A FRAMEWORK FOR ANALYSING THE DIFFUSION OF TECHNICAL KNOWLEDGE : THE CHEMICAL INDUSTRY IN SOUTH EAST ASIA

by

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THESIS ABSTRACT

The role attributed to technology in international investment and trade has been growing in importance even though its economic attributes still remain poorly understood.

This study explores the way that the diffusion of technical and scientific knowledge is affected by the form in which it is cast. The more an item of knowledge has been codified -i.e. made explicit and set out in writing- the faster and more extensively it can be diffused. This simple proposition is explored through an analytical framework that offers a unified description of an international firm's technological posture and the type of transactions it will seek in order to exploit it.

The analytical framework is applied to twenty case studies of technology transfer operations carried out through wholly owned subsidiaries, joint ventures, and licensing agreements, and involving European chemical firms in the ASEAN countries. Although the exploration is qualitative in nature, propositions derived from the framework are well corroborated in the case of joint ventures and licensing agreements but yielded inconclusive results when applied to wholly owned subsidiaries. From the data available these cannot easily be distinguished from joint ventures.

The study concludes that through more detailed case studies, the framework could be developed to describe a firm's or an industry's technological assets and its possible technological strategies and that doing so would shed light on a number of important issues in economic development.

PREFACE

This study was conducted in parallel with a research project carried out for the EEC Commission, Brussels, by the author with Professor Philippe Lasserre of the European Institute of Business Administration (INSEAD), Fontainebleau, France. At a number of points this study draws upon material developed for the research project, namely:

1. Interview data - some of this was collected by Professor Lasserre on his own using the interview guide described in Appendix 1. The interview guide itself, was developed by the author and the interview data was subsequently converted into the case studies presented in Chapter 5 by the author. These case studies were developed solely for incorporation in this dissertation and have not been used elsewhere. Approximately 20% of the interview data was collected in the field by Professor Lasserre and the rest was collected by the author.

2. Aggregated data - the interview data collected was coded for subsequent analysis. The coding activity was carried out by Professor Lasserre and the author together and although none of the analysis that was subsequently performed on the coded data has been incorporated in this study, the data itself is presented here in tabular form and discussed in Chapter 4.

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INTRODUCTION

Background Issues

The plethora of social indicators now used to complement economic data when comparing the wealth and wellbeing of nations expresses a growing distrust of singular measures applied to complex social phenomena. Yet if this filter of measures affords some protection against analytical simple-mindedness, it makes the real world ever more opaque to view and makes powerful generalizations that much more difficult. In few places is this loss of economic innocence more apparent than in the changing relationship between science, technology and economic development. The equation that linked them together in the post-war period probably owed more to the credibility established by science through its powers of destruction than to any clear understanding of how such powers could be harnessed to more productive purposes.[1] Today those statistically intractable social problems consigned to the 'residual' in the equation have become the heart of the matter - or at least of current perceptions of the matter. Clearly, a more historical and less Eurocentricly whiggish form of analysis would have shown up much sooner than it has the central importance of social structure and processes in the development of science, as the probing studies of Joseph Needham on the growth of Chinese science illustrated.

Needham poses a simple, yet fundamental question: Why did China which, between the second century B.C. and the sixteenth century A.D., was manifestly more efficient than Europe in applying a knowledge of nature to useful purposes, fail to undergo a scientific revolution similar to that which took place in Europe? It clearly had the technical and intellectual capacity to do so. During that period the flow of new technology between East Asia and the West was overwhelmingly in favour of the latter: gunpowder, the stirrup, the wheelbarrow, the principles of magnetism and chemical affinity, techniques of innoculation, mechanical clockwork, surveying techniques, were all developed in China first (Needham, 1969:17-20) and many of them subsequently transferred to Europe.

Needham has shown that Chinese technology travelled better than its scientific ideas which remained as ethnically bound as those of medieval Europe. A systematic mechanical philosophy never took root in Chinese thought which distrusted theory and remained steeped in an organic materialism. For Taoists, nature remained inscrutable and quite unsympathetic to the strivings of logical analysis; Confucians, on the other hand, were interested mainly in social and ethical issues, and for them nature was almost irrelevant. The Chinese concept of harmonious and organic cooperations of all creatures within a hierarchy did not imply the existence of an external law giver or a body of laws to be obeyed; each followed the dictates of his inner nature. Yet belief in an orderly universe, submitting to the imperatives of natural laws, was a precondition for the scientific revolution that transformed the European mind from the seventeenth century onwards.

Moreover, if the Chinese intellectual climate was inhospitable to such developments, social conditions were no less so: China's merchant class never achieved the mystique that it did in Renaissance Europe, and its dominant ambition for its children was to get them out of that class and into the feudal bureaucracy. For Needham, China's failure to develop a modern science was coextensive with its failure to develop first a mercantile and then an industrial capitalism.

The complexity and subtlety of the issues addressed by Needham in an historical context are currently hitting development planners and government policy-makers with particular force and creating a certain conceptual disorientation. The shrinking of international space and the communications revolution clearly pointed to an acceleration of development and a speedier diffusion of the benefits of civilization on an international scale. Yet for many poorer countries, the road travelled leads from the barrenness of undevelopment into the crowded squalors of underdevelopment, rather than towards any technological dreamland. For them, the 'global village' spells little more than a return to domination by the foreigner. It is a wonder that nationalism grows strident?

The Purpose and Structure of the Study

This study makes technology transfer between countries the focus of its investigation; it takes an agnostic position in the debate provoked by the term, that currently opposes rich and poor countries in international fora such as UNCTAD, and concentrates instead on the semantic issues that it raises. If the expression has any inner coherence and meaning at all, wherein does it lie? The transfer of technology is viewed here as a trade in tangible and in intangible knowledge both of which may be embodied in goods like machinery or consumer durables. The tangibility condition is taken as a critical variable in the transfer process and essential to an understanding of its underlying mechanisms, and while the assimilation of effective knowledge to the form in which it is communicated can be traced back to Condillac[2], his insight has received no explicit treatment in the literature on technology transfer, nor, to this author's awareness, in the literature on growth and spread of science in general.

Tangibility as an attribute of technical knowledge is analysed in the chapters that follow, and brought into a formal, but not quantitative relationship with the conditions under which knowledge is traded and diffused. This is done through the development of an analytical framework that weaves into a unified representation strands from Organization Theory, Industrial, and Institutional Economics. The analytical framework is then tested for consistency in a preliminary way with field data gathered by the author in the ASEAN countries from thirty-three mini-case studies in technology transfer. This exercise, drawing on case study material, must be considered a modest affair in methodological terms. One hypothesis concerning the behaviour of knowledge within the framework is developed in the course of its elaboration, but this is done for illustrative purposes only and is not tested in the study itself. Nevertheless, the interest it arouses, together with the prospects offered by the preliminary tests, will speak for the worth and viability of further investigation.

The study is divided into six chapters. Chapter One looks at technology transfer through the lenses provided by the literature. This is not a survey; the very vagueness of the term makes its relevant literature potentially

infinite. The presentation will, therefore, be confined to sources that have been considered pertinent to the current debate on international technology transfer. Even here, the best that can be managed is but a sample - representative, one hopes - of what has been written on and around the subject, yet one through which the main features of the argument, and how it has evolved, may be discerned. The chapter concludes with a brief discussion that outlines the issues to be addressed in the study.

Chapter Two develops an analytical framework that speaks to the issues defined in the preceding chapter. It does this in an iterative fashion by taking, as its point of departure, an analysis of the way knowledge flows in the general case, successively converging on the flow of knowledge in the corporate case and that of the international corporation. With the framework now fully elaborated, an institutional economics approach is applied to yield a number of propositions that can seek support in the field data available.

Chapter Three discusses the methodology used and some of the problems encountered in carrying out the field survey. The data from the field work is presented in an aggregated form in Chapter Four and analysed on a case by case basis in Chapter Five with reference to the propositions advanced in Chapter two. The aggregated data is abstracted from interview material to create a context for the subsequent analysis and give a broader perspective to its findings, and while no sweeping generalizations can emerge from the matching of the propositions against the idiosyncratic data garnered from field interviews, some common patterns will show through, witholding or conferring plausibility on any claim made. The detailed explorations of Chapter Five remain more in the nature of case illustrations than systematic empirical tests. Their methodological power resides primarily in their ability to refute. Yet even here no final verdict will be possible since case studies can always deflect any final judgement by resorting to special pleading. However, final verdicts are not what this study is about. If it can establish the potential value of the framework it presents as a guide to future research, it will have achieved its aims. How these have been met, and what future research they suggests, are matters discussed in Chapter Six.

NOTES TO INTRODUCTION

1. The approach is illustrated in Meier (1956).

2. Condillac's influence on the scientists of the Enlightment is discussed in Gillespie (1960:164-173).

CHAPTER I

A BRIEF REVIEW OF THE ISSUES

INTRODUCTION

In recent years, a substantial literature on international trade, investment, and technical change has proliferated, much of which can claim some kinship to technology transfer issues. No attempt will be made here to review this body of literature as a whole. Instead, the main stages in the argument that has shaped the way practitioners in the field think about the subject will be briefly retraced and some of the milestones in the literature - large and small - that have helped to mark out these stages will be identified in passing. The focus of discussion will be the international firm.

The chapter divides into five sections. In the first, the view of technology transfer as a phenomenon arising out of international trade is described as are product cycle theories that have shifted the perspective away from trade and towards industrial organization. The next section looks at the international firm (MNE) as an independent actor in the technology transfer process, pursuing a strategy and displaying structural characteristics that are peculiarly its own. The problems of sovereignty that the operations of such firms pose for host governments are discussed. The relationship between host governments and MNEs is placed within a bargaining framework in section three and the bargaining position of the protagonists - host governments, MNEs - is examined. This is followed in section four by a discussion of technology transfer issues as seen through some of the recent literature on innovation, and in section five by a conclusion.

SECTION 1: TECHNOLOGY AND TRADE

Background

History shows the transfer of technology to be neither a new phenomenon, nor a new preoccupation. Noteworthy, however, is how far the process has depended on the merchant. Of course other channels existed - ambassadors, immigrants, slaves etc. - but the merchant was usually the one to combine the knowledge, the motivation, and the resources to see the thing through. Thus, an early identification of technology transfer with trade can partly be accounted for by the fact that the merchant adventurer was, until recent times, a dominant, if not the sole, channel of transmission for new technology, particularly where it was embodied in goods rather than in minds, that is, in concrete articles of exchange rather than evanescent know-how. The proliferation of alternative transmission channels has, of late, broadened the perception of the process, but the intellectual tradition that has crystallized around trade as a primary explanatory factor for technology transfer makes it a natural point of departure in tracing the evolution of current issues.

It should, however, be said at the outset, that there has taken place a move away from trade in the quest for economic explanations of technology transfer; away from the final culminating act of exchange itself to the steps that preceed it; from the flow of tangible consumption goods, to that of productive factors not all of which are tangible. Each step beyond trade has enhanced the part played by disembodied knowledge - i.e., that residing in people and organizations - at the expense of that played by embodied knowledge - i.e., that residing in goods for exchange - in any explanation of technology transfer processes.

Some Trade-based Views of Technology Transfer

The neoclassical view of international trade found its most articulate expression in the first half of this century in the works of Eli Heckscher (1919) and Bertil Ohlin (1933). Their world is static: technology and tastes

are held constant and production functions are assumed to be everywhere identical in shape. It is the difference in factor endowments and hence factor prices that determines a country's production possibilities, thus providing the stimulus to trade between countries, and over time, to specialisation. Goods incorporating abundant factors will be exported while those incorporating scarce factors will be imported. In this static world, perfect competition, the absence of trade barriers, and full utilisation of resources are required by the theory and economies of scale are ignored. A country's comparative advantage will be determined by factor endowments and its trade policies reduce essentially to exploiting that advantage as it stands rather than modifying or even reinforcing it. Trade will occur between dissimilar countries rather than similar ones: hence a capital-abundant North will trade with a labour-abundant South and technology will generally be assumed to flow south along with the capital-intensive goods that embody it.

The so-called Leontief paradox challenged the restrictive assumptions of the Heckscher-Ohlin (H/O) theorem. In 1953, Leontief observed that the US tended to export labour intensive goods and import capital intensive ones in direct contradiction with the provisions of the theory. Gunnar Myrdal's (1957) theory of cumulative causation also introduced market size as an additional explanatory variable: any market expansion by a firm or an industry resulting from some initial advantage will serve to reinforce that advantage and lead to cumulative growth. This dynamic also works in reverse so that any initial disadvantage will lead to cumulative contraction. Comparative advantage is now jointly determined by factor endowment and market size, and free trade, far from leading automatically to factor price equalization, as provided for by the more developed version of the H/O theorem, could well become a generator of inequality. Burenstam Linder (1961), like Myrdal, took market size as an explanatory variable, but argues that the factor proportions theorem had a valid application in the case of raw materials. He observed, however, that in the case of manufactured goods, producing for a home market usually preceeds exporting, and went on to hypothesize that similar income levels, production, and consumption patterns would stimulate trade between countries at comparable stages of economic development. South will now trade with South, and North with North.

None of the theories so far described invoke the transfer of technology as such in explaining trade; they all bathe in still neoclassical waters. Technology, embodied in goods, unquestionably offers both tangible and intangible benefits; but it sheds little theoretical light on trade patterns. Michael Posner's (1961) attempt to explain trade between developed countries breaks new ground in this respect. Here innovation is the stimulus to trade, but market growth for the innovating product provokes a competitive response from both foreign and domestic producers and creates pressures to transfer the technology directly to the burgeoning foreign markets and to set up local production. This eventually happens, leading to the elimination of trade. The 'technological gap' trade is initially opened up by an innovation and closed by technology transfer. Between technologically advanced countries the process will be continuous; between underdeveloped countries in which technological innovation is a rarity, it will not take place at all. As in the Linder model, North/North trade will occur, but South/South will not. The changing composition of international trade is now explained in terms of technology transfer with comparative advantage acting as the selection mechanism.

With the transfer of technology, productive factors are on the move and the neoclassical world, which reduced space to a point by eliminating transport and other fictional costs, loses its dominion. Locational issues, the spatial accessibility of productive factors and markets, suddenly become important. In international trade, tariff barriers act as a surrogate for distance, and the cost-minimizing firm will spread out its productive factors in a spatial configuration that will minimize the sum of the interregional trade costs (i.e., such as transport and tariff barriers) of serving all its markets. This can lead to dispersion or to concentration of its activities in space.

Ohlin had attempted to demonstrate that the theory of international trade is only a part of a general theory of location, but by allowing factor movement to occur only within regions rather than between them, he drastically limited the scope of his approach. In effect, the factor proportion theory does not address the issue of intraregional trade at all and, at the interregional level, it is believed at best to account for trade in a very limited class of goods only: primary commodities. The monopoly element that

inheres in all spatial relations, however, gives location theory a certain compatibility with theories of monopolistic competition so that at this point a 'Gestalt Switch'[1] may take place in the minds of those who have been staring at trade problems for a sufficient length of time: where they saw trading patterns and the movement of goods, they will now see firms and industries. This 'Gestalt Switch' first appears in the work of Stephen Hymer (1976) who with Charles Kindleberger (1958) placed international operations within the orbit of industrial economics and, in so doing, prepared the ground for dynamic explanations of technology transfer. This went beyond Posner's 'technology gap' in making the technical evolution of the product itself the focus of attention. The outline of this new approach is presented below.

Technology Transfer and the Product Life Cycle

Leontief's 1953 observation, that the US tended to export labour-intensive products and import capital-intensive ones, triggered off a search for explanations that would bridge the gulf that was opening up between the elegant simplicities of the Heckscher/Ohlin (H/O) theorem and accumulating empirical facts. One approach (Ellsworth, 1954), argues that if indeed nations enjoy widely different factor endowments then divergencies must also be expected in the relative costs of capital and labour. Another (Vanek, 1963), found solace for the H/O theorem in the fact that the US import of raw material depended heavily on the capital-intensive extractive activities of US foreign subsidiaries. But the most influential interpretation of Leontief's paradox was Vernon's (1966) life cycle theory which, like Linder's, confines the H/O theorem to an account of the behaviour of agricultural goods (Wells, 1972) and places the trade in knowledge-intensive goods under the aegis of industrial organization economics.[2]

Vernon explored a hypothesized relationship between changes over time in product-market characteristics and those in a firm's production location criteria. He did so by incorporating as variables in his explanatory scheme factors that had been set aside by the H/O theorem: production functions can and do change over time; information now carries both a creation and a diffusion cost: returns to scale are available to the firm itself - orthodox

trade theory had confined them to the industry level so as to protect its assumptions of perfect competition. His theory postulates that one source of a firm's oligopolistic strength lies in the creation of new products and the pursuit of product differentiation for both these and existing products. A high level of R & D expenditure will therefore be needed where knowledge, substituting for other factors of production (Streeten, 1974), plays an important role in the early stages of the product-life cycle. Knowledge, a free good in classical and neoclassical thinking, now explicitly carries a production cost - the R & D budget - and will be sought by firms on favourable and cost-effective terms. What might these be?

Access to knowledge will come cheapest where geographical proximity avoids the need for an elaborate communication infrastructure; where people can talk face to face, see each other informally, and acquire a breadth of experience that eludes the compact coding required for efficient long distance communications. Innovation, whether in products or in processes, rests upon the fleeting and shadowy perceptions of opportunity that such intangible knowledge can impart: a complaint from a purchaser, a helpful hint from a supplier, an article in the local newspaper, and so forth. In each of these, geographical propinquity puts a firm in close touch with its market and invests its perceptions with a texture indiscernible to one more remotely placed. Thus an innovating firm, seeking a least-cost location in terms of all its factors, and putting a heavy weight on the external communication economies available, will tend to locate near its most likely markets in the early phase of the product life cycle, when it is rapidly building up a knowledge of such markets and of its future factor suppliers. This is the 'messy' phase; the product is unstandardised and subject to constant modifications and redesigns. Its further refinement and improvement calls for accurate, speedy, and mostly informal communications with potential markets and suppliers.

Vernon's theory goes on to suggest that certain types of markets will be selected by the innovating firm where it is dealing with new products rather than processes: those characterised by high incomes and high labour costs. The lack of standardisation of new products makes their price inelastic, yet their inevitable differentiation appeals to high income earners. They are income elastic. The rational entrepreneur will therefore minimise his risks by

locating in high income markets where people can afford to buy his products and where they will pay a price that promises him windfall gains in those early stages of the product life cycle in which he needs to recover his outlays. At the same time, high labour costs will bias the design and subsequent modification of products towards labour-saving innovations and a substitution of capital for labour will occur.

This is the dynamic invoked by Vernon to explain, in the first instance, why innovation in capital intensive products is more likely to originate from the United States than elsewhere. The country enjoys high incomes, and, since these are widely distributed, it also incurs high labour costs. The innovator will introduce labour-saving products in this market first and minimise both his transport and communication costs by locating his production facilities in it. But the story does not end there. Over time, products mature, the early snags are ironed out, market preferences are recorded and the initial uncertainties that attended their launching are gradually dispelled. Standardization and economies of scale become feasible and contribute to price reductions. At the lower prices, demand expands and new markets open up for the firm's products, some of these abroad. Initially these are served by exports; but standardization has by now eased the firm's communication problems and abolished the premium placed on the geographical proximity of the producer and his market. A change in locational criteria occurs. Production becomes more footloose and less dependent on US inputs. Furthermore, standardization begins to attract imitators and price competition emerges as a consideration. The larger percentage of transport costs in the lower selling price, swollen by a judicious imposition of tariffs and other transaction costs, may lead the exporter to set up a production facility in his chosen foreign markets directly in order to forestall potential local competitors. The investment is a defensive one, carried out to avoid losses rather than to make a profit (Kindleberger, 1974). Yet once there, the firm may find that local labour, being cheaper than in its home market, the US, gives it a competitive edge in servicing third country markets. Accordingly, future expansion takes place away from the home base, at lower costs, and possibly incorporates a further round of standardization, leading to an increase in the product's capital intensity. The culmination of the product life cycle occurs when a US firm develops an absolute competitive advantage in its foreign location and can now service the US market with, by now, highly standardized, high volume, capital-intensive products from that base. The wheel has come

full circle: the US imports more capital intensive products than it had exported in the unstandardized, low-volume, early phases, of the product cycle and Leontief's paradox has been accounted for.

Empirical corroboration of the product life cycle thesis has not been conclusive. One study (Leroy, 1977) fails to detect the last stages of the product life cycle - the re-export of products back to the US - in a sample of five US manufacturing firms, and Vernon himself, from the beginning very modest in his claims for the theory, has come to see it more as an historical explanation of the Leontief paradox, applicable at a particular moment in time, than as a general theory of trade and location applicable to manufactured goods as a whole (Vernon, 1979). Not all products originate in their producer's home markets (Leontiadis, 1979; Pavitt, 1974) and the inverse relationship presumed to exist between the age of a product and its monopoly status may be tenuous. Also, the technical improvements now possible in the communications between a parent firm and its foreign subsidiaries, and the increasing sophistication of local competition, may compress the cycle to such an extent that production is 'induced' abroad, before the product itself has matured (Cooper, 1973; Wells, 1972). Firms frequently set up abroad as a response to threat rather than opportunity (Arahoni, 1966; Knickerbocker, 1973), and in so doing, run the danger of spreading themselves too widely (Kindleberger, 1974), thus losing the very competitive advantage they initially sought to exploit by concentrating their resources on specific markets.

But the theory's early predictions do not exhaust its powers. Its value lies in its attempt to reorient thinking and in its efforts to account for crucial variables which classical and neoclassical trade theories has assumed away. The idea that the outward pull to which multinational firms have responded results from an orientation towards innovative activity had first been mooted by Charles Kindleberger and by Stephen Hymer. Both treated knowledge, explicitly or otherwise, as a factor of production. This could take two forms: knowledge of markets, and knowledge of technology. Each required a heavy organizational and financial investment by the firm. While knowledge

c o n t i n u e d

to be regarded as a free good by orthodox economic theory, neither marketing nor technological variables played any significant part in explaining the trade and locational behaviour of firms. It is the merit of Vernon's theory to have afforded them an opportunity to play such a part.

The Industrial Organization Approach to Technology Transfer

The work of Kindleberger and Hymer brought about a shift in the perception of international operations. They are now seen less as a phenomenon of trade and factor flows, dependent on general and country conditions, and more as one of firms and industrial organization.

The industrial organization approach argues that all forms of international investment aim to exploit market imperfections that offer the firm protective barriers against actual or potential competitors in international product and factor markets (Giddy, 1978). The product life cycle theory focussed on the innovation and creation costs of new products as an entry barrier; it concentrated on manufactured goods, ignoring raw materials and service industries. Vernon saw three forces that might push US manufacturing firms to set up overseas operations: 1) the labour intensity of the product itself; 2) an absence of any economies of scale that might help to anchor the firm to one location; 3) high transport costs, with tariff barriers either adding to, or substituting for these to increase the returns to foreign production and decrease them to exporting. His theory accommodates all three, but the 'push' forces he cites are complemented by a single 'pull' force: the need for firms to defend against new competitors a market position that was developed behind the innovation barriers they had successfully created. Yet market barriers generally tend only to deter the creation of new firms in an industry rather than the entry of established firms into new product markets. Large existing firms can break into an oligopolistically structured market either through 'horizontal' or 'vertical' investments (Caves, 1971). A 'horizontal' investment describes a move to produce, in a new market, the same line of goods that is produced in existing ones. Market entry will be sought through a strategy of product differentiation and will be perceived by local rivals as entry by an established firm. A 'vertical' investment, on the other

hand, describes an attempt by the firm to reduce oligopolistic uncertainty by securing, in one market, control of the inputs it requires in another. Such vertical integration is most visible when a firm is trying to stabilize its raw material inputs, and although forward integration into distribution may also aim at uncertainty reduction and the erection of entry barriers, it will be most effective and beneficial to a firm if complemented with a horizontal investment strategy that can extend the opportunities for product differentiation.

Seen in this light, the decision to embark on foreign operations reflects a choice about the scope of the firm. In 1937, Coase, in an article that has become a classic, showed that the "make or buy" decisions that are continuously confronting a firm in its day to day operations ultimately determine the proportion of transactions that it choses to conduct internally and those that it conducts across markets - i.e., they determine firm size. He hypothesized that the profit maximizing firm will continue to internalise transactions while the cost of coordinating them by organizational means remains lower than those of letting the market do the job. The existence of international firms therefore creates a presumption in favour of internationalized transactions across national boundaries since market imperfections, in the absence of organizational control, may prevent such firms from capturing the full returns on their distinctive abilities in any other way - the unequal ability of firms being itself a sufficient condition for international operations (Hymer, 1976). For these firms the optimal economic area for their activities will likely be larger than the nation state, and will be defined by the point at which scale economies in production, marketing, finance, etc. are offset by the diseconomies incurred by a centralised administration and control of transactions (Kindleberger, 1974).

Yet empirical studies reveal that oligopolistic firms can overshoot the optimal point in their move abroad, and that, where local production gives them a marketing edge, they will produce in several regions at once on a rising cost curve and follow closely on each other's heels in extending their production activities to new regions. In a study of 187 US parent companies, Knickerbocker (1971) found strong evidence of 'bunching' in the establishment of their foreign manufacturing sutsidiaries in any given industry or country

which they entered sometime between 1948 and 1967. The phenomenon was most pronounced for those industries in which marketing constituted the dominant corporate activity, and appeared to be negatively related to overseas product diversity, to R & D, and to advertising expenditure as a percentage of sales. Bunching of market entry by these firms, however, was positively related to the profitability of overseas manufacturing operations, and to measures of market growth rather than market size. Knickerbocker labelled this bunching effect 'oligopolistic reaction'. The defensive investment process it designates will best characterize firms with a narrow product line, strong in marketing and in product differentiation, but not necessarily strong as innovators in their fields. The profitability of their foreign investment activities may either mask or compensate for the fact that they operate on a rising cost curve. Barlow and Wender (Caves, 1971) argue that profits from foreign earnings are viewed by such firms as 'gambler earnings' and will be ploughed back locally whatever the parent's profit-maximising criteria might suggest. Over time, the scale of their foreign operations might cease to reflect the profit-maximising size of firm that a rational investor might choose, and express instead the sales-maximising or market-share objectives of an internationally minded management team (Penrose, 1959; Perlmutter, 1969).

The work of Knickerbocker lends support to the view put forward by Hymer that firms will serve foreign markets through foreign production in order to exploit or defend some unique advantage - a differentiated product or a patented invention - on which a premium profit can be earned. The international oligopolistic firm consequently becomes an agent in the technology transfer process. Where a firm's oligopolistic advantage lies in its R & D strength, the investment may aim at exploiting rather than defending a market. In other cases, an investment may be made to protect a firm's market - as an asset built up through the application of distinctive marketing skills. The technology transferred by the firm is more likely to be innovational in the first instance than in the second.

Schumpeter (1950) was the first to conjecture that new products and production methods will emanate from firms with market power. If his speculation finds only equivocal support in the work of Scherer (1965) and Parker (1978), a study by Schrieves (1978) claims to see more vigorous innovators in concentrated industries than in those less so. In concentrated industries, however, large firms performed proportionately less R & D than

small firms so that a threshold effect may be at work, defining some minimum level of research below which a firm cannot hope to remain competitive in that sector. A distinctive competence or asset may well, therefore, be a prerequisite for a successful foreign investment if the initial advantage conferred on domestic entrepreneurs in their intimate knowledge of local host market conditions is to be counterbalanced.

Nevertheless, where a firm's distinctive competence is knowledge-based, it will cease eventually to yield private returns. From being a public good only within the firm it will, by degrees, become a public good outside it, and hence available to its local competitors (Magee, 1976). If, by that time, the firm has secured for itself economies of scale in production or marketing whether through the operation of an 'experience curve' or by some other means, they may replace the knowledge factor as a barrier to entry. This is what happens in mature oligopolies. The effects of this dynamic are traced out below and explored later in the study through the analytical framework presented in Chapter 2.

SECTION 2: STRATEGY AND STRUCTURE

The New Dispensation

The move from trade-based to firm-based theories of international investment have not been achieved without some measure of confusion. Indeed the development can be better described as an extension rather than a shift in theoretical thinking since trade is far from being left out of the picture. Yet explanations drawing on oligopolistic theories of firm behaviour create no simple interpretative scheme. They do not allow the effortless predictions of neoclassical theories in which the firm acting as an agent of its shareholders, could optimise for some definable sectional interest. The oligopolistic firm, and more particularly, the international oligopolistic firm, appears to have a will of its own. Its behaviour patterns are indeterminate and run ahead of any established theoretical framework. Students of international industrial organization cannot agree on what they see, and where they can, cannot agree on what they think about it.

Horst (1974) sees a rapprochement in the works of Williamson and of Chandler, between behavioural and organizational approaches on the one hand, and optimising theories of the firm on the other. He is led to ask, as might a behaviourist, whether differences in firm objectives lead necessarily to significant differences in firm behaviour, and whether, therefore, new theories, which look for clarification to the role played by organizational purpose, will add much to what is already understood. The issue boils down to deciding whether the essentially reactive behaviour of firms in competitive markets lead to signally different outcomes than the proactive behaviour of firms in oligopolistic ones. At stake is the concept of strategy: the steps followed by a firm over time to build up its strengths and achieve a greater control over outcomes. Internalizing transactions is one strategy pursued by many, if not most firms, to control outcomes that have a direct bearing on their viability. Firm size then expresses how far transactions have been successfully internalised and firm structure identifies which transactions have been relegated to external market processes.

Frequently, the integration sought by firms robs host countries of a measure of autonomy: power gained by the MNE in oligopolistic advantages is seen as so much sovereignty lost by a host country government. Here the danger for a firm is not the dissipation of an advantage through 'leakages' as in R & D, but its appropriation by a host country government or a local competitor. While, for Vernon (1977), the MNE epitomises the shrinking of international space and the declining autonomy of the nation state, the latter is not accepting the new dispensation passively, but is actively looking for opportunities to rewrite some of the rules of the game it is called upon to play. The issues that oppose MNE's and host governments are outlined in section three of this chapter.

The Issue of Sovereignty

Franko (1974) speculates that, like their US counterparts before them, European MNE's will increasingly be led to adopt supranational, or global strategies in order to counter host government attempts to control them. The MNE thus becomes an idea whose time has come and whose evolution is presented as the resultant of a single global set of historically determined social and economic forces. Yet any belief in the the continued expansion of the MNE in its present form rests precariously on two assumptions:

1) Vertical systems of integration such as organizations are more economic and innovative than horizontal ones such as markets.
2) This will be recognized and accepted by nation states (Keegan, 1977).

These assumptions, by themselves, are not sufficient to ensure the survival of the MNE. The nation state must also believe that, on balance, the possible loss of sovereignty it faces in accommodating MNEs within its jurisdiction is adequately compensated for by the social and economic benefits that they bring with them. Put differently, the nation state may pursue domestic policies that are far removed from economic liberalism, while in its international commercial dealings it may prove willing to adopt a somewhat more liberal approach in seeking the benefits package 'on offer' by the MNE.

But supranational strategies and global structures are neither inevitable nor even desirable choices for all international firms either. They favour mostly the "footloose" MNE with large interdivisional sales seeking a low cost production base for some of its intermediary products. They may be less relevant to firms that only seek access to a host government's markets or its raw material resources. Here, interdependencies between different organization units within the firm may be much lower, giving each more leeway in their dealings with host governments. Global structures and strategies should be seen as an expression of bargaining power and not necessarily a means for acquiring it. Where home and host governments have commanded a strong bargaining position, home and host country demands have had greater influence on MNE strategies than have market and technological opportunities (Neghandi and Baliga, 1978). Nor is a high per capita income an inevitable prerequisite for a host country to enjoy a strong bargaining position; some countries with a low per capita income have been very successful in imposing joint venture arrangements on foreign firms since their needs were not specialised and could be met by a greater number of prospective investors (Stopford and Wells, 1972). Moreover, such countries are dealt a second card to keep up their sleeve and to use once an MNE has invested: economic growth, when it starts from a low base, is likely to be fairly rapid, and give host country markets considerable appeal to prospective foreign investors; where this occurs the latter become more willing to accommodate changing government demands and expectations.

Seen in this light, many joint ventures can be viewed as the outcome of a struggle between host governments and MNE's for control of foreign investments in the host country. MNE's retain more flexibility in wholly owned operations than they do in joint ventures. As they grow larger and their organizations become more complex, they may find joint ventures increasingly hard to live with, and all the more so where the firms are strong in marketing and R & D (de la Torre, 1976). They tend to look upon joint venture partners imposed by a host government as 'passengers' who have not paid their way; the creatures of an artificial arrangement. A genuine joint venture is an attempt to manage organizational interdependence between two firms (Pfeffer and Nowak, 1976). Such interdependence can be competitive or symbiotic - i.e., horizontal as between competitors or vertical as in customer/supplier relationships. In each case, the joint venture increases the extent to which either party can depend

upon the other skills and resources, but does so at the expense of their respective independence and discretion (Thomson and McEwan, 1958). The development of informal interorganizational linkages more often than not preceeds the creation of the formal bonds that constitute a joint venture (Guetzkow, 1966). The parties will, therefore, often have had prior dealings and be known to each other. But where a joint venture is imposed on an MNE by a host government, organizational interdependencies between the investing foreign firm and its local partner are either absent altogether or relatively exiguous to the firm. If interdependencies exist at all, they occur between the firm and the host government itself. The joint venture then becomes a device used by the host government to prevent international firms from making abusive use of the powers conferred on them by their structures. A joint venture, like any joint stock company, must be managed in the best interests of all its shareholders.

SECTION 3: TECHNOLOGY TRANSFER AND ECONOMIC DEVELOPMENT

A Bargaining Framework

An industrial organization perspective on foreign direct investment has the internationalisation of the firm resulting initially from the exploitation abroad of firm-specific capabilities. Later, sheer size may come to replace - or add to - capability as a source of strength, if over time, the firm successfully internalises transactions which in the early phases of its expansion had been left to market processes. The trick may depend on how fast the firm's know-how and skills leak out to local competitors, and, if this happens rapidly, on how ready these are to absorb it. Where know-how is intangible its diffusion may be very slow, allowing a firm to retain a larger share of the benefits such know-how creates over a given period of time. The overall welfare effect of a foreign investment may, therefore, be positive while the host country is denied any share in it.

Vaitsos (1970) observed this dynamic at work in a study of the transfer pricing policies practiced by international pharmaceutical firms in the countries of the Andean pact. The traditional tools of economic analysis, he concludes, are inadequate to explain the complex relationships that obtain between international firms operating in oligopolistic markets and host governments. A bargaining framework which explicitly imputes a cost to information and know-how would be more appropriate. The analysis of perfectly competitive markets treats information as a free good; that of imperfectly competitive markets cannot legitimately do so. Empirical research on technology transfer by American MNE's in a manufacturing context, shows that knowledge is both costly to reproduce and costly to transmit (Teece, 1976). Yet many of the ethical norms that have been applied to MNE behaviour by both national and supranational bodies treat information flows between transfer partners as essentially costless. Observed market imperfections are then partly attributed to the unethical and monopolizing behaviour of MNE's when they withhold information, whether or not they have the sanction of a patent system behind them.

A bargaining framework brings to the surface some of the elements in the deepening conflicts between MNE's pursuing global strategies and host governments desirous of retaining control of their respective countries' economic destiny - between the international planning by MNE's and the national planning by political units (Hymer and Rowthorn, 1970). Rowthorn (1971) foresees that as the struggle for world markets becomes more bitter and intense, this conflict will increasingly appear as one between states seeking to defend their firms. This vision may be too apocalyptic. In many instances, MNE subsidiaries are too small either to have any independent bargaining power with host governments or to claim the attention of central management back in their firm's home country in any confrontation with a host country government (Gilbert, Henderson, Misia, 1978). At the same time, they are too numerous and diverse in their activities to embroil their own home country governments in their problems. The latter want to avoid giving what could become open ended committments to an indefinite number of their firms abroad. Where trade flows today, the flag cannot always follow.

Bargaining between MNEs and host governments must be interpreted as a 'game between adversaries' rather than as a 'game against nature' as suggested by the more conventional approaches to economic analysis where in deference to the imperatives of perfectly competitive markets, one of the players is ignored. How the adversary is perceived will affect the 'value of the game' for the players and the payoff they will come to expect from a given strategy. A host government that has a favourable perception of MNE's and international operations in general will consider a very different set of bargaining options to the one which does not. Conversely, MNE managers drawing on widely varying host country experiences will each be led to adopt very different attitudes and bargaining strategies when dealing with a given government.

The Position of the Parties

Differences in attitudes towards MNE's can be briefly illustrated. A number of observers interpret the issue from an ideological position that puts the accent on equity rather than welfare, the equitable distribution of resources between nations being the heart of the matter. If they subscribe to

a socialist view of MNE operations (Constaninto, 1976), the latter become an expression of the internationalisation of capitalist relations described by Lenin and by Bukharin, with its attendant expansion of international syndicates, cartels and trusts. They serve the increasingly conflicting interests of different national groups of the bourgeoisie and must eventually lead to competitive anarchy and waste. The apparently defensive nature of US foreign investment is but a symptom of the process (Mandel, 1967). Other observers, stressing the welfare dimension of MNE operations in an LDC context, argue that the penetration of modern capitalistic enterprises into archaic economic structures leads to a state of underdevelopment (Furtado, 1964); this is not a necessary staging-post on the path to development at which other industrialised countries have also been detained. It is a state of stagnation brought about by the lack of any coupling mechanism that could link the economic structures of the capitalist enterprise in any positive way to those of the host country. Where the links do exist, far from being used to channel resources into the host country, they tend to drain it of whatever scarce skills and infrastructural resources it already possesses, leading to the phenomenon known as dualism in which a small modernizing sector waxes fat at the expense of a large traditional sector. Choices available to developed capitalistic societies in their early phases are no longer open to LDC's if only because of the existence and pervasive influence of the former today. A century ago, MNE's, with their market power, their mobility and their technology, were not yet around and even where some positive welfare effects can be conceded to them, the price paid for these in terms of dependency is a heavy one to bear for countries that have known colonialism.

In his later writings, Stephen Hymer (1972) argued that the basic relationship that the international division of labour had created between countries was that of superior and subordinate: the head office and the branch plant. Under this dispensation those unfavorably disposed towards MNE's see few if any welfare gains on offer for LDC hosts. Neither the technology nor the products they bring are appropriate to local conditions, income levels, and factor price relationships (Johnson, 1970). They minimize their foreign exchange contribution by borrowing funds locally and crowding out more needy cases, and the monopoly price they charge for their technology 'package' hardly amounts to philanthropy.

Frances Stewart (1977) has laid bare the technological selection mechanisms which are used by foreign firms and which, in LDC's, contribute to the creation of dualistic economic structures. Local factor availability is not a constraint on the technical choices of such firms which can buy directly from, or through, their parent organizations and have therefore, little incentive to adapt their technology to local circumstances as it evolves. From the start, the technology used is developed country technology. With growth and development of a firm's local operations its local technology will change in the direction it would have taken in a developed economy, responding to opportunities of achieving economies of scale, automating processes that will render operations more controllable,[3] and increasing the capital intensity of its activities wherever this proves feasible. A successful venture becomes one in which a manager has succeeded in adapting his proximate local environment to the needs of his production activities, taken as a given, rather than the other way round. The disproportionate claim on scarce local resources imposed by this strategy will be met by the traditional sector. The dualistic pattern that ensues is therefore a direct consequence of the firm's decision to adopt an advanced country technology.

Yet if MNE's have their critics, they also have their defenders. For some, they are important catalysts in the development process of nations, providing essential inputs at a volume and in a time span that more leisurely "arms' length" trading relationships could not hope to match. They reached their present size, it is argued, by outperforming the market in those transactions they have internalized and if, in so doing, they have crossed national boundaries, this has often proved to be a stimulus to efficiency, emulation, and competition. In developed economies it has also been a stimulus to innovation.

Innovation, and, more generally, economic development, each follow a growth path which approximates the shape of a logistic curve (Rostow, 1960; Mansfield, 1968) characteristic of certain self-regulating systems. A link between them was forged by Jacob Schmookler (1966) who showed a lagged, but positive, relationship between the rate of growth of demand in a given industrial sector and the intensity of inventive activity within it. Furthermore, as a country's capacity to absorb technology grows through

education, infrastructural investments, and so forth, so does the vigour and scope of its international technological exchanges (Michalet, 1976). The phenomenon tends to favour late-comers to economic development who can enjoy the double external economies of not having to pioneer the technologies they import, and of avoiding the transition costs incurred in shifting from an existing technology to a new one (Eames and Rosenberg, 1971). MNE's are the transmission belts for such benefits. Where they fail to function, it is said, the fault lies with the way the machine has been operated and not with its basic design.

Whatever the judgement one may form on the ultimate value of MNE's to their host countries, and however one views their intentions or their behaviour, all are agreed that the source of their legitimacy, and hence of power for their control, must now be clearly identified and institutionalized.

It would not do much violence to the facts to suggest that those who view MNE's with suspicion or hostility have tended to favour their regulation by governments or international bodies, and those who grant them some redeeming virtues have shown a preference for a self-regulating approach (through voluntary codes of conduct, guidelines, etc.). For the latter group, many of the admitted abuses of market power by MNE's could be taken care of by fostering the development of efficient markets both in host countries themselves and at an international level. The fair trading principles that have evolved over time in a number of industrialized countries could now be applied internationally. For the former group though, this still leaves the dice loaded in the MNE's favour; they seek 'positive discrimination' against MNE's to the benefit of LDC's and a greater political and economic control of their operations by host governments. These two groups, we may call them the pro-MNE's and the anti-MNE's, adopt different approaches to the bargaining process that brings together firms and host governments. The pro-MNE's would like to see the rules of the game preserved, but more fairly applied; they consider underdeveloped market structures as creating opportunities either to bend or ignore the rules. Improve the functioning of markets, they will argue, and many of these abuses will disappear. The anti-MNE's claim that the rules of the game were written by the winners in the first place and that consequently, the cause of 'fairness' would be better served by changing them than in applying them, however zealously.

Both pro and anit-MNE's, however, see a greater part for host governments to play, whether in policing new or existing rules of the bargaining process, or as direct participants in the process itself. A number of free market economies such as the US or the UK cast their governments in the role of rule maker and umpire leaving the bargaining directly to the firms and the outcome to be determined by market forces. Mexico exemplifies the second option. With the help of UNIDO in 1973, it modelled its legislation on technology transfer on US anti-trust laws, creating the National Technology Transfer Registry Directorate within the Ministry of Trade. By requiring all technology contracts with foreign firms to be submitted to government approval, the state gives itself the power to modify the terms of any technology bargain struck between domestic and foreign firms. A similar approach has been adopted by Andean pact countries (decisions 24, 84, 86) in an attempt to 'unbundle' imported technology and acquire it, piecemeal, on more favourable terms. At a global level, the UN Program of Action for the establishment of a New International Economic Order has also pursued the second option, producing an International Code of Conduct for technology transfer for deliberation at the 1975 UNCTAD conference. The code, which identified and prohibited 40 restrictive business practices, was the work of three distinct interest groups: the group of 77 representing the third world; Socialist bloc countries; and a group representing the OECD countries. The idea was to produce a universal code that would help to regulate the pricing and 'packaging' of technology in such a way as to favour LDC's. Not surprisingly, progress has been slow and consensus elusive.

Some Strategy Issues for the Parties

In dealing with technology, most countries that band together to counter MNE bargaining strength face two problems. The first is the classic 'prisoner's dilemma': any country that breaks rank in a confrontation with MNE's could benefit disproportionately and an unspoken-of temptation to do just this must be ever present in a grouping whose cohesiveness cannot be taken for granted. The second is more subtle. The promotion and diffusion of innovation, over the short term, present conflicting welfare objectives. The promotion of innovation, sought by the state through a patent system that

grants temporary monopolies to inventors, will reduce the rate of its diffusion for a given period of time and skew the distribution of any benefits it may yield in favour of the innovator or inventor. Push the diffusion of an innovation too far and too fast and you destroy the incentives for creating it in the first place. Some countries, however, stand to gain much more from an accelerated diffusion of existing technologies than from the creation of new ones; it gives them an opportunity to catch up while their innovating competitors slow down. For them, the nation's rank in international affairs is a constituent part of national welfare, and however else it may be defined elsewhere, Pareto optimality holds no appeal. Countries with a strong nationalistic bent may therefore take a tough line and a coalition of countries following such a line may achieve a measure of bargaining strength. But the economic and technological parity that binds them together will be temporary, so that the 'prisoner's dilemma' retains its force. Furthermore, those more tangible forms of welfare which depend upon a continuing supply of innovations will suffer as the supply dries up in response to a forced diffusion. How strong a hand a coalition of this type can play when dealing with MNE's depends on what its member countries have on offer. Nevertheless, national dignity and relative strength in the comity of nations is a value which, in itself, cannot be challenged on purely rational grounds.

The global structures through which a large number of MNE's manage their affairs worldwide lower the flashpoint for any confrontations with host countries as these push for a greater measure of managerial decentralisation to the national level and a more rapid diffusion of MNE benefits. That global structures are on the ascendent as the preferred organizational form for international operations is now becoming the conventional wisdom (Franko, 1974; Michalet, 1973; Vernon, 1976). Baranson (1978) sees evidence that some American MNE's are developing global technological strategies and designing for a world market from the start, rather than doing so for the US market initially and subsequently diffusing whatever is produced. Product life cycle theories no longer adequately explain such a strategy; the international diffusion of technologies still hot from a firm's R & D laboratories is, in fact, problematic for these theories.

If MNE-host country relationshps are best characterized using a bargaining framework, then the simple optimizing behaviour patterns suggested by conventional economic theory will not serve. More subtle prescriptions, in which the moves and countermoves of players can be anticipated, evaluated and countered will be needed. But does not a fully operational global structure in effect suggest that host country moves can be ignored, that the world is seen by MNE's as a single integrated market in which national frontiers have little or no material impact upon the way the game is played? If the concessions or side payments wrested out of MNE's by host governments are not strategic, and do not weaken the firm's posture in its central game, will a bargaining framework need to expand much beyond what is already provided by theories of oligopolistic behaviour? In short, do the moves of host countries matter anything like as much as the moves of competitors? These questions cannot be answered with any confidence as yet, but, the successful imposition of joint venture arrangements on MNE's by host governments, makes global structures less than universal, either in extent or in scope. Firms move abroad in search of different things - raw material inputs, market outlets for their outputs, or more efficient production facilities for the transformation of inputs into outputs. The first two cases give host countries far more bargaining leverage with MNE's than the third, and consequently the potential they offer for the efficient operation of a global structure may in fact turn out to be quite limited. Only in the third case is the world still an MNE's oyster. But when governments begin to move about the stage as actors, when they refuse the passive role of stage props, then the outcome of the play will be even less predictable than when the cast was made up only of oligopolists. No intelligible script has been written for such a drama by either economists or politicians; no lines are available to guide the actors through their roles.

SECTION 4: INNOVATION AND TECHNOLOGY TRANSFER

Problems of Definition

Many of the underlying conflicts between MNE's and LDC host governments would vanish if a gap was not assumed to exist between the demand and the supply of advanced country technology. In fact two gaps have been discerned. The first is purely quantitative: demand being shaped by currently available technical choices is articulated along lines that favour MNE's as sources of supply; these control and limit the technology they make available by exploiting their monopoly positions, and are therefore, the root cause of a technology shortfall experienced by LDC's. The second gap is qualitative: the technology demanded by LDC's is not appropriate to their needs; it reflects a highly skewed income distribution as well as the distorting effects of local technical standards borrowed, out of context, from industrialised countries by host governments (Stewart, 1974:81). The technical choices that ensue are neither efficient in their use of avaiable host country factors nor effective in furthering desirable social objectives, and not infrequenty they impose a scale of operation unrelated to the size of the local market. The capacity utilisation problems thereby created are by now well established (Winston, 1971; Little, Scitovski and Scott, 1970). Furthermore, the imported technology calls for advanced management methods that are unavailable locally creating a gap too large to be bridged by local talent.

The supply of technology, as the term is here understood, is a joint product of the twin acts of creation and diffusion. It brings together, within a single expression, concepts which for Schumpeter (1959) were distinct and independent: invention, innovation; and imitation. Innovation, in the sense used by Schumpeter, was more modest in scope than diffusion and only extended to the first commercial applications of a technology, not to its subsequent spread and development; this was left to imitation. The effective creation of a new technology by a firm requires its initial diffusion within the firm itself. This is an intrafirm diffusion process over which a firm must establish some measure of control if it is to innovate successfully. On the other hand, the technology's subsequent spread outside the firm represents an

interfirm diffusion process that may be only partly, if at all, under the firm's control and may depend at least as much on a would be imitator's willingness to adopt the technology in question. Yet, insofar as MNE's are perceived to be important sources of technology supply, they are often charged with both its creation and its diffusion. A failure of supply will be seen as covering both intrafirm and interfirm diffusion processes and an MNE will therefore be held accountable for both. The firms themselves are partly responsible for this view since the arguments they have advanced to justify or promote their direct investment activities have tended to reinforce it.

Neither historical nor more recent evidence, however, supports the conflating of technology creation and diffusion into a single conceptual package labelled 'supply'. Peter Mathias, for example, assessing the diffusion of British technology to Europe in the late eighteenth and early nineteenth centuries writes:

"... there is in-built bias in setting up an enquiry to look at the diffusion of such technology from Britain to Europe which isolates a principally one way flow in what was, in fact, a very turbulent stream of change moving in different directions. The view from Russia in 1815, for example, shows French and German entrepreneurs more prominent than British in many fields (save in machine-making and cotton textiles) with Dutch and French skilled artisans present in large numbers. Estonia was largely a technological and business dependency of German groups. Germans were most prominent in the Russian Academy and as technical advisers to the government... British technology also spread indirectly; when direct exports of machinery were prohibited (if never prevented), Russian textile factories drew on French and Belgian machines, much dependent on British expertise... (Mathias, 1975:22,23).

In a more contemporary context, the disjunction between technology creation and diffusion - in this case with the accent on the early phase - is further emphasized in an OECD study (1968:17):

"There is ...one conclusion that appears irrefutable. US firms have turned into commercially successful products the results of fundamental research and inventions originating in Europe. Few cases have been found of the reverse process."[4]

The contents of the technology package on offer from an MNE may be amenable to further processing, adaptation, and diffusion with or without the firm's participation. It should not, therefore, be judged 'appropriate' or 'inappropriate' prematurely. Any bargaining between host governments and MNE's over the 'supply' of their technology, whether or not it is accompanied by an investment by the firm or takes a packaged form, impacts not one variable but three: invention, innovation, and diffusion. But if, at one extreme, practitioners have tended to treat these variables too monolithically, at the other, theoreticians - historians and economists - have often succumbed, partly on Schumpeter's authority, to the analytical convenience of treating them as discreet, sequential entities, that can be analysed and, by implication, managed independently of each other (Myers and Marquis, 1969; Grilliches, 1960; Mansfield, 1961; Shoemaker and Rogers, 1971). For many empirical studies such a simplification may be a precondition for carrying out any useful work at all in the face of the 'blooming, buzzing, confusion'[5] that characterizes the process of technical change. Yet if it imbeds itself too deeply in the conceptual aparatus, it will mask from view important systemic properties that link the three variables and seriously distort perceptions of their behaviour in space and time. The point is well made by Rosenberg (1976:193, 194):

"... we are led to treat the period after the conventional dating of an invention as one where a fairly established technique is awaiting adoption whereas, in fact, highly significant technological and economic adaptations are typically waiting to be made. It is this same fore-shortening of perspective which greatly increases our general impression of the slowness of diffusion." In short, "Any delay becomes a 'lag'." This view is echoed by Usher (1955):

"Many presume that the diffusion of technical knowledge and the application of known techniques are imitative acts devoid of novelty... these fail to recognise the pervasive novelty in our own behaviour."

Usher maintains that a major strategic invention represents a "cumulative synthesis" of many individual ones and challenges the conventional demarcation that separates the process of invention from that of innovation. To adopt an

innovation is in varying degrees to adapt it to circumstances of time and place, and this requires a measure of inventiveness, however modest, from the recipient, as well as a capacity to solve problems occasioned by a new product or device not foreseen by its creators.[6] How extensive the process of adaptation can, or must, be will depend on how far an innovation has been standardised by the time it reaches a given adopter. The early stages of the diffusion process deliver the verdict of the market on a new product or service, and, for good or ill, banish the technological, economic, and market uncertainties that make invention and innovation such a hazardous business. This reduction in uncertainty constitutes an external economy for adopters further downstream in time and space. Yet the products and processes available to them have by now been fixed and have become relatively inflexible. They may offer those features that the market wants most but no more. Also, as the market grows, it offers scope for achieving economies of scale, and thus helps to define the performance parameters upon which efforts at standardisation will converge. For these reasons the early phases of diffusion will be associated with much greater adaptive efforts than the later stages, and will call for a much more active involvement by the recipients of a new technology.

The Supply Approach

Yet, by treating the supply of technology as a block, much of the literature on technology transfer has been inclined to view the process of adaptation as having ended by the time a transfer occurred. Only established products and processes form the object of transactions, or, where this is not so, adaptation remains the responsibility of the transferor, in which case the learning it gives rise to stays exclusively in his possession. The product life cycle model presented above, implicitly takes this line by making proximity to a market and the need for producers to adapt to changing consumer demand, the cornerstone of an international theory of location. Customers, as well as competitors, are expected to take a product as given and leave the process of adaptation and standardization in the hands of the original producer. His willingness to adapt and standardize expresses his concern to hold on to, or increase, his share of a growing market. When his technological lead begins to offer diminishing returns he will hand on a standardized product to those that follow.

The economic assumptions that underlie much of the current discussions on technology transfer require well-defined products, stable production functions, and widely available information - characteristics which describe what is left of an innovation when it has long ceased to be one. The early, uncertain, formless, adaptive phases of a product's life cycle have been treated in the literature on innovation, but have tended to be ignored by the economic literature on technology transfer. Yet, economic historians have been at pains to point out the marked influence exerted by the movement of individual artisans, specialists, and technicians, in the early stages of a product's technical development, when much innovation and adaptation was still needed. According to Usher (1955): "The beginnings of commercial application precede the full accomplishment of the secondary invention. In many instances, even the major invention remains to be achieved; in other cases the process of critical revision is conspicuously incomplete. The implications of Schumpeter's analysis suggest the opposite order of development: the completion of the secondary invention is represented as preceding the entrepreneurial work on application."

In a trade-based view of technology transfer, any malfunctioning of the transfer mechanism could be accounted for by referring to imperfections in the factor markets or to the dynamics of industrial organisation which would lead to market failure. The essential point is that such failure arose from the behaviour of technology suppliers.[7] Demand, its nature and extent, could be taken as given. An absence of demand posed problems, to be sure, but these addressed the issues of economics development in general and not of technology transfer in particular. The technology recipient was a rigid container passively receiving the bounty of knowledge poured into him by the transferor. His capacity to absorb and give shape to what he received was fixed and limited. Far from being considered to be an entrepreneur, adapting new productive factors to local circumstances under conditions of uncertainty, he was given the Hobson's choice of a final consumer. In short, technology transfer was treated as an act of replication devoid of creative content, in which what was received was more or less matched by what was transmitted, and since the object of such replication was standardized and well defined, the cost of its diffusion, or that of the information that described it, could be taken as negligible. Thus, any shortfall in what was actually received would

be naturally attributed to restrictions on the supply side, whether institutionalized in patents and trademarks or exercised by some other means. Today, monopolistic and oligopolistic explanations of transfer failures, have acquired the force - some would call it inertia - of self-evident truths.

The Adaptation Approach

Admitting creativity and adaptation into the equation brings about a significant shift in perspective. Firstly, any transaction involving a new technology will embody a higher information content and will be subjected to a greater level of uncertainty[8]. Secondly, for the recipient to be active and adaptive in the transfer process, he must be capable of absorbing the higher quantity of information involved. Thirdly, what is transmitted and what is received will be perceived by the transferor and the recipient respectively as two different things. Finally, and as a consequence of the foregoing, insofar as it goes beyond replication, diffusion will not be costless. It follows that such transactions will be riskier and therefore, more likely to end up in failure, and one can reasonably surmise that the allocation of the attendant risks will be a matter for bargaining between the transacting parties.

The risks can be reduced if the transferor of a given technology takes the trouble to teach a recipient how to use it and adapt it to his requirements. But this will take him beyond the 'arm's length' low-cost information transmission that the sale of a standardized technology allows, and he will have to develop an understanding of the recipient and his problems. Yet, this he may do to an extent that gives him a singular bargaining advantage in negotiating the allocation of transaction risks which his involvement was initially intended to reduce. Thus, technology transfer operations that aim to go beyond mere replication - and these are the ones that are increasingly sought by LDC host governments - must devise transaction modes that motivate the transferor's involvement in the recipient's problems of adaptation without allowing him to press any bargaining advantage he thereby acquires to the point of exploitation, and without saddling him with transaction costs (including the opportunity costs incurred in transferring his technology in the first place) so high that they might lead him to withdraw. That such modes

have yet to be found is evidenced by the marked preference shown by technologically strong MNE's for wholly owned operations when dealing with any but the most banal technologies. When these firms enter into transactions such as joint ventures voluntarily, they either take place between technological equals and aim at some form of technological exchange, or between suppliers and, say, distributors, or customers, operating further downstream, and more often than not only require an established technology to be transferred.

The guiding hypothesis for the study presented in the following chapters is that the transaction mode sought by those who trade on their technological strength will partly depend on how extensively the technology in question has been standardised, or, put differently, how much uncertainty still attaches to it. Whether transaction modes actually chosen effectively reflect the preferences of the parties turns on their respective bargaining skills and strengths. Either way, it is conjectured that the higher the level of uncertainty that attaches to a particular technology, the less it will be diffused, whatever the transaction mode - exporting, licensing, joint venture, or wholly owned subsidiary - through which it is channelled. Uncertainty, by simultaneously increasing the perceived level of risk and the costs of transacting, upsets the risk/return ratio that underpins the viabilitiy of transferring or diffusing a particular technology and makes the prospects of concluding a successful transaction more remote. The theoretical grounds for entertaining such a view are developed in the next chapter and explored empirically in chapters four and five.

SECTION 5

CONCLUSIONS

In this brief survey of technology transfer issues, trade theories offer essentially a bird's eye view. Coming down closer to earth, firms and industries become discernible, and the texture and contours of the landscape become distinct; climatic variations between regions are also noticeable. The change of scale does not just enrich our perception; it restructures it. Many generalizations that were thought possible from a broad trade perspective no longer apply when a narrower industry view is adopted.

It must be acknowledged that in much of this research, technology transfer itself has rarely been considered central to the concern of investigators. This is understandable. The ambiguities of meaning and the political controversies that still befog the term, as well as the absence of any systematically developed corpus of knowledge that could dispel these, both bear witness to how much painstaking research remains to be done before the expression describes anything approaching a mature field of study. For the present, technology transfer remains something of a folk science, and its insights aphoristic and unsound. The present need is not so much for new facts as such, as for the building up of conceptual structures that can subdue them. In the past few years, what started as a trickle of data has turned into a flood which now threatens to sweep away any interpretative framework erected in haste to contain it. Nevertheless, the attempt must be made and although 'theorizing' is too ambitious a term for what follows, this study aims to make a modest contribution to the theory-building process.

NOTES TO CHAPTER 1

1. The term is Kuhn's (1962).

2. Ohlin himself did not suscribe to the simple factor proportion's view of trade that had been ascribed to him. He fully recognized the importance of transport costs, economics of scale, tariffs, and taxes. His followers, however, regarded the factor proportions component of his theory as his most important contribution - certainly the one they found easiest to remember. See Linder (1961).

3. See Wells (1973).

4. Quoted in Rosenberg (1976).

5. The expressions was used by William James to describe the manner in which the phenomenal world reaches the senses.

6. For a discussion of this theme as applied to the discussion of British technology in the nineteenth century, see Landes (1969) and Rosenberg (1976).

7. An alternative treatment of the "supply side" is given in Cooper (1974).

8. The information content of a transaction is a function of the number of alternative choices it opens up. A theoretical underpinning of this somewhat paradoxical statement can be found in Shannon and Weaver (1949).

CHAPTER 2

DESCRIPTION OF THE ANALYTICAL FRAMEWORK

INTRODUCTION

This chapter develops an analytical framework that will be used to explore the field data presented in Chapters 4 and 5. It tries to make explicit the grounds for the belief that has motivated this study, namely, that the creation and diffusion of knowledge are characterised by complex interdependencies which escape conventional economic analysis but can be addressed through an approach that stresses the changing qualities of knowledge as it flows in time and space. Economic analysis is not thereby done away with; its services, however, will only be required following a further refinement of the raw materials it must work with.

The chapter builds up the framework in four stages, each confined to one chapter section. In the first, the processes of knowledge creation and diffusion are explored and brought together in a simple framework at a general level. Both in its simple and its developed form, it will be referred to as the codification - diffusion framework, or C-D framework. In the second section, the C-D framework is applied to the corporate case and for this purpose undergoes some modifications and refinements. In the third, it is further elaborated to accomodate the operations of international firms. Finally, the last section introduces the analytical apparatus of institutional economics to study the transactional behaviour of such firms within the framework, and develops a number of propositions for subsequent empirical exploration.

