## Managing uncertainty

Whilst management in general involves coping with uncertainty, sometimes trying to reduce uncertainty, the *raison d'être* of managers involved in innovation is to develop something different, maybe something new. The management of the innovation process involves trying to develop the creative potential of the organisation. It involves trying to foster new ideas and generate creativity. **Managing uncertainty** is a central

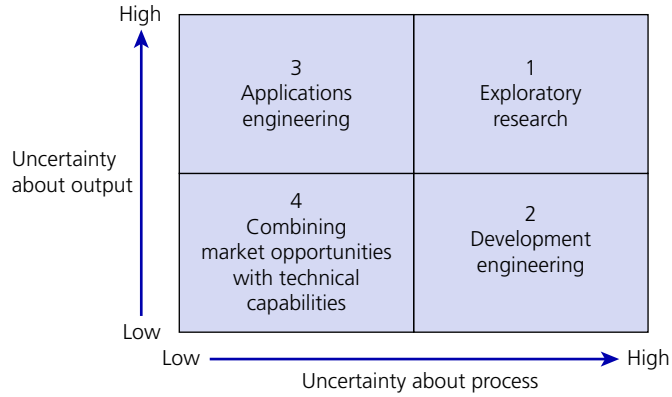


**Figure 4.2 Pearson's uncertainty map**

*Source*: Pearson, A.W. (1991) 'Managing innovation: an uncertainty reduction process', in Henry, J. and Walker, D. (eds), *Managing Innovation*, Sage/OU.

feature of managing the innovation process. This has been recognised for over 40 years within the innovation and R&D management literature (Pearson, 1983). Nonetheless, it continues to be a cause for concern for firms. At the very least, there is the uncertainty of output (including market uncertainty) – i.e., what is required – and also uncertainty of process – i.e., how to produce it. Pearson offered a helpful uncertainty matrix for managers to help them deal with different levels of uncertainty. This recognised that different environments required different management styles (see Figure 4.2).

## Pearson's uncertainty map

Pearson's uncertainty map (Pearson, 1991) provides a framework for analysing and understanding uncertainty and the innovation process. The map was developed following extensive analysis of case studies of major technological innovations, including Pilkington's float glass process, 3M's Post-It Notes and Sony's Walkman. In these and other case studies, a great deal of uncertainty surrounded the project. If it involves newly developed technology, this may be uncertainty about the type of product envisaged. For example, Spencer Silver's unusual adhesive remained unexploited within 3M for five years before an application was found. Similarly, if a market opportunity has been identified, the final product idea may be fairly well-established, but much uncertainty may remain about how, exactly, the company is to develop such a product.

So, Pearson's framework divides uncertainty into two separate dimensions:

> *uncertainty about ends (what is the eventual target of the activity or project); and uncertainty about means (how to achieve this target).*

The development of Guinness's 'In-can system' clearly highlights the problems of managing uncertainty about means. Here, several projects were unsuccessful and there were, probably, several occasions where decisions had to be taken regarding future funding. Decisions had to be made, such as whether to cancel, continue or

increase funding. In these situations, because the degree of uncertainty is high, senior managers responsible for million-dollar budgets have to listen carefully to those most closely involved and those with the most information and knowledge. Further information and knowledge usually are available with the passage of time, so time is another element that needs to be considered. Indeed, it is because time is limited that decisions are required. It is clear, however, that many decisions are made with imperfect knowledge, thus there is, usually, an element of judgement involved in most decisions.

Pearson's framework, shown in Figure 4.2, addresses the nature of the uncertainty and the way it changes over time. The framework is based on the two dimensions discussed above, with uncertainty about ends on the vertical axis and uncertainty about means on the horizontal axis. These axes are then divided, giving four quadrants.

### *Quadrant 1*

Quadrant 1 represents activities involving a high degree of uncertainty about means and ends. The ultimate target is not clearly defined and how to achieve this target is also not clear. This has been labelled **exploratory research** or blue sky research, because the work sometimes seems so far removed from reality that people liken it to working in the clouds! These activities often involve working with technology that is not fully understood and where potential products or markets have also not been identified. This is largely the domain of university research laboratories, which usually are removed from the financial and time pressures associated with industry. Some science-based organisations also support these activities, but, increasingly, it is only large organisations that have the necessary resources to fund such exploratory studies. For example, Microsoft conducts the majority of its research in Seattle, United States. Interestingly, it calls this centre a campus.

