JAPAN'S POSTWAR EXPERIENCE WITH TECHNOLOGY TRANSFER

by

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ABSTRACT

The international transfer of technology is increasingly seen as a major element in economic development for both the developed and less-developed countries. The thesis examines Japan's postwar economic development and the role played in that process by imported, foreign technologies. The discussion focuses on commercial transfers of technology and, because of the frequent close connection between technology transfer and foreign direct investment, there is considerable discussion of foreign direct investment in Japan.

The paper is based on an extensive review of existing government and non-government material in both Japanese and English and on a series of interviews with Japanese government and business officials involved in postwar transfers. In addition, three case studies of technology transfers were carried out and are included as appendices.

Following an introductory chapter dealing with general issues of technology transfer and economic development, the postwar Japanese experience is treated chronologically for the period: 1945-1955 "Japan's Postwar Recovery", 1955-1963 "Structural Transformation", and 1963-1973 "Liberalization and Internationalization". The central importance to Japan's postwar development of the period of "structural transformation", and the technology transfer which took place during that period, is stressed.

The current status of technology transfer in Japan is also discussed and the present and future importance to Japan of technology exportation and independent technology development is pointed out.

A concluding chapter outlines major special characteristics of the Japanese postwar experience and suggest what lessons it may hold for others. It is

argued that the favourable domestic and benign international environments as well as the large size of the domestic market and a basic antipathy to foreign direct investment are all special characteristics which strongly influenced the course of postwar technology transfer to Japan. On the other hand, a competitive domestic business environment, consultation between government planners and businessmen, selective or discriminatory development policy, and widespread public support for goals supportive of technology change are all argued to be aspects of the postwar Japanese experience which hold important and general lessons for other countries.

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Introduction

This paper deals with the dual themes of technology transfer and Japan's postwar development. The separate themes are both of interest; technology transfer (TT) as a major means of directing overall technological change, and postwar Japan as the exemplar for rapid economic growth and as the first 'non-western' addition to the ranks of the advanced developed nations.

The themes are, however, interrelated. Technology transfer and overall technological development are primarily of interest because of their association with economic growth and development. Conversely, Japan's amazing postwar record of economic growth and development was accompanied by a massive transfer of industrial technology from other countries to Japan. While no claim can be made that the discussion here definitively deals with the question of the extent and nature of the relation between TT and Japan's postwar development, this joint examination of the two themes shows them to mutually illuminate important aspects of each other.

The discussion is primarily centered on commercial transfers of industrial technology to postwar Japan. This is partly because of data availability (official statistics, for example, deal almost solely with such transfers) and partly because such transfers seem to be most closely related to the main currents of postwar Japanese technological change. Further, because of the relatively explicit nature of such transfers, comparison of the Japanese experience with those of other countries will likely be easier if studies, such as this present one, concentrate on examination of commercial TT.

Extensive use is made of official government reports and statistics which are, generally, far more comprehensive in the case of Japan, because of official interest in TT during the period, than they are for other countries. This data is not without its defects and limitations but, withall, provides a depth, breadth, and continuity exceeding any other available sources.

This official data is supplemented with other Japanese-language material, relevant non-Japanese sources, and material gathered in the course of numerous interviews with informants in Japanese government and business. In addition, a series of three case studies of specific postwar TT were carried out by the writer and are included here in summary form as appendices 1., 2., and 3.

The concept 'technology transfer' has taken on a variety of meanings and, as well, is imbedded in a body of literature encompassing issues of social change, economic growth, and modernisation of far broader generality than postwar Japanese development and TT. Chapter one clarifies the concept of TT and its relationship to these broader issues. It concludes with a discussion of the relevance of the postwar Japanese experience as regards TT and some of these larger issues with which TT is associated.

The subsequent three chapters which deal specifically with the Japanese postwar experience with TT pose some organizational problems. On the one hand, the importance of various Japanese social, economic and organizational features to the overall discussion argue for treatment of the period under a series of topical headings relating these various features to postwar TT. On the other hand, the actual course of postwar TT seems to be best treated as a series of chronologically ordered stages or 'periods'.