SECTION 1: THE C-D FRAMEWORK - THE GENERAL CASE

Introduction to the Section

This section has nine subsections. The first three deal respectively with the codification of experience, its communication, and the role that codification plays in the creation of knowledge. The fourth and fifth deal with the costs and benefits of creating and diffusing knowledge. In the sixth and seventh subsections, the C-D framework is introduced and the way that knowledge flows within it is described. The cyclical flow pattern out of which new knowledge emerges is outlined in the eighth subsection and a recapitulative summary of the main points of the section is presented in the ninth.

Codification as the Giving of Form

Any living organism, in its quest for survival, must learn to deal with its environment with some measure of economy, whether this applies to the resources it consumes or to the range of its activities that such resources must sustain. Another way of saying this is that an organism must be selective; it is driven to make mutually exclusive choices. If it is eating, it cannot be hunting; if it is sleeping it cannot be eating. Such choices are risky, their outcome, uncertain: a choice prey might escape while the predator is eating; while it sleeps it lays itself open to possible attacks, and so forth. But the risks of choosing are reduced by familiarity. The territory becomes known, and its salient characteristics, those to which the predator must necessarily attend, engrave themselves so thoroughly on the animal's perceptual apparatus that the slightest anomaly will elicit a response (flight, fight, alertness, etc.). In effect, through a learning process that started at birth, the animal has given a perceptual structure to its environment which does away with the need to respond to everything indiscriminately within its field of consciousness. Only the important and the unexpected need a response and, after a time, only they will get one. The animal has codified the chaos of data crowding its senses and reduced it to a structure that serves its needs. The structure is not discarded after use, but is retained and developed for the processing of further data on subsequent occasions.

Codification is a form-giving activity which attempts to respond to the flux of the phenomenal world by structuring it through its most accessible states in order to represent it. In this restricted sense codification is little different from categorisation; both reduce the complexity of an environment through the ordering and relating of events or classes of events (Brunner, Goodnow, Austin; 1956). Codification can take place at the level of the senses, as when the constellation of green and brown dots on a canvas suddenly resolve themselves into the foliage and branches of a tree as one steps back from a painting; it can be behavioural, as with the mime who, in a few facial gestures, can convey to a large audience any one of the 250,000 expressions that the human face is capable of (Birdwhistell, 1973:8); it can be conventional, as with a language that provides a limited set of rules for expressing infinitely many thoughts and responding to infinitely numerous situations (Chomsky, 1965:6); and finally, it can be highly abstract and removed from immediate perception, as in the case of a price system, which can signal, in a summary form, subtle changes in the quality of a product or in the technical conditions of its supply.

Complex phenomena are more difficult to codify than simple phenomena: their most accessible states are not necessarily the most representative. In a complex system the properties of the parts, and of their interaction, allows no simple prediction concerning the properties of the whole (Simon, 1969:86). Complexity thus makes for uncertainty.

Any process of codification involves some loss of information. By selecting the most accessible among a set of possible states as a basis for classification or coding one is denying oneself any ready reference to states not so favoured and these may become lost to view. By such a process of classification, objects are identified which may differ from one another in every particular (Polanyi and Prosch, 1975:51). Plato and his school were greatly troubled by this problem. In the philosophy of idealism he found a justification for believing that the information lost was not, after all, worth bothering about. Yet, in this less-than-ideal world, such a loss of information increases the chance of error in achieving a faithful representation.

An example will illustrate the point. Two people, who know each other, arrange to meet under the large clock in the main concourse of a railway station. They have no difficulty finding and recognizing each other, even if one of them is standing somewhat at a distance from the clock. One may recognize the other from afar by his gait or his posture and, as he approaches, by his physiognomy. Yet, if they have never met before one may have suggested to the other beforehand, "You will recognize me by my red hat." If two people now happen to be wearing red, or off-red hats in the vicinity of the clock, confusion will most likely occur. A single representative element, the red hat, replaces the more extensive and uncodified information available to a familiar acquaintance as the basis for responding. Nevertheless, if the chance of error was increased by codifying the encounter, the prior process of search and selection itself was simplified: two parties, which had never met before, had a better chance of doing so without undue inconvenience in the transient and crowded environment of a railway station. In sum, complexity can be reduced by a process of codification, but the amount of information lost on the way increases the chances of an error occurring. Effective codification will allow some prediction in spite of the loss of information, and, within certain limits, will help to anticipate and respond to complex events that are not, in fact, fully grasped (Kelly, 1955:11,46). Complex events that remain uncodified, on the other hand, may well elicit no response whatever and, indeed, may not even be perceived. Here, the risk of error in formulating a response resulting from crude attempts at codification must be balanced against the risks inherent in a failure to respond at all.

Codification in Communication

Codification, by giving form and structure to the phenomenal world, makes it accessible to communication processes. A tree is a more tractable object of discussion than the variable cloud of green and brown dots referred to above. It can be discussed with little danger of ambiguity even when not immediately present to the senses always providing that there is prior agreement among the parties that the word "tree" will invariably stand for "green and brown dots" in a given context (i.e., they should hover a few feet above the ground, rustle in the wind, etc.). In this sense a code must be shared if it is to serve the purposes of "collective representation"[1]; it must result from a

social convention, consciously or unconsciously developed, stipulating that phenomena will be subsumed under representative signs in particular ways. The signs available for the process of codification form a repertoire that address a finite range of events or experiences only. No amount of verbal description of the self-portrait by the later Rembrandt, for example, will adequately replace its direct contemplation. Conversely, it would be quite impossible to convey the discursive complexities of a building contract through a painting. A community, nevertheless, extends the realities within its reach by developing new codes and adding these to its existing repertoire of codes.

Very few of the codes used by an individual are created by him. Most are made available from a pre-existing community stock, and they will help him to construct a world that is familiar to his fellow men. The codes shared by the members of a community over time build up a sediment of shared perceptions of existing phenomena and will predispose them to respond to new phenomena in similar ways[2]. In this sense, codes can be coercive. They shape attitudes and expectations and limit the range of responses to phenomena to something that falls far short of what is conceivable. Thus, the road to prejudice is paved with codes.

Codified knowledge, by drawing on shared conventions, is diffused within a community, and, to varying degrees, becomes public knowledge. The medium of transmission used may be written or oral, and is subjected to a measure of control which reflects the potential importance of the information itself as well as difficulties of identifying sources of its transmission as the communication network grows. For example, many oral traditions show a concern for the accurate retransmission of that knowledge vital to the life of a group; a system of sanctions and rewards is developed to control public recitals which only certain members of the group are allowed to perform; also, their attendance is often restricted to specific subgroups (Vansina, 1973:34).

Uncodified knowledge, on the other hand, has much more limited possibilities of diffusion; it is tacit and personal (Polanyi, 1958) and represents an accumulation of experience over time, the outcome of "learning by doing", that can only be shared with those that have partaken of the experience itself. This is the kind of knowledge that is transmitted from master craftsman to

apprentice by force of example over a number of years; it yields insights which cannot be effectively diffused by other than time-consuming interpersonal means.

Sometimes personal transmission is required by the fact that the knowledge involved is only partially codified or uses a combination of communication channels (sight, sound, touch, etc.). The possibility of errors creeping in increases and can only be reduced by a process of feedback between communicators ("Have you understood?"; "Shall I repeat the demonstration?"; "Let me draw it for you on the board", etc.). As a general rule, the more adequately the totality of a message can be encoded and transmitted through a single channel, the more easily it can be conveyed by impersonal means such as books, newspapers, diagrams or tapes.

Codified and uncodified knowlege do not exist in separate compartments of the mind; they form a continuum which indicates how far a given experience has been articulated into meaningful categories. For example, a chemist, a doctor, an art dealer, and cloth merchant, each acquire part of their knowledge from a repertoire of codes generally available in textbooks; but these texts will avail them little without an attendant training of the eye, the ear, and the sense of touch (Polanyi and Prosch:43). Both types of knowledge are brought to bear on new experiences, and through their interaction, existing codes and categories are modified and the possibilities for creating new ones emerge. The experiences most frequently shared by a group or most central to its concerns will receive more articulation and hence will more likely be codified; less immediate experiences will remain less formulated. The process is continuous, involving an on-going confrontation between the uncodified personal knowledge of the individual and the more codified public knowledge of the group or groups to which he belongs. At the margin, personal and public knowledge are competitors for the community's investment in the codification effort. How far one gives way to the other depends on the resources available to both individual and group respectively for exerting pressure on each other[3]. Either way, the outcome is rarely a uniform distribution of knowledge throughout the social space. Not only do people's personal experiences differ, but not everyone has equal access to the community stock of codes: esoteric knowledge may only be available to a priesthood or an aristocracy; technical

secrets may be jealously guarded by a given occupational group; certain forms of speech may become the cement that binds a socioeconomic group together[4]: and so on. In this way the diffusion of codified knowledge is constrained by the erection of social and institutional barriers.

Codification as the Creation of Knowledge

At certain critical moments in a community's life (Kuhn calls them crises[5]) their repertoire of codes fails them. Either new phenomena, which cannot be filtered through existing codes, press an urgent claim on the community's attention, or available codes, developed independently of each other to serve different purposes, display critical inconsistencies when brought together, which eventually sap their credibility. Societies differ in their capacities to tolerate such failures of their systems of collective representation. Abnormalities and inconsistencies arouse anxieties in proportion to their ability to threaten the established order of things, the fragile edifices of meaning that give coherence to habits, customs, efforts, sacrifices, pleasures, and pains. Some communities absorb the threat, and cocoon it in myths and explanations designed to neutralise or capitalise on its more potent attributes; some fence it off and through a system of taboos make it unapproachable[6]; others slowly and painfully seek out new codes or attempt to refashion existing ones in order to confront the threat head on. The same community may react in any one of these ways at different times, but only the last mentioned course of action actually involves the creation of new knowledge.

The development of science in sixteenth and seventeenth century Europe offers well-documented examples of how different interest groups attempted to cope with the failure of a Ptolemaic cosmology to meet the changing demands that were confronting it. That the system was shaky had been implicitly acknowledged since the time of Nicholas of Cusa[7] but it was only when Copernicus cast the heliocentric theory in a specifically mathematical form, and in effect codified it for public transmission with the publication of "De Revolutionibus Orbium" in 1543, that the threat to the Ptolemaic system was made explicit. Yet, if the older cosmology was threatened, the one that was

being groomed to replace it was hardly ready to take up its duties. In the course of its elaboration, it met considerable opposition from the Church which saw a serious challenge to its spiritual authority in the contingent universe that was emerging, and it was not until the advent of Newton that its triumph was complete. Before this, a whole new generation of scientists -Beeckman, Mersenne, Gassendi, Descartes, de Roberval, Torricelli, Pascal, Huygens - had had to develop the new mechanical philosophy, the mathematics, and the observational tools without which the scientific revolution would have been impossible (Butterfield, 1957:71,89). In effect the Ptolemaic paradigm was not killed off by an unchallengable empirical refutation; it was pensioned off when a replacement eventually became available and no further employment could be found for it (Kuhn, 1962:77).

The change that took place, according to Keith Thomas, was not so much technological as mental:

"The triumph of the mechanical philosophy meant the end of the animist conception of the universe which had consitituted the basic rationale for magical thinking... the epistemological demand for certain knowledge was eroding the status of every kind of magical belief" (Thomas, 1973:771).

But this quest for certainty required, in turn, a new approach to uncertainty: "Contemporaries showed more of that ability to tolerate ignorance which has been defined as an essential characteristic of the scientific attitude" (Thomas, 1973:790).

It was this capacity to tolerate ambiguity over a prolonged period that allowed the new men gradually to dissolve the specious theologically-based certainties of the medieval world-view and to reconstruct afresh by "putting on a different kind of thinking cap" (Butterfield, 1957:1). Medieval science was the product of literary transmission and was taken over as a heritage from ancient Greece and Imperial Rome. The new science achieved supremacy by relinquishing this ready made stock of codified knowledge and by seeking out a new basis for codification in observation and experiment. The most articulate spokesman for this approach was Francis Bacon.

The Cost of Creating and Diffusing Knowledge

The process of codifying and diffusing new knowledge is costly, whether measured in time, effort, anguish, or money. The Heliocentric theory took a century and a half to triumph over its rival, and its final victory rested upon the untiring dedication of a large number of people who made it their life's work. Often toiling in isolation, they had to fight the vested interests of those who stood to gain from sharing with the Earth a position at the centre of man's universe.

The codification of new knowledge is a form of problem-solving, of devising reliable and specific solutions under specific circumstances. The costs of codifying are the costs of searching, identifying, testing and evaluating possible solutions - and starting again! The process is iterative, and, where successful, it becomes convergent: the range of possible outcomes to the problems addressed narrows over time and eventually leads to a "puzzle-solving" activity which, for Kuhn (1962) characterizes "Normal Science". As the early uncertainties of the search recede, the systematic nature of the phenomena under investigation became increasingly apparent and gradually crystallize into a new model - a Paradigm - that serves to guide and give coherence to future research:

"... One of the things a scientific community acquires with a paradigm is a criterion for choosing problems that, while the paradigm is taken for granted, can be assumed to have solutions. To a great extent these are the only problems that the community will admit as scientific or encourage its members to undertake." (Kuhn, 1962:37).

In effect, the acquisition of a paradigm marks the onset of maturity in a given field of inquiry.

The costs of diffusing newly codified knowledge on the other hand, however varied the process may appear at different times and places, are essentially those of overcoming the three fundamental problems of communication first identified by Claude Shannon in 1949.

1. The Technical Problem - how accurately can the information be transmitted?
2. The Semantic Problem - how precisely does the transmitted information convey the desired meaning?
3. The Effectiveness Problem - how effectively does the received meaning affect conduct in the desired way?[8]

The three types of problems can be illustrated with the help of a simple example. An Englishman is sitting at his desk on a rainy day writing a report when suddenly the doorbell rings and a soaked and tattered telegram is delivered by the postman. It is written in Greek, and asserts that cats are quite fond of sugar on their fish. If the state of the document is such that the letters are erased, the recipient has a technical problem, the information received is not the same as the information transmitted. Furthermore, if the Englishman speaks not a word of Greek, the desired meaning will not be conveyed and he has a semantic problem. Finally, unless he owns a cat or happens to be writing his report on catfoods, he may well be at a loss as to how to respond effectively to the information received - the effectiveness problem. Clearly, the channel selected for this kind of message, although highly cost-effective in other circumstances, is inappropriate. The sender would have fared better, although at a much higher cost, had he come in person, bringing an interpreter with him.

Likewise, newly codified knowledge remains somewhat vague and is as unfamiliar to potential recipients as the information just described. Its diffusion also creates technical, semantic and effectiveness problems which can only be overcome at comparatively high costs. Over a period of time such knowledge becomes further systematized and codified and acquires a form more amenable to communication thus alleviating the technical problem. It also becomes familiar to a wider community, and so, simplifies the semantic and effectiveness problems. The costs of diffusion begin to fall, and the process, feeding on itself, is accelerated.

The Rewards of Knowledge Creation and Diffusion

Rarely does anyone knowingly incur the costs of creating and diffusing new knowledge without expecting some kind of benefit from the process. To be sure, it often happens that the costs - financial and human - are seriously

underestimated or only vaguely apprehended by those involved (as indeed are the returns on occasions), but this is only to suggest that expectations are not always well founded, not that they do not exist.

For some, the efforts and pains of research will be amply rewarded if they lead to the recognition and prestige that attend a major discovery or a breakthrough in the field. For others, untold wealth lies at the end of their rainbow should they succeed in establishing the viability of a new technical process or product. In certain instances, the community as a whole may sponsor the creation of new knowledge in response to a pressing problem faced by its members. What distinguishes the first two cases from the last one is the problem they pose concerning the appropriability of benefits. Simply stated, the problem arises following the successful codification of new knowledge, when it has been put in a communicable form by its creator, but control of its diffusion is not in his hands. In such a case, the creator of new knowledge cannot capture the fruits of his efforts since what he has to offer may now already be freely available to others. Where the community itself is the originator of new knowledge, on the hand, investor and beneficiary are one, and no immediate problem arises. Even if another community were freely to benefit from its efforts, it could still achieve a fair return provided that these external benefits are not obtained at the expense of those accruing to itself, as might happen, for example, if the two communities were trading in goods, the production of which depended on such knowledge. But in the first two cases, investor and beneficiary are rarely the same person or group, and institutional means have to be devised for securing a fair return on the risks and efforts involved in the creation of knowledge if further efforts are not to be discouraged.

Over the last three centuries two institutional devices have evolved to secure the protection of intellectual property. The first,the research report, authenticated by publication in a specialist journal, establishes a priority claim to the creation of disembodied knowledge. The property comes into existence upon publication, that is, when it is put into a form that makes it available for use by others. Payment for the use of this property takes the form of a citation which publicly attests the quality of the work. An accumulation of citations thus offers a measure of recognition and prestige

to the author of a research report (Ravetz, 1973:245-247). The second, the patent, establishes a priority claim to the creation of knowledge embodied in some product or device. Here, publication also creates a property right, but this time by defining knowledge which is not available for use by others. A temporary monopoly is granted the holder of the patent, allowing him to exploit his discovery commercially; this he can do directly or indirectly through licensing.

Both the research report and the patent, by institutionalising the publication mechanism, conditionally place control of the diffusion process in the hands of the knowledge creator, thus allowing him, by operating the barrier to diffusion, to make the fruits of his labour an object of exchange. In the case of disembodied or abstract knowledge, information is exchanged for recognition by colleagues (Hagström, 1965); in the case of a new technical process or product, information is exchanged for temporary monopoly profits. In both, the adequacy of the claim that new knowledge has been created is tested by encoding it in a form acceptable for publication, and its value is tested by the use to which it is subsequently put (Ravetz, 1973:274).

The institutionalisation of intellectual property rights marks the transition from a perception of knowledge as belonging solely to a tradition to one in which it could belong to an individual. That the protection of intellectual property, by the seventeenth century had become of major concern to scientists, is attested by the virulent disputes that arose between them on occasion over priority claims. Galileo, Hooke, Huygens, and Newton, each at some time or other, had recourse to the use of the anagram to stake a priority claim for their work: they would publicly state their results in an undecipherable form pending full confirmation at a later date (Ravetz, 1973,249). Yet, until that time, knowledge had not been thought of as the product of an original mind; it had a prior existence and had been fully available to the ancients. It only awaited rediscovery. Those who sought knowledge did so to validate a claim that they were participating, like the alchemist in an ancient tradition, not that they were being original. Indeed, such was the force of tradition, that much original work had to be published as the rediscovered texts of old masters if it was to gain any recognition at all (Ravetz, 1973:247), and in the field of theology, little could be advanced that did not appear to be sanctioned by the early Christian Fathers.

The C-D Framework: An Outline Presentation

The discussion so far has argued that there is some positive relationship between the extent to which knowledge is codified and the extent to which it is diffused, and that this can be evidenced by the fact that institutional barriers have to be set up to bring the diffusion of newly codified knowledge under some kind of control whether for economic or social purposes. The phenomenon has only been granted recognition at an implicit level in the historical and economic literature and does not appear to have been subjected to systematic treatment except in the most general way as a branch of phenomenological analysis (Luckmann and Berger, 1967; Schutz, 1973; Schutz and Luckmann, 1976). The framework presented below and further developed in the second and third sections of this chapter attempts to set out the basis on which systematic treatment could be developed. Its initial aim is to condense into a simple and unified representation the phenomena so far discussed.

The two concepts that have been discussed, namely codification and diffusion, are each presented as a dichotomised dimension of the diagram in Fig. 2.1. When cross-classified, they yield the following four types of knowledge available to an individual or a group:

A: Personal Knowledge - the tacit knowledge that is unique to an individual or subgroup as they accumulate experience, but that remains mostly uncodified and undiffused.

B: Proprietary Knowledge - knowledge that has been codified, but that has not as yet been diffused; it constitutes a private repertoire of codes.

C: Textbook Knowledge - codified knowledge which has been diffused and is therefore available as part of an established repertoire in the public domain.

D: Public Knowledge - the tacit knowledge that all those who partake in the culture of a given group or community are presumed to share.

The dichotomising which has produced these four distinct classes is only an analytical convenience; in reality, the dimensions involved are continuous. Both the processes of codification and diffusion are matters of degree and can therefore be subjected to much finer gradations than are attempted here.

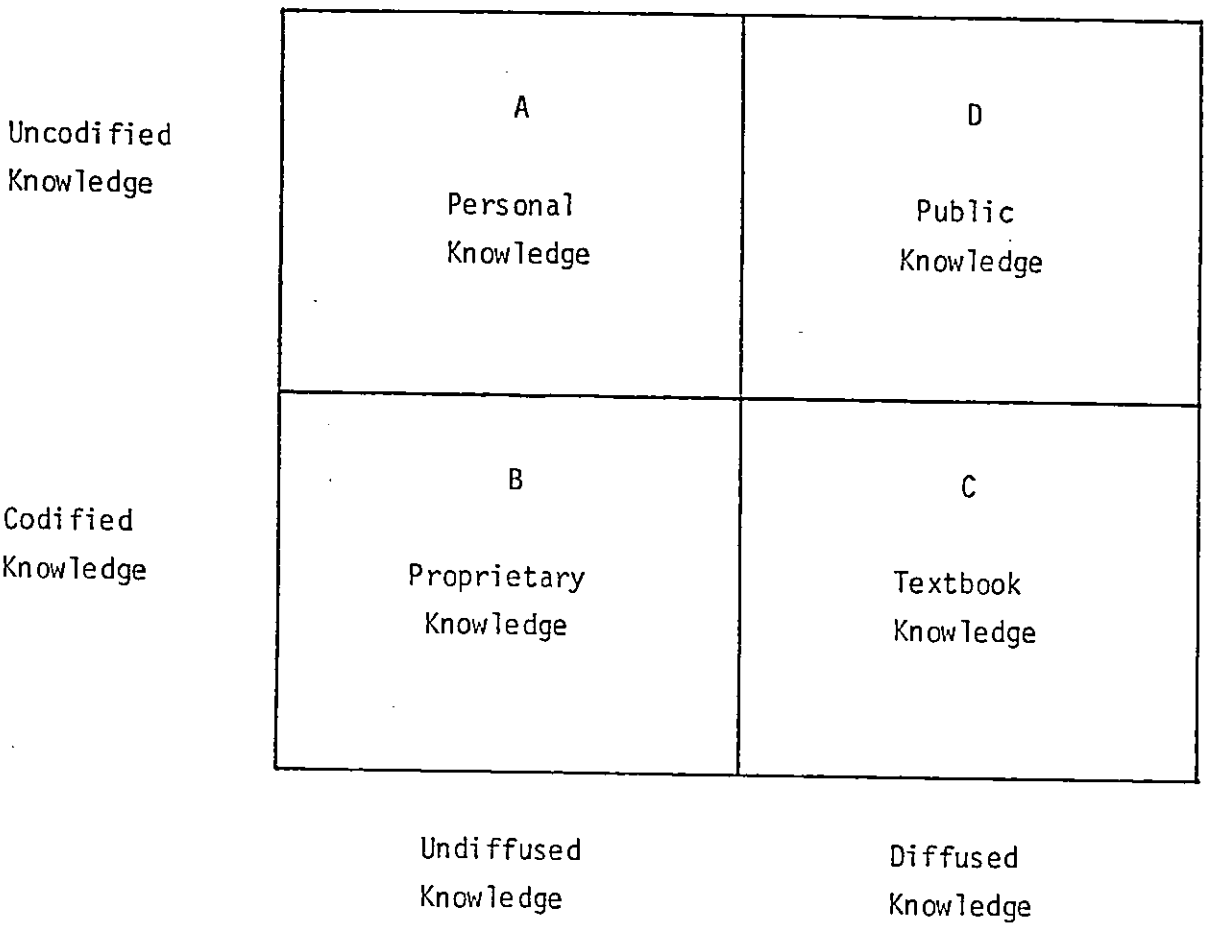


FIGURE 2.1

THE C-D FRAMEWORK - THE GENERAL CASE

Nevertheless, this simple framework allows a description of the way that the knowledge accumulated by an individual or subgroup can be distributed at any given moment in time. What stands in any of the four quadrants constitutes their total investment in knowledge, and since, over time, an item of knowledge can flow from one quadrant to the other, the investment pattern will be modified. This flow of knowledge must now be examined more closely.

The Flow of Knowledge

1- Codification - Any downward movement in the diagram from A to B or from D to C describes an attempt at codifying what has hitherto been experienced as tacit knowledge. Experience is gradually rendered systematic and structured, and eventually can even be routinised and programmed. This is the habit-forming operation through which cognitive and behavioural skills are learnt and built up. An upward movement from B to A or from C to D, conversely, describes an opening up to experience, an escape from the rigorous impositions of the available repertoire of codes and the preconceptions through which they filter experience. In fact, the escape is never quite successful and to every new experience one brings consciously or otherwise a disposition to encode it along the lines of least resistance, in the first instance usually through one's mother tongue.

An experience unfolds over time through a continuous commerce between codified and uncodified knowledge; these interact and modify each other in ways that weaken or reinforce the existing structures through which the experience itself is processed. The interaction between the codified and tacit knowledge possessed by an individual affects all the experiences he can have and infuses them with an indeterminate mixture of the two types of knowledge. In many situations he will not be able to locate the point at which articulate discursive processes shade off into intuitive "hunches", since it lies in a kind of no man's land between the two ways of thinking. Increasing doses of doubt or certainty will infuse his experiences and at the extremes, agnosticism or dogmatism can cloud any judgement that they invite.

When this vertical traffic up and down the diagram occurs on its right hand side, a communal form of learning results: tacit knowledge, widely shared, encounters a publicly available stock of codes in situations as various as the classroom, the boardroom, and the building site. When it occurs on the left hand side of the diagram, the kind of learning that takes place is unique and may, by degrees, separate the individual or subgroup from the wider community. But working in relative isolation, and possibly less constrained or influenced by more conventional thought processes, such isolations stand a better chance of producing genuinely new knowledge. In its formative stages, radically new knowledge is inherently implausible (Popper, 1959) and for this reason its development will not find much popular support. Indeed, in some cases, its creation and diffusion may be actively opposed by the wider community.

2- Diffusion - Diffusion is a horizontal movement. In the top part of the diagram it requires direct interpersonal contact since knowledge has not been codified and will most likely be transmitted by example. In the bottom part of the diagram codified knowledge can travel by impersonal means in print, picture, tape, product, etc. Uncodified knowledge will travel more slowly than codified knowledge; not only will each communication act require more time for demonstration, the reception of feedback, repetitions, learning, and so on, but it will at best, be addressed to a small group of people in a face-to-face situation. Codified knowledge, conversely, can more readily take the form of a mass broadcast in which a large target audience is reached simultaneously. The costs of diffusion per recipient will be lower in the latter case, but the knowledge transmitted will have to be more standardised, and, by implication, less complex and uncertain.

Knowledge travelling from D to A or from C to B is already public; it flows from large social aggregates to smaller groupings or from groups to individuals. Its subsequent processing may remain undiffused and hence takes place on the left of the diagram. The information conveyed may describe pressing social, technical, political, or moral issues that beset the wider community. The move from C to B, in this way, will convey well defined problems or opportunities - an energy shortage, rising food prices, high infant mortality rates, the discovery of a new x-ray star, etc. - through

communication media designed to handle codified information, such as the press, specialist journals, radio, television, etc. The type of information transmitted from D to A, however, is much less tangible, and, as suggested above calls for interpersonal processes. Sometimes the issues and problems identified through this kind of transmission can be described as no more than "gut feelings", "hunches", or intuitions. They are no less knowledge for taking this form and when they encounter an individual's idiosyncratic outlook, skills and experiences, they are no less capable of generating the radical new insights from which durable and reliable knowledge eventually emerges. New knowledge, however, codified and uncodified, always travels from left to right in the diagram and describes a diffusion process from singular sources.

Any movement from one quadrant to another adds to the total stock of knowledge and involves a cost which may be reckoned in time, effort, or money. The movement upwards entails the cost of acquiring and absorbing experience; the movement downwards that of codifying new knowledge from such experience. Horizontal movements incur communication costs which are likely to be higher per recipient in the upper part of the diagram than in the lower. The very ease of diffusion of codified information leads to institutional attempts to control diffusion for exchange purposes in the form of barriers erected between B and C. Thus, costs incurred in creating new knowledge - movement from A to B - are recouped in exchanges made possible by a diffusion barrier set up between B and C. The barrier to diffusion could be a patent and the return on investment in knowledge creation could be financial; or the barrier could operate through the rules of publication and the returns could be tallied in citations and recognition from peers.

The Knowledge Creation Cycle

The flows of knowledge through the four quadrants, as described, have a random character that probably characterises their behaviour at any given moment when analysed in an atomistic fashion. Over time, however, and in the aggregate, flows appear cyclical and move counter-clockwise from quadrant to quadrant. Knowledge which was tacit and personal to individuals, may become

proprietary to their successors, textbook knowledge to their children, and mere common sense to their grandchildren. The resulting cycle is, in effect, an idealisation of what happens in reality since much movement either peters out, giving way to new flow patterns or leads up the innumerable blind alleys that constantly beckon on those who seek knowledge. Until recently historians of science have tended to underestimate how far a scientific field is littered with such false starts. Kuhn has observed:

> "Invariably, histories written in this way reinforced the impression that the history of science is not very interesting chronicle of the triumph of sound method over careless error and superstition." (Kuhn, 1977:149)

While the term "knowledge", as used here, covers technology as well as science, the knowledge creation cycle which will now be briefly described, restores "careless error and superstition" to its rightful place in the analysis in both cases. The cycle itself will not be tested for in this study. It is presented here and in more detail in the next section to illustrate a dynamic application of the C-D framework and to show that it can be the source of fruitful hypotheses. A test of these, however, is beyond the scope of this work.

The cycle can be broken down into a number of steps each reflecting the counterclockwise move from quadrant to quadrant.

Step 1: Need Formulation - The Move from D to A - "Chance favours the prepared mind" is another way of stating that the process of discovery is rarely entirely divorced from that of searching. Nature has not usually yielded her secrets to those who have not been prepared to expend considerable effort and time courting her, and since only the most quixotic suitors devote themselves to hopeless causes, it becomes no trivial matter to select those which offer prospects of a payoff for the efforts required. Knowledge is sought in response to problems worth solving (Ziman, 1968). These are not stacked up on a shelf waiting to be picked up according to fancy; they emerge from the deliberations of a group or a community experiencing them (Merton,

1957; Langrish et al, 1972). The majority will be the well defined routine problems that characterise Kuhn's "Normal Science". Travelling from C to B they will encounter individuals or small groups with a repertoire of codes ready to tackle them. When solved, they will add their mite to the existing fund of knowledge. Others will be less well defined, and are more likely to be the fruits of shared experiences and interpersonal processes. These move from D to A. Eluding any simple definition, such problems, when successfully resolved, sometimes become a veritable fountainhead of radically new knowledge.

It is important to note that the signals which convey problem information from D to A are uncodified, ambiguous, and for that reason infinitely slower to transmit than those conveying problem information from C to B. Signals in the upper quadrants may remain undetected for years or even decades where in the lower quadrants their transmission can often be a matter of hours, days, or even minutes - think of a stock market crash.

Step 2: Knowledge Creation - The Move from A to B - The movement of knowledge from D to A maps out the path of a stimulus to problem-solving, a need, an opportunity, perhaps a threat, that calls for some kind of response. The move from A to B maps out the path of a response; it is a slow, uncertain attempt to give shape to the pressures and experiences accumulating in A. The response does not inevitably lead to a systematic solution of problems experienced; it may, for example, amount to little more than a clearer representation of the problem itself, giving it an outline and a definition that helps to direct further work, i.e., the next move towards a solution. In Herbert Simon's words: "Solving a problem simply means representing it so as to make the solution transparent" (Simon, 1969:77). A solution to a problem is a programme for eliminating it; the stabilisation of a sequence of mental or behavioural steps that will alleviate the pressures experienced in A. Identifying the steps and their sequence moves the problem-solver out of A and into B: it requires imagination and painstaking rigour, a tolerance for the uncertainties and ambiguities that shroud the problem in A, as well as the patience that will drive it to B in order to eliminate them. In short the move from A to B - codification - requires creativity.

Step 3: Knowledge Diffusion - The Move from B to C - Knowledge deposited in B has form and stability, its fuzzy edges have been removed; it has been codified. The word "codified" is used throughout this chapter to emphasize the suitability of formalised knowledge for impersonal tranmission. If it has been received from a source already in C, this knowledge is already publicly available; while it may interact with other items of knowledge in B and subsequently acquire proprietary attributes, its own diffusion is not a problem. Knowledge coming from A is different. As yet undiffused, none save its creators are aware of its existence. It could perish with them. This nearly happened, for example, to Copernicus. A temperament much given to secretiveness and dissimulation led him to delay publishing the Heliocentric Theory for some thirty years after it had been formalised. Indeed, he received the first printed copy of his work only a few hours before his death (Koestler, 1964:121). Copernicus did not fear persecution, he feared ridicule. In his eyes, the benefits to be gained from publication did not outweigh the personal human costs.

This cost-benefit calculation is made by all those who invest in the creation and diffusion of knowledge. Today, the inventor will publish if his position is protected by a patent. The scientist will do so if his priority claim is recognized. The fear of ridicule, however, appears to have lost its force as a deterrent to publication. Copernicus was perhaps too modest.

It is in C that the social stock of codified knowledge accumulates; it is from what is available therein that knowledge can best be selected for transmission from generation to generation. This is done by institutional means, using the classroom, the lecture hall, the family, and so forth. The repertoire in C is neither an atomistic congeries of knowledge elements nor an encyclopaedic monolith that has compressed and set all experience into a single, majestic edifice. It might best be described as a collection of "subassemblies" of knowledge elements - Schutz calls them "finite provinces of meaning" - which resist a total integration and claim a quasi-independent existence from each other.

New knowledge arriving from B will either reinforce or weaken the structure of these subassemblies and be welcomed or resisted accordingly.

Step 4: The Absorption of Knowledge - The Move from C to D - A society's stock of knowledge, the extent to which it needs or achieves integration, and the rate at which it evolves and grows, all determine the social orientation towards new experiences and the social capacity for absorbing them. The faster new knowledge accumulates in C the more likely it is to bring about some restructuring of the existing stock, but since this stock, although available to everyone, is not in effect mastered or used by all except in the simplest societies, new knowledge will impact various social groups in different ways. Their respective capacities to absorb new experiences will vary as will their ability to share them. The tacit public knowledge that helps to bind people into a common culture at D will exhibit fissile tendencies under the impact of new knowledge building up in C. Society's total coverage of experience is extended by limiting and specialising that of its constituent members. But, the world views of a biochemist and a stockbroker overlap only to a very limited extend; they move, and have their being in quite different universes. Their respective opportunities, hopes and fears do not match. Consequently, the messages which they transmit back to A to complete the knowledge creation cycle will be ever more specialised and will express the perceptions and needs of a differentiated group rather than those of the wider society. In this way, knowledge passing through the cycle becomes less and less accessible to the man in the street and more the fief of specialised subgroups. The sediments of common knowledge deposited by early shared experiences such as school and "telly", are made to bear increasingly heavy, free-standing superstructures of differentiated know-how and experience, well defended against assault by outsiders, and only willing to admit the acquiescent acolyte.

In the knowledge creation cycle just outlined, only the horizontal flows of well codified knowledge between B and C are visible. They are also the fastest. By contrast, the absorption of knowledge and its consolidation through experience, the transmission of new problems and opportunities it provokes, and the generation of new knowledge that ensues - moves in the cycle from C through D back to A and B - are both hard to discern (being either undetectable or undiffused) and slow. In effect, what one generally sees of the creation and diffusion of knowledge is just the visible tip of the iceberg.

Summary

The main points presented in this section can be summarized as follows:

1- Codification skills are basic to the processing and communication of existing and new experience; when their application is institutionalized they become the key to the creation and diffusion of new knowledge within a community.

2- A C-D framework can offer an integrated representation of the state of knowledge codification and diffusion at different levels of social aggregation. Cognitive profiles of individuals, groups, or communities, can be built up in this way.

3- The flow and metamorphosis of knowledge over time - i.e., its dynamic behaviour - can be traced within the framework. In the case of new knowledge, it is seen to follow a cyclical counterclockwise pattern decomposable into a number of identifiable steps:

1. Need formulation.
2. Knowledge creation.
3. Knowledge diffusion.
4. Knowledge absorption.

SECTION 2: THE C-D FRAMEWORK - THE CORPORATE CASE

Introduction to the Section

The C-D framework presented in the preceding section will now be adapted and applied to the corporate case. The dichotomy that has been used to present a polarised relationship between the cognitive attainments of an individual or small group and those of the wider society, to which they belong, will be be replaced by a trichotomy that links somewhat more narrowly a social construct - the commercial organization (Crozier and Friedberg, 1977) - to some of its relevant publics. The exchange conditions that govern the production and diffusion of new knowledge now becomes a central feature of the analysis. The section divided into six subsections. The first two explore codification and diffusion in a corporate context. Subsection three presents a number of possible knowledge creation cycles one of which is described in detail in subsection four. Its implications are discussed in subsection five, and a recapitulative summary of the section as a whole is offered in subsection six.

The focus throughout this section will be on intrafirm processes - the codification and diffusion of knowledge within the firm. Occasionally, reference will be made to knowledge flows across the organization's boundaries, but a fuller treatment of this interfirm phenomenon is reserved for Section 4.

Codification

The flourishing of contingency theories of organization in the 1960s (Burns and Stalker, 1961; Woodward, 1965; Lawrence and Lorsh, 1967) pays a belated tribute to the experienced complexities of organizational processes whilst at the same time rebelling against the conceptual regimentation of earlier theorists such as Frederick Taylor and Henri Fayol. The belief that there was "one best way" of addressing all organizational phenomena, was a para-military legacy which reduced all organizations to the uniforms designed to parade them in. With the new theories, the organization became less of a proverbially stereotyped chinaman and more of a differentiated personality,

the product of an individual history, a specific environment, a unique technology, a complex set of objectives, and so on. In particular, the uncertainty and complexity of task and environment emerged as important determinants of organizational behaviour both within and between subunits (Hall, 1962). In their study of twenty firms in the Scottish electronics industry, Burns and Stalker (1961) could categorise organizations as 'organic' or 'mechanistic' according to how far they felt constrained by uncertainty, organic forms being more appropriate to changing conditions and the occurence of unforeseen events. Lawrence and Lorsch (1967), in a survey of six firms in the plastics industry, were also able to rank organizational subunits by the uncertainty they generated. Executives in the innovating firms placed organizational activities associated with scientific knowledge at the head of their uncertainty list, followed by those associated with market knowledge and finally those drawing on techno-economic knowledge (i.e., production and sales). Within a single organization Anthony (1965) has also made uncertainty and complexity the basis of a hierarchical subdivision into three levels which reflect different capacities for the routinisation of decisions. At the top of his hierarchy he puts strategic planning, the most complex and uncertain of the management tasks; he places management control at an intermediate level; and assigns operations control, the most programmable activity of all, to the base of his pyramid.

These studies all point to the possibility of applying to organizational units and subunits the codification dimension that was developed in the previous section. The extent to which organizational knowledge has been codified is a measure of how far uncertainty has been "absorbed" (March and Simon, 1958) or reduced. The relationship between complexity and codification, on the other hand, is somewhat obscure and needs some clarification. The assertion that codification reduces complexity as well as uncertainty turns on a subjective definition of complexity as something experienced rather than an inherent property of phenomena studied. To illustrate: the physiological processes that underlie that act of seeing are exceedingly complex (Hubel, 1963; Lettvin et al., 1959) but the normal adult does not experience them as such; he has routinised them to the point where, for him, they have become mostly unconscious and automatic. It is only when a person has consciously to learn to see - i.e., as when a congenitally blind adult has his sight restored

to him - that he experiences the full complexity of the task. So it is with codes. Learning a code is in itself an uncertain and complex task, but a code, once mastered, reduces the complexity of the experiences it subsequently helps to process.

In looking at the corporate case, the codification dimension of the framework is now trichotomised into the categories of Uncodified, Semi-codified, and Codified knowledge. Such a refinement helps to rank organizational subunits by decreasing complexity and uncertainty and on this basis to assign each of them to different locations in the framework along this dimension. As will be seen below, a similar assignment of organization subunits is made along the diffusion dimension. The results of this exercise, when carried out empirically, can describe a unique assignment pattern of subunits for each organization that resist any simple labelling such as 'organic' or 'inorganic' for the whole. For the purpose of this analysis, complexity - as defined above - and uncertainty are not distinguished. We now examine the three categories in more detail.

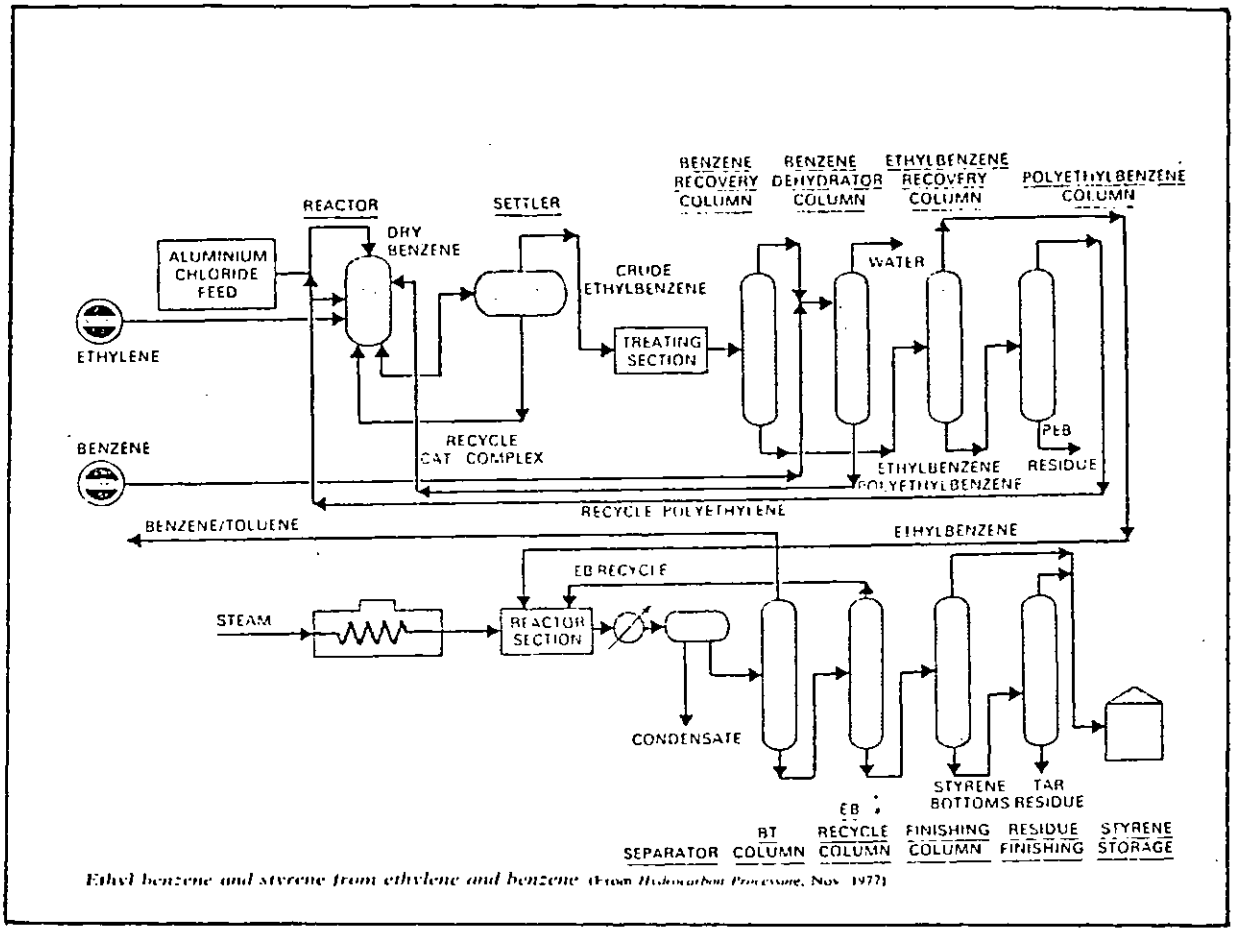
1. Uncodified Knowledge: (U) - This is the tacit knowledge built up by experience that was encountered in the preceding section; the costs of acquiring it are reckoned in units of time and variety of exposure. It is impressionistic and uncertain, and diffuses best in small face to face groups. Organizational units or subunits whose operational effectiveness rests predominantly on the use of uncodified knowledge often find it difficult to use formal management control systems. Control is achieved by a process of negotiation and socialization not unlike that applied by independent professional bodies: objectives, standards of work, and codes of conduct are internalised by individuals in the course of interaction with their peers[8]. The management style that results is described as strategic and is typically found in the top echelons of an organization: in the boardroom, the basic research laboratory, in the corporate relations department and so on. In Burns and Stalker's terminology, it is "organic".

2. Semi-Codified Knowledge: (S) - Here uncodified and codified knowledge coexist. Some organizational activities, although themselves well-defined and certain, are embedded in a matrix of vague and elusive prescriptions. Inputs such as costs, or outputs such as objectives, may be formalised, but the way

one is transformed into the other remains what cyberneticians call a 'black-box' - i.e., ill-understood. The know-how required for driving a car provides a good example of semi-codified knowledge. A minimum number of rules must be learnt and followed to set the vehicle in motion and guide it through town traffic - the use of the wheel, the accelerator, the gears, etc. Yet anyone who set out to drive a car applying only such rules would very quickly end up in a ditch. A great deal more knowledge - of the car itself, of traffic behaviour, of the road pattern - is required for effective driving than can be transmitted through rules alone. While much semi-codified knowledge can be committed to paper in operating manuals, instruction sheets, and specialist publications, interpersonal communications remain a major channel for its transmission. Although to a lesser extent than in the case of uncodified knoweldge, much remains uncertain and intangible. The management control style called for by organizational units using mainly semi-codified knowledge is one of direction and persuasion;[9] it will most likely be applied to the running of organizational units such as an applied research or development laboratory, a small or medium sized overseas subsidiary, or a marketing department.

3. Codified Knowledge: (C) - Codified knowledge exhibits the least amount of uncertainty, and, once mastered, complexity. The relationship between organizational inputs and outputs is well understood (i.e., there is no 'black box', or if there is, it is a small one) and can be routinized or programmed. This is the kind of knowledge that can by systematically embodied in physical objects, allowing men to be replaced by machines, computers, industrial robots, numerically controlled machine tools, and the like. The control techniques required are impersonal and can take a written (or punched!) form. They can also be highly centralised - much as the operations they are applied to may themselves remain decentralised. Both production and sales - in many industries, now highly codified activities - are becoming increasingly amenable to this form of control. Burns and Stalker call it "mechanistic".

A technical illustration of how uncodified, semi-codified, and codified knowledge interact can be briefly described by drawing on an example from the chemical industry, the focus of this study. Fig. 2.2 depicts schematically the steps followed to make Carbon Tetrachloride by the Chlorolysis Process. This



Ethyl benzene and styrene from ethylene and benzene (From Hydrocarbon Processing, Nov. 1977)

FIGURE 2.2

Source : Chemicals From Petroleum, A.L. Waddams, 4th Edition, 1978.

is a textbook illustration taken from A.L. Waddam's Chemicals from Petroleum using well codified knowledge that is further set out in two pages of text. The level of description used, however, is only sufficient to introduce the basic principles of the process. Any firm operating a plant based on this process will need far more detailed information on flow rates, reaction temperatures and times, expected yields, shutdown, procedures, and so on. These will be set out in the company's own engineering manuals along with a number of prescriptions and rules of thumb that embody the firm's own accumulated experience of running the plant. Some will reflect standard industry practice, but many will also reflect the company's preferred operating style and remain therefore idiosyncratic. Engineering manuals accumulate the kind of semi-codified knowledge referred to when training up plant engineers, but by themselves they will not impart the kind of operating know-how needed to run a plant. This is ultimately a matter of sight, sound, smell, and touch, and the skillful and routine deployment of one's senses in running such a plant can only be acquired over time by watching other doing so. What types of sound should one listen out for? What types can be ignored? What gauges need attending to most? What 'tricks of the trade' are used in a shutdown? In answering such questions uncodified knowledge is acquired which, in the absence of codified and semi-codified knowledge to structure and guide its application, would quickly reduce to an incoherent jumble of disjointed experiences. Nevertheless, to try and rely on the first two types of knowledge without drawing on this rich fund of accumulated intangible know-how, would be to invite almost certain disaster.

Diffusion

The smooth logistic curves used by sociologists to describe the diffusion of innovation implicitly suggest that the only empirically observable barriers to the process are those set up by the adopters themselves. The plethora of empirically supported propositions that form an appendix to Rogers and Shoemaker's book, The Communication of Innovation (1971) places the change agent firmly on the side of the angels: only adopters can or are inclined to resist innovation. A diffusion curve registers the sum of their deliberations and grades them on a scale of virtue that measures how long each of them

requires to make up his mind (early adopters, laggards, etc.). This approach effectively treats knowledge as a free good; one person's consumption of it does not diminish the supply available to his neighbour, and the cost of reproducing it can be taken as negligible.

The framework presented in the preceding section suggests that the creation and diffusion of new knowledge is assessed in cost-benefit terms by its originators, and whilst most new scientific knowledge diffuses rapidly once priority claims to its creation have been safeguarded, this is manifestly not the case for much new technological knowledge whose priority claims form the basis for blocking its diffusion through the operation of a patent system. The reason why this is so is that new technological knowledge, by contributing to the differentiation of saleable products, is a generator of scarcity - chanelling demand disproportionately towards one set of differentiated products rather than another - and hence of monopoly profits. The uncontrolled diffusion of such knowledge, by eliminating the scarcity, real or imagined, largely removes the prospects of benefit from the cost-benefit calculations that precede any investment in the creation of knowledge. In fact, such knowledge, far from being a free good is what Fred Hirsch (1977) defines as a 'positional' good: one that is scarce in some absolute or socially imposed sense or subject to congestion or crowding through more extensive use. For such knowledge 'early adopters' are rarely lacking; it is on the supply side that barriers to diffusion are erected.

As with codification, the diffusion dimension will be trichotomised to describe two barriers to the diffusion of corporate knowledge: one operated by a firm itself, another by the industry or industries within which it falls. The categories developed are an adaptation of those developed by Hall and Johnson (1970) and by Teece (1976) in his study on the resource costs of technology transfer by multinational firms. The trichotomy distinguishes betwen firm-specific, industry-specific, and market-specific knowledge, thus reducing the polarisation created earlier to illustrate the difference between the knowledge held by an individual or small group and that available to the wider society. The resulting dynamic, however, is not affected.

Firm-Specific Knowledge (F) - Firm-specific knowledge will here be taken to mean knowledge available to only one producing firm. Implied in the term is the notion that the firm itself created such knowledge and took steps to control its diffusion. The knowledge in question may be proprietary but need not be. Much valuable intangible knowledge is locked up in the minds of company employees who have been sworn to secrecy or remain loyal to a firm's purpose. Nor need such knowledge only be used by the firm to which it is available, for it might have decided to trade in the knowledge it owns. Again, others may share in the knowledge created by a firm (i.e., upon publication of the technical data for which it obtains its patents) without sharing in the right to use it. All that is intended by the phrase "Knowledge available to one firm" is that the firm should have some measure of control - backed by laws or other means of enforcement - over the diffusion of any new knowledge it creates, the terms on which such diffusion will be allowed to occur, and its extent.

Much of a firm's research output is firm-specific, but so are innumerable specialist practices developed in the course of a firm's activities as it learns to cope with unforeseen, and often unique, technical and administrative problems - those experienced for the first time and hence not encountered elsewhere. Indeed many currently established management practices started life as the property of a single organization, as part of its firm specific knowledge. Today, this kind of knowledge has a highly conditional existence; either it survives the hazards of its early development, waxes strong, eventually leaving its parental home in search of outside employment - patents expire, employees move on, etc. - or it atrophies, neglected and unloved by a parent that can find no use for it. In this sense firm-specific knowledge has a temporary character.

Industry Specific Knowledge (I) - This is knowledge - tangible and intangible - available to all producing firms within a given industry. It may come from several sources: the expiry of patents; the circulation of specialists and skilled labour between firms; it may also be the creation of industry research associations or of specialist information services. Industry-specific knowledge also accommodates the information leaks that drain an organization of its firm specific know-how when it fails to control its diffusion. Most of

it, however, describes current practice within an industry; what its members can be presumed to know. It is the type of knowledge used in production, in general management, and in the shaping of corporate strategy. It is not as a rule diffused to customers outside the industry and is a source of competitive strength for the industry as a whole.

Market-Specific Knowledge (M) - What in the preceding section was available to all - public knowledge - is here reined in a little to become accessible only to the consumers of an industry's products and services as well as to the producers themselves. Such knowledge is offered to consumers in many forms: it can be embodied in the goods sold, as with a mechanical clock or a radio set both of which can be dismantled to reveal how they work; it can be conveyed in printed form in documents or on the packaging of a product, informing the purchaser of its weight, composition, method and context of application; it can be transmitted verbally, as by a market stall-keeper shouting out the prices of his fruit and vegetables to passers-by; it can represent an accumulation of experience by consumers in the use of a product, evidenced by the confidence and familiarity with which it is handled, its quirks avoided, and its promised performance obtained. Much market-specific knowledge is deliberately transmitted by producers to actual or potential consumers with a view to increasing the overall size of the market for their products and their share within it. Its essential function is to inform, motivate, and to hold customers. Some knowledge, however, will be produced by customer groups themselves - consumer associations, buying cooperatives, etc. - or by their representatives such as government information services, public health authorities, and so forth. Producers will also draw upon market-specific knowledge in shaping their sales, marketing, and new product strategies.

The technical example used to illustrate the codification categories described above can also serve for diffusion. Figure 2.2 embodies market specific knowledge available in any technical bookshop. It represents what an industrial customer might reasonably be expected to know concerning the processes whose output he purchases. The engineering manuals used by those who operate the plant, on the other hand, generally contain industry specific knowledge and are written for an audience already thoroughly familiar with the

industry and its ways. But certain sections of the manual may describe processes used only by a particular firm, and where these are confidential they may be treated in a separate document. Such a description constitutes firm specific knowledge; it is as yet undifused to the industry and in some cases may require additional training of plant operators.

Knowledge Creation Cycle

Knowledge codification and diffusion have been somewhat more particularized and articulated in the corporate than in the general case. Codification has been given an organizational context and diffusion an industrial one. In each case it has been possible, if only approximately, to position a number of organizational subunits along the two dimensions created. To take two examples, basic research has been placed in the top left hand corner of the diagram since both its problems and its search procedures are relatively ill-defined and much of the information it uses or generates remains undiffused. Sales, on the other hand, have been placed in the bottom right hand corner because they operate according to narrow, well-defined objectives, using generally well-established selling techniques and widely available information. The framework that emerges, and the position assigned to organizational subunits within it, are outlined in Figures. 2.3 and 2.4. The letters inside each box are the alphabetical coordinates of the categories created; they provide a convenient shorthand in the discussion of the knowledge creation cycle that now follows.

Although only one knowledge cycle will be described in any detail, the more elaborate framework developed for the corporate case allows nine to be clearly identified. None involves any departure from the principles set down for the general case. To illustrate them briefly:

Cycle 1: UI,UF,SF,SI - Usually the diffusion of new know-how and techniques from a firm to an industry, often through the movement of people - the kind of knowledge produced by professional or consulting firms, pure research organizations, etc.

Cycle 2: SI,SF,CF,CI - The introduction of tested and standardized production techniques into an industry upon the expiry or by-passing of a patent as when Hoechst in the 1930's by-passed Du Pont's newly discovered nylon by studying the company's patents for the product and coming up with its own version: Perlon (Baümler, 1968).

Cycle 3: UM,UI,SI,SM - The diffusion of industrial know-how and techniques from an industry to its existing and potential customers, e.g. the standard contract clauses developed by professional engineering organizations to facilitate client negotiations.

Cycle 4: SM,SI,CI,CM - The introduction of standard products by an industry into a market together with specific instructions for their use, e.g. programmable calculators.

Cycle 5: UI,UF,SF,CF,CI,SI - A combination of Cycle 1 and Cycle 2 suggesting a longer time span before diffusion, a higher innovation content in the diffused product, and a longer time required to absorb it. The creation of a major new drug might go through this kind of cycle.

Cycle 6: UM,UI,SI,CI,CM,SM - A combination of Cycles 3 and 4 with the characteristics of Cycle 5. A certain amount of customer resistance to the innovation content may be implied as has been the case with the domestic minicomputer for example.

Cycle 7: UM,UI,UF,SF,SI,SM - A combination of Cycle 1 and Cycle 3. If the firm can by-pass the industry diffusion stage by transferring knowledge directly to customers it can secure a strong competitive advantage in the market. This cycle describes the innovative professional firm which has developed a new service and whose effectiveness depends on a coordinated team approach to customer problems. Customers will absorb some knowledge from the firm through face to face contacts; much more will remain uncodified within the firm, however.