### *Quadrant 2*

In this area, the end or target is clear. For example, a commercial opportunity may have been identified but, the means of fulfilling this has yet to be established. Companies may initiate several different projects centred around different technologies or different approaches to try to achieve the desired product. Also, additional approaches may be uncovered along the way. Hence, there is considerable uncertainty about precisely how the company will achieve its target. This type of activity often is referred to as development engineering and is an ongoing activity within manufacturing companies that are continually examining their production processes, looking for efficiencies and ways to reduce costs. A good example of a successful development in this area is the Guinness 'In-can system'. The company was clear about its target – trying to make the taste of Guinness from a can taste the same as draught Guinness. Precisely how this was to be achieved was very uncertain and many different research projects were established.

Quadrants 3 and 4 deal with situations where there is more certainty associated with how the business will achieve the target. Usually, this means that the business is working with technology it has used before.


The Guinness In-can system illustrates an output from a research environment where there is a clear objective in mind, but there is uncertainty about precisely how this is to be achieved.
*Source*: Chloe Johnson/Alamy

### *Quadrant 3*

In this area, there is uncertainty regarding ends. Usually, this is associated with attempting to discover how the technology can be used most effectively. Applications engineering is the title given to this area of activity. Arguably, many new materials fall into this area. For example, the material kevlar (used in the manufacture of bullet-proof clothing) currently is being applied to a wide range of different possible product areas. Many of these may prove to be ineffective, due to costs or performance, but some new and improved products will emerge from this effort.

### *Quadrant 4*

This area covers innovative activities where there is most certainty. In these situations, activities may be dominated by improving existing products or creating new products through the combination of a market opportunity and technical capability. With so much certainty, similar activities are likely to be undertaken by the competition. Hence, speed of development is often the key to success here. New product designs that use minimal new technology but improve, sometimes with dramatic effect, the appearance or performance of an existing product are examples of product innovations in this area. A good exponent of this is Samsung. It has demonstrated an ability to introduce new mobile phones incorporating new designs rapidly into the market, thereby maintaining its position as market leader.

## Applying the uncertainty map in practice

The uncertainty map's value is partly the simplicity with which it is able to communicate a complex message, that of dealing with uncertainty, and partly its ability to identify the wide range of organisational characteristics that are associated with

managing uncertainty with respect to innovation. The map conveys the important message that the management of product and process innovations is very different. Sometimes, one is clear about the nature of the target market and the type of product required. In contrast, there are occasions when little, if anything, is known about the technology being developed and how it could possibly be used. Most organisations have activities that lie between these two extremes, but such differing environments demand very different management skills and organisational environments. This leads the argument towards the vexed question of the organisational structure and culture necessary for innovation, which will be addressed in the following sections.

Quadrant 1 highlights an area of innovative activity where ideas and developments may not be recognisable immediately as possible commercial products. There are many examples of technological developments that occurred within organisations that were not recognised. In Xerox's Palo Alto laboratories, the early computer software technology was developed for computer graphical interface as far back as the early 1970s. Xerox did not recognise the possible future benefits of this research and decided not to develop the technology further. It was later exploited by Apple Computer and Microsoft in the 1980s. This raises the question of how to evaluate research in this area. Technical managers may be better able to understand the technology, but a commercial manager may be able to see a wide range of commercial opportunities. Continual informal and formal discussions are usually the best way to explore all possibilities fully, in the hope that the company will make the correct decision regarding which projects to support and which to drop. This is a problem that will be returned to in Chapter 10.

At the other extreme is Quadrant 4, where scientists often view this type of activity as merely tinkering with existing technology. However, commercial managers often get very excited because the project is in a close-to-market form with minimal technical newness.

Between these two extremes lie Quadrants 2 and 3. In the applications engineering quadrant, where the business is exploring the potential uses of known technology, management efforts centre on which markets to enter; whereas in the development engineering quadrant, special project-management skills are required to ensure that projects either deliver or are cancelled before costs escalate.

In all of the above, particular organisational environments and specialist management skills are required, depending on the type of activity being undertaken. These will be determined by the extent of uncertainty involved.

Chapters 9 and 10 examine R&D management in more detail.

**Pause for thought**

If most new products are minor modifications of existing products, why do firms continue with high-risk, high-cost projects?