The compromise ultimately adopted here treats Japan's postwar TT under three chronologically ordered headings with chapters two through four dealing, respectively, with; 1945-1955 'Japan's Postwar Recovery', 1955-1963 'Structural Transformation', and 1963-1973 'Liberalization and Internationalization'. Within each of these chapters various aspects of the Japanese social, organizational, and economic environment are developed as the flow of the narrative necessitates. On occasion, relevant background material has been relegated to the 'Notes to the Text' in order to maintain the continuity and coherence of the main text. The compromise adopted has led to some disproportion in the length of the chapters, and, of course, detracts from whatever incidental merit this paper might have had as an outline of the Japanese business environment, per se. It is felt, however, that there is more than compensating gain in the continuity and coherence with which the two themes which are the focus of the paper are developed.

Following this, chapter five outlines the current status of TT in Japan and suggests what will be the trends in the years ahead. The sixth, and last, chapter, discusses the 'special characteristics' of the Japanese postwar experience with TT and the lessons that experience may hold for others. Finally, some areas for further research are suggested.

A debt of gratitude is owed to the many Japanese in business and government in whose interest, time, and knowledge I indulged myself, if not always with wisdom, with little restraint. The Japanese Ministry of Education is to be thanked for their financial support during the period of study in Japan as is Rikkyo University, in Tokyo, for providing a supportive academic environment.

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I. ECONOMIC DEVELOPMENT AND TECHNOLOGY TRANSFER

1. Technology and Social Change

(a) Technology

Technology profoundly affects the lives we lead; the amount and forms of our work and leisure, where we live and the length of our lives, the content and forms of our education - in short, both the realities of the world around us and our perceptions of them. To say this is merely to echo what has become a common perception of people in the industrialized world of the central role of technology in their lives. What is somewhat surprising, however, is that some similar perception of the role of technology was absent in the pre-industrial world. For then too, no less than now, technology was a major determinant of the lives men led; of whether they plowed fields or hunted, how they did so and for whom.

Technology, of course, is and was not the only determinant of the lives men lead. It is, however, technology and mens' perceptions of it which have in the past two hundred years or so moved from being perceived, if at all, as peripheral to the concerns of mankind to being one of the central concerns. And this is true even where, as in much of the less-developed world, the basic technologies employed are little changed from those of centuries ago. For, even where modern industrial technologies have had no impact on the lives people are living, it has had enormous impact on the lives they aspire to live and on what they perceive to be the processes which will enable them to do so.

'Technology' can be defined in a multitude of ways but a useful statement, for our purposes, defines technology as: ". . . knowledge of a

vector of activities which transforms, with a more or less high degree of predictability, inputs such as resources, labour, and capital into goods and services."[1] It should be noted that the 'vector of activities' referred to both can and, taking the definition in its most generalized sense, should be interpreted as including not only the more obviously technical aspects of processes 'transforming inputs into outputs' but, also, the social environment in which productive activities take place. It is perhaps precisely these social implications of technology and the social changes at once demanded and made possible by technological change which have made technology a central concern of mankind during the past two hundred years of rapid change we now recognize as 'industrialization'.

(b) Technological Change

In terms of the above definition of technology, technological change can be broadly classified into one of two categories. The first of these, what we will here term 'new-production technology', consists in a change to a new vector of activities producing essentially the same output (goods or services) usually, but not necessarily, from a different 'mix' of inputs. To the extent that such change economizes on the use of factor inputs (at existing relative prices) it means that more goods and services can be obtained from the same amount of inputs. It is a change of this type which is most commonly referred to as 'technical progress' and which Schumpeter[2] and others[3] have identified as a prime source of economic growth.