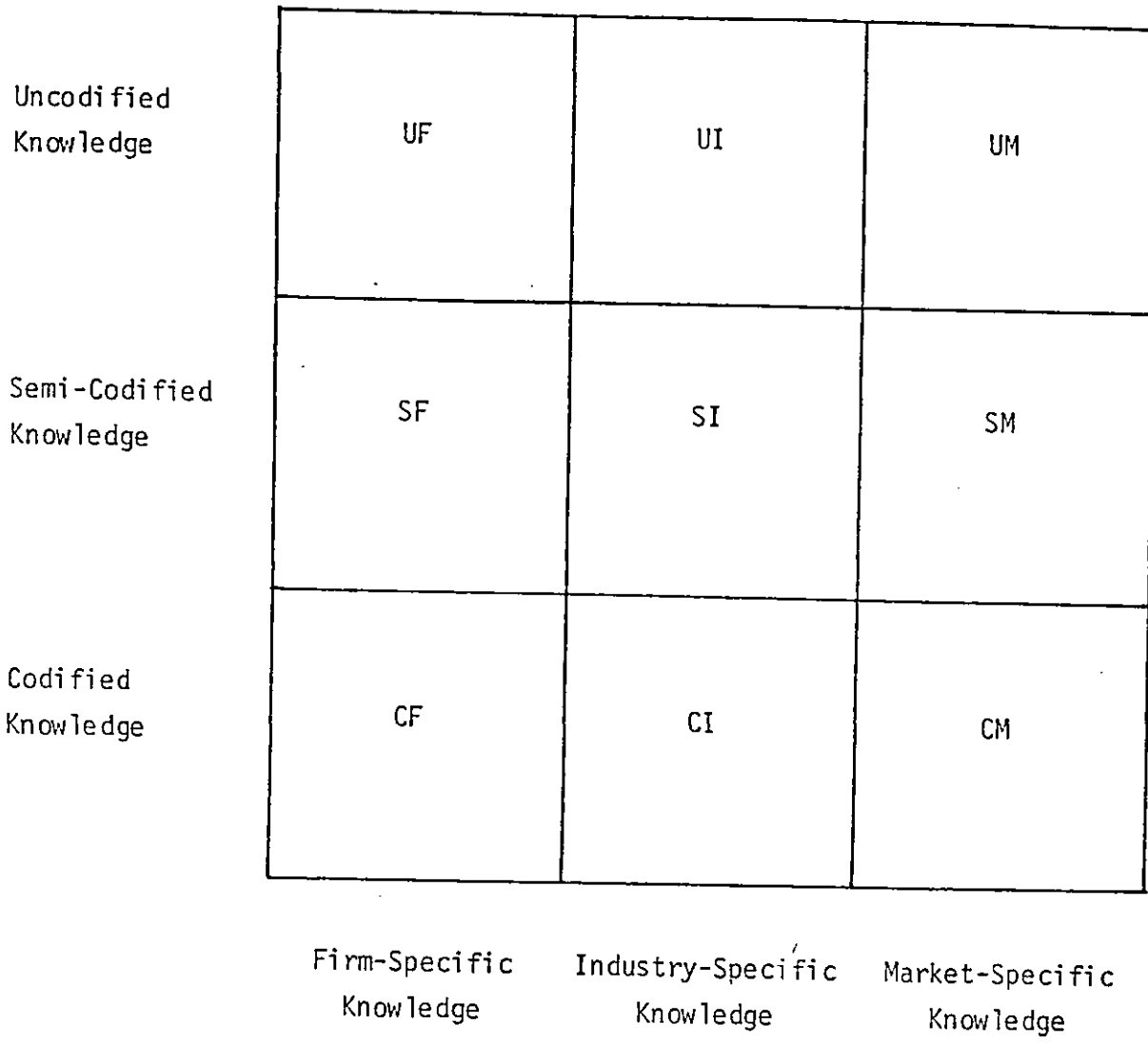


FIGURE 2.3

THE C-D FRAMEWORK - THE CORPORATE CASE

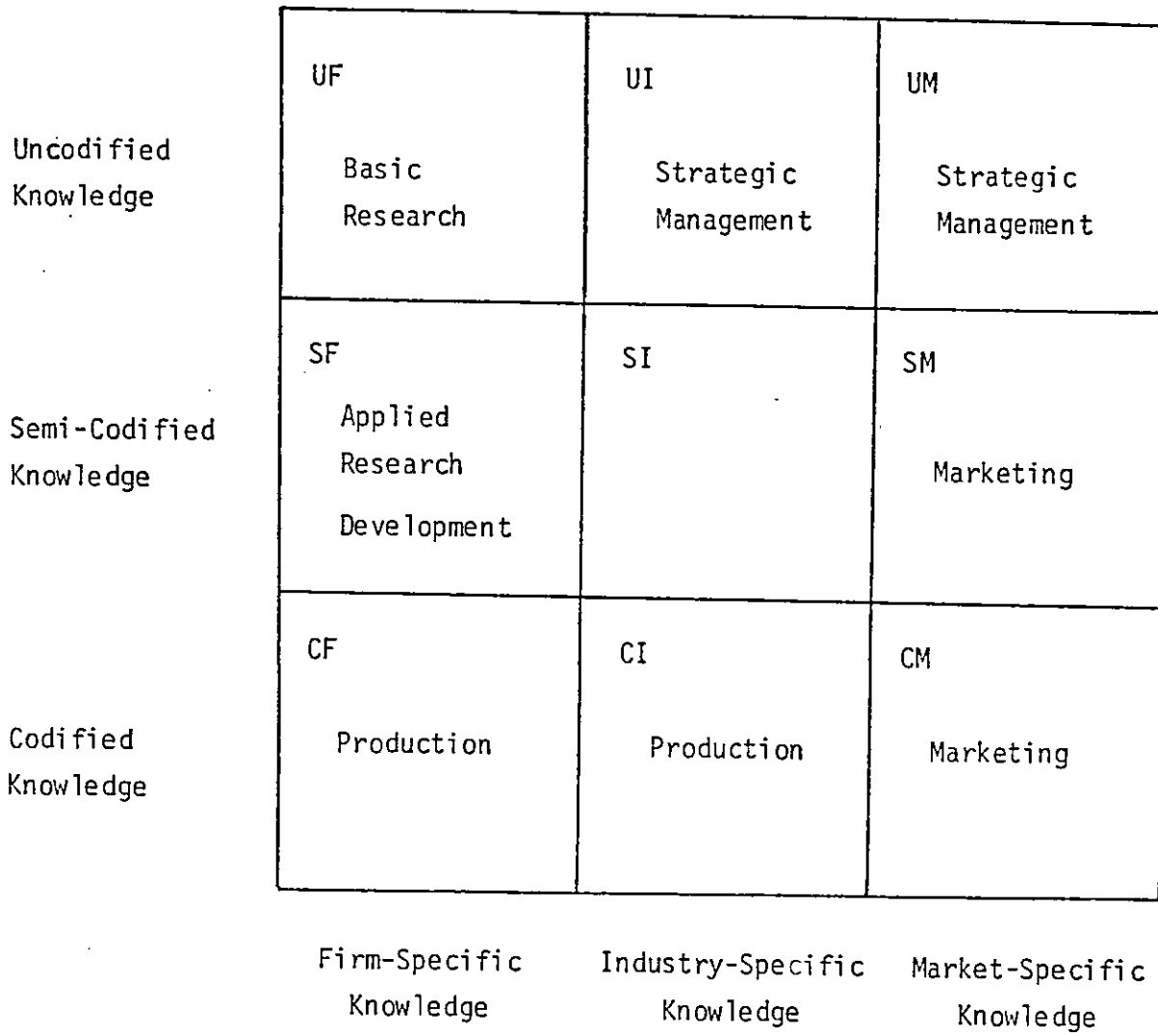


FIGURE 2.4

ORGANIZATIONAL UNITS IN THE C-D FRAMEWORK

Cycle 8: SM,SI,SF,CF,CI,CM - A combination of Cycles 2 and 4. Here again, the firm by-passing the industry diffusion stage gains a competitive advantage. The cycle typifies the moderately innovative manufacturer with a strong sales capability, who is a source of differentiated, but not radically, new products.

Cycle 9: UM,UI,UF,SF,CF,CI,CM,SM - A combination of Cycles 1,2,3, and 4. This cycle takes the longest to complete, carries the greatest risks, consumes the most resources, and offers the greatest prospects for creating radical innovations. To an increasing extent, the complete cycle is only within the reach of technology-based firms that are large in their industries, but not necessarily the largest.

These nine cycles are clearly idealisations of the messy processes that characterize the real world: constructs whose analytical value turns on their validity and method of application in a given context. As was stated earlier, this study does not test for any of the cycles, they are presented to illustrate the dynamic behaviour of knowledge within the C-D framework. A detailed treatment of all nine cycles is therefore not required and only the last one, Cycle 9, will be examined here in further detail. For this purpose it will be broken down into the four steps used to describe the knowledge creation cycle in the preceeding section.

A Description of Cycle 9

Step 1: Need Formulation - The Move Through UM,UI,UF - The initial stimulus to research or problem-solving in the corporate case is entrepreneurial - the profitable response to a perception of need. Schumpeter made the innovating entrepreneurial function the keystone of the capitalist system. With the advent of managerial capitalism the responsibility for this function was entrusted to the senior management of a firm. It set the strategy for an enterprise and allocated scarce investment resources in the light of perceived opportunities (Chandler, 1966). These are mainly created in the market. In a study of 121 firms in five industries, Myers and Marquis (1969), found that three quarters of the innovations they produced could be classed as responses to demand recognition. At a more aggregated level, Jacob Schmookler (1966), in a study of 934 inventions made in petroleum refining, paper making, rail-

roading, and farming between 1800 and 1957 found that where the initial stimuli to inventive processes could be traced, they pointed to an existing or potential market. Although technology itself is not spoken for, in no case was a scientific discovery the initiating factor - the stimulus.

The essence of the entrepreneurial problem is posed in dealing with stimuli - transmitted from the market - that are not well formed, those that are ambiguous, both as to their origin and as to the response they call for. They point to potential, rather than actual demand, and to several ways of satisfying it. The entrepreneur or the executive must be selective, and at the same time reduce the risk that inheres in his choice by bringing into play a deep and extensive experience of his market, a kind of tacit empathy that puts him in the shoes of his prospective customers. But, as Myers and Marquis point out, effective innovation originates in an idea that recognizes both demand and the technical feasibility of meeting it. In the language of the framework, it requires a hefty investment by an innovator in UI as well as in UM, together with an ability to communicate, largely by interpersonal means, his intangible and impressionistic insights to people in research laboratories located in UF.

Step 2: Knowledge Creation - The Move Through UF,SF,CF - Whitehead once observed that the greatest invention of the nineteenth century was the invention of the method of invention. Its legacy is the modern research and development laboratory which brings together, in a controlled environment, highly sophisticated facilities for the observation, recording, and testing of phenomena. Research and development link together a long, risky sequence of steps that must be performed before marketable products can emerge. At the most aggregated level, they can be classified as basic research in which new knowledge is created, applied research where this knowledge finds concrete embodiment in new designs, and development, the process of adapting designs to specific contexts for their application. Each constitutes a separable investment phase, in which costs incurred must be compensated by some degree of uncertainty reduction - i.e., by some new knowledge systematically gained and codified through a process of searching and testing. Many research projects, in fact the majority, fail this test and are scrapped 'en route'. Those that emerge unscathed still have to run the gauntlet of a market test.

Myers and Marquis found that only two-fifths of the innovative products launched by the firms they studied generated enough profit to offer a break-even return on the investment they required. Often basic and applied research are considered too uncertain and risky even by large firms who prefer to secure reductions in uncertainty by selectively buying patent rights from independent inventors rather than carrying out the work themselves (Jewkes, Sawers, and Stillerman, 1958; Hamberg 1963; Mueller and Tilton, 1969; Silberston, 1974). For them, the output of an investment in research remains too intangible; innovative ideas are the product of information acquired by a researcher or inventor in the course of his training and experience, and the stimulus that elicits them is often informal personal contact with professional colleagues, and sources outside a firm (Myers and Marquis, 1969). The uncertain outcome of this random process is not necessarily improved by systematically investing it it. Put differently, size and market power are not always preconditions to successful innovation.

A successful outcome in the applied research or development phase (located at SF in the framework) gives rise to patent applications. Now the world gets to know about the impending innovation, and responds. A certain amount of diffusion, controlled by the firm, may take place in the form of licences although where it does not wish to pursue the project itself the firm may sell the patent rights outright. Important innovations may focus and stimulate technological rivalry since the information made available in a patent publication is an important external economy to those who aim to invent their way round the patent rather than use it directly. By merely demonstrating the technical feasibility of the solution to a problem that an industry has been trying to solve, a patent publication often reduces more uncertainty than can be capitalized on by the protection it promises.

Although it may be initiated in SF, production for the market will take place on a large scale in CF, when a certain level of standardization of the product or service has been reached. Efforts at standardization may well continue after the market launch, and, with growth in demand and market expansion, can lead to economies of scale in a number of related production technologies.

Step 3: Knowledge Diffusion - The Move Through CF,CI,CM - With every advance in standardization, an innovation becomes more diffusion prone, which may explain why new products that aim at a mass market diffuse more rapidly than new processes (Silberston, 1974). Diffusion may be brought about by sales, by licensing, or by simple imitation. A highly standardised product can spread through a market by means of impersonal exchanges; little personal interaction with producers is required other than to gather information on the product or to learn how to use it.

The rate of diffusion of standardized knowledge from CF to CI and CM, whether embodied in products, services, or documents, is set by a number of factors. The first is a firm's patent position; some products and processes can be walled in behind unassailable ramparts of patents. After a number of years, they will gradually collapse, but a second line of defence may then be revealed in the shape of competition deterring economies of scale in production or marketing - a second factor. A third may emerge in the case of seminal innovations that give rise to further development and a rapid accumulation of experience by certain firms. Would-be rivals then face established competitors and high learning costs in marketing as well as production, a consideration which may well discourage market entry, particularly if standardization has already ushered in a measure of price competition (Scherer, 1967). A study by Mansfield (1968) finds a tendency for diffusion rates to be higher in the case of more profitable innovations and those requiring a small investment; also, lesser degrees of industrial concentration seem to favour the process.

Much standardized technological knowledge flows from a firm (CF) to producers within an industry (CI) without ever reaching final consumers downstream in CM. This is more likely to apply to knowledge of processes than of products, but even in the latter case, the purchaser may still view the product as a 'black box' of which he has only limited knowledge. He may know enough, for example, about the product to use it, but not to repair it, as in the case of a home appliance or a complex piece of hi-fi equipment. Or again, he may know how to use it in one situation, but not in another - is an aspirin sold to an adult to alleviate a headache, suitable for a small child with a high temperature? And so on.

Step 4: The Absorption of Knowledge - The Move Through CM,SM,UM - The move from CM through to UM completes the knowledge creation cycle for the corporate case; it describes a process of accumulation of experience at the end of which the market has effectively drained a product of its innovative features and in a sense ceases to 'learn' about it. The product is no longer new and hence imparts no new knowledge; it has become familiar and is taken for granted much as an electric kettle, and now, a digital watch are taken for granted. The same holds for products and services whose diffusion is confined to an industry. Yet, in both instances, the tacit knowledge acquired in the course of interacting with a product has a capacity, be it ever so modest or unconscious, to disturb the cognitive order of things for the user, provoking shifts in his perceptions, in his attitudes, and in his needs.

Some of these shifts will call for minor adjustments in product characteristics and be relatively well defined: the twin blade on a razor, the child-proof bottling of medicine, the portable can-pack for beer, etc. Such requirements are transmitted systematically from the sales to the production department - from CM back to CI or CF - where product adaptations are carried out as a matter of routine. Others will call for more extensive redesign or generate a need for complementary products: the adaptation of car designs to meet anti-pollution regulations, the development of the electric can opener as a response to the tin can, the telephone answering machine, etc. Products like these have a higher innovation content; they answer needs that take longer to emerge and become articulate. The market signals that elicit them are ambiguous and hence less certain, and will travel more slowly from SM to SI or SF - from marketing managers or brand managers to people in applied research or development. Finally, some innovations are so radical in their effect that a continuous adjustment process is initiated, calling for a stream of improved versions or complementary products to meet the needs of a developing market as it assimilates the new experience and accomodates itself to it. In our own day the rapid evolution of the consumer electronics industry exploiting the potential of the microprocessor offers a ready-made example, yet the technical impact of this product is so radical and pervasive that most manufacturers have a hard time identifying the adjustments that it will call for, or the needs that it will be pressed to satisfy. The ever-widening gap between the

technical promise of the microprocessor and what is actually delivered by way of electronic gadgets and toys, bears witness to the difficulties experienced by radical new technologies in eliciting the learning required to adapt to their consequences.

While the consumer himself is still acquiring experience of the product in different contexts, his responses will remain erratic and exploratory and the market signals he will transmit back to producers - from UM to UI and to UF - will be contradictory and often misleading. The function of the entrepreneur, as was shown in Step 1, is to respond specifically to such confused and uncertain signals. His ability to do so will depend in no small way on how far he has shared with consumers the tacit experiences that such signals so vaguely express, and on how well he can interpret them. It was precisely this kind of intuitive "feel" for a potential market that allowed Henry Ford, at his Highland Park factory in Detroit in 1913, to transform the motor car from a luxury available to the few, into an object of mass consumption. As it is, society's adjustment to the consequences of this innovation has not yet run its course.

Discussion

The cycle just described is a summary representation of a swarming social process. Only in a tiny number of cases is it completed by an individual firm. For the rest, it is a lengthy relay race in which each firm has its runners pick up a baton of knowledge and travel a small distance with it before handing it on - or stumbling. Many who participate never complete their lap, for knowledge is a strange baton with magical properties, capable of metamorphozing in strange ways. In some hands it will melt away into nothing, in others it will grow so large as to need several runners to carry it; on one stretch it will be rigid, light, and portable, allowing a runner to sprint; on another it will turn into a formless jelly, spilling over if he does not slow down.

Firms can invest in the knowledge creation cycle either by spreading their available resources throughout the diagram so as to complete the cycle on their own, or by concentrating them in order to achieve a distinctive strength

on one or two laps. They can develop a general capability in strategic management, research and development, production and marketing, or, they can become primarily research oriented, marketing oriented, and so on. For the larger firm, these are not exclusive choices; both options may be affordable depending on the minimum investment required to build up a distinctive capability in a given industrial sector. The firm's choice will be influenced by what competitors are doing and by industry characteristics. Up to a certain level of competitive intensity the firm will feel that its prospects are enhanced by the creation of new proprietary knowledge; beyond that level, the proprietariness of such knowledge can no longer be safeguarded and will in any case be limited in its value by the emulative efforts of a firm's rivals. As prospective payoffs to innovation are eroded by sharper competition, investments in the more uncertain segments of the cycle such as R and D may come to be seen increasingly as so many squandered resources. Firms will then hold back from undertaking such investments, and the flow of knowledge through that part of the cycle will start to slow down (Scherer, 1967; Mansfield, 1968).

Firms which concentrate their investments may do so in F, in I, or in M in the diagram: they may build up a specialized competence around a single proprietary product group in F; they may exploit a geographical location to become an established supplier (I) to a local industry with little need to market or to innovate; or they may develop their skills as a buyer in M, backed by a strong investment in distribution. Any subsequent attempt to integrate backwards or forward by such firms moves them respectively to the left and to the right of their position in the diagram where they may face industry or market barriers to entry and will certainly need to acquire the skills and know-how that go with their new position. They can either buy the knowledge they need as a 'package', through a merger or the acquisition of an existing firm, or they can build it up more slowly for themselves, by initially mastering the established and codified repertoire of "textbook" skills that has accumulated in the bottom part of the diagram, and letting them fertilize the new experiences that now confront them in S and in U.

Summary

Section two has established three points about the C-D framework:

1) The codification and diffusion dimensions of the framework can be given an operational meaning in a corporate context. Specifically, codification finds a strong echo in the task and environmental uncertainty that differentiates organizational subunits, and diffusion, likewise, can be expressed in terms of the differential access to an organization's knowledge enjoyed by various groups or subgroups.

2) The knowledge creation cycle can also model the information-related aspects of various corporate activities and can subsume under a single representative scheme their dynamic contribution to the flow of knowledge.

3) The rate of flow of knowledge through the cycle is the product of an institutional and cultural environment which stimulates or inhibits the creation and diffusion process.

SECTION 3: THE CASE OF THE INTERNATIONAL CORPORATION

Introduction

Any discontinuities in the creation and diffusion of new knowledge as discussed so far, have all occurred within the space of a single national culture. Any difference in the codes built up on the right and left hand sides of the diagram respectively could still be mediated through a single common language shared throughout the culture and providing a common base. Any industrial barriers to diffusion were the institutional product of a single jurisdiction. In this section, the 'single culture' assumption will be removed and a country barrier, effectively a new subdivision of the diffusion axis, will be introduced. The resulting framework that emerges, whilst leaving the subdivision of the codification axis untouched and the underlying principles of the knowledge creation cycle unmodified, allows a unified description of the international diffusion of corporate knowledge at different levels of articulation and complexity.

The effect of a country barrier on the codification and diffusion process will be examined in the first and second subsections, and will be followed the third and fourth subsections by a discussion of what happens to the knowledge creation cycle when it goes international. The role of government in this scheme is examined in the fifth subsection, and is followed by a recapitulative summary. As with the preceding section, the focus here will remain on intrafirm processes.

Codification

Vertical movement up or down the codification axis is not affected by country barriers and the process of reducing or attempting to reduce uncertainty and give structure and coherence to experience remains essentially the same. However, at any point in the diagram, what is codified will show differences that reflect the distance between cultures in matters of environment, language, habits, beliefs, values, norms, resources etc. Cultures structure

their common experiences according to the possibilities offered by the unique repertoire of codes that each has built up, and "in this partnership" of language and culture, as Whorf (1956) has observed, "the nature of language is the factor that limits free plasticity and rigidifies channels of development in the more autocratic way."

Cultural differences are a matter of degree, which, at one extreme, leave two groups with so little in common that no communication between them is thought possible, and, at another, leaves them so similar that to speak of two cultures may occasion surprise. The qualitative barrier that separates the pastoral Dinka tribesman of the Sudan from a US corporate executive virtually dissolves into nothing when the latter meets his Canadian counterpart at an international convention. At some intermediate level, one can cite the differences between, say, French and English culture, which, seen in a larger context, become variations within a common European heritage. Spoken languages differ, their linguistic basis less so. Religious practices vary, religious antecedents do not. Intellectual styles remain distinct, but intellectual traditions converge. And so on.

The cultural anthropologist, Edward Hall, sees culture as a whole as a form of communication (Hall, 1959:37), which implies that communication between two cultures will be limited by the extent to which they differ and have independently built up repertoires of codes that show overlap neither in their origins nor in their orientations.

Diffusion

The firm-specific, industry-specific, and market-specific categories will now be further subdivided to incorporate the country barrier. The country in which knowledge first appears will be called the Home country and that to which it is diffused the Foreign country. The subscripts h and f applied to the alphabetical coordinates within each cell will make clear whether one is referring to Home country (h) or Foreign country (f) diffusion (Fig.2.5). New knowledge still flows from left to right in the diagram as well as across the country barrier within each cell, and established knowledge still flows both

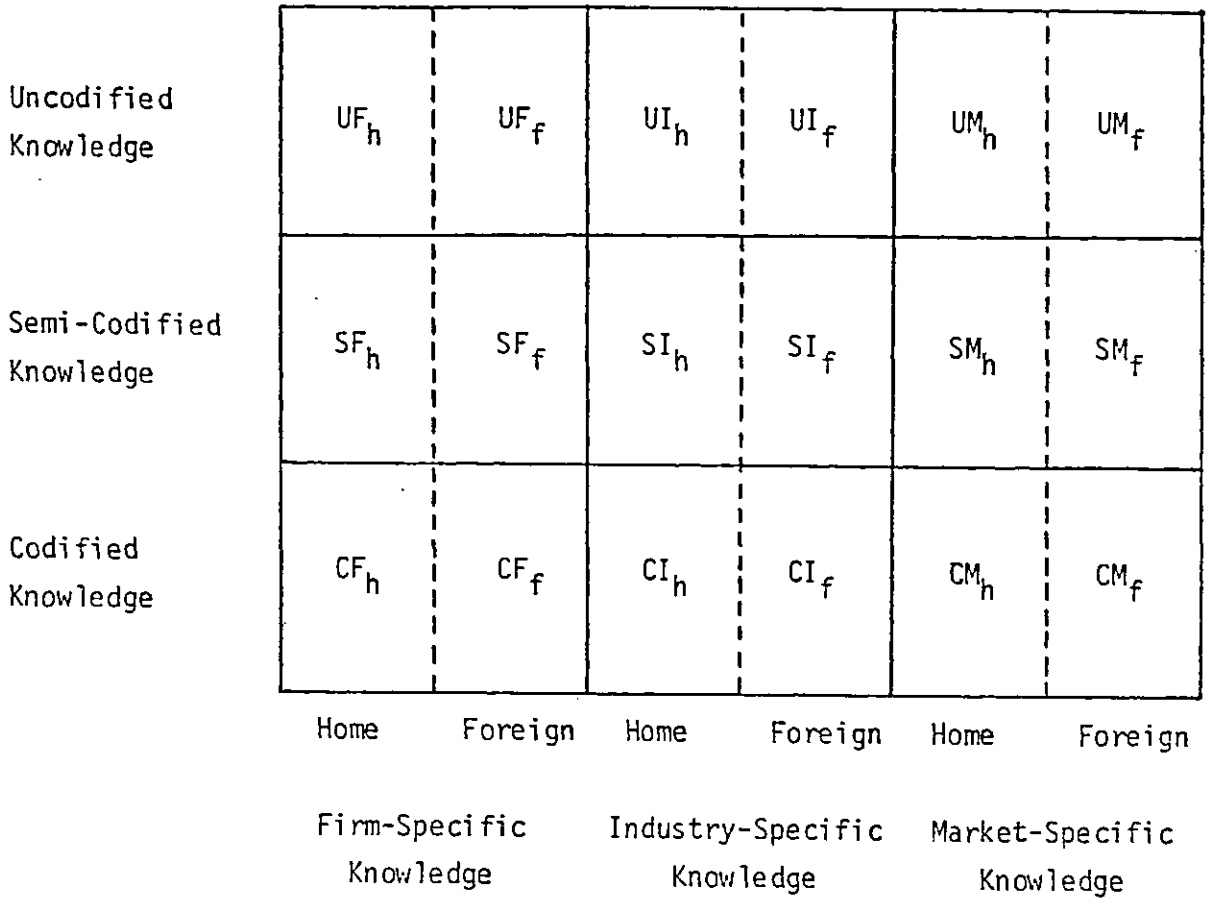


FIGURE 2.5

THE C-D FRAMEWORK :

THE CASE OF THE INTERNATIONAL CORPORATION

ways, although the country barriers now give some type of established knowledge - for example that of consumer needs in the Foreign Market at CM_f - certain proprietary qualities which can command a monopoly price so that a concern will develop among those who possess it to prevent it flowing back to CI_h where it becomes available to all.

At any point in the diagram, new knowledge that flows from h to f within a cell is a corporate contribution to the international transfer of technology. The terms on which the contribution is made are not specified and nor are its consequences: it may well have the recipient country worse off in terms of foreign exchange allocated to paying for it, or of independence sacrificed. By registering only the knowledge flows associated with technology transfer a narrow definition of the term is avoided; the knowledge transmitted can be embodied in goods, documents, trained minds, or any mixture of these. All that is required is that it should add to the stock of useful knowledge, tacit or codified, in some f-cell in the diagram. The contractual forms and terms under which this may occur will be considered in the next section; here three considerations that will influence an international firm in its decision to cross or not to cross the barrier betwen h and f will be briefly discussed. They are: the feasibility of a transfer, its desirability, and its legitimacy.

Feasibility - Not all corporate activities carried out on the h-half of each cell can be transposed to the f-half. Differences in resource endowment, factor availability, infrastructure, cultural factors, and size of markets, may be insurmountable in the short term and render the transfer of an operation uneconomic on whatever terms are offered. It follows that under such circumstances an international firm has little motivation to transfer the knowledge associated with its activities and nothing will flow. With the passage of time some of the differences that block an operation may narrow and the transfer of some activities may be considered, whether to exploit new opportunities that open up with the development of a country's productive factors, or those that are offered by the evolution of its domestic markets. Some minimum basis on which communication between the h-and f-part of a cell can occur must either exist at that time or be built up, if only to negotiate the initial set of transactions that will make the growth of subsequent operations possible. Initial transactions could involve the host government

and other subgroups, as, for example, a labour force in the case where productive factors are sought, or consumers in the case where market development is the aim. A minimum repertoire of shared codes is required to allow the parties in h and f to communicate, and, eventually, to devise rules for translating as yet inaccessible parts of their respective repertoires for each other.

In this way the links created across country barriers introduce exogeneous influences within the cultures concerned. Where new information appears to flow mostly one way as is the case with most LDC's, a state of dependency may eventually build up which currently goes by the name of 'Westernization'. Where such a state of dependency is actively promoted to serve the interests of one subgroup in one subregion at the expense of the recipient culture as a whole, it creates a 'dualism' in which, as was seen earlier, a small modernizing sector develops by draining a traditional sector of its resources and by forgetting its past as it moves ahead. This is the sector in which the international firm will seek its potential markets or productive factors, and whose prospects ultimately determine the feasibility of local operations giving rise to a transfer of knowledge. This is also the sector which painfully tries to achieve a measure of independence from the traditional culture whence it emerged, only to establish seemingly unbreakable ties of dependency with some of the new industrialised cultures with which it comes into contact.

Desirability - the attractiveness of an investment for an international firm once its feasibility has been established turns on the total flow of the prospective returns it promises over its anticipated life multiplied by the likelihood of such returns materializing - its expected value. The size and the timing of a firm's foreign earnings are perceived as being subject to a wider set of influences and hence, a greater measure of uncertainty than is the case for domestic earnings. At the most general level there are country risks which are associated with a given country's overall prospects for establishing and maintaining political stability and achieving economic growth; these tend to be imperfectly reflected in the relative performance of that country's currency. At an industry-level within a country's borders, uncertainties plague any estimates of the potential size of the market for a

foreign investor's products, its future rate of growth, its structure, and the market share he could command - these make up a foreign firm's marketing risks. Finally, at the operational level, a firm must secure the services of productive factors - skilled labour, raw materials, distribution services, etc. - on terms that do not compromise its returns: some factors may be unavailable locally and have to be brought in from outside the country at great cost; others may be under the control of an entrenched local monopoly supplier; some may require special adaptation to the local climate, the prevailing skill level, infrastructural facilities, etc. Taken together, these factors define a foreign firm's operating risks.

A firm required to offer stable and competitive earnings to its shareholders, will seek compensation for the greater risks and uncertainties it perceives in foreign operations in the form of a higher overall rate of profits than it would expect from domestic operations. If by transferring its know-how, its skills, or its technology, a firm can reduce some of these risks and uncertainties, it will do so, but often on terms, that to a host government, express its abnormally high profit expectations, and only to an extent that directly serves a firm's own narrow range of interest - i.e., those of developing its productive factors and its potential markets.

Legitimacy - A foreign operation whose feasibility and desirability has been established by the firm, constitutes a commercial opportunity that lies within a foreign jurisdiction. This consideration more than any other, qualifies an investment as foreign; it makes access to such opportunities the subject of negotiations and bargaining with a host government where it might well have been open to all indigenous enterprises - at least, within a firm's own national territory.

With the notable exception of currency risks, the problems that a firm must overcome in establishing feasibility and desirability can be found to operate between regions within a single national territory as well as between countries. For many products, for example, the US market has been segmented into three main geographical regions; the East Coast, the Midwest, and the West Coast. Recently, the South has also begun to emerge as a region in its own right. In some countries, regions and markets are defined by linguistic boundaries, as in the case of Belgium.

It often happens that economic and cultural disparities between regions are no less pronounced than those between countries, a phenomenon linked to the rate and intensity of an urbanization process that skews the distribution of development resources in favour of certain areas within a territory at the expense of others. The manifest failures of governments to develop effective policies in tackling domestic regional imablances, must raise some doubts as to how well they can expect to cope with the much more powerful set of forces that shape international affairs and bears down upon their respective territories from outside.

In the diagram, the barrier between h and f in each cell is operated and controlled by governments which thereby determine who shall have access to their resources, their productive factors, and their markets, and on what terms. They rule on what goods, raw materials, equipment, manpower, shall be allowed to enter or leave the country, as well as on the conditions with which they must comply when inside it. Governments, by establishing the legal and institutional framework which governs corporate behaviour within their jurisdiction, in effect write the rules of the game in which foreign investors are invited to play. The fact that no foreign firm can be compelled to accept such an invitation limits the abilities of governments to slant the rules too much in favour of domestic firms. The fact that once an invitation to play has been accepted by a firm, host governments still retain the legislative power to change the rules, adds both to the uncertainty felt by a firm and to the profits it will require to play the game at all.

Of central concern to a foreign investor is a government's attitude towards physical and intellectual property rights. A well established system of property rights constitutes a major external economy for a firm whose very existence has been made possible by not having its rights to ownership challenged at every turn in a Hobbesian war of "all against all". In the case of intellectual property, one can observe that firms will seek the institutional protection of a firm-specific and industry-specific barriers to knowledge flow on the f-side of the country barriers within each cell in the diagram, in as much as they have secured it on the h-side. Hence they will only transfer their proprietary technology if its diffusion does not slip out of their control, and, where host governments are unwilling to offer the

necessary protection, they will refrain from investing in ways that would require sensitive technology to be transferred. The difficulty, for example, that Italy has experienced in attracting foreign investment in Pharmaceutical Research because of its lack of any credible patent policies illustrates the point (Fisher; 1979).

The Knowledge Creation Cycle

The discontinuities introduced by country barriers limit the possibilities of transmitting new knowledge, and slow down the rate at which it will diffuse from h to f in any cell in the diagram in a number of ways that reflect how far it has been codified. How this works within the C-D framework and with what effects on the knowledge creation cycle must now be considered.

Uncodified Knowledge - Tacit, uncodified knowledge will travel least. Its effective transmission requires extensive interpersonal contact, and hence geographical proximity, as well as a solid investment in shared experiences whose implicit meaning is derived from a single common cultural frame of reference, or from the overlap between several of these. Cultural convergence, as we have seen above, is a matter of degree, and admits of diffusion in some instances more readily than in others. But even a shared culture sometimes fails to overcome the communication problems created by the loss of geographical proximity if a country barrier also has to be crossed. A study by McInnes (1971) illustrates the problem. He looked at the financial reporting and control procedures used by thirty international American firms in the manufacturing sector and showed that the major influence of a multinational environment on a company's information flows was seen to be a curtailment of informal communications. Since it is precisely through such informal communications that overseas executives receive and retransmit information about their environment back to parent company headquarters (Keegan 1974), one can infer that the experience which a firm - as opposed to its individual members - can accumulate in h or in f will be biased towards what can be transmitted in codified form and will be the more impoverished for it. The constricting effects of the country barrier on the exchange of tacit knowledge and experience, show up in the problems that face senior overseas executives

on their return to the home country in finding a role compatible with their achieved status on the one hand, and their comparative lack of any recent experience of home country and parent company conditions on the other. They find it difficult to rejoin the managerial 'club' to which they belonged.

Thus, country barriers reinforce the cultural and geographical obstacles to the transmission and diffusion of uncodified knowledge; their effects can only be overcome by an increased investment in the building up of common experiences shared by groups on each side of the barrier. Recent attempts by large multinational firms, such as IBM, to build up a cast of mobile 'Geocentric' managers (Perlmutter and Heenan, 1974) assignable to any part of the globe, address this problem but may only effectively solve it in the case of firms operating in science-based industries which perform to technical standards that are set internationally and have little need to adapt their output to idiosyncratic local conditions. Such a cast may accumulate a valuable experience of international operations, however, without ever acquiring any deep understanding of national ones - indeed where a firm is offering a well-established, standardized product - such as the recently mooted 'world car' to an identifiable and well understood market segment, it may not need to. For this reason a genuinely entrepreneurial response to specifically local needs is unlikely to come from that quarter.

Codified Knowledge - If the central problem of tacit knowledge is that of being able to share experiences across country barriers, that of codified knowledge is of building up a stock of common codes on each side of such barriers. Codified knowledge can be transmitted faster, more economically, and in greater volumes per channel of communication than tacit knowledge, but the process of encoding and decoding it, that is, of putting a message in a form suitable for transmission in a channel, and subsequently, of reconverting it to its original form, is a skill that must be mastered. Its acquisition takes time and has a cost. Thus, if the most costly feature in the diffusion of tacit knowledge lies in its transmission, for codified knowledge it lies in the development of compatible coding skills. The most efficient communication channel in the world will not help a sender who cannot condense his message, by a process of successive structuring, into a code that can pass down the available channel, and will not make such a message intelligible to a receiver

who is unfamiliar with the code used for the transmission itself or the higher level codes from which the message is constructed.

Yet, overcoming the simple coding problem for transmission is merely the first step: it forms but one part of the engineering problem that must be resolved if effective communication is to take place at all (Shannon and Weaver, 1949). It leaves quite untouched the earlier-mentioned semantic and effectiveness problems. These are more context-dependent and more likely to draw on higher level coding skills, and on the fund of tacit knowledge available to the communicating parties, than on any further refinement of the basic coding skills required to operate the communication channel itself. It is at this level that differences in the coding repertoire available to sender and receiver will show up in their behaviour. To quote Warren Weaver: "... with any reasonable broad definition of conduct, it is clear that communication either affects conduct or is without any discernible and probable effect at all." (Shannon and Weaver, 1949:5).

The existence of a country barrier decreases the likelihood that the repertoire of available codes on one side will overlap with that on the other, and, for any transmission of new knowlege, increases the likelihood that some investment in the acquisition of coding skills by either the sender or the receiver of knowledge will be required.

Knowledge Flows through the Cycle

The analysis has so far concentrated on the stimuli and impediments to the flow of knowledge across the country barriers that separate the h- and f-side of any one cell in the framework. Important differences emerged in the behaviour of information in the upper and lower parts of the diagram: in the upper quadrants international flows of uncodified knowledge are slowed down by a lack of shared experiences between sending and receiving groups; in the lower ones international flows of codified knowledge are hampered by a lack of shared codes. The first is a problem of people and their spatial and cultural distribution, the second, primarily a problem of skills. Crudely stated, one problem can only be tackled by increasing the area and duration of contacts

between people and culture, the other, only by the application of disciplined effort and systematic drill. Both, however, require an investment in learning.

The relevance of these observations to a discussion of the international knowledge cycle is that the distribution of any investment in effort, time, and money required to transmit codified and uncodified knowledge across country barriers, is likely to be the opposite of what it would have been within the home country territory.

This anomaly can be explained by the use of two imaginary examples:

Example 1 - At an international conference for neurobiologists a French and English scientist meet for the first time. The Frenchman speaks a little English and the Englishman some French. With the help of paper and pencil it would take no more than an hour for each of them to bring the other up to date on his current research. One may be working on a cellular study of the hippocampus[10] as part of wider investigation of the phenomenon of memory; the other, researching the organization of the limbic system and the development of the visual system. They have no difficulty in communicating the most sophisticated concepts to each other, occasionally switching to a mathematical notation to elaborate on a particular point. Before parting they exchange notes and agree to keep in touch by letter. Then, just as they are about to take leave of each other, the English scientist cracks a joke. The Frenchman at first stares at him blankly, and then smiles politely feigning comprehension. He has understood nothing and both he and the Englishman know it. The incident is passed over, and they part amicably.

Example 2 - On a London commuter train two women are sitting opposite each other. One is an eye surgeon working in one of the teaching hospitals, the other a barrister specializing in commercial law. They strike up a conversation. The rain outside is a suitably uncontroversial candidate for a first topic and after a brief but riskless exploration of germane subjects such as recent weather conditions and the meteorological prospects for the summer they cautiously inquire

> into each other's occupation. Conventional acknowledgements and expressions of mutual approval by each mask a hasty retreat towards more accessible subjects of conversation to fill the remaining journey time. They joke and chat about a wide range of subjects until the train draws into the station, always taking care, consciously or unconsciously, not to make any reference to occupational matters.

These two examples have in common the exchange of codifed and uncodified information. In the first the French scientist had no difficulty in trading complex specialized knowledge with his English colleague for the better part of an hour, yet it would have taken him many years of living in England to capture the full flavour of the latter's three second joke (always assuming it was a good one). In a corporate context, the point is echoed in Thomas J. Watson Sr.'s quip that "it's easier to teach IBM to a Netherlander than to teach Holland to an American." (Davis, 1979:53). In the second example the two women could chat and joke together with ease, but they lacked any common specialised language that would have made a conversation on their respective occupations anything but a strain and an effort. Again, such a language would have taken a number of years to build up. In the first example codified communication was possible, but cultural differences blocked any exchange based on tacit knowledge. In the second the opposite was true; tacit exchange presented no problems but those requiring the use of specialised codes had to be avoided. In either case, communication would not have been possible without some prior investment, either in coding skills or in experience, on both sides of a barrier. In one instance the barrier was cultural, in the other, occupational.

In what way are intrafirm knowledge flows affected? Do these differences in the investment required by codified and uncodified knowlege help in interpreting the course followed by international firms in their overseas operations? Both the normative and the empirical literature reviewed in Chapter 1 indicate that a firm which developed within a single national territory internationalizes its operations by investing abroad at the margin, initially exporting at modest volumes the most standardized goods in its range through local agents, and then responding to foreign market growth firstly by setting up a local sales office, and secondly, by carrying out locally the

last manufacturing steps - i.e., assembly - of its production operations. The subsequent internationalization of its remaining activities will turn on considerations of market size, process indivisibilities, and factor costs. But drawing on the preceding analysis one important observation can now be made. International firms have developed a specific competence in the spatial decentralization of operations which have been sufficiently standardized or codified to make them amenable to systematic central control. They will be least able or willing to internationalize those activities which are intensive in the use of uncodified knowledge, and which therefore can only be controlled effectively through frequent interpersonal interactions requiring geographical propinquity.

Can the effects of this observation be traced out on Figure 2.5? What it asserts is that, internationally, the tendency will be for knowledge to start flowing across national boundaries but still within the firm from left to right in the lower right-hand part of the diagram, the origin of the flow gradually spreading leftward and upward in the diagram as foreign experience accumulates. It goes on to claim that the cost of crossing the country barrier from h to f increases as one moves North Westwards towards knowledge that becomes increasingly firm-specific and intangible, and that most firms will refrain from transferring across the country barrier somewhere short of the Northwest corner, at a point that will be determined by the distribution within the diagram of their prior investments in knowledge, and the nature and scale of their international operations.

Using the notation of the diagram, the observation can be restated as follows: a firm seeking to exploit a foreign market for the first time will initially transfer knowledge from CM_h to CM_f and channel it through the sale of established, standardized goods. With the passage of time, it will accumulate experience of foreign operations, and, with a growing market, it may be willing to consider setting up a more sophisticated marketing operation involving knowledge transfers from SM_h to SM_f. A more sophisticated product range may be introduced, and with it, a number of technical and after sales services. Also, a simple and riskless local assembly operations may now become economic, a transfer from CI_h to CI_f. These local operations will have to managed, and some limited technical facility for adapting parent company

products to local conditions and for performing limited quality control functions will now be required. These considerations will push for a transfer of knowledge across the country barrier from SI_h to SI_f.

Beyond this point, however, things may start to slow down. Any further transfer of activities involves knowledge which is increasingly firm-specific or intangible, and hence more costly to transfer. Some firm-specific knowledge may well have to be transferred to allow local assembly operations to be carried out, but how far this is taken will depend on how separable the different production stages are, and on how far the local output volume, by offering economies of scale, encourages the local use of more sophisticated production methods. Also, at a certain scale of operations a firm may feel justified in decentralizing its management function at senior level - a transfer from UM_h to UM_f and from UI_h to UI_f. This is what IMB World Trade Corporation did, when, in response to rapid growth, it shifted from an operating style based on management by country, to one based on management by areas or groups of countries (David, 1979:53). Large Market size furnished the incentives and the imperatives for crossing country barriers in the U and F zones of the diagram.

A number of tentative conclusions emerge from the analysis so far:

1. Only in the largest and most developed markets will the incentives on offer to the innovative international firm cover the costs of transferring knowledge across country barriers in every cell of figure 2.5.

2. Only in such cases will all segments of the knowledge creation cycle be transferred abroad and with them an autonomous capacity to innovate and create new knowledge. It remains in the firm's interest, however, to keep such a capacity under its control.

3. Elsewhere, knowledge will be transferred by firms in such a way as to protect their existing investments in U_h and in F_h. This requires that a state of dependency be created that would tie the f-part of their operations to the h-part in any cell where the country barrier has been crossed and in which knowledge has already been transferred.

4. Firms exploiting a local market will transfer their most codified and their least proprietary knowledge first, and only shift their transactions towards the north-west cells in the diagram on a cost-benefit basis. Firms exploiting local productive factors, for example, are more likely to transfer industry-specific knowledge between CI_h and CI_f than are firms exploiting local markets only.

Country Barriers and the Role of Government

Foreign governments are sovereign powers on their side of the country barriers. They can raise the height of the barrier with tariffs and other controls, or lower it with subsidies and incentives. But their power is essentially a negative one - a power of veto. They can choose from among prospective outside investors who shall be allowed to pass the barrier and who shall not, but their ability to create prospective investors is much more circumscribed and resides more in the soundness of their long-term domestic policies and the prevailing economic climate than in their dexterity in operating the barrier. Country barriers act like sluice-gates that can regulate the flow of knowledge that accompanies investments, speeding it up here, slowing it down there; but they cannot motivate it, nor provide its basic impetus. Knowledge flows at a rate and in a pattern of channels that adapts to the cultural and economic topography of the territory it crosses. A well located sluice-gate can help to control and direct the flow, but its positioning requires a thorough familiarity with the lay of land and a sound understanding of flow characteristics.

Most national governments seek some measure of technological autonomy. Outside sources of knowledge are not necessarily rejected, provided that some indigenous capacity exists, or can be brought into existence, to capitalise on it or to create new knowledge. Technological interdependence is acceptable; technological dependence is not. In the language of the analytical scheme presented, governments would ideally like to see knowledge creation cycles flourishing inside the national territory, functioning independently of external sources, and responding adaptively to domestic cultural and economic needs in a way that imported knowledge cannot. An appropriate technology, then, becomes one of the fruits of technological autonomy in the knowledge creation cycle.

Yet, autonomy is perceived by many governments - often the most disadvantaged, technologically speaking - in static rather than dynamic terms, and policy has consequently been framed to achieve a rapid mastery of currently available foreign technologies and knowledge in the belief that this will enhance the local capacity to create an indigenous technology. The emphasis, in these cases, has been on operating country barriers in such a way as to accelerate the flow of existing technology across those barriers to diffusion initially set up by foreign firms and industries, in order to bring newer and more modern technology into the country. The analysis suggests that such an approach will only be successful where host countries have already developed institutional facilities for completing the knowledge cycle themselves - R & D establishments, trained managerial or entrepreneurial cadres, etc. - or, where they have the bargaining resources measured in markets or productive factors that will tempt international firms to complete the cycle for them by investing in the appropriate cells. In all other cases a state of technological dependence may well be reinforced.

An Application of the Knowledge Creation Cycle

The issue can be addressed through the knowledge cycle. Earlier in the chapter, a number of knowledge cycles were identified within the C-D framework although only one was subsequently developed and analysed. These cycles are depicted in Figure 2.6. The number of cycles that can be presented will be determined by the grain of the analysis, for at a sufficient level of detail an infinite number of cycles could potentially be developed. The only requirement placed upon them is that where they involve the creation of new knowledge, they should describe an anticlockwise movement. A clockwise cycle is conceivable, and may help to explain phenomena such as, say, the development of new artistic sensibilities, but it describes little that is immediately relevant to the theme of this study. Any social aggregate in which the creation and diffusion of knowledge functions effectively must be able to activate all cells in the diagram. The efficiency of the process will find expression in the volume and pattern of knowledge flows. An unactivated cell is the equivalent of a stagnant pool which may result from an impediment to either the creation, the diffusion, or the absorption of knowledge. The effect of such a cell propagates throughout the framework, it is "system-wide", distorting the patterns of flow and modifying its volume. Hence, the way that

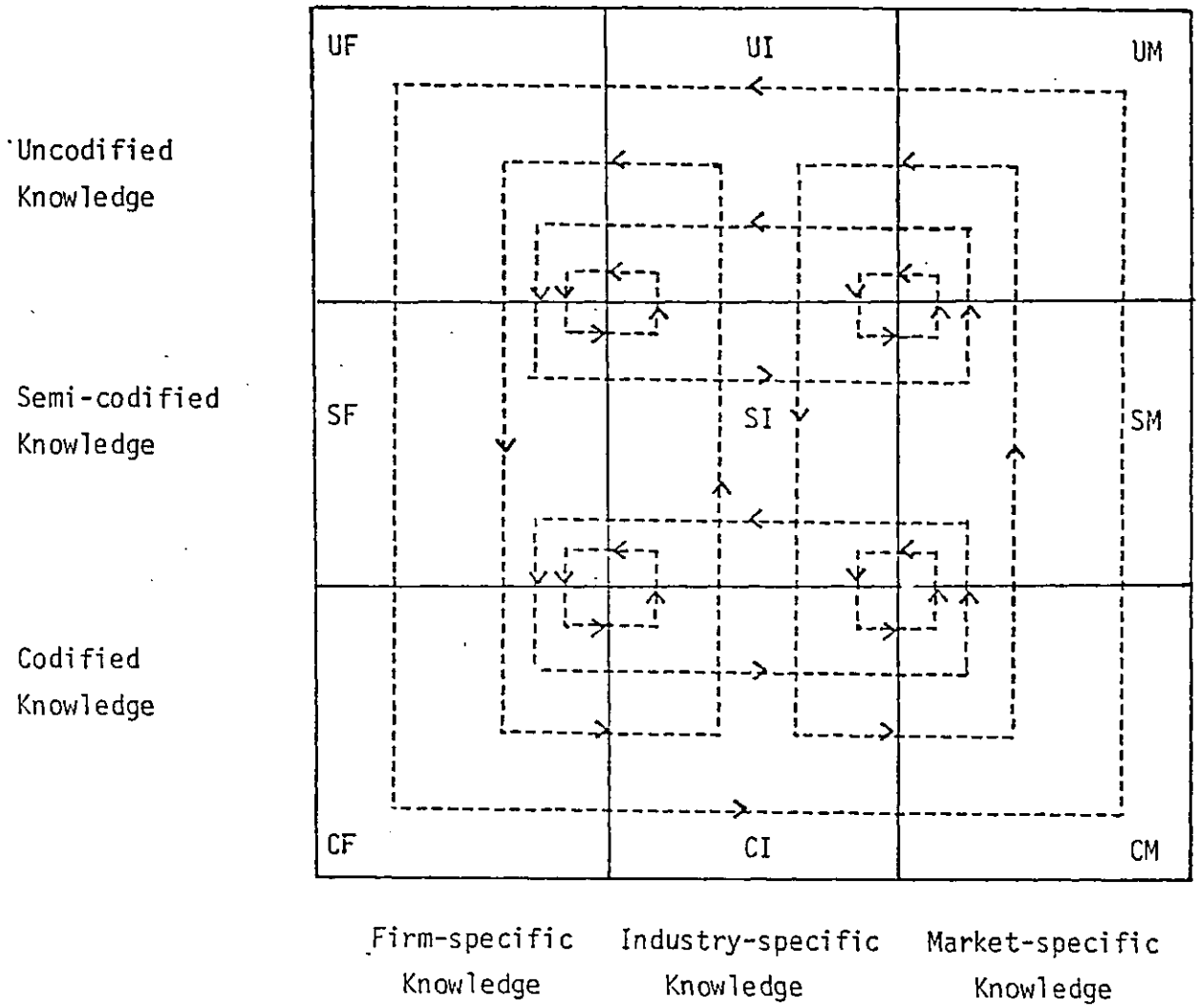


FIGURE 2.6

KNOWLEDGE CREATION CYCLES

knowledge is embodied, used, transmitted, and experienced will inevitably be affected by the presence of inactive cells.

To illustrate: imagine that no flow was possible from SF to CF; what would result? Firstly, the fact that the ongoing process of codifying knowledge had been brought to a halt would limit the possibilities of standardising the technology in which it was embodied; secondly, this lack of standardisation would reduce the scope for realising economies of scale and automating production processes; thirdly, the resulting higher product costs would confine its diffusion to the richer, but smaller, market segments; fourthly, the reduced size of the market, together with the impossibility of increasing its size by reducing costs through standardisation, would make it a poor candidate for an increased allocation of R & D funds. Thus, what starts out as an impediment to knowlege flows downstream of UF, ultimately leads to a reduction in flows through UF itself. Blockages at different points in the framework will produce different effects, and each social grouping - the scientific community, the business community, country A, country B, etc. - will exhibit its own characteristic actual or potential set of blocking points. At some locations the transactional mechanism that could stimulate the flow has not been institutionalised (i.e., workable patent laws); at others the mechanism is readily available, but no container as yet exists to accomodate the resulting knowledge flows (i.e., an industry, or a market).

The case material presented later in this study, in a number of instances points to possible blockages in the UI and UM cells of the framework. How does this show up? It will be recalled from Section 2 of this chapter, that the cells UI and UM covered knowledge transactions by a firm's top management who received ill-formed stimuli from the market concerning its needs and who responded entrepreneurially by channelling resources into new fields of research in UF under conditions of high risk and uncertainty. The field research will show that for technology creators in the sample here operating in LDC's the local UI and UM cells are either not occupied at all, or, where they are, the transactional mechanism is not functioning. That is to say, either the cell is occupied by an expatriate manager with only limited knowledge of host country conditions, or by a passive joint venture partner who will be largely ignored at the level of the parent company.

Thus, in effect, a double barrier blocks effective communications between UM_f and UF_h: the first operates within the host country where a highly skewed income distribution will hinder the expression of economic need through effective demand; the second occurs because no effective interpersonal communication channel exists between UM_f and UF_h which might make a parent firm's creation of new knowledge responsive to its subsidiary's accumulating experience of host country market conditions, small as this may be. Much of the local experience of a firm's products, and the knowledge associated with them, whether acquired through training or direct use, accumulates in the domestic market outside the firm, and it is only internalised by the firm insofar as it serves to adapt its existing product range, usually in minor ways. It is rarely used as a source of information to direct the firm's innovational efforts in its home country, and the firm's R & D activities consequently remain anchored to the requirements of industrialised markets, large enough to justify an investment in an informal communication infrastructure which can link the senior research scientist to the corporate strategist.

In sum, those who by their continued presence in the domestic market, the local entrepreneurs, have invested heavily in UM_f, or UI_f, lack the resources to extend their investment to UF_f and tend to confine their business activities to general trading and distribution, treating manufacturing as an ancillary activity. Conversely, those which like foreign firms, can afford the investment in UF_h fail to invest in UM_f, either directly by developing a strategic capacity within their own local management team, or indirectly by building up stronger communication links with an active local partner. Hence the blockage of flows through the knowledge cycle from UI_f and UM_f, through to UF_f.

The analysis of the knowledge cycle, hypothetical as it is, sheds new light on the elusive and controversial issue of appropriate technology. The fact that none of those addressing the issue can agree on a single meaning for the term "technology" makes the problem of identifying appropriateness doubly difficult, but generally speaking the focus has been on the gap that separates a country's factor endowments, broadly defined, and the factor requirements of the technologies it is led to use, either in the foreign sector of the domestic economy or in imitation thereof (Wells, 1973; Morawetz, 1974, Stewart; 1977). Inappropriateness is a source of factor price distortion and

according to Stewart it is self-reinforcing, being the product of a technological selection mechanism that was itself created in an advanced country environment. But selection is a singular event that forms part of a wider transaction even if occurs at a single moment in time. While a plausible case can be made for its self-reinforcing character, (Jequier, 1978), the grounds on which it rests are essentially static and compacted out of economically tractable data such as can be accommodated in production functions. As Cooper (1974) has pointed out, problems of 'choice of technique' tie up with questions concerning the nature of what is produced and hence of income distribution, social organisation, and class structure; but they leave out of the picture the dynamic, interactive, fluid side of technical change. The knowledge cycle, by making transactions the sluice-gates that channel and regulate the flow of knowledge converts this static analysis into a dynamic one.

As might be expected, Stewart finds that economic analysis will not of itself produce viable solutions to the problems posed by inappropriate technology. She therefore rightly seeks an answer in the "political economy of technological choice" (Stewart, 1977:110) where complex interdependencies and system attributes create total objects selected more on the basis of personal preference than on that of objective analysis. She is led to this approach by two considerations: the first is that advanced technology behaves as a complex system whose high degree of integration makes almost impossible the kind of adjustments and adaptation required by a less developed technological environment; the second is that since an appropriate technology is conceivable, it must also, in principle at least, be attainable, and it is only the tendency to reify existing advanced country technology that blinds people to this possibility.

The knowledge cycle approach described above, however, does not suggest that the high degree of systems integration to be found in advanced country technology is inviolate, although clearly it remains heavily biased in its evolution towards advanced country conditions. Technology embodies knowledge in the form of a repertoire at different stages of codification. Uncodified or semi-codified items in the knowledge repertoire retain a certain fluidity and freedom of movement so that what may appear to an outsider, at a given moment of time, as technically fixed and brittle, turns out on closer examination to be open to subtle transformation and metamorphoses, as newly codified know-

ledge takes an emerging technology in new and sometimes unexpected directions. But it is the source of the stimuli which elicits such new knowledge that will determine the technological orientation of further developments, and as the analysis indicates, few such stimuli from LDC markets currently penetrate the knowledge creating apparatus located in advanced countries. No one has yet shown, though, that the communication of such stimuli is impossible in principle.

The polarisation of political choices into two technological "packages", one labelled "appropriate" and the other "inappropriate", leads Stewart, no less than those she accuses, to reify technology into impermeable systems and to spurn the adoption of a more gradualist approach such as could be developed through a more extensive exploration of the knowledge cycle. Stewart holds out little hope of making advanced country suppliers responsive to LDC needs and would lead a retreat into a third world technological autarky. In effect, she suggests that LDCs disconnect themselves from the knowledge creation cycles of advanced industrialised countries altogether and "grow their own" in the belief that synergetic coexistence between the haves and the have-nots could only result in an even more unendurable dualism. What Stewart is advocating is to eliminate the problems of dualism in an LDC economy by doing away with one of its major causes: the modern sector as it now stands, with its irrelevant products, its inappropriate technology and its inexhaustible gluttony in a resource scarce environment.

Stewart's prescription finds an echo in Sagasti's (1976) plea for technological self-reliance by LDCs. But he argues, in contrast, for a form of institutional and regional collaboration between LDCs that would lead to technological economies of scale and hence to sophisticated technical developments, the aim being eventually to make these countries competitive with industrialised ones. Sagasti does not turn his back on the industrialised world. Where Stewart advocates the collaborative development of intermediate technologies as expressive of LDC autonomy and independence from industrialised country dominance, Sagasti prescribes a form of economic integration that would lead to an upgrading of LDC technology to a competitive level. The former would exploit LDC factor endowments as they stand, the latter would redefine them.

The knowledge cycle does not prescribe any solution to the problems of appropriate technology raised by Stewart, Sagasti and others. It does, however, throw into sharp relief the difficulties that attend "growing one's own" where a total technological coverage is aimed for. To be sure, many technologies in the traditional sector could be "home grown" in this way, but run the constant danger of being "dominated" by more sophisticated advanced country technologies in cost-benefit terms (Cooper, 1974). The development of operating knowledge cycles thus emerges from the analysis as a fully integrated cultural process whose effectiveness depends on complex institutional mechanisms expressing to varying degrees in each transaction, societal aspirations, attitudes, norms, and values. These are the fruits of a lengthy evolutionary process that can lead to cyclical patterns differing widely between countries, as well as to diverse technological postures. The contrasting experiences of Western Europe and contemporary Japan in developing their respective technological strengths springs to mind as an illustration, and points to the possibility of achieving some measure of technological autonomy over a realistic time period. But to go for total autonomy will appear as a very partial solution to the problems of dualism and its technological correlates, since it must be considered very doubtful whether institutional mechanisms could be set up to create any viable and productive knowledge cycle in the time available to most LDCs to meet the many challenges that confront them.

Summary

The main points presented in this section can be summarized as follows:

1. Country barriers - cultural, institutional, and geographic - accentuate differences in the behaviour of uncodified and codified knowledge as it flows throught the framework.

2. These barriers will affect the feasibility, desirability, and legitimacy of a firm's foreign investment objectives, and will increase the rate of return it will expect from international operations.

3. A firm will minimize its risks and maximize its returns by confining itself to the transfer of standardized and codified knowledge until market developments are sufficiently far advanced to compensate it for the hazards that attach to more sophisticated and complex transfer operations.

4. By the control they exercise over country barriers, governments are better able to regulate the flow of existing knowledge, codified or otherwise, than they are to stimulate the creation of new knowledge which depends upon a broader set of factors.

5. Breakage points in the C-D framework, are potential sources of inappropriate technology.

SECTION 4: MARKETS, HIERARCHIES AND FEDERATIONS

Introduction

In the preceding section, the assumption that knowledge was created and diffused within a single jurisdiction was relaxed. In this section the "single actor" assumption - whether he be individual or corporate - that has helped to simplify the analysis will also be discarded. Interfirm as well as intrafirm flow will now be admitted. Also, the emphasis will shift from knowledge flows within the C-D framework to the transactions that give rise to such flows. In the aggregate, transactions create knowledge flows by stimulating interactions in which information is exchanged. Transactions may occur anywhere within the framework as developed and will display the information characteristics of the cells to which they have been assigned. But now the transaction mode is subject to a process of analysis and choice. It can either be internalized by firms and made subservient to organizational goals and controls, or it can be left to the self-regulating tendencies of a market or other institutional devices.

This section draws heavily on some of the recent work in the field of institutional economics currently associated with the name of Oliver Williamson. Building on tradition that goes back to John R. Commons (1934) and R.H. Coase (1937), institutional economics makes of transactions the ultimate units of microeconomic analysis. Williamson sums up the approach as follows:

"1. Markets and firms are alternative instruments for completing a related set of transactions.

2. Whether a set of transactions ought to be executed across markets or within a firm depends on the relative efficiency of each mode.

3. The costs of writing and executing complex contracts across a market vary with the characteristics of the human decision makers who are involved with the transaction on the one hand and the objective properties of the market on the other.

4. Although the human and environmental factors that impede exchanges between firms (across a market) manifest themselves somewhat differently within the firm, the same set of factors apply to both. A symmetrical analysis of trading thus requires that we acknowledge the transactional limits of internal organisation as well as the sources of market failure. Basic to such a comparative analysis is the following proposition: just as market structure matters in assessing the efficacy of trade in the market place, so likewise does internal organization." (Williamson, 1975:8,9)."

Characteristics of Transactions

In his book Markets and Hierarchies (1975), Williamson discusses a number of characteristics through which transactions can be analysed. The most important are set out below.

Uncertainty and Complexity: Uncertainty is a product of environmental factors, but it can also result from computational inabilities when confronting even a comparatively certain environment. Complexity incorporates uncertainty, but is further qualified by the presence of interdependent elements, as well as by a certain vagueness or lack of definition of either inputs or outputs. Complexity reflects the multiplicity of contingencies to be dealt with in a given situation (Butler, 1979) and consequently requires a measure of synchronization of activities as transactions proceed as well as a higher level of feedback between them. Transactions that are uncertain or complex would be defined as uncodified in the C-D framework.

Bounded Rationality: According to Simon (1957:98) "the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems where solution is required for objectively rational behaviour in the real world." In this sense bounded rationality describes a relationship between the rationality available and that which is needed to solve problems. Its manifestations only become interesting under conditions of uncertainty or complexity when limits on rationality are effectively reached. Means can be devised for economizing on bounded

rationality such as coding or converting problems into a sequential form - i.e., by programming them. Organization structures are cited by Simon as instances of economies on bounded rationality. In the C-D framework, the phenomenon will more likely manifest itself when confronted with uncodified rather than codified knowledge providing of course that the relevant codes have already been mastered.

Small Numbers Bargaining: Perfectly competitive markets require the involvement of large numbers for their effective performance. Small numbers bargaining describes the absence of this condition; it points to bilateral monopolies, oligopolies, and a general lack of flexibility in transactions. Firm-specific knowledge would best describe such a condition in the C-D framework, but it could be found anywhere within it, since, for example, a monopoly, under certain circumstances, could operate on the basis of market-specific knowledge alone.

