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# PART I

## *The Framework for the Study*

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CHAPTER 1

# *Innovation and Policy*

This opening chapter begins by outlining the interests of the book. It then sets the scene for the studies of the law, first by recounting recent insights into the nature of innovation. It next considers the implications of these insights for the fashioning of policy measures in the Western economies. It raises particularly the question whether a market-oriented approach to innovation promotion has been supplanted by closer, more selective, relations between government and industry.

## OUTLINE OF THE BOOK

### THE FIELD OF STUDY

This book is the result of a study of the responses in the law to recent policies to promote innovation in high technology industries. I have become interested in innovation as a theme for a study because it is so often advanced these days as the key element in the transformation of the economy, influencing the distribution of power and wealth, and perhaps altering the nature of our relations as members of society – even our definition of ourselves as human beings. Certainly, the concern with competitiveness in a rapidly changing, often internationally drawn economy explains much of the experience with government policy in the field of economic law during the eighties.

In return, I hope to make some valuable connections between innovation, policy and the arcane world of law for the benefit of non-lawyers and lawyers alike. For some, law is an esoteric interest to pursue in the round of innovation policy, but in fact it is represented in a broad spectrum of policy measures. I suggest that even non-specialists will find its consideration rewarding. Accordingly, the book attempts to bring together developments in the economically



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interdependent areas of intellectual property law, the law of contract and economic association; competition, foreign investment and trade law, the legal supports for government assistance to industry, and the legal frameworks for the participation of public enterprises in industry. The focus is upon the law most directly relevant to the origination of new high technology products and processes, and the organizing theme is that this law might no longer be confined in its approach to the classic liberal law of property and trade, but is now also associated with a range of administrative styles of mediation, patronage and organization. Connections can be made between these two competing legal approaches and the more familiar rivalries of free market and free trade policies on the one hand and neo-corporatist and neo-mercantilist industrial policies on the other. The book is especially concerned with the space found for these closer collaborations between state and industry in their complex relationship with the very resilient, yet itself evolving, liberal approach.

The field of study is of course a large and complex one. The bulk of the book therefore comprises a set of case studies of the legal experience with particular policy interventions in the last decade. Their ultimate focus lies with recent Australian developments but, because the high technology industries operate today on a world scale, the studies also consider legal developments elsewhere in the advanced Western economies, such as the United States, the European Community and Japan. It should thus be of interest beyond the shores of the Australian outpost. The particular case studies chosen concern the patenting of living organisms; the copyright of computer software; the confidentiality of industrial know-how; trade practices regulation of intellectual property licensing and research and development consortia; foreign investment review and technology transfer; grants and tax concessions for research and development; procurement preferences and offset arrangements; and the licensing of telecommunications carriers. These case studies commence in chapter 3.

Naturally, the process of innovation also involves the application of these new products and processes to established industries. I have endeavoured elsewhere to evaluate the roles of labour, health, safety and environmental law in smoothing the path for the application of new technology and ameliorating its deleterious impacts (e.g. Arup, 1983; 1991). There is of course a wider literature on the complex relationship between regulatory standards and innovative activity (e.g. Rothwell and Zegveld, 1981; Stewart, 1981). The focus

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here on economic law does not mean to belittle the questions associated with the social regulation of new technology. But it does work on the premise that, because new technology is a social construct, it can be treated as a resource with potentially many beneficial uses, at least in comparison with aspects of the old, 'dirty' technology characteristic of the industrial revolution (Mathews, 1989). If it is at all evidence of a beneficial use, it should be remembered that this manuscript was produced on a computer. Certainly, the study holds to the view that the law of property and other elements of economic law structure the innovation process, sending messages about areas in which to invest and creating commitments to distinctive versions of the technology. By the time we try to apply social regulation, powerful forces have already formed around the technology, making it difficult for that regulation to have much effect (Collingridge, 1980). Concern with social justice and environmental balance starts with the supply side of the system, by which we meet our various needs.