The other broad category of technological change we will term 'new product technology'. In this instance, the change involves the use of factor inputs in the production of new, hitherto nonexistent, goods or services. Such

change, of course, invariably involves a new mix of factor inputs or a new vector of activities, or both. The significance of change of this latter type is a far more contentious issue - involving, as it does, such disparate 'new products' as the airplane, colour television, nuclear weapons, and vaginal deodorants. Controversy can centre around the extent to which such change represents a change in values - as opposed to technological progress - and, in any event, argument itself tends to involve value judgements. Additionally, there is the prior judgement as to whether, or to what extent, the change, in fact, involves a 'new product'. For, at some level of abstraction, almost any such change can be identified with some prior product and be viewed as a mere incremental metamorphosis of an existing product or as a new manifestation of a good or service meeting some immutable human need.

In fact, of course, technological change seldom falls neatly into one or the other of these two categories and almost always involves some elements of both. The value of the two concepts, therefore, lies less in their taxonomic precision than in their identification of two aspects of all technological change; the objective, in which change can be measured by some technical efficiency criterion, and the subjective, in which value judgements reflecting the social environment of change are inevitably relevant. The broader significance of this technical-social duality of technological change is especially evident when we examine the changes associated with the process of industrialization.

(c) Socio-technical Change and Industrialization

The Industrial Revolution is generally dated from 18th Century England and since then numerous other countries, mainly 'western', have in varying degrees undergone a process of industrialization. The process has

by no means been uniform from case to case. In fact, variations in starting time, initial social and non-social resources, and many incidental 'autonomous' events, among other factors, have led in various ways to a variety of forms of 'industrialized country'. It is possible nevertheless, to identify some major aspects of social change which have tended to accompany the revolution in industrial technology wherever it has occurred.

While there have been many attempts to quantify the relative importance and to establish the temporal ordering of these aspects of social change associated with industrialization,[4] we will, here, treat them under a few broad, topical headings without intending to imply relative importance or temporal ordering.

Economic organization: In traditional, subsistence economies the processes of production are largely carried on within the confines of family- or village-based groups in which barter is common and exchange relationships are importantly related to religious or kinship factors. Industrialization, in contrast to this, is associated with the evolution of a differentiated market economy in which money commands the movement of an increasingly large proportion of goods and services and traditional, particularistic, exchange relationships disappear or are greatly reduced in relative importance.[5] Of course, by definition, industrialization means that the importance of manufacturing grows in relation to the primary industries and, with this, there is increased urbanization of the population and further differentiation of work tasks and increase in the numbers and importance of bureaucratic forms of organization.

Political forms: Political change associated with industrialization parallels changes in the economic sphere. The political system comes to be separated from its traditional familial, caste or religious contexts and

takes on an increasingly independent existence. With this, political roles become, as Almond and Powell put it: ". . . more specialized or more autonomous . . . new types of roles are established . . . (and political action becomes) . . . increasingly rational, analytical and empirical. . . ." [6] As a result, the political system becomes increasingly able to extract goods and services from the society, to regulate behaviour in it and to serve as a symbol of the state as a whole.

Social structure: The reduced economic and political role of the extended family (or similar particularistic groups) which accompanies industrialization weakens traditional sanctions and controls on behaviour. This is reflected, for example, in a tendency for universalistic, rational considerations to supplant those of nepotism in the hiring practices of economic organizations. There is, similarly, a tendency to greater individual and inter-generational economic and social mobility as the particularistic traditional roles and sanctions diminish in importance.

Ideological change: With (some might say prior to) industrialization there is usually a shift from a static and fatalistic view of society and mankind to a belief in both the potential for and ethicality of change. Further, there is a tendency for nationalism to replace or subsume existing religious ideologies and, often, to serve as a means of sanctioning many of the drastic changes in traditional social forms brought about by industrialization. [7]

Considering the depth and breadth of the social changes associated with industrialization one might well wonder that it should have occurred at all, let alone in a variety of countries. More than this, one might wonder that people would intentionally court such drastic social upheaval by seeking

to set their nations on the path to industrialization. One might wonder, that is, were it not for the fact that the small proportion of mankind which has managed to industrialize is almost universally deemed to live better, fuller, and less brutish lives than their brethren in the non-industrialized world. It is precisely that fact which has made industrialization not a social trauma to be avoided but, rather, a goal for most of humanity and the most successful ideology of modern or perhaps of all, times.

