening and evaluation of new products; feasibility and concept testing; product development and consumer tests; marketing plan development; pre-test on product name, packaging, pricing, advertising, promotion; test marketing; national launch. Emphasis on testing at all stages.
- New products: product manager's comment that what is a product modification is regarded as 'new product' by the new product group. They spent two years developing an instant chocolate sponge which was eventually killed because the market did not want it.

- Control of product development: product planning manager said a problem was that on the new product committee, each member's vote counts as only 1, therefore technical research has little say. One of our new instant puddings never satisfied the committee, and it went back and forth with minor changes for two years.

Now as a consultant answer the following questions:

1. What factors do you think caused the recent problems in the company's new products?
2. Do you think they were caused by:
  - (a) lack of knowledge in the company,
  - (b) lack of discrimination between incremental and radical new products,
  - (c) poor collaboration, decision making, project control?Can you identify any other factors?
3. How do you think product development should be planned and controlled in the future?
4. What personnel does the company need in product development in the future?
5. What could be the management structure? Who should be responsible for critical decisions, for the effective and efficient running of the projects?

This example shows how product development is very much influenced by people, their knowledge, attitudes, beliefs and indeed their culture. It is important to recognise this when managing people in product development.

#### *New product department*

A new product department is sometimes used to integrate and coordinate the company's capabilities and bear the responsibility for product innovation (Urban *et al.*, 1987). This can work well where there is already good integration between functional departments, but can be left out on a limb if there is competition among functional departments. It certainly focuses the company's product development and also can combine the product, processing and consumer research in the early stages, but it is never large enough to do the marketing and production development in the commercialisation and launching.

All these formal systems can be suitable for incremental product changes, the choice being dependent on the character of the company and its staff, but they are usually not a successful structure for radical innovations.

#### **6.8.2 Dynamic, changing organisation**

The radical innovation needs a more dynamic product development organisation, which can change with the, often unpredicted, changes in the project. Some organisational methods are: matrix, subsidiary/divisional, entrepreneurial/venture, corporate structures.

**Matrix organisation** is where the product development team member is also a member of a functional department. An individual staff member who is contributing to a product development project will be responsible to the project manager for the daily work on the project but will remain responsible to the departmental head on the standard of work and career direction. This can bring a wide variety of knowledge and skills into the product development project as needed, but can cause uncertainty, hesitation and strife between the two managers.

**Subsidiary/divisional** is where the product development projects are divided among subsidiary companies, or product divisions, in large companies, and they may be supported by corporate groups in R&D, market research, strategic planning and intellectual property. This means that there is a small product development group embedded in the functions of the subsidiary with specific knowledge, supported by strong groups in the central research. This would appear to be the optimum system for large multinational food companies, developing incremental products in the subsidiary and the radical innovations in the corporate research. But it can build communication problems, which can cause lower technology in the incremental products, and difficulties in technology transfer for radical innovations coming from the corporate research. To keep them as a combined product development structure needs more than the occasional visits between corporate and subsidiary; it needs combined knowledge building by moving staff between groups and joint workshops. Another problem is that the subsidiary may identify a radical innovation, but is not allowed to develop it and so becomes frustrated.

**Venture/entrepreneurial** seeks to introduce some of the attributes of the small entrepreneurial company into the large, multinational food company. The basic philosophy is to provide maximum responsibility to the venture manager/project leader who is able to recruit the members of the team, free to use the resources as long as the budget is kept, and organise the activities within the overall aims of efficiency and effectiveness. The team creates the ideas and develops the product through to the launch and, if successful, the team may be allowed to form a company. This gives the opportunity for creative people with management and general business abilities to build a new product area for the company. The company not only has a new product platform but also has someone who has the abilities and the experience to develop new products in the future. If the idea is not developed to full commercialisation, and the project leader returns to their own area, the company has an employee experienced in product development. Venture/entrepreneurial is for introduction of radical innovations and not incremental products.

**Corporate structures** include new product committee, corporate new product task force or a group of directors on the Board. All of these report to the Board or at least the Chief Executive, and are formed from the senior people in the company. This is bringing innovation into the company at Board level, and is more likely to occur in the new enterprise, rather than the large, long-established company. These groups will set the product strategy for the company, coordinate the projects in the product development programme, monitor the progress of the projects and provide the critical decisions and the

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resources. A task force may be formed for a major project with high capital costs and risks. With these structures, top management has taken responsibility for product development in the company, and has taken control of it.

In conclusion one cannot say that any one structure is the way to manage product development, but that there are right and wrong ways to manage specific types of product development in specific companies. Incremental product development can have a semi-permanent, slowly changing structure which not only creates knowledge but stores the knowledge either in explicit data sources or in the tacit knowledge in the heads of people who have been in product development over time. Collaboration between people who have the multifaceted knowledge needed for a project is built up over the years. They work closely and develop an extensive shared knowledge. The company becomes a product development team, which splits into small teams for the projects but always feels connected together through the projects. This is very much easier to do in the small company, but the larger companies need to have large teams in different product areas or in different geographical areas, or in different markets. Radical innovations need a much looser, more temporary structure, because they are working in areas of not easily predictable change. Their organisation needs to give the dynamism to drive the project forward to completion.

In all product development organisations, there are some key ingredients:

- A corporate commitment to product development, starting at the top of the company. Product development is a major part of the company culture.
- One person takes responsibility for a project, no matter how large or small.
- The project leader or the product champion, if the project is too small for a team, should have direct access to personnel and their knowledge needed in the project.
- The project leader manages the people working in the project, makes decisions and is accountable for the project.
- Critical decision making is by top management, but all other decisions involve people responsible for the project.

As food enterprises grow from the small company with a few entrepreneurial individuals running or indeed comprising it, the need for more elaborate organisation grows and with that comes the need for explicit frameworks to maintain and expand the activity. Systems will be tried, become accepted and are used often, and then have to be adapted as the company grows. Product development changes a company, and the system for product development needs to change. It must not become a rigid, bureaucratic system, but retain the dynamism needed for successful product development.

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