Opportunism: The joining of uncertainty with bounded rationality and small numbers bargaining leads to opportunism, a condition in which, superordinate goals are sacrificed to sectional interests. Codification is one of the devices used by organizations to cope with opportunism, which, in a C-D framework, would tend to emerge in UF.

Idiosyncratic Knowledge: Knowledge of "particular circumstances of time and place" (Hayek, 1945) can be termed idiosyncratic and confers "first mover" advantages on its possessor. It is generally acquired "on-the-job" and economizes on bounded rationality in idiosyncratic job circumstances. At the same time it can give rise to internal opportunism within firms and can only be avoided by shunning idiosyncratic technologies and techniques in favour of more standardized operations. Idiosyncratic knowledge is usually uncodified and may become firm-specific in the sense that no equivalent know-how may be readily available outside a given firm.

Information Impactedness; This describes a condition in which the true underlying circumstances concerning a transaction are known to only one of the parties involved and cannot be costlessly disclosed to the other. The assymetrical distribution of knowledge concerning a transaction gives rise to

"moral hazards" (Arrow, 1969:55) - the temptation for one of the parties to behave opportunistically - if there is a cost to achieving information symmetry. Information impactedness will affect firm-specific knowledge in the C-D framework, but not exclusively so; it also has a greater application in the case of uncodified than in that of codified knowledge.

Strategic Behaviour: The conditions that give rise to opportunism derive from an actor's strategic behaviour - described by Williamson as the pursuit of self-interest with guile. It implies the withholding of impacted information in such a way as to conceal strategic intentions or at least make them ambiguous. This kind of behaviour is effective in a C-D framework when applied to firm-specific knowledge, but it can be equally so when market-specific knowledge is impacted, as with, say, foreign markets - i.e., in M_f.

Atmosphere: It often hapens that the transaction itself can be regarded as an object of value and that the prevailing norms of reciprocity also make it difficult to insist on the contractual completeness or the exacting execution of a transaction. "Atmosphere" sums up the attitudinal factors that motivate a transaction in a given context; it is likely to count for more in those transactions that depend on the use of uncodified knowledge.

Transaction Modes

For Williamson, firms and markets coexist in symbiotic equilibrium; they offer alternative, and complementary means of organizing technologically separable activities, and the choice between them will be made on the basis of their respective costs and benefits. Firms, through a process of hierarchical control, subordinate the goals and behaviour of their members to a dominant set of objectives. Markets serve a broader range of objectives than firms, but through a process of self-regulation that does not yield the type of efficiencies achievable by hierarchical means. Intermediate between hierarchical and market transaction modes, and somewhat neglected by Williamson in this analysis, lies what could be called a communal, or federative transaction mode (Butler, 1979; Bauer and Cohen, 1979) which, whilst unable to establish control by fiat as can a hierarchy, aims at a more efficient realisation of a

more limited number of goals than does a market. Like markets and unlike hierarchies, federations set up lateral relationships between transacting parties. But they differ from markets in that they involve small numbers rather than large ones and their effectiveness often depends upon face to face negotiations rather than the free play of impersonal market forces. A federation offers a transaction mode based on peer group interaction; it is more political in nature than the other two modes and will show a greater sensibility to atmosphere. Williamson sees such peer group arrangements as inherently unstable and open to "free-rider abuse" (1975,p.45) leading eventually to a switch to one of the two other modes available. Yet in dismissing federations in this way, he is playing down the effect of social norms that may induce conformity within a peer group, and assuming away those components of atmosphere that might be developed to make this transaction mode a viable third choice. Mauss' essay on the gift (1925) shows that stable and reliable transactions can occur through forms of social organization less formally compelling than a hierarchy, yet less atomistic than a market. Federations will, therefore, form part of the analysis, representing a transaction mode, viable in itself, and lying on a continuum between markets and hierarchies, between the indeterminate amorphous atomism of the one, and the stable, integrated structures of the other.

Transactions are assigned to markets, hierarchies, or federations with a view to minimising the total costs of executing them. Williamson's own analysis, by omitting federations from consideration, puts forward a narrower basis for assessing transaction costs than is actually necessary to his conclusions. An efficiency calculation can admit of psychic costs and benefits as well as pecuniary ones with no loss of scope, the only difference being that the endurance of federations under some circumstances is thereby better explained. The matter cannot be further pursued here and the assignment to each mode of transactions arising within the C-D framework must now be considered.

Market Transaction - contracting in the market will be economically desirable and feasible insofar as:

1. The goods or services contracted for can be defined and set down in writing.

2. They can be delivered even in uncertain circumstances without occasioning costly re-haggling as to terms and conditions.

3. Monitoring and enforcing the terms of the contract is not unduly costly for either party.

4. Both parties feel they stand to gain from the contract given their circumstances. Additionally, market contracting will favour those transactions, occasional or recurrent, in which the parties can be indifferent to each other's identity and where a valuable on-going relationship is not implied.

Market transactions require large numbers bargaining to provide ready substitutes, a sufficient quantity of codified knowledge available and relevant to transactions which can speedily diffuse throughout the market and act as an input to decision-making, separable transactions that can be negotiated independently, thus reducing their complexity, and finally, a low degree of atmosphere, making them accessible to large numbers at low social costs. That these conditions usually only obtain in the real world at any one time for a limited class of transactions explains the fact that organizational decision-makers are constantly faced with a stream of "make-or-buy" decisions. This is but a more conventional way of confronting the transactional issue.

Market transactions fail to satisfy, in circumstances which combine opportunism, bounded rationality, and small numbers bargaining (Williamson, 1975:7). Within the C-D framework, an optimal assignment would place such transactions in CM, with moves upwards or to the left creating incremental market imperfections which eventually lead to market failure and thus to hierarchical or federal alternatives.

Hierarchical Transactions - Contracting through hierarchies (i.e., through an employment relation) will be preferred where:

1. There is a need to extend the bounds on rationality - hierarchy does this by specializing decision-making and communication processes.

2. Opportunism due to small numbers must be curbed.

3. Interdependent units must adapt to contingencies in an interdependent way.

4. Conflict issues can be resolved by fiat.

5. Internal auditing can improve contract performance.

6. A better atmosphere is offered than in market transactions.

Hierarchies enhance the efficiency with which goals can be pursued oy reducing their number and by ranking those that remain according to a clearly established system of priority. Integration is brought about through the use of authority:

"While the habitual assumption back of the decision in bargaining transactions is that of equality between willing buyers and willing sellers, the assumption back of the managerial transaction is that of superior and inferior... the superior gives orders, the inferior must obey" (J. Commons, 1934).

The routinisation of decision-making and communication that hierarchy makes possible is a form of codification that enhances the organization's capacity to process a wide range of experiences, to address complex issues, to economise on bounded rationality, and to reduce dependency on idiosyncratic knowledge and hence, information impactedness.

Yet hierarchies, like markets, tend to break down beyond certain limits. The codification and transmission of data across hierarchical levels create distortions and information losses (Williamson, 1975:123) which pose afresh the problem of bounded rationality and give rise to internal opportunism and the pursuit of subgroup goals. The inability to resolve by fiat all conflicts between politically powerful subgroups, often result in strategic concessions that give a hierarchy an expansionary bias, and that can push it beyond a size - organizational form held constant - which this transaction mode can efficiently service. A switch of organizational form from a functional to a

divisional structure will mitigate the unwanted effects of growth, but only by substituting internally a quasi-market relationship between the new divisions for the former hierarchical one. They will now compete with each other in the resource allocation process, subject only to a limited number of superordinate constraints required for coordination and direction by the centre. In effect, in order to manage these constraints, the hierarchy, in its top echelons, will function like a federation.

In the C-D framework the natural home for hierarchical transactions is in CF where the relevant knowledge is impacted in the firm but, because it has been codified, not in groups within it. As transactions become less codified, a federated transaction mode may be preferred. As they become less firm-specific a market transaction mode may come to be chosen.

Federated Transactions - Federations are the poor relation in Williamson's analysis. Precariously perched between markets and hierarchies, they do not provide a stable home for transactions. Yet as Butler (1979) points out, their instability is a function of prevailing social conditions. To a greater extent than the two other transaction modes, the viability of federations rests on prevailing cultural norms, the climate of trust and tolerance that they foster, and the styles of behaviour they legitimate.

Federations will claim those transactions whose complexity and vagueness make them refractory to treatment by markets or hierarchies, where bargaining occurs between small numbers, and where information is not so impacted in one party that it can dominate the transaction. Such circumstances make atmosphere all important as transactions will have to be completed in a climate of trust and of give and take, and any overt manifestation of calculative, maximising, or strategic behaviour by one party, conducted at the expense of the other, will destroy the basis for further collaboration. Thus, where a hierarchical relationship can be characterized by a measure of dominance and coercion, a federated one rests upon the use of influence through negotiation (Bauer and Cohen, 1979). It is a political relationship in which the superordinate goals and values shared by transacting parties mutually commit them in a way that divergent goals pursued through market transactions do not. But it is also a relationship in which each party possesses sufficient power to make the

process of mutual accomodation one of continuous bargaining - albeit carried out implicitly, as in the case of oligopolistic collusion - rather than one of dominance by one party and subordination by the other, as in the case of hierarchies.

Federated transactions describe the relationship that is gradually built up, for example, between a skilled professional and his client, between powerful groups of shareholders in a company, between large defense contractors and government procurement officers, and, as already suggested, between the members of a management board. In all these examples, the complexity or the vagueness of the issues to be treated escape the provisions of formal contracting, whether this is done through markets or hierarchies (i.e., the employment contract), and require a high degree of trust and shared bargaining norms between the parties if transactions are to take place. This level of trust must be built up over time through extensive personal contact, and represents a sunk cost for each of the transacting parties that increases their commitment to each other. Such an investment in the transaction, however, will often only be repaid in small numbers situations, where norms of reciprocity can effectively be enforced at an interpersonal level.

Federations, like markets and hierarchies, can suffer failures. At one point a concern for mutual accomodation can give way to a concern for efficiency which may drive federations towards hierarchy if goal congruence between the parties can be maintained. Or the complexity and vagueness of transactions is eroded by accumulated experience, so that more formalised - i.e., codified - and less 'trusting' arrangements can be reached. Finally, what started off as a small numbers situation can develop into a large numbers situation if exclusivity provisions cannot be maintained; face to face relationships will give way to impersonal ones and the enforcement of implicit bargaining norms could then become excessively costly giving rise to opportunistic behaviour. A move towards market arrangements would then become likely.

Federated transactions, depending as they do upon the deployment of uncodified knowledge, are best accomodated in UM or UI where information impactedness is at a low or medium level and the scope for achievement of

dominance by any one party on information grounds is therefore limited. With a move towards firm-specific knowledge, the opportunity of switching to a hierarchical mode increases, but the uncertain nature of the information dealt with suggests that a federated arrangement will be maintained within the hierarchy in an attempt to reduce opportunistic behaviour internally while increasing the scope for the pursuit of such behaviour with respect to outsiders. Conversely, with a move downward from UM to SM or CM the opportunities for re-assigning federated transactions to the market increase.

Discussion

The markets and hierarchies approach developed by Williamson takes an essentially unitary view of organization: transactions are assigned to firms or to other institutional arrangements, but any further differentiation of transaction modes within a firm is not pursued. By looking at transactions in the context of a C-D framework as shown in Fig. 2.7, it becomes apparent that one of the information characteristics which has helped to guide their assignement to markets, hierarchies, or federations - its degree of codification - has been used by Lawrence and Lorsch to establish the organizational linkages within a firm on the basis of which activities are integrated and differentiated. The focus of Lawrence and Lorsch's analysis (1967) is on intraorganizational linkages, that of Williamson on interorganizational ones. They share a contingency approach to the form and the content of transactions, but with Williamson putting perhaps more emphasis on the distribution of information between the parties. The preceding analysis, however, indicates that markets, hierarchies, and federations, suitably adapted, will operate inside firms as well as outside them, shaping the administrative style of organization subunits and setting limits to the possibilities of integration and differentiation which together they can achieve. Here institutional economics meets organization theory within a single framework.

The C-D framework, in effect, explores the political economy of information. Its behaviour over time (its flow) and at an instant (transactions) as it moves within organizations, and between them, makes it a mercurial resource in the hands of those whose strategic effectiveness depends on an ability to

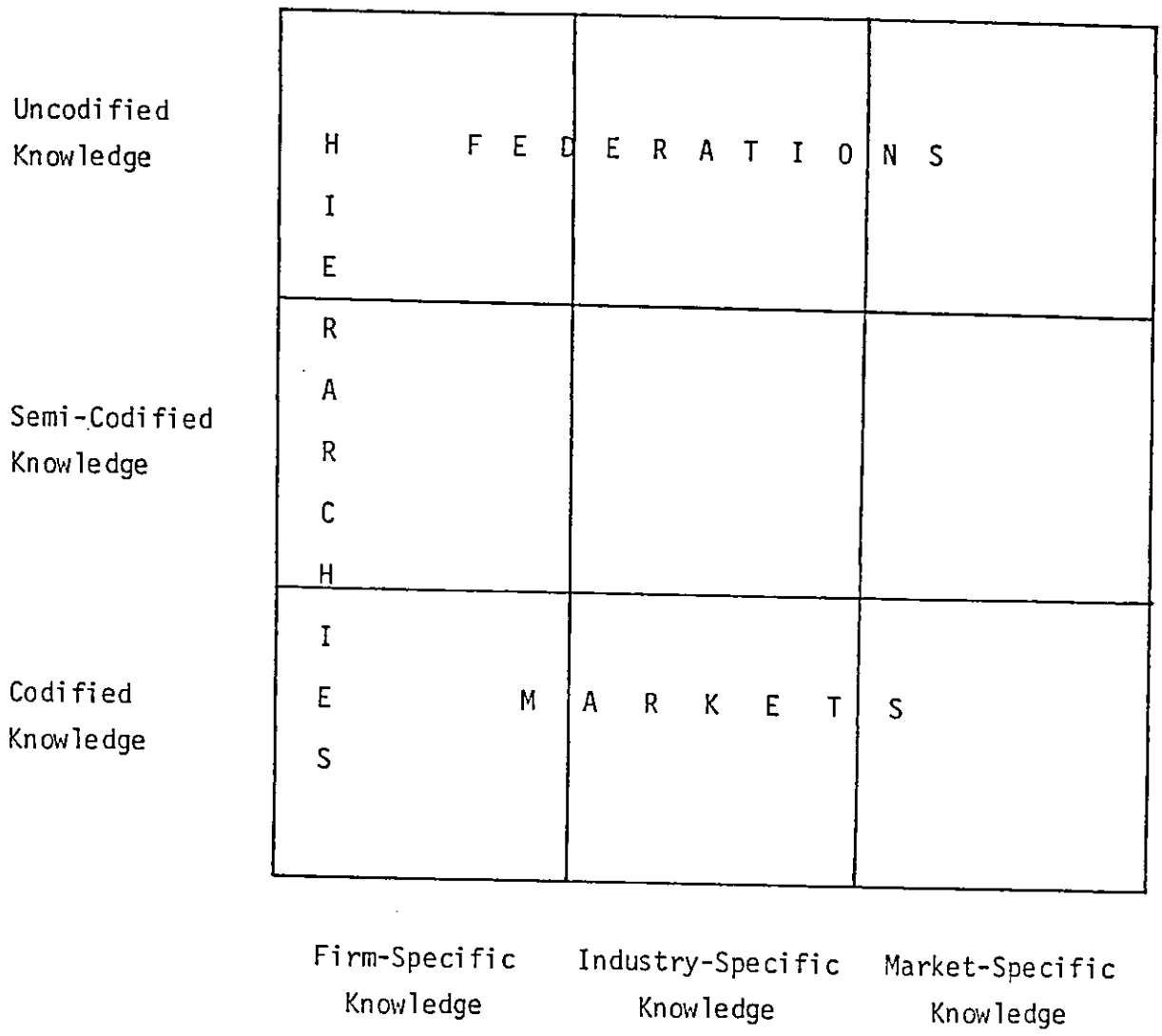


FIGURE 2.7

ASSIGNMENT OF TRANSACTIONS IN THE C-D FRAMEWORK

capture it, contain it, and eventually channel it in a controlled way. The contention made here is that the international transfer of technology, crystallizing in transactions that could either accelerate or block the process of creating and diffusing new knowledge, would be better understood from the perspective opened up by such a framework. A political economy of information operates beyond the confines of microeconomic analysis, narrowly defined, to encompass behavioural characteristics, now acknowledged by organization specialists, but hitherto dismissed by economists as elusive to their craft. These behavioural characteristics are at the heart of technology transfer processes, as the empirical investigations which follow this chapter propose to illustrate.

Some Propositions

The analysis developed in the four sections of this chapter leads to a number of empirical propositions which are presented below and will be further explored in Chapters 4 and 5. Before presenting them, however, a number of recapitulative points concerning the analysis must be made:

1. The C-D framework describes the diffusion characteristics of uncodified and codified knowledge, as well as the process whereby one is transformed into another by acts of codification and accumulating experience.

2. In a corporate context, acts of codification constitute an investment which is more likely to be carried out if its benefits are appropriable. For this reason the further one moves towards the left in the C-D framework the greater the tendency to assign transactions to hierarchies rather than markets.

3. Federated transactions are more likely to occur in the upper part of the C-D framework than in the lower part; but with a move leftward, they begin to compete with hierarchical transaction modes. At some point, either a switch is made from one to other, or both are maintained, but one is made subordinate to the other.

4. Market transactions are more likely to occur in the lower part of the C-D framework than in the upper part; but with a move leftward, they also begin to compete with hierarchical transaction modes. Here again, as in 3 above, either a switch is made from one to the other, or both are maintained, but one is made suordinate to the other.

5. The internationalisation of a firm's operations increases the costs of communication and diffusion. This has two consequences: 1) hierarchy is more costly to maintain in any of the foreign cells of the C-D framework, so that other transaction modes - markets and federations - may now become more competitive; 2) transactions on the left hand side of the C-D framework are less likely to be transferred to foreign cells (i.e., abroad) - insofar as they have been assigned to hierarchies - than are transactions on the right hand side.

6. Markets, hierarchies, and federations compete for transactions throughout the C-D framework. Their respective competitive strengths are determined partly by exogenous institutional and cultural factors, partly by their position within the framework, and partly by how effectively diffusion and codification barriers (which include country barriers) limit their field of influence. A C-D framework dominated by a single transaction mode is perfectly conceivable, the other two remaining, but latent, possibilities.

International technology transfer subjects the C-D framework to extreme conditions. Geographical distance, cultural gaps, and differing jurisdictions, make communications difficult and diffusion costly. Additionally, the repertoire of codes, norms, and beliefs of transferor and transferee will often show little overlap. Such circumstances, as stated above, may favour market and federated transactions over hierarchical ones, so that firms which had effortlessly internalised transactions when operating within a single jurisdiction, may be forced to reassign them when they come to extend their operations, abroad. Thus, markets, hierarchies, and federations all become eligible candidates for transactional re-assignments when a firm makes arrangements to transfer its technology abroad, and the presence of country barriers should, in some sense, help to explain a firm's transactional pattern within

the C-D framework. For this reason, the empirical propositions that follow will be confined to technology transfer operations by international firms as will be the case study data through which these propositions are explored.

Proposition 1 - Joint ventures involve a pooling of returns between parties, but one in which they maintain their identity and independent claims to ownership. The relationship created is a negotiated one characteristic of Federations.

Corollary 1.1 - The transactions executed between contracting parties will be complex or vague; information will not be solely impacted in one party, so that each will enjoy some bargaining power; atmosphere will be important to the transaction, and so therefore, will the quality of the personal contact. A small numbers bargaining situation is implied.

Corollary 1.2 - Joint venture arrangements will tend to be placed in the upper part of the C-D framework rather than in lower part, but towards the left of the diagram they will compete with hierarchical transaction modes. At some point either a switch is made from one to the other, or both are maintained but one is made subordinate to the other. Their natural "home" in the framework is in UM.

Proposition 2 - Licencing agreements are contracts in which one party makes a single, or a number of regular payments to the other, for the purchase of technological know-how, trademarks, or other intangible assets. The relationship is an arm's length one between a willing buyer and a willing seller characteristic of markets.[13]

Corollary 2.1 - The goods transacted can be defined in writing and the terms of the agreement can be implemented without rehaggling and enforced without costly monitoring. Transactions are technologically separable, but small numbers bargaining is implied where the goods and services transacted are firm-specific. Atmosphere is not important and the parties can be indifferent to each other's identity in those cases where a valuable on-going relationship is not implied.

Corollary 2.2 - Licencing agreements are more likely to be placed in the lower part of the C-D framework than in the upper part, but towards the left they begin to compete with hierarchical transaction modes. Here again, either a switch is made from one to the other, or both are maintained, and one is made subordinate to the other. Nevertheless, the framework will naturally tend to assign them to CF.

Proposition 3 - Wholly owned operations describe technology transfer arrangements in which the transferor and transferee belong to the same firm as it straddles country boundaries, so that the transactions involved remain internal to the firm. They typify hierarchies.[14]

Corollary 3.1 - The operations involved will be characterized by interdependencies and complexity, and their technologies by non-separability; bounded rationality will be tackled through routinization as will small number opportunism. Conflicts can be resolved by fiat with reference to a clear set of objectives whose attainment can be ensured by internal auditing.

Corollary 3.2 - The transactions that typify wholly owned operations are more likely to be placed on the left hand side of the C-D framework than on the right hand side, and will tend to be firm-specific in nature.

Proposition 4 - The relative cost of internalising transactions will be lower for large than for small firms so that the international operations of the former should show a bias towards the use of wholly owned subsidiaries when compared with small firms.

Proposition 5 - The preference for hierarchy on the left hand side of the C-D framework and the increased costs of executing transactions across country barriers will give international firms a preference for first externalising these on the right hand side of the framework, where this proves necessary or desirable, and particularly so in the case of firms whose relative strength lies in the creation of firm-specific knowledge.

Proposition 6 - Firms will seek to cover the C-D framework as a whole by whatever transaction mode is cost-effective given their circumstances: firms whose relative strength lies in F will seek to complement it through transactions with firms strong in M; firms whose relative strength lies in U will aim at arrangement with firms strong in C.

Proposition 7 - International firms will be least reluctant to transfer knowledge that is not firm-specific and that has low transmission costs; indeed, those that seek to develop their markets have an active interest in transferring knowledge in CM to potential customers.

Proposition 8 - Knowledge purchasers will tend to locate on the right hand side of the C-D framework and knowledge sellers on the left.

Conclusion

Only the last of the above propositions implicitly refers to the knowledge creation cycle which is epiphenomenal to the functioning of the C-D framework. In fact, the increased costs of transactions in the international case makes it more difficult to complete the cycle and more difficult to observe it over a short time span. Any test of the knowledge creation cycle lies beyond the compass of this study. The case presented for it here must rest on analytical grounds and on what can be garnered from the relevant literature on the creation and diffusion of innovation, some of which has been referred to in this and in the preceding chapter. If the propositions and their corollaries receive sufficient empirical support from the data presented in the next two chapters to give the C-D framework a measure of plausibility, then the knowledge creation-cycle may become the source of further fruitful hypotheses that make it worth testing.

NOTES TO CHAPTER 2

1. The term "collective representation" was used by Durkheim and Mauss (1963).

2. This statement is a variant of the Sapir-Whorf hypothesis. See Whorf (1956).

3. For a discussion of the relationship between classification systems and the distribution of power in a social group, see Douglas (1973:173-188).

4. Bernstein (1973) develops this point at length.

5. Kuhn (1962).

6. Douglas (1966).

7. Shannon and Weaver (1949:4).

8. A treatment of professionals as a social group is given in Carr-Saunders and Wilson (1933).

9. See Anthony (1965) for an elaboration of this point.

10. An enfolding of the cerebral cortex into the lateral fissure of a cerebral hemisphere having the shape in cross section of a sea horse.

11. See the papers by Butler (1980) and Williams (1980) presented at the Conference on Markets and Hierarchies at Imperial College of Science and Technology, London, January 1980.

12. Williamson (1975:257).

13. The proposition is not as tautologous as it may appear. Not all licensing agreements are market-based - for example, those used by international firms to extract non-taxable royalty payments from their wholly-owned subsidiaries. The term market is here used in the narrow sense suggested by Williamson (1975) when he describes its information characteristics.

14. As with markets, the term hierarchy is used here in a narrow Williamsionian sense. Not all wholly-owned operations will meet its requirements.

CHAPTER 3

RESEARCH OBJECTIVES AND PROCEDURE

INTRODUCTION

Chapter 2 ended with a number of propositions which were claimed to be amenable to some form of empirical investigation. The purpose of the present chapter is to briefly describe what fieldwork has actually been carried out to this end and why. The presentation is split into four sections. In the first, the research strategy is outlined, and shown to be the joint product of issues explored in the first two chapters and of operational constraints on the collection of field data. In the second, the field study objectives, themselves products of the strategy, are discussed. The third section describes the procedures used in the field to collect the data and some of the problems encountered in doing so, and the fourth, and final, section presents the sample data in a summary form. A more detailed description and analysis of the sample data will be given in the next two chapters.

SECTION 1: RESEARCH STRATEGY

The first chapter treated of technology transfer at two different scales: a macro scale at which firms were invisible - all that could be observed was a movement of goods between countries - and a middle scale which allowed an analysis of firm behaviour at an industry level. To each scale corresponded a preferred approach: trade theory at the macro scale and industrial economics at the middle scale. The chapter concluded with the view that in technology transfer a number of theoretical perspectives developed at the macro and medium scale found insufficient empirical support and that more detailed fieldwork was needed to correct this defect. For this investigation therefore, a case study approach commended itself.

The case study, it must be said, has limited usefulness as a generator of pure and homogeneous empirical data. It yields a crude ore which must be further refined and by the end of the process little may be left that can be used for systematic analysis. It follows, therefore, that one must be methodologically modest in applying case study material, and must shun overambitious generalizations. Cases, while often a fruitful source of new hypotheses or of illustrative material for existing ones, rarely offer an adequate context for their extensive corroboration.

Nevertheless, the case study offers three undoubted benefits. First, as a tool of field exploration, it brings a researcher into direct contact with his data, however crude, and allows the identification and study of variables which never reach the statistical yearbooks beloved of desk researchers. Second, the experience-based knowledge acquired in researching a case is a fruitful source of usually modest but relevant hypotheses which may serve as a guide to further work in the field. Third, whilst a case study may only weakly support one or more hypotheses, its findings can strongly challenge their claims. No number of positive instances of a generalisation can validate it, but one negative instance can often effectively invalidate it.[1] This, of course, does not give the case study the status of a "crucial experiment" such as are devised in the physical sciences; yet both, however, play not dissimilar parts in developing their respective fields of enquiry.

The case studies of Aharoni (1966), Baranson (1978), Teece (1976), and Behrman and Wallender (1976) each looked at U.S. firms in their worldwide operations; the ones that follow will be on Western European firms in the ASEAN countries. Also, these five authors generally tended to make the U.S. firm itself - the technology transferor - the object of their investigation; here the focus will be on the relationship betwen a transferor and a transferee, i.e., between a European firm and one or more local firms or individuals. This is done to explore at a general level the hypothesis that a technology transfer transaction is the outcome of an interaction between two strategies describable within the C-D framework, the transferor's and the transferee's. By confining one's attention exclusively to a transferor, one runs the danger of trying to evaluate the success of his strategy without looking at the circumstances under which it was implemented, and without considering how far the strategy pursued by other relevant actors constrained his own choice of moves.

The relationship between a transferor and a transferee can take a number of forms. At one extreme, it can establish an arm's length trading relationship in which any technology transferred is wholly embodied in goods and transactions are limited to an exchange of these for money. A transfer of technology in disembodied form can also take place at arm's length, through a licencing agreement or a turnkey contract. The mutual involvement of transferor and transferee is more committing in a joint venture arrangement, but to a degree that varies according to ownership and control arrangements between the parties. It becomes strongest in a wholly owned subsidiary where the transferor and the transferee belong to the same organization and can therefore be presumed to pursue parallel or complementary strategies. In the latter case, of course, and in an international context, the term technology transfer takes on a more restricted meaning, describing a flow of technology between countries but not between firms.

Taken as transaction modes, licencing agreements and turnkey contracts, joint ventures, and wholly-owned subsidiaries are the main focus of the propositions developed in the last chapter and, for that reason, must become those of the fieldwork. Technology transfer can be viewed as one of a number of outcomes that result from transactions between a transferor and a

transferee. In some situations, the transfer is central to the relationship between the parties, in others it is peripheral. At some stage, the transactional relationship between the parties may become formalised, whether as a purchasing contract, a turnkey operation, a licencing agreement, a joint venture agreement, or an outright creation or acquisition. Such a formalised arrangement, is a part-manifestation of the parties' strategic intentions; what were they looking for in coming together? How successfully did the relationship evolve subsequently? and so forth. The expression 'part-manifestation' is carefully chosen. How far strategic intentions can be inferred from the deal finally struck depends on how extensive were the concessions made by one party to the other, whether at the negotiating table itself or in the course of their evolving relationship.

The term "strategy" is used here in the sense suggested by Ansoff (1965) to denote the way that a firm establishes linkages to regulate its transactions with its environment. The process of establishing a firm's posture requires a matching of the firm's capability as defined through a number of attributes, with the performance called for in response to specific environmental threats or opportunities. The strategic postures of transferors and transferees can be taken as indicative of their respective capacities to generate or absorb new technologies. Thus, if a firm's strategic intentions are reflected in its preferred transactional modes, they are nonetheless constrained by its technical capacities as expressed through its strategic posture. In this way a link is forged between a firm's structure, which establishes its bargaining strength, its strategy, which determines its bargaining objectives, and its achieved transactions. Although the link cannot be assumed to be solid and systematic in its occurrence, it will nevertheless help to orient the field investigations.

SECTION 2: FIELD OBJECTIVES

The aim was to collect information from two sources and in two geographical regions:

Source 1: A technology transferor - Both in his home base and where appropriate, in one of his field operations. A licensor would probably only need to be seen in his home base. A joint venture partner would have to be seen both in his home base and in the field. This would also apply to a firm's wholly owned operation.

Source 2: A technology transferee - He would be contacted in the field i.e., in his home base.

Region 1: Western Europe - The home base of the technology transferors to be studied.

Region 2: The ASEAN countries - The home base of the technology transferees under study.

Note that the geographical emphasis is on regions rather than countries - one being industrialized, the other not. This was done to try and factor out some of the more idiosyncratic country features from any pattern that might emerge. However, as will be seen below, such an endeavour remains without any statistical sanction in view of the small number of cases and the even smaller number of countries involved.

The above categories have only analytical usefulness and some cases do not fit them very comfortably. What, for example, is one to make of a direct foreign investment through a wholly owned local subsidiary - a case of Source 1 and Source 2 being the same firm? Or again how does one deal with a joint venture between a European and, say, a Japanese firm operating through a local subsidiary in one of the ASEAN countries? Where encountered, such anomalies were allowed to stand. They broke the classification rules of the field investigation, but did not necessarily violate the principles of the study.

Field Data was to be collected through semi-structured confidential interviews. In effect, a case would consist of three interviews: one with the relevant senior executives of a European firm in its home base; one, where appropriate, with the European firm's executives in the field; and finally, one with the relevant executive of a local ASEAN firm. In those cases where joint venture arrangements were made with local individuals rather than organizations, they would be sought for interviewing. Twenty-five cases were aimed at on the basis of approximately five per ASEAN country. This small number of cases would not allow any sophisticated quantitative analysis, but would nevertheless offer a good spread of qualitative data. Furthermore, some informal comparison between cases might become possible at this sample size, thus broadening the perspectives of the investigation beyond the self-contained views offered by the cases themselves. In the event, thirty three case studies were completed as against the twenty-five originally planned.

What dictated the choice of regions? Recently Europe, and particularly the EEC, has become a focus of attention for ASEAN and although until November 1978 countries of the Economic Community still tended to deal with ASEAN on a bilateral country-to-country basis, the EEC has extended a general scheme of preference to cover many ASEAN products (Far Eastern Economic Review, 23/2/1979). Europe, like the U.S. and Japan, has also begun to take an active interest in ASEAN, partly for political reasons, and partly because the association lies in a region which at present is enjoying one of the fastest growth rates in the world. ASEAN trade is heavily dependent on the industrial markets of the U.S. and Western Europe, and member countries are large importers of capital goods and others, essential to the proces of industrialization. The overall balance of trade between the EEC and ASEAN is in the latter's favour, part of which may be accounted for by the fact that many EEC firms have been replacing direct exports from Europe with direct investments in local production facilities. These are mainly set up to exploit the local markets and substitute for exports as has been shown in a study of foreign investment motives by Thomas Allen (The ASEAN Report, Vol.1 1979).

SECTION 3: PROCEDURES FOLLOWED

A word must be said about the interview as a data collection device, for it presents limitations in an investigation of this kind which must be identified and acknowledged. Perhaps the most severe is the language barrier. Both the Europeans and the South East Asians interviewed have a varying command of English, the language used in the interviews, and while in none of the cases did this consideration emerge as an explicit obstacle, questions or answers may not always have been interpreted as intended. If the information to be collected had been highly specific, procedures could have been standardised, and a questionnaire developed and pre-tested, at least in Europe, before the field work began. As it was, the interview was semi-structured, that is to say, the interviewer had a list of questions drawn up on an interview guide which he could put in any sequence, and, indeed, in any form. A certain need to react opportunistically at times dictated this approach. Each case had its idiosyncrasies and its own "personality" and called for a flexible approach in which points could be developed and omitted as circumstances dictated. Questions were mostly open-ended, and not all were applicable in a given case. Often a discussion context created in the course of the interview itself would endow or rob a question of meaning for an interviewee. The interview guide tried to mitigate this kind of semantic problem by addressing some issues through two or more questions in which one could act as a consistency check on the other.

A second limitation of the semi-structured interview is the danger of observer bias creeping unnoticed into the process. Questions can freely be framed in such a way as to favour particular answers and replies given in less than perfect English can be corrected for grammar in a way that creates semantic distortions. All this may be quite unconscious, and well outside an interviewer's control, given the informal nature of his data collection methods. A third problem is the one of reliability: would someone asking the same question at a different time and/or to a different person in the firm being investigated get the same answer? Also, would the answer given, adequately describe or measure the phenomenon to be captured? In short, was the information valid as well as reliable?

In order to overcome some of the limitations of the data gathering methods, it was decided to develop transcripts of the interviews; each person interviewed would receive his own for checking. Corrected transcripts were returned for approximately one third of the interviews given - not all within the six weeks allowed for. None called for major modifications to the data, and in many, additional information was volunteered which had not been available at the time of the original interview. One must remain agnostic about transcripts that were not returned, comforted only by the thought that any flagrant misrepresentation of an interviewee would have elicited some kind of response.

The interview guide grouped 147 questions under twenty sections (see Appendix 1 for the complete interview guide). Since not all questions would be relevant to all interviewees, three subguides were developed: one for the parent company in Europe; one for the local indigenous firm or person in the field with which or whom the European firm was transacting; and one for the operating company, whether wholly owned by the European firm or jointly owned by the European firm and a local firm or person. Each sub-guide contained approximately one hundred questions at varying levels of detail.

Interviews, whether given in one or two sessions, lasted on average between two and five hours. The time taken was partly dictated by the case material itself and partly by what the respondents could spare. Documents were used, if available, and their contents, where relevant, were woven into the transcripts for subsequent checking by respondents. As a rule, interviews were only sought at senior management level, whether in Europe or in Asia since only they would dispose of the data relevant to the study. In the one or two instances where respondents had middle management responsibilities, it was made clear that they had been closely involved in the relevant transaction and could therefore answer questions as well, if not better, than their seniors. Occasionally, at the firm's suggestion, interviews would take place with a group of managers representing different functions, or with several managers in succession. In such cases, the transcript when completed, was sent to one of them who then distributed it to his colleagues for checking.

The completed transcripts were coded and put into a form that would allow broad patterns to emerge from the aggregated data. This was not a mechanical process. Most of the data was qualitative in nature and could not be reduced to a common measure without exercising some judgement as to what information would be sacrificed in the process. This is true of any process of data reduction.

Rather more interviews were obtained than could make up cases as earlier defined. Sometimes it was only in the course of the discussion that one discovered that a firm's operations did not meet the requirements of the investigation, so that while the data collected was kept for reference, it could not be used directly. Nevertheless, out of a total of 89 field interviews actually carried out, only two outright refusals to participate were encountered: one by a European firm in the field, and one by a local indigenous firm.

In order to limit the variability of the data and to allow for some comparison between cases, it was decided to confine the investigation, where possible, to cases within one industry. The chemical and allied industries were chosen, with a certain emphasis being placed on the Pharmaceutical sector. A number of considerations guided this choice of industry:

1. The industry has been established in Europe for well over a century and typifies the kind of process oriented industries identified by Franko (1974) as the home of European MNE's. It is therefore an industry in which Europe enjoys a distinctive strength. It is also one of the few industries in which Europe has maintained a pre-eminent role as the 1977 ranking of the world's top 25 chemical companies as Table 3.1 makes clear: Europe has 13 companies in the league table of chemical giants to the United States' 10, and Western Europe's total production is greater than North America's (The Economist, 7-13/4/79).

2. It is research intensive and therefore a generator of new technology and innovations.

TABLE 3.1

The top 25 chemical companies in 1977

	Sales $bn	Net profit $m	Net margin %	Capital spending $m	R & D $m
Hoechst[1]	10.5	145	1.3	708	498
BASF	10.1	185	1.8	789	372
Bayer[1]	9.7	162	1.6	901	442
Du Pont	9.4	545	5.8	780	367
ICI[2]	8.6	434	4.8	943	288
Union Carbide	7.0	385	5.5	805	156
Montedison	6.3	(522)	-	840	150
Dow Chemical	6.2	566	8.9	1163	203
Rhône-Poulenc	5.0	18	0.4	310	221
Ciba-Geigy	5.0	211[3 & 4]	4.2	322	382
Shell[5]	4.6	200[3]	4.3	1219	na
Akzo	4.6	(23)	-	181	190
Monsanto	4.6	276	6.0	607	132
DSM	4.5	49	1.1	624	na
Exxon[5]	3.6	224[3]	6.2	311	na
Allied Chemical	2.9	135	4.6	465	53
Solvay	2.9	9	0.3	249	75
Roche-Sapac[6]	2.8	169	6.1	305	382
American Cyanamid	2.4	136	4.0	235	96
Sandoz	2.4	108	4.5	108	203
Celanese	2.3	70	3.0	243	77
Mitsubishi Chem Ind.	2.3	(21)	-	167	na
Grace, W.R.[5]	2.1	43[3]	6.6	91	na
Pfizer	2.0	175	8.6	91	98
Sumitomo Chemical	1.9	6	0.3	128	52

[1] Hoechst & Bayer sales include only 50% of 50%-owned associates.

[2] ICI estimates of Imperial Metal industries results include Jan-Oct 1977.

[3] After-tax operating profit.

[4] Profit based on current value.

[5] Data relates to chemicals only.

[6] Listed previously as F. Hoffman-La Roche na-not available.

3. With the exception of the Pharmaceutical sector, the industry is capital intensive, although not at all stages of production. The sophistication of the technology used by the industry and its capital intensity make it oligopolistic in structure and stimulate efforts at vertical integration, prompted by the need felt by chemical firms on the one hand to stabilize their petrochemical supplies, and by petrochemical firms on the other to find outlets for their products in saturated markets.

4. It uses a wide and varied range of technologies at different levels of sophistication and an astonishingly wide variety of products. Even the largest firms, in contrast to, say, the aircraft or automative industries, each produce only a small share of total industry output. In spite of its oligopolistic structure, the industry remains intensely competitive and price wars have been frequent, especially in fibres, plastics, and fertilizers. Consequently, chemical prices have risen less rapidly than those of other products and the industry's overall profitability has not stayed significantly above that for manufacturing industry as a whole (Reuben and Burstall, 1973:113).

5. Every country wants to have a chemical industry, however small, and indeed, to some extent, every country has one. In LDC's the industry is generally limited to final processing and to making simple products: fertilizers, bulk inorganic chemicals, and, in those few cases where freight costs and raw materials availability allow it, speciality chemicals. The bulk of the world's chemical manufacture, however, is accounted for by only a handful of developed countries nine of them being responsible for 95% of total chemical sales and the bulk of trade in chemicals (Reuben and Burstall, 1973:136). The industry is the handmaiden of industrialization.

The development of this industry is therefore a priority objective in each of the five ASEAN countries, so that foreign investment in the chemical sector is actively solicited.

The interview guide had listed many more questions than one expected answers to. Sometimes, the information was simply not available; the person interviewed had not been present in the negotiations; the whole thing had happened ten or more years ago; and so forth. In other cases, the respondent was unwilling to divulge information solicited as, for example, financial data concerning a privately held company. In one research intensive firm, even the organization chart would not be disclosed; it was considered to be competitively sensitive information. A positive response to a question, furthermore, should not necessarily be taken to mean an adequate response: some interviews were substantially completed, but with a parsimonious flow of data; others covered only one third of the questions listed, but these brought forth a torrent of facts.

SECTION 4: DATA STRUCTURING AND ANALYSIS

Interview data is used in two quite different ways. The first structures the material in the aggregate across all cases so as to create a context of interpretation for subsequent analysis. The result of this work is presented in a summary form in the next chapter. The second condenses the interviews into short case studies each of which can be analysed independently with reference to the propositions set out in Chapter 2, and can draw on the aggregated sample data where an interpretative context might be needed to offer a broader perspective. These case studies will be found in Chapter 5.

Table 3.2 below shows the distribution of cases by country of transferor and by country of transfer and tables 3.3, 3.4, and 3.5 show the transaction modes by country of transferor and by country of transfer. The second table shows the distribution of turnkey projects and arm's length licensing agreements in the sample, the third shows the distribution of joint ventures, and the fourth the distribution of wholly owned subsidiaries. Where a joint venture's technology was itself the object of a licencing agreement with either of its shareholders, the agreement was treated as an integral part of a joint venture arrangement and was not further subclassified. Also, the definition of joint ventures used here is a broad one: taken as such is any firm that is partly owned by two or more identifiable parties to the transaction, even if one of them only owns 10% of the shares and is wholly passive in the operation. This is done deliberately to explore the constraining influence that joint venture arrangements can exercise on the respective strategies of either party.

A profile of the sample is developed in the next chapter using data aggregated and codified from the field interviews.

TABLE 3.2

Distribution of cases by country of origin and country of transfer

	COUNTRY OF TRANSFER					
	INDONESIA	THAILAND	SINGAPORE	MALAYSIA	PHILIPPINES	TOTAL
COUNTRY OF ORIGIN						
UK	0	2	1	1	1	5
GERMANY	3	2	1	1	2	9
FRANCE	1	1	0	0	4	6
HOLLAND	0	2	0	0	0	2
SWITZERLAND	1	0	0	0	1	2
NORWAY	0	1	1	0	0	2
DENMARK	2	0	0	1	0	3
DUAL*	0	0	0	2	0	2
JOINT**	0	0	1	1	0	2
TOTAL	7	8	4	6	8	33

NOTE: (*) DUAL refer to a case where the European company has no single national identity, but is owned by shareholders from a number of European countries.

(**) JOINT refer to a case where two European partners of different nationality are involved in a local operation.

TABLE 3.3

Distribution of arm's length operations (Turnkey projects and licensing) according to country of origin and country of transfer

	COUNTRY OF TRANSFER		
	INDONESIA	PHILIPPINES	TOTAL
COUNTRY OF ORIGIN			
UK	0	1	1
FRANCE	1	3	4
SWITZERLAND	1	0	1
DENMARK	1	0	1
TOTAL	3	4	7

TABLE 3.4

Distribution of joint ventures by country of origin and country of transfer

	COUNTRY OF TRANSFER					
	INDONESIA	THAILAND	SINGAPORE	MALAYSIA	PHILIPPINES	TOTAL
COUNTRY OF ORIGIN						
UK	0	2	1	1	0	4
GERMANY	3	2	0	0	1	6
FRANCE	0	1	0	0	1	2
HOLLAND	0	2	0	0	0	2
NORWAY	0	1	1	0	0	2
DENMARK	0	0	0	1	0	1
DUAL*	0	0	0	1	0	1
JOINT	0	0	1	1	0	2
TOTAL	3	8	3	4	2	20

NOTE: (*) DUAL refers to a case where the European Company has no single national identity, but is owned by shareholders from a number of European countries.

(**) JOINT refers to a case where two European partners of different nationality are involved in a local operation.

TABLE 3.5

Distribution of wholly-owned subsidiaries according to country of orgin and the country of transfer

	COUNTRY OF TRANSFER				
	INDONESIA	SINGAPORE	MALAYSIA	PHILIPPINES	TOTAL
COUNTRY OF ORIGIN					
GERMANY	0	1	1	1	3
SWITZERLAND	0	0	0	1	1
DENMARK	1	0	0	0	1
DUAL*	0	0	1	0	1
TOTAL	1	1	2	2	6

NOTE: (*) DUAL refers to a case where the European company has no single national identity, but is owned by shareholders from a number of European countries.

NOTES TO CHAPTER 3

1. Popper (1959).

CHAPTER 4

AGGREGATED RESULTS

INTRODUCTION

This chapter creates a context for the presentation of the individual case studies in Chapter 5. The aggregated sample data is presented in one single section. The sample's market position will be examined first, followed by its organizational characteristics and its technological orientation. The section will conclude with a look at the sample's involvement in different types of transaction, their strategic posture and their perceptions of the outcome of their involvement. A brief summary and conclusion then follows. All tables are placed at the end of the chapter.

The data describes 33 case studies in technology transfer. For analytical purposes a case has been defined here as an operation involving a European firm, and either a local firm, or an operating company, or both. A licensing agreement for example would involve only the first two entities, whereas a wholly owned operation would find a European firm linked to a local operating company - its subsidiary. A joint venture, on the other hand, would involve all three entities with a European firm coming together with a local firm through an operating company.

With the exception of one German Pharmaceutical firm, a French contractor and one British chemical firm, all those that had operations covered by interviews in the ASEAN countries were also interviewed in Europe. Moreover, a regional representative of the British Chemical firm just mentioned was interviewed in Singapore so that the parent company was represented in the case.

Not all the local indigenous firms and private local investors that participated in the operations were interviewed: some key personnel were outside the country at the time the fieldwork was being carried out; one individual joint venture partner was taken on as an employee of his European partner's local subsidiary and no longer represented an independent entity: finally, in a few joint ventures, the local shares were either publicly held or held in trust by government institutions on behalf of some sectional interest (e.g., local Malays) from which potential local partners were expected to emerge in the future.

Where a local partner participated in an operation in a private capacity the data presented will refer to his corporate interests since in all such cases these had a determining influence on the individual's decision to get involved in the first place.

AGGREGATED SAMPLE DATA

The Market

Given the emergent regional aspirations of the member countries of ASEAN what market image did they project? More specifically, how did the European firms in the sample view them? Did they see them as belonging to a single region or did they maintain a country by country approach? Only four respondents claimed that their firm had adopted a regional approach. For one or two firms, the region defined extended beyond ASEAN itself to encompass other countries in the Pacific basin. For the remainder, a regional approach was considered to be premature; little regional integration has as yet taken place, and not a few considered it easier to carry out trade between Europe and ASEAN than between the ASEAN countries themselves. Some firms found it expedient to carry out management training or management reporting through regional organizations, but these activities are internal to a firm and do not necessarily affect the way that it perceives its markets.

Most European firms had investments in more than one ASEAN country and indeed operated throughout Asia so that the absence of a regional orientation could not be attributed to a lack of experience with the region; quite the contrary. Furthermore, the country itself was not unknown to these firms prior to their operations; in five cases only did a European company enter into a transaction in an ASEAN country without prior involvement. The remainder had become acquainted with the region through a local importing agent, a licensee, a joint venture partner or the firm's own sales office. A number of respondents felt that regional integration would come eventually and were looking forward to the day when they could increase both the scale and the technical sophistication of their local operations.

Table 4.1 describes the market position of the European firms in the sample. Only three could be considered small in their markets and three quarters of the firms were among the market's top five producers, one quarter of them at an international level. In seven cases, the firm's operation in the ASEAN countries was not considered to be in the firm's main line of business so that its market position may not have been all that relevant. In most other cases, however, the firm got involved from a position of comparative marketing strength. Seven of the respondent firms were strongly diversified and their

main activities were unrelated to the chemical industry. In fact, for only nine was chemicals the main or the dominant activity of the firm, in the sense that at least 70% of its output originated in that sector. The rest of the sample showed varying degrees of diversification which generally pointed to moves into, rather than out of, the industry from different bases outside it.

A striking feature of the sample was the age of its investments. In only twelve out of the thirty three cases had the investment occurred more than ten years ago, and in seven cases it had occurred within the last five years. Investments were highly focussed with nearly half the sample confining its activities to a single two digit sector of the chemical industry (two other cases also operated within a two digit sector of their industry, but these did not belong to the chemical industry); a further eight cases had operations in chemicals only and three were involved in other industrial sectors (table 4.2). Table 4.3 lists the products produced locally by the firms in the sample, using the three digit Standard International Trade Classification (SITC). Of course, one case may include several product groups.

The sample also appeared to serve a limited number of market segments with only nine firms serving five segments or more. One frequently saw a firm investing initially in the local production of a fairly narrow range of goods, those that it had been previously exporting, and then broadening its range as it familiarised itself with the market. The largest chemical firms in the sample tended to be those with the broadest product range, and none of them were the most recent investors.

European companies tended to take on partners in response to government policy rather than to complement their activities with a specialized contribution. Local partners were frequently sought for their contacts rather than their skills, as well as their willingness to leave day to day management in the hands of their European partners. Nevertheless, two-thirds of the local firms felt that their involvement in the operation was in line with their main business activities, and all of them occupied an important position in their own markets; three of them could be described as market leaders, and over three quarters of local respondents placed themselves among the top five in their respective markets.

Local indigenous firms also appeared to be more outward looking than their local European counterparts, less than half the sample confining its operations to the national market. Three firms had worldwide operations, and one of these was in the process of becoming a full-fledged multinational in its own right.

What kind of goods and markets formed the object of transactions between European and local firms? The operating companies in the sample were predominantly producers of intermediate and consumer goods. Only three were involved in the production of raw materials (see table 4.4) and many received raw materials from their European parents for further processing thus forming part of a vertically integrated operation. Market size for the goods was often difficult to estimate. Many of the products sold in this industry aim at very small highly specialized markets and in some cases the estimate was given for product groups rather than individual products. Ten firms claimed to be selling in markets of less than or equal to US $45m, eight in markets of between US $45m and US $100m, and fifteen in markets ranging in size from US $100m to US $300m. Sixteen out of twenty-nine respondents saw their markets as essentially stable in spite of a modest to rapid market growth for most cases.

An impression of the market's competitive structure could be formed by asking respondents to spontaneously name their main competitors. Only in very rare cases was an indigeneous firm named. For the rest, the subsidiary was competing with other established international firms. In addition, respondents were asked to give an estimate of the firm's absolute or relative market share (i.e., the firm's market share divided by that of its largest competitor). In some cases they were unable or unwilling to make available precise information, but the answers obtained are shown in tables 4.5 and 4.6. In table 4.7, this information is brought together with the number of competitors named by each respondent in a summary estimate of the competitive structure of the sample. A highly concentrated market was taken to mean that the firm had no more than three competitors, an oligopolistic market to be one where the firm had not more than ten competitors, and a fragmented market as one in which significant competitors could not all be named. In each case, the firm's absolute and relative market shares were also taken into account.

Most operating firms in the sample were effectively operating in the upper tier of a two-tier market selling relatively sophisticated and differentiated products, whereas indigeneous firms were to be found in the lower tier of the market selling undifferentiated products ("commodities", generics, etc.) and competing on the basis of price. Also most operating companies were exploiting the domestic market rather than exporting (table 4.8). Only one European firm had sought an export base to service a world market and that firm was not considered, strictly speaking, as belonging to the Chemical Industry. Another firm had explicitly sought a regional export base, but in the main, the eight other firms that were exporting to the region in addition to serving the domestic market, saw this as a marginal activity. In no case was an operating firm, which was partly or wholly dependent upon a European parent, exporting in a systematic way to other subsidiaries of the same parent in the region either intermediate or final products. On the few occasions that this happened, the firm was "helping out" by meeting another subsidiary's temporary shortage out of its own stock. Nevertheless, one or two cases were encountered in which an operating company, unknown to its European parent, was discretly exporting at modest volumes to other markets in the region, somewhat in competition with locally established subsidiaries of the same parent.

Most respondents in the operating companies thought of their markets as price sensitive which came somewhat as a surprise in view both of their competitive structure and the degree of differentiation of the products offered. It turned out, however, that effective differentiation was not always easily achieved. Product quality depended on attributes that were not readily perceived by purchasers who might continue to buy on the basis of price and ignore quality differences. When this happened, the price-quality trade-off worked in favour of indigenous competitors - often Chinese - since a European parent's concern with protecting its brand name made it difficult to trade down to a lower quality level in order to meet the local competition head on. Over time, however, the operating firm could recover and build up its position as purchasers became sensitive both to brand promotion and to the range of services made available through its sales force.

The services offered to customers are described in table 4.9. Although the sheer variety and differences in complexity of chemical products makes interpretation somewhat difficult, it is clear that a sale in this industry often requires a fair degree of interaction between salesmen and customers, ranging at the simplest level from an exchange of information on product characteristics and customer needs, to demonstrations, customer training, and other forms of technical assistance.

For this reason, most firms preferred to carry out their own distribution. This was not always possible as in some cases - i.e., in Indonesia - the government required that distribution be carried out by local firms. For pharmaceutical products, this caused less of a problem than for other chemicals; the role of the detailman who visits doctors on behalf of pharmaceutical firms is to provide information on the firm's medical products, not to sell as such. For firms selling other chemicals, however, this severely limited their scope for contact with actual and potential clients, and a few had recourse to using "consultants" who could visit clients on their behalf much as a detailman would visit a doctor.

Organisation

Not only were the European firms in the sample large in their product markets, most were large in absolute terms (table 4.10). 60% of respondents had average sales of over US $1 billion, and 12% had sales of over US $10 billion; indeed, only 12% had sales below US $100 million. Particularly striking was the international orientation of the firms interviewed. Less than 10% of respondent firms sold under 25% of their output abroad, and 75% of them sold abroad 50% or more of their output. The ASEAN involvement of these firms could be considered modest in the context of both their total and their foreign operations. This is partly because the latter tended to be concentrated in Europe and the U.S. with a few in Japan.

Only one third of European respondents had less than ten subsidaries and nearly one third had over 100. Problems of size and international operations had pushed most of these European firms to adopt either a divisional or some

kind of mixed structure (table 4.11). One quarter of them still retained an organization structured by function, although for some of the others, divisionalisation was a comparatively recent phenomenon. In structuring their international activities, three firms has made no organizational concessions to their international operations; a further ten retained a "mother-daughter" structure, treating each foreign subsidiary as an independent entity which reported either to an international division, or directly to the board; three firms had their foreign subsidiaries reporting directly to product divisions, and nine had some form of dual line reporting by product line and by geographical area, country, or region. One firm had explicitly segmented its geographical areas by level of economic development, and another had done so implicitly.

At the level of the operating firms, building a financial profile of the sample proved to be a hazardous task. In many cases financial information was considered strictly confidential and so was withheld. In others the information given was only approximate and language problems also made it difficult to be clear on the meaning of terms like "equity" or "fixed assets." For these reasons, the data presented should be interpreted with caution.

Yet they tell a story of sorts. Table 4.12 shows, in most cases, how modest was the original investment in the operation; three quarters of respondents put their original investment at US $5 million or less. The high level of nonresponses makes it difficult to relate the debt and equity data obtained, but if fixed and total assets are brought into the picture (tables 4.13 and 4.14) we see that nearly two thirds of respondents had fixed assets of US $5 million or less, and that for over two thirds of them, total assets did not exceed US $10 million. Only two respondents had assets in excess of US $30 million in their operation. Profitability data was even more difficult to obtain. Of the seven answers given, three reported a return of 5% or less on sales and four a return of between 5% and 15%. Some respondents suggested that their operations were as yet too young to yield a profit figure that meant anything; others were simply unwilling to divulge the relevant figures. The sales figures (table 4.15) show that over half the sample had local sales of US $10 million or less, and that five respondents reported sales of more than US $30 million.

Table 4.16 shows the number of people employed by the operating companies. The smallest operation employed 24 people, the largest 1000, and two thirds employed 300 people or less. The management of operations was mostly in indigenous hands with only nine firms employing more than one or two European expatriates. This was partly due to government restrictions which either placed a limit on the number of expatriates that an operation could employ initially, or set a deadline by which they had to be replaced by local managers. But this was only experienced as a serious constraint by larger firms which felt hampered by the lack of senior management skills and experience available locally. The rest of the sample generally saw expatriate managers as an expensive resource that might be needed to get a local operation under way, but which quickly became a luxury when their numbers extended beyond the one or two needed to run the firm. A large number of respondents claimed to have no expatriate managers involved in their operations at all. This can be accounted for in part by the seven cases describing licencing agreements and a turnkey operation. Joint ventures, and the wholly owned subsidiaries of European firms, generally showed a clear preference for having at least one expatriate manager - "their man" as some of them put it - running things. This was often described as a problem of "being on the same wavelength" as the parent, and of sharing its outlook.

Expatriate managers were given a fairly free hand in the management of their subsidiaries; they were generally allowed to set their prices in response to market conditions and most were free - within certain limits, and some, only after consultation - to develop their own investment policies. However, their relationship with the European parent was sometimes quite complex and in 23 cases dual or triple line reporting was involved. The organizational structure of the operating firm sometimes reflected this complexity. Half of them, and certainly most local firms had organizations structured by functions (i.e., marketing, finance, production, etc.); four had straight product divisions (i.e., a pharmaceutical division, an agrochemical division, an industrial chemicals division, etc.) in which the functions played a subordinate role - these were among the larger firms in the sample; other firms exhibited a hybrid structure in which functional departments rubbed shoulders with product divisions. Their operations were not integrated in the way that a "matrix" organization's might be, but were accomodated in loose, transitional structures - the result of rapid growth.

The local firms were, on the whole, slightly larger than the operations they were participating in with European firms. As shown in table 4.17 four of them reported annual sales of more than $100 million and another four annual sales between $10 million - $100 million. If size is gauged in employment terms (table 4.18) it can be seen that nine local firms employed five hundred people or more, but that only three of them employed more than five thousand. By local standards they were probably sizeable; by that of their foreign partners they were not. The majority of them were well established, over two-thirds of them having been set up over ten years ago and over one third of them by owners of Chinese origin.

The organizational structure of the local firms in the sample revealed certain differences with those of operating companies in which European firms participated. For a start, only two of them were large enough to justify a divisional structure. More to the point, however, is that although nine of them had developed an articulated functional structure, the rest had retained a somewhat amorphous structure, part functional, part divisional, that expressed the past development of the organization and to some extent the personal management style of its owner more than its current and future coordination needs. In that sense they were closer to the 'Entrepreneurial' or family firm described by Alfred Marshall (1880) at the turn of the century than to the hybrid organizations described above.

Technology

Since the Chemical and allied industries are research intensive, any assessment of the of the technological scope of the transactions can usefully start by looking at the research posture of transferors.

Table 4.19 gives R and D expenditures as a percentage of sales for the European firms in the sample. The mean expenditure was 5.5% with seven firms spending under 2% and five spending 10% or more. The biggest R and D spenders were not necessarily large firms: the largest percentage expenditure on R and D - 30% - was claimed by an undiversified pharmaceutical firm employing 2500

people worldwide. Development usually took the lion's share of a firm's R and D budget and in the case of some of the larger ones considerable sums were allocated to the identification and development of new applications for existing products rather than the creation of new ones.

Trying to identify the geographical spread of a firm's R and D activities was complicated by the fact that much work that comes under the heading of development in this industry involved minor adaptations of products to local conditions, at a level of technical sophistication that can only be called modest. From what could be gathered, eight respondents confined their R and D activities to their home countries, some quite deliberately and as a matter of policy; a further nine carried out R and D abroad in one or more of the OECD countries, apparently on the basis of the infrastructural facilities available or market size. Finally eight had worldwide R and D operations, but these made it clear that if development activities - at whatever level of sophistication - were scattered, research itself was not.

How did the technological sophistication in the field match that in the laboratory? European respondents did not attempt to compare them since they were separated by a wide gap both in developed and developing countries. They replied instead with reference to the state of the art (table 4.20) which described the minimum technological standards applied by three quarters of them, with two operating above that level. The six who felt their operations to be technologically below par explained this either as a concession to the need to adopt somewhat more labour intensive technologies in a high unemployment environment, or as a limitation placed upon them by a small market size which denied them the technological benefits of scale economies. In fact, two thirds of the sample was led to modify its technology in some form or other in order to adapt it to local conditions, and although the extent of the adaptation process should not be exaggerated, in many cases it involved a move towards more labour intensive processes.

In general, however up to date it may have been, the production technology used by most operating firms was not considered by respondents to be sophisticated. In the chemical industry, sophisticated technology is to be found upstream in plants operating continuous processes and exploiting

economies of scale. Most operating firms in the sample were downstream using a technology based on batch processing. The technical processes in the main consisted of mixing and packing operations with the majority of firms reformulating parent company products in order to adapt them to local market conditions.