2. Technology and Development

(a) The Ideology of Industrialization

It has now long since been demonstrated that the complex of socio-technological change we term 'industrialization' has the capacity to improve the lot of man. It has only recently, and then only in the most industrialized countries, become evident that there can also be excessively high social and environmental costs associated with industrialization under certain conditions. Even where these costs have become apparent however, the impulse, with a few exceptions, is not to seek a return to the pre-industrial or less-industrialized condition but, rather, to adjust the form of industrialization - perhaps through further innovation - so that the same or a higher level of industrial or "post-industrial" society can be maintained at a more acceptable level of social and environmental costs.

This same tendency to view industrial technology - extant or as yet unknown - as the panacea for the ills of mankind is perhaps even more evident in the less- or non-industrialized countries. Indeed, in these countries, the words 'modern', 'advanced', and 'developed' have become all synonymous with industrialization. In these countries however, unlike the industrialized countries which are concerned with incremental adjustments

to the form of their industrialization, industrialization and the change and adaptation which it implies have yet to occur or have only just begun.

A great deal of theoretical and empirical effort has gone into examination of the 'industrialization-modernization' process. Most of this effort has involved analysis of the historical processes of industrialization in the western, developed nations[8] and most of our understanding of industrialization and its concomitants derives from such analyses. However, in contrast to these relatively undirected historical processes of industrialization, today men in both the developed and undeveloped countries consciously seek to, in the former case, shape the further evolution of their industrialization and, in the latter case, to initiate and maintain an industrialization process. In this important sense then, industrialization has ceased to be, if indeed it ever was, something that could be viewed as a 'natural process' and has become both an ideology and a strategy for development. This is most clearly evident in the less-developed countries which face the difficult task of trying to reshape what has, in the past, seemed to be an evolutionary process into a directed, revolutionary transformation of their societies.

(b) Government, the 'Private Sector', and Technological Change

Regardless of political persuasion; socialist, communist, or capitalist, industrialization or further industrial development has become a central goal of governments everywhere. Moreover, the political implications (in the non-doctrinaire sense) of industrialization, and the change and conflict it implies, bear no simple relationship to political categorizations based simply on the ownership of the means of production. The challenge to traditional values and institutions implicit in industrialization extends far beyond the economic sphere and to some degree or another can touch on all that comprises a culture. In reflection of this, there remain

considerable differences among existing industrialized countries and one can expect further 'variants' to appear as the presently underdeveloped countries, representing a broader cultural spectrum than the pre-industrial west, achieve their industrialization.

But, regardless of the cultural setting or the political doctrine which prevails it is clear that successful industrialization is dependent upon both the government (leadership) and the private elements (masses) in a society. While both elements need not be positively committed to industrialization and change at least one must be so committed (most often the leadership) while the other is at least more or less amenable or positively responsive to the process.

The role of government may extend to the detailed planning and administration of industrialization or may be confined to a passive responsiveness to private sector initiatives (and it is here that doctrinaire political ideologies can play a major role). But, almost invariably, the government serves as a source of national sanction for much of the more traumatic change associated with industrialization. The 'national interest' is invoked - with varying degrees of success - as a justification for the resolution of the internal conflicts and the passing of traditional values and institutions which accompany industrialization.

