Whitley
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pp 147-162
162-174
175-190
190-202
238-248

6

The Institutional Structuring of Organizational Capabilities: Variations in Authority Sharing and Organizational Careers

Introduction

A central concern in the analysis of competing capitalisms is to understand how different institutional arrangements and rules of the competitive game generate different patterns of economic organization and behaviour that in turn lead to variations in economic outcomes across market economies. What are the crucial social processes, or 'mechanisms' (Boudon, 1998, 2003; Bunge, 2004), through which variations in governing institutions generate varied economic results? In particular, how do the distinctive logics of economic action implied by different institutional regimes and associated dominant coalitions become translated into distinctive patterns of authoritative coordination and control such that they lead to contrasting sectoral structures and performances?

A useful way of dealing with this issue is to develop the competence or 'dynamic capabilities' (Dosi *et al.*, 2000) theory of the firm, which builds on the seminal contribution of Penrose (1959) in emphasizing the organizational nature of competitive advantages and the critical role of managerial routines in transforming human and material resources into productive services (Foss and Knudsen, 1996; Lazonick and West, 1998; Teece and Pisano, 1994). By coordinating and directing particular inputs systematically through firm-specific rules and procedures, managers generate idiosyncratic organizational capabilities that provide unique competitive advantages. Such capabilities vary in their flexibility

and adaptability from those largely concerned with coordination and control of business activities, through the ability to improve products and processes incrementally by individual and collective learning to those more 'reconfigurational' ones that enable firms to transform their competences and knowledge quite radically (Teece *et al.*, 2000).

By developing different kinds of organizational capabilities, companies become more or less able to compete successfully in different markets and technologies. The types of competences that managers seek to specialize in thus affect their likely effectiveness in different industries, and so market economies dominated by particular institutional regimes that encourage firms to focus on specific kinds of capabilities are likely to become more specialized in these sectors. In this sense, the ways in which leading firms in an economy develop particular kinds of organizational capabilities constitute the crucial mediating mechanisms between institutional regimes and economic outcomes. Different sets of dominant institutions and interest groups enable and guide leading firms in differently organized economies to develop particular kinds of collective competences that, in turn, lead to relative success in particular kinds of competitive markets.

How, then, do firms in different economies develop different kinds of capabilities? As many discussions have emphasized, the key feature of firms is the use of authority, or subordination to legitimate superiors, to direct and control economic activities in a variety of ways. Hamilton and Feenstra (1997: 56), for instance, claim that firms, and economic organizations in general, are 'above all authoritative organizations that structure relationships according to established rules of conduct' in which participants recognize that they are bound to the authoritative norms of the organization, and there are coercive means to enforce collective rules.

The ability to direct employees to undertake specific tasks through delegated authority from private property rights' holders is crucial to the organizational development of distinctive collective competences, not least because the flexibility that employment agreements provide enables managers to organize economic activities in different ways for varied purposes, and to change these to suit altered circumstances (Richardson, 1998). This flexibility enables authority hierarchies to manage increasingly complex and uncertain activities, particularly innovation. As Lazonick (1991; Lazonick and West, 1998) and others have suggested, the planned coordination of a specialized division of labour has enabled firms to build distinctive organizational capabilities for developing process and product innovations on a continuing basis.

Central to the development of distinctive organizational capabilities is the willingness of employees to commit themselves to joint problem solving and the improvement of employer-specific knowledge and skills, sometimes at the expense of enhancing their own individual competences and value on external labour markets. The more complex and risky are problem-solving activities, and the more they involve the coordination of complementary activities and types of knowledge, the more important such commitment becomes. Two major means of developing continuing employee commitment to collective problem solving and enhancing firm specific competences are authority sharing and organizational careers.

Authority sharing here involves owners and top managers delegating considerable discretion over task performance—and sometimes task organization—to skilled employees, and encouraging them to contribute to product and process improvements. It varies in the degree of such delegation, i.e. the amount of discretion exercised by subordinates, and its scope, i.e. the range of activities and decisions over which discretion is exercised. While these aspects are often positively correlated, it is clearly possible for managers to delegate high levels of discretion over specific, narrowly defined, tasks without extending it to more general features of the work situation.

Such intra-organizational delegation of discretion to employees is sometimes complemented by external authority sharing with suppliers, customers and competitors in varied inter-firm networks, especially when there are strong constraints on short-term opportunism. In both instances, firms are thereby enabled, in principle, to learn from the knowledge and experiences of their employees and business partners. On the whole, then, the greater is the degree and scope of such authority sharing, the more firms should be able to integrate different kinds of activities and types of knowledge in dealing with complex problems, and to develop new routines and knowledge.

Similarly, providing long-term organizational careers to key groups of employees, as exemplified by many large Japanese companies in the post-war period, encourages them to contribute to the development of collective firm-specific capabilities through extensive collaboration within and across departmental boundaries. By tying personal futures to the growth of the employing organization, and making credible commitments to maintain employment across the business cycle, such careers intensify employee commitment to the improvement of collective competences, even if that limits their visibility on external labour markets.

Authority sharing and organizational careers are interrelated in the sense that providing the latter for some employees involves a considerable amount of the former. It seems most unlikely that owners would offer relatively long-term commitments for managers and skilled workers if they were not prepared to delegate substantial levels of task autonomy to them. While, then, firms that do not provide long-term careers for employees can vary in the degree of authority sharing they implement, between for instance isolated autocracies in many developing economies and project-based firms in Silicon Valley (Bahrami and Evans, 1995), those that do offer organizational careers for at least some groups of staff are also likely to delegate considerable task autonomy to them.

Variations in authority sharing and organizational careers help to explain differences in the kinds of collective capabilities that companies develop, especially those involving extensive collaboration and sharing of knowledge and expertise. The willingness of owners and managers to share authority with different groups and offer organizational careers is, in turn, greatly affected by societal institutions, especially those governing trust relations and skill formation and control. As a result, economies dominated by different institutional regimes vary significantly in the concentration or dispersion of authority over various kinds of decisions in work groups, organizational divisions, firms and business associations, as well as the significance of organizational careers, and these differences affect the sorts of collective capabilities that leading firms and other strategic actors are able to generate in them. In turn, such distinct competences enable companies to be more or less effective in dealing with particular kinds of problems and innovating in different ways. Consequently, market economies with contrasting institutional arrangements tend to display different kinds of economic development and specialization.

In this chapter I explore these relationships in more detail through an analysis of how institutional frameworks are connected to variations in authority sharing and organizational careers such that firms in contrasting institutional contexts are encouraged to develop different kinds of capabilities. Initially, I summarize the ways in which authority sharing and delegation affect the kinds of competences that firms develop, and then consider how these latter are connected to the institutionalization of careers within and between companies. In the following section, I explore the key features of different institutional frameworks that encourage divergent patterns of authority sharing and career development, and help to explain how different countries and regions generate contrasting types of firms and organizational capabilities.

Authority Sharing and Organizational Capabilities

In analysing the connections between variations in authority sharing, organizational careers and the sorts of capability that are developed by different kinds of firms, it is useful to follow Teece and Pisano (1994) and Teece *et al.* (2000) in distinguishing three kinds of collective capabilities that may be particularly effective in different technological and market situations. These vary in their ability to adapt to changing circumstances. First, coordinating capabilities involve the development of integrative routines that, for example, gather and process information about internal and external processes, connect customer experiences with engineering design choices and link production facilities with suppliers. In Chandler's (1990) account of the rise of large companies, these were key to the realization of economies of scale and scope through managerial hierarchies.

Second, organizational learning capabilities involve joint problem solving and improvement of production and related processes, both through continuing work experience and the execution of specific projects, as well as continually developing the firm's understanding of business partners and other external agents. Firms with strong learning skills rapidly codify, diffuse, and apply throughout the organization new knowledge that is developed by individuals and groups, so that routines and procedures are continuously being updated in a process of cumulative improvement. This ability to incorporate new knowledge into organizational procedures on a continuous basis has been seen as key to the success of many large Japanese companies, such as Toyota (Fujimoto, 2000; Nonaka and Takeuchi, 1995).

Third, reconfigurational capabilities involve the transformation of organizational resources and skills to deal with rapidly changing technologies and markets. They enable companies to restructure their operations and routines quite radically as knowledge changes, often by acquiring new skills and competences through hiring on external labour markets or buying newly formed firms, as in the case of Cisco (Lee, 2000). Such transformations can destroy existing routines and competences, as arguably happened with the changes in drug discovery methods and skills following the molecular biology revolution (Casper and Matraves, 2003; Zucker and Darby, 1997).

Differences in the degree of authority sharing and provision of organizational careers are associated with variations in the development of these organizational capabilities. We can consider how differences in authority sharing impinge upon the development of collective competences by

Table 6.1. Varieties of authority sharing and competence development

Characteristics	Authority Distribution in Different Types of Firms		
	Isolated Autocracies	Managerially Coordinated	Cooperative Hierarchies
Extent of internal authority sharing	Low	Limited to managerial hierarchy	Extended to skilled staff
Extent of external authority sharing	Low	Limited and highly specific	Considerable and wide-ranging
Key developer of competitive competences	Owner-manager	Managerial hierarchy	Organization of skilled staff
Ability to integrate varied knowledge and problem-solving skills systematically	Low	Restricted to managerial hierarchy	Considerable
Focus of competence development	Flexibility, responsiveness to short-term market changes	Managerial integration and routinization	Collective development of new skills, products and processes

contrasting three ideal types of firms in terms of how much authority over economic decisions, organizational issues and work performance is shared by owners with managers and skilled staff. The key attributes and capabilities of these types are summarized in Table 6.1 and will now be discussed.

First, in what might be termed isolated autocracies, authority is highly concentrated in the hands of owner managers, delegation of discretion to managers and skilled employees is usually very limited, and authority sharing restricted to close family members. Second, there are managerially coordinated companies where considerable authority is delegated to a managerial hierarchy, sometimes including senior technical staff, but not to the bulk of the labour force. Third, more cooperative hierarchies share considerable authority with technical staff and skilled workers, especially over task performance and perhaps work organization and direction. In some European countries such authority sharing is enshrined in legal regulations and extended to broader issues.

Isolated autocracies are typically owner-controlled firms in economies where formal institutions for generating and reproducing trust between economic actors are weakly established. Usually funded from family resources, and often operating in environments that are unsupportive of privately generated and controlled concentrations of wealth, owner-managers find it difficult to share authority beyond those with

whom family-like connections have been established. Delegated discretion tends to be limited to a relatively narrow range of activities whose outputs can be easily monitored, as in many businesses in Taiwan, Hong Kong and other parts of Pacific-Asia (Hamilton, 1997; Hamilton and Kao, 1990; Redding, 1990).

Such high levels of centralized authority enable firms to make decisions rapidly, and to alter key features of the business, such as the products and services offered and the markets served, as exemplified by small firms in Hong Kong that switched from making plastic flowers, to wigs, to toys etc in very brief time spans (Enright *et al.*, 1997; Redding, 1990). They do not, though, encourage the long-term development of organizational capabilities, since commitments by employees tend to be limited—or highly personal—and turnover among the more skilled and competent is often high as they leave to start their own businesses.

Competitive competences accordingly are more dependent on the personal qualities of the owner-manager and his or her close associates rather than on the planned coordination of different kinds of skills and knowledge. Flexibility and responsiveness to market changes are more important to these kinds of firms than the systematic and continuous improvement of products and processes. They do not, then, readily develop strong coordinating capabilities through systematic routines and organization-specific knowledge. As a result, isolated autocracies tend not to be highly effective in managing complex technologies and introducing innovations that need highly skilled staff to be motivated and coordinated to work together for substantial periods. Although highly responsive to changes in market demand, their organizational ability to mobilize new skills and knowledge for dealing with uncertain and risky problems is limited by their reluctance to delegate and involve specialist staff in joint problem solving.

In more predictable and rule-governed environments, owners are usually willing to delegate authority to salaried managers who establish routines and formal procedures for coordinating and controlling work and skills. However, in institutional regimes favouring exit over voice (Nooteboom, 2000) this kind of delegation is often limited to the managerial hierarchy and rarely extended to skilled workers or business partners. According to Lazonick (1990) such 'Chandlerian' firms in the USA developed distinctive organizational capabilities by taking control of production operations away from manual employees and codifying work procedures in formal routines and managerial control systems. As Chandler himself (1990: 36) puts it: 'The combined capabilities of top

and middle management can be considered the skills of the organization itself. These skills were the most valuable of all those that made up the *organizational capabilities* of the new modern industrial enterprise' (italics in original). If firms are constituted by their distinctive knowledge and problem solving capabilities (Kogut and Zander, 1992), this means that most employees are not really full members of such companies.

Organizational competences are here embodied in managerial procedures that do not depend greatly on the skills and knowledge of individual employees below the management group and senior technical staff, or on their long-term commitment to this particular organization. Consequently, most staff, including some technical experts, have little incentive to contribute to the development of firm-specific competences at the expense of developing their own skills, and will need considerable persuasion to commit large amounts of time and energy in resolving problems that require organizational cooperation and collaboration across functional boundaries. Innovations, and organizational improvements more generally, that depend on such commitment for their effective development and implementation are therefore not likely to be rapidly realized.

Rather, significant process and product changes will probably be decided by unilateral authority and coordinated managerially, and may well involve changing the skills of employees by hiring and firing or acquiring new businesses with the desired skills, instead of developing those of current staff. The limited extent of authority sharing and cooperation with suppliers and customers likewise restricts the flow of new information and problem-solving routines from outside these kinds of firms, and discourages investment in customer-specific innovations. The variety of information and knowledge coordinated through such managerial hierarchies is therefore limited in these kinds of organizations.

While the managerial coordinating capabilities of such firms may be quite considerable, they usually do not involve much cooperation between skilled workers or direct connections between operators, suppliers, and customers. Organizational learning tends likewise to be restricted to the managerial hierarchy and focused more on what Lazonick (1991: 199) terms adaptive rather than on innovative strategies. These kinds of strategies concentrate on improving the efficiency with which material and human resources are used as opposed to investing in the development of novel capabilities for producing new goods and services at reduced costs. As Lazonick (1991: 200) puts it: 'the adaptive organization chooses to avoid productive uncertainty by investing only in those process and

product technologies for which the required productive capabilities are known'. This suggests that the transformation of assets and resources in these kinds of firms will be infrequent and disruptive, and may well involve destroying current competences and routines. Reconfigurational capabilities depend considerably here on the ability of senior managers to implement such restructuring without radically reducing managerial commitments.

Third, where collaboration between economic actors is more encouraged by dominant institutions, owners and managers are more likely to delegate authority to skilled technical and manual workers. These cooperative hierarchies also tend to develop closer relationships with customers and suppliers, and cooperate with competitors in setting technical standards, deciding skill definitions and managing union negotiations. This is partly because they are more able to rely on employees and business partners in adjusting to external changes and integrating information from a wide variety of sources than in more adversarial environments. Commitment to dealing with organizational problems across skill boundaries is likely to be easier to elicit in these contexts, and, once change has been agreed, it should be introduced faster and more effectively than elsewhere.

Many such firms incorporate individual learning and skill development into organizational routines. Typically, this involves engaging core employees in continuous improvement activities and codifying their suggestions so that these can be systematically incorporated into work processes throughout the organization—including suppliers and customers where appropriate, as in Toyota (Fujimoto, 2000). In other words, organizational learning can occur on a much broader scale in cooperative hierarchies because it builds on the contributions of all long-term employees and closely allied business partners, and is diffused to a much wider range of groups within and beyond the formal boundaries of the firm. Whereas the US Chandlerian enterprise typically restricts learning to the problem solving activities of the narrowly circumscribed managerial hierarchy, and modifying work routines within the formal organization accordingly, here the organization incorporates most long-term employees, business partners and competitors into a collective endeavour in such as way that the whole ensemble 'learns' by integrating new knowledge and skills into codified routines and problem solving practices.

In principle, then, these kinds of companies should be able to learn faster and more effectively from a wider range of sources and activities than more isolated managerial hierarchies. Authority sharing—while

varying in degree and scope between different groups within and between formal organizational boundaries—here facilitates coordination of knowledge and skills by encouraging joint commitments to growth through continual improvements of processes and products as employees and business partners become locked-in to the authoritative organization's development of distinctive collective competences. This lock-in leads to joint investments in enhancing firm-specific capabilities rather than individual and group skills and reputations.

Consequently, innovations produced by such firms tend to be relatively incremental in that they build on existing skills and knowledge. Where inter-firm cooperation throughout industrial sectors—as distinct from supplier networks—is considerable, product development also tends to focus on particular kinds of customers rather than being generic across a mass market. Competition between firms here is based more on quality and differentiating products and markets than on price and cost reduction (Soskice, 1997). As a result, both coordinating and learning capabilities of these kinds of firms are considerable, but their ability to restructure operations and competences radically is restricted by these lock-ins.

Organizational Careers and the Development of Organizational Capabilities

This kind of employer–employee interdependence is greatly enhanced by the provision of long-term organizational careers for those who demonstrate commitment to, and success in, organizational problem solving and collaboration. Given the risks of being fired and/or having employment conditions unilaterally changed in many market economies, employees seem likely to prefer to demonstrate their prowess in using generally applicable skills to deal with specialist problems than to focus on improving employer-specific capabilities. Organizational careers therefore have to be relatively stable over business cycles to convince staff that it is worth taking these risks by improving their internal organizational reputations (Marsden, 1999; Miller, 1992).