## SOCIO-LEGAL ASPECTS

As an interdisciplinary work, the book's primary concern is to place this law in its social context and in particular to study the ways in which the law is implicated as high technology producers and their government sponsors try to step up the pace of innovation. If its treatment of the law is to be 'socio-legal', it must look not only at recent developments in the content of the 'law in the books', but also at the practical significance of the different kinds of law to the strategies of the innovating firms and the promotional activities of their governments. It should endeavour to draw upon schematic analyses and empirical findings regarding the experience with the take-up of the different kinds of legal facilities by the corporate and public sectors. As much as innovation policy is concerned with the objective of capturing the benefits of innovation as with the generation of innovation *per se*, a study of this nature should also consider the place of the law in efforts to ensure the success of particular firms and nations within the technological revolution which is taking place in world markets.

Yet, if one of the characteristics of the legal experience in the eighties has been attempts to gear it to the objectives of innovation interests, it remains the case that the law does not prove to be a wholly

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pliable or effective instrument. We should be mindful of the fact that in many respects the law responds on its own terms to the policy demands which are placed upon it. We need not go as far as the recent notion of 'autopoietic law' to suggest that law is a totally closed normative system (Teubner, 1989), but the engagement of the law as a prospective instrument of policy does have its own impact on the producers and governments who turn to it for aid (Daintith, 1988). To some extent, as we know, its inflexibilities and impositions encourage them to bypass the law, but we shall hold to the view that it is difficult to do entirely without the law in this field. Rather, the characteristics of the different competing legal approaches help to explain the choices made in matching policy functions to government structures in the field of innovation. Accordingly, even for non-lawyers, I argue that it is worth investing some time in the study of the law.

## APPROACHES TO INNOVATION POLICY

This section explores recent insights into the nature of successful innovation. It considers how these insights might bear on the formation of government policy. It commences with their impact on the liberal approach by which the state provides industry with a clear, general framework for investment in innovation. Doubts are raised about the continuing relevance of property to investment decisions, but the section also suggests how interest in the appropriability of innovations can be broadened. The section next looks for evidence in recent policy measures for the proposition that the state has moved beyond the liberal approach into corporatist and administrative arrangements with industry. It notes, for instance, ways in which liberal regimes might be qualified to provide advantage to favoured producers. It also identifies the tendency to deploy positive measures of assistance to improve the prospects of targeted activities.

### INSIGHTS INTO INNOVATION

#### *The Process of Innovation*

Before we turn to the law, it is important we set the scene by recounting some insights into the nature of innovation that have premised recent policy interventions. We should start by acknowledging

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the fact that innovation has become a central concern of policy as governments (or at least elements within them) subscribe to the view that a country's economic success now depends not so much on the comparative advantage of natural resource endowments as on the comparative advantage of technological and organizational superiority (Porter, 1990). And this means in part that innovation is anti-establishment. It has the potential to undermine existing monopolies of thought and interest within the economy. Of course, it can on occasions be used to confirm the strength of established producers; one of the impacts of the new technology is the way in which it extends the reach of existing products by offering new media for their expression and diffusion. But it also provides opportunities for fresh rivals to enter and capture burgeoning markets by capitalizing on freedoms and flexibilities which the incumbents may no longer enjoy. Indeed, the technology may provide a direct means to bypass the existing monopolies by offering cheap ways to copy their products or to achieve the same result by alternative routes. These opportunities may provide scope for whole countries to participate for the first time in the high technology industries.