Eight operating firms did claim to be also manufacturing one or more active chemical substances locally, an operation rather more sophisticated than those just mentioned. But it is difficult to know how to interpret this information. Indonesian authorities, for example, were insisting that pharmaceutical firms produce at least one active ingredient locally, by which they meant a product requiring at least one chemical reaction. For the production of most active ingredients, a sequence of chemical reactions is required, so that in some cases its local manufacture consisted of importing a semi-processed material and simply passing it through the last chemical step. In other cases, the size of the market was considered sufficiently large to justify the local production of active ingredients, since economies of scale were available.

The absence of economies of scale, however, was the reason given for the use of second-hand equipment in some production operations, newer up to date equipment requiring a larger scale. One firm had set up local production operations, using only second-hand imported equipment on the basis of a modest initial estimate of market size; it then discovered that it had underestimated the size of its potential market and was forced to trade up to newer, more up to date equipment, which could offer the required capacity. Again, some firms had developed an internal market in fully depreciated equipment, within which lists of what was available were regularly circulated to all subsidiaries worldwide. The cost to a subsidiary which wanted to acquire such equipment was no more than the cost of having it freighted.

Yet, despite these examples, most respondents preferred new equipment to old equipment, the two main constraints acting on the sophistication of the techniques they adopted locally being the scale of their operations and a host government preference for labour-intensive processes. As table 4.21 indicates only four firms claimed to have brought in second hand equipment to set up their operations.

A telling pointer to the lack of technological competition experienced by European firms in the operations studied is that whereas most of them felt that their advantage in the local market lay in their technology, this appeared to be an established one which was better protected by the accumulation of intangible know-how inaccessible to competitors and by a strong brand position than by patents. Twenty four respondents claimed to protect their position through the use of trademarks (table 4.22) whereas only ten of them saw their patent position as their major strength (table 4.23). However, exclusive access to active ingredients and product formulations from the parent were considered by many to be a major source of competitive strength. In 13 cases, the firm's marketing know-how was also thought to be a strong competitive asset and in three cases its major one. Only one operation was based on the use of a technology which was ahead of that being used in Europe: the scale of operations was regional rather than national and the venture was described by the European investor as a 'bold experiment' the outcome of which was still in the balance.

Prior to investing, the majority of Europeans carried out some kind of technical and market study, usually a fairly modest exercise. Technical studies were more often than not done in Europe, strongly suggesting the routine application of an established technology. When a production plant was built, some attempt was made to adapt the building to local climatic conditions, but less so the equipment, and the design skills for carrying out such adaptation as might be required were more readily available to European firms within their organizations back home than locally.

All local firms in the sample, except the largest, had a comparatively low technological profile, and were "dominated", technologically speaking, by their European partners. This was as true for licensing agreements as it was for joint ventures. None of the local firms, had an autonomous capacity to generate the technology which was used in the operations studied. This does not mean that their technical capacities are to be considered negligible. Many of them operated at a level of sophistication comparable to firms of similar size and structure in Europe. None of them however, could be considered technological innovators in their own right. Indeed, where the local firm was a trading company or a bank, this was hardly to be expected.

Local firms that were involved in chemical or pharmaceutical manufacturing treated these operations as an adjunct to their marketing and distribution activities. Only the last stages of the manufacturing process - those requiring the simplest technology - were carried out locally. Some firms did little more than pack a product that had been made abroad; others formulated and mixed imported raw materials, prior to packing them. Two of the largest local firms in the sample were manufacturing on a large scale, using a sophisticated technology, but the operations were not in chemicals, properly speaking, and here again, the technology they were using was that of their European partner.

The distribution of skills inside the operating companies was extensive. In only three firms had less than 25% of the workforce attended secondary school and in ten of them over 75% of the workforce had done so (table 4.24). Also, as table 4.25 indicates, in twelve firms, over 10% of the workforce had attended university. Most of these firms had established links of one kind or another, with local educational establishments. These varied in strength. At one extreme it involved no more than occasional exchanges with the head of a local university's chemistry department; at another, a firm recruited the establishment's graduates, offered apprenticeships, and sent its senior managers to lecture there or its technical staff to organize demonstrations for the students. One or two pharmaceutical firms also collaborated with the medical department of the local university in carrying out clinical trials for its products. The great majority of new entrants into the operating firms would have completed primary school and well over half would have attended secondary school. For most of them, a month or two of formal training following recruitment would be followed by on the job training. For those going into management, training activities appeared to be more formalised and on going, with more of these being carried out in Europe as they moved up. Most training appeared to be carried out internally, but many firms also made use of external courses where these were available locally, and where the standard was thought to be satisfactory. Some of the larger firms had regional training centers to which local executives were sent. Significantly, in only six cases did an operating firm offer extensive training in a technology which was proprietary.

Training was one of a number of areas in which the operating companies depended on European parent firms for help. The notion of dependence as used here needs to be qualified. Many respondents felt that if their European parent firms were to disappear tomorrow, they would somehow survive; they had skills and many had an established position in the local industry. What they would lose were the intangible links which conferred upon them distinctive competitive advantages. Table 4.26 makes the point; two important strands that tied the operating firms to those in Europe consisted of technology embodied in people and in written documents. Hardware - proprietary or non-proprietary equipment - did not figure prominently nor did finance following the parent's initial injection of funds. After the startup period most operating firms grew by reinvesting their profits. Some respondents stressed particular forms of dependency between their operation and the European firm such as in matters of quality control where sophisticated equipment was sometimes required at a scale of operation that did not justify importing it. Samples had therefore to be sent back to Europe. Others also emphasized the intangible managerial and technical links that made available to the operation a range of services that would simply not be available to a local firm.

It is hard to assess how far the European connection reduced the need to establish local links since they were not necessarily substitutes for each other. While the operating firm looked to the local environment for its labour, it only purchased a limited amount of its raw materials locally, and this mostly for packaging operations. Currency risks and restrictions pushed most firms to seek local borrowing facilities, a move which was not always popular with host governments (i.e., in the Philippines) since it was thought to crowd out local applicants. One or two of the operating firms had subcontracted their production to a local contract manufacturer, but in one case at least this seemed to be a temporary expedient that gave the firm time to build up its base without risking too much capital. Despite the operating firms' tenuous links with their local environment, many of them over time were building up their operations with local suppliers. Eighteen of the respondents reported having increased the number of their local suppliers since the investment was made. Few of them considered such links as yet important in terms of the volume of business that they represented, but most hoped that eventually many items that they were currently purchasing abroad at a high cost could be obtained locally at a cheaper price. Economic necessity, rather than altruism, fed this aspiration.

The transaction between transferor and transferee

Most of the European firms interviewed had developed some kind of policy with regard to the internationalisation of their technology. If six of them had no policy to speak of, thirteen had established some articulated guidelines on the matter. Sometimes this was a measured response to a feeling of pressure arising out of the competitive situation in which the firm found itself with respect either to other technology suppliers, developments within the markets it served, or host government moves (table 4.27). Thirteen respondents saw their ASEAN operations as a reaction to some external event or development and another ten had entered the region in pursuit of long term market objectives. In six cases the transfer of the firm's technology to the local operation was thought to be inconsistent with the firm's overall technological strategy, in the sense that it had entered into a deal that did not express its best interests given its resource base.

Many interviewees in the course of the discussion expressed a clear preference for 100% owned companies or straight licensing arrangements. They saw the extension of the joint ventures formula as an inevitable consequence of the need to come to terms with host governments, but few had a taste for them. A minority, often among the smaller firms, viewed joint ventures more favourably as a means of expanding operations without overstretching the firm's resources, and one or two explicitly aimed to extend their operations through such arrangements.

The equity stake of European firms in the transaction studied is given in table 4.28. In 18 cases they had a majority stake in the operation or owned it outright, and in another seven they had no shareholding at all but were acting as straight technology suppliers. So in how many cases was the local participant actively involved in the operation? Table 4.29 divides local participants into those who brought services (i.e., distribution, production facilities, etc.) and funds to the venture, and those who brought funds alone. Those who were "active" included the seven licencees (one of whom was the client for a turnkey contract) and if these are excluded the majority of those that remain - joint venture partners - are seen to have had a passive role in the local operation. In 11 operations more than one local participant was involved,

sometimes in the guise of a local institution set up by the host government to hold shares in trust for future local partners where suitable ones could not be found at the time the operation was set up. In the typical joint venture, the local participant was an indigenous corporate entity which had been approached by a European firm with a joint venture proposal. Only three operations involved foreigners only (table 4.30) and in only seven was the local partner acting in an individual rather than a corporate capacity (table 4.31).

What had prompted local firms to enter into transactions with European firms? A number of reasons were advanced.

Two firms were responding to a government request, in one case expressed quite forcefully. The case concerned one of the largest firms in its own country whose volume of imports was giving the government some cause for concern. The firm was therefore asked by the government to find an activity with some export potential which could redress its unfavourable trade balance. The firm duly complied by setting up a manufacturing joint venture quite outside its main line of business which would export all its output.

In another case, a prominent local businessman acting in a personal capacity entered into a joint venture arrangement with a large European firm in order to familiarise himself with the internal functioning of international organisations of that size. By sitting on the board of its local subsidiary he would have an opportunity to observe the firm's operations and its dealings with its European parent at close quarters, and to discuss the firm's problems and potential with its local managers as well as those back at headquarters to whom they reported. The insights gained, he felt, would find application in his other business activities, where these also involved Europeans.

There were one or two instances of local distributors approaching the European firms that supplied them either in anticipation of, or following the erection of tariff barriers by their own government. Sensing that the European firm would probably be setting up a local manufacturing operation and that, in response to government pressure or legislation, it would be shortly taking on a local partner, they made the first move in order to ensure that the distribution stayed in their hands. Six of the local firms interviewed were direct customers of a European firm in the sample or of the local operation in which they both participated.

In the case of licensing agreements, two local firms were seeking to develop their marketing or their technical capabilities. For both, licences were a continuous and profitable source of competitive products. These firms were well able to meet the technical specifications of the licensors and were systematically seeking out - sometimes by employing licensing agents - European firms, large and small, who were willing to licence their products.

Four of the local firms saw themselves purely as investors in the operation and while this is also true of two banks in the sample, the latter had entered into a joint venture partly to keep a given European firm's accounts and thus had a collateral involvement with it on the financial side.

Finally, the majority of local firms interviewed were involved in other joint ventures or licencing operations with foreign companies. Although the information is sketchy, a significant important proportion of such operations seemed to have been with U.S. or Japanese firms. A number of respondents expressed some concern over the increasing involvement of U.S. and Japanese firms in their country's chemical industry and seemed quite eager to have European ones participating to redress the balance. How far such comments can be put down to courtesy is hard to say.

Government policy had played a significant role in many of the operations studied since most of them took place in priority industries and were therefore eligible for investment incentives of various kinds. If one excludes licensing agreements and the turnkey contract it appears that most joint ventures were entered into in response to existing or anticipated government legislation. Some wholly owned European subsidiaries were in the process of taking on local partners at the time of the interview, others had already done so. A number of the early wholly owned European investors, however, did not feel compelled to make this move yet as they had entered the country on favourable terms and were not immediately threatened by current legislation. Distribution was another area where government policy had an effect, but this was mostly confined to Indonesia and Malaysia whose policies of positive discrimination in favour of the Malay race required that wherever possible Malays should be appointed distributors by foreign firms. Trade was

not usually identified by respondents as an area in which government policy affected them unduly, again with the exception of Indonesia which had banned the import of certain raw materials in order to stimulate their production locally. Firms were mostly left free to choose their technology, although government expectations pushed a number of them into choosing a somewhat more labour intensive one than they might have otherwise, and the restrictions on employing expatriates were seen by some as a brake on the technological sophistication of their operations.

Governments also played an active role in the negotiation of transactions although respondents complained that they slowed down the process through excessively bureaucratic practices. In nearly half the sample, the main parties to the negotiations had known each other prior to the venture: many local participants had been either the customers or distributors of European firms they were now talking to.

Strategy

The strategy pursued by operating firms was sometimes difficult to grasp. Respondents interpreted the word "strategy" in different ways and it was felt that to attempt a rigorous definition of the term for them would if anything inhibit rather than stimulate an informative answer. Moreover, in a number of cases involving either wholly owned or partly owned European subsidiaries, strategy was seen by respondents to be primarily the concern of the European parent, and the answer given was framed in terms of the operating firm's immediate objectives - i.e., the short and medium range operating targets it had set for itself - rather than in terms of its long term orientation. Nevertheless, an attempt was made to group respondents into five general categories according to their replies as follows:

- The long term investor - the firm sees a long term potential in the market and is investing early in order to secure a foothold and be present as it develops. It does not expect quick returns from its investment, but does not expect to lose money on it either.

- The offensive investor - the firm has a particular strength which it wishes to exploit in a new market; its assets could be technology, marketing, or management know-how.

- The defensive investor - the firm is investing to protect an established market position threatened by government action (tariffs, import control, etc.) or that of competitors.

- The opportunistic investor - the firm had not planned to invest, but an opportunity presents itself unexpectedly and the firm responds.

- The low cost investor - the firm does not invest with a view to seizing a market opportunity but in order to exploit the availability of low cost factors of production in the host country.

The results of the exercise are set out in table 4.32. The preferred strategy for most firms seems to be either that of the long term, or the offensive investor (the single low cost investor in the sample was not properly speaking, in the chemical industry). Yet, when interviewees were asked why their firm actually undertook investment, their answers underwent a subtle shift (table 4.33). Although the classification still remains somewhat subjective, it can be seen that references to the long term were dropped and defensive and opportunistic motives predominated with many more showing a concern for cost factors. The twin threats of government actions on tariffs or the control of imports, and of losing market share to competitors, was in many instances a powerful inducement to invest. It is not to imply that long term strategic considerations were necessarily sacrificed in the process, but rather that the timing of strategic moves by a firm must adapt to various pressures, and cannot always be controlled.

There was little evidence that operating firms were implementing some highly centralised "global" strategy of their European parents who, seeing the world as a single market, were coordinating the activities of their subsidiaries throughout the globe in order to optimise a single output figure. Only one respondent in the sample had his marketing strategy set by the European parent. In twelve cases, the marketing strategy of the subsidiary was a matter

for negotiation between local managers and headquarters. In the remaining twenty cases (these include the licencing agreements and the one turnkey project) marketing strategy was a matter for the local or the operating firm to decide upon. Subsidiaries were generally free to choose from a range of products on offer by the parent although they were sometimes constrained by product strategies that limited their choice. Parents might also have a say in the way certain products were promoted, i.e., ethical drugs. But it is hard to see in such parental influence, the centralised and highly coordinated global strategies pursued by large international firms in, say, the automotive industry.

Results

What did respondents feel about the results of their operations? What were the perceived causes of success or failure?

These were difficult questions to ask executives involved in operations at a senior level. Pressing current problems could colour the reply, and a balanced assessment might still be difficult even where the investment had been made some time ago. Nevertheless, an attempt was made to get such an assessment and the replies are reported in tables 4.34 and 4.35. In less than a quarter of the sample was the operation's overall performance thought to be problematic, and in only one was it unsatisfactory; in 15 cases, respondents could not identify problems that they considered as anything more than routine. Of problems that were most frequently mentioned, those of penetrating the market and of achieving profitability will occasion little surprise when one considers how recent were some of the operations. Less expected, perhaps, were some of the causes to which problems had been attributed. Operating partners, for example, were mentioned 13 times by both locals and Europeans. Why was this?

Often the issues seemed to boil down to one of communications. A few problems could be attributed to divergent expectations concerning a partner's performance: a local distributor had failed to come up to scratch as a joint venture partner; a European licensor had not given the technical assistance he

had promised; and so on. In the one case reported by both parties to the venture as unsatisfactory, the relationship had broken down completely. The operation involved a large capital intensive technology that was new to the country, and, indeed, new to Europe. Project delays and technical difficulties had brought the plant on stream as the market was turning down and a financial crisis had followed. Neither the case profile, nor the problems encountered within it were representative of the rest of the sample where respondents tended to explain their problems in terms of general economic conditions, government bureaucracy, or the motivation of employees. Intriguingly, with the exception of the case just mentioned, only two other respondents identified production as an area in which problems had been encountered.

Summary and Conclusion

What the data presented in this chapter shows up, is the diversity of the activities covered by the cases. This can partly be explained by the nature of the chemical industry itself, selling thousands of different products in almost as many market segments. The wide geographical coverage of the study, extending across cultures as different as Indonesia and Singapore is also a source of variety. Yet, behind the variety a pattern of sorts emerges. Local firms are generally smaller and technically less sophisticated than their European counterparts. Local markets are small and relatively underdeveloped and do not justify an extensive transfer of manufacturing technology. Most are quite marginal to the European firm's overall strategic posture. Finally, the technology itself is rarely a source of major problems for the European firm's local operation. How these general observations work out at the level of the individual case study is explored in the chapter that follows.

Table 4.1

Competitive Position of European Firm

Among the Top 5 in the International Market:	7
Among the Top 5 in the Home Market:	14
Is medium-sized in the Home Market:	4
Is Small in the Home Market:	3
Sample Size:	28

Table 4.2

Degree of Diversification of Operating Companies

In a two digit section of the Chemical Industry:	18
In Chemicals only:	8
In Chemicals and related activities:	4
In Chemicals and unrelated activities:	3
Sample Size:	28

Table 4.3

List of Product Groups for Total Sample

TYPE OF SECTORS (Standard international trade classification 3 digits)	. Organic Chemicals (512)	3
	. Inorganic Chemicals & Gases (513)	5
	. Dyestuffs (531)	4
	. Dyeing and Tanning (532)	4
	. Paints (533)	9*
	. Pharmaceutical (541)	16*
	. Perfumery Preparation (533)	4
	. Soaps (544)	1
	. Fertilizers (561)	4
	. Plastics (581)	8*
	. Fine Chemicals (599)	8*
	. Synthetic Rubber (231)	1
	. Artificial Fibres (266)	2
	. Paper Pulp	1
	. Foods (09)	2
	. Metallurgical Process (69)	2
		75

* NOTE: One case may include several sectors

Table 4.4

Classification of Product - Operating Companies

Intermediate goods:	9
Consumer goods:	11
Raw materials and Intermediate goods:	3
Consumer goods and Intermediate goods:	10
Sample Size:	33

Table 4.5

Share of Market - Operating Companies

Low:	11
Medium:	4
Large:	15
No Reply:	3
Sample Size	33

Table 4.6

Relative Market Share - Operating Companies

One third or less of largest competitor:	6
Between one third of larges competitor and parity with him:	16
Market Leader:	5
No Reply	6
Sample Size:	33

Table 4.7

Competitive Structure of Market - Operating Companies

Highly Concentrated:	8
Oligopolistic:	10
Fragmented:	12
No Reply:	3
Sample Size:	33

Table 4.8

Geographical Spread of Market - Operating Companies

National:	22
National & Regional:	8
National and World	1
Regional:	1
World:	1
Sample Size:	33

Table 4.9

Services offered to Customers - Operating Companies

	Technical Assistance	Training	Demon-stration	Visits & Information	Main-tenance	Testing
No	17	18	9	4	28	26
Yes	16	15	24	29	5	7
Sample Size	33	33	33	33	33	33

Table 4.10

Sales - European Firms

Less than 100 M $ US:	3
Between 100-1000 M $ US:	7
1000 M $ or more:	15
No Reply:	3
Sample Size:	28

Table 4.11

Organizational Structure - European Firms

Functional:	6
Divisional:	9
Mixed:	11
No reply:	2
Sample Size:	28

Table 4.12

Size of Original Investment - Operating Companies

1 M$ US or less:	9
Between 1 and 5 M$ US incl.:	6
Between 5 and 10 M$ US incl.:	2
Between 10 and 150 M$ US incl.:	3
No reply:	13
Sample Size:	33

Table 4.13

Fixed Assets - Operating Companies

1 M$ US or less:	8
Between 15 M$ US incl.:	3
Between 5-60 M$ US incl.:	5
Between 60-120 M$ US incl.:	1
No reply:	16
Sample Size:	33

Table 4.14

Total Assets - Operating Companies

5 M$ US or less:	11
Between 5-10 M$ US incl.:	5
Between 10-30 M$ US incl.:	5
Between 30-130 M$ US incl.:	2
No Reply:	10
Sample Size:	33

Table 4.15

Sales - Operating Companies

5 M$ US or less:	13
Between 5-10 M$ US incl.:	5
Between 10-30 M$ US incl.:	7
More than 30 M$ US:	5
Investment too recent for results:	3
Sample size:	33

Table 4.16

Number of Employees - Operating Companies

100 or less:	11
Between 100-300 incl.:	11
Between 300-100 incl.:	11
Sample Size:	33

Table 4.17

Sales - Local Firms

10 M$ or less:	4
Between 10-100 M$ US:	4
Greater than 100 M$:	4
No reply:	3
Sample Size:	15

Table 4.18

Number of Employees - Local Firms

Less than 500:	6
Between 500-5000:	6
More than 5000:	3
Sample Size:	15

Table 4.19

R & D as a Percentage of Sales - European Firms

Less than 2%:	7
Between 2-5%:	7
Between 5-10%:	6
10% or more:	5
No reply:	3
Sample Size:	28

Table 4.20

Competitiveness of Technology Transferred - European Firms

Behind the State of the Art:	6
At the State of the Art:	15
Ahead of the State of the Art:	2
No reply:	5
Sample Size:	28

Table 4.21

The Use of Secondhand Equipment - Operating Companies

None used:	29
Some used:	4
Sample Size:	33

Table 4.22

Reliance on Trademark - Operating Companies

None:	5
Yes:	24
No reply:	4
Sample Size:	33

Table 4.23

Patent Strength - Operating Companies

No Strength:	12
Some Strenght:	10
Considerable Strength:	10
No reply:	1
Sample Size:	33

Table 4.24

Secondary School Attendance - Operating Companies

25% or less of workforce:	3
Between 25-50% incl. of workforce:	11
Between 50-75% incl. of workforce:	4
Between 75-100% of workforce:	10
No reply:	5
Sample Size:	33

Table 4.25

University Attendance - Operating Companies

5% or less of workforce:	6
Between 5-10% incl. of workforce:	10
Between 10-20% incl. of workforce:	5
Greater than 20% of workforce:	7
No reply:	5
Sample Size:	33

Table 4.26

The Local Operation Depends on the Company in Europe for:

	None	To Some Extent	Almost Totally	Sample Size
Proprietary Equipment	28	4	1	33
Equipment	24	8	1	33
Exclusive Raw Materials	15	9	9	33
Non-Exclusive Raw Materials	11	6	16	33
General Imports	6	9	18	33
Procurement	8	13	12	33
Technical Assistance	4	14	15	33
New Technical Information	1	11	21	33
Training	8	14	11	33
Money	33	-	-	33

Table 4.27

Pressure to Transfer Technology - European Firms

None:	8
Pressure from Technical Development:	6
Pressure from Market Development:	5
Pressure from other sources:	8
No reply:	1
Sample Size:	28

Table 4.28

Shareholding of European Partners in Operating Companies

No Shareholding:	7
Minority Shareholding	7
50% Shareholding:	1
Majority Shareholding:	12
100% Shareholding:	6
Sample Size:	33

Table 4.29

Role of Local Partners in Operating Companies

Active:	16
Passive:	11
No Local Parnter:	6
Sample Size:	33

Table 4.30

Nationality of Local Partners in Operating Companies

Indigenous:	21
Foreign:	3
Indigenous and Foreign:	3
No Local Partner:	6
Sample Size:	33

Table 4.31

Corporate Status of Local Partner in Operating Companies

Corporate Only:	20
Private Individual Only:	4
Corporate and Private Individual:	3
No Local Partner:	6
Sample Size:	33

Table 4.32

The Local Operation's Declared Strategy

Long Term:	9
Offensive:	10
Defensive:	4
Opportunistic:	9
Lower Costs:	1
Sample Size:	33

Table 4.33

Reasons Given for Investment in Local Operations

Offensive:	17
Defensive:	15
Opportunistic:	6
Lower Costs:	7

Note: Some respondents gave more than one reason and all of these have been recorded.

Table 4.34

Classification of Local Operating Problems Perceived

Profitability:	6
Marketing:	7
Production:	3
No problems perceived:	15
Sample Size:	33

Table 4.35

Perceived Problem Attributed to:

Government action	7
General economic conditions:	10
Social and Cultural factors:	7
Operations Partner:	13

Note: More than one attributions was made by some respondents.

CHAPTER 5

AN EMPIRICAL EXPLORATION OF THE C-D FRAMEWORK

INTRODUCTION

The propositions that emerged from the C-D framework must now confront the empirical data collected. The word confront is perhaps a strong one suggesting large statistical battalions of data besieging the framework rather than the handful of cases to be presented. The preceding chapter offered a summary view of the field data collected and helped to create a context for the case by case approach that will now be adopted. The aim here is to draw upon this case material, identifying instances which support or contradict the propositions advanced. The case format has been preserved mainly because it creates a self contained, coherent context for the evaluation of propositions. A context-independent statistical treatment might have offered a more powerful test, but required a larger sample of cases to work from, and a much clearer idea of what specific empirical measures could adequately cover the full range of phenomena through which the propositions could manifest themselves. The C-D framework itself has not yet been sufficiently articulated to make such precision worth pursuing at this stage.

Two cases were dropped from the analysis; it had not proved possible to interview the parent companies in Europe, and since their strategies as technology suppliers have an important bearing on the propositions put forward, to evaluate the case solely on the strength of data collected through local operating companies could have seriously distorted the analysis. They were retained in the previous chapter, however, for what they could contribute to the overall pattern of operations that was taking shape. Another difference with the last chapter lies in what constitutes a case. There, each operation created a case, several of which could involve the same firm. Here cases crystallize around firms which may be involved in several operations locally. Thus, for example, one case involves a European firm which has five local operations; these figured before as five separate cases. Likewise, another case describes four operations by a local firm which had previously appeared as four separate cases. In this way, and allowing for the two cases that have been dropped, the number of cases that will be presented in the chapter reduce from 33 to 20.

Given that many of the European firms in the sample were relatively large in the local markets, and could possibly be identified, the individual ASEAN countries have not been named in the cases. In most instances, the European firm's home country is also not identified. Where sales figures are given for the firms, since this is done only for illustrative purposes, they are drawn from any of the three years between 1977 and 1979 inclusively. European firms and local firms are labelled A, A_1, A_2 and B, B_1, B_2 respectively, the subscripts applying only where several European or local firms are involved in a single case. For each case only the salient points are described, and although the material is presented factually, with the exception of what was obtained through a company's written documents, it has the status of a verbal report, the limitations of which were described in Chapter 3. Where a passage in the case appears to support one or more of the propositions under scrutiny, the proposition itself is referred to in brackets in the text itself. Where a proposition is contradicted, however, or where it can only be evaluated with reference to the case as a whole, it is briefly treated at the end of the case under a separate heading. In either instance, the matching of a proposition with a given body of facts is a matter of judgement which may not command universal assent; the heterogeneity of the material does not allow the mechanical application of decision rules for this kind of exercise, and the plausibility of the analysis presented rests on the configuration of the case as a whole as well as the particular facts that may or may not support it. A more general discussion of how the propositions relate to the material treated in this chapter is deferred to the following chapter.

The chapter is divided into three sections. In section 1 the emphasis is on the operations of wholly owned subsidiaries, in section two on that of joint ventures, and in the third section on licensing agreements. Since some cases now group together a number of overlaps between operations inevitably occur; thus a wholly owned operation will be found in section two and joint ventures in both section one and section three.

In order to make the reference to propositions in the cases a manageable affair, they are listed once more below, but are now further broken down into their sub-elements. A diagrammatic representation of the C-D framework as it applies to the corporate case is also provided in Figure 5.1.

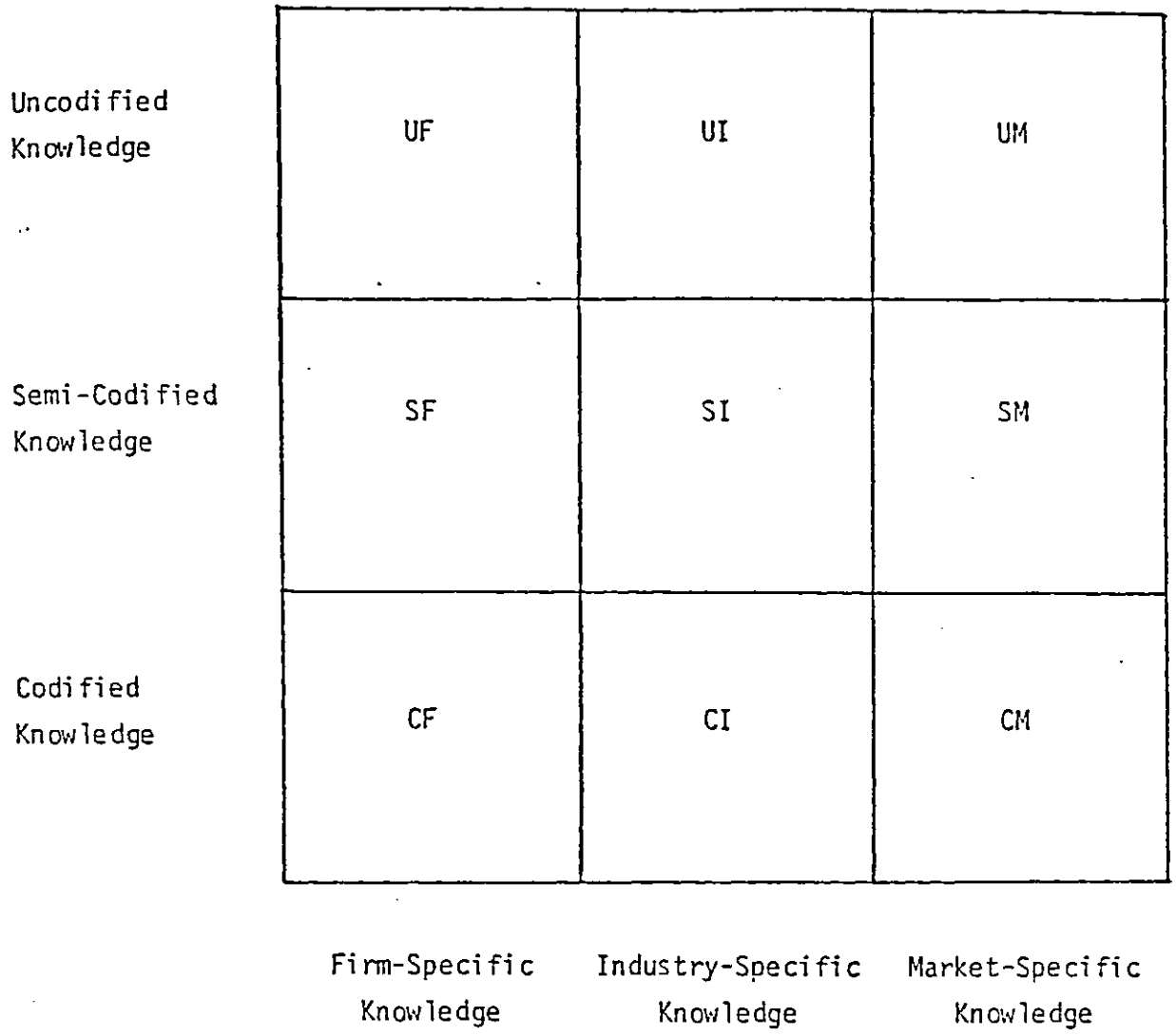


FIGURE 5.1

THE C-D FRAMEWORK - THE CORPORATE CASE

REPEAT FIGURE 2.3 RENAME FIGURE 5.1

Proposition 1: Joint ventures create a relationship characteristic of federations.

Corollary 1.1: a) Transactions betwen contracting parties will be complex or vague.

b) Information will not be solely impacted in one party.

c) Atmosphere will be important to the transaction and hence the quality of the personal contact.

d) A small numbers bargaining situation is implied.

Corollary 1.2: Towards the left of the C-D framework, joint venture arrangements compete with hierarchical transaction modes.

Proposition 2: Licensing agreements create a relationship characteristic of markets.

Corollary 2.1: a) Goods transacted can be defined in writing.

b) The agreement can be implemented without rehaggling or costly monitoring.

c) Transactions are technologically separable.

d) Small numbers bargaining is implied where the goods and services transacted are firm-specific.

e) Atmosphere is not important and the parties can be indifferent to each other's identity where a valuable on-going relationship is not implied.

Corollary 2.2: Towards the left of the C-D framework, licensing agreements compete with hierarchical transaction modes.

Proposition 3: Wholly owned operations create a relationship characteristic of hierarchies.

Corollary 3.1: a) Transactions will be complex and vague.

b) The technologies used will be non-separable.

c) Bounded rationality will be tackled through routinization as will small numbers opportunism.

d) Conflicts can be resolved by fiat with reference to a clear set of objectives whose attainment can be monitored by internal auditing.

Corollary 3.2: Wholly owned operations are more likely to be placed on the left hand side of the C-D framework than on the right hand side.

Proposition 4: Large firms should show a bias towards the use of wholly owned subsidiaries compared with smaller ones.

Proposition 5: a) International firms will show a preference for externalizing transactions on the right hand side of the C-D framework.

b) Externalisation on the right hand side of the C-D framework will be particularly apparent in the case of firms whose relative strength lies in the creation of firm-specific knowledge.

Proposition 6: a) Firms whose relative strength lies in F will seek to complement it through transactions with firms whose relative strength lies in M, and vice-versa.

b) Firms whose relative strength lies in U will seek arrangements with firms relatively strong in C and vice-versa.

Proposition 7: a) International firms will be reluctant to transfer abroad knowledge that is firm-specific.

b) International firms that seek to develop their markets have an active interest in transferring knowledge already in CM to existing or potential customers.

Proposition 8: Knowledge purchasers will tend to locate on the right of the C-D framework and knowledge sellers on the left.

SECTION 1: MOSTLY WHOLLY OWNED

CASE 1

Company A was set up in 1946 in one of the Scandinavian countries as a pharmaceutical marketing organization, handling the exports of a number of small firms. During the 1950's it integrated backwards into R and D. Today, research accounts for 12% of its $77 million sales and A has become a full pharmaceutical manufacturer in its own right employing 1,300 people, nearly half of them abroad. The firm is 25% owned by a large diversified Scandinavian trading company, B, which was originally set up in the Far East and has been operating there since the late nineteenth century. The remaining 75% is owned by a Canadian research organization specialising in biological vaccines. A has lent its corporate name and identity to a number of foreign operations, either wholly owned or partially owned by the trading company. In addition, A decides the corporate and product strategies of these foreign subsidiaries, provides them with procurement and quality control services, as well as new research findings and new products as they emerge from its laboratories. The trading company then provides an access to local markets for A's products. B's pharmaceutical subsidiaries have been trading in the two ASEAN countries in which they were interviewed since 1959, and had set up local production facilities in 1961 and 1969 respectively. One of them set up locally in order to be able to compete more effectively with one of A's international competitors and ended up sharing the local market with him.

A's strategy is to 'sell where it can and produce where it must.' Although the firm has a clear preference for keeping its technology to itself (proposition 7.a)) it has currently 14 licensing agreements, seven of which are with subsidiaries of B, and the remaining seven with outside firms. The latter, however, are not allowed to make use of A's name. For A, licences are useful devices for testing a potential market. Its R and D strategy is essentially based on patent breaking - in its home country only process patents are recognised - and consequently, it tends to protect its know-how by investing in trademarks. As one executive puts it "at least trademarks do not run out."

The technology that A has transferred to B's subsidiaries is non-proprietary, although in one of the two ASEAN countries, a modest amount of raw material manufacturing is undertaken (1.5% of turnover) to comply with host government requirements. For the rest, local operations consist of simple mixing, filling, and packing activities. The firm, however, is edging towards automatic and semi-automatic processes, in order to achieve larger production volumes without having to expand its physical plant, and this, in spite of government pressure to maintain a labour intensive profile. One subsidiary will also shortly set up its own biological laboratory in order to increase the number of quality control operations that can be performed locally.

One of B's subsidiaries that was studied was quoted on the local stock exchange, 35% of its shares being publicly held; the other was still wholly owned, but saw the day approaching when 25% of the company would have to be handed over to one or more local partners. Each is run as an independent profit centre with dual reporting links to A through the local subsidiaries board and interdepartmental channels. In one, the chief executive is a host country national, in the other he is European - there was a greater need to ensure a convergence of views with A's own management in the second case. The subsidiaries have acquired a good knowledge of the tropics, and see their strength in the adoption of a management style that is well suited to local conditions. Although one of the subsidiaries is prohibited by host government legislation from carrying out its own distribution, the other has built up a considerable know-how in consumer marketing - 95% of the firm's products are nutritional, 4% are over the counter (OTC) and 1% are ethical - and A itself, less familiar with this field, now sends over people to this subsidiary from Europe to be trained in consumer marketing techniques. In fact, the bulk of the subsidiary's technical training is devoted to marketing rather than to production. Through the quality of its sales force and the services offered, the subsidiary aims at building up a strong corporate identity with doctors and consumers; in a highly competitive market, trust is an important competitive variable (proposition 7.b)). Nevertheless, faced with the need to expand its production base, the firm will soon be pushed into manufacturing and distributing products from other sources than A.

Discussion

The relationship between A and B creates an awkward fit between the facts of this case and the propositions put forward. A is small, and research oriented (i.e., in UF), and 25% owned by B, a large established trading company which was originally established in the Far East (i.e., in CM). Both propositions 6.a) and 6.b) find support here. If this is accepted, then propositions 4, 5.a) and 5.b) hold good in this case although one is then left with the fact that the transactions between A and B are more complex and vague than might be expected in a licensing relationship and that corollary 2.1.a) is in turn contradicted. No clear judgement can be made from the evidence available, but the very difficulty of resolving this problem is due to the links created by A - a research based organisation - to establish some form of hierarchical control over B's subsidiaries, insofar as they affect its product policies and trademark position (Corollary 2.2). Finally, some limited support for proposition 7.b) can be inferred from the extensive technical training that B's subsidiaries give their sales force as a preparation for their information diffusion role.

CASE 2

The case describes the wholly owned operations of a large Chemical and Pharmaceutical manufacturer from one of the smaller European countries in one of the ASEAN countries. The firm employs 35,168 people worldwide, and has sales of $2,670 million, 95% of which are abroad (7% in Asia). Its activities are strongly research oriented, its pharmaceutical R and D budget being 13.5% of sales, and it is a leader in the field of cardiac, brain, and geriatric products. It aims to use its research capability to reinforce its position with hospitals, a strategy which involves extensive training of its sales force in order to give it the technical credibility required to establish and maintain such links.

The firm, in its international operations, works to a ten year planning horizon. Its technological strategy can be subdivided into three sequential steps: 1) It begins by exporting from Europe, and organizing distribution in the local market through a representative office; 2) as the market develops, it sets up an affiliated company and recruits and trains up a local sales force; 3) with further market development, it moves into local galenic production, at first through a third party manufacturer, and subsequently by setting up its own manufacturing facilities locally. No further transfer is envisaged beyond this point as the firm aims to confine the chemical production phase - i.e., the manufacture of active ingredients - to its home base in Europe in order to prevent an uneconomic fragmentation of production. At present the firm itself carries out galenic production in 19 countries, and organizes production through third party manufacturers or licensees in another 20, much as licensing agreements are not its preferred way of operating. In fact, the firm only decentralises galenic production under pressure and controls the process with carefully defined product guidelines.

The parent company is essentially in the business of selling active ingredients to its own subsidiaries: 70% of its pharmaceutical output is exported in this way. Internationally, the firm operates a dual line reporting system, and structures its markets both by level of economic development and by degree of social and political stability. Where circumstances warrant it, joint venture arrangements are considered, although, again, not willingly. There are currently 12 majority owned and 20 minority owned joint ventures in force between the firm and local partners in 25 different countries.

The ASEAN operation that was studied had secured an overall market share of approximately 1.8% in its various product-markets, but like other international firms, its efforts were only aimed at the 20% of the local population that could afford to pay for its products - domestic per capita expenditure on drugs being approximately $6 per annum. A two-tier market has consequently developed, with indigenous firms, under the protection of a government purchasing umbrella, servicing the 80% of the population ignored by international Pharmaceutical firms. Despite this splitting of the market, the firm feels that the climate still remains too competitive to consider setting up its own production facilities locally although it plans to do so at some time in the future. For the time being, it has entered into a manufacturing agreement with the main third party contract manufacturer in the country. The agreement, a straightforward fee contract requiring virtually no negotiations, dates bact to 1974. Prior to that date the firm had been servicing the local market through exports from Europe. Another local third party manufacturer had also been considered when the firm moved into local production, but the company in question also had a strong marketing capability, and its ability to take advantage of the host government's compulsory licensing laws together with its reputation for practising 'no holds barred' competition made it too threatening as a potential competitor for comfort.

Under the terms of the manufacturing contract, the European parent would provide technical assistance to the manufacturer, and assist him in upgrading his equipment as economies of scale, made possible by growing sales, became available. Also, since he lacked the equipment necessary to carry out his own formulations, this would be done by the local subsidiary. The manufacturing technology involved in this operation is not considered proprietary and only four of the European firm's locally marketed products are still covered by patents. The chief executive of the local subsidiary, a host country national, sees his firm's main strength in its ability to motivate its local sales force and this is what its main training efforts - carried out both locally and in Europe - are directed at. That the subsidiary had been consistently achieving a high volume of sales from a narrow production base, is put down largely to sales force motivation.

Discussion

The fact that the subsidiary is using a third party manufacturer does not detract from the fact that its transactions with the parent - dual line reporting, the training of its sales force, product guidelines etc., - are complex and vague in the sense intended by corollary 3.1.a). Limited evidence for the operation of bounded rationality (Corollary 3.1.c)) is to be found in the fact that the first two general managers of the local subsidiary were of the nationality of the parent company and that neither lasted for more than one year and had to be replaced by an indigenous local manager. What weight can be attributed to this information remains unclear, however.

Proposition 4 finds support in the operations of the local subsidiary, but none in the policies pursued by the parent although, here again, a clear refutation of the proposition based on the data is not possible. Proposition 5.a), on the other hand, is apparently contradicted by the case data since the sub-contracting operations studied would be asigned to CF and CI. However, any interpretation must be qualified by the fact that the propositions have only been formulated with respect to licensing agreements, joint ventures, and wholly owned operations. What is being considered here is one transaction mode nested within another: a sub-contract in the context of a wholly owned operation. Proposition 6.a) is consistent with the case data and Proposition 7.a) is supported by the parent company's reluctance to transfer abroad any technology more complex than that involved in galenic production. But proposition 7.b), on the other hand, finds no evidence locally beyond the fact that the detailmen employed by the subsidiary distribute the parent's printed product information to doctors and potential customers. Despite this, the parent's overall R and D strategy, particularly with respect to hospitals, suggests a greater commitment to the transfer of medical knowledge to its potential markets.

CASE 3

This case concerns the wholly owned operation of a large, international, market oriented firm specialising in toiletries, detergents and foodstuffs, whose sales worldwide are $19,000 million and which employs 327,000 people. While there are few really new products in the firm's chosen field, it spends 1.3% of sales annually on research and development, much of which is devoted to improving its production processes. Its technology, however, is generally well established, and operates in batch and semi-continuous modes. When used abroad, this technology will reflect best practice at a given scale as a matter of policy, but it will usually not embody innovational features to any extent that might justify the application of transfer pricing between parent and subsidiaries as a device for recovering investment outlays (Corollary 3.1a)).

The firm's technological strategy is to apply within subsidiaries expertise created at the centre, and to transfer it at its marginal cost. This had led it to invest directly wherever there is a market, and to licence manufacturing through third parties or to go for joint ventures either in small countries where the size of the market does not justify a large organizational committment, or in territories where its own home country had no colonial presence. The change in the international business climate, however, has recently led the firm to modify its stance on joint ventures: it no longer seeks an automatic 100% ownership of its business operations, but insists on retaining management control of operations. Whether this requirement implies a majority share ownership for the firm will depend on the business morality that prevails in the country under consideration. Day to day management is decentralised to local boards working to overall guidelines and international marketing strategies for each brand set by the parent. As a rule the larger the foreign subsidiary, the more independent of the parent its operations will tend to be.

Local subsidiaries of the firm had been trading in South East Asia since before the war and the one that was studied had obtained pioneer status and a number of tax and financial incentives at the time it was set up. By 1990, however, it will have to make over 30% of its shares to one or more local

partners in order to comply with local legislation. The distinctive strength of the local subsidiary lies in its management know-how. It is run through a functional organizational structure and controlled through multiple reporting lines to the product divisions, area directors, and central staff departments in Europe. A detailed control of local operations is carried out through an elaborate cost accounting system (Corollary 3.1.d)).

Discussion

The size of the firm and the fact that it remains wholly owned when so many other firms in the sample have taken in joint venture partners lends some support to proposition 4, albeit qualified by the firm's recent policy reorientation on ownership issues. The multiple and complex communication links with the parent and the firm's strategy coordination requirements are in line with corollaries 3.1.a) and 3.1.b), while the policy of tranfering expertise to the subsidiary at its marginal cost is evidence for the routinization identified in corollary 3.1.c). The case provided no clear evidence one way or the other for corollary 3.1.d) and only weak evidence for Propositions 7.b) and 8, insofar as the subsidiary had only developed sophisticated customer services - technical assistance and services, demonstrations, etc. - for its industrial customers; these, however, accounted for only a modest proportion of total sales.

SECTION 2: MOSTLY JOINT VENTURES

CASE 4

This case describes the activities in the five ASEAN countries of one of the world giants of the chemical industry. After a brief introduction to the parent's technological and investment strategy, the case treats its involvement in the region on a country by country basis, although these are not named. A brief discussion on the propositions follows.

A was one of the founders of the European chemical industry in the second half of the nineteenth century. Today it employs 180,000 people to generate sales of $13,237 million, two-thirds of which are abroad. The firm's dominant aim is to translate its R and D capability, which absorbs 4.8% of sales and employs 14,000 people, into profitable products - as it is, one third of A's sales concerns products which did not exist 10 years ago. At the same time, the growing proportion of foreign sales, coupled with rising costs at home, are pushing the firm to expand and consolidate its foreign production base. Its investment strategy consists of gaining a foothold in a market and staying there whatever happens, frequently in the face of poor short term profit prospects, as long as its local activities make some contribution to capacity utilisation back home. In pursuit of this strategy, the firm aims for joint venture arrangement where these will generate government goodwill, and this, in spite of its preference for wholly owned subsidiaries. However, in LDC's, it will only consider local partners who will not interfere in the subsidiary's management, and the firm will often increase the number of local shareholders participating in a joint venture to dilute their individual power (Corollaries 1.1.d) and 1.2). Local partners are not thought to contribute much to the success of a local operation other than by helping to project a more domestic corporate image and thereby helping to make relationships with host governments and local institutions more manageable (Corollary 1.1.a)).

The relationship between the parent and its foreign subsidiaries is a negotiated one, mediated through three separate lines of reporting: one on a product basis, one on an area basis, and a third to central staff departments.

The result is a fairly complex, and sometimes political, pattern of transactions between parent and subsidiaries (Corollary 1.1.a)). The latter, however, are independent profit centers which are expected to implement the parent's worldwide product strategy.

A's technological strategy is to transfer to its foreign affiliates - particularly those in LDC's - only the last steps of the manufacturing process (i.e., those that do not involve chemical reactions) since these rarely give rise to technical problems. Technology transfer is not a specific objective per se of the firm, and any proposals to license third parties are carefully examined by the parent's licensing committee to ensure that a competitively sensitive technology does not get out of its hands (proposition 7.a)). The firm recognises, however, that a considerable volume of technological know-how must be transferred free of charge to its customers if it is to remain competitive in its markets in order to generate demand for its specialized products (Propositions 7.b) and 8).

ASEAN 1 - A's ASEAN 1 subsidiary is a wholly owned trading company that exports 80% of its output to the region - this can sometimes be a source of friction with some of A's other affiliates in the area. It is considered to be an independent profit centre by the parent, but it carries an obligation to broaden the latter's presence in the local market even if it is not always profitable to do so, in order to bring forward the day when a local production facility can economically be set up. Thus, its objectives remain somewhat ambiguous (Corollary 3.1.a)). The subsidiary depends heavily on A for proprietary products, the training of its personnel, technical assistance on customer problems, and a regular supply of technical information (corollary 3.1.b)); these have enabled the firm to extend its market coverage, improve the services it offers its customers, and build up their loyalty to A's products.

ASEAN 2 - A has been trading in ASEAN 2 since before the war through a locally established European distributor, and it set up its own operation in 1968. At present it has three joint ventures in the country set up in response to tariff barriers and the government's economic policies; one is in chemicals, the second in pharmaceuticals, and the third was created for the manufacture

of polyethylene pipes. Two of these joint ventures are with the same local partners, a retired minor civil servant who was selected for his political connections and knowledge of local affairs. There is fierce competition between foreign firms in the country for competent, indigenous local partners, those whose government contacts can secure production licences, permits, etc., and generally smooth the path for the would-be investor (Corollary 1.1.a)). A does not, however, consider its current local partners a success. One of them tends to interfere with management, and may either be replaced or submerged by the expansion of the business and the subsequent taking on of new partners. Future local partners will be selected with greater care by the firm (Corollary 1.1.c)).

The host government has been putting pressure on the firm to place its distribution in indigenous hands and to extend its local production base, but since the equity participation it will be allowed depends on the sophistication of the technology it brings in, and since, in turn, the current size of the market limits the scale and hence the sophistication of the technology it can viably operate, the firm decided, for the time being, to shelve its plans for expanding local pharmaceutical production as not economically viable (Corollary 1.1.d)). In fact, the technology used locally by the firm is unsophisticated. Further, research intensive products do not pay in a market where products are sold purely on price. Of the fifteen textile formulations used locally by the firm, not one is still covered by a patent. The stiffest competition is offered, not by the ten international firms operating in the local marekt, but by 'backyard' producers, whose cost-cutting tactics make the firm's products comparatively expensive. Thus, A's local subsidiary can only compete through the range and quality of its technical services, and by appealing to customers who are themselves trying to break into sophisticated export markets, and who must therefore buy on other considerations than cost alone (Proposition 7.b)). The firm's strongest assets in this market are its marketing know-how coupled with the name and reputation of the parent.

ASEAN 3 - A had set up an affiliate in ASEAN 3 in 1958, and had taken on as a joint venture partner the agent through whom it had been trading in the country before that date; however, he was bought out shortly after as the firm wanted to control its own distribution (Corollary 1.2). Today, the firm is

among the top ten in the local pharmaceutical market and among the top four in agrochemicals. A few years ago, A, needing capital for its local expansion, was faced with government restrictions on local borrowing by foreign firms. since it was becoming apparent at that time that wholly owned foreign subsidiaries would increasingly be at a disadvantage in dealing with the host government, A decided to seek out a local partner who was prepared to take a long view when investing, and who combined financial robustness with a sound knowledge of local business practices and government affairs as well as offering useful political contacts (Corollary 1.1.a)). The person finally selected was the president of an established local bank who had become known to A while sitting on the board of a small European chemical company which A had acquired (corollary 1.1.c)). While this investor's interests in the venture remained predominantly financial, he also felt that it would be useful to his banking activities to be able to observe and get to understand the inner workings of one of the major European Multinational firms, even if this was confined to board level activities (Corollary 1.1a)). One of his major concerns as a joint venture partner was that A's internal transfer pricing practices should not compromise his shareholding interests; accordingly he insisted on a take-out clause to cover this contingency (Corollary 1.2).

A's local subsidiary has considerable autonomy within the guidelines that it has been set although it still depends on European headquarters for 70% of its raw materials, for its quality control services, for the training of its senior and middle managers, for new products, and for technical information. The scale of its domestic operations has allowed it to set up a certain number of 'last step' chemical reactions locally, which, while still not very sophisticated in comparison with other upstream processes, mark an important step forward from the formulation stage. Yet, although the firm also carries out a limited amount of R and D locally, its production processes remain essentially non-proprietary.

The local business climate is found by the firm to be increasingly restrictive and every minor operational change now calls for protracted negotiations with the government (Corollary 1.1.d)). The latter's recent legislation on patents and compulsory licences, by lowering profitability and increasing the risks of launching a new product, have led the local subsidiary

to withhold a number of its parent's products from this market. Under the terms of its licensing agreement, it is obliged to purchase its raw materials in the open market rather than exclusively from its parent. Its only recourse has been to specify a standard of quality that only the parent can provide. Furthermore, the firm had wanted to restrict the purchase of its active ingredients to certain suppliers and to place a market restriction on the sale of certain products by its distributors. This was also disallowed, and the firm had to rely on its powers of management control to achieve its objectives. For A, this underlines the importance of keeping a majority equity control of its foreign operations (Corollary 1.2).

ASEAN 4 - A set up its ASEAN 4 operation in 1958. Before that date it was exporting to the country. In order to obtain the promotional privileges and fiscal incentives that would make its operation economically viable it had to take on a local partner - its Japanese subsidiary was already a participant and transferring its technology to the venture. A therefore, approached one of the largest banks in South East Asia, employing 16,000 people, with whom it already had an account. The bank, by now active in three other joint ventures, saw these as a way of holding on to client accounts in what was fast becoming a very competitive business. It therefore, accepted to participate for up to 20% of the equity. Dividends, though attractive, were considered secondary to the bank's objectives in the venture (Corollary 1.1.a)). Because the bank's main links with the venture are maintained in its capacity as a banker, it enjoys a better access to financial data than it would as a shareholder. Its role as a joint venture partner, however, remains a purely passive one.

A's ASEAN 4 operation is managed through a chemical, a pharmaceutical, and a marketing subsidiary, each run as an independent profit centre under a common administrative system. The chemical subsidiary set up a modest manufacturing facility locally to guard against a possible import ban by the government. This subsidiary is technically strong in resins and exploits its position through a well developed marketing team of applications technicians who will spend anything between three days and three months training customers in the subsidiary's own laboratories and will, if necessary, have specialists flown in from Europe to look at cusotmer problems (Proposition 7.b)).

The fact that ASEAN 4 offers no effective patent protection, acts as a disincentive to the local manufacture of pharmaceutical products. Also, the firm had set up its local pharmaceutical operation on the strength of a verbal commitment that it would be granted promotional privileges. As it turned out, not only have these not been forthcoming, but the government, through its purchasing activities, has been stimulating the local development and sale of imitator products, and is itself manufacturing generics in direct competition with the firm through a state organisation. It has therefore been difficult, if not impossible, for A to introduce research-based products on to a market that has been spoilt in this way. The result of such an experience is that A would now be reluctant to repeat its pharmaceutical investment in ASEAN 4, and two other major European pharmaceutical firms for whom A had been manufacturing locally under contract have decided not to further invest in a market that puts their technology at risk in this way (Proposition 7.a)).

ASEAN 5 - A has two joint ventures in ASEAN 5 under its overall management; the first, in pharmaceuticals, was set up in 1972, the second, in chemicals, manufactures textile auxiliaries and polyvinylacetate, and was set up in 1975. It is the latter that will be outlined here.

A had been trading in ASEAN 5 since the early 1950's, and was led to set up local production facilities in accordance with parent company policy as a result of a growth in sales. The bringing in of local partners was done in anticipation of government legislation on foreign investment. The person approached for the chemical joint venture was - as in ASEAN 2 - a middle-ranking civil servant who was about to retire, and was believed to be rich in government contacts and political experience (Corollary 1.1.a)). In the event, this belief proved somewhat illusory, and although his advice is occasionally sought on matters that might involve the host government, the local partner has no active role in the venture. Neither party is satisfied with the present arrangements: certainly not the local partner who would have liked a more operational role, nor the management of the subsidiary which, despite the parent's preference for non-active partners, views with some disapproval the participation of a partner with a purely financial interest in its activities. Some light is shed on this puzzling state of affairs by the fact that at the time the joint venture was being set up, the local partner was turning himself into a distributor with a view to handling its products. However, A was insisting that he operate exclusively under its company name which he was most reluctant to do. The matter was dropped and A's local partner, who now runs a

seven man firm, currently distributes for one of A's American competitors. He has not maintained his financial contribution as the subsidiary expanded and has therefore been led to make over half his shares to a new partner who has recently joined the venture.

The joint venture is managed as an independent profit centre with its operating and administrative overheads being pooled with A's other local activities. The technology used locally is standardized and non-proprietary and consists mainly of mixing, filling, and packing activities, together with a polymerisation condensation operation. This is consistent with the parent's strategy of only transferring overseas those low value-added operations that stimulate demand for high value-added products whose manufacture will be kept at home (Proposition 7.a)).

Discussion

The case provides evidence for a number of corollaries of proposition 1. The multiplicity of links between parent and subsidiaries is indicative of complex transactions as are the parent's underlying motives for entering joint venture arrangements (Corollary 1.1.a)). In all the joint ventures studied the identity of the local partner was an important consideration. In ASEAN 2 and ASEAN 5, however, this conclusion was arrived at by A in retrospect (Corollary 1.1.c)). Also, the joint ventures appear, not as A's preferred operating mode as a market leader, but as the outcome of an explicit or implicit bargaining process with a host government (Corollary 1.1.d)). In all cases, the venture ended up with an essentially inactive local partner which allowed the firm to assert its hierarchical interests through the retention of management control (corollary 1.2). Yet, the nature of their organizational links with the parent are identical and do not help to distinguish between wholly owned and joint venture operations. Furthermore, the reluctance of the parent to push its products in countries where it felt that its hold on the proprietary technology they embodied might be threatened - ASEAN 3 and ASEAN 4 - supports proposition 7.a)).

Clearly, proposition 4 is contradicted; one of the largest firms in the sample operated through joint ventures in all the ASEAN countries save one. However, being strong in most cells, it consistently chose to externalise in UM in support of proposition 5.a), and in partial support of proposition 6.a).

CASE 5

Company A with sales of $12,954 million and a staff of 179,000 is one of the world's largest chemical firms. It has over 400 subsidiaries and affiliates worldwide, 47 of which carry out production operations. Its R and D budget represents 5% of sales and gives employment to over 10,000 people; much of it is now allocated to the discovery of new applications for existing products, since not only are new active substances getting harder to discover, but government regulations are making it even more costly to bring those that are discovered to the market. In pursuit of its applications development objectives, A had created a network of technical experts who travel between subsidiaries bringing them technically up to date and who also acquire on the spot an awareness of their market and product problems. This had the double effect of stimulating R and D activities back home while making them more sensitive to the specific needs of the firm's subsidiaries.

A currently has 100 licensing agreements in hand, and while the main incentives for the firm to enter into licensing agreements, as such, are the royalty payments they generate, its main aim in pursuing other forms of technology transfer is to develop a working relationship with local partners who are capable of developing their respective markets (Proposition 6.a)). These are particularly hard to find in an LDC context, with the result that the firm's technology transfer operations are necessarily much more limited there. Local partners in these countries rarely bring with them technical or market knowledge, so that A has to settle for people who, at a minimum, "know the ropes" politically and institutionally, and can actively mediate between itself and the host government (Corollary 1.1.a)). But the firm will then insist on retaining full management control of the venture (Corollary 1.2).

The firm's 'core' technology is slowly being transferred to those of its subsidiaries established in large developed markets, with the consequence that A increasingly faces capacity utilisation problems for the plant remaining in its home base. Yet, that is where A's brainpower still resides, and there, the firm insists, it shall remain for the foreseeable future (Proposition 7.a)).

Two of A's joint venture operations, each in a different ASEAN country, are briefly outlined below.

Joint Venture 1 - A had been trading in the local market for nearly eighty years before setting up local production facilities. the decision to do so through a joint venture reflects an attempt to integrate the subsidiary's operations into the local culture (Corollary 1.1.a)). Neither competitive pressure nor government legislation played any part in the decision. The local partner selected had been an employee of the firm's former distributor; he was known to the firm, committed to its success, and perceived as being entirely trustworthy, thus meeting the three criteria by which A chooses joint venture partners (corollary 1.1.c)). Today, while still a 40% shareholder in the venture, the local partner is employed directly by A as the subsidiary's financial and administrative director. The subsidiary itself has become the 40th largest commercial firm in the host country, and, through a series of independent profit centres, represents eleven of the parent's operating divisions. Management reporting is conducted through three independent channels to a regional committee, a number of corporate divisions, and to the operating divisions themselves.

The technical operations performed locally are the simple ones of mixing, filling, and packing, although to an increasing extent formulations are also developed in the subsidiary's local laboratory. A's dominant aim is to offer a first class product and service, even if this means that, on occasions, profitability must take second place. Considerable efforts are also made to train customers to use the firm's products. Over 2,000 farmers a year attend its demonstration projects and many customers are trained on the firm's premises for periods of one or two weeks, with ten to twenty of them a year being sent to Europe at the firm's expense for more intensive training (Proposition 7.b)).