Where such internal careers are highly significant, employees are encouraged to demonstrate their commitment to organizational goals and contribution to company success through, for example, working effectively in cross-functional teams and welcoming rotations across departments and divisions. Knowledge of organization-specific activities, skills, technologies, and markets—including major customers—will be

highly valued by employees in such situations, and they will focus on improving their internal reputations for effective organizational problem solving rather than enhancing their external visibility. Firms that create such strong organizational careers for skilled staff encourage long-term commitments to organizational problem solving, and are more likely to develop distinctive and effective collective learning capabilities, than are those that do not do so.

However, just as the level of authority sharing varies between firms, so too do the extent and scope of organizational careers. In uncertain and low trust institutional environments, for instance, most isolated autocracies tend to restrict long-term commitments to members of their immediate family and those partners with whom they have established close personal connections. Business careers in these kinds of society are more often built around a succession of new firm start-ups than being organizational specific. A similar limitation of long-term organizational careers exists in more predictable contexts where many small firms are too vulnerable and lack a hierarchy of positions that could reward organizational success through promotion. In addition, the structure of organizational careers varies as firms organize their hierarchies in different ways, especially in terms of the importance of functional departments and publicly certified expertise.

We can, then, distinguish between types of organizational careers in terms of three characteristics. First, the longevity of commitments between employers and employees, and in particular the willingness of companies to establish long-term careers for those who demonstrate high levels of organizational commitment. Second, the range of staff covered by such careers, especially their extension to skilled workers beyond the managerial hierarchy. Third, the functional specificity of organizational careers in terms of how far up the formal hierarchy of managerial positions successful staff remain in the same broad functional field of expertise. At least four distinct types of skilled employees' careers that help to develop distinctive organizational capabilities can be distinguished in terms of these dimensions. In order of increasing organizational commitment, these can be described as, first, professional team careers, second, managerial careers, third, functionally specialized careers, and, fourth, organizational generalist careers. Their key characteristics are summarized in Table 6.2 and will now be discussed.

Considering first professional team careers, these consist of a series of memberships in teams of specialists with varied skills tackling complex and often highly uncertain problems. Successful careers of this kind

Table 6.2. Organizational careers and organizational capabilities

Characteristics	Types of Organizational Careers			
	Professional Team Careers	Managerial Careers	Functionally Specialized Careers	Organizational Generalist Careers
Organizational longevity	Low	Considerable	Considerable	High
Range of employees covered	Most skilled staff, but for short periods	Limited to managers and senior experts	Considerable	High
Functional specificity	Technically specialized careers	Limited to roles within profit centres	High, up to senior management	Limited
Associated organizational capabilities				
Coordinating	Limited to teams	Considerable	Considerable	High
Collective learning	Limited to teams	Limited to managerial hierarchy	Considerable within functional departments	High within and across departments
Reconfigurational	High	Limited by managerial routines	Considerable within current competences, low beyond these	Considerable within current competences, low beyond these

depend on reputations in both employing organizations and external technical communities for dealing with more and more complex and difficult problems, often under tight time constraints. As well as being able to demonstrate high levels of technical excellence, an additional important requirement for such careers is the ability to work together with other specialists in teams to achieve visible success in complex problem solving. Because of the highly risky and uncertain nature of many projects undertaken by such teams, these kinds of careers do not usually involve lengthy commitments to particular employers, especially in emerging industries where new technologies are being developed. Labour mobility is typically quite high, although often territorially restricted, as in Hollywood and Silicon Valley (Almeida and Kogut, 1999; DeFillippi and Arthur, 1998; Marsden, 1999: 238–41; Storper, 1989).

Even where engineers are locked-in to individual firms through programmes of rolling share options and bonuses, as at Intel (Jackson, 1997), organizational careers are frequently structured around a series of relatively discrete projects in which specialist staff compete to demonstrate their technical excellence and contribution to collective success. Project team membership and success is often more important for employees in this situation than building company-wide organizational capabilities. As a result, the development of coordination and learning competences at the organizational level can be limited by individual and group mobility where labour markets are highly fluid and structured around publicly certified skills, as discussed in Chapter 9.

Firms that are dependent on the success of such teams often limit the provision of long-term organizational careers when high levels of technical and market uncertainty restrict financial and employment commitments, and results have to be achieved relatively quickly. Competitive advantages and competences here derive from flexible and speedy responses to new knowledge and skills, and the ability to integrate new kinds of information and expertise to generate disruptive products and processes, especially in winner-takes-all competitions where network externalities and economies of scale of demand are high (Shapiro and Varian, 1999).

More managerial careers consist of a series of hierarchical positions within a company based upon success in dealing with significant organizational problems. They are, then, more firm specific than professional team careers, and usually involve greater employer commitment to key staff. However, these careers are usually restricted to managers, engineers and other technical experts who demonstrated success in dealing with

organization-specific problems and were willing to acquire knowledge of different functions and activities through job rotation and management development programmes (Lazonick and West, 1998; Lazonick and O'Sullivan, 1997). In particular, they typically have not been available to non-college educated staff in the USA and elsewhere, and have also been subject to corporate restructuring, especially since the 1970s (Jacoby, 2005).

As a result, organization-specific knowledge development and learning in these kinds of firms tend to be limited to the managerial hierarchy and reified in formal procedures and routines that often limit flexibility and adaptiveness to changing technologies and markets. Although these kinds of organizational careers are often available for specialist staff within functional departments, they can involve relatively early moves from such functional fields to more general managerial posts that integrate a number of complementary activities and skills in distinct profit centres, especially in multidivisional companies that decentralize such general profit responsibility below top management. Demonstrating a commitment to developing general managerial competences across fields of functional specialization is thus an important requirement for success in such careers.

Companies where these career types dominate are able to generate strong coordinating capabilities, particularly of different functions and expertise, but tend to be less effective in learning how to implement continuous improvements to work processes, especially when that involves the skilled labour force. The restriction of organizational careers and commitments to managers and potential managers seems likely to discourage many employees from making great efforts to improve firm-specific knowledge and skills, and so limits organizational learning capabilities. It may, though, enable such firms to restructure resources and activities by changing personnel, depending on the rigidity of their managerial routines and their ability to gain the commitment of new staff to contribute to organizational objectives.

Functionally specialized careers extend further down organizational hierarchies to encompass many skilled employees, and so encourage widespread commitment to joint problem solving and organization-specific knowledge development. Such a broadening of long-term commitments to non-managerial groups enables firms that establish these kinds of careers to improve product functions and production processes through continuous cumulative innovations by gaining the active cooperation of core employees in coordinating complementary activities and

enhancing collective organizational capabilities (Lazonick, 1991; Soskice, 1999; Streeck, 1992).

However, by structuring organizational careers largely around functional departments, at least up to senior management levels as in many German companies (Stewart *et al.*, 1994), success may be based as much on contributions to departmental problem solving activities as on those to more general organizational issues. Skilled workers, technical experts and managers may accordingly develop quite strong departmental loyalties that can inhibit cross-functional cooperation and the development of organization-wide collective capabilities, as Herrigel and Sabel (1999) have suggested happens in parts of Germany. Coordinating and learning capabilities are likely to be quite strong here, then, but organization-wide learning may be restricted by departmental boundaries. While innovation capabilities within existing technological trajectories and skill bases can be quite considerable, more radical transformations of resources and activities are unlikely in firms with these kinds of careers because of the long-term commitments to existing skills and competences.

More generalist organizational careers encourage greater mobility across functions and departments, and reward employees who learn new organization-specific knowledge and skills in a variety of jobs over the course of their working lifetime. Comparing engineers' more generalist careers in Japanese firms with those in German firms, for instance, Sorge (1996: 82) suggests that: 'The Japanese engineer is more of a multi-specialist, the German engineer a specialist who extends his domain into other specialisms'.

Success in companies with more generalist careers depends on demonstrating significant contributions to organizational problem solving in different teams and different fields. Flexibility and continuous learning are therefore key qualities for ambitious employees, as well, of course, as dedication to their employer's growth and success. Because staff are strongly locked-in to the long-term fate of their employer through the firm-specificity of their knowledge and skills, they are highly committed to improving organizational problem solving capabilities, including knowledge of key customers' processes and needs. Additionally, the generalist nature of organizational careers here facilitates the development and introduction of new products as employees rotate between departments. As a result, such companies are able to develop very effective coordination and learning capabilities within the enterprise.

However, this focus on continuously improving organization-specific knowledge and skills can inhibit learning from external sources, especially

if those are organizationally and cognitively remote such as some academic science or radically new industries. While absorption of new information and skills in areas close to current activities and competences is likely to be straightforward in such companies, greater difficulty may be involved in searching for and using effectively knowledge and expertise that is more distant, as has arguably been the case for many firms in the Japanese pharmaceutical industry (Kneller, 2003; Thomas, 2001; see also Nooteboom, 2000).

These different degrees of authority sharing and types of organizational careers are encouraged to develop and be reproduced by varied institutional frameworks. Where the dominant institutions governing authority and trust, the allocation of capital, and the development and organization of skills, as well as state structures and policies, differ significantly, owners and managers are likely to adopt varying degrees of authority sharing and investment in organizational careers.

Institutional Frameworks, Authority Sharing, and Organizational Careers

As emphasized in earlier chapters, one of the most important factors affecting owners' willingness to share authority in market economies is the extent to which they trust the formal institutions governing economic transactions, and economic activities more generally. Where this is so low that they feel unable to rely on the legal system, accounting conventions and formal systems for assessing competence and contractual compliance to control the behaviour of customers, suppliers and employees in predictable ways, they are less likely to delegate substantial amounts of authority to relative strangers with whom they do not have strong personal bonds of loyalty and reciprocity. Additionally, in paternalist political cultures that justify leadership more in terms of elites' superior abilities to look after the best interests of the population than through their formally credentialed expertise or by success in formally governed electoral competitions (Beetham, 1991), owners tend to consider employees as unqualified to exercise discretion.

Such low levels of trust in formal institutions are often associated with predatory states and unpredictable financial systems. Where state elites are unwilling to allow the growth of large concentrations of privately controlled capital and/or seek to extract substantial amounts of surplus for their own benefit, owners are faced with a highly uncertain political

and economic context in which personal connections are often the only reliable means of ensuring trust and predictable behaviour. The legal system in such countries is either very limited in its ability to resolve disputes, or liable to render capricious and unpredictable judgements.

Many industrializing countries, and those undergoing radical institutional change such as the former state socialist societies of Eastern Europe in the early 1990s, exemplify this kind of institutional context (Fafchamps, 1996; Humphrey and Schmitz, 1998; Menkhoff, 1992; Whitley and Czaban, 1998; Whitley *et al.*, 1996). When business owners do develop alliances and partnerships in such economies, these are usually based on personal ties, and are family-like if not actually based on close kinship links, as in Taiwan and other Pacific-Asian societies (Gates, 1996; Hamilton, 1997; Hamilton and Kao, 1990). They also tend to be quite limited in scope, so that owner-managers are not exposed to high levels of risk by such shared commitments.

In these relatively particularistic business environments, authority tends to remain highly concentrated and personal, and commitments to impersonal collective enterprises very limited. Organizational structures are usually fluid, without a stable set of positions that could constitute a career for ambitious skilled workers and managers, and highly dependent on the personal decisions and judgements of the owner-manager, as in many Chinese family businesses (see, e.g. Redding, 1990; Silin, 1976). Incentives for long-term organizational commitment are dependent on personal ties and often restricted to the immediate family or those with whom family-like connections have been developed. Collective problem solving is therefore dependent on the direct authority of the owner-manager, and limited to a small proportion of the workforce. Firms are often organized as isolated autocracies in such market economies.

In contrast, where the dominant institutions governing economic activities are more reliable and patterns of authority are less paternalistic, owners may well feel able to share authority with some employees and business partners and establish organizational careers. However, how much they do so, and with whom, varies considerably between market economies with different political, financial and labour market institutions. As a result, the sorts of organizations and the nature of their capabilities that become established in societies with contrasting institutional regimes vary considerably.

The key features of institutional regimes that affect variations in authority sharing and organizational careers concern the support they provide

for firms to enter into continued commitments with business partners, including employees, and their limitation of rapid exit from them. In general, the more financiers, managers, and skilled workers are locked-in to each others' destinies the less likely they are to act opportunistically and seek short-term advantages through changing business partners. Institutional frameworks that encourage such lock-in therefore reduce the risks associated with long-term commitments and so facilitate both authority sharing and the development of organizational careers. They can also, though, inhibit firms' ability to adapt to radical technological and market change.

Extending the analysis presented in earlier chapters, four main features of institutional regimes that help to explain variations in authority sharing and organizational careers across industrialized market economies can be identified. First, the extent and nature of the state's provision of collective competition goods and concern to constrain short-term economic opportunism. Second, the cohesion and organizational basis of business associations. Third, the strength of the market for corporate control. Fourth, the organization and effectiveness of the skill formation system and its links to labour market institutions.

Since the provision of organizational careers for key employees typically involves delegating considerable task autonomy to them, we can explore how these institutional features affect employers' willingness to delegate discretion to different groups of employees and to develop long-term organizational careers for them by combining these two organizational characteristics. In addition to the low levels of authority sharing and provision of organizational careers characteristic of particularistic business environments, there are at least four distinct combinations of some authority sharing and careers that can be readily identified. The first combines high levels of discretion over task organization and performance with professional careers that limit the extent of organizational commitment. The second restricts delegation and long-term organizational careers to managerial and expert employees, while the other two extend both discretion and careers to skilled employees, but organize careers differently. The expected connections between these four types and the four key features of institutional regimes are summarized in Table 6.3 and will now be discussed.

Considering first the role of the state in supporting economic development and limiting opportunism, as described earlier this can vary considerably across market economies in ways that affect the extent of cooperation between firms and their ability to share risks, both with

Table 6.3. Connections between institutional features, authority sharing, and types of organizational careers

Institutional features	Types of Authority Sharing and Careers			
	High delegation and professional team careers	Considerable delegation and organizational careers limited to managers	Considerable delegation to skilled staff and functionally specialized careers	Considerable delegation to skilled staff and generalist organizational careers
State support for coordinated development and limits on opportunism	Negative or neutral	Varies	Positive	Positive
Strength of business and employers' associations	Negative	Negative or neutral	Positive	Positive
Strength of market for corporate control	Positive	Positive	Negative	Negative
Strength of professions and public education system for certified skills	Positive	Positive	Varies	Negative
Effectiveness of employer–union controlled public training system	Negative	Negative	Positive	Negative
Segmented, enterprise-based unions and training	Negative	Negative	Varies	Positive

state agencies and with each other. In particular, an important aspect of such state support is the implementation of what Ergas (1987) has termed 'diffusion' technology policies that encourage widespread diffusion of new knowledge and practices throughout an industry so that all firms can engage in technological upgrading. Through state support for collaborative research projects, subsidy of public and quasi-public laboratories, joint setting of technical standards and the dissemination of new information, such policies attempt to improve the general standard of technological competence rather than leaving it to individual firms to develop new knowledge and appropriate rewards as separate entities. Sometimes, states delegate considerable authority to business associations to organize research projects and gain access to public support for technology development on behalf of their members, as in Germany (Abramson *et al.*, 1997).

In general, the more that states provide these kinds of collective competition goods and limit short-term opportunism, the more firms are likely to work together in developing new technologies and opportunities and to plan long-term investments. Owners and managers thus share more authority between themselves and reduce risks of opportunistic behaviour in economies with coordinating states. This provides a relatively stable basis for establishing organizational careers for skilled staff and investing in their training. Because the state here encourages cooperation and mutual commitment between firms, they are more likely to feel able to enter into commitments with many employees than in societies where the state operates more at arms' length from companies and opportunistic behaviour remains considerable.

State encouragement of national business associations to collaborate in policy development and implementation is an important factor in the institutionalization of strong business and employer associations. These are a significant feature of the business environment that encourages employer–employee commitment by restricting opportunistic behaviour by both member companies and employees. Particularly if wage rates and other aspects of employment relationships are agreed centrally, either at the industry or national level, and firms are constrained from poaching skilled staff by offering higher wages, employers are encouraged to develop quite long-term commitments to employees. This is enhanced by strong regulatory frameworks governing employment relations in many of the more coordinated market economies of Continental Europe. In contrast, economies with weak employers' groups and fragmented bargaining practices have few institutional constraints on employer or

employee opportunism and so do not encourage long-term commitments between them.

Additionally, where there are strong legal restraints on unilateral employer actions and strategies, such as the Works Constitution Acts in Germany and European legislation on works councils' rights, employees are more likely to believe in employers' commitments and themselves engage in long-term joint problem solving and firm-specific knowledge development. According to Streeck (1992), the expansion of co-determination in Germany has encouraged continuous retraining and redeployment of the labour force as both managers and workers become more committed to the success of the firm and internal labour markets dominate external ones. In his words (1992: 163): 'Acceptance by the workforce of rapid technological change, flexible work organization and high internal mobility is required to ensure the competitive edge and the economic success of the enterprise on which, in the last instance, the realization of the employment guarantee depends.' The importance of organizational careers for most employees has hence been increased by the expansion of such formal joint governance structures.