Even so, it is well appreciated that innovation is not driven by some autonomous, irresistible logic (Winner, 1977). New technology needs the right social conditions in which to flourish, and its progress may falter if these conditions are not present (Heilbroner, 1970). Its actual course will be mediated by the nature of existing economic, political and cultural conditions. Accordingly, one of the most crucial developments in policy circles has been the acceptance that innovation is not confined to bright ideas and original inventions (Rothwell and Zegveld, 1981). Of course, innovation still depends in part on the contribution of rare and abnormal qualities of curiosity and creativity. But, despite the notorious success of certain individuals, it would be wrong to think that innovation is a singular endeavour. Many of the basic innovations of recent years are the products of big science and planned research and development, shaped by the signals received from major sponsors, large producers and key users (Cicciotti, Cini and De Maria, 1975). We know that this insight has had an influence upon the practice of science itself. There has been a shift in emphasis from the descriptive to the instrumental disciplines of science and a growing industrialization of the practice of scientific research (Yoxen, 1981).

Generally, this process favours the capacity to invest on the scale

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required for big science: to provide, for example, the critical mass of equipment, materials and researchers, or to carry the risks of failure and survive the long lead times, and see the inventions through to successful production and sale (Freeman, 1983). One consequence of this is that innovation becomes less of a serial activity, progressing from research to development, manufacturing and marketing. If it is in fact technology-driven, it is less likely on the whole to be a success. Successful innovations are designed, refined and applied in an interactive loop of collaborative problem-solving that involves researchers, producers, financiers, distributors and customers (Gardner and Rothwell, 1986).

The collective, cumulative nature of contemporary innovation is further illustrated by events in the second phase of the latest technological revolution we are experiencing (Hill, 1983). The basic or breakthrough innovations are followed by what Joseph Schumpeter (e.g. 1954) characterized as a swarming of imitators who are attracted to the opportunities arising in the newly emergent industry. As the technology matures, firms turn their attention to product refinements and applications, and to processing efficiencies and marketing capabilities. Only some of the initial designs survive, and standardization sets in with the exploitation by producers of economies of scale and scope. An important insight into successful innovation, then, is its dependence, not only on the development and appropriation of particular inventions, but also on the control and exploitation of less discrete and transferable resources, such as research, development and processing know-how, and firm-specific cumulative learning or 'learning by doing'. It also depends upon the command of complementary assets, such as access to finance, production facilities and marketing networks, and organizational flexibility and general capability (Pavitt, 1984).

### *The Structure of the Industries*

Such conditions tend to favour large organizations (Commonwealth of Australia. Bureau of Industry Economics, 1989). Evident in the computer and converging information and communications industries is the dominance of a small number of large companies, originating in the United States and Japan, but now operating on a transnational basis (Smith, 1982). So too in biotechnology, while many of its inventions remain to be commercialized, drug and other

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multinational companies in such fields as medicine, agriculture, food processing and materials refining are already assuming control (Elkington, 1985). These companies can exploit the advantages of internalization, performing much of their research and development in-house, raising their own finances internally, organizing their own manufacturing, and marketing their products through their own networks (Mercer, 1987).

Yet, even the large corporations sometimes see the need to go outside their own organizations, so that industry relations are also characterized by a variety of semi-market connections, such as specialized subcontracting and sales to the large producers by small firms, and collaboration through joint ventures, strategic partnerships and technology consortia between the large producers themselves, sometimes with the participation of major users and sponsors. To the extent, then, that there is still reliance on external circulation, much of it involves relations between firms of similar technological sophistication, notably in the high technology industries, possibly as part of loosely knit, international oligopolies (Chesnais, 1986). Large corporations perceive the advantages of pooling resources and limiting competition by forming consortia, cartels and blocs – for example, in the semiconductor and superconductor markets. These connections tend to be formed within the larger producer nations and regions such as the United States, Japan and Western Europe, carrying the danger of the exclusion of firms from the smaller, peripheral countries such as Australia (Commonwealth of Australia. Australian Science and Technology Council, 1986a).

