PART I

From innovation to innovative design

1 What do we know about innovation? Testing the economic and social sciences

What do we know about innovation? Apart from inherited ideas and a host of scientific articles on the subject, do we now have a clear picture of the problems raised by innovation in firms today? To introduce the issue from a concrete foundation, we shall begin by describing a number of real case examples in which the authors have been personally involved and which became the starting point for several of the 'innovation adventures' described in greater detail later on in the book.

1.1 Contemporary innovation: received ideas versus facts

1.1.1 Mad ideas? Yes, but well-managed ones!

In the early 2000s, at Linköping University, Sweden, several research teams were working on a project to design unmanned aerial vehicles (UAVs) for traffic surveillance. For the project's promoters, the WITAS project was a 'blue sky project', i.e. aimed at stimulating the researchers' imaginations rather than designing a commercial product. The researchers' first objective was to venture off the beaten track usually trodden within their disciplines in the hope that such explorations would lead to the discovery of new concepts and alternatives for products or technologies. The research project had a substantial budget, sufficient to last several years, even though it did have a specific target for direct industrial application.

One of the key elements in the project was the steering committee. Far from being an administrative formality, the carefully prepared meetings were attended by the project manager, his team and the main stakeholders, which included the former director of the Swedish Space Agency and the Vice-President of Corporate Technology at Saab Aerospace, Billy Fredriksson. Although he was in charge of the Swedish firm's most important

aeronautical programmes, Billy Fredriksson was quite prepared to spend several hours in these meetings, several times a year.

There were fears that the project would get lost in bureaucratic meanderings, as is often the case for projects financed in this way, but the steering committee meetings certainly did not give this impression. The members examined all the results in detail, studying the experimental approaches and the targets to be set. Their recommendations could be cutting and, at times, unexpected. For instance, at one stage in the discussions on alternative prototypes, the discussions were so fierce that the project manager resigned and the research teams were completely reshuffled.

There could be no doubt that WITAS's conceptual explorations were imaginative and prolific, but the project's managers decided that strict, frequent management interventions were required to ensure really fruitful, varied and innovative work. The results were convincing and in fact the WITAS project was an archetype of innovative design management. The project is studied in more detail in Chapter 10.

1.1.2 Good ideas or good organization?

Our second case is Tefal, a specialist in the highly competitive small electrical goods sector, based in Annecy. In 1995, when we first became interested in the company, it produced all its products in France. It had the best profit record in its sector and its employees sometimes received the equivalent of up to twenty-three months' salary per year.

The CEO, Paul Rivier, met Vincent Chapel, a young engineer from the Ecole des Mines. 'Mr Chapel, I was very interested to receive your request to do a PhD thesis on innovation management in our firm. As I am sure you are aware, Tefal is a highly innovative firm and innovation is not a problem for us. Look at this prototype, for instance, or this product that will be launched next week. If you work with us, you will no doubt discover good practices, but this is not what I want your doctorate to be about. What I am looking for is a formal framework of how innovation is organized at Tefal. Tefal innovates, but needs a model. This may seem surprising, but good practices are not enough. Tefal needs to explain what is behind its success to its shareholders, before they decide to impose traditional management rules which, I am convinced, would be harmful to the firm's innovation capability. I hope your work will help us explain a model that is specific to Tefal.'

This approach was not new, as many industrial champions (Ford, General Motors under Alfred Sloan, Toyota, etc.) developed theories from their own

models. In the past, it was enough to implement 'good practices' for innovation, but at Tefal, innovation had become the key to performance and conditioned the firm's very survival. The firm's efficiency was linked to efficient processes. Although its performance seemed to stem from what other sectors such as the pharmaceuticals industry would call 'blockbusters' – leading products that account for the bulk of a firm's profits – Tefal's success went far beyond its flagship products, non-stick frying pans. In fact, at that time, the patents for the pans had already been in the public domain for many years. Could the firm's performance be linked to its ability to keep up a high rate of repeated innovation?

How did it sustain this repeated innovation and make it profitable? What resources did it employ and were they used 'efficiently'? R&D intensity (a firm's expenditures on R&D divided by its turnover) is often used as an indicator of a firm's innovation capability, but this ratio was so low at Tefal that it raised questions about its R&D.