The third feature of institutional frameworks that is likely to affect authority sharing and employer–employee commitments is the nature of the financial system and in particular whether it facilitates a strong market for corporate control. The combination of liquid capital markets, legal and other restrictions on managers' ability to develop strong defensive measures against hostile takeovers, and fragmented shareholdings in outsider-based financial systems results in a strong market for corporate control that limits investor-manager commitments and reduces the credibility of long-term career incentives (Tylecote and Conesa, 1999). Where capital is impatient and volatile it is difficult to convince skilled employees to become committed to the long-term development of a particular firm's organizational capabilities.

In contrast, insider-based financial systems are characterized by relatively small and illiquid capital markets and much greater concentrations of shareholder control over large companies. Here it is much more difficult to transfer ownership and change direction radically, especially if significant proportions of firms' shares are held by strategic investors and/or are effectively controlled by top managers, as is the case in many European countries (Barca and Becht, 2001) and Japan (Sheard, 1994). Such stability encourages longer-term employer–employee commitments, and indeed other long-term strategies. In general, where firms are committed to long-term alliances with suppliers, customers and other members

of enterprise groups through mutual shareholdings, links with banks and other financial institutions, and regular exchanges of information and personnel, as in the alliance capitalism of Japan (Gerlach, 1992; Lincoln and Gerlach, 2004), they are more likely to make credible long-term commitments to employees. Such alliances additionally of course facilitate collective control of labour markets and restrict employee opportunism.

Lastly, the skill formation systems of market economies vary considerably in ways that, together with labour market institutions, affect the kinds of skills developed, social identities and organizational commitments. At least three distinct kinds of education and training systems can be distinguished that encourage increasing levels of employer–employee commitment in conjunction with other features of labour market control. First, the relatively unstandardized and variously controlled skill development and certification system found in many liberal or arms' length societies. Second, the much more standardized and wide-ranging public training systems of many continental European societies, which often involve highly influential labour unions, and third the highly selective educational system and 'segmented', employer-based training practices developed in Japan and some other countries (Crouch *et al.*, 1999; Finegold and Wagner, 1999; Thelen and Kume, 2001).

In the first kind of skill formation system, general educational success is more valued than the acquisition of practical skills, which are developed and controlled by a variety of public and private agencies including professional elites. Certified practical skills tend to be 'owned' and developed by individuals who invest in particular training programmes provided by relatively autonomous educational institutions without much involvement of employers or unions. Skills are often generic across firms, and sometimes industries, as in the case of accountancy and some other business services, and are rarely tied to specific organizational arrangements. In terms of the problems they deal with, though, they can be quite specialized, especially when controlled by practitioners. In such cases, workers identify strongly with their professional expertise, particularly when occupational associations combine trade union functions with those of technical societies, as in the UK.

As a result, managers can find it difficult to develop cooperation across functional boundaries tied to such skills, and to develop organizational career paths (Child *et al.*, 1983). Because most skilled staff in these sorts of economies owe their primary loyalty to their profession, they will be reluctant to invest in developing firm-specific skills and acquiring firm-specific knowledge. Even when employers establish internal labour

markets and organizational careers, many may prefer to remain technical specialists if such careers require professionals to abandon their technical identity in favour of a more managerial one, as did some British engineers (Watson, 1976). Such attitudes and behaviour limit employers' willingness to share authority with professional employees, which of course further restricts the latters' commitment to develop firm-specific knowledge and skills, as well as other staff. While innovative firms rely on the specialist skills of these staff to develop new products and improve process technologies, they cannot assume that professionals will readily transfer across functions and dilute their specialist skills by working in cross-functional teams to deal with organization-specific problems.

Second, in more solidaristic training systems, such as that developed in Germany (Thelen, 2004; Thelen and Kume, 2001), employers, unions, and state agencies together organize and control strong skill formation systems that develop highly valued standardized skills for a majority of the labour force. These form the basis for strong occupational identities in both large and small companies. Here, pride in one's publicly certified expertise is considerable, and encourages loyalty as much to horizontally defined occupational groups as to vertical authority hierarchies constituting firms. Such skills additionally facilitate mobility between companies and the institutionalization of active labour markets within particular occupational boundaries (Hinz, 1999). However, in many continental European countries this mobility is restrained by strong employers' associations and centralized wage bargaining organized on a sectoral basis, as well as by legal constraints on unilateral employer actions.

Overall, the systematic involvement of sectorally based employers in the standardized system of skill formation here ensures that skills are valued by firms and fit into their particular systems for organizing and coordinating work. Consequently, firms should find it easier to use and coordinate specialist skills in such economies than when they are controlled solely by state agencies or practitioner elites. Together with regulatory barriers to firing staff in market turndowns, and industry wide barriers to hiring new skills from competitors, these factors mean that both firms and workers in these kinds of societies have strong incentives to improve individual and collective skills within current technological trajectories and industry boundaries. Organizational careers are here encouraged by extensive employer–union collaboration within each industry that ties firms and workers into a common destiny.

Employers in these circumstances are encouraged to establish organizational career paths for skilled employees to advance along, so contributing

to the development of firm-specific knowledge and skills on top of their standardized expertise. Careers and identities are accordingly structured by both certificated skills and organizational hierarchies. Because of the widespread diffusion of new knowledge, technologies and skills throughout each sector, firms in these kinds of coordinated market economies seek to differentiate themselves in terms of products and market niches, and to construct distinctive competences through the organizational coordination and development of skilled staff. They therefore invest considerably in developing skilled workers' commitments to construct such capabilities, but the strong commitment to certified professional expertise in these societies often restricts the amount of job rotation across major departments and cross–functional integration that can be implemented easily.

While gaining commitment to solving complex, organization-specific problems should be easier in such environments than in arm's length ones, skilled workers may well resist transfers across occupational labour markets. Accordingly, developing highly firm-specific capabilities on a long-term basis that threaten established occupational identities will be difficult in such societies. As Herrigel and Sabel (1999: 93) suggest in the case of Germany:

> the craft system itself involves hierarchy and fragmentation: divisions between separate *Berufe* are considered to be virtually natural division within the production process and in the system of social differentiation in society. Masters, moreover, are the superiors of apprentices and of newer and younger skilled workers within their *Beruf*.

Similarly, Crouch *et al.* (1999: 148) suggest that: 'today... the training which equips workers with this kind of occupational identity is providing a static concept of the occupation that can run counter to the flexibility required of new firms'. However, some German firms faced with intense foreign competition and technological change have managed, with considerable difficulty, to break down these kinds of boundaries (see also Finegold and Wagner, 1999).

Third, in market economies where the educational system strongly selects children and young adults for different positions in the labour market through academic examinations, and the public training system is relatively poorly developed and/or low in prestige, skill-based occupational identities are weaker (Marsden, 1999: 121–38). Firms here rely on the educational system to select and train workers in general competences that they can build upon during the course of a working lifetime. Because

the strong business associations characteristic of many such societies restrict poaching and limit free riders' ability to appropriate skills developed by competitors, both employers and employees make considerable investments in collective competence development through organizational careers, especially in the larger firms. Authority sharing in the larger firms in these kinds of collaborative institutional frameworks is often considerable because both managers and workers are highly dependent on the growth of the firm, and jointly develop distinctive competitive capabilities. Such interdependence tends, however, to be lower in smaller firms where labour turnover is greater and skills less organization specific.

The lack of strong horizontal occupational identities based on certified expertise and reinforced by skill-based unions here facilitates job rotation across functional groups, as well as cooperation between them, so that innovation development and implementation are, in principle, faster and more effective than where functional boundaries are reinforced by publicly standardized skills. Expertise therefore becomes highly firm specific in large companies in such economies as both managers and core workers invest in the long-term development and improvement of distinctive organizational capabilities. Firms thereby establish strong organizational cultures, but may also share authority with long-term business partners to ensure continuous acquisition and use of new knowledge and cooperation with firms possessing complementary capabilities.

Conclusions: Institutional Frameworks and Organizational Capabilities

This analysis suggests that market economies with different combinations of these institutional features will encourage firms to share authority and develop organizational careers to varied extents, and so generate different kinds of organizational capabilities that are likely to be more or less effective in different kinds of industries. For example, firms with strong competences in the integration of complex forms of knowledge and advanced skills to develop and commercialize systemic technologies are unlikely to be successfully established in societies where trust in formal institutions is low and the state is antagonistic to independent control of major economic activities. Rather, companies in these sorts of contexts are more likely to compete by being highly flexible to be able to deal with an uncertain environment, and responding rapidly to changing customer requirements through centralized decision making. In particular, they will

be reluctant to make substantial investments in developing organizational competences through long-term commitments to skilled staff, or to institutionalize managerial routines that might inhibit flexibility.

More systematic coordinating capabilities are more likely to be developed by firms in arms' length institutional regimes that combine regulatory states with liquid capital markets. These features encourage owners to delegate some authority to salaried managers by providing a more predictable environment for investments than where the legal system is unreliable and/or corrupt, as well as an educational system that identifies the more academically able and offers a range of publicly certified skills. However, the weak business associations and strong market for corporate control often found in these kinds of market economy provide few incentives for long-term inter-firm cooperation or widespread investment in developing firm-specific problem solving skills and knowledge. The largely adversarial and fragmented relationships between economic actors typical of such societies prevent lock-in effects and limit the effectiveness of attempts to sanction opportunistic behaviour. In particular, the focus on professional careers and low institutional support for long-term employer–employee commitment here limit professionals' willingness to subsume their specialist identities under more organizationally specific groupings and activities.

The limited authority sharing characteristic of these kinds of market economy restricts skilled workers' contributions to problem solving and hence the ease of developing continual improvements to production processes and innovating by upgrading products on a continuing basis. The Chandlerian firm is a typical product of such an environment in which coordination of specialists takes place through the managerial hierarchy and its routines, rather than at the project level, and unilateral decision making is more common than joint problem solving and development. Accordingly, the ability of firms to develop strong organizational learning capabilities is often quite restricted by this kind of business environment.

However, the strong market for corporate control here enables firms to buy and sell units relatively easily, and the fluid labour markets pose few restrictions on managers hiring and firing people to change their skills and capabilities. Depending on the rigidity of managerial routines and procedures, as well as the significance of managerial loyalties, then, this kind of institutional framework can facilitate considerable restructuring of firms' assets and resources, although these obviously take some time to generate novel organization-specific capabilities. These kinds of

institutional frameworks also enable firms to develop radical, transformative innovations and technologies when the state and other agencies, such as universities, invest in producing new technological knowledge and research skills on a large scale. In the case of the US biotechnology and computer hardware and software industries, direct and indirect state support was critical to their rapid development (see, e.g., Kenney, 1986; Langlois and Mowery, 1996; Leslie, 2000; McKelvey, 1996; Saxenian, 1994).

More coordinated institutional frameworks restrict opportunism to a greater extent and encourage higher levels of authority sharing within and between companies. As a result, owners, managers and skilled employees become more willing to invest in the relatively long-term development of organization-specific problem solving skills and knowledge. In these circumstances skilled workers are more likely to pursue organization-specific careers than to concentrate on enhancing individual expertise for external labour markets because employers are more inhibited from adopting very short-term labour management strategies. Coordinated market economies with these kinds of institutions, coupled with credit-based financial systems that encourage close ties between capital providers and users as well as supportive state policies, therefore tend to develop collaborative types of large firms that have strong coordinating and learning capabilities. Such firms are likely to be quite effective in sectors where the precise coordination of complementary activities and the continuous improvement of production and development processes are crucial to their competitive success, as in the car assembly industry.

Firms in these sorts of societies, however, are less likely to be effective where technical and market uncertainty are high, so that neither the outcomes of development projects, nor the nature of skills required to undertake them, can be reliably predicted in advance, because their ability to reconfigure their skills radically is restricted. As a result, many companies in countries such as Germany focus on developing incremental, cumulative innovations that depend on employee commitment and firm-specific knowledge in new industries such as biotechnology and internet software (Casper, 2000; Casper and Glimstedt, 2001).

Variations in skill formation and certification systems between these kinds of coordinated market economies affect the strength of occupational identities and the institutionalization of occupational labour markets. Consequently, the ease of obtaining skilled workers' commitment to collective competence development that threatens such identities as well as reputations for high levels of individual expertise is likely to be lower

in countries with strong public training systems and powerful expertise-based unions. This may affect the speed with which knowledge, skills and activities can be integrated across functional departments, and so the rate of new product development and introduction.

Continuing job rotation across functions and use of cross-functional problem solving teams to build firm-specific knowledge and capabilities should be more straightforward in societies where practical skills are largely developed inside companies and unions are either weak or predominantly based on enterprises, as in postwar Japan. If individuals have few externally certified skills that are generic across employers, they become highly dependent upon the growth of their firm and so are much more willing to invest in gaining knowledge of all a company's operations and contributing across specialist boundaries in order to progress. However, such generalist organizational careers may inhibit the acquisition and use of new knowledge and skills from cognitively distant sources.

In summary, variations in authority sharing and organizational careers connect differences in institutional frameworks to the generation of distinct kinds of organizational capabilities. These capabilities in turn affect firms' competitive effectiveness in different sub-sectors, especially their ability to develop cumulative or radical innovations, such that economies with contrasting institutional arrangements develop relative strengths and weaknesses in different kinds of industries. In particular, employers' establishment of distinctive types of organizational careers in variously coordinated market economies influence employees' willingness to commit themselves to the continuous improvement of firms' knowledge and collective problem solving capacities, and hence enhance companies' learning capabilities. These relationships will now be explored in more detail through an analysis of how different kinds of firms develop innovative organizational capabilities in different institutional environments, and so affect patterns of technological and sectoral specialization in differently organized market economies.

7

Developing Innovative Competences in Different Institutional Frameworks

Introduction

This analysis of how key features of dominant institutional regimes encourage owners and managers of leading firms to develop different kinds of organizational capabilities can be integrated with the account of innovation systems presented in Chapter 3 to help explain how different institutional frameworks lead to contrasting patterns of technological development through their structuring of firms' innovation strategies and competences. While the connections between institutions, firms and innovation patterns have been explored in a number of papers contrasting the technological and sectoral specialization of Germany, the USA and some other countries in the last few decades of the twentieth century (see, e.g. Casper, 2000; Culpepper, 2001; Soskice, 1999), these have tended to rely on an overly stylized contrast of coordinated and liberal market economies (Crouch, 2005).

Additionally, as the literature on national innovation systems has emphasized, the increasing importance of academic research skills and knowledge in the development of new industries (see, e.g. Cohen *et al.*, 2003; Mansfield, 1995; Narin *et al.*, 1997) means that variations in the dominant institutions governing the development and use of research skills also have significant consequences for the rate and type of technical changes in different market economies. Differences in the rate of movement of scientists and engineers between the public research system and private firms, and between firms, also affect the flow of knowledge and skills throughout the economy (Riccaboni *et al.*, 2003). These variations are especially important in industries where product and process changes are dependent upon the integration of knowledge from different scientific

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fields, as they seem to be in many of the newer sectors (Brown and Duguid, 2000; Cohen and Fields, 2000; Gambardella, 1995).

In this chapter I suggest how we can extend and integrate the analysis of innovation systems presented in Chapter 3 and the account of how different firms develop different kinds of organizational capabilities outlined in the previous chapter to explain how leading firms in differently organized market economies develop distinctive innovative competences and strategies. Differences in these strategies reflect the pressures and possibilities of different institutional environments, especially constraints on opportunism, the nature of the public training system and a number of features of the public science system.

Initially, I shall discuss four major differences in how innovating firms develop distinctive competences. These are connected to variations in the kinds of innovations developed by different types of firms, particularly their cumulativeness and customization. The following section suggests how key features of the institutional frameworks governing labour and capital markets, as well as public science systems, encourage firms to develop innovative competences in contrasting ways, and so generate different patterns of technical change in different societies.

The Development of Innovative Competences

In comparing innovative firms across market economies, key differences between, say, new technology based firms, large integrated mass production companies and firms enmeshed in business associations, concern the ways in which they develop innovative competences. These vary considerably in terms of their relative dependence on knowledge generated internally as distinct from that obtained externally, on the one hand, and in their ability to adapt to radical technological and market change by changing organizational competences, on the other hand. These differences can be summarized in terms of four sets of choices that help to distinguish the innovation strategies of leading German, Japanese, US, and other firms in the post-Second-World-War period.

The first key choice concerns whether firms concentrate on developing innovative competences internally, keeping knowledge production and skill development in house, or prefer to develop them in cooperation with external agencies and business partners. Second, if external partners are involved in developing innovative capabilities, are these to be the organizations and personnel working in the public science system, or those in

the same industry and using similar technologies, or both? A third major choice concerns how much innovative firms invest in the development of firm-specific organizational capabilities and problem-solving routines, as distinct from relying upon more individual specialist skills that are generic across companies. Fourth, how flexible are firms in responding to new knowledge and techniques, and how able and willing are they to change technological trajectories in the short to medium term?