At the same time, small firms often represent the most creative and enterprising side of these industries, especially in the early years of an innovation, where barriers to entry are low. Their presence has been felt, for example, within computer technology (in microcomputers, software and specialist information services) and within biotechnology (in diagnostic techniques and new plant varieties). But they are often daunted by the high investment thresholds in the core of the markets and discouraged by the aggressive practices of the large companies (OECD, 1985a). The large companies seek not only to consolidate their traditional bases by vertical integration with smaller suppliers (Soma, 1976), but also to move horizontally into converging fields by buying into smaller firms which hold specialized assets. Thus, IBM has acquired interests in companies making private digital telephone exchanges, operating

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communications satellites, and providing commercial information services (Barr, 1985).

Large firms also tap into specialized expertise and externalize the risks of innovation by contracting out work to the smaller firms, often in exclusive agreements, patronizing these suppliers and distributors selectively, or buying up inventions for production and sale. Small firms tend not to compete directly with the corporate producers. Instead, they gear their activities to fit in with the strategies of the large companies, for example by providing specialized chips, software and peripherals which are compatible with the core technology (MacDonald, 1983).

Thus, the high technology industries reflect a pecking order with a division of cultural labour and a layering of markets on an international scale (Smith, 1982). Some manufacture and assembly work is moved offshore to foreign subsidiaries and local licensees, notably in the low wage countries. Design and management functions are often concentrated in the home countries, technology transfer to foreign subsidiaries and local licensees being delayed and subjected to restrictive conditions (Long, 1981). Small firms, especially those based in the peripheral industrialized countries, seek to find niches and develop specialities, participating marginally in new product markets and adapting the core technologies to local uses.

### *Public Sector Participation*

A further feature of note is the connections in the high technology industries between the private sector and the public sector performers and sponsors of research. These connections go back a long way (Noble, 1979), but are receiving renewed attention now (Kenney, 1986). Such connections have been notable in the biotechnology area, where much of the original breakthrough research is performed in universities, public hospitals and research institutes. Scientists from these institutions have moved out to set up their own firms, feeding off and finding applications for the basic research and subsequently selling their businesses to large companies (Etzkowitz, 1983). The larger companies have also established direct connections with public institutions, most commonly by taking on an invention at the prototype stage to scale up for production and marketing, but also by commissioning applied research and sponsoring generic research in these institutions (Clarke, 1986).

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In the computer field too, the early innovators often started in public research institutions and moved out to private companies (Pugh, 1984). The contribution of public sponsors (notably the military agencies in the United States) has been influential in establishing connections between professionals, bureaucrats and industry representatives, in conditioning the kind of technology which was developed, and in insulating the work from economic pressures (Noble, 1979). Such public agencies have also been major consumers of high technology products and their facilities have been used as a means to trial, refine and implement innovations, for example in the field of telecommunications.

Thus, recent innovation studies stress the importance to success of the presence of clusters of firms, often cutting across traditional industry and sector demarcations in chains or *filières* of effective economic networks (Porter, 1990). Marceau (1990) cites such exotic examples of the linkages as integrated hierarchy, semi-hierarchy, coordinated contracting, coordinated revenue links, joint ventures, co-making and spot-networking – all organizational responses to the new economic challenges. These linkages are often greatly aided by advances in the information and communications technologies themselves, so that the networks can transcend physical boundaries, even on a transnational scale (Rosegger, 1991). Accordingly, a country's chances of success benefit greatly from its development of superior transport and communications infrastructures. Yet, interestingly, recent studies detect a residual hankering for physical proximity and face-to-face contact, so clusters may take on a spatial, often regional, dimension (Jevons and Saupin, 1991), and transnational corporations still have identifiable home bases (Thurow, 1992). Obviously, this insight provides lessons for policy formation, partly of a land-use planning nature.

## THE LIBERAL APPROACH

Perhaps this is a good point to begin to discuss the impact such insights have had on government policy generally. The discussion will help to map out the areas which require detailed analysis in subsequent chapters. Of course, in some schools of thought, notably free market economics, the place for government policy is minimal. The recurring advice from free market economists is for government to abstain from policy interventions, as the firms of each country

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