In 1997, three years after this interview, Vincent Chapel defended his thesis (1997) entitled: 'La croissance par l'innovation intensive: de la dynamique d'apprentissage à la révélation d'un modèle industriel, le cas Tefal' [Growth by intensive innovation: from learning dynamics to the revelation of an industrial model in the case of Tefal]. We will come back to Tefal in Chapters 4 and 5 to help illustrate performance and efficiency in the context of intensive innovation.

1.1.3 Managing innovation: choosing or guiding?

The first steering committee for a major project on 'comfort in the car interiors of the future' took place at a leading automobile manufacturer's premises in Paris in 2000, grouping the product manager, the engineering managers, heads of research, the head of front-end innovation and representatives from the industrial design and purchasing departments. The project manager had been preparing for this meeting for several months and had wanted to mobilize the company on an issue that was a key source of innovation with high added value for the customers. He enthusiastically described several architectural innovations, explaining how technical problems could be solved in each case. He also gave a review of all the vehicles due to come onto the market in the following ten years, pointing out the windows of opportunity for innovation. He had carefully prepared the different alternatives which the managers could choose between, describing the solutions and demonstrators for each of the possible themes of

innovation. He concluded by asking the participants to say which of the demonstrators should be given the highest priority.

However, the meeting did not go as he had planned. After listening to all the other actors' opinions and the discussions, instead of choosing between the three alternatives, the front-end innovation manager suggested a new path for the explorations, 'thin-seat' technology. The designers were baffled by this recommendation. Why should they explore what seemed to be a secondary subject compared with other aspects of comfort in car interiors? Why should they give up the other research paths and, moreover, did this recommendation actually fall within their remit?

After a meeting of this sort, it is easy to imagine the innovation team's confusion and frustration, and yet there had been no lack of communication between the various actors involved. How could the front-end innovation manager have explained the reasoning, based on his long experience and expertise, which had helped him identify the seat as the linchpin of any new features for car interiors? How could he have described the organization entailed by his recommendations, i.e. an organization that was no longer based on project management with clearly defined objectives set after a preliminary choice but on quick, one-off searches, exploring a vast, previously unknown territory beyond the profession's usual perimeters? The problem was not a lack of communication but a lack of basic tools to explain the reasoning and the organizations required.

What role can managers play in the context of innovation? Are they still decision-makers with the prerogative to choose between several carefully studied alternatives, or should they serve as guides to explore new territories?

This raises the issue of the cognitive challenges of innovation. In situations of innovation, the actors are naturally obliged to go beyond the usual organizational divisions and frontiers between functions; but apart from multifunctional meetings, which ideally bring all the players together, the problem is to find the modes of collective reasoning and the appropriate organizations to explore the concepts and create new competencies. We will return to this crucial question often throughout the book and will see in Chapters 10 and 11 how the problems were solved in the case we have just sketched out.

1.1.4 Can clients be more creative than their suppliers?

In the mid-1990s, the Saint-Gobain Sekurit research centre in Germany finally decided, after much hesitation, to launch a solar control windscreen project. Nonetheless, many people in the company, which specializes in glass

for the automobile industry, were sceptical about the project, wondering why they should be studying something that would substantially increase the product's price but with nothing to show that the user would notice a significant improvement in thermal comfort.

An obvious answer was that one of the firm's leading clients, a car manufacturer, had been persistently asking the firm to work on the project and so there were fears that some of its competitors might be ready to respond to the demand. Yet clients often made strange demands and one of the roles of a competent supplier is to guide them towards areas of innovation with obvious value creation. Saint-Gobain Sekurit is renowned for its capacity to supply glazing in the most complex shapes, much appreciated by automobile designers, so why should it embark on a project that did not make the most of its competencies in shaping and might even encourage other car manufacturers to turn to solar control features rather than complex shapes? As specialists in development in the traditional competitive environment, it was quite reasonable for Sekurit's experts to be sceptical.