Considering first the decision about whether to develop knowledge production and technical problem-solving competences internally, or to involve other organizations and groups on a continuing basis, firms that rely primarily upon their own organizational resources ensure that ownership is secured and spillover risks are minimized. In theory, such internal development also facilitates the integration of varied skills and competences through a unified authority structure based on ownership. It does, though, limit access to, and integration of, new knowledge and skills that do not easily fit into the firm specific technological framework, as well as restricting learning from suppliers and customers. As a result, firms that focus on developing innovation capabilities internally are more likely to have difficulties in incorporating varied kinds of new knowledge, and to produce generic rather than customer-specific products and services. Such isolation from business partners and public researchers can be particularly disadvantageous in sectors where the rate of technical change is high and dependent on a wide variety of knowledges from different fields produced with different research skills. In newly emerging industries especially, reliance on external sources of knowledge and research skills is often considerable, as is perhaps most clearly seen in the development of biotechnology firms (Kenney, 1986; McKelvey *et al.*, 2004).

For firms that do decide to develop innovative competences in cooperation with external partners, there are important differences between types of such partners that affect how these relationships are managed and the sorts of innovations that they generate. In particular, there are significant contrasts in how firms cooperate with agencies in the public science system, on the one hand, and with organizations in the same industry, on the other hand. These reflect major contrasts in research objectives and the types of knowledge produced. In considering how companies cooperate with external agencies, then, it is important to distinguish between cooperation with researchers in the public science system and that with industry partners.

The principal differences between involvement with the public science system and with business partners derive from the quite different

institutional frameworks governing priorities and rewards in research oriented towards publication and that focused on private use. In very broad terms, the public sciences are primarily reputational work organizations in which researchers compete with specialist colleagues around the world to make significant contributions to the collective intellectual goals of their specialism or discipline (Whitley, 2000b). This encourages them to focus on theoretically significant intellectual problems dealing with general phenomena because these have more impact on the work of colleague/competitors. As a consequence, the results, techniques and intellectual approaches involved in current research in the public sciences tend to be more generic than specific to particular materials, phenomena and technologies, and are often remote from current industrial concerns and practices. Firms wishing to access and use them have to make considerable investments in what Cohen and Levinthal (1990) term 'absorptive capacity', typically by hiring trained researchers and conducting more generic research than is required for current technological problem-solving activities.

The extent to which this idealized contrast between theory-driven generic research in the public sciences, and proprietary technological development in firms and business association laboratories, is institutionalized in practice varies across historical periods and countries. For example, in countries that pursue what Ergas (1987) has labelled 'diffusion-oriented' science and technology policies, there are a considerable number of public and semi-public organizations that focus more on technologically and industry specific research than on theory-driven topics (Abramson *et al.*, 1997). Firms can be involved in the former without being closely connected to the latter, as are many German firms that have close ties to applied research and technology transfer institutes (Herrigel, 1993; Soskice, 1997).

Similarly, in some countries the postwar separation of theory-driven public science from commercially driven private research has weakened in the last few decades of the twentieth century. Changes in patent law, state funding policies and university structures have encouraged some companies in emerging industries to become more closely involved with theoretically focused research in academic laboratories. As well as hiring trained researchers from universities, these firms increasingly rely on the latest generic knowledge produced by academics to develop new products and services, especially in the US biotechnology industry (Gambardella, 1995; Henderson *et al.*, 1999; Kenney, 1986; McKelvey, 1996). In this industry, the key research remains largely conducted in university laboratories but

has been used to found new firms, often by the academics themselves, and knowledge of general biological phenomena has had direct commercial utility (McKelvey *et al.*, 2004).

In considering how firms develop different kinds of innovative competences, it is useful to elaborate the distinction between passive and active involvement in public science systems drawn in Chapter 3 by distinguishing between two levels of active involvement in terms of the degree of companies' use of current research skills and knowledge of generic phenomena and processes. We can therefore identify three patterns of firms' involvement in academic research.

First, there are firms that have only a minimal, rather passive, involvement with current research, relying essentially on scanning the published journal and patent literature for obtaining relevant scientific and technological knowledge. Many large Japanese companies seem to have followed this pattern, especially in the pharmaceutical industry (Coleman, 1999; Kneller, 1999; 2003; Westney, 1993b). Second, other firms may be more actively engaged with researchers and organizations in the public and quasi-public research system, but these are usually working on particular technologies and materials that are most relevant to firms in specific industries. A third group of firms is more directly involved in current research on generic phenomena and processes. They are concerned to access relatively general and abstract knowledge, especially the skills for producing it, to develop key competitive competences. Especially in the pharmaceutical industry, it has become increasingly important for firms to gain first mover advantages through their employees being part of the recognized network of competent contributors to general public scientific knowledge, and so to be much closer collaborators of academic scientists than hitherto (Gambardella, 1995).

These three varieties of involvement in the public science system can be termed passive, industry and technology specific, and complementary. They vary in the extent to which: (a) firms recruit trained researchers, (b) fund and participate in generic academic research, and (c) actively recruit leading engineers and scientists from the public science system. Companies that have an essentially passive involvement, for instance, tend to recruit graduates with BSc and MSc degrees rather than PhDs and post-doctoral researchers, limit financial support of academic research to consultancy payments, and rarely, if ever, hire academics in mid-career. In contrast, those that invest in complementary involvement with the public science system recruit both highly trained researchers and leading scientists, as well as funding significant research projects into the study of

both generic processes and technologically focused ones. Generally, the more firms are involved in such research networks, the more they should be able to search effectively for, and use appropriately, new knowledge and skills from a wide variety of fields and disciplines (Gambardella, 1995). This obviously has implications for the sorts of innovations that they develop, the kinds of resources they use, and the risks that are involved in doing so.

Considering next the development of innovative competences in cooperation with business partners, innovating firms often gain considerable knowledge about new technologies, markets and process improvements from trade associations, industry groupings, suppliers and customers (Cohen *et al.*, 2003). Firms vary greatly, though, in the extent to which they share knowledge with business partners through membership of industry associations. In countries like Germany and Japan, for example, business groups, industry associations and similar networks often engage in joint standards setting, knowledge diffusion and technical development, as well as establishing and policing norms of appropriate firm behaviour (Culpepper, 2001; Morris-Suzuki, 1994; Odagiri and Goto, 1996; Soskice, 1997; Tate, 2001). Their members are accordingly able to access new knowledge and information more quickly than those not involved in such groupings, which can be especially advantageous to small and medium-sized companies (Herrigel, 1993).

This kind of knowledge sharing with suppliers, competitors and customers can be termed the degree of involvement in industrial collaborations. When this involvement is considerable and continuing, it encourages firms to invest more in the development of customer-specific knowledge and skills than when inter-firm relationships are more adversarial. Through such stable connections and authority sharing, firms are also likely to develop strong competences in integrating information from a variety of industry sources, and in developing innovations that are more customized than generic. Equally, though, the mutual commitments developed in industry networks will typically limit the degree of technological change undertaken by firms since radical, transformative innovations threaten current organizational competences (Christensen, 1997; Tushman and Anderson, 1986). High levels of industry network involvement, then, tend to be associated with relatively incremental innovation strategies in the sense of developing existing technological knowledge and skills.

The third aspect of competence development considered here concerns the extent to which firms rely more on the specialist skills of individuals

that are generic across organizations as opposed to developing distinctly organizational capabilities based on a stable group of core employees. As discussed in the previous chapter, while all companies develop collective competences as emergent properties of each organization, the degree to which these depend on individuals' specialist expertise varies considerably. The ability of Toyota to improve production processes continuously through the results of employee commitment to joint problem solving being codified and disseminated throughout the organization represents an extreme case of core workers investing in the development of collective firm-specific knowledge and skills (Fujimoto, 2000). Elsewhere, staff are more concerned to enhance the value of their own expertise on external labour markets and so firms are here less able to build collective capabilities separately from individual skills.

For instance, the role of new firms founded by highly trained and experienced engineers and scientists in the development of the US biotechnology and computer industries has shown how relatively small and quickly formed organizations of specialist researchers and designers can play a major role in developing significant innovations. Under particular conditions, that is, the ability to create firms that integrate high level skills around specific goals can generate competitive advantages in industries undergoing high rates of technical change. Such firms depend greatly upon the skills and knowledge of project leaders and their teams of specialist staff to develop innovations, as distinct from developing distinctive collective competences that are more organizational and institutionalized into managerial routines.

Among the important conditions that encourage such reliance on individually owned and controlled specialist skills are the ease of appropriating profits from innovations, for example through patenting in the pharmaceutical industry (Gambardella, 1995), and the existence of open standards facilitating the development of modular innovations (Langlois and Robertson, 1995; Langlois and Mowery, 1996; Sturgeon, 2002). High levels of appropriability and modularity of innovations facilitate the specialization of firms in product design and development without having to invest in complementary assets in marketing and distribution (Teece, 1986).

Coordination of innovative activities in such circumstances can thus be carried out by project groups of specialist experts rather than needing extensive organizational routines and procedures. They organize their activities around teams of highly qualified specialized engineers and scientists focused on short- to medium-term innovation goals because

the high levels of market and technical uncertainty in emerging industries, where such firms play a major role, limit financial and employment commitments and results have to be achieved relatively quickly. Competitive advantages and competences here derive from flexible and speedy responses to new knowledge and skills, and the ability to integrate new kinds of information and expertise to generate disruptive products and processes, especially in winner-takes-all competitions where network externalities and economies of scale of demand are high (Shapiro and Varian, 1999).

Conversely, where appropriability is difficult and/or technological change is systemic rather than modular, innovating firms tend to coordinate product development with production, marketing and other complementary activities to protect their assets and integrate components of technological systems. Such coordination usually involves the construction of formal organizations with collective capabilities because spillover risks and technical uncertainty inhibit contracting for specialist services. Knowledge production and problem-solving skills are here more organizational than individually owned and developed.

Firms in many assembly and machinery industries, for instance, typically coordinate technological and market knowledge from different sources, both within and outside the organization, to develop and commercialize innovations, and establish organizational routines to do so. Distinctive firm-specific skills develop as a result that are not tied to particular individuals' skills and contributions. These skills become entrenched in distinctive technological paradigms that guide development trajectories and how engineers tackle problems in, say, car design and aircraft development. While all work organizations, then, generate particular kinds of competences by coordinating and controlling work in a systematic manner, the extent to which these capabilities depend on the generic skills of specific individuals, as opposed to collective, organizational competences, varies considerably. This aspect of innovating firms' competences can be characterized as their dependence on the specialist skills of individuals.

The fourth aspect of competence development to be considered here concerns the speed with which, and degree to which, firms are able and willing to change their innovative capabilities and competitive competences. Many companies, for instance, diversify into new technologies and markets through developing new skills and abilities incrementally, building on existing ones, as emphasized by the dynamic capabilities approach to firm behaviour. In contrast, others are able to change their

core competences more radically by hiring new staff with quite different skills, as in the case of some US pharmaceutical firms developing biological research skills (Zucker and Darby, 1997), or by acquiring companies with expertise in new technologies such as biotechnology and software start-ups. Depending on the modularity of technological systems, such acquisitions may involve quite radical changes to firms' competences and the overall architecture of their technologies.

This contrast reflects the level of firms' commitments to staff and business partners, as well as their specialization in particular technologies and industrial sectors. The more they develop distinctive competences through investments in employee training and customer-specific knowledge, the more difficult they will find it to develop radically new capabilities, and to be successful in novel and discrete technologies in emerging sectors, as argued by Rosenbloom and Christensen (1998). Technological changes made by such firms will, then, tend to be incremental and customer-focused rather than generic and transformational. This aspect of innovative competence development can be described as the rapidity of competence transformation.

Some of these alternative modes of developing innovative competences are mutually independent. For example, involvement in public science networks can be combined with varying degrees of involvement in industry associations. Firms can develop close connections with public and private research organizations, hire PhDs and participate actively in scientific and technological conferences and technical exchanges, and yet fail to form powerful industry associations or long-term ties with customers and suppliers. Many firms in the US computer hardware and software, and biotechnology, industries seem to combine such considerable technical involvement in the research community with largely adversarial and autarchic inter-firm relationships (Chesbrough, 1999).

Similarly, high levels of industry embeddedness and inter-firm dependence, as in many Japanese industries in the postwar period, can be combined with largely autonomous knowledge development in relative isolation from the public science system. Most large Japanese firms, for instance, have restricted their academic contacts to hiring engineers and scientists with MScs rather than PhDs and informal research support for individual professors on a relatively small scale (Coleman, 1999; Kneller, 1999; Westney, 1993b; Yoshihara and Tamai, 1999). On the other hand, many German firms in the chemical and engineering industries seem to combine strongly coordinated technical exchanges within industry sectors with close connections to applied research organizations such as

the Fraunhofer Gesellschaft laboratories and technical schools (Herrigel, 1993; Lehrer, 2000).

Other choices, however, are more interconnected. High levels of involvement in industry collaborations, for instance, tend to lock firms into current technological trajectories and sectoral boundaries. This is because firms that share information and risks with industry partners need to be fairly sure that business partners are equally committed to the industry and improving current technologies, so that opportunistic use of such information and resources can be meaningfully sanctioned by loss of reputation. Where companies restrict such commitments, and can change their competences quite radically through hiring and firing, other firms will not be willing to share important resources with them. Strong and continuing collaborations with industry partners, then, encourage relatively cumulative development of innovative competences within firms, and not the introduction of competence-destroying innovations. This limits their ability to change innovative competences radically, as well as inhibiting their capacity to absorb quite different forms of new knowledge.

Equally, firms able and willing to transform their capabilities radically are unlikely to invest greatly in developing strong collective competences through organizational routines, unless perhaps they change the nature of the firm through buying and selling whole businesses. This suggests that companies that institutionalize career paths for core employees, such as managers and senior technical experts, as a way of gaining their commitment to developing firm-specific knowledge and capabilities that are not dependent on individual skills, will not usually radically transform their competences.

On the other hand, those pursuing incremental innovation strategies that build on current skills can either rely heavily on the specialist knowledge of individuals or on more collective competences, depending on their ability to access complementary assets and the modularity of their innovations. Similarly, small firms that depend on the specialist skills of their employees can develop either incremental or radical innovations in different situations, as the comparison of craft-based businesses in Italy and Denmark with Silicon Valley-type firms shows.

Given these interconnections between some of the choices that firms make in developing innovative competences, four major combinations of involvement in public science and industry networks with varying reliance on individuals' generic skills and ability to transform competences can be distinguished, as summarized in Table 7.1. These are ideal

Table 7.1. Approaches to developing innovative competences

Characteristics of Competence Development	Isolated Hierarchy	Flexible Teams	Cumulative Commitment	Highly Collaborative
Involvement in public science networks	Passive	Complementary	Passive	Technologically specific
Involvement in industry networks	Low	Low	High	High
Dependence on specialist skills of individuals	Limited	High	Low	Low
Rapidity of competence transformation	Limited, but potentially considerable through acquisitions	High	Low	Low
Innovation pattern	Cumulative, generic, except when restructuring organization	Transformative, generic, modular	Cumulative, market-driven	Cumulative, building on new technologically specific knowledge, customer-focused

types of strategies for developing innovative competences that are encouraged to varying degrees by different institutional frameworks. In practice, of course, individual firms can follow different combinations, but the ones discussed here do reflect four particular approaches to technical change that seem prevalent in different kinds of market economy such as those of postwar Germany, Japan and contrasting sectors in the USA (Casper, 2000; Coleman, 1999; Kenney and Florida, 2000; Kneller, 2003; Soskice, 1997).

First, the type of approach that focuses on largely internal innovation development with little continuing involvement with either the public science system or industry partners can be termed the isolated hierarchy mode of developing innovative competences.

Second, the flexible team approach adopted by many project-based firms in new industries combines complementary forms of involvement with public research institutions with arms' length relations with suppliers, customers and competitors, and short-term commitments between employers and employees.

In contrast, the third, cumulative commitment, approach to developing innovative competences combines close relationships with industry partners, and high levels of employer–employee commitment, with little involvement with current research projects and teams in the public science system. A variant of this combination occurs in coordinated industrial districts where smaller firms both cooperate and compete with each other, and rely on a range of territorially specific agencies for general services, but do not usually develop close links with public researchers, or offer long-term careers to skilled employees. Finally, the approach that involves the greatest cooperation with external partners, both in the more technologically and industry specific parts of the public science system and in their industrial sectors, can be termed highly collaborative. This also involves substantial employer–employee commitment.

The isolated hierarchy approach to developing distinctive innovative competences relies heavily upon internal resources and so produces highly firm-specific knowledge and skills, often codified into managerial routines. Organizational boundaries are here quite strong and relatively impermeable. Problem-solving competences and procedures in these kinds of firms are usually strongly institutionalized, with limited openness to new knowledge and skills from outside. They thus develop collective technological approaches and frameworks that depend relatively little upon the skills and knowledge of individuals. In principle, though, their

isolation from business partners enables them to change technologies quite radically by acquiring new skills and/or businesses if the institutions governing capital and labour markets facilitate such restructuring, as in the UK and the USA.