Joint venture 2 - In this venture, A has two minority local partners each of whom was known to the firm beforehand (Corollary 1.1.c)), and each of whom was advised by host government officials during the course of their initial negotiations with A (Corollary 1.1.d)). Today, one of the local partners has become president of the joint venture and works for it full time. The other had helped to build the plant in his capacity as a contractor, but is now no longer operationally involved, except for approving the subsidiary's budgets and objectives before they get submitted to the European headquarters.

Since setting up its local operation, A has become market leader in nousehold chemicals, and has taken fourth place in the market for agrochemi-

cals. It used to have its own distribution network, but this has been abandoned now that government legislation stipulates that all distribution must be placed in indigenous hands. Local company executives believe that without such restrictions firm sales could be increased by 50%. Another important constraint acting on A's local operation is the ceiling imposed by the government on the number of expatriate managers it can employ. The firm is finding it extremely difficult to recruit suitably qualified local managers.

The technology operated by A's local subsidiary is non-proprietary and well established, and makes use of equipment that, in Europe, the parent has had replaced 10 years ago. Any technological advantage that the subsidiary possesses, resides in the formulations themselves, since the active ingredients that they use, all of which are covered by A's patents, are generally made freely available by the parent to its subsidiary's competitors.

Discussion

Corollary 1.1.a) is well illustrated by joint venture 1 and the importance of the local partner's identity (corollary 1.1.c)) is apparent in both of them. The difficulty of finding suitable local partners also highlights a small numbers bargaining situation (Corollary 1.1.d)). But perhaps the most telling feature in each of these two cases is the co-option of a local partner as the firm reverts to a hierarchical transaction mode (Corollary 1.2). Indeed, in joint venture 2 the non co-opted partner, after an initial phase, became inactive in the venture.

In neither venture can one find for proposition 4 and only in the first can one find any worthwhile support for proposition 5.a) on the grounds that the local partner used to work for the subsidiary's former distributor. Whether he himself was directly responsible for the joint venture's distribution is unclear. Both propositions 6.a) and 6.b) can be defended on the basis that the local partners selected were people 'who knew the ropes' locally - although the point emerges more strongly in joint venture 1 than in 2.

The extensive diffusion of newly researched applications technologies to customers is in contradiction with proposition 7.a) much as it may support proposition 8.

CASE 6

B is a local development bank set up by the host government partly with a view to making itself available to prospective foreign investors as a joint venture partner. This presents the bank with worthwhile lending opportunities although it will limit its equity committment in any one venture to 30%. B employs 1,000 people and has a current turnover of $77 million; originally it was only active in development banking and project finance, but it is now branching out into commercial banking and real estate. While this case describes one of its most successful joint ventures, requiring no more from it than a modest board level participation, the bank has come to feel that joint ventures, as a whole, are a drain on its scarce managerial resources, and that these could be more profitably reallocated to straight banking activities.

A is a medium sized Scandinavian firm with sales of $270 million and a staff of 3,200 people, producing explosives, chemical products, packaging materials, plastics, and earth-moving equipment. Ten years ago the bulk of the firm's business was in explosives, but since then its chemical division has grown and now exports 70% of its output. This has led to the firm's expansion in different parts of the world. Three years ago its foreign operations were moved from an international division back into the product divisions in order to cope with the pressure of expansion. A spends 2-3% of its sales on R and D, and has a policy of encouraging a free flow of new technology to subsidiaries only where these are under its managerial control (Proposition 7.a)). It has four joint ventures at present, one of which is outlined below; the other three are in Europe. In addition, A's chemical division has currently 10 licensing agreements in force with outside technology purchasers.

A's local operation involves the manufacture of adhesives, polyester, and alkyds, using an up-to-date batch technology. Polyester is only produced locally by the firm and much of the new technology its production requires is acquired directly by the subsidiary and does not emanate from its Scandanavian base. Few of A's local products are covered by patents, and the firm relies on trademarks to maintain its competitiveness as well as its links with the parent company to fend off the threat of technological obsolescence. However, A used to depend on these links more than it does now as the local labour

force has shown itself to be more than equal to the task of upgrading the firm's technological capacity. Today, it is in constant consultation with its industrial clients and has come to view technology transfer as an effective device for achieving market penetration in the face of Japanese competition - the threat that triggered off its local investment in the first place (Proposition 7.b)).

Prior to investing, the firm had been exporting to the region and its first local partner had been its former distributor who, being known to the firm, was offered 10% of the venture (Corollary 1.1.c)). The arrangement had to be cancelled after one year since not only was the local partner unable to meet his financial committments to an operation that was expanding rapidly, but more importantly, A felt that its future success would call for a much closer and intimate collaboration between the firm and its customers and hence, for the development of its own permanent sales force (Corollary 1.2). After discussions with the local development board, the firm approached B as a prospective joint venture partner on the grounds that the participation of a state owned organisation could prove politically useful. Negotiations centred mostly on financial matters and on the somewhat vexed issue of royalty payments for the parent's technology, both symptomatic of B's lack of an operational involvement.

The joint venture is currently run as an autonomous operation with only its chief executive as an expatriate Scandinavian. The parent European firm insists on this measure as a guarantee that in its thinking and its attitudes, the subsidiary will remain 'on the same wavelength' as itself (Corollary 1.1.a) and Corollary 1.1.c)).

Discussion

The motives of each partner in entering the venture were both complex and somewhat indeterminate (Corollary 1.1.a)). A's brief involvement with its erstwhile distributor suggests that its position in F was pushing it towards hierarchical transactions (Corollary 1.2). Bounded rationality would naturally set a limit to how far this could be achieved, hence the need for an

expatriate manager on the same wavelength as the parent. To some extent this contradicts Corollary 3.1.c). Corollary 1.1.c) appears only weakly supported by this case since the bank was not known to A prior to the venture. The only case that can be made for it rests on the cordial relationship that the firm had established with another government department - the development board - before the venture and on the fact that the bank was approached at the latter's recommendation. Proposition 5.a) gets some support from the fact that A's first joint venture partner was a ditributor and the second, a bank, could plausibly be assigned to UM. How far this consideration also argues for Proposition 6.a) turns upon the view taken of A's strength in F. Although little of its technology is patented, A's R and D gives it some sort of a claim in F, although more likely in UF - protected by trademarks - than in CF. Thus, the outcome would be a joint venture between a foreign firm assigned to UF and a local partner assigned to UM in contradiction with proposition 6.b). But the venture involves only the chemical division of A's parent company and the technology it transfers is not to the local partner in UM, but to potential and actual customers in CM (Proposition 7.b) and 8.

CASE 7

Company B is a 200 man strong Scandinavian shipping company, whose local subsidiary is majority owned by indigenous shareholders, and which has been operating exclusively in the Far East since 1926. It was by virtue of its indigenous majority that it was invited by Company A, another Scandinavian firm, to participate in a joint venture since this would make such a venture eligible for promotional privileges offered by the host government. The two firms were already known to each other in Scandinavia, (Corollary 1.1.c)) and they set up the operation 'over a beer in a bar' (Corollary 1.1.a)). B has no active role in the venture, but, sharing a floor with A in the same building, it informally advises and consults with it on sundry operational matters. As a matter of policy, B will normally only invest where it can trust those who are running the business (Corollary 1.1.c)).

Company A is a paint manufacturer with 50% of the market in its own country. Its annual sales are $149.5 million of which $45.9 are abroad, and it employs 2,410 people of which, again, one third work abroad. 2-3% of the firm's sales are spent on R and D. A has reached the limits of viable domestic expansion, and since the export of finished and semi-finished goods has now become uneconomic in this industry, the firm aims to capitalise on its accumulated know-how either through foreign licensing or through the setting up of manufacturing operations abroad. Foreign political risks, and a lack of investment funds, have pushed A to adopt a policy of expanding foreign sales through the reinvestment of locally generated funds, rather than through the injection of further capital by the parent. It has currently fifteen licensing operations, and ten subsidiaries and affiliates abroad. Only the last two mentioned will receive a total and unstinting transfer of the firm's technology (Proposition 7.a)). Straight licensees get a more limited - and better delimited - technology package (Corollary 2.1.a)).

A had been exporting through an agent to this particular ASEAN country since 1964, but at a sales volume below the firm's potential; in 1968, therefore, the firm decided to invest, and sought out a suitable local partner in order to meet the government's conditions for the granting of promotional privileges.

Finding an indigenous firm that was actively willing to contribute its 'know-how' of local markets and of the workings of government proved no easy task (Corollary 1.1.d)) and it was only after some considerable time that A gave up the attempt and the arrangement with B was made.

Today, A is the third largest paint manufacturer in the local market. Its production technology is a simple non-proprietary process, similar to the one it uses in Scandinavia, but at a lower level of automation. The firm's formulations are covered by 28 trademarks and are adapted to the specific requirements of the domestic market in its local laboratories. In this market, the firm itself has to train customers to use its products whereas in Scandinavia this is done directly by the customer firm or by an outside agency (Propositions 7.b) and 8). The subsidiary is free to buy its raw materials from the cheapest source, subject only to an initial quality check by the parent. Its operations are controlled by A on a day to day basis through the overseas production manager, and at a more formal reporting level through the chairman of the parent company board.

Discussion

The subsidiary has a fair degree of autonomy, but relies on the parent for technical assistance, technical data, new products, etc. A's sees its relative strength in F, hence its licensing operations and its move abroad. But this is more likely to be in UF, given the firm's reliance on trademark protection and despite the comparative straightforwardness of its technology. The most that can be claimed for B, given its inactive status, is a highly tentative assignment to UM, resting on little more than the firm's general commercial knowledge of the host country. The relationship that obtains, therefore, is in line with Propositions 6.a) but not with 6.b). Proposition 4 appears to be supported but propositions 5.a) slightly less so, insofar as B, in spite of the indigenous majority ownership of its local subsidiary, remains, in effect, a Scandinavian firm at heart.

CASE 8

A is a large European pharmaceutical firm which set up a local joint venture operation in the mistaken belief that it was a precondition for investing in the country (Corollary 1.1.a)). It had been trading in the domestic market since before the war and had created its own local manufacturing facilities in 1964 as a response to newly erected tariff barriers. The firms used a local European distributor until 1972 when it decided to invest in the development of its own distribution facilities. The joint venture partner was one of the firm's ex-employees who had represented it in the country before the war (Corollary 1.1.c)). He is not operationally involved and is merely treated as a shareholder (Corollary 1.2). The joint venture concerns A's local manufacturing company. Marketing and distribution are carried out through another subsidiary entirely under the firm's control.

A, worldwide, has sales of $1,200 million, 70% of which are overseas; half of its 30,000 employees are also located abroad. With an R and D expenditure representing 4.6% of its annual sales the firm aims to exploit its technology directly. Royalty payments offer inadequate returns on its research and therefore it will only enter into licensing arrangements in sophisticated markets where cross-licensing is possible (Proposition 7.a)). Even with its own overseas subsidiaries, the firm will only transfer technology on a 'need to know' basis, and while a subsidiary will be free to market the parent's products in its own way - if it refuses a product however it must explain why (Corollary 3.1.d)) - its technological operations are tightly controlled from Europe. This is achieved through regular technical audits of its facilities and through its dependency on the parent for raw materials, training, formulation, technical data, etc. (Corollary 1.2). All overseas companies begin initially with the secondary manufacturing operations of mixing, packing, and filling. Primary operations, such as formulating, are carried out in A's European headquarters, and are thereafter only transferred to the larger markets. Overall, the trend has been towards local secondary manufacturing with A supplying the bulk materials. Technological dependence on the parent is reflected in the way the latter classifies the markets it serves according to their level of development; subsidiaries in large mature markets enjoy considerable autonomy compared with those in small LDC's who look to A for a wide variety of goods and services.

A has a regional management centre in Singapore to which the venture studied here reports. Reporting is quite a complex business, and is carried out both on a line as well as on an area basis so that a direct reporting link to the parent exists (Corollary 1.1.a)). Over the years, the subsidiary has developed a sound knowledge of the local market despite the fact tha personality problems initially clouded its relationship with the national drug retailers' group, leading to a boycott of its products and subsequently three years of stagnation. Its organisation is structured on functional lines, a new function having been added when it set up its own distribution, and its manufacturing activities consist mainly of mixing, filling and packing, with some adaptive formulating being carried out locally. Thus, they remain essentially non-proprietary, secondary processes. The absence of any effective patent laws in the country makes the firm vulnerable to independent formulations and leads to a heavy reliance on trademark protection.

Discussion

The joint venture described above is purely nominal and A's behaviour is essentially that of a hierarchy (Corollary 1.2). Corollary 3.1.a) is well supported by the case as suggested by the fact that executives interviewed in the local subsidiary challenged the idea that they were working to any clear set of objectives from the parent. Likewise, neither the executives interviewed in A's headquarters, nor the publications made available by the firm were clear about what such objectives might be. To be sure, the circumstances attending the setting up of the joint venture tend to support corollaries 1.1.a) and, to a lesser extent, 1.1.c), but proposition 4 is contradicted. The local partner is hardly present in any cell, but if he is, it will be in UM. Since A is well invested in virtually every cell no clear evidence can be cited in support of propositions 6 a) or b). Proposition 5.a) however, is supported.

CASE 9

A is a large chemical firm from one of the smaller European countries which began to internationalize its operations during the 1970's and to that end, was seeking a foothold in the Far East. It has annual sales of $4,938 million and employs 80,000 people in eleven product divisions, four of which are now international. This case examines a joint venture between its surface coatings division and a local southeast Asian company. A spends 4.1% of its sales on R and D, 15% of which is basic research carried out in Europe, and 85% of which is supportive and carried out in different parts of the world. 5,350 people are employed in research.

A favours joint ventures as an economic way of penetrating a new market rapidly by drawing on local expertise and experience (Corollary 1.1.b)). While this applies to both industrialized countries and LDC's, in the latter, government restrictions, lack of infrastructure, and the complex local structure of the retail trade (this is particularly the case in South East Asia), make a joint venture formula almost inevitable. However, the firm's move into those more sophisticated technologies that will help it to maintain its technical and commercial position, has constrained it to limit the products that will be put into a joint venture to those whose technology has been fully amortized, and where a technological leak will not flow back and harm it in its home markets (Proposition 7.a)). The firm's technological know-how resides more in its formulations than in its production processes, since these are well established and when transferred abroad, often make use of old or second-hand equipment. If more sophisticated equipment must be sent abroad, however, A will sometimes hold back a crucial component or item of information, or send these over in a coded form to prevent local employees transferring them to the competition (Proposition 7.a)).

B is a local paint manufacturing company created in 1966 by an Indonesian businessman of Chinese origin who has paint factories in each of the ASEAN countries except the Philippines. B has sales of $48 million and employs 2,000 people, 1800 of them in Indonesia. A and B came together by accident through the introduction of a third party. B, at the time, was suffering from a certain amount of managerial neglect in what was becoming a highly competitive

market, and although it was initially looking to A for nothing more than a licensing agreement - such as B's owner had with A through another of his local firms - the latter was looking for a local company to invest in. A was already trading in the country and had built up a healthy sales volume through its relationship with a single large automotive customer. The firm felt that its local agent was not doing enough to allow it to exploit its full market potential, and since the 35% local content requirement imposed on the car industry offered paint manufacturers the prospect of a solid market base on which to build, it was seeking a joint venture arrangement that would give it the organizational capacity to meet the competition as it developed. Accordingly, it was agreed in 1974 that A would take a minority interest in B - a third shareholder was then brought in to ensure that neither A nor B had a controlling majority (Corollary 1.1.d)) - and would take over its management, thus allowing its owner to attend to his other regional interests. Today, B's former owner is only involved in the joint venture as a shareholder. As far as A is concerned, it simply bought into a local company and the local partner came with it. He was not personally screened since the nature of the deal as structured did not seem to require it.

Prior to the joint venture B had been operating at the cheaper end of the local household paint market. A intended to push it into manufacturing the more sophisticated automotive and industrial paints since both serve specialist markets in which A enjoyed a technological advantage. Today B carries out formulations itself, and offers customers a range of specialist technical services, most of which will require about one man-week of an expatriate engineer's time for each service. B's technology, however, remains non-proprietary, and relies on trademarks rather than patents for protection from imitators. There is, in addition, a labour-intensive bias in B's technology, and the difficulty it faces in educating its market to discriminate on the basis of quality rather than price also sets a limit to the sophistication of the products it can offer. This makes effective customer training all the more crucial to its ultimate success and for this it relies on a free flow of technical services from A (Corollary 1.1.a), Proposition 7.b), and Proposition 8).

Discussion

The evidence in this case goes against Corollary 1.1.c) since A was not unduly concerned about the identity of its joint venture partner either at a personal or at a corporate level. A possible explanation for this indifference lies in the firm's securing management control and thus reverting to hierarchy. Insofar as this was done to protect and exploit its technological assets it supports Corollary 1.2. A's control of B's management may also account for the case's failure to support Proposition 4, however, it also contradicts Propositon 5.a) since A, a firm strong in F, was not looking for an active partner in M, but rather in I (A itself was already doing nicely in M).

In conclusion, one might note that A's foreign investment policies support some of the above propositions better than its 'realized' strategy, and this case could, with some justification, be seen to describe not so much a joint venture as the purchase of a 'shell' company which is subsequently developed as if it were wholly owned.

CASE 10

Company A unintentionally bought its way into South East Asia through the acquisition in Europe of a paint firm which already had an operation there. A is the second largest producer of household paints in its home market and the second largest supplier of surface coatings to its domestic industry. Its annual sales are $137 million and it employs 3,200 people, 488 of them overseas. Although A leaves basic research to the petrochemical industry, it spends 1-2% of its annual sales on applied research and development. It aims at exploiting new markets through the diffusion of its existing technology, while simultaneously developing new technical capacities mainly in the form of technical services for industry (Proposition 7.b)). In its foreign operations, the firm prefers to put in skills rather than cash, but where this is not possible it will seek to limit its financial commitment to that of a minority joint venture partner while retaining a management control of operations (Corollary 1.2). In this way, it argues, it can always move out if things get too difficult without incurring disproportionate losses.

Company B is a local trading company that has diversified into financial services, insurance broking and mining; its annual sales are $70 million and it employs 400 people. Despite the fact that B claims no technical expertise in the field of paints or surface coatings, it was formerly A's local distributor. Today, however, the firm has no operational role in the joint venture and treats it purely as a portfolio investment. B is also involved in four other joint ventures only two of which it considers successful.

The joint venture between A and B was set up in 1966 when B, who was distributing A's product, sensed that the local trend towards import substitution would eventually threaten A's market share, and by implication, its own position. B consequently approached A with a proposal to set up a local production facility (Corollary 1.1.a)). A would have preferred to team up with a firm specializing in its range of products rather than an agent, but B was a known entity 'not particularly dynamic, but not threatening either' (Corollary 1.1.c) and 1.1.d)), whose experience and knowledge of local conditions was bound to prove useful (Corollary 1.1.a)). After a while, as sales grew, it

became apparent that B was too diversified an organization to give A's products the attention the latter felt they deserved. This difficulty was aggravated by a visible cooling of the relationship between the partners following the arrival of a new chairman at A who, by all accounts, did not easily make friends (Corollary 1.1.c)). A second distributor was then brought in to compete with B, a move that proved so destructive that A was eventually led to abandon both its distributors and to set up its own sales force.

The operation is currently run as a profit centre pretty well independently of A, the lower quality imposed on its products by the local market requiring only modest technical links between parent and subsidiary, and even these are activated only by the development of a new product or a new technology. Furthermore, the technology transferred is simple 'textbook stuff' that would be difficult to protect, and the subsidiary is thus led to rely on its trademarks and on the coding of its active ingredients rather than patents. The equipment it uses is second-hand and was fully amortised by the parent before being shipped across, thereby reducing the investment funds required by the local firm to achieve viability. Recently, the subsidiary has added a formulating capability to its mixing, tinting, filling and packing activities and is now able to offer clients both formulating and colour consulting services. It would like to diversify on the back of its increased capacity, but lacks the managerial resources to do so.

Discussion

Both proposition 4 and 5.a) find support in this case although the first only in the negative sense that A was comparatively small. Support for the second is qualified by a move back towards hierarchy (Corollary 1.2) as A accumulates experience and feels the need for a more specialised distribution operation under its own control. Yet, its behaviour in this case does not reflect its general policy which is to sell its skills, or at most, to take a minority position in a venture. A, whose strategy was based on an increasing strength in F, sought a partner who was strong in M (Proposition 6.a)). B's strength, however, was in UM whereas A would apparently have preferred a partner strong in CM. Bringing in a second distributor could be considered as an attempt to move the distribution operation from UM to CM.

CASE 11

Company B is a host country state corporation which is a 'sleeping partner' in a joint venture for the manufacture and distribution of fertilizer in two states. Although it is not involved in the venture's operations, the heavy dependency of local farmers and dealers on its services and activites makes it a natural partner for this kind of activity.

Company A started life at the beginning of the nineteenth century as a trading firm based in Southeast Asia. During the course of the century it moved its base to Europe from where, as a holding company 40 people strong at headquarters, it now runs a diversified worldwide operation with sales of $656 million which employs 30,000 people in activities as varied as heavy engineering, textiles, and plantations. Although A spends about 1% of its revenue on R and D - through its U.S. engineering subsidiary and its palm oil research establishment - it sees its main strength in distribution, and has therefore relied either on its suppliers for its technology, or, on occasions, on its joint venture partners. It is the firm's policy to operate through joint ventures both to capitalise on the technological know-how of its partners and to comply with increasingly stringent government regulations. To this end, A has set up two management service companies, one in each of two ASEAN countries, to coordinate the inputs of various partners in the joint ventures the company manages in the different countries of the region. It is through joint ventures that the firm's current trading and manufacturing operations evolved, and, given its diversity, this has meant that the parent's overall strategy has had to remain essentially a financial one, characteristic of a holding company, rather than an integrated industrial one made possible by wholly owned operations.

A is B's minority partner in the fertilizer venture, a comparatively small, downstream, marketing operation consisting largely of mixing, filling and distribution to dealers, in which the technology used was mastered by the local labour force in six months. A is currently number two in the country's fertilizer market with a 35% market share; it was approached by the state corporation with this project because other foreign firms were reluctant to invest. The firm's decision to go ahead with the venture was conditioned

partly by the need to be seen to comply with the government's economic policies - particularly where they concern joint ventures - and partly by the state corporation's strong position with the farming community, and hence by the considerable marketing advantage that the involvement of such a partner, albeit a pasive one, would confer upon the venture (Corollaries 1.1.a) and 1.1.d)).

The venture is managed by A as a decentralized operation, independent of its other activities, and was set up by converting one of the divisions of A's local subsidiary into a joint venture organisation. It was thought by some interviewees that A was reluctant to allow the joint venture to expand its activities as this would bring it into direct competition with more sophisticated local subsidiaries. Thus, its activities have been confined geographically to two regions and little reinvestment in new equipment and production facilities has taken place (Corollary 1.2). The venture has developed a modest capacity to market its products through the use of advertising, film shows, and technical demonstrations, but its overall prospects remain limited.

Discussion

The varied motivations that drove A to embark on this joint venture are consistent with Corollary 1.1.a). Also, the respective strengths of the parties would probably place B in UM, but A in CP in contradiction with proposition 6.a), but in conformity with proposition 6.b). In a sense, the contradiction is resolved if one considers that the state corporation enjoys a strong bargaining position in its relationship with the farming community not by virtue of its know-how - which would have placed it in F - but through its legislative and monopsony power in the agrochemical market. Proposition 5.a) is trivally corroborated since A had little investment in F in this industry, but for this reason neither corollary 6.a) nor proposition 8 find any support. The marketing services offered by the joint venture offer weak support for proposition 7.b).

CASE 12

Company A_1 is a large, diversified, European trading company that originally grew out of a number of Asian partnerships, and through a process of acquisitions, developed into a worldwide operation, distributing the products of 2,750 manufacturing firms in markets these are not familiar with, and developing export outlets for them as well as opportunities for expansion. A_1 has sales of $3347 million, and a staff of 50,000 only 7,650 of which are employed in its home country. As a trading company, A_1 carries out no R and D itself. The firm is currently involved in about a hundred joint ventures in various fields, and it encourages local participation in the equity of its subsidiaries many of which are publicly quoted in their respective countries of operation and run as independent profit centres with dual line reporting back to the parents. The nature of its trading activities requires the firm to react to events rather than anticipate them as a manufacturer might, and for this reason, it lacks a distinctive management style that could be applied to its overseas operations. Nevertheless, the increasingly restrictive trading conditions imposed by many host governments are gradually pushing the firm to adopt a manufacutring posture, albeit indirectly through joint ventures with suitable partners. At present, manufacturing activities represent no more than 1% of its turnover. The need to reduce its vulnerability to tariffs is also pushing the firm into more sophisticated product markets, requiring more extensive training of its sales force in the uses and applications of products manufactured by its principals. Such training is carried out for A_1 directly by the firms it represents (Proposition 7.b)).

The two joint ventures outlined below, each take place in a different ASEAN country, and each with a different European chemical firm as a joint venture partner to A_1.

Joint venture 1 - Company A_2 is a wholly owned subsidiary of a small European country's national oil company; it specializes in surface coatings and employs a staff of 2,000 people. The firm's R and D expenditure absorbs 4-5% of its turnover. Its preferred way of operating abroad is through direct exporting or licensing arrangements; if this is not possible it will settle for a joint venture formula, especially in LDC's where the political and

market risks make it imperative to bring local expertise and know-how into the operation (Corollary 1.1.a)). A_2 currently has 25 licensing agreements in force in different parts of the world, as well as 10 joint ventures, but in no case has it - or will it - transfer a technology that is not already established and in commercial use (Proposition 7.a)). The technical agreements involved all cover simple chemicals, although licensees and the joint ventures depend on A_2 as a source of new technical developments, new products, quality control services, and general consultancy services on particular problems. A_2's joint venture with A_1 in one of the ASEAN countries was set up in response to that country's protectionist policies in 1968, and has now becme one of 12 promoted companies in the industry which share 37% of the domestic market between them. A_2 had been exporting into the country for nearly 30 years prior to the joint venture and had built up a strong brand position which allowed it to extend its product range. It had originally entered the market through the creation of servicing points for its marine paint customers and subsequently developed its building, automotive, and industrial paint business. A_1 had been A_2's distributor at the time and was therefore well known to the former. A was taken on as a joint venture partner because of its extensive and intimate knowledge of the local market (Corollary 1.1.b), and 1.1.c)).

The deal between them was that A_2 would supply the technology and that A_1 would provide the funds, the general management, and the distribution (Proposition 6.a)). A_1 has the controlling interest in the company. The technology used by the venture is standard, self-contained, and non-proprietary. Protection from imitation is secured both through trademarks and the accumulation of intangible know-how, and customer loyalty is developed through the provision of technical advisory services covering the application of the firm's products (Proposition 7.b)).

Joint venture 2 - Company A_3 is an oil major, employing 220,000 people worldwide, whose chemical division ranks eleventh in the world's 25 largest chemical companies. The division has $4625 million of sales, 3.2% of which are spent on R and D (this compares with 0.8% of sales spent of R and D for the group as a whole). The firm prefers to hold on to the technology it produces and generally will not license new processes outside the group except in the context of a mutually beneficial technological exchange (Proposition 7.a)).

Despite A_3's technological strength, it sees its specific advantage in its marketing and distribution capabilities which cover a wide range of activities from distribution and storage to formulating products for end uses. As one of the home base executives succintly put it: "know-how comes from learning how to use what you produce." The exploitation of this advantage requires the firm's presence in its potential markets which is why it is now aiming at an equity participation with those who would use its technology rather than relatively less profitable licensing agreements. A_3 is currently involved in 34 joint ventures, many of which are with other international firms. These are controlled through a dual line reporting system to the parent holding company for line management matters and to the parent's service companies for technical and financial matters. The firm's corporate objectives are developed slowly though a consensus seeking dialogue with its subsidiaries and affiliates (Corollary 1.1.a)).

A_3 had been trading in the joint venture's host country since the end of the nineteenth century. It set up local production facilities in 1971, and, in anticipation of the host goverment's foreign investment legislation, it made available 21% of its shares to A_1 - which, in the local market, was itself a joint venture, majority owned by host country nationals - 30% by the general public. A_1 had been distributing for A_3 until that time and was chosen as a joint venture partner who was known and who would not interfere in the firm's management (Corollaries 1.1.c), and 1.2). Today the joint venture is the fifth largest chemical firm in the domestic market, concentrating on industrial and consumer chemicals as well as agrochemicals. Half of its turnover derives from straight trading activities. None of A_3's products are unique, and although there is restricted access to some of its formulations, most of them hold no great secrets. Moreover, local production operations are very self-contained and use a simple batch technology which consists mainly of formulating, mixing, and filling, and which stands in marked contrast to the sophisticated continuous technologies used by the firm in Europe. The parent remains nevertheless an important source of technical support for the venture, and provides it with purchasing, quality control, and technical information services.

A_1's local subsidiary, although represented on the company's board, has no direct operating role in the venture. Its involvement however, reflects its policy of setting up joint ventures with foreign firms which have a strong production capacity and which are seeking a local partner of good repute. Wherever possible, the subsidiary will also try to secure its appointment as distributor for such a venture.

Discussion

The joint ventures involve European firms only, although, in the second one, their identity is diluted by local public participation. Nevertheless, identity seems to remain important: in both cases the partners knew each other before the venture (Corollary 1.1.c)), although in the second case A_3's concern was to find a partner that would remain managerially passive. Proposition 4 is partially supported in the first case, but not in the second and proposition 5.a) is corroborated in both. Company A_2 has relegated to A_1 considerably more operating responsibilities than has A_3, and, consistent with proposition 5.b) shows a greater expenditure on R and D relative to sales than does A_3. Each joint venture finds a firm strong in F seeking out a partner strong in M (Proposition 6.a)) and each finds the technology supplier dealing in a well-established technology at best protected by trademarks - i.e., in C. To assign a position to A_1 vertically within M is difficult: on the one hand it has worldwide marketing knowledge, and, by dint of its size, must enjoy considerable economies of scale; on the other hand, it is a diversified conglomerate whose knowledge of the products it distributes is limited to the training offered to its salesmen by its principals, and which sells its services to joint venture partners on the strength of its accumulated experience of local markets rather than any body of sophisticated marketing techniques. Thus, although A_1 has an undoubted strength in CM, its relative strength one could argue with some justification - and certainly this is what was actively sought by A_2 and only passively by A_3 - lies in UM. If this is accepted, then it constitutes evidence in favour of proposition 6.b).

CASE 13

Company B, a diversified Chinese firm with interests in property and textiles, a staff of 260 people, and sales of $10 million U.S., was set up in 1963 to manufacture detergents for its local market. Originally, the firm served only the domestic market, selling to a few large customers products which were technically unsophisticated - all raw materials were bought on the open market - and which needed little promotional effort other than offering technical advice and getting clients to visit the firm's laboratories if they had problems. With Japanese competition intensifying in the region, however, the firm began to look at backward integration as a way of cutting its costs, and accordingly, erected a plant for the manufacture of intermediate raw materials for detergents. Since the economies of scale this would create were only achievable in a much larger market than its own, the firm was also faced with the need to gain a foothold in the region - a region it knew well since its Taiwanese origins gave it strong connections with the informal and exclusive Chinese distribution network that operates so effectively throughout South East Asia. Thus, it was seeking a partner who could help open up new markets for its products in the region.

Company A is European based and is one of the four largest manufacturers of phosphates worldwide with sales of $713 million U.S. and a staff of 18,000 people. It is best known for its surfactants which have developed a strong brand position and which have been marketed by the firm throughout South East Asia since the 1950's. Rising freight costs (particularly oil) have made it increasingly uneconomic for Company A to go on exporting finished goods directly from its home country. It has therefore, pursued a strategy of investing downstream in or near its local markets abroad where there is the highest value added and supplying the basic raw materials (i.e., active ingredients requiring a more sophisticated technology) from Europe and Canada (Proposition 7.a)). A had been one of B's main raw materials suppliers and was also experiencing the onslaught of Japanese competition throughout its markets in the region. For A, however, the problem was compounded by the fact that B's projected backward integration created the prospect of turning an established customer into a serious potential competitor (Corollary 1.1.d)). The stark choice that now faced the firm was either to 'beat them or join them', and since 'beating them' could prove difficult in view of the long term assets B possessed with its regional 'Chinese' connections, company A decided to approach it with an offer of collaboration.

Initially, A had only wanted to license B to manufacture its products, but the latter wanted a much stronger committment on the marketing side to form part of any agreement between them. Negotiations, therefore, covered both manufacturing processes and market sharing arrangements. Company A became a minority partner in a joint venture which it licensed to manufacture intermediate raw materials, and to which it then granted a market exclusivity covering thirteen countries in the region (Proposition 5.a)).

A did not consider alternative partners for this joint venture. B, however, had opened discussions with a Japanese firm, but finally opted for A on the grounds that it was better known to the firm (Corollary 1.1.c) and 1.1.d)). Collaboration has grown between the two firms since the joint venture was initiated, and A has become more willing to pass on information to B concerning its technical processes. A number of people who used to work for A now work permanently for the joint venture and A's ex-area manager acts as a full time consultant to it, operating from the same building. Although no proprietary technology as such is used by the joint venture, its technical operations are more sophisticated than B's were, and the latter has come to depend on A for a range of technical services such as the training of the venture's staff, a regular supply of information on new technical developments, and quality control (Corollary 1.1.a)). At present, a number of other joint ventures between the two firms in the region are under active consideration. This formula is seen by A as a way of regaining the market share that it lost to the Japanese in the region and of subsequently expanding its market coverage.

Discussion

Wherein lay the relative strength of each party to this venture? A's sophisticated capability in upstream technology and its coverage of the regional market gave it - in the eyes of its joint venture partner at least - a relative strength in both CF and CM. A, itself, was seeking locally a firm with a downstream capability in CI, using an established manufacturing technology, and one in UM, as a necessary component of any regional marketing strategy for dealing with the Japanese threat. This is what B had to offer through its local manufacturing base and its informal connection with the

regional Chinese 'Mafia' (as it is known locally). A saw the operation essentially as one in which it was exploiting its 'know-how'; and given the complementarities between the parties, the case offers some support for Propositions 6.a) and 6.b).

CASE 14

Company B is one of the three largest companies in its domestic market; founded in 1980, it originally concentrated its activities in food processing and brewing, embarking on a diversification programme in the 1950's. The firm's sales stand at $450 million and today its shares are publicly quoted on the local stock exchange. It employs 27,000 people and, by virtue of its size, it sees its main strength as residing in its general management skills. For a number of years, the firm had been importing more than it had been exporting, a matter that was causing some concern to its government. Therefore, a few years ago the government asked the firm to initiate activities that would redress its negative trade balance. The firm's response was to embark upon a joint venture that was quite outside its main lines of business and which was run as an independent and self-contained operation.

Company A is a large European firm in the heavy capital goods sector employing 51,000 people to achieve sales of $2,875 million. Between 1964 and 1970, the manufacturing costs of its domestic pipe fitting operations had risen by 70% while the government was maintaining rigid price controls. Between 1972 and 1977, these operations ran up $177 million of accumulated losses and had to be closed down. A then decided to seek out a low cost production site abroad. The technology used was a simple, partly-batch process, well established in the industry and requiring little training of the workforce. Although a number of the technical operations were difficult to codify, the work involved was not inherently complex and could be carried out to international standards using second hand equipment; the firm's R and D budget for pipe fittings was only 0.5% of sales.

A had some experience of B's country through local contracting activities prior to the joint venture and, with local labour costs standing at 15% of what they were back home, the operation seemed viable. B, which had been recommended to A by a local bank, was not familiar with pipe fittings. It was argued, however, that its broad manufacturing experience, together with the simplicity of the operations themselves, would made it a fast learner, and although initially A only transferred second hand equipment to get things going, it envisaged a rapid upgrading of the technology it would pass on as B accumulated experience.

Defining the operational roles of the joint venture partners was no easy task as B had initially been seeking out a wholly owned operation to satisfy the government's expectations. While A was purchasing the whole of the output, it was also deciding the venture's marketing strategy, and providing technical services, training, and equipment. Quality control was relegated to a local government institution, a source of considerable operational delays as it turned out. Each party feels that the venture is still too young to talk about results, but the operation has not been without its problems. B feels that communications have not always been clear, and that its partner has often tried to discharge its obligations by remote control from Europe. Furthermore, A had sent out the wrong type of person to help set up the operation, and B maintains that things would have gone faster and more smoothly had he been chosen with more care. A, for its part, views B's managerial capacity and motivation with concern, and now wishes either that it had invested less in the venture, or that it had spend more time checking out the real capabilities of its joint venture partner.

Discussion

The problems referred to in the case, arguably stem from the operation being a joint venture rather than a licensing agreement. The initial problems of defining the terms of the agreement notwithstanding, the transactions involved were neither inherently complex nor vague and hence, if anything, contradict Corollary 1.1.a). In fact, the marketing and manufacturing transactions would have been more easily separable had they been properly defined (Corollaries 2.1.a) and 2.1.c)), and then atmosphere would have been less important than it turned out to be in reality (Corollary 1.1.c)). Although small numbers bargaining is evident in this case, it does not appear to have been a necessary feature of the transaction given the scale and complexity of the technology involved, so that Corollary 1.1.d) is only weakly supported. On the other hand, the large size of B in the domestic economy, and its extensive experience of local conditions, make a good case for placing the joint venture in UM, even if the transactions it covered moved down out of that cell fairly soon after the start of operations as B mastered and codified the procedures and techniques associated with pipe fitting fabrication.

Neither partner can be plausibly described as having a particularly strong position in F or M from the data available although B's relative strength is probably greater in M (though not necessarily with respect to this operation) than elsewhere. The ideal partner A was seeking would probably have been stronger in I than B was. At the same time, a case could be made for proposition 6.b) with A's relative strength in C and B's in U. The fact that A marketed the output of the joint venture refutes Propositions 5.a) and 8 in this case, while B's initial attempt to make the operation a wholly owned one offers limited support for Proposition 4 in view of its relative size in the domestic economy.

CASE 15

The case describes two joint ventures between two European companies, A_1 and A_2, one in each of two ASEAN countries.

Company A_1 is the world's second largest producer of industrial gases and its largest producer of industrial welding equipment. Its recent takeover of a large U.S. firm, also in the field of industrial gases, may soon make it the world leader in its industry. At home the firm has been the subject of antitrust investigations. Of its $2,595 million world sales, $2,551 took place outside its home base; the firm also employs 63% of its 55,000 staff abroad. The reason for this is that it is almost impossible to build up a viable gas business through exports, given that a major source of the firm's competitive strength lies in its ability to offer fast and reliable deliveries, often at volumes requiring large infrastructural investments. Thus, the major investment in developing a market lies in creating an efficient distribution system, and the firm's policy has been to set up a local production operation as early as possible, even if its small scale only allows the use of a twenty year old plant, and to 'trade-up', technologically speaking, as the market develops. The continuous nature of the technical processes, and the gaps that exist in the range of plant sizes available, make it impossible to use an optimal technology for plants at all scales. The market-based nature of A_1's operations have led to a highly decentralised management style, operating through a divisional structure in which local subsidiaries are granted maximum autonomy.

A_1 spends 1.4% of its turnover on research and development. Little of this is in basic research, and most is devoted to seeking out new customer applications for industrial gases (Propositions 7.b) and 8). Although basically commodities, in many applications industrial gases find no substitutes, and their use requires considerable know-how and skill; this is transferred by the firm to its customers by applications specialists and sales engineers, through time consuming interventions that may last as long as two to three years. A_1 sees the transfer of its technology to customers as a major source of competitive strength, and as the key to further market development. The firms will only grant licences in applications technologies, or for the use of its equipment, however, and not for the actual production of its mainstream gases.

Company A_2 is another major European producer of industrial gases with sales of $1,605 million and a staff of 24,000. The firm spends 2% of its turnover on research and development, but unlike A_1 grants few licences for the use of its technology other than to its own subsidiaries. Where it does so, they will be tied to the use of its equipment, and not be offered solely for industrial gas applications on their own.

A_2 has been present in the markets of South East Asia for over 40 years and has learned to avoid some of its over-competitive and over-regulated markets. A_1 and A_2 have been fierce competitors on a worldwide basis for a number of years, and are well known to each other (Corollary 1.1.c)). They have a joint venture together in Hong Kong and were pushed into the ones described below by the collapse of their local markets that followed shortly after the 1973 oil crisis.

A first joint venture between A_1 and A_2 was set up in 1975, and a second one followed in 1979. In each case, the firms between them had 80% of local markets which neither considered strategic, but in which each wanted to maintain a position (Corollary 1.1.d)). The sudden shrinking of their markets had created a problem of over-capacity compounded by that of potential local competition. Local operators were attracted by an industry in which the basic raw material - air - was free. Thus, the joint ventures in each case were defensive in nature and do not in fact reflect parent company policy for either firm. Initially, A_1 and A_2 had considered sharing production facilities and marketing their output separately, but this proved too complex and costly (Corollary 1.1.a)). Consequently, the need to protect their respective technologies - which were sophisticated if generally non-proprietary - became a major concern, calling for the setting up of a technical filter between the two partners (Corollary 1.1.b) and Proposition 7.a)), restricting the access of technical data to certain people in the joint venture, and filling the post of chief executive of one of the joint ventures - the one in which the two partners had equal shares - on a rotational basis.

In one of the joint ventures, a local partner had to be brought in as a result of government pressure. The state, a large purchaser of the venture's output, had threatened to buy elsewhere if the firm did not comply with its

foreign investment policies (Corollary 1.1.d)). A local partner was therefore, sought who was politically influential, could bring in business, and would not interfere in management matters (Corollaries 1.1.a) and 1.2). The joint venture's management reported to both A_1 and A_2 but was fairly independent of the European parents. Only during periods of turbulence and change were the links with the parents effectively activated (Corollary 1.1.a)) although both were considered important sources of new technology. This was particularly true in the case of aplications which would allow the ventures to extend their range of customer services (i.e., technical consulting, systems engineering, training in welding techniques, etc.) - their main source of market strength along with an efficient distribution system.

Discussion

All the corollaries of Proposition 1 find some measure of support in this case although the interdependency between A_1 and A_2 only became critical as the result of an external event: the collapse of their local markets. But for this A_1 and A_2 would have each maintained independent, wholly owned operations (Proposition 4). Clearly, neither firm was seeking technological complementarities, although the economies of scale made possible by merging their local production facilities became a significant factor in keeping out would-be local competitors. The selection and treatment of the local partner are both consistent with Propositions 5.a), 6.a) and 6.b, although it might be difficult to argue that either firm's relative strength was in CF. However, A_1's technological strategy corroborates Proposition 7.b) and Proposition 8. A_2's technological strategy is less clear, but in both cases Proposition 7.a) is supported.

CASE 16

For some time, company A has had a clear policy preference for direct investments and arm's length equipment sales in selected countries, as well as a clear reluctance on policy grounds to invest in textiles in Southeast Asia. Yet, this case outlines its $50 million joint venture in a technically sophisticated plant, manufacturing polyester fibre and yarn with local Southeast Asian partners. One of the latter, seeking to break the local Japanese monopoly on polyester supplies, had originally sought nothing more than a licensing agreement for the process from A.

A is the world's eighth largest chemical producer. With sales of $5,920 million, it employs a staff of 113,000 in eight product and four area divisions, and allocates 4.3% of its sales to R and D. A's U.K. subsidiary was already present in the local market, but not in textiles, and was not involved in setting up this joint venture. The proposal for the venture originated with the firm's suppliers of spinning equipment back in Europe; it was then actively promoted by the local trade commissioner for A's home country, who virtually selected the local partners himself. The trade commissioner's enthusiasm for this project can be explained by the fact that if it went ahead it would be the first joint venture carried out by one of his country's firms in the local market.

Company B_1, the main local partner in the venture, is the largest textile manufacturer in the country with sales of $300 million, one sixth of which represent exports to the U.S., the E.E.C., the Middle East, and now, China. B_1 is a family firm run along functional lines, with each of the owner's six children having an operating responsibility for one of the organizational functions. It remains, however, by common consent, a 'one man show', in which all operations are planned by the owner for the year ahead and implemented under his tight personal supervision. The firm's strengths are evenly spread between production and distribution, and outside this particular joint venture - it has a number of other joint ventures with U.K., U.S., and Japanese firms - its technology remains quite conventional.

Company B_2 is one of the largest banks in Southeast Asia; it was invited to join the venture along with one or two small local banks essentially as a provider of funds, and whilst participating in joint ventures is not part of its policy, it consented to do so in order to keep B_1's account. Its involvement is purely at board level.

The joint venture was created in 1972 and provided that A would contribute the technology and the plant management and that B_1, who had been trying to stabilize its supply sources, would purchase 60% of the plant's output - the balance being exported directly by A (Proposition 6.a)). The technology used was ahead of anything that was currently being operated in Europe, and in the host country, it was being tried out for the first time. A batch process was being replaced by a continuous one, all of which was patented, and 40% of which had been entirely conceived by A's engineers. The operation, when running smoothly, is technologically self-contained and thus only requires A's involvement at a management level. It should be said that A is a minority partner in the venture, that it shares the management task with B_1 - joint managing directors were appointed for the venture - and that it has to achieve its parent's managerial and operational objectives through a process of influence rather than authority as well as through control of the management resources that its parent can make available (Corollary 1.1.a)).

From its very beginnings, the joint venture was plagued with problems. Firstly, the initial feasibility study carried out by A had been over-optimistic with respect to both the market and the technology. Secondly, the project suffered serious delays during the construction phase, a problem that A has no hesitation in attributing to B_1's unwarranted interference - B_1's owner was on site at 5 a.m. each morning directing construction workmen according to his own lights. Thirdly, by the time the project came on stream, the market was turning sour through the indirect effects of the 1973 energy crisis, and a serious problem of overcapacity emerged. Fourthly, the production process itself was beset by a number of technical and quality problems some of which, according to B_1, have not yet been properly resolved. Finally, a lack of any clear division of tasks and managerial responsibilities between the partners led to misunderstandings and a rapidly deteriorating relationship (Corollary 1.1.a) and 1.1.c)). A saw B_1 as attempting to take over the venture, and B_1 charged A with staffing the venture with managers who lacked experience both of the technology and of host country operating conditions. B_1 further claims that A is withholding crucial technical information and training services in order to secure its continued involvement in the venture and control of operations through its technology (Propostion 7.a)).

The venture soon began to make losses, and as relations between A and B_1 showed no signs of improving, B_2 stepped in as a mediator between them. At this stage, B_1 wanted to write off its investment and pull out of the venture; it was persuaded by B_2 to stay in as its withdrawal would have led to the collapse of the project, and the possible bankruptcy of the smaller banks that had also invested. B_1 however, was also asked to 'uninvolve' itself in the management of the venture and to leave it to A. How far this has actually happened is not clear. B_1, however, is clear that it will not embark on further joint ventures.

Discussion

The case essentially describes an attempt at backward integration by a local firm seeking to break a supply monopoly by a Japanese firm. The joint venture represents neither party's preferred option: B_1 originally wanted a licensing agreement, A was looking for direct investment opportunities. The relative strength of the partners support Proposition 6.a) and B_1's posture weakly supports Proposition 6.b). A's size as a joint venture partner is evidence against proposition 4 despite its preference for wholly owned direct investments, but its operations role in the venture supports proposition 5.a). The size of all parties to the joint venture in their markets also supports Corollary 1.1.d). However, the claim by B_1 that A was able to withhold crucial technological information in order to stay in the project is not consistent with Corollary 1.1.b)). Finally, the fact that the local trade commissioner virtually selected A's local partner himself, flatly contradicts Corollary 1.1.c)).

SECTION 3: MOSTLY LICENSING AGREEMENTS

Case 17

The case outlines three licensing operations and one joint venture by an established local pharmaceutical firm. Each of these activities will be described in turn and will be discussed together at the end of the case.

B is the fifth largest pharmaceutical firm in its country employing 200 people in production and 300 in distribution. While it sees its main strength in marketing, government regulations, which require all distribution to be in the hands of indigenous firms, make it hard to assess how far its strength is due to intrinsic or extrinsic factors and hence, how far it is real. B started in 1966 as a distributor of imported drugs, and subsequently set up a small laboratory out of which grew its manufacturing operations. The firm carries out no basic research itself although it has developed and adapted products for the local market. Its technological strategy has consisted in taking advantage of its government's restrictions on foreign investment in order to establish joint ventures and licensing agreements with foreign firms. Through these it can acquire enough technical know-how to develop, over time, its own production operations. It currently has 14 licensing operations with 11 different foreign firms. Three of these are examined here: the first covers tranquilisers and antibiotics; the second does not in fact involve licensing, but a manufacturing and distribution agreement covering antibiotics and vitamins; and the third, iron preparations. B actively seeks out licensors with an international reputation, a strong R and D capability, an established position in their domestic markets (i.e., one of the top ten) and, of course, a good product (Proposition 6.a)). Licensing arrangements are a convenient path to technology acquisition for B, requiring little or no investment on its part, and apart from some initial training of its marketing people by the licensor, creating very little technical dependence on the latter other than for raw materials (Corollary 2.1.c)). The price of these are often the subject of protracted negotiations between the parties whereas the rest of the licensing contract is a detailed, but unproblematic document setting out unambiguously the mutual obligations of the parties and the services offered

(Corollary 2.1.a)). Another advantage of licensing arrangements for B is that it keeps the technology components of the transaction distinct from the managerial or marketing ones, where it feels that licensors have rarely anything to teach the firm in a domestic context.

Operation 1 - Company A_1 is a medium-sized European pharmaceutical firm with sales of $495 million and a staff of 7,000. Its licensing agreement with B is partly a defensive reaction to the recent loss of the firm's established markets in Indochina, and partly an expression of its regional strategy of rapidly building up its sales volume through the marketing of its own active ingredients as inputs into the products it licenses. A_1 met B after its fifth visit to the region and decided to enter into a licensing arrangement with the latter on the strength of its size, its image, and its reputation (checked-out by taking up references locally). Clearly, in A_1's eyes, B had the industrial capacity to be a viable licensee. This judgement, however, was not formed through any long acquaintance between the parties (Corollary 2.1.e)).

A_1's technical strength resided in its patented active ingredients and its formulations. Profitability was achieved by selling the active ingredients themselves rather than by securing royalty payments for product licences, and for this reason the firm had to be able to control both the sales and the promotion of its products as if they passed through one of its subsidiaries (Corolary 2.2). Training up B's technicians to produce an acceptable product posed no problems and required not more than ten man days work from A_1. However, B failed to set up the necessary quality control facilities, and more seriously for A_1, failed to promote the product as intended. A_1 now feels that it should have established a stronger control of B's promotional activity instead of relying on the contract (Corollary 2.1.b)) or should have carried out this activity directly. It aims to cancel its contract with B, seek another licensee, and at the same time open up its own regional sales office in the capital.

Operation 2 - Company A_2 employs a total of 2,500 people of which 200 work in R and D. Research, which together with quality control account for around 30% of the firm's turnover, is the firm's core strength. Much of A_2's know-how is firm-specific and remains protected by trademarks when a patent

expires. Nevertheless, the firm feels vulnerable to technological imitation by competitors and for this reason is most reluctant to transfer its proprietary technology abroad through the setting up of local production facilities (Proposition 7.a)). It has a clear preference for direct exports and arm's length licensing arrangements which limit its financial exposure (Corollary 2.1.b)) and shuns direct investment or the joint venture formula, since these would overstretch its resources (Proposition 5.b)).

A_2 had been exporting to the country in question a numer of years ago, but had had to stop as the domestic political situation deteriorated. The firm had recently sought a cheap and riskless way back into the market that would meet the government's requirements that some part of the products should be locally produced, but that would leave it in control of its technology and its trademarks. The solution it hit upon was a manufacturing and distribution agreement with Company B which it had known for a number of years, both directly as well as by reputation. Under the arrangement A_2 would provide B with training services, quality control services, and new technical and product knowledge, while the latter would be responsible both for production operations and for developing a promotional strategy for A_2's brands. This formula has allowed a good relationship to flourish between the two firms.

Operation 3 - Company A_3, founded in 1972, employs 180 people and has annual sales of $13.6 million. Like A_2, it sees its main strength in R and D to which it allocates between 10% and 15% of its turnover. The firm fell back on a licensing strategy when the finished pharmaceutical products it was exporting to the country were banned by government legislation. Since, at the present time, it cannot afford to set up and supervise local production facilities by itself, A_3 has entered into licensing agreements with B as it has done with other producers in about 20 countries (Corollary 2.1.b)). It is not involved in any joint ventures, however. Eventually, the firm intends to set up its own production facilities locally, but does not yet feel confident enough that it knows how to manage things in the still unfamiliar Southeast Asian environment.

A_3 approached B whom it had not known beforehand after hearing 'on the grapevine' that it had adequate production and distribution facilities (Corollary 2.1e)); since good and knowledgeable producers are hard to find in the local market, agreement was quickly reached (Corollary 2.1.d)). Under its terms, A_3 advises B on product strategy, and contributes to the training of the firm's detailmen by sending them documents containing the relevant product data. Initially A_3 used to visit B to ensure that things were running smoothly, but this is now no longer necessary (Corollary 2.1.b)), and, except for the provision of active ingredients, the local production operation has become more or less independent of A_3 (Corollary 2.1.c)).

Operation 4 - A_4 is a European pharmaceutical firm that has a joint venture with B. It is a medium sized firm employing 2,650 people to achieve sales of $165 million, of which 10% is then allocated to R and D. Since, for the firm, production is still cheaper overall in its European home country than abroad, its policy has generally been to license its products, but not its process technology which is currently being 'traded up' as the firm moves into more sophisticated upstream processes (Proposition 7.a)). Until the mid-1970's the firm's strategy had been to carry out its own production abroad where this was necessary or appropriate. But a shortage of funds has recently pushed it towards joint venture and licensing arrangements (Corollary 2.1.b)), not in LDC's, however. Only in developed markets is local production embarked upon voluntarily and the preferred way of servicing LDC markets remains through exports. A_4's joint venture with B was defensive; it was set up when the host government banned the import of finished pharmaceutical goods. No suitable sub-contractor was available as had been the case for its operations in two other ASEAN countries and B, then its distributor, approached the firm with the new government regulations in its hand. Given the nature of its products, A_4 would have preferred to set up and manage its own distribution network (Corollary 1.2), but government regulations stipulated that it should use a local indigenous distributor, and that pretty well settled the issue. In A_4's view, however, B has now over extended itself, and has been unable to meet its financial committments to the venture. It is, accordingly, in the process of being replaced both as a joint venture partner and as a distributor. Someone 'more in the know', and with better institutional and political connections is being sought as a new partner - i.e., someone better able to contribute to the complex and ambiguous dealings that the firm has with the host government (Corollary 1.1.a)).

A_4 now sees local partners as more trouble than they are worth, and intends in future to confine its joint ventures operations to industrialized countries. Today, the local operation is run virtually independently of the parent since production is galenic and fairly simple to manage. No R and D activities of any kind - even modest ones - have been transferred to the venture, since the danger of a technology leak was considered to be too great (Proposition 7.a)).

Discussion

In all the above cases, B is presenting itself as strong in M and is looking for licensors or joint venture partners strong in F (Proposition 6.a)). Yet some of the problems B has encountered undermine its claim which, as earlier suggested, may owe more to host government policies than to its own intrinsic capacities. Government influence may, in the same way, explain the support found for Propositions 4, 5.a) and 5.b). A_1, for one, was not handing over control of its distribution willingly, and neither A_2, A_3 nor A_4 would have manufactured locally, were it not for government legislation, Indeed, A_1 was looking for ways of protecting its proprietary interests by re-establishing some form of hierarchical control over local operations (Corollary 2.2).

In all the cases described, B was the technology purchaser and was located to the right of technology sellers who were in F (Proposition 8). Small numbers bargaining obtained, but could be attributed at least as much to B's strength in M as to the technology seller's strength in F (Corollaries 1.1.d) and 2.1.d)). Neither A_1 nor A_3 had any prior experience of B (Corollary 2.1.e)) although A_2 did, and this had been an important consideration. In the case of A_4, it is difficult to gauge what had been the importance of atmosphere and identity at the time the joint venture was set up, but the fact that B had been A_4's distributor and was therefore known to the firm is presumptive evidence in favour of Corollary 1.1.c). Finally, the licensing and manufacturing agreements discussed, appealed to the parties as a low cost transaction (Corollary 2.1.b)) that could be clearly specified (Corollary 2.1.a)) and managed independently of their own activities (Corollary 2.1.c)).

CASE 18

Company B fabricates, installs, and trades in aluminium in the local market. It occupies the third place in the market, with a 20% market share, $4.6 million of sales, and a staff of 1,350 people. The whole of the firm's top management came into the firm in one jump from a major American competitor; it represents a stock of 130 man-years of accumulated experience of the aluminium industry. B operates a standard plant using a continuous process and a technology well within its competence, requiring little adaptation to local conditions. The very high fixed costs of the operation and the fact that the plant must be kept running makes it imperative to sell its output quickly. This is one of the reasons the firm wants to move downstream and integrate forward into fabrication activities that can help to absorb output. These also offer a larger value-added than current operations. Local customers are as familiar with potential product applications as is the firm itself, so that the possibilities of developing and offering a specialised technical service are limited, given B's still narrow technical base in this highly competitive, price conscious industry. Since it carries out no R and D in the domestic market the industry's know-how has to be imported, and it was the need to keep technically abreast of its major competitors that pushed B to seek technical links upstream of its present operations through a licensing agreement with a large European firm.

Company A is one of the top six aluminium producers on an international scale; between them these six firms hold 50% of the world market. A has sales of $6,180 million, a staff of 97,340 people - of which 19,063 work abroad - and an R and D budget of $70 million (1.1% of sales), covering the decentralised operations of 3,000 people working in forty laboratories and pilot plants. Much of this R and D work is not basic, but a direct response to customer demands and problems. In the early 1960's the firm opted for a strategy of selling its technology abroad, using it as a low-cost wedge to penetrate new markets by creating customer loyalty and building up its brand name (Proposition 7.b)). By making available its amortized technology to downstream customers, A would create a bias in favour of the firm's technical specifications and products without threatening its proprietary position in the new technologies it was currently developing (Proposition 7.a)) - most of

A's products are based on its own research. The firm's licensing department is responsible for getting and selling under-utilised technologies developed by the firm, but its overall policy is shaped by the moves of its competitors - much new technlogy was transferred by the firm to Japan because the reticence it felt at doing so was not being matched by its foreign competitors. To make its technological strategy effective, A has recently set up a worldwide network of sales offices and technical service centres which make the firm's research capabilities available to its customers.

The licensing agreement studied covers an aluminium colouring process which A has already sold in ten countries and which is technically ahead of what is currently used in Europe. It is the third step out of a twenty step process, but sufficiently self-contained, technically speaking, to be sub-contracted out by 50% of aluminium producers in Asia (Corollary 2.1.c)). The agreement was confined to this step alone as B felt itself competent enough to carry out the remaining steps on its own. The operation fitted in well with A's technological strategy; the firm was a late entrant into the Asian market and was looking for a low cost point of entry. An executive explained: "The idea was to sell the firm's technology to an independent, build him up, and then make him dependent. It required no capital, and since the firm already had a representative office in the country, it seemed to be the best place to start penetrating the market." The host government had tried to get A to invest in the operation, making it into a joint venture, but the latter was reluctant to do so as it would have put its brand name in the hands of the customer. As it was, both A and B spared no pains in trying to keep the government out of their negotiations (Corollary 2.1.d)).

Several firms had been considered by B as potential technology suppliers, but although the parties were unknown to each other before the deal, A's terms and its sales presentation had made it the most attractive choice (Corollary 2.1.e)). Under the agreement, B received a complete set of plans, specifications, and layout drawings, a set of quality standards, equipment, training and technical assistance, know-how, and a six week visit by a plant engineer. In return, it was to enter into long term purchasing agreements for aluminium at a price 2% above the best available market offer, as a way of getting round the royalty restrictions imposed by the host government (Corollary 2.1.a)).

Today, B purchases 60% of its aluminium supplies from A and the balance on the spot market. The operation is currently running smoothly and only requires the occasional trouble-shooting intervention by A. Initially, however, it was beset by co-ordination and language problems as well as problems of 'wavelength' between the parties. An executive from B was clear that if such a transfer was to be repeated, his firm would insist on an exchange of technical teams between the licensor and the licensee before the operation got underway (weak support for Corollary 2.1.b)).

Discussion

Each party to this agreement was large and strong in its market, one at the national, the other at the world level (Corollary 2.1.d)). B saw its relative strength in the accumulated experience that its top executive team posessed of the local aluminium market - a strength in UI and UM - where A was attempting to use its amortized technology - a strength in CF and CI - to enter new markets at a low cost by transferring technology to customers. This supports proposition 6.b, 7.b, and 8). The case further provides support for propositions 5.a) and 5.b), but fails to do so for Proposition 4. Finally, B's attempts to strengthen its downstream position in M while seeking links in F offer a good illustration of proposition 6.a).