However, in the end, when Saint-Gobain Sekurit decided to go ahead with the solar control project for Renault it was probably not because of the car manufacturer's insistence, or to do with the competitors, but rather that some of the designers realized at that stage that the nature of competition was beginning to change. Instead of working on the best price/quality ratios for known functions, should they not be exploring new functions? Instead of constantly fine-tuning well-identified areas of expertise, should they not be trying to create new functions and competencies? Not only did Saint-Gobain Sekurit have great success with the solar control project, but five years later the firm had been transformed and was marketing multi-functional glazing products based on technologies that had never been used on such a large scale before. In a period of just five years, the research laboratory became a centre for innovation whose work stimulated and protected the development departments and the other research centres. In Chapter 9, we will see how all this came about and look at the new organizations that emerged during that period.

At this stage, this short example serves to show that it was not a question of innovating with the client or of imitating competitors. The two alternatives can be equally risky: clients can be changeable and uncertain and 'followers' can lose out if they follow the wrong path and are always late if they follow the right ones. It is a question of finding the right forms of organization to maintain a high rate of new product launches, combining functional exploration and the regeneration of competencies, and also to

cater for novel client demands, to counter competitors' proposals and even launch new proposals to attract clients.

1.1.5 Perseverance? Yes, if it means learning

In 2002, a meeting took place at the Ecole des Mines in Paris with managers from Schlumberger, a world leader in oilfield services with a solid reputation for innovation. However, even its specialists were sometimes puzzled by the form taken by their innovative projects. 'In this study on innovation, we would like you to analyse a strange project: we have spent a great deal of money on it, mobilizing a large number of designers, for development and research, we have carried out a host of different trials, mainly in partnership with clients. But after several years' work, with lots of ups and downs, the project is coming to an end. And yet we have the impression that we have tried out a new form of organization that was actually very effective.'

Who could deny that innovation is a mixture of ups and downs, setbacks and perseverance, or to paraphrase Edison, '1 per cent inspiration, 99 per cent perspiration'? Schlumberger's project was a good example of this. The problem is to find the right impetus and the right organization to deal with long research projects, teeming with ideas. Also, however good the projects may be, at some stage they have to be evaluated. The development department will assess whether the teams were effective and whether or not they had supplied the product in question in the required time. The research department will look at any work that has been published. In both cases, the setbacks will be judged as inexplicable and costly, and put down to the designers' incompetence.

Does this mean that there should be no evaluation? Should projects take the form of skunk work, carried out by a few enthusiasts on top of their normal activities? And is it wise to resort to such limited, high-risk ways of working, now that competition through innovation seems to be the norm? There is another possibility: could it be that the evaluation criteria need to be revised, given that innovative design reasoning has its own specific criteria, thus making it different from research or development reasoning? Innovative design prefers variety rather than convergence, originality rather than routine, the production of new knowledge rather than existing expertise. When it was judged on the basis of these criteria, Schlumberger's project could be seen in a completely different light: a variety of directions had been explored, original paths had been uncovered and new competencies had been developed. This confirmed the designers' vague impressions that the

project had indeed been a successful innovative design project (*see* Chapter 13). We will come back to these evaluation criteria in Chapters 10 and 13.

These anecdotes, which are all based on real cases although we have simplified them here, serve to show how original and sometimes surprising management approaches can be hidden behind incumbent ideas. Perseverance, best practices, blue-sky projects and user relations are all traditional watchwords in innovation, but their practical implementation involves managing the economic, market, cognitive, organizational and managerial aspects of innovation.

1.2 Innovation seen by the different disciplines

What do we know about these different aspects of innovation? Each of them comes under a different scientific discipline and has given rise to a wealth of literature. In the following pages, we give a brief overview of the current state of the art, before seeing to what extent the disciplines are able to propose models of collective action to foster innovation. A more detailed study can be found in the bibliographical appendix, which describes the concepts proposed by each discipline, how they came into being and their impact, placing them whenever possible in the genealogy of research work.

1.2.1 Economic policy and innovation

The relationships between innovation and economic policy go back a very long way. For example, the emergence of new industries played an enormous role in the economic policies of Colbert, French Minister of Finance from 1665 to 1683. More generally speaking, the policies of patents and privileges practised in both France and England in the seventeenth and eighteenth centuries favoured inventors, entrepreneurs and the growth of new economic sectors (Hilaire-Pérez 2000). With the arrival of the railways, which required concessions and forms of State intervention, each new project gave rise to debates on whether the new techniques were really 'progress', as Booth described one of the first railways, the Manchester–Liverpool line, when it was opened in 1831 (Booth 1831). The first 'technical economists' demanded State intervention to support science in the name of industrial progress. For example, Charles Babbage questioned the British authorities on their scientific policies and on the 'decline of science in England' (Babbage 1830, 1833), speaking of the threat for the 'future development

of industry' and proposing compensations for people carrying out scientific investigations.