The predominantly internal focus of knowledge production and innovation development in isolated hierarchies means that their ability to integrate quite different kinds of knowledge and research skills is limited, with new recruits usually being expected to fit into the dominant way of thinking. Except when top managers deliberately restructure the technological paradigm by acquiring new organizations and skills and selling or sacking current ones, then, such firms tend to limit the variety and novelty of new knowledge that is integrated into development programmes. Similarly, their relative lack of close involvement with the public science system restricts their ability to develop innovations on the basis of new generic knowledge and skills, at least before it has been published, as well as their capacity to take advantage of new techniques and skills.

Additionally, their low level of commitment to suppliers and customers limits their investment in customer-specific knowledge and technologies, and implies a preference for more generic innovations. As Chesbrough (1999) has pointed out, the reluctance of IBM to become dependent on particular suppliers of disk drive storage products, and its willingness to change them if others offered better technical specifications and/or lower prices, discouraged firms such as Seagate from investing substantial sums in technical research to meet IBM's needs. Clearly, there is little incentive for them to develop customer-specific innovations if customers are likely to switch suppliers abruptly.

Flexible team approaches, on the other hand, focus on producing quite novel innovations, which are often disruptive, in rapidly emerging technologies and industries. They combine complementary involvement in public science research networks with a willingness to change key skills and knowledge bases at short notice to deal with high levels of technical uncertainty. This implies a low level of commitment to current industry partners. Such uncertainty also means that investment in developing distinctly organizational capabilities over the medium to long term would be highly risky for these firms. Instead, they rely on specialist experts to work together in project teams to develop generic products for largely anonymous markets, often with relatively high-powered incentives, as in many project-based firms in Silicon Valley and elsewhere (Ferguson, 1999; Kenney and Florida, 2000).

As Angel (2000:128) suggests: 'The ease with which firms in Silicon Valley are able to assemble and reassemble teams of highly skilled engineers and technical workers, and the knowledge and experience they embody, are central to the technological dynamics and commercial success of the region.' Because the risk of project failure is high in such emerging industries, employees have little incentive to commit themselves to developing firm-specific skills, and both firms and staff have a common interest in developing and improving more generic skills that can be readily recognized and traded in fluid external labour markets.

This kind of approach has been facilitated by the growing importance of generic knowledge of general processes and phenomena that can be applied to a range of materials. Gambardella (1995), for example, sees the growing use of molecular biology and genetic engineering in pharmaceutical R&D as increasing the dependence of drug discovery on generic sources of knowledge that are quite codified and can be traded between firms. In these circumstances, research-focused firms are likely to be more closely involved in public research networks than innovative firms relying more on specific forms of knowledge, especially where the public science system is relatively organizationally fluid and technical labour markets are well established.

Although generic knowledge is often more codified and formalized than specific understandings of process technologies and applications, the skills that produce it are usually quite tacit, as the process of engineering human growth hormone illustrates (McKelvey, 1996). This means that the more firms rely on new generic knowledge of fundamental processes—i.e. unpublished and in process—the more they will either conduct such research themselves, or develop close alliances with research teams in the public science system. As innovations become more closely dependent on generic knowledge, then, firms can no longer rely on remote and formal access to the scientific and technological literature, but have to become more involved in acquiring and managing the relevant skills themselves.

The cumulative commitment approach, in contrast, combines extensive involvement in industry networks with the development of strong collective and organization-specific skills to produce technologically cumulative innovations. This emphasis on the rapid development of new products through integrated research, development, manufacturing and marketing activities at the expense of developing more generic specialist research skills, as in many large Japanese companies (Westney, 1993b), may well prevent firms from gaining close access to current research and skills in the public science system. This is because careers and other rewards in

such firms are more tied to long-term investment in firm-specific knowledge and organizational skills than to competence in producing generic knowledge and collaborating with university researchers. Firms adopting this approach apply formal scientific and technological knowledge that is already in the public domain to achieve product development goals, and rely on organizationally-specific knowledge and skills to bring new products to market faster than their competitors.

This concentration on competence coordination within the firm and group, often through quasi-lifetime employment for core staff, little or no mid-career recruitment, and systematic rotation of researchers and engineers through the major technologies and functions, and sometime affiliated companies, provides the basis for integrating development projects effectively, as in many large Japanese companies (Chesbrough, 1999; Kneller, 2003; Westney, 1993b). Together with their embeddedness in industry networks, it also encourages them to invest in customer-specific knowledge and enables them to develop technologies that meet their needs. These practices do, though, limit the development of highly specialized research skills and make it difficult to adopt radically new ideas and skills, as well as to change current technological paradigms that are entrenched in organizational routines, careers and cooperative agreements, in the short to medium term. It is important to note, however, that long-term strategic shifts can be implemented by such companies, as many Japanese firms demonstrated in the development of the optoelectronics industry (Miyazaki, 1995).

The more extensive highly collaborative approaches to innovative competence development adopted by absorptive hierarchies, on the other hand, combine technologically specific knowledge from the public science system with their own research and with knowledge from industry collaborations to develop new products and processes within current technological trajectories. They invest in the development of strong organizational competences and firm-specific skills to carry out this coordination, which typically restricts their ability to transform key skills quickly. Building on current competences and expertise to innovate incrementally, they have a deep organizational understanding of the dominant technology in the industry that is often remote from the intellectual approaches and concerns of more theoretically directed research in the public science system.

This involvement in both kinds of networks, together with substantial commitments to the core labour force, limits their capacity to transform their core competences radically, as well as sometimes creating

coordination difficulties within the enterprise. Membership of business groups, industry associations and networks of mutually interdependent suppliers and customers helps to share risks and knowledge, but it also locks firms into current trajectories and competences, and restricts the ease with which absorptive hierarchies are able to reshape radically their organizational capabilities around highly novel skills and ideas. Similarly, their dependence on organizational routines and collective competences to develop innovations with firm-specific skills based on long-term employer–employee commitments means that such innovations will be competence enhancing rather than destroying.

Innovative Competence Development in Different Institutional Frameworks

Firms are encouraged to adopt some of these alternative ways of developing innovations, and discouraged from pursuing other ones, by particular combinations of dominant institutions in different kinds of market economies. The critical features of institutional frameworks considered here are those encouraging 'voice' rather than 'exit' modes of behaviour (Nooteboom, 2000), especially information and risk sharing between firms in developing innovations, as well as those facilitating the generation and transfer of formal and tacit knowledge of generic processes between the public research system and private enterprises.

Since the general institutional arrangements structuring economic behaviour have been extensively discussed in previous chapters, I shall here focus on two major features that directly affect inter-organizational relationships and constraints on short-term opportunism: the strength of business associations and the organization of financial flows. Then the key relationships between the organization of scientists' training and careers, the flexibility and pluralism of the sciences, and the nature of state technology policies and firms' prevalent strategies for developing innovative competences will be outlined. The links between these features of institutional frameworks and the approaches that firms adopt in different market economies are summarized in Table 7.2 and will now be further discussed. Particular kinds of institutions are listed in this table to highlight relationships between institutional arrangements and patterns of innovative competence development.

Beginning with the general features of market economies that encourage firms to develop innovative competences in different ways, as

Table 7.2. Associations between institutional features and approaches to developing innovative competences

Institutional Framework	Approach to Developing Innovative Competences			
	Isolated Hierarchy	Flexible Teams	Cumulative Commitment	Highly Collaborative
Strength of business associations and involvement in strong public training systems	Negative	Negative	Positive	Positive
Insider-dominated financial system	Negative	Negative	Positive	Positive
Size of research training system and its integration with current research	Positive	Positive	Negative	Positive
Flexibility and pluralism of public science systems	Weakly positive	Positive	Unconnected	Positive
Dominance of professional researcher role model	Positive	Positive	Negative	Somewhat negative
Strong diffusion-oriented science and technology institutions	Negative	Negative	Positive	Positive

emphasized in earlier chapters powerful business associations can play important roles in constraining short-term opportunism as well as in diffusing new technologies, establishing technical standards and generally facilitating cooperation in particular kinds of 'industrial orders' (Herrigel, 1994; 1996). In some European economies where employers' associations are also directly involved in the public skill formation system, often in collaboration with unions and state agencies, companies cooperate with each other in defining, developing and assessing publicly certified expertise on a continuing basis.

Given the limits on individual wage bargaining and restrictions on poaching in many economies that have such strong business associations, mobility between employers tends to be lower than in more arm's length market economies, and skilled workers have strong incentives to invest in enhancing their firm-specific skills (Culpepper, 2001). Equally, employers have considerable incentives to integrate workers' skills and knowledge into product and process improvements since they are unable to change them easily and, in effect, much of the labour force in countries like Germany and Japan is a fixed cost in the medium term for large firms. Labour mobility of technical staff between employers does not appear to be nearly as great in these countries as in the UK and USA, not least because the risks of changing organization are higher and the rewards less obvious (Casper, 2000; Streeck, 1997).

Likewise, employers are often constrained in many of the more coordinated market economies from rapidly changing the nature of scientific and engineering skills through hiring and firing by legal rules, works councils pressure, strong unions and collective bargaining conventions (Soskice, 1997; 1999). This means that new technologies and capabilities are built more on existing ones, and the ability of companies to access and integrate radically novel knowledge that differs strongly from existing skills will be limited in such economies.

Conversely, more arm's length institutional regimes that have a relatively weak education and training system, in the sense that it does not provide most of the population with valuable qualification and skills, encourage the academically successful to invest in skills that are generic across firms and sectors. They also lead to considerable mobility between employers. As a result, skills are more individually owned and traded in these kinds of market economies. Depending on the particular structure of higher education and the organization of professional expertise, such skills can be rather remote from employers' collective views of what is needed, and so may be differently valued by different firms. Given the greater tendency to hire and fire in these kinds of economy, this further encourages skilled staff to invest in qualifications that are generic across a range of firms and industries, such as the MBA.

In broad terms, then, firms in economies with strong trade, industry and employers' associations will be deeply embedded in industry networks that facilitate collective standards setting, joint research activities and cooperation on a range of issues. Skills in such societies are as much organizational as individual. They are also difficult to change radically in the short to medium term, although continual incremental improvement will be the norm as both employers and employees seek growth opportunities through innovations in technologically and market-related activities. This contrast in institutional arrangements can be summarized as the strength of business associations and their involvement with strong public training systems. Where this is high, firms are more likely to find it easier to share information and risks in developing innovations than in economies where such associations are fragmented and weak. Accordingly, they are more likely to adopt highly collaborative and cumulative commitment approaches to innovative competence development than flexible team and isolated hierarchy ones.

The second major institutional feature that directly affects firms' preferences for adopting different ways of developing innovative competences

is the type of financial system. In general, insider-based financial systems in which major investors are locked-in to the fates of individual firms favour innovating firms that build long-term organizational competences with business partners and employees to develop new products and technologies within existing technological trajectories. Majority owners here develop detailed knowledge of each firm they control and their industry in order to evaluate risks and opportunities adequately to deal with their greater exposure. They are therefore able to judge innovation strategies and competences within established industries in a more informed way than are investors in outsider-dominated financial systems, who operate more at arm's length from individual companies. This means that they can evaluate and support incremental and long-term technological developments relatively effectively.

As Tylecote and Conesa (1999) suggest, such insider-dominated financial systems should, then, be more competitive in industries where innovations are jointly developed by employers, employees, suppliers and customers and appropriability risks are reduced by long-term alliances between key actors. Conversely, outsider-dominated ones find it easier to develop radically novel generic innovations that are competence destroying because they facilitate rapid restructuring of assets and skills, often through venture capital firms that provide high-risk capital for start-ups in industries where the returns to successful innovations are high and can be appropriated by the innovating firm and its shareholders (Kenney and Florida, 2000). They therefore are more associated with flexible team and isolated hierarchy approaches rather than highly collaborative and cumulative commitment ones.

Turning now to consider how differences in the organization and control of the public science system affect firms' approaches to developing innovative competences, a crucial feature concerns the amount and type of research training. Where this is integrated with research projects and is carried out on a large scale, as in the postwar US biomedical sciences, it reduces the costs of undertaking research and encourages the rapid diffusion of new research skills throughout the economy (Riccaboni *et al.*, 2003). As Feller (1999: 83) suggests:

> Students also are a means by which new scientific findings and technologically relevant knowledge are transferred from the campus to the firm. Indeed, as new technologically relevant research findings become more embedded in the tacit know-how of students regarding laboratory procedures and software, their importance as technology transfer agents is likely to increase.

The more that research training is integrated with the production of new knowledge, and is supported on a large scale, then, the more firms are likely to acquire novel research skills and be able to change their knowledge producing and using capabilities relatively quickly. Depending on the extent to which academically constituted identities are preferred by engineers and scientists to organizational ones, such integration may additionally encourage the development of strong specialist skills that inhibit the establishment of more organizational capabilities. Conversely, in economies where either research is not integrated with training and/or the public science base is limited in size and scope, firms will find it more difficult to change their innovative competences substantially—at least in the short to medium term.

This is especially so when the number of PhD students is lower than those undertaking masters' degrees, as in Japan for much of the postwar period (Coleman, 1999; Ogura and Kotake, 1999). Despite the expansion of graduate schools at many state universities in Japan since the 1960s, most of their students have left with MScs rather than PhDs. This is because firms rarely preferred to recruit PhDs, regarding them as being too specialized and remote from commercial concerns (Westney, 1993b). In fact, not only did PhDs not receive more pay than MScs in most firms, but often they were paid less because they had less seniority with the company (Sienko, 1997; Yamamoto, 1997). Together with the limited expansion of universities and other public sector research organizations in the 1970s and 1980s, this discouraging labour market for researchers in Japan has considerably restricted the output of knowledge producers, and so the availability of novel kinds of research skills for Japanese firms.

On the whole, then, integrating research and training through doctoral programmes that are well funded facilitates involvement in public science research networks, and the development of innovation strategies based on rapid access to new knowledge and skills. Flexible team and highly collaborative approaches are therefore encouraged by such arrangements. They also provide a substantial pool of skilled researchers that can be drawn upon by isolated hierarchies, even if these firms are not concerned to become closely dependent on new knowledge generated by the public science system.

The second major feature of public science systems concerns the ease and frequency with which research scientists and engineers in the public science system are able to develop new intellectual goals, fields, and approaches, such as software engineering and molecular biology (Whitley, 2003b). Where research objectives and strategies are varied and

changeable, as distinct from being tightly integrated around established disciplinary goals, frameworks and expertise, it should be easier to extend and apply new ideas and techniques for technological purposes, and to develop new areas of research with new skills. The boundaries between theory-driven scientific research and more instrumental knowledge production are more fluid, permeable and overlapping in such public science systems than in those where intellectual, skill and organizational boundaries are structured around separate disciplines.

In the more flexible research systems that have relatively low levels of organizational segmentation, firms find it easier to become involved in research networks that combine theory-driven research with more instrumental projects and organizations than they would in more stable, discipline-bound research systems. Such fluidity and adaptability of intellectual goals and skills in public science systems also generates a high level of change in ideas and expertise, which in turn enables firms to hire new kinds of skills relatively easily. Because labour markets in such systems are typically not highly separated around distinctive goals, performance standards and career paths, researchers move across employment organization boundaries fairly often, and can trade their specialist expertise between a variety of employers.

The intellectual and organizational flexibility of national research systems is additionally affected by the nature of the employment system in universities and allied organizations (Whitley, 2003b). Where individual heads of departments and research institutes exercise considerable control over resources and careers, the rate of change and variety of intellectual approaches and skills is likely to be less than in employment systems where there is greater pluralism of power and authority within administrative units.

The US, and to some extent UK, pattern of locating a number of research groups within relatively large university departments permits greater intellectual pluralism of projects than the German and Japanese pattern of individual research groups and institutes controlled by a single or couple of professors who combine scientific leadership with administrative responsibility (Clark, 1995). When this separation of intellectual production units from administrative ones is combined with extensive reliance on external funding of research projects, the power of institute heads to direct research programmes is greatly reduced and competition between groups within departments encouraged. Diversity of research goals and approaches is therefore greater in such employment systems than where control over research programmes is more centralized.

This flexibility and pluralism of national research systems affect the ease with which firms are able to develop innovation strategies based on rapid access to new knowledge and skills produced by public science systems. *Ceteris paribus*, flexible team and highly collaborative approaches to innovative competence development are more readily adopted when the organization of intellectual goals, identities, and boundaries is flexible rather than when it is structured around distinct, separate theoretical objectives that segment labour markets and administrative units. Firms that are not so concerned with integrating new generic knowledge and research skills into their development programmes are less affected by this factor, although flexible and pluralist research systems may well generate new skills that isolated hierarchies will find useful when seeking to change their competences.

A further feature of public science systems that affects the ways firms develop innovative competences concerns the extent to which professional researcher roles and identities are institutionalized. These cosmopolitan role models focus on the development of highly specialized skills that are generic across employers, and limit researchers' commitment to organizational goals. Where these models are strongly established, typically in societies with fluid external labour markets, firms find it more difficult to develop collective innovative competences on a long-term basis than in societies with stronger organizational than professional identities, such as Japan (Westney, 1993b). They are associated with the establishment of a professional labour market that enables firms to access new specialist skills and techniques, and so to develop new innovative competences and access the public science system quickly. Flexible team and isolated hierarchy approaches, then, are more likely to be adopted in societies dominated by the professional scientist model than are highly collaborative and cumulative commitment ones.