CASE 19

Company B is a local, publicly quoted trading company, 60% owned and closely held by local investors, and 40% owned by a number of geographically dispersed U.S. investors; 80% of the company's $23 million sales are in pharmaceuticals, and of these, 20% are produced by the firm itself which imports the necessary active ingredients and carries out the downstream mixing, filling and packing operations locally. B employs 2,800 people, 1,000 of them in its plantation operations and another 800 in its pharmaceutical division. The company trades only in branded goods, since these require only a modest marketing effort, and is run like a holding company on account of the diversified nature of its activities - mining equipment, plantations, pharmaceuticals, etc. It sees its main strength as being in domestic distribution, and this, largely because the operational difficulties of effectively covering the country's 7,080 islands constitute a major barrier to market entry for potential foreign competitors.

The technology used by B is unsophisticated; the company feels that there are too many low cost suppliers of more sophisticated upstream products in the market to justify its investing in upstream processes such as might involve chemical reactions. Whatever degree of backward integration into production is currently envisaged is done purely with a view to stabilising its source of supplies. B's technological strategy is to seek out small foreign firms with neitner the inclination nor the capacity to enter the local market, who are prepared to license the manufacture and sale of their proprietary products. By applying this strategy to a broad enough product range and to a large number of firms, B remains independent of any one licensor and maintains its bargaining strength (Corollaries 2.1.c) and 2.1.d)).

Company A is a small European pharmaceutical firm employing 750 people and specialising in the manufacture of active ingredients for brain metabolic and inflammatory disorders. It was recently acquired by a larger group in the same industry and has consequently been pushed into adopting more of a marketing role than hitherto. The firm's technological strategy distinguishes between LDC and developed markets: with the latter it adopts a collaborative approach involving technological exchanges; with the former it limits its

operations to the export of active ingredients and to the possible licensing of the last manufacturing steps required by established products. It will thus hold on to the manufacture of the active ingredients themselves, a technologically more sophisticated operation (Proposition 7.a)). A is currently flooded with demands for licensing arrangements from Asia. The initial contact is made by mail (Corollary 2.1.e)) and when an operation has been set up and gets under way, its routine supervision is also carried out by mail (Corollary 2.1.b)). The firm has at present about 40 to 50 licensing agreements in force all concerning established products. It has, however, no joint venture operations.

The licensing operations between A and B that was the focus of investigation had been initiated and transacted through a broker. B relied on the broker's recommendations in assessing A's reputation (Corollary 2.1.e)) and little contact took place between the two principals: "A just handed over the manual and that was that" (Corollary 2.1.a)). B was free to market the product at a price and in any way that suited him and depended on A only for the supply of active ingredients and the initial provision of technical information (Corollary 2.1.c)). Thus, after a short start up phase the only dependency link between the parties was through the product's raw materials reaquirements.

Right from the start, however, the transaction was beset by problems. Firstly, A initially sent the necessary registration documents in its own language (not English) thereby creating delays in the market launch of the product. Secondly, the product had not been adapted to the specific requirements of the local market and serious dosage problems soon emerged. it was understood that A would deal with such problems, but it was unable to do so since it had not been informed by the broker of the situation until the product had already been withdrawn from the local market.

Discussion

Nothing is known of A's research and development activities save that the firm has an R and D division. Nevertheless, the fact that it licenses established proprietary products argues for assigning these transactions in CF. Also, the number of licensing agreements it holds, given its size and the absence of joint venture operations supports proposition 4 while the low technological profile and market orientation of the licensee in this case is consistent with Proposition 5.a). The comparative technological strengths of the parties and their choice of transaction mode are in accordance with Propositions 5.b), 6.a) and b), and 8. Proposition 7.b) receives some support from the fact that B passes on to doctors technical product data provided by A and sponsors monthly science meetings for them as well as having a number of them sent abroad for further training.

CASE 20

Company B is a firm of 200 people run along functional lines, with sales of $6 million; it manufactures paints, resins, and inks. Although operating a downstream technology it still carries out a certain number of research and development activities itself. The main distinguishing advantages claimed by the firm in maintaining its competitiveness, are its technical know-how in resins, and the fact that its sales force offers a 'personalised' service run along western lines. This must be contrasted with the 'cut-throat' practices used by its competitors in what B describes as an overcrowded industry with few entry barriers.

Company A is a small U.K. firm based in the Midlands. The bulk of its $31 million sales are currently in fatty acids, a product that is manufactured to the specification of customers who are large and sophisticated by comparison with the firm itself and the technology it operates. The firm employs 200 people and considers itself one of the 'backroom boys' of its industry. Spending 2% of its sales on research and development, A has been put on the defensive by its customers which are integrating backwards into its own increasingly obsolete and accessible technical fields. A's response has been to increase its R and D budget to 3% and to 'trade up' technologically into the specialty and fine chemicals business for which the firm set up new production facilities in 1978 together with a new technical centre. At the same time, A, in spite of a lack of any international experience, has found it advantageous to commercialize its current technology in LDC markets while it moves up the technological ladder.

A's licensing arrangement with B was a defensive response to the host government's protectionist policies which were pushing foreign firms into setting up local production facilities. B, which up until then had been a distributor of A's products in the country, approached the latter with a request to license. A U.S. firm had also been approached by B, but A appeared to offer the better deal (Corollary 2.1.d)). For its part, A, which preferred a licensing to a joint venture agreement - partly because of a shortage of investment funds (Corollary 2.1.b)), partly because of the shareholding restrictions imposed on foreign investors by the government - agreed to license B after the chairman of the U.K. firm had visited B's installations. The chairman's view had been that it was better to deal 'with the devil you know.'

The technology involved was neither basic nor sophisticated and could have been developed by B itself albeit over a longer time and at a higher cost. Some divergency of views exists between A and B over the complexity of the technology licensed. A takes the view that most of what was transferred consisted of firm-specific know-how which considerably cut down B's learning time. B, on the other hand, claims to have purchased a well defined product, less complex than that claimed by A, using non-proprietary formulations, and requiring little technical back-up. Before the government would allow the licensing agreement to go through, however, it had to be satisfied that the technology was not already available locally. The transfer agreement intially called for the sending of one of B's product technicians to the U.K. for training at A's plant for two weeks. The technical operations have now been mastered and at present, require no more than one man-day a year of A's time (Corollary 2.1.b)). Despite this, A does not consider the experience to be a happy one, claiming that relations with B have given rise to payment and personality problems, and a gradual encroachment by B on A's other export markets in the region.

Discussion

The case supports the contentions of Corollaries 2.1.a), b), c), and d) concerning licensing agreements. However, A's concern to deal with 'the devil it knows' does not support Corollary 2.1.e). The firm's cautious attitude may be partly explained by its comparative lack of international experience and partly by the relative importance of a licensing operation to a small firm. A's technology is patented, although it is well established and getting obsolete, yet the firm hesitated for four years before embarking on this licensing agreement, a response consistent with the technological reticence suggested by Proposition 7.a). Propositions 4 and 5.a) find support in this case, although the first more by default. Proposition 5.b), however, does not. The rejection of 5.b) must be qualified by the fact that the firm is at least attempting to 'trade up' towards UF, and at the same time aiming to license its current technology in foreign markets. Proposition 8 is confirmed.

CHAPTER 6

AN ANALYSIS OF THE CASE STUDY MATERIAL

INTRODUCTION

In the preceding chapter, where it proved possible, the propositions and corollaries derived from the C-D framework were identified in the text at points where they were thought to be applicable. If they depended on the text as a whole for their meaning they were placed at the end of the case. This chapter draws upon this enumeration of positive and negative instances of the propositions to analyse them each one by one. In what follows propositions and corollaries will be presented in the form and sequence they were put in at the beginning of Chapter 5. As with the case studies themselves the approach rests on the exercise of personal judgement. An assessment of the results of this analysis is given in the conclusion to the chapter.

ANALYSIS

Proposition 1 - Joint ventures create a relationship characteristic of federations.

Corollary 1.1.a): Transactions between contracting parties will be complex or vague.

The meaning of the term 'complex or vague' is perhaps best understood in contrast with a licensing agreement in which the terms and conditons of the transaction can be clearly set out in writing. In this case the transaction is well codified; in that of a joint venture arrangement it is not. The implementation of the former, can quickly be reduced to a matter of routine, that of the latter remains uncertain, negotiable, and often ill-understood.

Complexity and vagueness will appear as characteristics of the inputs that each transacting party contributes to the joint venture either as directly recorded in an agreement or as perceived by his partner. Each can be considered in turn.

What did European firms seek from their local joint venture partners? In only eight out of twenty joint ventures described in the relevant fourteen cases would a partner have been taken on by a European firm independently of government expectations. The remaining twelve saw joint ventures arising out of a bargaining process with host country governments whether explicitly or implicitly conducted. Yet this did not necessarily change the nature of the contribution sought from local partners. Only in case 9 was it explicitly stated that nothing was sought from the local partner himself. The European firm had bought a minority position in his company and was using it as a shell to develop its operations. Nevertheless, bargaining with host governments over the terms of a joint venture does suggest that where the government was involved the contribution was to be made not so much by the local partner as by the state and that it would take the form of providing access to the domestic market on terms profitable to the investor. Where this was most apparent (cases, 4, 6, 7, 8, 10, 17) the local partner was still expected to play a role. In one of the joint ventures in case 4, and that of case 6, the local partner, a bank, acted as a provider of funds, and in cases 10 and 11 he acted as distributor to the joint venture. But in addition to such well-defined assignments, in virtually all cases involving a local partner (as well as in Case 12 where the "local" partner was European), he was expected to make available to the venture a sound knowledge of the local environment, an ability to deal with the local bureaucracy, and political connections that could be consulted on specific issues. No specific level of performance was expected of him apart from showing general goodwill towards the venture.

What was the contribution of European firms to their respective joint ventures? This varied from the most extensive transfers of managerial and technical know-how (Cases 4 and 5) to the more remote forms of financial management typical of holding companies (Case 11). One measure of the complexity of transactions between European firms and local joint ventures is given by the structure of reporting relationships. Cases 4, 5, 8, 9, 12 and 15 show the local operation reporting to two or more centres within the parent's organization. In Cases, 4, 5, and 8 had the management of the joint venture reporting on a line basis, an area basis, and a functional basis to various departments at company headquarters. The senior management of the joint venture then became the locus of a complex coordinating activity in which

diverse, and sometimes divergent, performance objectives had to be reconciled. Parent-subsidiary relationships were a 'negotiated order', often more dependent on the exercise of political skills than managerial authority.

The 'internal' complexity of the parent-subsidiary links complements the 'external' complexity of the subsidiary-local partner link. The latter addresses the joint ventures' external environment, the former its internal environment. The need to manage the complex and often political relationships between a European parent and its local operation helps to explain the importance that many of these international firms attach to having an expatriate chief executive in charge, someone 'on the same wavelength' as home country managers (Cases 4, 5, 6, 17). It is precisely because transactions are complex and vague that these firms wish to have someone on the spot who shares their value systems and who can be relied upon to approach problems, as yet undefinable, in the way that they would have been back at headquarters in the absence of an established decision rule.

Only Case 14 does not show evidence of complexity and vagueness in the transaction. The technology used by the joint venture could well have been transferred by way of a licensing agreement. Indeed, this was the transactional mode initially chosen by company B. It was company A's bargaining strength as well as B's relative lack of committment to any single transactional strategy that led to a joint venture arrangement. The operation was not in B's main line of business and since it was only entering into it in order to redress a trade balance, it was not unduly concerned by what form it might take.

A word on Case 15 is also in order. Although in one of the joint ventures between A_1 and A_2 a passive local partner was also involved, the joint venture was essentially between two European rivals. The motives were defensive and while the firms initially tried to keep their relationship at arm's length by pooling production facilities and marketing their output separately, this proved impossible given the complex and integrated nature of the operations. A full-blooded joint venture was the only viable solution.

In sum, the corollary appears well supported by the case material. If the local joint ventures, once set up, could be run in a routinized manner, both the technical and managerial inputs of European firms on the one hand - as evidenced by the diversity of organizational channels through which they flowed - and the political and environmental inputs of local partners on the other, were characterized by a complexity and vagueness that could not be adequately and fairly remunerated within the framework of a market transaction. Only a federated transactional mode could compensate the parties for their intangible contribution.

Corollary 1.1.b): Information will not be solely impacted in one party.

Information impactedness "exists in circumstances in which one of the parties to an exchange is much better informed than is the other regarding underlying conditions germane to the trade, and the second party cannot achieve information parity except at great cost because he cannot rely on the first party to disclose the information in a fully candid manner" (Williamson, 1975:14).

Information impactedness becomes problematic when it is used to increase the dependency of one contracting party upon the other to the point that a marked assymmetry in bargaining strength ensues. How far the concept can be applied to joint ventures, where the local partner is passive and considered to be no more than a shareholder, is not clear. Nevertheless, the frequent and extensive dependency of the joint ventures as a whole on the European partners involved as a source of new, proprietary, technical data concerning processes, products, performance standards, and so on, must be considered presumptive evidence for the existence of information impactedness in these cases where the local partner is passive in the operation. Whether this leads to a feeling of dependency is hard to say, particularly where he himself considers his role as that of a shareholder.

Tangible evidence that might help to support or refute this corollary was hard to come by. A_1 in Case 9 favours the joint venture formula as a device for rapidly penetrating foreign markets precisely because it allows the firm

to draw on the expertise of local partners and to accelerate the learning process required for effective foreign operations. Likewise, A_2 in Case 12 chose A_1 as a local partner because of its extensive and intimate knowledge of the local market. In both these cases, one party possessed technical knowledge, the other market knowledge. Where a local partner was sought for his political and bureaucratic connections (i.e., Cases 4, 5, 6) he was not without recourse when confronted with the technological superiority of his European partner. Yet, how valuable his experience and connections might prove to be was by no means obvious. His knowledge assets aree rapidly amortized after the production permits have been granted and the first contacts with the bureaucracy have been made. After a while many foreign investors feel quite capable of handling bureaucrats and politicans themselves. Unambiguous support for the corollary is offered in Case 15 where the two European partners are evenly matched, technologically speaking, and have been led to set up an elaborate set of technical filters and to allocate the managing director's post on a rotational basis in order to prevent one of the parties from securing an undue informational advantage that could be applied in third markets where the partners remain rivals.

Case 16, at first sight, contradicts the corollary. B is accusing its joint venture partner of withholding curcial information in order to maintain its position in the joint venture, a clear case of information impactedness. Yet, if A is guilty of this (and no judgment is offered here) the accusation comes long after the relationship between the transacting parties went sour so that the climate of trust and openess required by federated transactions was no longer present - in fact the parties were moving towards litigation at the time of the interview.

On balance, the slender evidence available tilts in favour of the corollary. Those joint ventures in which information impactedness is most apparent are the ones in which local partners are passive. Yet, even here, the information available to them will generally go beyond what is made available to an ordinary shareholder. They will have a seat on the board of the joint venture and will be actively involved in deliberations concerning the future development of the subsidiary. In Case 5, no budget proposals are submitted by the subsidiary to the European parent which have not had the approval of the

local partners. In one of the joint ventures of Case 4 and in Case 6, the local partner is a bank which enjoys full access to detailed financial information concerning the subsidiary's activities. That said, in weighing up the knowledge possessed by local partners against that possessed by European firms nothing conclusive can be claimed, concerning its impact on the transactions between them.

Corollary 1.1.c): Atmosphere will be important to the transaction and hence to the quality of the personal contact.

Where an exchange is not viewed by the parties in a purely neutral and instrumental manner, where 'supplying a satisfying exchange relation[1] is made part of the economic problem, broadly construed' (Williamson, 1975:38) then considerations of atmosphere and personal identity become important. The corollary takes atmosphere and identity as important attributes of joint venture arrangements insofar as the vagueness and complexity of the transactions inhibit a purely instrumental approach. The attitude and goodwill of the contracting parties become important determinants of their willingness to transact.

All cases involving joint ventures except three (Cases 6, 9, 16) confirm the importance of atmosphere and identity. In all joint ventures save four, the parties had known each other for some time prior to the setting up of the operation. In Cases 4, 5, 6, 10, 12, 13, 17 a European firm tied up with its local distributor; in Case 8 the firm brought in an ex-employee as a local partner. The fact that the parties were well known to each other at the time of the joint venture transaction, should not be taken to mean that they were necessarily happy with their choice of local partner. Here, dissatisfaction is as much evidence for the importance of atmosphere as satisfaction might be. In Case 6, for example, the local partner, a distributor, was bought out one year after the joint venture was set up because the firm wanted to set up and control more directly its own distribution operation. A second local partner was brought in which the firm had not known beforehand, but given a passive role in the venture. In Case 10, the local partner found the distribution being taken out of his hands when the European firm concluded that it could

achieve a larger volume of sales with its own network. In Case 14, the importance of atmosphere and identity was discovered too late by the European firm which concluded that it had not devoted enough care and effort to the selection of its local partner.

Of the other two cases which challenge the corollary (Cases 9 and 16) the first was not seen by either party as an operational joint venture. Company A bought into company B and took over the management. The local partner was part of the acquisition package, but was not expected to be involved other than as a shareholder. The second case does not show that atmosphere and identity are not important, but merely that they had not been considered as such at the time by the contracting parties. These were brought together by the trade commissioner of A's home country who can properly be described as the architect of the deal. However, the soured relationship between the joint venture partners has been a significant factor in the operation's poor performance and the impending litigation between them hardly suggests that the provisions of the corollary are trivial.

A number of firms had made prior knowledge of their prospective joint venture partners an explicit policy requirement (i.e., Cases 5, 7, 12). Others, implicitly sought local partners who were known entities. Nevertheless, the dearth of suitably qualified local partners was a problem that was widely recognized by European firms and the problems encountered by a number of them were put down to this.

Corollary 1.1.d): A small numbers bargaining situation is implied.

A small numbers situation obtains when the substitution of one input for another, or here, of one partner for another become problematic - i.e., sufficiently difficult as to materially effect the terms of a transaction. In economics, this is usually referred to as the monopolistic or oligopolistic condition. In the first, not substitution is possible, in the second, only a very limited amount.

The cases present three types of evidence for small numbers bargaining. The first, is the size of joint venture partners in their respective markets. This measures the market power - however acquired and however applied - of a firm as a prospective partner. All European joint venture partners showed evidence of such market power, as did the local partners in Cases 11, 13, 14 and 16. The second is the technological strength of a firm as expressed throught its trademark and patent position. Here, although the evidence cannot be quantified, the European firms in Cases 4, 5, 9, 13, 14, 15 and 16 appear to be technologically dominant, and hence present few possibilities of substitution to prospective local partners. None of the local firms interviewed presented comparable technological profile. The third, is the actual scarcity of suitably qualified prospective local partners in the face of a rising demand for their participation. Government requirements for a measure of local participation in local investments is partly responsible for this and doubly so where it is specified that local participation must give preference to a particular ethnic group, i.e., the Malay race. The scarcity of suitable local partners seems to have posed prolems for the European firms in Cases 4, 5, 7, 15 and 17. In Case 4, the absence of suitable local partners and the host government insistence on full local participation in any new investment has led company A to shelve its expansion plans for its pharmaceutical operation in ASEAN 2. Also, the difficulty experienced by the European firm in Case 7 in finding a suitable local partner, led to the taking on in that role of another "European" firm whose corporate shares were, in fact, mostly in the hands of local shareholders. Finally, the stipulation by the host government that all local distribution should be in indigenous hands put the local partner in the joint venture of Case 17 in an initially strong position. There were few, if any, alternative firms available to the European firm which was led to finance the local partner's share acquisition and which has yet to get itself reimbursed.

In a number of case, the small numbers condition emerged in the course of negotiations with the government itself rather than local partners. A discreet form of this was apparent in joint venture 2 of Case 5 where it transpired that the two local partners with whom company A was negotiating, were in fact being advised throughout by officials from the local investment board. Likewise, in Case 15, the host government, one of the joint venture's major customers, threatened to buy elsewhere unless to two firms A_1 and A_2 took in one or more local shareholders.

Some measure of the scarcity of suitable local partners can be gathered from the complaints heard in two European firms (i.e., in Cases 4 and 15) that where the local partner had to be Malay, a secondary market in local partner shares would fourish and that many Malays, having been offered shares in the firm's local operation, not infrequently at a price that was set by the host government well below asset value, promptly resold them at their full market value to local Chinese businessment for whom they would "front".

In no case is the corollary challenged and in many instances, the requirement by the European investor that a prospective local partner should be known to the firm (Corollary 1.1.c)) restricted its choice below what it might have been, thus ensuring that a small numbers condition would apply to both transacting parties.

Corollary 1.2: Towards the left of the C-D framework, joint ventures compete with hierarchical transaction modes.

This corollary can be interpreted as saying that the more industry - or firm-specific, the knowledge used by a joint venture the greater will be the tendency of the knowledge providing partner to control operations through hierarchy rather than negotations - i.e., to internalize transactions.

What illustrations of this move back towards hierarchy do the cases provide? Case 5 presents perhaps the most extreme example of a shift to hierarchy. In both the joint ventures described, the Euroepan firm coopted local partners and made them employees of the firm, in one case as president, in the other as financial vice-president. This is in spite of the fact that in any joint venture, the firm will insist on retaining full managerial control anyway. In Cases 4 (ASEAN 3) and 6, the European firm's joint venture partner had originally been its distributor. The complex nature of the product and services offered by these firms to their customers made this an unsatisfactory arrangement however, so that eventually the local partners were bought out and the firms then set up their own distribution network. In Case 10, the local partner stayed in the venture, but was replaced as a distributor and in Case 17 the only thing that prevents such a move is a government requirement that distribution be placed in indigenous hands. Cases 4, 5, 8, 9, 10, 11 and 15, each reveal a European investor seeking local partners who will not interfere in the management of the venture, in Case 10, the firms seek to control operations from a minority position.

Generally speaking, the presence of a passive local partner, points to the predominance of hierarchy in a joint venture. But, how does this relate to the type of knowledge used by a firm? This is hard to answer, but as a guide one may note that the average expenditure on R and D for firms with active local partners is 2.4% of sales whereas for those with passive local partners it is 3.4%. A non-parametric Mann-Whitney test shows this difference to be significant at the 5% level of confidence. Equally telling for the corollary is the fact that the average R and D expenditure for firms with wholly owned local subsidiaries is 6.5% of sales although the sample is too small to be statistically significant.

Proposition 2: Licensing agreements create a relationship characteristic of markets.

Corollary 2.1.a): Good transacted can be defined in writing.

Unlike the transactions explored under Corollary 1.1.a), these are well codified. A minimal expression of this is the fact that they can be set down on paper in their relevant particulars. The mutual obligations of the parties to each other can be made explicit and contract terms can express a comparatively high degree of certainty.

The licensing agreements in the sample generally support this corollary. There is also evidence that where some of the European firms involved in joint venture or wholly owned operations, get involved in licensing, they offer a well defined, highly standardized package (Cases 4, 5, 7, 15, 16). One of the joint ventures (Case 14) was using a technology which was sufficiently standardized to make licensing a viable alternative transaction mode. In Case 1, however, the relationship between A and B was problematic, being apparently conducted at arm's length as might be expected in a licensing agreement, but with B having a sufficient shareholding in A (i.e., 25%) to infuse the transactions with complexity and vagueness. A, for example, decides the corporate and product strategy of B's pharmaceutical subsidiaries since these are allowed to use A's name. Again, A sends people into B's subsidiaries to be trained in consumer marketing techniques. None of this, however, challenges the corollary as applied to licensing agreements as such.

All the straight licensing agreements were highly specific as to the products or processes being traded and as to the terms. And this, in spite of attempts on occasions to hide their provisions from government scrutiny. Case 18 describes a licensing agreement that took place in the face of highly aggressive government legislation on technology transactions. In order to circumvent the royalty restrictions that were sure to be imposed by the host government, the parties agreed to a payment formula in which B would buy a given percentage of its aluminium purchases from A at 2% above the prevailing spot market price. The other licensing operations were much more straightforward; in Case 19, for example, "A just handed over the manual and that was that."

Finally, it should be said that a number of joint ventures also had licensing agreements with their European parents. These, however, were short general documents, designed to safeguard the parent's position in any dealings with the host government and to provide an alternative channel for the repatriation of profits under restrictive conditions. Licensing agreements, in a joint venture context, neither described nor affected the transactional mode of the operation.

Corollary 2.1.b): The agreement can be implemented without rehaggling or costly monitoring.

If licensing operations are well codified (Corollary 2.1.a)), they must be lower in uncertainty than other transaction modes. Uncertainty here can take two forms: that which is intrinsic to the operation given its technical nature; and that which introduces unforeseen factors from outside. One is endogenous, the other exogenous. Uncertainty can affect the outcome of operations in ways that can violate transactional expectations and seriously undermine their contractual basis where transacting parties are led to assert their own interests at the expense of mutually agreed obligations. The corollary asserts that licensing agreements, being well codified transactions, should be freer of such problems than other transaction modes.

The licensing agreements studied show that for a number of European firms, they offered an inexpensive low-risk way of penetrating a foreign market. In Case 17, both A_2 and A_3 use licensing deliberately as a way of avoiding the costs of setting up local production. A_4, on the other hand, had a policy of producing abroad, but a shortage of funds pushed it towards joint ventures and licensing formula. The European firm in Case 20 was also too small to be able to afford foreign operations other than through licensing. In Case 18, licensing was an intermediary step by the European firm, forming part of a market development strategy which would ultimately lead to some form of direct investment.

That licensing agreements were also costless to monitor was apparent in all but one case. In Case 17, A_1 had relied on the provisions of the licensing agreement to get B to carry out the required quality control and promotional activities, but B had failed to deliver. A_3 in the same case, however, used to visit B regularly in the early stages of the agreement, but this has now become unnecessary and the operation for which A_3 is the licensor, is now run virtually independently of him. Company A, in Case 19, manages all its licensing agreements by mail, and the Europeam firm in Case 20 claims that B, having now mastered the relatively simple technology that was transferred, the licensing agreement between them now takes not more than one man-day a year of its time. The aluminium coloring process that was the subject of licensing agreement in Case 18 is currently running smoothly despite some early communications problems between A and B: so costless had A hoped to make the transaction that it forgot to have the technical documents it sent over translated into a language that B could understand. This case was the only one in which the licence covered a technical process rather than a product; the others concerned the licensing of individual branded products requiring little technical sophistication on the part of the licensee beyond a knowledge of the simple operations of mixing, filling and packing.

Generally then, the case material finds for the corollary. Even in the single disconfirming instance of Case 17, the transacting parties had <u>expected</u> a costless transaction and contracted accordingly; what happened subsequently may well have been the result of attempting to transact too much through this particular mode.

Corollary 2.1.c): Transactions are technologically separable.

At the extreme, the corollary would mean that transactions are technologically entirely self-contained. A more realistic interpretation would be that since licensing agreements stand here for market transactions, their object should be confinable as well as definable, that is, the technological linkages from an operation to activities and resources outside it should be sufficiently specifiable and controllable as not to compromise the arm's length nature of the transaction mode itself. This implies that such external linkages should not be too numerous, and should themselves be defined enough to constitute marketable entities in themselves, whether or not as part of a single licensing package.

The technological operations that formed the object of licensing agreements were all presented as pretty much self-contained. In Cases 17, 19, and 20, the operation consisted of mixing, packing and filling. After an initial learning process, the operations became a matter of routine and the only dependency that still tied licensor and licensee together was the supply of active ingredients by the licensor and the trouble-shooting service that the licensee could occasionally draw upon. In both Cases 17 and 19, it was this very independence from the licensor that had motivated the local firms to seek him out and to pursue a licensing strategy as a way of acquiring technology. After the initial supply of technical data, they only looked to the licensor for his proprietary raw materials.

Only in Case 18, was the technology licensed - an aluminium colouring process - inserted in an integrated set of operations. However, its separability was evidenced by the fact that in East and South East Asia, this process is subcontracted out by 50% of local aluminium producers.

In conclusion, it must be admitted that technological separability as such does not always distinguish between certain categories of joint venture and licensing agreements. What does set them apart from each other, though, are the intense managerial and organizational linkages that tie joint ventures to their European parent. A joint venture generally benefits from a flow of services accompanying any technology transferred that a licensee must largely

supply for himself. Conversely, as the case studies revealed, in no instance were the fortunes of a local licensee's business dependent on any one of his licensing operations. These were usually small in the context of his other activities.

Corollary 2.1.d): Small numbers bargaining is implied where the goods and services transacted are firm specific.

The small numbers condition specified here is the same as that which applied to Corollary 1.1.d) above, but it is only activated by the possession of proprietary knowledge by a licensor, whether this be embodied in goods or in services. Other sources of monopoly or oligopolistic power, at least on the supply side, will not have any bearing on the terms of a licensing transaction unless they are themselves generators of proprietary knowledge.

The plausibility of the corollary varies with the type of goods or services for which a licence is sought. For example, the aluminium coloring process of Case 18 had no ready competitive substitutes. At most, one other process might be technically within the licensee's reach, but may not be economically viable. On the other hand, the licensee in Case 17, had considerably more choice and hence more room for manoeuvre. To be sure, no ready substitute may exist for a given proprietary product and a drug may completely dominate its therapeutic submarket. Yet, a licensee's product range is not immutable and can adapt itself to supply constraints in a way not open to those seeking process licenses in technically advanced fields.

There was no evidence to support or refute the corollary in the two cases dealing with pharmaceutical products (Cases 17 and 19). None of the licensors were particularly large in their markets, but all had an established position with a given product range. The licensees, on the other hand, made it their business to actively seek out small European producers with a modest foreign involvement in order to mitigate the effects of a small numbers condition. The two cases dealing with intermediary products revealed the small number effect more clearly. In Case 18, as has just been said, the licensor had a virtual monopoly on the coloring process to be licensed, and the need to come to terms

with him had led the licensee to accept a covert form of payment of an amount that would have been rejected out of hand by the host government had it been more visible. In Case 20, only one other technology supplier approached by B was competitive with A, but the latter was able to offer the better deal.

If the corollary fares only modestly among technology suppliers, among technology recipients the small numbers condition obtains. All, without exception, were of a significant size in their markets, and thus all, would have been legitimate targets for a licensors marketing efforts. A_3 in Case 17, to cite one example, had been particularly anxious to sign up with B since viable licensees were particularly hard to find in this country. Or again, company B in Case 18, was the only one in the local aluminium industry of a profile that would allow A to implement its market penetration strategy.

In sum, slim though the evidence may be, where avialable, it tends to work in favour of the corollary rather than against it.

Corollary 2.1.e): Atmosphere is not important and the parties can be indifferent to each other's identity where a valuable on-going relationship is not implied.

In contrast to Corollary 1.1.c), a satisfying exchange relationship is not an issue in the context of a licensing agreement. The fact that transactions will be well defined rather than complex and vague makes the goodwill of the parties a less critical resource than in the case of a joint venture.

The corollary is supported by four of the six licensing agreements examined and challenged in another two. In Case 17, neither company A_1 nor B knew of each other beforehand, and before the deal, A_1 confined its investigation of B to a checking of references and a visit of its production installations. Again A_3 and B in the same case were unknown to each other. The former got in touch with the latter after hearing "on the grapevine" that it had adequate distribution and production facilities to act as a potential licensee, which is all that A_3 required to start negotiations. In Case 18 the

parties had never met prior to the transaction and the deal went through on the strength of A's sales presentation and the terms it was offering. The best illustration of the corollary, however, is provided by Case 19 in which contact between A and B was made through a licensing broker and the whole transaction was conducted and implemented by mail - as are A's other licensing agreements. To this day A and B have not met.

In both the cases that challenge the corollary, prior personal acquaintance with the licensee had been, for the licensor, an important consideration in deciding to license. Company A_2 in Case 17 had been operating in the country a number of years previously, but had pulled out when faced with a deteriorating political climate. It was looking for an inexpensive route back into the local market and therefore set great store on a choice of licensee that would help it to implement its long term strategy. It chose one that it had known in earlier times - its ex-distributor. Company A in Case 20 also chose to license its local distributor. The firm was small, and only had one or two licensees in Europe. It hesitated for four years before agreeing to this license and having eventually decided that licensing would form a part of the firm's strategy it chose to deal with B on the grounds that it was better, in the words of its chairman, to treat 'with the devil you know'. The firm was not technically very strong and felt unsure about its ability to control the transaction. As it turned out, it has had payment and market encroachement problems with its licensee every since the deal was signed.

It would seem that while atmosphere and identity are not indispensable features of licensing per se, there are circumstances in which they will matter to a licensor. Sometimes strategic considerations will make atmosphere and identity important, sometimes the licensor's sheer lack of foreign experience will do so. However, this is just to say that situations exists in which a valuable on-going relationship is implied as provided for in the corollary.

Corollary 2.2.: Towards the left of the C-D framework licensing agreements compete with hierarchical transaction modes.

The move towards hierarchy specified here follows the same dynamic as that of Corollary 1.2. The stronger the firm's proprietary position, the more it will attempt to control the terms and outcomes of the transaction and hence the further it will move away from market processes.

One instance of a reversion to hierarchy is provided by Case 1 which although not a licensing agreement describes an arm's length relationship between firms A and B (the parent of the latter, it will be remembered, owns 25% of the former) and to that extent is assimilable to a licensing arrangement. However, A aims to control B's corporate and promotional strategy. B's parent has a number of pharmaceutical subsidiaries all using A's name, a situation which has led A to protect its proprietary interests through a number of hierarchical controls. This case does not describe an actual licensing agreement and remains for that reason somewhat anomalous. It is cited here to illustrate what the corollary is intended to cover.

Unfortunately, with only six licensing agreements to draw from, and none, except Case 18, using an advanced technology, evidence to explore this corollary is wanting. The only evidence that can be cited in its support is provided once more from one of the licensing agreements of Case 17. A_1 had expected a better overall performance from B, and, specifically, one more in line with its product and promotional strategy. A_1 was now looking for ways of cancelling its contract and setting up with a new licensee, while at the same time, creating a local sales office to supervise its operations more closely (direct distribution by foreign firms in the domestic market was not allowed). Profitability for A_1 was achieved by successfully selling its active ingredients in which its technical strengths and market advantages both resided. Royalty payments, though useful, were secondary. For this reason, product and promotional strategy, were all important to the firm and needed to be implemented and controlled by hierarchical means.

The remaining licensing agreement showed no hierarchical tendencies suggesting that some possibilities for technical and product substitution existed. Only one case, 18, used a technology which was clearly not only firm-specific in itself, but for which no immediate possibility of substitution existed since the aluminium coloring process developed by A so clearly dominated its rivals by its cost-performance characteristics. This case challenges the corollary as it stands and can probably be accounted for by the fact that the coloring process transferred by A, while a sophisticated technology, still did not form part of the firm's technological 'core'. A had an established policy of transferring abroad only its amortized technology.

Proposition 3: Wholly owned operations create a relationship characteristic of hierarchies.

Corollary 3.1.a): Transactions will be complex and vague.

The complexity and vagueness are those of Corollary 1.1.a). As with federations, these attributes pull transactions away from the market. The uncertainty, or lack of codification, that attends them make an arm's length approach too risky. The remaining options are transactions based on trust, i.e., federations, or those based on fiat, i.e., hierarchies. In the latter case one would expect complexity and vagueness to characterize the relationship between parent and subsidiary rather than that between the subsidiary and a local economic agent, as for example, in the case of joint ventures. As Corollary 1.1.a) indicated, the first forms part of a firm's internal environment, the second, of its external one.

The four wholly owned operations studied in the sample (in Cases 1, 2, 3, 4) showed the same degree of internal complexity and vagueness as did joint ventures managed by the larger European firms. Transactions between parent and subsidiary took place through multiple communication channels with local executives being resonsible to a number of different departments back at the firm's headquarters (particularly evident in Cases 3 and 4). The fact that market, line, and functional objectives were not always reconciliable made the parent-subsidiary relationship a negotiated one and placed a considerable

amount of power in the hands of the subsidiary's chief executive. In fact, a number of local executives said that they regarded the various home-country departments as providers of consultancy services to the subsidiary which they were free to draw upon and combine as they saw fit.

If the structure of the links with the parent was complex and vague, the use that was made of them was no less so. As with the larger joint ventures (such as those in Cases 4 and 5) the flow of information, goods, and services, from the parent to the subsidiaries was unstinting, informal, and ultimately unquantifiable in its effect. Taking Case 3 as an example, the knowledge that if a piece of equipment was creating problems and broke down, a qualified engineer could be despatched at very short notice from the parent, or indeed, from another subsidiary, to investigate, allowed the local subsidiary to select from a more sophisticated range of technical options, and, hence to aim for higher standards of performance than would be available to an indigenous firm. Or again, the continuous stream of new products that the parent company in Case 4 could make available to its subsidiaries, coupled with extensive and sophisticated technical and sales services, gave an exceptional range and flexibility to their local marketing strategies.

There was some evidence, among wholly owned subsidiaries, that profit objectives were more ambiguous than in joint ventures. In Case 3, for instance, it was claimed that the technology used locally was less innovative than it might have been since the firm, for political reasons, was unwilling to use transfer pricing as an investment recovery device, and the royalty payments allowed by the host government for this purpose were quite inadequate. In Case 4, while the wholly owned subsidiary in ASEAN 1 was evaluated as an independent profit centre, it was nevertheless expected to promote parent company products in the local market even if these were not profitable. The need to invest in long term market development, gave this subsidiary's profit objectives a different time horizon to those of a joint venture.

To conclude, the evidence from four cases is not extensive, but what is available tends to support the corollary.

Corollary 3.1.b): The technologies used will be non-separable.

In contrast to the market based transactions of Corollary 2.1.c), the technologies used by wholly owned subsidiaries will not be self-contained. Strong technological interdependencies between parent and subsidiary can be expected to tie the latter to the former and to create both the necessity and the justification for hierarchical modes of control.

Yet, if a distinction can be made between the degree of technological separability of licensing operations and wholly owned ones, virtually none can be made between the latter and joint ventures. 'Internal' vagueness and complexities (Corollary 1.1.a)) create technological interdependencies between parent and subsidiary in both cases. The move back towards hierarchy in a number of joint ventures, particularly in Cases 4, 6 and 10, can partly be explained by the presence by such dependencies. In the three cases mentioned, the presence of an outside distributor, the local partner to the joint venture, could inhibit the free flow towards customers of technical and sales services that originate with the parent. Problems of coordination, confidentiality, and sheer efficiency would become acute.

Only in Case 3 was there any suggestion of a greater degree of technical integration between parent and subsidiary than was the case for joint ventures. Here, the subsidiary's technology was both batch and semi-continuous, and since the parent's technological strategy placed the emphasis on process rather than product development, the continuous upgrading of the local subsidiary's technical base seemed to require a greater degree of coordination with the parent's engineering services than would apply for the introduction of a new product on the market. In Case 2, on the other hand, manufacturing operations were sufficiently self-contained to be subcontracted out to a third party.

Technological separability was more applicable to the hardware used by a subsidiary than to its software. Where the production technology was a standard one, equipment was purchased on the world market, often independently of the parent or by using the latter as a purchasing agent in order to get

better terms. The operation of such equipment was a matter of routine for the subsidiary given the simplicity of the technology used locally. The parent's unique contribution took the form of back-up services: quality control, non-routine maintenance, new product and process data, technical training, and so on. many local executives were clear that in the absence of such parent company support, the firm's local operation would not be viable and could not survive for long in its present form.

Thus, if technology is taken in its narrow sense to refer solely to a local subsidiary's manufacturing installations, the corollary stands refuted since separability was manifest in Case 1, 2, 4, to some extent in Case 3, and in all those joint ventures which were managed as hierarchies - i.e., those with passive local partners. If, on the other hand, technology is broadly defined to cover all the social and technical means available to a subsidiary to achieve its objectives then the non-separability of the parent's and the subsidiary's technology stands. It does so, however, for joint venture and wholly owned subsidiary alike, so that the corollary sets them apart from market-based transactions such as licensing agreements, but not from each other. The complexity and vagueness of transactions between parent and subsidiary turns out to be the cement that binds together their technology, and, to some extent, determines its selection.

Corollary 3.1.c): Bounded rationality will be tackled through routinization as will small numbers opportunism.

Bounded rationality, it will be recalled, describes a limit on the cognitive means available for addressing complex problems. Small numbers opportunism on the other hand describes the scope offered to signficant organizational actors to pursue divergent objectives under conditions of uncertainty. Routinization involves a codification of an organization's response to these two conditions, making its overall behaviour more predictable and stable when confronted with a given class of events. How appropriate that response will be turns on how well the classification system captures the relevant features of the events it covers and on an effective assignment of the latter to different classes. Almost by definition every

organization routinizes; every attempt to stabilize behaviour into a structured set of roles being an instance of it. For this reason merely to look at the internal operations of a local subsidiary or its European or local parent will contribute little to the analysis. What must be sought is evidence of routinization as a response to problems of bounded rationality or small numbers opportunism at the organizational boundary, in parent-subsidiary relations.

Here, as with the preceding two corollaries, the evidence does little to distinguish routinization in the context of wholly owned operations from that in joint ventures. Routinization everywhere abounds, but is almost impossible to link to specific instances of bounded rationality or small numbers opportunism. These did not generally emerge from interviews. Only one came to light in Case 3. The parent's policy of transferring its expertise to subsidiaries at its marginal cost, allowed it to routinize a decision which would normally be the subject of much haggling and uncertainty. It thereby stabilized an area of contention in parent-subsidiary relations and reduced the scope for opportunistic representations by both parties.

With the very minor exception of the above example, the available evidence, if anything, went the other way.

In Case 2, the local subsidiary of company A had gone through two European chief executives in the space of two years before taking on an indigenous manager. The difficulties faced by the European managers in running things in an alien cultural environment provide a clear example of bounded rationality under conditions of uncertainty. Yet the issue was not tackled by routinizing the problems they faced but by replacing them with an indigenous manager whose outlook, from the parent company point of view, could only increase the dangers of small numbers opportunism. Indeed, when, in the course of the interview, this manager was asked what his subsidiary's objectives were, he replied "to contribute to the development of my country."

In Cases 4, 5, and 6, conversely, great emphasis was placed, in the course of the interview, on the importance of having an expatriate manager in charge of the local operation; someone 'on the same wavelength' as the senior

management back home, who, in a crisis, could be expected to act as they would. Here, the objective was to reduce the scope for the occurence of small numbers opportunism. Once more the issue was not addressed through an effort at routinization, but by selecting managers who, by nationality and cultural background, could only face increased problems of bounded rationality.

In sum, in these cases, no attempt is made to reduce the uncertainty by a codification effort. Instead the uncertainty is absorbed by choosing local managers who can be trusted to establish a viable federated relationship between the parent company and its subsidiary in spite of the constraint imposed on transactions by bounded rationality and small numbers opportunism. The case study evidence does not support this corollary although it is only weakly refuted and only in one particular area.

Corollary 3.1.d): Conflicts can be resolved by fiat with reference to a clear set of objectives where attainment can be monitored by internal auditing.

Fiat is the ultimate instrument of hierarchical control and will therefore be present in any organization that is hierarchically organized. Whenever a manager has delegated parts of his resonsibility or two or more subordinates, he faces a problem of coordinating their respective activities. This he does through the obectives he sets them and through a more or less intense monitoring process. Should a conflict arise between subordinates because their activities clash or jointly fail to cover an important part of the original assignment, the hierarchical superior has the job of arbitrating in the dispute. he can do so either with reference to the responsibilities he has delegated, or, if this fails to resolve the matter, he can refer to the initial mission that was entrusted to him. In his role as arbitrator, the manager can also draw upon the past performance data of his subordinates to help him reach a decision, and he may try to get them to negotiate first in any conflict situation. However, the compromises that are the very stuff of a mediated solution often consume more organizational resources than arbitrated ones and in many conflict situations have but a limited efficiency in terms of the organization's objectives. A skillful handling of the arbitrating function therefore is a key to the effective use of managerial authority.

As with routinization, managerial fiat is a common attribute of any commercial organization and is deployed internally by every organization studied in the sample. To be sure, the larger organizations tended to have a more articulated set of objectives and more elaborate monitoring devices, and for that reason had successfully routinized activities which in a smaller firm might be conflict laden. But once more it is at the organizational boundary, in one firm's dealings with another, that variations in the use of fiat as a conflict resolution device by different transaction modes can be expected to appear.

What says the evidence? Firstly, as with the other corollaries of Proposition 3, the joint ventures and the wholly on wed operations studied, are virtually indistinguishable from each other with respect to the use made of managerial fiat at the organization's boundary. Managerial control is managerial control, and it will be used in the same way, and for the same purposes in both cases. Joint ventures and wholly owned subsidiaries alike had established regular planning and control systems which allowed parent companies in Europe to direct and monitor the activities of local subsidiaries at a general level. This was more developed in some cases than in others: thus the subsidiary in Case 3 had set up an elaborate cost accounting system to control manufacturing operations and report upon them where, for example, the European parent in Case 11, was content to receive the barest financial summary of activities in the field.

Secondly, no instances of conflict as such, between parent and subsidiary, emerged from the data. The closest the interview material gets to describing a conflict situation between parent and subsidiary is in Cases 5 and 8; both are joint ventures and both refer to a hypothetical issue. In the first the chief executive of the local subsidiary explained what he would do if he received an instruction from one of his hierarchical superiors in the parent organization, that he was unwilling to comply with. He would have to resort to playing politics, he explained, drawing on the credit that he had built up with other departments to which he reported, and in this way he would bring pressure to bear on the superior in question to modify or withdraw his instruction. Clearly, in this case, the chief executive's behaviour, by the challenging the managerial authority of his superior, is also challenging the

corollary. In the second, Case 8, the subsidiary is less free to develop its marketing strategy than its apparent autonomy might lead one to suppose. True, the parent acts as a consultant on a wide range of issues; true the subsidiary is free to draw on its technical services almost at will. But the local firm is expected to accept for local distribution those products that the parent presents it with. Any refusal to do so must be fully justified. Thus, what in some decentralized organizations would pass off as an arm's length transaction, is here imbued with authority relations, and to that extent it supports the corollary.

The corollary is supported trivially within the organizations studied. Looking at parent-subsidiary relations, however, it is only supported in a general way by the fact that joint ventures and wholly owned subsidiaries both have the planning and control systems that allow the excercise of managerial authority. Again, this sets both transaction modes apart from licencing agreements, but not from each other. There is some suggestion that it is the possession of equity control rather than the fact that an operation is wholly owned that establishes the scope for the excercies of managerial fiat. Minority European partners in the joint ventures, for example, had fewer administrative and managerial links with the local operations than majority ones. This applies to Cases 12 (Joint venture 1), 13 and 16. In the last mentioned case it was the very inability to exercise managerial authority, as well as the confusion of roles between the parties - joint managing directors had been appointed by the two main partners - that was causing so much friction and undermining the venture's ability to respond to changing market conditions.

One must conclude the discussion on this corollary with the observation that in wholly owned and majority owned joint ventures, the presence of objectives and internal auditing facilities were much in evidence, but that the manner in which these are pressed into the service of managerial authority in conflict situations between parent and subsidiary remains to be shown. Some of these conflicts, as in Case 15, appeared to be resolved by a process of negotiation; others, as in Case 8, by more directive methods. How far the negotiated solutions are themselves shaped by underlying authority relations and how far by other considerations is hard to say on the strength of the available data.

Corollary 3.2: Wholly owned operations are more likely to be placed on the left hand side of the C-D framework than on the right hand side.

This is a further development of Corollary 1.2. If, as suggested, a move towards the left of the C-D framework is accompanied by a reversion to hierarchy, then one can reasonably expect to find more wholly owned subsidiaries clustering in that part of the diagram. An assignment to the left of the framework is based on the possession of proprietary knowledge whether expressed directly through patents and trademarks, or indirectly through R and D expenditure figures and other such measures.

Firm-specific knowledge is threatened in two ways in the course of a firm's operations. The first is through information leakages: the execution of any complex technical activity inevitably mingles firm-specific, industry-specific, and market-specific knowledge. Unless a firm can carefully control its information boundaries, firm-specific knowledge can quite quickly find its way into outside hands. This is more of a problem with codified than uncodified knowledge since it can travel well through impersonal communications channels. The second way is through an inefficient use of firm-specific knowledge. Proprietary knowlege has a limited life; sooner or later it finds its way into the public domain. At the same time it is new and those who would use it must master its complexities. The resulting know-how, when acquired by a group, is a form of organizational learning which, for a period of time confers on the firm a specifiable market advantage. Some transactional modes allow a more efficient acquisition and application of know-how than others. Both licensing agreements and active joint ventures impose a time cost on the exploitation of know-how since knowledge must be transferred between organizations and allow for the learning process to run its course. Where speed and coordination are important to the exploitation of firm-specific knowledge, this time cost can become crippling and the would-be transferor may find it more advantageous to exploit his knowledge advantage in the context of a wholly owned operation where both speed and coordination can be achieved through hierarchical controls.

No adequate data on patents and trademarks were made available in interviews so that only R and D figures can be used to decide how far a firm can be asigned to the left hand side of the C-D framework. The R and D figures quoted in Corollary 2.1 clearly support this move, registering an average of 6.5% of sales for European firms with wholly owned operations as opposed to 3.4% of sales for firms in joint ventures with passive local partners, and 2.4% of sales for firms in joint ventures with active local partners. With only four wholly owned operations to draw on, not much statistical significance can be read into the first figure although a non-parametric Mann-Whitney test shows that the last two figures to be significant at the 5% level. Furthermore, no R and D figure has been set which could serve as the basis of any assignment within the diagram and although an ordinal approach can be justified on the grounds that one is dealing essentially with one industry, the decisions are made on purely relative grounds.

Equally relevant for the corollary is the fact that none of the four wholly owned operations can be assigned to the right-hand side of the framework. Even Case 1 finds company A - 25% owned by B - behaving in every way as B's research arm and using hierarchical controls to direct B's pharmaceutical operations in the field, an instance of matrix management across organizational boundaries.[2] Insofar, then, as one is prepared to disregard the small size of the sample, the corollary finds support in the cases studied.

Proposition 4: Large firms should show a bias towards the use of wholly owned subsidiaries compared with small ones.

The organizational capacities of the large firm and its administrative economies of scale should lower the marginal costs of further internalization of transactions up to the point where the constraints of bounded rationality and control-loss (Williamson, 1967) begin to push costs up once more. The existence of a profitable large firm allows one to proceed here on the assumption that the limits on its size, although possibly within sight, have not yet been reached, and that the lower cost associated with an internalized transaction will make it the preferred option among those available. Furthermore, the large firm enjoys more bargaining power to enforce its preferred

choice when alternative transaction modes - joint ventures, licensing agreements, etc. - are pressed upon it by host governments or other economic agents. The corollary suggests that the use of wholly owned subsidiaries expresses the large firm's preference for internalized transactions.

At first sight, the data does not appear to square with this view. Cases 4, 5, 8, 9, 12, 16 and 18 all involve large European firms, yet all describe joint ventures, or licensing operations. On the other hand, it is true that none of the smaller firms interviewed had set up wholly owned operations.

Using employment data from the sample, however, a different picture emerges. Since one firm could operate through different transaction modes within a single case - a joint venture with one, a licensing agreement with another - the analysis was carried out on the basis of the ownership characteristics of the European firms involved in each operation examined, where one case could cover one or more operations. This led to a certain amount of double counting for some firms which, if anything, tended to load the figures up against the proposition. The analysis conversely, treats the two joint ventures described in Case 15 as one: the same two European firms are involved in each of the ventures and they themselves considered it as essentially a single one until political and legislation changes in the host countries concerned forced them to give them separate administrative structures. Finally, one of the European firms had to be dropped from the sample for the purposes of this analysis as no employment figures had been made available.

Firm size was computed from the total number of people employed worldwide by the European firms in the sample. Manpower was preferred to sales as a measure of size since it was more likely to reflect the transaction costs that might lead a firm to internalize or externalize a given activity. It should be borne in mind, however, that such transaction costs will vary with the skill levels of those concerned, and that, without further data on these, the measure still remains rudimentary.

Table 6.1 gives the average size of European firms involved in each transaction mode. The small number of firms in the sample with wholly owned operations robs the figures of any statistial significance, but they still

speak in favour of the corollary. If, at this point one wishes to explore why a number of the larger European firms settle for joint ventures, these can be dichotomized into those with passive and those with active joint venture partners. The grounds for doing so would be that the retention of management control in joint ventures with passive partners achieves much of what is sought in a wholly owned operation.

Table 6.2 presents the results of an exercise in which joint ventures with passive local partners were grouped with wholly owned operations, and those with active local partners were grouped with licencing agreements. Those results clearly support the propositoin and a Mann-Whitney test for small samples shows them to be significant at the 5% level.

To sum up, either a weak case can be made for the proposition as it stands, or a stronger one presented for a modified version which would accomodate nominal joint ventures.

Proposition 5.a): International firms will show a preference for externalizing transactions on the right hand side of the C-D framework.

Section 4 of Chapter 2 showed that a firm's foreign operations are associated with increased transaction costs incurred in overcoming physical, cultural, and economic barriers to the flow of goods and services. These costs are assumed to be uniformly distributed across the C-D framework, much as on a case by case basis they could vary considerably. The returns on transactions, however, are not assumed to be uniformly distributed, but should vary directly with a firm's investment in proprietary knowledge - i.e., they should increase as the firm's investment in knowledge shifts towards the left, where, as has been shown, the transaction mode is likely to be hierarchical. Any increase in transaction costs will make a given transaction mode non-viable for some so that those showing the lowest returns will be candidates for elimination or reassignment to another mode. This is less likely to happen to hierarchical transaction modes on the left since there, either the returns are high enough to cover the increased cots of foreign operations, or no transfer abroad takes place out of those cells in the framework for fear of information leakages and

the loss of a proprietary position. Thus, when a firm faces the increased costs of operating abroad, any reassignement from a hierarchical transaction mode to a federated or a market-based one is more likely to take place on the right hand side of the C-D framework, than on the left.

Three cases in the sample, 2, 9 and 14, do not appear to support this contention. In Case 2, the firm's wholly owned local subsidiary had subcontracted out its manufacturing operations, but kept hold of marketing and distribution, a case of externalizing in CF and CI, and not, as the proposition asserts, in CM. However, what the case describes is one transaction mode nested within another. Would a local purchase of raw materials by a wholly owned subsidiary, for example, challenge the propositon? Only if the proprietary information lost in the transaction was such as to wipe out any efficiency gains achieved in going to the market. As long as the subsidiary can control the information boundary during the course of a transaction at an acceptable cost, the assignment decision can be made on grounds of simple short run economic efficiency; the protection of proprietary knowledge need not intrude as an issue. The firm's initial transactional strategy, its decision to go for a wholly owned local operation, will restructure the costs of all transactions that flow from it. Their own assignment within the C-D framework therefore, may well follow a different course. The proposition is essentially only concerned with those transactions that determine a firm's operating style within a country - i.e., whether it shall be a wholly owned subsidiary, a joint venture, or a licensing operation - not with those that may naturally follow from the options which are subsequently opened or closed.

Case 9 is less easy to dispose of. Company A had already developed a distribution network in the country and was looking for a corporate vehicle through which it could build up a local production capacity. B was bought as a shell and became a joint venture by virtue of the fact that its original owner kept a stake in the venture, but only as a shareholder. The challenge to the propositon comes from a firm which externalized a transaction in I rather than in M in the C-D framework.

Likewise for Case 14. The European firm marketed the output of the joint venture worldwide and the local firm, as in Case 9, was in I as a low cost producer, so that externalization took place in the centre of the C-D framework and not in M on the right. This was the only case in the sample where a European firm was looking for a low-cost production base to serve a worlwide market rather than an opportunity to serve a domestic market. This is an investment strategy that the propositon does not cater for.

The remaining cases all more or less support the proposition. They can be split, however, into those where European firms undertake a genuine externalization by handing over an organizational function that the firm might have carried out for itself to a local partner or an outsider, and those where such firms externalize nominally by retaining the organizational function and giving a local partner a comparatively exiguous role that would place him on the right hand side of the framework by default. Genuine externalization, for example, can be seen in Cases 12, 13 and 16 where the local partner each time takes over the marketing function for the joint venture (in Case 12 though, the local partner is still 'in reality', a European firm). Nominal externalization on the other hand, is exemplified by Cases 4, 5, 6, 7, 8 and 12 in each of which the local partner 'knows' the local commercial environment usually by dint of his nationality, and has been selected because he may one day turn out to be useful rather than because he has any genuine and durable role to play.

Proposition 5.b): Externalization on the right hand side of the C-D framework will be particularly apparent in the case of firms whose relative strength lies in the creation of firm-specific knowledge.

Two different interpretations can be put on this proposition. Under the first, the firm's relative strength in R and D is the combined product of a small size and minimum expenditure levels required to carry out any worthwhile research at all. For such firms R and D expenditure as a percentage of sales will of necessity be higher than for larger firms although absolute expenditure levels may in fact be very modest. When these small, research intensive firms market their products overseas, their preferred transaction mode is the

arm's length, market-based transaction. They generally lack the resources to internalize further. Some of the European firms described in Cases 1, 12, 17 and 19 provide ready illustrations for this interpretation.

Under the second interpretation, a large established firm has developed a strong, well protected, firm-specific, core technology and is willing to externalize some of its non-core components in order to stimulate customer demand for products that would activate its core. Here externalization on the right is specifically designed to stimulate dependency on the left. An outstanding illustration of such a strategy is furnished by Case 18 in which a main objective of the European aluminium producer was to sell customers enough competitive technology to make them dependent.

The R and D figures given for the European firms in the sample can help throw some light on the proposition. Such figures are unsatisfactory insofar as much firm-specific knowledge can originate and accumulate outside the laboratory. Nevertheless, in the chemical industry, R and D expenditure is commonly used to measure technical strength since most competitively useful knowledge does seem to be the fruit of organized research activities. The proposition would lead one to expect that firms with licensing agreements - i.e., those that have externalized most - will spend proportionately more on R and D than firms in the rest of the sample. Table 6.3 presents the relavant figures and although, once more, the small sample size robs them of any statistical significance, they speak in favour of the corollary. The figures for the firms that license, however, must be treated with caution, as they contain one suspect figure (given by one of the licensors in Case 17) which merges R and D and quality control expenditures. yet, even if this rogue figure is removed, the average research expenditure of licensors stands at 5.5% of sales, a figure well above the 3.5% given for the other European firms in the sample. One must bear in mind though that the wholly owned subsidiaries in the sample, spend on average 6.5% of their sales on R and D (as shown in the analysis of Corollary 1.2 above) so that support for the proposition, while generally positive, is not unequivocal.

Proposition 6.a): Firms whose relative strength lies in F will seek to complement it through transactions with firms whose relative strength lies in M, and vice-versa.

The delivery of a technically sophisticated product into a customer's hands requires an investment in knowledge assets by one or more organizations working in concert throughout the C-D framework. Customers and distributors must build up a minimum stock of knowledge in M, suppliers and subcontractors need the industrial know-how that accumulates in I, and finally a firms needs to generate competitive, differentiated products on the basis of investments in F. Some firms are large enough to be able to invest directly right across the framework and will attempt to internalize transactions throughout. Where this is not possible Proposition 6.a), 6.b), and their corrolaries assert that firms will internalize transactions in and around their areas of comparative strength in the C-D framework - i.e., where they have already invested - and will seek to complement these through federated or market-based transactions with firms whose strength lies elsewhere. They will do this with two objectives in view: the first will be to cover as much of the C-D framework as possible through such transactions so as to ensure an efficient flow of goods and services, the second will be to avoid transactions with firms whose relative strengths overlap - and hence could compete - with their own. The underlying hypothesis is the firms will feel least threatened by, and most attracted to, organizations whose comparative strengths in the C-D framework stand in some polar relationship to their own. Proposition 6.a) accordingly states that a polar relationship exists between firms whose relative strengths lie in F and M respectively that make them eligible transactional partners.

Two cases, 11 and 15, challenge the proposition. In the first, the two firms A and B are both comparatively strong in M, although A is much more so than B which is a state corporation. In the second, the two European partners to the joint venture - there is also passive local partner to contend with - are both strong in F. In Case 11, complementarities were sought within M itself. The European firm tied up with a state corporation to manufacture and distribute fertilizers to farmers. The former would contribute its marketing skills, the latter its access to customers. The production technology involved was elementary and required no strength in F from either party and the fact that A's joint venture partner was a state corporation meant that any overlap in M would be perceived as posing little threat commercially.

In Case 15, however, the overlap in F posed a considerable threat to each party as evidenced by the technical screens that were set up within the joint venture organization itself to allow each party to control the access to its proprietary technology. So why, then, did these two European firms tie up in a joint venture? The reason, it will be recalled, was purely defensive. In the shrinking local markets they were faced with, these two major firms could either compete destructively or collude. They chose the latter. In third markets, however, the two firms remain fierce competitors.

Joint ventures with passive local partners such as those described in Cases 4, 5, 6 and 7 do not adequately test the proposition. Where the European firms in these cases are strong in F then they are also strong in M. If the local partner's relative strength lies in M, by virtue of his knowledge of local political and economic conditions, it still represents a very modest asset in comparison with what the firm itself brings to M and in no way relieves the European firms of an investment burden in that part of the framework. Thus, although the transactional relationship between the parties goes in the direction of the proposition it is not sufficiently polarized to travel very far.