Even where, as in much of the less-developed world today, there is a strong governmental commitment to and central planning for industrialization, the importance that there be motivation for change supportive of industrialization among the masses of society is evident. This need not, of course, be perceived by the masses as a motivation related to the industrialization process. It may, at root, be as diffuse and personal a motivation as the desire for personal advancement.[10] Of course, the mere

prospect of a 'better life' can provide such motivation but - and this is a crucial point - it must be a motivation sufficiently strong as to overcome man's inherent conservative nature. As W. E. Moore has put it:

> Given the option, or even the knowledge of alternatives existing elsewhere, . . . most people in most places prefer food to hunger, health to sickness, physical comfort to suffering and life to death. Whether they also prefer work to "leisure", urban agglomeration to village life, close temporal synchronization to the uneven pace of traditional production is more doubtful, and it is at this level that problems arise in the process of development and industrialization.[11]

Even where conditions in the government and private sector are favourable for industrialization there remains, of course, the further requirement of industrial technology or the means of acquiring it. In the developed nations this requirement is met both by a domestic innovative capability and by acquisition from other developed countries. In the less-developed countries, however, there is, most often, neither the capability nor the necessity to develop technologies domestically as these can be acquired on one basis or another by means of transfer from more developed countries.[12]

3. The Role of Technology Transfer

(a) Varieties of Technology Transfer (TT)

As the term 'technology transfer' (hereinafter, 'TT') is used with a variety of meanings, it will be useful to clarify the sense in which we will use the term here.

First, a useful distinction can be made between 'vertical' and 'horizontal' transfers. Vertical TT refers to the process of moving from basic scientific knowledge to a new product or production process. This need not take place within a single organization (or country, for that matter). It is, in essence, a process of relating abstract knowledge to human needs first, conceptually (as in applications research) and, second, in practice (as in the manufacture of a new product or start-up of a new production process).

In contrast to this, horizontal TT can be viewed as the transfer of an existing technology meeting specific needs in one environment to another environment - in order to meet identical or similar needs. Transfers from one company, industry, or country to another would all be examples of horizontal TT. The last of these, TT across national boundaries, is the particular sub-type of TT of concern to us here - international transfer of technology. Hereinafter, unless otherwise indicated, 'TT' will signify such international transfer of technology.

A second, or further, distinction is often made between TT to developed and to less-developed countries. Though the conceptual reasons for making the distinction are often not made explicit, in most cases it corresponds with the view that, in the case of the developed countries, TT is largely a matter of economic or technical factors (eg. market size, levels of income, transportation costs, sources of supply, etc.) while, in the case of the less-developed country, it is much more profoundly affected by 'non-economic' or social factors (eg. levels of education, values, social structure, etc.).

In a sense, then, this further distinction can be viewed as being between international TT across <u>national</u> boundaries and TT across <u>cultural</u> boundaries - with an implicit dichotomy between the cultural forms 'modern, industrialized' and 'other'.[13] While the distinction is obviously a simplification which obscures a great deal of variety within both categories it does accord in a broad, intuitive, sense with reality and we, here, will also adopt this distinction where it seems appropriate.

Finally, a series of further conceptual distinctions can be made as regards the form in which technology is transferred. Technology can be transferred by international movements of ideas, people, literature, etc., and the actual TT may or may not be the primary, explicit purpose of the

activity. The international transfer of products - especially producer's goods and the information required to use them - can also be a transfer of technology. The purposive international transfer of technology is, however, most often associated with commercial ventures - with the main alternative forms being foreign direct investment (FDI) and licensing. This is not to say that such transfers are, in sum, more important than (or, even, always clearly distinct from) other forms of TT. In fact, such commercial transfers themselves usually involve movement of ideas, people, products and written documentation as a necessary part of carrying out the TT. It is true, however, that the concrete, delimited, and contractual nature of such purposive, commercial, transfers makes them both more evident and more amenable to examination than are other forms of TT. Moreover, they tend to be more 'controllable' than other forms of TT and thus of greater interest to persons with either an academic or concrete, applied, interest in TT. In reflection of this, most discussion of TT - including this present one - focuses on such purposive, commercial, transfers of technology.

(b) Technology Transfer as a Process

A great deal has been written, largely by economists, about the broader subject of technological change because of its association with economic growth.[14] Comparatively little in the way of theoretical models has been developed for that sub-species of technological change which is implicit in TT. There are, however, two models drawn from international trade theory which have found some application in discussions of TT and which deserve brief mention here.