One example of a research system that combines this role model with considerable organizational flexibility is biomedical research in the late twentieth-century USA. Here, the fluidity and pluralism of employment units and funding arrangements are reinforced by the provision of considerable research resources by the state and other organizations, as well as by the NIH laboratories that provide alternative sources of employment and elite hierarchies to the leading research universities. As a result, constraints on intellectual novelty are relatively low in US biomedical fields, but the high rate of competition for scientific reputations—enhanced by substantial state delegation of control to practising scientists and by the high number of qualified researchers produced by the graduate schools

(Feller, 1999)—ensures considerable coordination of research results and a willingness to take intellectual risks.

Where the knowledge produced by this kind of research system is directly relevant to R&D activities in firms, as in biotechnology, this combination of novelty and competition in the public sciences generates a continuous stream of potentially useful research results that innovative companies have to keep up with, and hence need to be involved with research networks. They also have to be flexible and able to adapt to changes in the public knowledge base, typically by changing their skill mix and reorganizing R&D projects, as new knowledge becomes available (Casper and Kettler, 2001).

Flexible team approaches adopted by project-based firms are particularly well suited to such an environment. Indeed they are themselves more likely to develop in countries with these kinds of public science systems since the combination of intense competition for funds and reputations in pluralist intellectual and employment environments generates intellectual entrepreneurs who rapidly incorporate new results and ideas in pursuing their distinctive research agendas. Such entrepreneurs are skilled at recognizing intellectual opportunities, and combining different expertises and knowledges in the pursuit of potentially highly rewarding research goals.

National research systems that encourage intellectual competition without strong disciplinary ties and boundaries are, then, favourable to the adoption of flexible team approaches to developing innovative competences, especially when combined with fluid labour markets (Casper and Murray, 2005). Equally, those that are less competitive, and/or more constrained in the degree of intellectual change and novelty they encourage, develop different kinds of research skills and attitudes that are less flexible and adaptable. Strong disciplinary control, for example, encourages theoretical integration and highly coordinated research programmes, but inhibits interdisciplinary cooperation in project teams. Scientists trained in national research systems dominated by such control are unlikely, then, to find it as easy to work with colleagues from other fields as their counterparts trained in more fluid intellectual and organizational environments.

However, strong disciplinary control enhanced by hierarchical determination of research programmes and approaches within departments and institutes can be combined with elaborate applied research facilities and technology transfer arrangements in countries with 'diffusion-oriented' state science and technology policies, such as Germany (Abramson *et al.*,

1997). The highly collaborative approaches adopted by absorptive hierarchies here link firms to the more applied or instrumental research networks quite easily, but connections to the more generic and theoretically focused academic system are often more remote. Depending on the degree of segmentation of organizations and labour markets, this sort of system can be quite effective at rapidly diffusing new knowledge and technologies within established industrial boundaries. It is, though, less effective at coordinating the flow of knowledge and skills across such boundaries, and linking academic research goals with product development opportunities.

This highlights the importance of different state science and technology policies in the development of distinctive innovative competences. Although the contrast between 'diffusion' and 'mission' oriented state science and technology policies and practices is too simple to describe the variety of institutional arrangements and goals that states have established in the late twentieth century to manage public research, it does highlight important differences between them (Doremus *et al.*, 1998; Ergas, 1987). As emphasized in Chapter 3, a key feature of the diffusion oriented policy style is the strong collaboration between firms, business associations, state agencies and both public and private research organizations in developing and diffusing new technological knowledge. By underwriting much of the costs associated with technological research, and involving industry associations in its management, states here encourage firm involvement in the public science system.

Such involvement, however, is usually limited to work on technologies and materials that are connected to current problems and trajectories rather than with more generic research that could lead to quite different technologies. Because the primary goal here is to enhance and improve current industrial competences, diffusion oriented policies are unlikely to encourage close links with researchers engaged on more remote topics intended to produce general explanations of phenomena, especially in academic systems that are strongly structured around discrete disciplines. Since such policies are typically implemented with the help of industry associations and inter-firm alliances, they additionally reinforce firms' embeddedness in industry networks.

On the other hand, they limit the rate of change of technological competences and skills by focusing on the continual improvement of current capabilities within existing technological paradigms. Acquiring radically novel skills and knowledge to develop new products and processes in newly emerging technologies will be difficult for most firms in states pursuing such policies because they are locked into cooperative relationships

with suppliers, customers, and core employees based upon the incremental upgrading of current ones. Strong 'diffusion-oriented' state science and technology policies, then, are linked to the adoption of highly collaborative and cumulative commitment approaches, as in Germany and Japan, rather than of flexible team and isolated hierarchy ones.

More 'mission-oriented' science and technology policies, conversely, encourage greater technological diversity across sectors as states invest in particular developments for public policy goals. When combined with high levels of intellectual competition, such policies increase the fluidity of research goals and skills as scientists adapt their projects to state priorities within the overall peer review system. If research additionally involves training, mission oriented policies generate large numbers of highly skilled researchers in the favoured fields who can be recruited by firms investing in developing new competences based on such knowledge.

Conclusions: Institutional Complementarities and Patterns of Technological Development

This analysis suggests how different features of institutional frameworks encourage firms to adopt distinctive approaches to developing innovative competences. As discussed in Chapters 2 and 3, some of these features are themselves interrelated to constitute distinctive institutional regimes that help to explain how particular kinds of market economies are associated with contrasting patterns of technical change and sectoral specialization.

For example, many, if not most, market economies dominated by arm's length institutional regimes establish quite strong professional researcher role models and labour markets. Together with liquid capital markets and fluid markets for corporate control, the lack of strong business and employers' associations in such economies discourages firms from sharing risks and knowledge with suppliers and customers, and from developing long-term commitments with technical employees. As a consequence, there is little incentive for engineers and scientists to invest in firm-specific skills, but considerable encouragement for them to improve specialist skills that are generic across organizations. Since such societies are often characterized by strong professional identities and conceptions of high-level expertise based on generic knowledge that are credentialed and controlled by professional associations independent of the state, the professional researcher model usually dominates that of the organizational researcher here.

Additionally, diffusion-oriented state science and technology policies and institutions are often associated with strong industrial associations as the state typically involves them in diffusing technological knowledge, developing research programmes and establishing standards. Mission-oriented policies and agencies, on the other hand, can encourage flexibility in public science systems when combined with decentralization of resource allocation decisions through a peer review system, but need not always do so, as the case of France indicates. These sorts of science and technology policies are, then, quite consonant with different types of financial systems and labour market institutions, as the comparison of Britain, France, and the USA demonstrates.

The implications of these interconnections can be summarized by considering three particular combinations of institutional arrangements that lead to firms adopting contrasting ways of developing innovative competences: arm's length with strong mission-oriented science and technology policies, coordinated knowledge production and coordinated knowledge acquisition institutional frameworks. These highlight many of the key features of the postwar market economies of the USA, Germany and Japan. The first combines weak forms of market organization, outsider-dominated financial systems, and strong professional researcher role models with relatively flexible public science systems, and large-scale publicly supported research programmes. These features of the institutional environment encourage firms to adopt the following forms of competence development.

First, in fields where the state has provided considerable support and/or risk sharing for knowledge production that is critical for innovation development they will become quite highly involved in public research networks. Second, by generating large numbers of highly skilled engineers and scientists who seek to update and improve their expertise, such societies encourage firms to rely on the specialized expertise of individuals who can be acquired through fluid labour markets to change their competences rapidly. Such radical shifts in organizational capabilities are also assisted through the active market in corporate control in these kinds of economies. Finally, these institutional features discourage extensive and long-term involvement in industry networks and hence limit investment in customer-specific knowledge and innovations.

In sectors where appropriability and modularity are high, they therefore encourage project-based firms to adopt flexible team approaches in developing major innovations with generic, codified knowledge from a variety of fields and novel skills. In other sectors where these conditions are

not present and the state does not fund large-scale research programmes, however, this combination of institutional features encourages different kinds of approaches for developing innovative competences, particularly those associated with isolated hierarchies. Focused on developing new products and processes in house, but with limited investment in firm-specific skills, firms in these industries recruit staff with generic skills that can be integrated through authority hierarchies to achieve development goals. Both labour market institutions and the educational system encourage individuals to identify more with their specialist expertise than with particular employers in such economies, so that firms can readily acquire new skills and knowledge through the labour market. This does, however, make coordination across skill areas and functions more difficult, and can slow down the development of new products.

In contrast, societies dominated by coordinated knowledge production institutions combine strong business associations and diffusion-oriented state science and technology policies with large, integrated research training systems and substantial segmented public science systems. In these environments, firms are also likely to become involved in public research networks, albeit more technologically focused ones than in the previous case. They also will tend to be supportive of specialist researchers developing generic skills and researching topics not directly tied to current development projects. Such absorptive hierarchies integrate knowledge and skills from the applied sciences and industry networks to improve products and processes largely within current technological trajectories, but with the capability to absorb new kinds of knowledge and technologies in the longer term.

Finally, coordinated market economies with strong business associations can be combined with diffusion-oriented policies but weak research training and relatively low mobility between public science and industry, as is arguably the case in postwar Japan. Firms here have used the public research system more to find information to solve specific problems than to develop more generic knowledge that could be used for a range of new products and technologies. Social identities and loyalties are not so tied to specialist scientific expertise as they are where the role model of the academic researcher is well established and prestigious, and so graduates will be more amenable to developing careers and skills within organizations in these kinds of societies.

Together with strong diffusion-oriented science and technology policies, these features encourage firms to focus on developing new products and processes with general, firm-specific skills that facilitate

organizational integration, rather than relying on more specialist research skills that could coordinate public knowledge production with corporate purposes. Typically sharing risks and knowledge with suppliers and customers, these kinds of firms are embedded in industry networks that encourage alliances and partnerships. Strong industry associations and insider-dominated financial systems support such long-term commitments and facilitate the speedy development of new products with a flexible, stable workforce.

These interconnections suggest that, while public science systems can and do vary considerably in some respects between market economies, their general organizational pattern, and consequent effects on the development of innovative competences, reflect broader institutional frameworks and priorities. In Japan, for instance, the long-standing concern with economic and technological catching up with Western Europe and the USA led to the development of a predominantly diffusion-oriented science and technology system (Ergas, 1987; Morris-Suzuki, 1994; Odagiri and Goto, 1996), and an educational system that focused on developing knowledge acquisition skills as much as advanced knowledge production. It is, then, the combination of general institutional arrangements governing capital and labour markets with particular features of public science systems that encourage firms to develop innovative competences in different ways, and so follow distinctive innovation strategies.

In sum, firms have a number of choices in developing innovative competences and selecting innovation strategies that are guided by dominant institutions. These institutions include those governing the development of skills and labour markets, capital markets and inter-firm relationships as well as the organization and conduct of research in the public sciences. As a result, societies with distinctive institutional frameworks encourage the development of particular kinds of innovative capabilities, and so manifest contrasting types of technological development and sectoral specialization, as the examples of late twentieth century Germany, Japan, and the USA illustrate. These interconnections will now be further explored by considering how entrepreneurial technology companies in two different kinds of industries develop competences and manage risks in contrasting kinds of institutional environments in three European countries.

8

Constructing Capabilities in Entrepreneurial Technology Firms: A Comparative Institutional Analysis of Germany, Sweden, and the UK

with Steven Casper

Introduction

In explaining how institutional frameworks generate distinctive innovative strategies that are effective in different kinds of industries, it is important to understand the varied nature of technological and market risks in different subsectors, especially in emerging industries. Because key kinds of risks, such as appropriability and competence destruction, differ between subsectors of new industries, we would expect entrepreneurial technology companies in these subsectors to develop different types of capabilities. Their ability to do so is strongly affected by the nature of the dominant institutions governing economic activities, and so the relative success of entrepreneurial technology firms in different kinds of subsectors can be expected to vary between countries dominated by contrasting institutional frameworks.

In this chapter we explore these processes through a comparison of how the institutional frameworks of Germany, Sweden and the United Kingdom have affected strategies for dealing with two major kinds of organizational problems that firms have to manage in developing new technologies in different subsectors of the biotechnology and software industries. In particular, we focus on the role of different kinds of skill formation systems and labour market institutions in encouraging the

9

Project-Based Firms: New Organizational Form or Variations on a Theme?

Introduction

The important role of project-based modes of organizing and controlling work in new industries, such as the biotechnology and software sectors considered in the previous chapter, together with their increasing use in more established sectors, have been seen by some as heralding the development of a new 'logic of organizing' in market economies (Powell, 1996: 1; see also, DeFillippi and Arthur, 1998; Eckstedt *et al.*, 1999). According to Powell (2001), this involves the flattening of organizational hierarchies, the weakening of firms' boundaries in favour of networks of collaborations, and the restructuring of competition between firms within and across industries. Both the nature of the firm as a hierarchically controlled system of work organization combining legal personality, centralized authority, investor ownership and transferability of shares (Kraakman, 2001), and the arm's length, adversarial nature of inter-firm relations in markets, are, in this view, becoming transformed into more fluid, overlapping organizational arrangements in which both internal and external boundaries are breaking down and cooperation between firms is growing (Jones *et al.*, 1997).

Additionally, entire companies are becoming structured around distinct projects in which people with different skills are brought together to develop innovative products and services within fixed periods of time, and business functions become embodied in project teams (Prencipe and Tell, 2001; Sydow *et al.*, 2004). As Hobday emphasizes (2000: 874–5), in such project-based organizations (PBOs), 'the knowledge, capabilities, and

resources of the firm are built up through the execution of major projects'. These kinds of organizations differ from other ways of organizing highly skilled workers in their focus on: (a) creating novel outputs by, (b) integrating varied forms of expertise in, (c) fixed time periods.

A similar contrast is expressed by Mintzberg in his comparison of the 'Adhocratic' organizational form, which is similar to the PBO in its emphasis on novelty, with the professional bureaucratic one. As he suggests (1983: 255–6): 'the Adhocracy must treat existing knowledge and skills merely as bases on which to build new ones. Moreover, the building of new knowledge and skills requires the combination of different bodies of existing ones... Thus, whereas each professional of the Professional Bureaucracy can operate on his own, in the Adhocracy the professionals must amalgamate their efforts... in multidisciplinary teams, each formed around a specific project of innovation.' Task coordination here requires much more face-to-face mutual adjustment than in professional bureaucracies, which rely predominantly on standardized skills for doing so.

In addition to the growing use of projects as coordinating mechanisms, project-based firms (PBFs) in which the company as a legal and financial entity becomes project specific seem to be spreading from the feature film and other entertainment industries to new media and similarly highly dynamic sectors such as computer software development (Grabher, 2002c; DeFillippi and Arthur, 1998; Sydow *et al.*, 2004). Vermeer Technologies, for example, was specifically established as a separate firm to develop a software package for Internet websites that became FrontPage, and was subsequently sold to Microsoft with most of its technologists (Ferguson, 1999). The legal entity controlling property rights was here principally a means of mobilizing a project team to create a new product in a highly competitive and risky environment.

Not only, then, are project-based methods of organizing work in general becoming more noticeable in a range of industries, especially perhaps in the USA (Christopherson, 2002a), but temporary and limited purpose project-based firms (PBFs) seem to be critical agents in the development of new industries, particularly those producing highly innovative products and services. Furthermore, as technologies and markets develop, such PBFs often remain significant actors rather than being replaced by larger, more stable, oligopolistic enterprises. Relatively small, entrepreneurial firms continue to play important roles in the biotechnology industry, for example, instead of being swallowed up by the established pharmaceutical companies, especially in its highly risky therapeutic subsectors (Casper, 2000; McKelvey *et al.*, 2004; Powell *et al.*, 1996).

In their combination of rapid entry and exit, high flexibility and focus on developing major innovations involving discontinuous learning, these kinds of PBFs are distinct from many other kinds of project-based organizations that undertake a number of projects with more cumulative learning and greater continuity of employment, as in the Munich software industry (Grabher, 2004b; Ibert, 2004). Insofar as they play a leading and continuing role in the development of a number of industries, they raise questions about the nature of firms as learning organizations specializing in the creation and transfer of knowledge, especially how firm-specific problem-solving capabilities can be developed if skilled staff have only very short-term and temporary commitments to particular companies (Grabher, 2002a; Kogut and Zander, 1993; 1996; Teece *et al.*, 1994; 2000). As DeFillippi and Arthur (1998: 125) put it: 'How can project-based enterprises create competitive advantage when its knowledge-based resources are embodied in highly mobile project participants?'

If organizational learning is indeed key to the development of innovations and effective dynamic capabilities, and 'the firm creates its distinctive signature by coordinating the internal division of labour and... by transforming the knowledge and skills of the individual members into a collective unitary capability' (Metcalfe and James, 2000: 42–3), in what sense can single-project firms be considered viable enterprises? They may constitute distinct legal and financial entities yet fail to develop organizational capabilities that are firm specific. Insofar as major new industries, and some more established ones in the Italian industrial districts and Denmark, are dominated by such project-based enterprises, how and where does learning take place, and how is it incorporated into new routines and procedures (Andersen and Christensen, 1999; Gann and Salter, 2000; 2003; Hobday, 2000; Kristensen, 2006; Prencipe and Tell, 2001)?