Two of the active joint ventures, those of Cases 13 and 14, were too weakly polarized to offer any clear support to the proposition. In both cases the European firm was undoubtedly stronger in F that the local partner whose relative strength was in M, but in both, a considerable overlap in I occurred between the parties, and in Case 14, the local partner's relative strength in the local market was of little interest to his European partner since the latter was responsible for marketing the joint venture's output worldwide. The joint ventures described in Cases 10, 12, 16 and 17, on the other hand, clearly supported the proposition. In each, a technically strong European firm had tied up with a local distributor. The same is true of the licensing agreements of Cases 17, 18, 19 and 20, although in the last of these, in absolute terms, its technical know-how still represented a very modest asset.

In conclusion, larger firms in the sample appeared less impelled by a relative strength in F to seek complementarities in M since the marginal cost to them of internalising transactions in that part of the C-D framework was

probably well within their reach. This is borne out by the very nominal nature of the transactions they sought when driven to do so by host government expectations or legislation. Since, as Proposition 4 has shown, larger firms are more likely to be wholly owned or seek out passive joint venture partners, they are hardly in need of the complementarities discussed here. Where, on the other hand, externalised transactions are genuine, as in the active joint ventures and the licensing agreements, then they do indeed show the polarization between F and M asserted by the proposition.

Proposition 6.b): Firms whose relative strength lies in U will seek arrangements with firms relatively strong in C, and vice-versa.

Do firms with codified skills seek out those with experience to guide their application? What is the value to an established firm of a local partner who "knows the ropes"? Does this kind of knowledge of local conditions save time and prevent costly mistakes? Sufficiently so to warrent some specific transactional arrangement? In short, should one add to the horizontal polarization of the preceding proposition a vertical one between firms which possess codified skills and those which possess uncodified ones?

As before, the issue is one of relative investment and strength. As with individuals, all firms have codified skills and experience in varying degrees. Yet, those that would be assigned to U in the C-D framework will have invested more in the acquisition of experience than in the acquisition of skills. The reverse is true for those that would be assigned to C. As before, the proposition asserts that if a lack of time or resources prevents an investment in both the top and bottom parts of the framework, complementarities will be sought in external transactions.

Two cases, 6 and 7, fail to support the proposition. In each, a joint venture, the local partner was not operational, and had little to contribute outside his knowledge and experience of local business conditions. In the C-D framework he would be assigned to U. But, so also would the European firm. Each claimed that its strength resided mainly in its technical know-how, but that it relied on trademarks rather than patents to protect its proprietary

interests. Trademarks are essentially indications of product origins, a kind of producer's signature on his product.[3] Unlike a patented product, only the name is protected from imitators, and the fact that a firm may feel that this affords it sufficient protection, strongly suggests that imitation will be a more difficult matter than in the case of a patent, and that a product's quality advantages rest on intangible factors that are hard to codify.

Cases 2, 4, 5, 13 and 15 fail to show a strongly polarized relationship. In the first, the third party subcontractor would be assigned to C, and in the last four the local partners would be placed in U. But in each of these cases, while the European partner has complementary strengths to those of his local partner he also has overlapping strengths. Thus, in Case 2, the European firm is strong in C as well as in U, and envisages in the very near future, setting up its own local production facility. In Cases 5 and 15, the European firm over time has probably acquired as much knowledge of local conditions as its local partner could boast originally, and, in effect, has little need of him. In Case 13, the joint venture partners share the same extensive experience of the region, a strength in U, but the local partner is looking to the European firm for its regional distribution network, a strength in C. It will be remembered that in this case the joint venture, as with Case 15, was defensive in nature since A's local customer, B, was about to become a major competitor.

Of the remaining cases, 1, 12, 17 and 19, describe small, research intensive European firms relatively strong in U, taking on, through joint ventures or licences, local partners relatively strong in C who could offer them established distribution networks through which their products could flow. So concerned were some of these European firms (i.e., in Case 17) to maintain their positions in U that they deliberately avoided patenting many of their products to prevent their know-how from being communicated to competitors and would-be imitators. In Cases 11, 14, 16 and 18, on the other hand, both parties had invested in U and C and nothing certain could be said concerning their relative strengths. All that could be observed was that in Cases 14, 16 and 18 the Europeans had invested in U and C on the left-hand side of the C-D framework - i.e., in F - and that their local partners had done so on the right-hand side, in M so that there was, in effect, little competitive overlap between them.

Only four cases offer any clear support for the proposition, and while only two other cases challenge it directly, the remainder do no allow sufficiently clear assignments to form a credible judgement as to its plausibility.

Proposition 7.a): International firms will be reluctant to transfer abroad knowledge that is firm-specific.

Comparatively little research is carried out by industry with a view to any new technology it produces as such. The greatest value added is achieved when the fruits of research can be embodied in products that, for a period of time, are spared the rigours of imitative competition, either because they enjoy patent protection, or because the firm-specific know-how is still uncodified and therefore difficult and costly to transmit between firms. Where a firm produces a greater number of new products and technologies than it can exploit directly, it will either license those it cannot use or seek to exchange them for some that it can. A straight licence though, represents the least profitable return on its investment in knowledge when compared with either cross-licensing or a direct exploitation.

If, as asserted by the proposition, international firms are reluctant to transfer firm-specific technology abroad, this is because where knowledge is still uncodified the transmission costs are too high for the transfer to be economic even when the recipient is the firm's own subsidiary. And where knowledge has been codified and the transmission costs have dropped, the danger of a leak, whether brought about by host government legislation or unscrupulous imitation, is too great. Of course, firm-specific technology does get transferred abroad and reluctance often gives way to pragmatism in specific circumstances. There will be countries in which a firm will meet infrastructural and competitive conditions similar to those back home, in which technology transmission costs can be kept at manageable levels, and where the dangers of a proprietary technology slipping out of its hands do not loom too large. In most other cases, however, one would expect to see a firm confine its transfer activities to those technologies required to keep a subsidiary abreast of local domestic and foreign competitors, and, more particularly, to those mostly non-proprietary parts of the technology which,

through backward linkages, can stimulate demand for high-technology intermediary goods produced back home.

Evidence of a general reluctance to transfer firm-specific technology is provided by Cases 1, 6, 7, 17 and 20. In the first, the European firm's policy is to "sell where it can and produce where it must." The firm, however, has expressed a clear preference for keeping its technology to itself and none of that which has been transferred abroad so far is proprietary. In Cases 6 and 7, the technology only flows freely towards those subsidiaries in which the management retains managerial control. In Case 17, company A_2, a small research-oriented firm, feels particularly vulnerable and will even avoid patenting its technology to keep it in an uncodified state. All this apparently with good reason. Lack of viable patent laws, for example, have led the European firm in Case 4 to keep its research based products out of the markets of ASEAN 4.

More articulated attitudes towards the transfer of proprietary knowledge surfaced in Cases 8, 9, 12, 18 and 19. Technology suppliers in Cases 9, 12 (joint venture 1), and 18 had a policy of only transferring abroad or selling to outsiders their amortized technology. In Case 18, this was explicitly aimed at making recipients dependent (at least in the case under study) on the firm's more sophisticated technology back home. Technology suppliers in Cases 8, 12 (joint venture 2), and 19, were prepared to make their new technologies available to outside and foreign firms under cross-licensing arrangements. In this way, they felt they could obtain a fair return on their research efforts, a prospect not offered by conventional royalty payments. also, while in Cases 4, 5, 15 and 16, a specific policy towards technology transfer was not mentioned, the European firms involved had all set up some form of screening procedure, whether locally or in their home countries (i.e., licensing committees) to make sure that commercially sensitive technology did not slip out of the firm's hands.

Finally, Cases 2, 4, 5, 8, 13, 17 and 19, showed European firms deliberately keeping their upstream technology in Europe. Upstream technology in the chemical industry is capital and skill-intensive, sensitive to economies of scale, and a major source of competitive strength in foreign markets through

the proprietary raw materials (active ingredients) it could provide. Downstream technology, conversely, is much more labour-intensive, standard, simple to operate, and much more adaptable to small market conditions. It should not be imagined, though, that upstream technology would be dammed up in Europe by these firms whatever happened. To larger markets (even newly industrializing ones like Brazil), some of these firms (i.e., those in Cases 4 and 5) were quite prepared to transfer upstream process if competitive conditions required it, and a number of them had already done so. The markets of Southeast Asia, however, were as yet too small and exiguous to be so favoured.

A major concern expressed by some firms in transferring sophisticated upstream processes appeared to be the danger that if its proprietary technology slipped out of its hand through an LDC subisidary, it could be used by competitors to hit the firm back in its home markets in Europe. Partly for this reason, many firms transferred active substances to their subsidiaries in coded form. Ostensibly, the argument given for doing so was to avoid a confusion in the mixing process by staff who may not be fully conversant with chemical nomenclature. But access to the codes was restricted to one or two senior people in the local subsidiary, and the prevention of a technical leak was often given as a major consideration for the procedure. One firm (Case 9), when shipping sophisticated equipment to an LCD subidiary, always held back one or two crucial components as a safeguard. These were not essential to the machine's routine performance requirements, but in certain situations they constituted its distinctive advantages. If they were required, the parent would intervene. In Case 16, also, the European firm was accused by its local partner of withholding technical data and servies crucial to the functioning of the venture.

Such were the instances through which technological reticence manfested itself. Three cases, however, involving larger firms (Cases 4, 5 and 15) challenged the proposition. These allocated a significant proportion of their research budget to the development of new customer applications for their existing product. The knowlege created may or may not have been proprietary (although it was considered firm-specific), the products or processes whose use it was designed to stimulate certainty were. This is further discussed in the proposition that follows.

Proposition 7.b): International firms that seek to develop their markets have an active interest in transferring knowledge already in CM to existing or potential customers.

At the most elementary level, the proposition states little more than that firms seek to inform their customers of their products in order to stimulate demand for them. This is the promotional function in which the task of creating customer awareness is carried out through advertising, an activity practised by nearly all the European firms in the sample. It is a well codified, high volume activity with a low transmission cost per target reached. In the field of consumer goods, once customer awareness has been created, the product is left to sell itself by virtue of its availability in the shops, the attractiveness, convenience, and informativeness of its packaging and so on. The information a customer receives through advertising and through the product itself is deemed to be sufficient to allow him to reach a decision on his own.

Where a produt is technically sophisticated and requires a high level of knowledge for its use, the firm has to intervene in the customer's decision process. Awareness alone will not suffice where a potential customer has a technical problem which may be articulated in a number of different ways. A firm's product then only beomes a solution to a problem defined in a particular way and a firm will devote considerable effort to helping a potential customer shape his problem so as to favour a firm's product as its solution. The problems posed may be only half-formulated, i.e., still in SM, and a firm will transfer coding skills in CM to potential customers which will influence the manner in which their problems get codified. Where a customer's perceptions get structured in this way, they are often difficult to restructure and will resist attempts to do so. If a firm's products have been locked in to the structure as constituent elements of a problem's solution, they will enjoy a degree of customer loyalty rarely seen with consumer products. If the problem and its solution are complex, competitive substitutes may not even be perceived let alone considered. It follows, therefore, that firms supplying sophisticated products have a considerable interest in transferring knowledge of their range of applications and skills to both potential and actual customers in order to build up customer loyalty. In some cases the loyalty

will attach to a firm's products, in others, to the firm itself as a source of useful and credible messages.

So strong was this dynamic in the cases observed that in three of them - 4, 5, 15 - they challenged the proposition itself: the firms were transferring application knowledge to custmers as it emerged from their research laboratories. It was too new to be in CM and would require further standardisation over time. In effect, the customer was receiving technology in SM, some of which required a considerable time for its transfer and subsequent mastery. In Case 4, for example, the European firm's applications technicians will spend anything between three days and three months training customers in their own laboratories, and will, if need be, fly in specialists from Europe where customer problems prove too intractable for the firm's local engineers. In Case 5, a large number of customers are trained on the firm's premises for periods of two weeks at a time and each year some twenty of them are flown to Europe for further training. In Case 15, the transfer of an applications technology to customers can take up to two or three years and the European firms have set up a welding school locally to take a large number of customers throught the first steps of the process.

Firms in the sample dealing in customer goods, on the other hand, were committed to a much more modest effort. In Case 3, the firm was producing consumer perishables for the mass market and only envisaged a training effort where it was supplying large industrial or commercial customers. Pharmaceutical firms were also limited to the dissemination of medical and new product information to doctors, pharmacies, and hospitals, although a number of them tried to go further by organizing conferences and lecture tours for their European specialists, and assisting local hospitals in the carrying out of clinical trials.

The European respondents in Cases 4, 7 and 9 claimed that the lack of customer skills in the domestic market was leading them to transfer technical knowledge locally that in Europe the customer would either acquire for himself or would already possess. Often quality differences between complex products were not perceived by customers and where their criterion of product selection was exclusively price, a European firm selling more highly priced differen-

tiated products, could appear uncompetitive. It became an important matter, therefore, to ensure that a product's quality attributes were perceived by customers and this in some cases required extensive training.

In Cases 4, 6, 10, 12 and 18, the building up a customer loyalty by transferring to him some of the firm's applications technology had been made into an integral part of the European firm's strategy for penetrating the local market.

In sum, this is a proposition that finds considerable support in the cases. The technology transferred to customers, with some exceptions, tended to be well codified, hence justifying its assignment to C in the C-D framework, and its orientation towards customer applications took it downstream of the chemical industry into technical fields not necessarily less sophisticated than those that characterize the industry's own downstream processes, but nevertheless justifying its assignment to M in the framework.

Proposition 8: Knowledge purchasers will tend to locate on the right of the C-D framework and knowledge sellers on the left.

Purchasing and selling are used here in a wider sense than that associated with market-based exchanges. Specifically, it need not be assumed that knowledge is either a sole, or even an explicit object of exchange, nor, for that matter, that money is the only means of payment. The proposition asserts that whatever the transaction mode chosen for a local operation, the bulk of technology recipients will cluster on the right of the framework and most technology transferors will cluster on the left. Otherwise stated, more technology will be deliberately transferred by firms in an industry to firms outside it - and most probably downstream of it - than to other firms inside it.

The reasoning that underlies this proposition is a further development of Propositions 7.a) and b). If firms strong in F are reluctant to transfer their 'core' technologies, because of their vulnerability to competition, one would expect to see comparatively few exchanges with other firms, also strong in F in the same industry. Cross-licensing arrangements may be acceptable, but will

be undertaken selectively and with a view to further strengthening a firm's position in F. Likewise, transactions between firms with a strong investment in F and firms in I, are more likely to characterize knowledge exchanges between a parent and its foreign subsidiaries whether or not these are wholly owned than, say, those between the latter and their local suppliers. Finally, where a firm strong in F, transfers knowledge to firms - customers, distributors, joint venture partners, etc. - located in M, it is more likely to be downstream of industry-specific knowledge, and although quite possibly proprietary in nature as suggested by Proposition 7.b), it is unlikely to form part of the transferor's 'core' technologies, one of the main sources of his industrial strength.

If the bulk of technology sellers are placed on the left of the framework, it is because towards the right they have less to offer in any exchange. Conversely, if knowledge purchasers cluster on the right, it is because the largest volume of profitable knowledge transactions for a firm strong in F are to be developed with customers located in M.

Taken individually, the amount of knowledge transferred in each transaction may well be quite modest, and being mediated by the local subsidiary may have to be mastered by it first. Yet, this quantum of knowledge multiplied by the total number of actual or potential customers which a subsidiary deals with each year - the total volume of knowledge flowing from F into M and largely to outside firms or individuals - may well exceed that flowing from F into I, the firm's own local subsidiaries. As shown in Proposition 7.b) technologically oriented firms have a clear interest in seeking and developing these kinds of transactions since they simultaneously help to create a market for the class of products offered by such firms and secure for it a significant share thereof.

Empirical explorations of this proposition are complicated by the difficulty of weighing the importance of the information that flows from F to I and M respectively, as well as by the fact that the volume of such flows will likely vary with the country and industry studied, thus limiting to an extent as yet unknown the propositon's generality. Nevertheless, confining one's attention to the sample, the following observations can be made.

Firstly, although the European firms in Cases 8, 12 (Joint venture 2), and 19, claimed to practice cross-licensing where the circumstances were right, no instance of this kind of technology exchange was observed in the sample. Only in Case 15 did the firms seem technologically matched so as to make cross-licensing a plausible option; in the remaining cases, the technological gap between transacting firms appeared too great. Thus, while one transaction - Case 15 - took place between two firms strong in F, no technological exchange occurred between such firms, indeed, in Case 15, the two firms deliberately erected technological barriers in F to prevent such exchanges.

Secondly, in only four cases - 3, 14, 16 and 18 - did the bulk of the technology transferred flow from F to I. In each, the European firm was supplying a local subsidiary, joint venture or licensor, with a sophisticated continuous process technology or some component thereof. But in those, like in the remaining cases, once the initial training period was over, and once the initial stock of knowledge required to get operations under way had been digested by the local labour forces, the flow of production know-how between the European firm and the local operation, between F and I tended to drop quite appreciably.

Finally, except in the four cases just mentioned, the training of the sales force for local operations appeared to be both technically more sophisticated and more extensive than that offered to its production workers. Such training appeared to vary with the complexity, diversity, and changeability of the applications technology that a firm aimed to transfer to its customers. Although only Cases 1, 2, 4, 5 and 15, provided any hard data on this, an employee recruited into a local operation's sales force would have received more years of education prior to joining, was more likely to receive all or part of his in-company training in Europe, and could expect to be more regularly retrained in the course of his career than an employee recruited into the production department.

Thus, if the somewhat ambiguous patterns that emerge from the data are accepted, a local operation's salesman, when dealing with technologically sophisticated products becomes a change agent in M, diffusing a technology which is not that used by the firm itself in F or in I, but which, advanced or

simple as it may be, is dependent upon it and aims to secure the sale of products that embody it. In the chemical industry, a firm seeking to develop a submarket for a sophisticated intermediary product has much to gain and little to lose from the effective diffusion of a downstream technology. Although the data only offers vague support for the proposition it does seem to point to a firm's marketing function as a major agent - if not the major agent - of technology transfer and diffusion across national boundaries.

DISCUSSION

What conclusion can be drawn from the foregoing analysis of the cases presented? what verdict do they allow on the framework developed in Chapter 2? Clearly, the events studied in the case material can be conceptualized in such a way as to come within the scope of the C-D framework. The propositions were devised to furnish an initial stock of rules to guide the assignment of such events to the framework and some of these turned out to be more helpful than others. A rich and wide variety of empirical material fell under the purview of each rule since these had been broadly framed, and in the absence of more developed measures and a more articulated framework, the exercise will remain imprecise. But, imprecision is not inaccuracy, and provided that the degree of tolerance imposed by the framework's current state of development is allowed for and accepted, its potential value as a conceptual aid need not be impaired. Note that the propositions themselves do not all have the same scope. The first three address the assignment of transactions - licensing agreements, wholly owned operations, joint ventures - to cells in the C-D framework on the basis of a fit between their constitutional attributes, and those of markets, hierarchies, and federations. The remainder explore those characteristics of firms carrying out such transactions as may be deduced from the type of knowledge they use and how far they possess it. By establishing rules of correspondence between the empirical material of the case studies and transactional properties derived from the framework, the first three propositons give coherence to the claims of those that follow.

With some qualification propositions 1 and 2 find support in the cases. Corollary 1.1.b) is only weakly supported for lack of adequate means of observing its provisions through interviews, but the rest of propositon 1 is corroborated by the way that joint ventures were set up and subsequently run. One point about Corollary 1.1.d) must be made. The small numbers bargaining situation observed was in many respects an artificial one. Very few of the joint ventures studied represented the preferred choice of the European partners. In many cases, perhaps a majority, in the absence of host government regulations and pressures, these firms would have chosen wholly owned operations - the number of passive local partners in the sample, and the not infrequent reversions towards hierarchy bear mute testimony to this

preference. Thus, the small numbers bargaining situation described covers both the foreign investors' relationship with his local partner - by all acounts a scarce resource - and his dealings with the host government which imposed such a transaction mode on him in the first place.

In Proposition 2, Corollary 2.1.d) remains somewhat inconclusive given the data, and the relevant cases do not support the idea that atmosphere and identity (Corollary 2.1.e) are negligible for all licensing agreements. They were not where the firm was small and had little or no international experience. A relationship between firm size and the role accorded to licensing within the firm's overall strategy, limit the scope of the generalization which is more likely to find application in firms organised to licence.

Propositon 3 is in difficulty. Corollary 3.1.a) is supported and Corollary 3.1.b) weakly so. Corollaries 3.1.c) and 3.1.d) are, if anything contradicted by the data. The reasons for this are instructive. A hierarchical local management style does not distinguish between joint ventures and wholly owned subsidiaries; local management controls operate pretty much the same way in both cases. It is in the relationship between the local operations and the European firm, that one would expect to see the provisions of the proposition in action. Yet, what emerges? A highly decentralised management style, often with several lines of reporting leading to a 'negotiated order' between the two organisations typical of federations, and a form of 'control by socialisation'. In its present form the proposition will not stand: it must be modified to allow for the change of management style that occurs when one moves up a hierarchy as was discussed in Section 4 of Chapter 2. In this way the hierarchy thesis could survive the refutation of the proposition that tests it through its reformulation. Nevertheless, the pervasive presence of hierarchy in both joint venture and licensing arrangements makes it doubtful whether the empirical material gathered here could offer a discriminating test for the presence of hierarchical attributes exclusive to wholly owned operations. These are more likely to show up, if at all, across technological and industrial categories than within them. But it may still be fundamentally easier to distinguish between licensing agreements and joint ventures, than between the latter and wholly owned subsidiaries - the differences between licensing agreements and wholly-owned subisidiaries remain readily apparent.

If so, one may infer that the degree to which knowledge has been codified has a more important bearing on the firm's management style and choice of transaction mode than its proprietary characteristics. This issue cannot be addressed on the data available.

So much for the assignment of transactions; what about the firms which do the assigning? Proposition 4 seems well corroborated: it would appear that the larger firms in the sample tended to internalise transactions over a larger number of cells of the C-D framework than smaller ones. If wholly owned operations were not the invariable result, joint ventures with passive local partners certainly expressed the tendency. Proposition 5.a) exploring the marginal decision to internalise or externalise transactions rests on empirical soil whose strength is patchy, supporting some cases but not others; it is strongest where the foreign investor is exploiting the loal market, access to which is controlled by a host government set on a joint venture formula. Where firms invest for re-export, as in Case 14, or sub-contract locally to third party contract manufacturers, the situation is less clear. Propositions 5.b)'s claims concerning the research orientation of firms which externalise most also leads to equivocal results, giving positive readings where, for example, licensing agreements are matched against the rest of the sample taken as a whole, and ambiguously negative ones where they are compared with wholly owned subsidiaries. Although no statistically enforceable conclusion is possible, the evidence does point to the idea that firms externalise away from their technological core, but that, possibly beyond a certain point, the strength of this core does away with the need to externalise at all, bringing us back to Proposition 4.

Proposition 6.a) is supported, but while Proposition 6.b), receives positive rather than negative answers from the data, these remain somewhat delphic and possibly leave too much room for interpretation to be useful. The restricted circumstances under which many transaction modes were chosen should make for caution in drawing inferences about complementarities actually sought from complementaries actually achieved between transacting parties.

Proposition 7 needs to be modified to allow for the fact that two or three larger firms, while sharing the rest of the sample's reluctance to share their 'core' technology, seem quite happy to transfer new firm-specific applications technology to customers if it will help to keep them and increase their numbers. The data suggests a distinction between firm-specific technologies used by a firm itself and those mediated by a firm. The latter type of technologies, the focus of a significant research effort by firms in this industry, are newer, more complex, and hence less codified than has been allowed for in proposition 7.b), which otherwise, like 7.a), remains well supported. Proposition 8 is well supported except in two cases where the purchaser was located on the right of the seller, but not on the right of the C-D framework. The proposition could be modified to reflect this condition, but would then lose in interest what it gains in generality.

In sum, none of the propositions derived from the C-D framework can be rejected outright, and while parts of Proposition 3 remain somewhat contradictory and some of Proposition 6 remains, as yet, untested, the case study material, with varying degrees of plausibility, does seem accessible to interpretation in C-D framework terms.

An Assessment of the Fieldwork

This study set out to examine whether there are any grounds for postulating a relationship between the creation and diffusion of knowledge and whether such a relationship would have any bearing on current problems in international technology transfer. The C-D framework presented in Chapter 2 addressed the technology transfer issue by treating it as special case of the creation and diffusion of knowledge, the initial focus of the chapter.

Concepts from the emerging field of institutional economics were introduced where their compatibility with the information attributes deployed in the framework afforded an opportunity to translate continuous events - knowledge flows - into discrete events - transactions and thereby provided observational empirical correlates for the kinds of corporate behaviour embodied in a number of propositions derived from the analytical application of the C-D framework.

The empirical material to which these propositions looked to for corroboration was described in outline in Chapter 4 and on a case by case basis in Chapter 5. This chapter has analysed the results proposition by proposition. What emerged, and how far does it support the case for using the framework as a tool of analysis?

1. The first three propositions and their corollaries link the three transactional modes studied in the field, joint ventures, licensing agreements, and wholly owned subsidiaries, respectively to the three conceptual categories emerging out of institutional economics, namely, federations, markets and hierarchies. The informational attributes of these transactional modes, in varying degrees, match those found in the cases and can be used to assign them to positions within the C-D framework. The case material allowed a better discrimination between market-based transactions such as licensing agreements and the other two transational modes than it did between the latter two themselves. Wholly owned subsidiaries were indeed hard to distinguish from joint ventures where the diacritical element was the nature of information exchanges between parent company and local operations. One of the reasons for this, as has already been stated, is that so many of the joint ventures in the sample were nominal and the presence of a minority local partner, taken in for political rather than operational reasons, drew few concessions from European firms in matters of management control.

A second reason was anticipated in Chapter 2 in the course of developing the analytical framework. Transactions between parent and wholly owned subsidiaries at a senior management level share with joint ventures the characteristics of vagueness and complexity, and, in the top left-hand side of the C-D framework, both transactional modes enjoy the same informational attributes. Given the research orientation of the majority of European firms in the sample, most had some investment in that corner of the framework; it would have required a much more detailed and systematic analysis of parent-subsidiary relationships than was possible in this study to identify the salient differences between the two transactional modes in UF, where they compete. Tellingly, in those three cases (1, 11 and 12) where the European parent was a trading company and hence assignable in M, the local subsidiary had much more freedom of manoeuvre and was much less constrained hier-

archically by parent company performance and technical expectations than was the case for other firms in the sample. Furthermore, the trading companies in Cases 11 and 12 offered two rare examples of European firms actively seeking genuine joint venture arrangements.

2. Propositions 4, 5.a) and 5.b) focus on the transacting firm itself: its size, its international orientation, its research intensity. The underlying assumption is that these are attributes that have a bearing on a firm's choice of transactional mode. They remain, as yet, incommensurable and cannot therefore be collapsed into a single measure from which such a choice could be predicted. Nevertheless, what emerges is that as a firm moves outside its home territory, and transaction costs, however defined, go up, it becomes more willing to externalize transactions through joint ventures or licensing agreements, but that this willingness varies with firm size - the larger firm being less willing to externalize further - i.e., through licensing - than those whose investments in the C-D framework are more evenly spread. In short, firms appear to transact in those parts of the C-D framework and through transactional modes that will not threaten their investment in knowledge, however distributed.

3. The incommensurability of firm attributes notwithstanding, Propositions 6.a) and 6.b) attempt an assignment of firms in transacting pairs within the C-D framework. Assigning individual transactions is comparatively straightforward since their information attributes are accessible. Assigning firms, on the other hand, is a different matter. Firms are vast aggregates of more or less structured transactions which are effectively scattered throughout the C-D framework. Each transaction would have to be given a weight and the firm's location in the framework would then constitute the centre of gravity of the scatter suitably weighted. Thus, the assignment of a firm and that of the transactions that constitute in may, in fact, lead to quite different locations within the framework.

Since the case study material provides no data for such an exercise, the assignment of firms to the framework was carried out using personal judgement on the basis of the heterogeneous information available. The guiding hypothesis was that if firms, as suggested in 2 above, sought non-threatening

transactions with respect to their investment in knowledge, this would show up in the distance between their respective locations in the C-D framework as well as in their choice of transactional mode. In other words, firms would feel most comfortable transacting with partners whose investment in a given area of the C-D framework, whether large or small (as in the case of passive local partners), complements rather than competes with their own. Unfortunately, only in the case of Proposition 6.a), does this exercise produce any results at all, namely, a well supported indication that firms strong in technology will tend to transact with firms that are not, and which, conversely, may or may not be strong in marketing. The details of a firm's technical or marketing activities are not clear enough to pronounce on how far they had been codified so that Proposition 6.b) lacks corroborative evidence.

Yet, support for Proposition 6.a) taken in conjunction with that found for Proposition 8 is not without value, for it seems to suggest that where transacting partners are technologically non-threatening and are complementary to each other, at least in terms of the framework's horizontal axis, then knowledge, even proprietary knowledge, will flow from left to right in the framework in larger volumes than where the polarization is less pronounced. The one joint venture (Case 15) in which the two partners had technologically identical profiles was also the one in which they took the most pains to prevent knowledge from flowing from one to the other. Conversely, Proposition 8 gave ground for believing that the greatest flow of knowledge took place between firms strong in F and those in M outside the industry, such as customers. What cannot be determined without the corroborative evidence of Propositon 6.b) is whether this knowledge flowed in U or in C. The evidence points tentatively to a flow in C and one in S (where knowledge, becasue it has been recently created, is only semi-codified), but the signs are too ambiguous to be reliable.

4. Finally, Propositions 7.a) and 7.b) try to say something about a firm's attitude towards the flow of knowledge at different points in the C-D framework. The emphasis is no longer on transaction modes as such, since these may fail to express a firm's disposition to transfer different types of knowledge. Rather, a firm's general policy towards various forms of technology

transfer operations are assessed in an attempt to guauge how far its motivations may vary with the location of the relevant transactions in the framework. The results of the empirical investigation could be plotted on a diagonal line in the framework running from UF to CM (See Fig. 6.1) with a firm's greatest reticence to transfer knowledge being registered at UF and its greatests willingness to do so showing in CM. Of course, other factors intervene to complicate the picture, such as the positioon and the distance between transacting firms in the framework, the availability and locations of alternative partners, and so on, yet a firm's motivational thrust remains clear. A crude analogy would be with a particle travelling through a field of forces where a knowledge item emanating from the firm is represented by a particle travelling at a speed and in a direction that is the joint product of the motivational impetus initially imparted to it by the firm given its disposition to transfer, and the forces that constitute the field set up by other bodies (firms, institutions, etc.) acting on the particle.

When taken individually, none of these interpretations will cause any surprise and each will find some support in the rapidly proliferating literature on international operations. What is new lies in the fact that whereas elsewhere they are accounted for more or less independently of each other here, through the framework, they are traceable to a single explanatory scheme unifying three theoretical strands: organizational theory for the treatment of codification and uncertainty, industrial economics for that of diffusion, and institutional economics for the analysis of different types of transactions.

Nevertheless, the propositions derived from the C-D framework enjoy no more than an informal, and by no means universal corroboration from the empirical data of the case studies, and some of the limitations of the exercise must be reaffirmed. Firstly, insofar as the C-D framework claims to be a contribution to theory building, it confronts the dilemma first described by Duhem (1954: 183-190) that generally, the test of a theory is in fact a simultaneous test of several hypotheses derivable from the theory and that no single hypotheses is falsified by a test. The C-D framework itself could be described as the major hypothesis of the study and the propositions derived

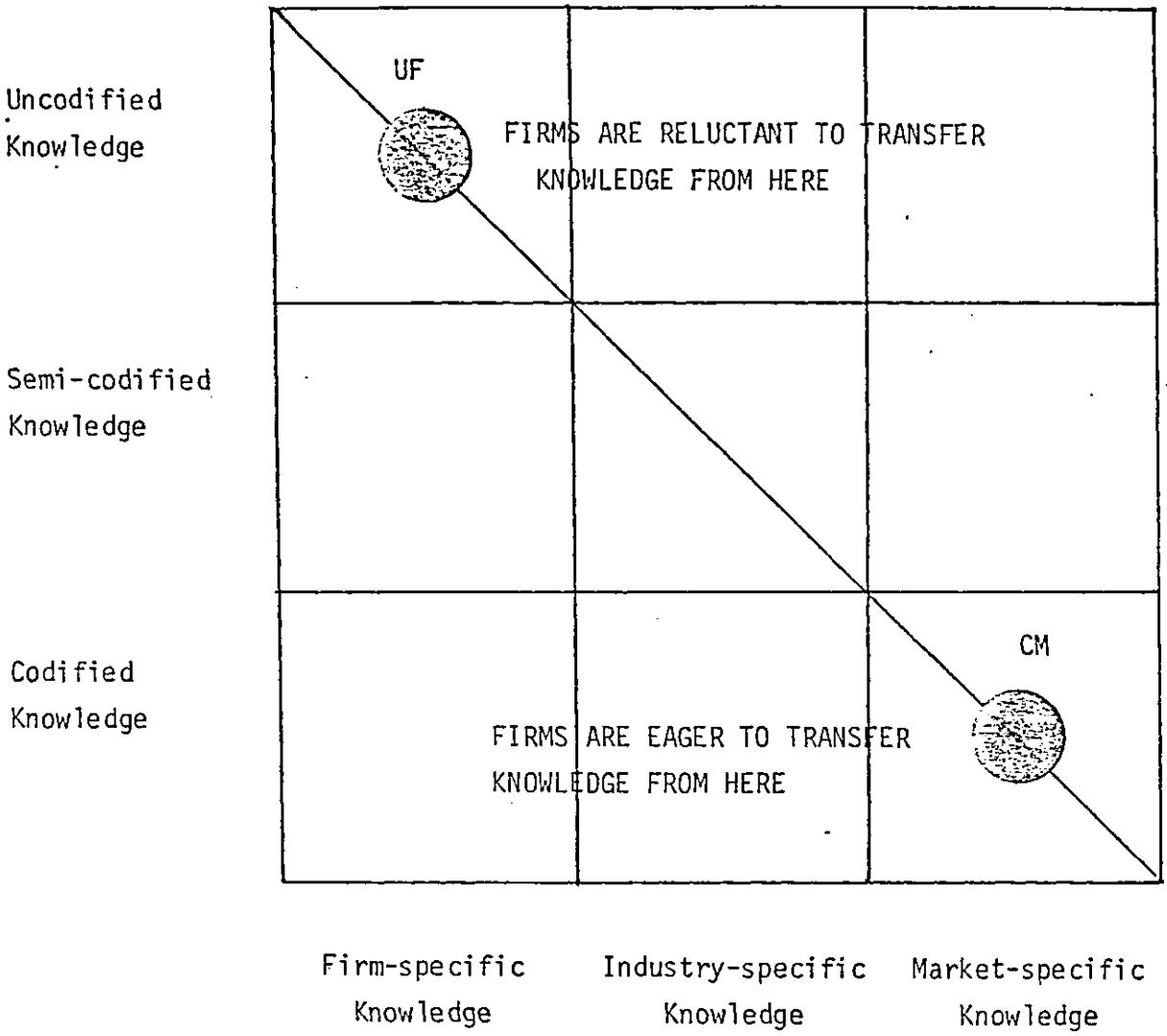


FIGURE 6.1

THE MOTIVATION TO TRANSFER

therefrom as auxiliary hypotheses, that is, correspondence rules that set out the procedures for attaching the major hypotheses to empirical phenomena. Auxiliary hypotheses are potentially unlimited and by suitable adjustments they can be used to prevent or delay the falsification of the major hypothesis (Causey, in Suppe, 1977: 398). Secondly, the propositions here put forward as auxiliary hypotheses sin by omission: they lack the articulation and precision that would allow for sophisticated testing. Finally, the non-specific nature of the propositions is matched by the uneveness of the case study material, which, as it stands, leaves plenty of scope for divergent interpretations of the events described, and different views of the ways these can be linked to various propositions.

How damaging are these limitations to the survival of the framework? For those who follow Popper 1959) in asking for fully testable theories, the framework, in its current state of development, remains probably too imprecise to satisfy his falsifiability criterion; they would argue that if it survives at all it may be for lack of a worthy empirical challenger. To be sure, the framework is capable of further systematic development, but whether it thereby become intrinsically more testable is questionable since it is protected from a direct empirical assault by an outer ring of defences in form of auxiliary hypotheses. That these may be strengthened and extended by a systematic articulation of the framework fails to solve the Popperian's dilemma since the major hypothesis remains no more accessible to direct testing than it was before.

A more permissive view of theories is that there are ways of representing phenomena and should be judged by their fruitfulness; they are devised to specify expected patterns of behaviour and explain deviations from them (Toulmin 1953). According to Achinstein (1968):

> "T is a theory, relative to the context, if and only if, T is a set of propositons that (depending on context) is (was, might have been, and so forth) not known to be true or to be false, but believed to be somewhat plausible, potentially explanatory, relatively fundamental, and somewhat integrated." (Achinstein, in Suppe, 1977:121).

The framework fares better under this dispensation for not only does it offer a unified explanatory scheme for the case studies and help to interpret the anomalous ones, but it is also a potential source of further theoretical development as will be shown below. The characteristics of transactions desribed in the case studies do, on the whole, point to an understanding of the strategy and behaviour of eonomic agents engaged in technology transfer activities. How consequential is such a relationship?

What does the C-D Framework Imply?

The C-D framework makes it possible to position transactions conducted by firms and individuals (in fact any type of contracting agent) according to two information attributes, codification and diffusion. Along the horizontal axis, firms themselves, taken as aggregations of transactions, can also be positioned, and while with the case study material available it has not been possible to demonstrate to feasibility of positoning firms along the vertical axis, such a feat does not appear to be beyond the reach of a more detailed empirical investigation. Additionally, a firm's disposition to enter into particular types of transaction has been shown to vary with the location of the latter in the C-D framework. If one now makes the unheroic assumption that the technology forming the object of a transaction, or in some way associated with it, can also be positioned within the framework according to how far it has been standardised (codified) and is available (diffused) then technology transfer operations become describable in framework terms through the plotting of their constituent element in the codification-diffusion space. Transacting firms, the technology transacted, and the transactional mode chosen, can all be represented together, the transactional dispositions of the parties offering a guide as to their behaviour over time within the framework.

The illustration given in Fig. 6.2 by way of example, describes the kind of licencing agreement found in the case studies (i.e., Case 19) in which a European firm (A) whose comparative strength lies in research (in UF) has a licensing agreement (in CF) in which the latter will carry out the manufacture and distribution of A's products using an established, but still proprietary technology (also in CF). The fact that the local distributor and the techno-

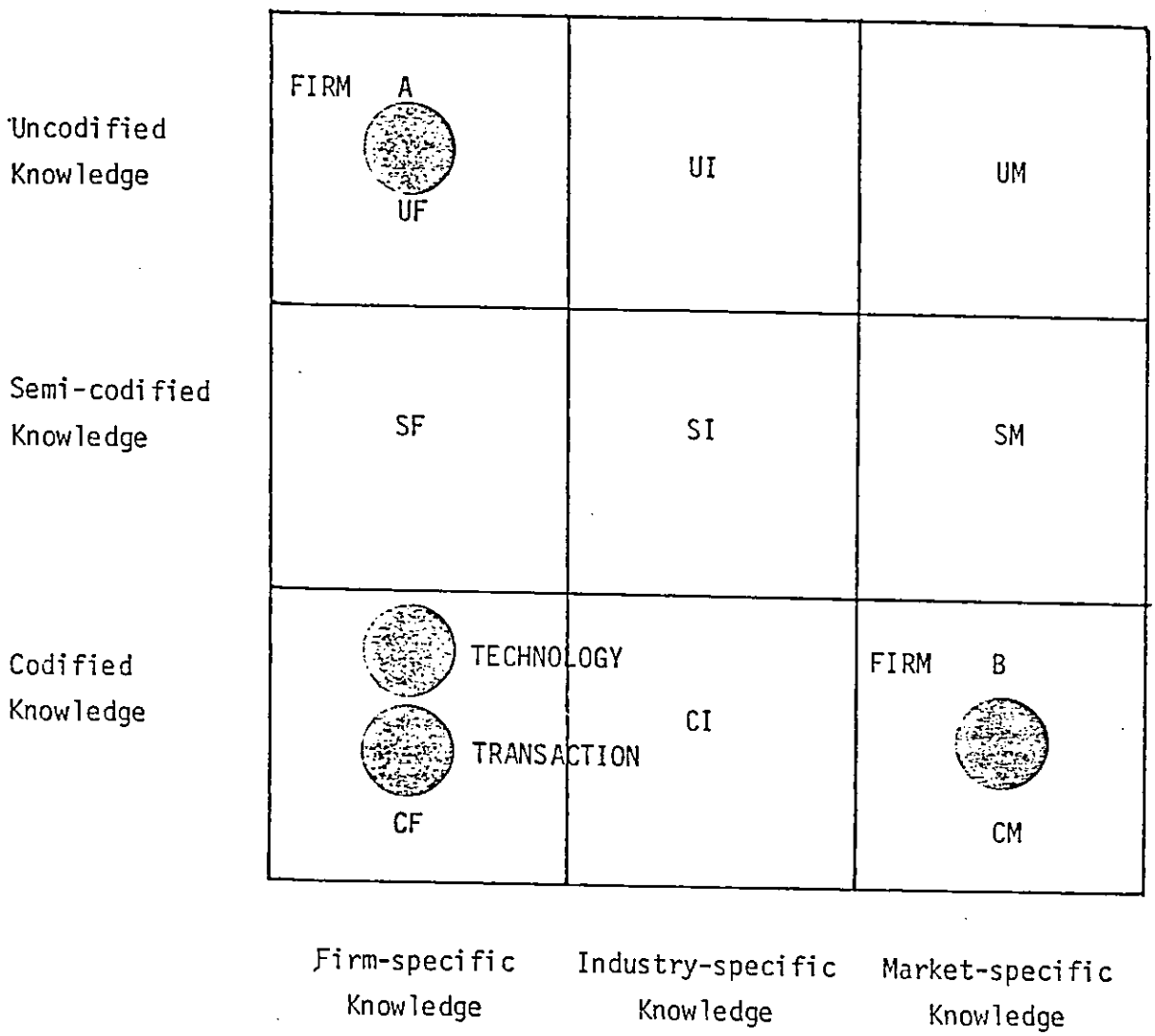


FIGURE 6.2

TRANSACTIONS, TECHNOLOGY, AND TECHNOLOGICAL POSTURE IN THE C-D FRAMEWORK

logy are both in C within the framework suggests that little learning will be required to master the technical processes that cannot adequately be transmitted through documents. Note that this would not be so if the technology involved had been, say, in SF. There, a much greater amount of interpersonal contact might have been necessary between A and B before the latter could handle the technology on its own. Note further that in such a case a much higher and more uncertain transaction cost would have been involved which would have had to be allocated between the parties. A licencing agreement, with remuneration fixed by royalties would become a less attractive transactional mode and make both A and B less disposed to transact as they haggled over who should bear the extra costs and risks. At that point they could either switch to a joint venture (i.e., a federated transaction), thus, sharing the costs and the risks, or each could go its own way with A possibly trying to set up its own production facilities locally (i.e., through hierarchical transactions). In order to assess which of these alternatives a firm will prefer, one might have to look at how it has spread its knowledge investment through the framework both in relation to its competitors and to its prospective transacting partners. The opportunity cost to a firm of transacting from a given location in a given technology would then become apparent.

Used in this way, the C-D framework becomes a descriptive tool through which effective and ineffective transactional configurations can be investigated. In a dynamic mode, it can also help to plot the evolution of a firm's, or indeed an industry's technological strength through a sequence of transactions that describe a path in the diagram. Both uses of the framework should help shed some light on some of the more elusive aspects of technology transfer operations by international firms, those concerning the behaviour of knowledge in space and in time as distinct from the behaviour of the goods in which such knowledge is embodied.

In orthodox trade theory the information content of traded goods tended to be ignored or assumed away under a perfect competition provision. Where it was a determinant of comparative advantage, its distribution, like that of other factors, was taken as fixed; where it was a determinant of market efficiency, it was taken as uniformly distributed. The first type of informa

tion was treated as a factor of production, the second as a prerequisite for market exchange. Industrial organisation economics acknowledged factor mobility and imperfect competiton; it consequently made production information more mobile and market information less so. Product life cycle theories building on these new developments hypothesized a spatiotemporal distribution of goods that expressed an evolution of their information content towards ever more standardization. The focus, however, was still on goods, the conditions and location of their production, and the terms on which they were traded. Product life cycle theories were devised to address certain problems in international trade, and there they stayed. If their treatment of information and knowledge was more realistic than that of the trade theories that preceded them, these were still given no more than a walk-on part in their interpretations. Most of the debate that has centered on international technology transfer has been framed in the language of hardware, not of software, of hard-edged economic exchange - i.e., of goods rather than information - rather than soft-edged reciprocity.

This study has taken the growth and spread of information rather than goods, as constituting an important problem for technology transfer. Only when the behaviour of information has been adequately conceptualised is it worth asking how it is manifested in exchange situations whih may or may not involve the flow of goods. The shift in perception required is subtle, but consequential, for in extending the notion of exchange beyond the realms normally governed by economists one is inevitably led to ask by what criteria the efficiency and effectiveness of such exchange are to be assessed.

No clear answer to this question can or will be attempted here. Suffice it to say that it will likely involve the cyclical flow of knowledge through the C-D framework at a speed and in a manner partly determined by infrastructural and societal conditions.

Further Developments

The case, if any, for further investigating the C-D framework and knowledge cycles, must rest on what has been presented so far, that is, reasoned arguments supported by case study evidence, and a brief examination of what consequences might follow from their adoption as tools of theoretical analysis. If such an enterprise is thought worthwhile, a fruitful line of attack must be selected. The study ends with a brief look at the scope for further research offered by the concepts developed therein.

In exploring the framework empirically, recourse to qualitative case study material was inevitable since no stable, robust, or representative measures were developed during the analysis which were amenable to rigorous statistical treatment. The use of such measures would be premature in this early stage of the framework's conceptual development. What is needed is a more intensive qualitative exploration of its behaviour under different conditions, and an extension of the number of "exemplars"[4] that can model its essential attributes. An ability to measure is a symptom of conceptual understanding, not a cause of it, and only a modest first step has been taken on the path to understanding the relationship between the flow of knowledge and its constituent forms at different stages in its evolution. Nevertheless, measurability marks an important stage of development in the growth and application of concepts and its absence here has meant a more personal approach in the analysis and a lack of commensurability across cases. It therefore seems reasonable to take the achievement of measurability itself as a medium term research objective.

Note that the two conceptual schemes presented each call for their own set of measures since the C-D framework can exist independently of the knowledge cycle and may become the object of independent theoretical development. Each will be briefly considered in turn.

The essence of measurement is the assignment of numerals to properties, objects, or events, according to rules (Stevens, 1951). To be effective it requires a clear understanding of which rules apply and which properties, objects, or events are suitable candidates for the assignment. In its current

state of development, the C-D framework applied to the international corporation limits assignments to three categories along the codification and the diffusion axes respectively: knowledge is trichotomosed as uncodified, semi-codified, and codified, on the one hand, and as firm-specific, industry-specific, and market-based, on the other. Not enough is yet known about the phenomena studied to justify the creation of more discriminating assignment rules. The first step in devising better measures must therefore be to further explore these phenomena through detailed case studies that can bring to light some of the mechanisms that affect the flow of knowledge. While this could be done for the general case, it may prove more tractable and useful if initially restricted to the technical operations of international corporations. Out of such fine-grained investigations, one may hope that a number of viable measures would emerge allowing for a much more accurate assignment within the framework of:

1. Different elements of the stock of knowledge possessed by a firm.
2. Different types of transactions entered into by a firm.
3. The various organisational units that make up a firm.
4. Firms themselves, taken as the constituent elements of an industry.
5. Finally, at the largest level of aggregation, whole countries could become candidates for assignment with the framework, and their respective technical strengths compared.

There is no reason to suppose that the measures devised to test the C-D framework would also serve to test the knowledge cycle. Although transactions provide a link between the two conceptual schemes - the cycle itself being no more than the pattern registered by successive transactions involving a specific knowledge element - they are themselves complex phenomena that may yet resist a singular representation. Accordingly, the knowledge cycle must also become the focus of detailed case studies; but here the field of investigation must be extended to cover those organisational and inter-organisational relationships critical to the cyclical flow of knowledge. Again, the hope must be that workable measures could be devised to test both for the presence of different cycles, and for the relative efficiency of various transaction modes in stimulating the cyclical flow of knowledge.

Knowledge cycles will only be made accessible to measurement when the C-D framework that houses them has been established. Yet, beyond both, the behaviour of actors that activate or inhibit knowledge creation and diffusion processes lies open for investigation. Are they playing a game and do they know it? If so what are its rules? what constitutes a move within the game and what are the opening and terminal moves that define a "play" of the game? Is this a game of strategy in which the moves of other players must necessarily be anticipated, or a game of chance in which only the workings of the knowledge cycle itself need be reckoned with? Or is it indeed a bit of both, the mix varying according to circumstances? Finally, what is the value of the game to different actors and how much discretion do they have in deciding whether or not to participate? For the time being, without knowing what measures are available to address these questions, it is easier to ask them than to outline any specific procedure for answering them.

Measures provide correspondence rules between theoretical constructs and empirical phenomena. The main thrust of any research effort in the next stage of the concepts' development must be in the direction of elaborating and refining such correspondence rules. But the endeavour will prove barren if it fails to lead to more extensive empirical applications - i.e., within firms, industries, countries, between countries, etc. - and, with the accumulation of field experience, to a more rigorous formulation of the concepts and how they relate to each other; in short, to further codification.

Table 6.1

Average Number of Employees by Transaction Mode : European Firms

Transaction Mode	No.	Sample Size
Wholly-owned	180 712	3
Joint-Ventures	85 181	21
Licensing Agreements	17 995	6

Table 6.2

Average Number of Employees by Transaction mode : European Firms with Active and Passive Local Partners

Transaction mode	N.O.	Sample Size
Wholly-owned operations and Joint Ventures with Passive L.P.'s	117 929	15
Licensing agreement and Joint Ventures with Active L.P.'s	44 664	15

Table 6.3

R & D Expenditure by Transaction Mode : European Firms

Transaction Mode	Average R&D Expenditure as a Percentage of Sales	Sample Size
Licensors	11.65%	4
Other	3.5 %	23

NOTES TO CHAPTER 6

1. Italics in the original text.

2. For an introductory discussion of Matrix Management, see Davis and Lawrence (1971).

3. See "Restrictive Business Practices Relating to Trademarks," OECD Paris (1978)

4. The term "exemplar" was developed by Thomas Kuhn (1977) to describe one of the two senses in which he used to term paradigm. The other sense he calls a "disciplinary matrix", a more integrated and cohesive version of what has been described in this study as a coding repertoire.

APPENDIX 1

FIELD QUESTION GUIDE

1. MARKET STRUCTURE

- Current size of market for output - Turnover by market area.
- Market trend: a) up; b) down; c) no change.
- % of market held by largest firm.
- % of market held by 2nd firm.
- % of market held by n^{th} firm.
- Market position of your firm in % terms:
  - i) Past
  - ii) Present
  - iii) Forecast
  - iv) Aim
- Please list your current competitors.
- How many products do you offer this market? All your markets?
- Please give your sales per product line.
- How is the market defined:
  - 1) Geographically
  - 2) By segments
  - 3) By intermediate/final consumers
- How stable is the market?
- What is the price sensitivity of the product?
- What is the degree of brand loyalty of the consumer?
- How sophisticated is the product from the customer's point of view?
- Is customer service important? In what way?
- What kind of distribution is used?
- How many customers do you have for the product?
- How many new products have you launched in this market in the last five years?
- How many new products do you aim to launch in the market in the next five years?

2. TECHNOLOGICAL DEVELOPMENT

- Is the firm's technology predominantly:
  1) Batch?
  2) One-off?
  3) Continuous?
- Please describe the basic technical processes in the industries concerned.
- What technological development of importance are occurring, or will occur in the field?
- What effects will they have on current operations?
- What technological developments have occurred in the field in the last five years?
- What effect have they had on current operations?
- Is there an investment cycle in this field and where are you placed in relation to it?
- Is this technology 'upstream' or downstream'?
- How competitive is the technology transferred? What are the competing processes?

3. ENVIRONMENTAL LINKAGES: SUPPLIERS

- Please give total number of main suppliers of both goods and services? What % indigenous?
- Please give number of main transferor country suppliers and number of total foreign suppliers.
- What is the import content of your sales?
- Is there a government maximum import content requirement?
- Has the % of local suppliers increased?
- How many independent professional consultants are used by the firm?
- How many from host country?

4. ENVIRONMENTAL LINKAGES: MARKET

- How many distribution channels do you use?
- What services are offered to the purchasers:
  1) After sales
  2) Other

- Does he have to be trained or educated by the firm to its product? If so what methods are used?
- How does the firm 'promote' itself (i.e., advertise)? And where?

5. ENVIRONMENTAL LINKAGES

- How does the firm recruit:
  a) Management?
  b) Other?
- What % of positions at different levels are filled locally? By nationals?
- What is the employee turnover per level?
- What training is offered at each level? How much? By whom?
- How much of this training is in the proprietary technology? By whom?
- What links has the firm with local educational establishments?
  i) Primary
  ii) Secondary
  iii) Higher
- Do ex-employees keep in touch with the firm? At what level? Nationals or expatriates?

6. INSTITUTIONAL FRAMEWORK

- What are the legal constraints on employing expatriates?
- How does the firm feel about such constraints?
  i) Fair
  ii) Unfair
- What constraints are imposed on the firm's ownership policies?
- What constraints are imposed on the firm's choice of technology?
- What requirements exist for the firm to export?
- What marketing requirements or constraints are imposed on the firm?
- What is government policy towards technology transfer? What is its preferred strategy?
- How does government policy towards direct investment and technology transfer affect your operations?
- What is your firm's policy towards the ASEAN countries?
- What is your firm's policy towards this ASEAN country?

7. HISTORICAL BACKGROUND AND DEVELOPMENT

- Year the firm was founded.
- Is the venture in its main line of business? Product/Markets?
- Year the firm invested in this line of business.
- Year the local operation was founded.
- What were the main steps in the growth of the firm?

8. ORGANIZATION STRUCTURE

- Please describe or supply the firm's organization chart and explain its geographical coverage.
- How many people are employed by the firm at the management level?
  - i) Parent
  - ii) Subsidiary
- Is the subsidiary free to set its own prices and level of investment?
- How frequent are the reporting relationships:
  - i) Within the venture?
  - ii) Between the venture and shareholders?
- What part of the parent organizations does the venture have contact with? And what kind of contact?

9. OBJECTIVES

- What is the venture's declared strategy? Its objectives?
- How were these arrived at?
- What is the process by which objectives are set?
- What control system is used?
- How does the strategy relate to that of the parent company?
- What is the planning horizon?

10. RESOURCE BASE: FINANCE

- What financial figures can the firm make available?
  - i) Balance sheet
  - ii) P & L
  - iii) Process costs
- How much did the firm invest in the venture?

11. RESOURCE BASE: SKILLS AND EXPERTISE

- What is the distribution of skills in the subsidiary?
- What skills from the parent are available to the venture?
- What skills from the host country are available to the subsidiary?
- What % of the management team is local?

12. RESOURCE BASE-ASSETS

- What specialist "know how" is claimed by the firm?
- What managerial "know how" is claimed by the firm?
- What patented technologies are used by the firm? By the venture?
- What proprietary equipment is used by the firm? By the venture?
- Does the firm have exclusive access to its raw materials?
- Is your know-how in process or project work?

13. RESOURCE BASE-MARKETS

- Does the firm provide access to foreign markets for the venture? Is this to all its markets?
- Does the venture sell in the national market?
- What percentage of the venture's imports from the parent re:
  - i) Finished goods
  - ii) Intermediary goods
  - iii) Raw material
  - iv) Proprietary goods
- What percentage of the venture's output is exported? Is this required by the host country?

14. RESOURCE BASE-TECHNOLOGY

- Does the firm claim a unique or specialised expertise in one or more of the subsidiary's production processes? If so name them.
- In what way has the venture's installed technology been modified in the last five years?
- Are there plans form modifying it is the future? In what way?

- How many patents does the firm hold in the technology used?
- How much of the technology does it apply under licence?
- How many licences has the firm granted in this technology? Where?
- How many other joint ventures has the firm undertaken with this process? Where?
- Does the firm operate under management contract? Where?
- What % of the firm's sales are spent on R & D? Centrally? Locally?
- What is the geographical spread of the firm's R & D efforts?
- Has the firm developed this technical process with LDC market in mind?

15. TECHNICAL PROCESSES

- Can one superimpose a "process flow" of the firm's technical operations on the firm's organization chart? On the ventures?
- How self-contained are the technical operations of the subsidiary?
- How much does the venture depend on the local infrastructure (labour, materials, etc.)?
- What specific links exist between the venture's technology and the parent company's technical support?

16. BACKGROUND TO THE TECHNOLOGY TRANSFER AGREEMENT

- Is technology transfer part of company policy? If so, what is the policy?
- Please state the basic reason why the firm undertook this venture? Was it:

    a) An unexpected opportunity?
    b) A defensive competitive move?
    c) An attempt to secure lower cost inputs?
    d) An attempt to exploit a competitive advantage?

  Please rank the above if more than one.
- What steps led to the decision to transfer?
- How did the transfer fit in with the firm's strategic requirements?
- How did the transfer fit in with the firm's operating needs?
- What criteria did the firm have for selecting a partner? For selecting a mode of transfer?
- What steps did the firm follow in seeking out a transfer partner?

- Did the firm initiate the venture?
- What contacts did the firm have with the host country prior to the venture?
- Did the firm carry out its own feasibility study prior to the venture?
- What financial criteria were applied:
    a) DFC
    b) NPV
    c) Payback
    d) Yield
    e) Other
- Where was the feasibility study carried out?
- What countries were considered and why?
- Why was this one chosen?
- How many local firms were considered eligible partners for the venture?
- Why was this one chosen?
- What different modes of transfer were considered?
- Why was this one chosen?
- How much do you feel pressurised by technical change to sell your current technology and know-how?

17. NEGOTIATIONS OF THE TECHNOLOGY TRANSFER AGREEMENT

- Please rank the elements of the negotiation in order of importance for your firm:
    1) Financial terms of the agreement
    2) Defining the elements of the transfer
    3) External constraints - government, etc.
    4) Others - Please specify.
- What were the elements in the above list that were most difficult to deal with? Easiest?
- How many parties were there to the negotiation? Who were they? Government, local authorities, etc.
- What specialist skills were used by the firm in the negotiations?
    1) Managerial
    2) Technical
    3) Professional

- What was the duration of the negotiations?
- What information was used in negotiation?
  - i) Information about the parent
  - ii) About the subsidiary
  - iii) About the processes
  - iv) About the market
  - v) About the people involved.
- Did your firm follow a standard negotiating procedure? If so what?
- How did the negotiating go?
- Who negotiated? Status, role, relationships, etc.

18. THE FORM OF THE TRANSFER AGREEMENT

- What form did the agreement take?
- What was included in the transfer?
  - i) Documents: Drawings, manufacturing manuals, equipment specifications, performance specifications, materials specifications, list of suppliers, bills of quantities, quality control manuals, manufacturing schedules, maintenance manual, training manual, standard operating procedures, plant layouts.
  - ii) Hardware: Proprietary equipment, non-proprietary equipment, raw materials.
  - iii) Services: Production training, marketing training, management training (in house or outside?), production support services, market support services, management support services.
  - iv) Goodwill: Brand name, trade mark, copyright, patent rights.

  Please check off those items explicitly mentioned in the agreement.
- What form did payments take?
  - i) Royalities
  - ii) Management fees
  - iii) Dividends
  - iv) Output
- What safeguards does the agreement contain with respect to your proprietary interests in the technology?

- What external constraints affected the agreement? Government? Tax? Other?
- Does the agreement stipulate how many expatriates shall be employed?

19. THE TECHNOLOGY TRANSFER PROCESS

- What was the involvement of respective partners in each project stage:
  a) at the management level,
  b) at the operations level.
- What control system did the firm use in setting up the venture?
- What control systems are used in running the venture?
- What documents are available (bar-chart, etc.)?
- How much of the operation was subcontracted:
  a) To firms that you have worked with before?
  b) To new firms?
- Where was the design work for this project carried out?
- How much did you have to modify current designs?
- Was this done in order to get the contract, or after?

20. RESULTS

- What was the most successful feature of the transfer operation?
- What was the least successful feature of the transfer operation?
- How well were the venture's objective met? Transferor's and transferee's.
- What were the major problems encountered?
- What lessons were learnt by this operation?
- Has the firm increased its links with the host country environment?
  i) With the market?
  ii) With suppliers?
  iii) With the labor market?
  iv) With politically relevant actors?
- What changes have taken place in the firm's organization structure?
- What changes have taken place in the firm's objectives?
- What changes have taken place in the firm's skills base?
- What changes have taken place in the firm's technology?
- How does your technology transfer experience in S.E. Asia differ from that elsewhere?

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