At that time economic policy addressed innovation in many different ways, including setting up training programmes, financing research, making laws covering inventions and protecting inventors and regulations on monopolies (concessions, privileges, competition laws, etc.), creating factories and launching major infrastructure programmes. Public policies on innovation sometimes also sought to assess the impact of innovation. For instance, the introduction of planned public policies – such as the New Deal after the 1929 crisis – meant that States began to wonder about the impact of scientific discoveries on the nation in terms of new products, new risks such as unemployment, infrastructure planning, etc. (Susskind and Inouye 1983). The innovations or the inventions – the distinction was not clearly made at this stage – were analysed like given facts and the consequences of their dissemination were studied.

When viewed in terms of economics and the stakes of economic policy, innovation was seen as a challenge or at least a powerful means of questioning the traditional economic theories. First, innovation finds fault in the general equilibrium theory as it is a dynamic force whereas general equilibrium describes a static equilibrium; second, it calls into question the theory of pure, perfect competition; and third, it means that forms of knowledge production and exchanges of skills, and not just products and services, must be taken into account.

Work on these questions led to a series of now widely used concepts: innovation typologies (product/process, radical/incremental, invention/innovation), the notion of R&D and investment in R&D, notions of technological trajectory, of national systems of innovation, etc. These notions cannot be separated from the economic contexts in which they came to life, whether it be the Great Depression of 1929, planning and massive State intervention in scientific research after the Second World War, the rise of Japan in the 1980s, etc.

Dynamic streams of research on economic policies and innovation seem to infer that new questions have appeared which also result from changes in the economic context. There are three main trends:

The question of knowledge: the use of the term 'knowledge-based economy' underlines the importance attached to the production and exchange of knowledge. This is not an easy question from a theoretical standpoint. What is a knowledge market? What are the advantages and disadvantages of barter or of contractual exchange? What are the

different forms of appropriation: public goods, patents, etc. (Foray 2000, 2003)? From the point of view of economic policy, these questions reflect the major challenges of legislative changes to contract and intellectual property laws in the face of new forms of partnership and collective production of knowledge (Segrestin 2003). In addition, although knowledge is an essential variable, the relationship between knowledge production and innovation is far from deterministic (Jones 1995a), implying that there are other variables which have still not been correctly modelled (Hatchuel and Le Masson 2006).

The question of the actors: all the above-mentioned research was inevitably based on certain representations of the innovation process and of the actors involved. The authors were often obliged to discuss these representations, as illustrated by the success of Kline and Rosenberg's article (1986), which proposed a new representation of the innovation process for economists. Today, there seems to be a need to reassess these representations. On the one hand, evolutionary works have come to a point where authors claim that 'research has to reach a much finer analysis at both the empirical and the theoretical levels, and to move from the statement that everything is changing with everything else' (Malerba 2006). On the other hand, microeconomists, whose theories of endogenous growth were based on a traditional representation of the firm as a production function, are once again discussing the status that firms should hold in a theory of endogenous growth designed to take into account the characteristics of 'innovative firms' (Pakes and Ericson 1998; Klette and Griliches 2000). More heterodox works, which had discussed the modelling of firms very early on (Cohendet 1998), are observing an apparently growing number of actors involved in the innovation process. Does this mean that new models are required for firms? How can the different actors' collaboration be modelled (Foray 2003)?

The question of the nature of innovation itself: new phenomenologies on industry lifecycles (Grebel, Krafft and Saviotti 2006) and on socio-technical regime transition echo recently discovered works on novelty by Schumpeter (1932 [2005]). Schumpeter defined development as 'a transition from one norm of the economic system to another norm in such a way that this transition cannot be decomposed into infinitesimal steps', wherein the norm represents 'all the concrete relationships of the concrete data that correspond to the Walrasian system'. Hence development is the renewal of both production functions and utility functions in the whole economy. This goes much further than