In attempting to deal with these sorts of questions, it is important to distinguish between the considerable varieties of different kinds of PBFs. While they all: (a) organize work around relatively discrete projects that, (b) bring particular groups of skilled staff together to work on, (c) complex, innovative tasks for, (d) a variety of clients and purposes, they vary in the number and variety of projects they undertake, the customization and market uncertainty of their outputs, and the technical uncertainty involved in achieving their purposes (Grabher, 2002a; 2004b; Jones *et al.*, 1997). These kinds of differences are related to appropriability regimes and patterns of technological cumulativeness (Malerba and Orsenigo, 1993; Breschi and Malerba, 1997), as well as affecting the ease of gaining investor and worker commitment in contrasting institutional

environments. In turn, differences between sectors and institutions help to explain variations in the prevalence of different kinds of PBFs in different industries, regions, and countries.

As a preliminary contribution to understanding how and why different kinds of PBFs seem likely to play a leading role in the development of particular industries in particular institutional contexts, this chapter outlines a way of distinguishing them as distinctive kinds of economic actors that can be expected to vary in their significance between societal environments. I separate PBFs from the more general project coordination and control of work by emphasizing their roles as economic actors with distinct legal and financial powers and responsibilities. Project-based firms are here understood as legally constituted collective actors that control property rights and exercise formal authority over task organization and performance through employment contracts. Some, but not all, types of PBFs are able to develop firm-specific capabilities and knowledge through the management of a succession of projects and employment of skilled staff.

In contrast, more general project forms of work organization are particular ways of coordinating tasks and skills that can be established both within individual firms and between them in various inter-firm networks and consortia (Jones *et al.*, 1997; Powell *et al.*, 1996; 2002). Thus, large firms may organize some of their activities around projects without thereby becoming PBFs, and people from different companies may work together on specific projects without becoming employees of a distinct and separate firm, although in practice it is not always straightforward to draw this distinction sharply, especially where activities are being outsourced and employees are 'lent' to sub-contractors (Grimshaw and Miozzo, 2006; Miozzo and Grimshaw, 2006).

To distinguish between kinds of PBF that are more or less likely to become significant in different industries and societies, I first outline two summary dimensions and identify the key characteristics of four ideal types. Next, I suggest how these different types can be expected to become prevalent in sectors with particular characteristics, notably the strength of appropriability conditions, the modularity of outputs and visibility of processes, the extent of client involvement in project development, and the degree of technological cumulativeness. I then consider the institutional conditions that seem likely to encourage the establishment of these different kinds of PBFs though their facilitation of investor and employee commitment. This analysis implies that highly flexible enterprises developing radical innovations are only likely to become dominant kinds of

firms in a limited number of industries in particular institutional regimes. Insofar as they do represent the key economic actor in Silicon Valley (Bahrami and Evans, 1995) and similar innovative regions, this suggests that such socio-economic systems of innovation are not likely to become widely established.

Characteristics and Types of Project-Based Firms

Project-based firms vary considerably in the kinds of products and services they produce, the level of market and technical uncertainty they have to deal with, and their organizational complexity. Project outcomes, for example, can differ in terms of their customization, ambiguity of specification and extent to which clients co-produce them. They are also more or less discrete, tradable, predictable, competence destructive and technologically continuous (Breschi and Malerba, 1997; Tushman and Anderson, 1986). Such variations have significant implications for the management of PBFs and their ability to generate distinctive collective capabilities and knowledge, as discussed in the previous chapter. Additionally, the variety, interdependence and stability of knowledge and skills differ considerably between PBFs, as does the uncertainty of their work environments. These kinds of variations affect the complexity of project organization and coordination costs. In considering which characteristics of PBFs are likely to lead to particular kinds of them being significant economic actors in different industries and environments, two underlying dimensions dealing with learning and the development of firm-specific knowledge seem especially important.

These concern: (a) the extent to which firms focus on developing unusual, sometimes one-off, products and services for varied, and often uncertain, markets, and b) the extent to which the organization of expertise, tasks and roles is predictable and stable over projects. The first differentiating dimension of PBFs can be termed the singularity of their goals and outputs because it contrasts those producing a single or small number of quite different kinds of results for different customers or markets from those conducting a series of related projects producing similar kinds of outcomes. The more singular are outputs, the more likely that organizations will have to deal with exceptions to their routines and adjust to variations in materials and the work environment.

Highly singular PBFs carry out a limited number, sometimes only one, of quite different projects with varied participants and outputs. The novel,

atypical and substantially inimitable nature of their products and services means that the development of market and technological knowledge is unlikely to be cumulative within the firm, although it might be at the individual level of analysis (Malerba and Orsenigo, 1993). In much feature film production, for instance, especially since the decline of the studio system in the USA (Christopherson, 2002b; DeFillippi and Arthur, 1998; Zuckerman, 2004), and many complex construction projects, a considerable number of technically qualified experts are contracted to work together on producing one or a small number of particular kinds of products, whose specification may be open to interpretation and change over the course of the project. The 'firm' coordinating such projects and employing these staff is often just a legal vehicle, or 'administrative convenience' (DeFillippi and Arthur, 1998: 137), for paying wages, acquiring other resources and owning property rights over the final product. Once the film or building is completed, such firms cease to exist, except perhaps as a paper entity with one or two principals controlling property rights (Davenport, 2005; Davenport and Czaban, 2005).

In contrast, what Grabher (2002a, 2004a) terms 'agency' businesses, such as those in the London advertising industry, undertake a series of similar projects, many continuing at the same time, with a core group of employees who work together over a period of time and develop collective routines for managing such activities. Although many staff are often quite mobile, changing employers, for instance, on average every two or so years in the London advertising labour market (Grabher, 2002b), they are more stable organizational members than freelancers, and the firms develop distinctive capabilities and reputations as a result of their collective learning. These kinds of PBFs, then, organize work around recurrent projects, and often rely on outsiders for completing individual tasks, but retain a core group of employees for initiating, organizing and conducting separate projects. Knowledge development is here more likely to be cumulative at the firm level than in highly singular PBFs.

The singularity of outputs is an important differentiating characteristic of PBFs because it distinguishes firms that are little more than a set of contracts, or 'hollow' companies in the terminology of Teece *et al.* (1994: 20), from those that are able to develop economies of recombination and repetition through learning from a series of relatively short-term and similar kinds of projects (Davies and Brady, 2000; Grabher, 2002c). Highly singular PBFs often contract specialists to work together as a team to achieve a specific objective, and neither party has any expectation of

continued employment or cooperation after the successful completion of that goal (see, e.g., Almeida and Kogut, 1999; Angel, 2000; Eckstedt *et al.*, 1999: 210–16). While such flexibility enables companies to change direction rapidly as knowledge and markets alter, it limits the development of shared identities and firm-specific capabilities through collective learning (Kogut and Zander, 1996). Commitments and identities in these kinds of industries are as likely to be focused on professional communities and project teams as on such flexible firms, and so their ability to develop firm-specific knowledge over a succession of projects will be limited (Bresnen *et al.*, 2004; Prencipe and Tell, 2001).

Less singular PBFs, on the other hand, employ skilled staff to work in a number of teams on a succession of similar kinds of outputs. Although their labour turnover may be considerable, where projects are similar in the type of problems they generate, and perhaps in the sorts of customers they serve, teams and employers are more able to learn across projects and to develop distinctive routines that could form the basis of firm-specific capabilities. In Perrow's (1967) terminology, they have to deal with fewer exceptions and are able to use more standardized techniques to deal with problems. In principle, then, the less varied are project customers, goals and problems, the more PBFs may be able to generate distinctive, organization-specific competences, as in the case of some 'systems integrators' such as W. S. Atkins (Davies, 2003).

The second differentiating feature of PBFs considered here concerns the distinctiveness and stability of work roles, professional identities and skills within project teams and over the course of several projects, and so the continuity of patterns of work coordination and control across projects. In some craft-dominated sectors, such as the feature film industry (Christopherson, 2002a; 2002b; Davenport, 2005), roles and skills are clearly separated throughout projects, and skill-based identities remain stable over a succession of projects, if not indeed entire working lifetimes. This enables project teams to be quickly assembled and to work effectively together at short notice (Jones, C, 1996). Detailed coordination of tasks can be delegated to teams of specialists without needing to establish an elaborate control system with formal, organization-specific procedures governing work activities as long as task uncertainty and complexity remain limited. Learning in these kinds of PBFs tends to occur within established skills and roles rather than between them, and innovations, or 'freshness' (Grabher, 2004b), are often developed more through changing team members than through developing new ways of working together and combining expertise in novel groupings.

In other kinds of PBFs, such as those in the Munich enterprise software industry (Grabher, 2004b; Ibert, 2004), workers adopt different roles over the course of projects and in different project teams, and the division of labour is not so strongly structured around previously codified skills. The mutability of task organization and expertise means that staff are often required to adapt their roles and knowledge to changing circumstances, and so a capacity for developing new competences together becomes as, if not more, important as formally certified skills. Learning and new knowledge development are here more team and organization specific than individual, with greater emphasis on cumulative improvements in collective capabilities than on individual skill enhancement. Coordination of tasks and skills is more complex in these kinds of PBFs, but their greater organizational flexibility enables them to change work processes more readily. This distinguishing feature of PBFs can be termed the degree of role separation and stability because it concerns the flexibility and distinctiveness of their system of work organization and control.

This characteristic differentiates PBFs that organize task and skills in novel, fluid and firm-specific ways from those that rely more on pre-established competences, identities and routines for working together. The former types are more likely to develop distinctive kinds of organizational capabilities and learning through establishing and changing patterns of work organization and division of tasks and skills that are specific to each company. In contrast, the latter kinds of PBF tend not to invest significant organizational resources in managing teams and developing novel forms of the division of labour. Learning here tends to be more specific to each individual and role than collective and organizational.

In principle, these two dimensions are orthogonal in that projects with varying degrees of singularity can be accomplished with different degrees of role separation and stability, as comparisons of the Munich enterprise software and London advertising industries indicate (e.g. Grabher, 2004a; 2004b). Highly singular PBFs can operate with contrasting levels of organizational flexibility, as in many feature film and internet software companies such as Vermeer Technologies (Ferguson, 1999), and multiple project enterprises can exhibit different rates of change of key expertise and organizational structures (Christopherson, 2002b). This means that we can distinguish four ideal types of PBFs that have contrasting levels of commitment between investors, managers and employees, and varying organizational complexity and fluidity. These are summarized in Table 9.1 and will now be discussed further.

Table 9.1. Types of project-based firms

Separation and Stability of Work Roles	Singularity of Goals and Outputs: Low	Singularity of Goals and Outputs: High
Low	*Organizational* PBFs producing multiple and varied outputs with different and changeable skills and roles. e.g. strategic consultancy, enterprise software, innovative business services.	*Precarious* PBFs producing risky, unusual outputs with varied and changeable skills and roles. e.g. some dedicated biotechnology firms, internet software firms such as Vermeer Technologies, many Silicon Valley companies.
High	*Craft* PBFs producing multiple, incrementally related outputs with distinct and stable roles and skills. e.g. some business and professional services including London advertising firms, Danish furniture and machinery firms, some IT consulting.	*Hollow* PBFs producing single outputs and coordinating tasks through standardized, separate and stable roles and skills. e.g. complex construction projects, many feature films in the UK and USA.

The first, which could perhaps be labelled the hollow (Teece *et al.*, 1994: 20) or contractual PBF, combines a focus on one or a small number of different kinds of projects with a reliance on relatively distinct and stable skills and work roles. The types of knowledge and expertise required are here fairly predictable and can be decided in advance, as can when they will be needed. While goals and performance standards may be subject to change as projects develop, authority to decide their nature and resolve disputes can be allocated beforehand and procedures established to manage on-site contingencies. Coordination occurs through generic and standardized skills that define roles in a relatively stable division of labour, sometimes reinforced by union agreements, as well as through temporary authority hierarchies and contracts. Many companies established to make feature films in the UK and USA and undertake complex construction projects resemble these kinds of PBFs (Christopherson, 2002b; Davenport and Czaban, 2005).

Second, there are multiple project firms carrying out a number of similar projects with relatively stable and codified skills that structure the definition and allocation of tasks. Such craft PBFs resemble the artisanal small companies found in industrial districts (Crouch *et al.*, 2001), but also provide some business and professional services where teams of diversely skilled staff are constructed to generate innovative solutions for complex problems. Such innovation, though, is typically incremental and client

specific. It does not usually result in major modification of occupational skills or the division of labour in project teams, it is competence enhancing or extending rather than destructive. Expertise and roles in these kinds of PBFs remain, then, quite stable over a series of projects.

Employees in craft PBFs owe their primary loyalty to their craft and occupational identity rather than to their current employer, as illustrated by Kristensen's (1996; 2006) account of Danish 'project coordinator' firms. Employment commitments are correspondingly limited, with many employees leaving to establish their own firms, and boundaries between owners, managers and workers being fluid. Firms are here built around the skilled workforce rather than being separate, autonomous managerially dominated organizations with distinctive administrative routines and capabilities (Karnoe, 1999).

The major difference between these kinds of PBFs and the third type to be considered here lies in the latter's greater fluidity and variability of knowledge, skills and the division of labour. In these organizational PBFs, expertise, work roles and coordination mechanisms are much more changeable, both within and across projects. Coordination costs are correspondingly greater since skills are only weakly standardized and do not structure work routines to a great extent. This means that cross-project learning has to be more formally organized than in craft PBFs, as is emphasized by Grabher (2000a; 2004b) in his contrast of the Munich enterprise software industry with the London advertising industry. Many business services, such as strategic consultancy, seem to be performed by these kinds of PBFs, although some consulting companies do use more distinct and stable skills sets and systems of work roles, as in certain information technology fields (Creplet *et al.*, 2001; Werr, 2002).

Such PBFs often develop systematic procedures for managing workflows, allocating skills and monitoring progress. They also sometimes establish formal systems for codifying and storing project team 'knowledge' and training staff in the firm's collective expertise. Despite quite high levels of turnover, as in many management consultancies, such procedures and the development of a core group of employees who make their careers within these PBFs enable them to generate distinctive organization specific capabilities and cumulative knowledge development. They become the basis for the firm's reputation and competitive advantages.

Finally, firms contracting skilled staff to work on highly uncertain and singular projects can be characterized as precarious PBFs. Here, the inherent difficulty in gaining investor and employee commitment to temporary organizations producing unique outputs is exacerbated by the

high risk of failure and difficulty of knowing which knowledge and skills will be needed as the project proceeds. The combination of singular goals and short-term commitments with complex and dynamic coordination needs makes such PBFs unstable and unlikely to become the dominant kind of economic actor in many industries, except in certain 'project ecologies' such as that surrounding many firms in Silicon Valley (Bahrami and Evans, 1995; cf. Grabher, 2002b; 2004b).

Coordination of workflows and knowledge in these kinds of PBFs is usually achieved through project teams in which roles and skills are highly fluid and changeable, as at Vermeer Technologies (Ferguson, 1999). Organizational procedures tend to be informal and project specific, as project failure is common and the firm cannot afford to establish more stable ones. The division of labour and expertise can become quite volatile in precarious PBFs as the organization is (re-) built around each major project and commitment is focused on accomplishing project objectives rather than being restricted to carrying out technically complex but recurrent tasks. Clearly, such commitment is difficult to develop, both for business partners and highly trained and skilled staff, and often depends on equity stakes and similar high-powered incentives, as in the case of Vermeer Technologies and many Silicon Valley firms (Bahrami and Evans, 1995; Ferguson, 1999).

Risk, Commitment, and Institutional Frameworks in the Development of Project-Based Firms

The economic significance of these four ideal types of PBFs can be expected to vary considerably between different kinds of industries and market economies. This is principally because of variations in: (a) the extent and kinds of risks involved in undertaking different kinds of projects in contrasting industries and, (b) the kinds of institutions governing the commitment of capital and labour power. I suggest that these differences are likely to encourage particular kinds of PBFs to become prevalent in particular kinds of sectors and societies, and discourage other types. For example, the widespread development, and continued significance, of precarious PBFs in new industries in particular geographical areas depends on the combination of specific circumstances that are difficult to replicate elsewhere, despite numerous attempts to encourage the growth of new Silicon Valleys in quite different contexts (Bahrami and Evans, 1995; Casper *et al.*, 1999; Casper, 2000).

In this section, I outline the major factors that are likely to affect the prevalence and continued significance of PBFs with varied singularity of goals and outputs and stability of roles. Particularly important are: (a) the nature of project outputs and processes, including appropriability conditions, client involvement and levels of market and technical uncertainty (Malerba and Orsenigo, 1993; Jones *et al.*, 1997) and (b) the nature of institutions governing capital and labour markets (Hollingsworth and Boyer, 1997; Whitley, 1999). I first consider the conditions in which PBFs producing highly singular outputs are likely to become significant economic actors in an industry, and then those affecting role separation and stability, before suggesting how these factors can be expected to influence the kinds of PBF that become prevalent.

A key concern for PBFs producing highly singular outputs is to gain commitments from investors and skilled staff to time delimited organizations whose products and services are difficult to value. This is especially difficult when: (a) both market and technical uncertainty are high and the risks of project failure considerable, as in many emerging industries, and (b) when project outcomes are intangible and hard to trade, as in many business services. Ease of exercising property rights and ability to assess their value are key characteristics of project outputs that affect commitment and organizational form in such fields as software, therapeutic drugs, strategic consultancy, public relations, and investment advice, as discussed in the previous chapter (see, also, Clark and Fincham, 2002; Grabher, 2002a; Kipping and Engwall, 2002).

Very broadly, the more project outputs are discrete and identifiable as separate entities, and the more straightforward it is to realize their value through trading property rights over them, the easier it should be to gain support for PBFs producing singular products and services. Conversely, the more the nature and performance of project outcomes depend on the context in which they are produced, for instance because clients become involved in project development as in some new media fields (Christopherson, 2002b; Grabher, 2002c), and the more difficult it is to appropriate their value as separate entities, the less likely are singular PBFs to be widespread in an industry. We can summarize these factors in terms of the strength of appropriability conditions that enable firms to protect innovations against imitation and extract profits from their innovative activities (Malerba and Orsenigo, 1993: 48).

This dependence of PBFs producing singular outputs on strong appropriability conditions reflects the difficulty of assessing the value of highly distinctive and one-off products as opposed to those that are more similar

to existing ones that have already been traded. Investors of capital and skilled labour are unlikely to become committed to a highly singular PBF unless they believe that it will produce a specific output whose distinctive value can be realized on external markets. The less tangible, visible and easy to trade are project outcomes, the more investors are likely to prefer PBFs that undertake a sequence of relatively short-term and similar projects. The risks associated with highly singular outputs also imply that investors will be more willing to support PBFs producing these in industries where there are common technical standards governing product specifications and their interoperability. Such standards enable firms to specialize in making modular innovations rather than producing whole technological systems, and thereby limit the risks of undertaking projects.

A further critical feature of highly singular projects that is needed to ensure continued financial commitment, especially for outside investors, is the visibility of milestones or indicators of significant progress being made (Tylecote and Conesa, 1999). Especially where failure risks are high, such visibility is likely to be essential for PBFs producing singular outputs to be established, and many venture capitalists insist upon obtaining board membership and regular progress reports as a condition of support for such enterprises (Ferguson, 1999; Kenney and Florida, 2000; Lewis, 1999). This often, in turn, means that investors have to be knowledgeable about the technological processes involved and market opportunities, as is the case with many Silicon Valley venture capitalists (Bahrami and Evans, 1995; Hellmann, 2000; Kenney and Florida, 2000). PBFs pursuing distinctive and unusual projects are, therefore, more likely to be supported in regional and national economies that have informed and risk taking venture capitalists, particularly where the rate of technical change is high.

Such venture capitalists often rely on capital markets to provide exit opportunities through public flotations or trade sales for their successful investments, especially where the firm has valuable innovative capabilities. These enable them to commit resources to a portfolio of projects that have considerable, but varying degrees of, risk and uncertainty. Without liquid capital markets that facilitate the trading of ownership cheaply, they are less likely to tolerate high levels of risk and to commit significant financial resources to funding PBFs producing unusual and uncertain outputs. Where, in contrast, capital is largely allocated through banks and similar financial intermediaries and capital markets are illiquid, investors and companies are more locked into each other's destinies (Tylecote and Conesa, 1999). As a result, financiers tend to be more risk averse and

reluctant to fund uncertain projects that have few, if any, assets to back them. PBFs producing highly singular outputs are accordingly less likely to be widely established in such financial systems.

Considerable singularity in the goals and results of PBFs additionally depend on the institutionalization of fluid labour markets where requisite skills and knowledge are readily available (Almeida and Kogut, 1999; Bahrami and Evans, 1995). To construct single project firms to carry out complex and varied tasks requires a pool of skilled labour that can be hired at relatively short notice, and whose expertise can be readily assessed. In addition to low commitment employment relationships, this implies the institutionalization of a signalling system whereby employers can advertise opportunities and skilled workers can display their technical knowledge and ability to work effectively in project teams.

While technical expertise can often be signalled through formal qualifications, these may not always communicate critical practical competences, especially where such skills involve working with a range of diversely qualified people. In the case of some media industries, achievements are signalled through formal credits (Faulkner and Anderson, 1987; Hirsch, 1972; Jones, C, 1996), but personal networks in technical, industrial and geographical communities are often the primary means of generating reputations for competence and effectiveness (Jones, 2002). Crucial to the organization of production and distribution of products and services around highly singular PBFs, then, are fluid labour markets and effective signalling systems through, for instance, reputational networks.

Turning now to consider the conditions encouraging the prevalence of PBFs with considerable role separation and stability, there are three factors that are critical. First, the extent to which new products and processes in an industry build on current knowledge and technologies, or are technologically discontinuous, and so likely to be competence destructive as discussed in the previous chapter. Second, the degree to which clients become involved in developing the product or service. Third, the strength of skill formation systems and the extent to which labour markets are structured around certified expertise.

PBFs with a stable division of labour between skills and considerable continuity of professional identities within and across projects seem more likely to become established in industries where technical change is cumulative than where new knowledge, whether developed within or outside projects, frequently and radically alters the evaluation and use of skills. If technical change is rapid and disruptive to existing competences (Christensen, 1997), companies cannot easily plan work around

existing established roles and expertise. Flexibility in changing direction, reorganizing skills and developing new knowledge and expertise become critical to PBF survival in such situations, either through rapid learning and altering roles by current employees, and/or by hiring other specialists.

Internal flexibility and restructuring of roles and skills are also important for PBFs in industries where project goals are liable to change as a result of client learning or market changes, as in many business services and new media sectors (Christopherson, 2002b). The more that clients are involved in the production and use of project outputs, as opposed to setting functionality targets and overall goals at arm's length from PBFs, the less likely are roles and skills to remain fixed over the course of projects, especially where these are long term and organization specific. Major consultancy projects that involve staff working intensively with particular firms over long periods to accomplish ambiguous and changeable goals will be difficult for PBFs to conduct successfully if they organize tasks around distinct, separate and stable roles and expertise. Many enterprise software companies that work closely with customers, for instance, encourage fluid roles and a flexible division of labour between technical specialists (Grabher, 2004a; Ibert, 2004).

High levels of role stability and separation within PBFs are additionally encouraged by the institutionalization of a strong public training system that standardizes skills throughout an industry and structures labour markets. The German 'skills machine' (Culpepper and Finegold, 1999) has of course been celebrated by many as critical to the effective production of standardized expertise that is both advanced and effectively signalled to employers. Countries without such an effective skill formation and credentialing system involving both unions and employers are unlikely to produce nationally standardized skills that employers feel able to rely upon in constructing project teams.

However, such standardized initial training is often followed by more idiosyncratic learning and development within companies as employees work on a series of problems with organizational colleagues. Depending on the system of labour market regulation within particular industries and nationally, practical skills become more or less firm-specific and tradable upon external labour markets as people: (a) remain working within a single organization, or (b) seek to enhance their specialist expertise and value in particular technical fields by working in a number of different companies. Where strong sectorally based unions and employers' associations establish industry wide wage rates and restrict poaching of skilled staff, as in Germany (Crouch *et al.*, 1999; Hinz, 1999; Streeck, 1992; Thelen and Kume, 2003), mobility based on occupational identities is likely to be less frequent than in more liberal market economies. As a result, initially quite standardized expertise becomes less so as workers develop organizational, rather than occupational, identities.

Conversely, in industries and societies that regulate employment relations through intermediary associations based on skills, as in the US film industry (Christopherson, 2002a; 2002b) and Denmark (Pedersen, 2006), identities and roles remain tied to expertise and are more generic across employers. Although working careers in a number of different companies and projects incrementally develop such skills, and in the case of Denmark skill enhancements are often credentialed by various training schools so that they become more personally idiosyncratic (Kristensen, 1999), expertise in these kinds of regulated labour markets remains technically specialized and tradable across organizations. Consequently, they facilitate the development of PBFs dependent on the ability to mobilize teams of specialists with particular, known skills to deal with complex problems, and arguably the institutionalization of 'project container' firms as the prevalent type of firm in a country (Kristensen, 1996; 2006).

These relationships suggest that different types of PBFs are likely to become more significant kinds of economic actors in industries with specific characteristics, and in countries dominated by different kinds of institutional regimes as outlined in earlier chapters. The key connections between characteristics of project products and processes, on the one hand, and of institutional frameworks, on the other hand, in relation to the four types of PBFs discussed above are summarized in Table 9.2. Here, a plus sign indicates that a positive relationship can be expected between a particular characteristic of projects or institutional feature and the likelihood that a particular kind of PBF will become a significant economic actor, and a minus sign the reverse. The combination of both signs indicates an indeterminate connection.

Considering hollow PBFs first, this analysis suggests that they are particularly likely to be significant economic actors in industries with strong appropriability conditions, visible milestones and cumulative technological change. Where the value of project outputs is uncertain, as in much feature film production, they will also be encouraged by flexible capital markets that can facilitate the packaging of projects into risk diversified portfolios. Fluid, dynamic external labour markets structured around relatively standardized practical skills, often regulated by intermediary associations such as unions, are also important features of the institutional environments of these kinds of firms. Additionally, integrated technical

Table 9.2. Project characteristics and institutional frameworks favouring the establishment of different types of project-based firms

	Type of PBF			
	Hollow	Craft	Organizational	Precarious
Characteristics of project outputs and processes				
Strong appropriability conditions	+	+/−	−	+
Modular outputs and visible milestones	+	+/−	−	+
High client involvement	−	−	+	−
Low technical cumulativeness	−	−	+	+
Characteristics of institutional frameworks				
Liquid, transparent capital markets	+	+/−	+/−	+
Knowledgeable venture capitalists	+/−	+/−	+/−	+
Fluid, dynamic external labour markets with effective signalling systems	+	+	+/−	+
Highly standardized expertise structuring labour markets	+	+	−	−
Integrated technical, sectoral and geographical reputational networks	+	−	−	+
Overlapping academic and business labour markets	+/−	+/−	+	+

and industry reputational networks improve signalling processes between temporary employers and employees and reduce transaction costs for these types of PBF (Jones, 2002).

Craft PBFs are also likely to become widely established in industries where technical change is incremental and client involvement in project processes is limited. Additionally, most of the projects that they undertake are relatively short term and outputs are sufficiently similar in kind to enable learning across them. They will be more prevalent in societies where standardized skills and strong professional associations institutionalize relatively stable work roles and structure labour markets. These reduce coordination costs within companies by enabling them to rely on relatively stable and reliable expertise that can be signalled effectively within occupational communities. They also need to be able to mobilize teams of specialized experts to deal with clients' problems at short notice and so fluid labour markets are important to their success.

Organizational PBFs, on the other hand, are more likely to play significant roles in industries where appropriability risks are considerable and the provision of customized services integrates production of problem solutions and knowledge with close customer contact and delivery. Project teams of specialists are here coordinated by managers who ensure that their knowledge is directed to solving the clients' problems and

providing customer specific outputs, as in much of the enterprise software industry (Lehrer, 2006). As argued in the previous chapter, while this means that such firms are quite complex in terms of combining different roles and competences, and have to invest in systematic forms of coordination and control, it also ensures that ideas and solutions remain relatively proprietary and are not easy for competitors to imitate.

Precarious PBFs dedicated to producing singular products in situations of high uncertainty, such as Vermeer Technologies in the mid-1990s (Ferguson, 1999), are most likely to play a prominent role in industries with strong appropriability conditions, visible milestones, and innovations are modular rather than systemic. They also depend on highly fluid labour markets in which skilled staff are willing to take high risks for potentially high rewards. Clearly, societies with high levels of employment protection and employer–employee commitment will not be conducive to the widespread formation of precarious PBFs, nor will they encourage highly trained workers to forgo employment in established organizations to join new firms in emerging industries. Equally, as many studies of Silicon Valley have suggested, the continued development of these temporary firms in emerging technologies and markets depends on a socio-economic infrastructure of knowledgeable venture capitalists, lawyers and other providers of business services who are willing to share some of the risks involved by taking equity stakes and managing these commitments as a portfolio of activities (Bahrami and Evans, 1995; Kenney and Florida, 2000; Lee, 2000; Suchman, 2000).

Given the limited stability of teams and work roles in such dynamic industries, and the need to attract new skills at short notice, precarious PBFs additionally depend extensively on reputational networks to find and attract skilled staff. Such networks are often, though not always, based on particular geographical localities where 'learning by monitoring' (Sabel, 1994) is relatively easy to practice and distinctive technical communities form. Effective signalling of relevant technical and social competences, as well as new job opportunities, becomes especially important in these circumstances, and is assisted by the institutionalization of reputational networks that integrate technical communities with industrial and territorial ones.

Furthermore, in industries where skills change rapidly because of new formal knowledge being produced, especially from universities and similar research organizations, the prevalence of precarious PBFs depends upon the boundaries between academia and business being quite permeable, with considerable mobility between universities and industrial

enterprises (Whitley, 2003b). This, in turn, implies that labour markets for researchers are not strongly segmented between universities and companies and so movement from one to the other does not usually suggest scientific inferiority or typically prevent reverse transitions, as in the US biotechnology industry (Casper and Murray, 2005; Higgins, 2005).

These points suggest that the widespread establishment of these kinds of PBFs as prevalent units of economic action in a sector will be limited to a few industries and institutional environments, rather than heralding a distinctly new logic of organizing economic activities that can be expected to dominate the development of new industries in most advanced market economies. In particular, contrary to much of the hype surrounding discussions of Silicon Valley and the new economy, precarious types of PBFs are only likely to become significant economic actors in sectors and societies that have the following six characteristics.

Three of these concern business sectors. First, critical technical skills and knowledge are rapidly changing, second, innovations can be effectively protected through copyright and/or patents, and third, technical standards governing the interoperability of components are widely agreed. The other three features reflect the nature of the business environment. First, there is a large pool of highly trained skilled workers who are willing to take risks, together with, second, a 'project ecology' (Grabher, 2002b, 2002c) of supportive and knowledgeable agents and organizations, and, third, research organizations that are relatively open to varied intellectual goals and career patterns.

Concluding Remarks

This discussion of project-based firms has emphasized their considerable variety and lack of convergence to a single form. Rather than temporary systems of work organization and employment becoming the paradigmatic replacement for the Chandlerian company in twenty-first century capitalism, as some have suggested, they differ in a number of key respects that affect the kinds of industries and societies in which they become significant economic actors. In particular, the innovative, highly flexible PBF celebrated in many accounts of the growth of Silicon Valley is only one variant of such companies that differs in important respects from those prevalent in the construction, business services, entertainment and other industries.

Project-based firms vary significantly in how they elicit commitment from investors and workers, and how they coordinate their activities—both internally and externally—as a result of the variable singularity of their goals and outputs, and contrasts in the degree of distinctiveness and stability of the skills they use and how they organize work roles. These differences are important for distinguishing between the quite distinct kinds of PBFs found in a variety of industries and locations such as Silicon Valley, Silicon Alley, the Italian industrial districts, and Denmark. They also suggest a number of reasons why different types of such firms appear to be more or less significant in the development of these industries, and occur with varying frequency in differently organized institutional contexts.

The extent to which PBFs develop distinctive, firm specific organizational capabilities, and of what kind, depends on their longevity, singularity of outputs and coordination procedures. Where firms are established to create a single or very small number of discrete, separate kinds of products and services, and employment contracts are highly project specific, the firm as such is too temporary an organization to develop any distinctive organizational or technical competences. Insofar as learning does occur in the course of the project, it will be largely accomplished and appropriated by individuals and small teams.

Similarly, where skilled workers coordinate their activities directly, as in many craft PBFs in industrial district types of business system and professional service sectors, without much reliance on managerial routines or organizational procedures, learning remains primarily individual or team based. Employees here may improve their technical and team-working skills during each project, but such incremental growth in problem-solving capacities remains largely the property of the individuals involved, not codified into organizational procedures and practices.

It is when the PBF undertakes a series of similar kinds of projects with a core group of employees who remain with the firm for some time that distinctive organizational identities, knowledge and capabilities may be developed and provide competitive advantages. By establishing managerial routines for coordinating and directing teams of specialists to accomplish innovative goals, some PBFs are able to generate firm-specific problem-solving capabilities, including learning from project experiences, both at the individual level and in terms of organizing teams more effectively for dealing with novel problems (Scarborough *et al.*, 2004). Many such PBFs invest in knowledge management systems and related procedures for codifying, combining and disseminating project-based

knowledge that enables the organization as a whole to develop distinctive organizational competences. This involves employers being able to offer both short-term incentives and credible long-term organizational career commitments to key staff to encourage them both to build such capabilities and to be flexible in the kinds of expertise and roles they perform within the organization. Organizational PBFs, then, are more likely to develop firm-specific collective unitary capabilities in the sense used by Metcalfe and James (2000) than are other types.

By focusing in this chapter on the singularity of PBF goals and outputs and the separation and stability of skills as critical features of PBFs, I have suggested a way of distinguishing them that might help to explain their varied importance in different kinds of industries and societies. Insofar as success in developing particular technologies and markets is associated with these sorts of companies—and dealing effectively with their commitment and coordination problems—these remarks should also contribute to our understanding of how and why countries and regions with contrasting institutional frameworks specialize to varying extents in such developments.

Part IV

Internationalization and the Development of Transnational Organizational Capabilities