First, there is what we might term a 'dynamic comparative advantage model' of TT. The (static) comparative advantage trade theory leads to the conclusion that nations will tend to specialize in the production of those

things in which their relative efficiency (vis-à-vis other nations) is greatest and to exchange some portion of that production for goods for which other nations possess a comparative advantage in production. There is, however, much evidence that comparative advantages are not, in fact, static over the longer term and, as comparative advantages change, production of various goods tends to shift from one country to another. This shifting of production implies that a transfer of production technology may take place, and in this sense the trade theory suggests a model of TT as a process. Unfortunately, models of this sort seldom provide much insight into the factors which lead to a change in comparative advantage and, thus, tend to beg crucial questions as to the primal causes of such TT. Nevertheless, something like the process suggested seems to account for some types of TT. Perhaps the classical example would be the repetitive transfer of the textile industry and its technology to successive areas of lower-cost labour.

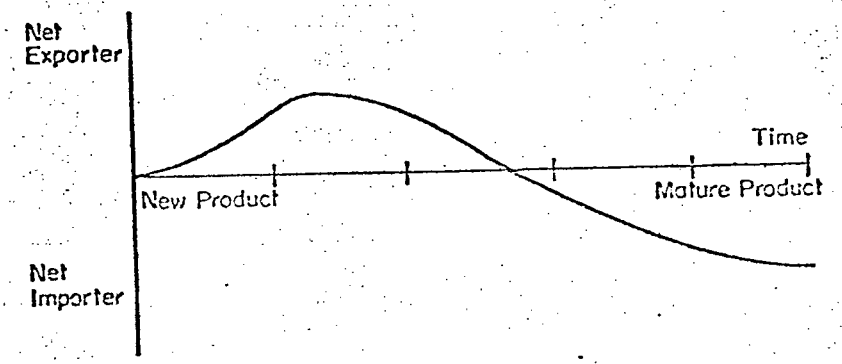
The second model, the 'product life-cycle model', is closely associated with Raymond Vernon and his associates at Harvard.[15] As Vernon puts it, the product life-cycle approach: ". . . puts less emphasis upon comparative cost doctrine and more upon the timing of innovation, the effects of scale economies and the roles of ignorance and uncertainty in influencing trade patterns."[16] This approach takes the view that innovation - in the sense of the actual application of a new production technology or the production of a new product - is not a random event. The potential for an innovation is likely to be first appreciated by an entrepreneur in or of the major potential market for the innovation. Though the approach need not be limited to innovations originating in the USA it is conventional to use the US case in discussing the model. In the US case, market characteristics (eg. affluence) and relative factor costs (eg. high-cost labour) tend to

generate the recognition of opportunities for labour-conserving and high-income consumers' goods innovations.

The model further argues that the initial production of these goods, also, will take place in the US - despite the fact that the inputs and costs associated with the initial production process might argue for production overseas for export to the US market. This will be so, the model argues, because, on the one hand, the unstandardized and evolving form of the new product requires prompt feedback from and response to market preferences as they are revealed and, on the other hand, the firm, typically, faces a relatively price-inelastic demand curve since such new products usually are something of a 'luxury item' initially and in any event are difficult for the consumer to compare on the basis of price. This inelasticity of demand reduces the pressures to seek out the lowest-cost location for production. As the product becomes standardized and the domestic and export markets expand however, the balance of incentives shifts so that either foreign producers or foreign subsidiaries of the US innovators are established to meet foreign, and then US domestic demand (see figure 1 on page 14).

Thus, the product life-cycle approach also provides a model for TT with the transfer of a production technology being a function of its own degree of standardization and of local market conditions in the recipient nation. This model, like the comparative advantage model, does not address itself to some fundamental questions - in this latter case, for example, to the primal causes of changes in non-US markets which create the conditions necessary for TT to them. Nevertheless, this model, too, seems to account for some types of TT - particularly TT of production technologies for many of the consumer durables goods.

Figure 1. A Schematic Presentation of the U.S. Trade Position in the Product Life Cycle



Phase I	Phase II	Phase III	Phase IV	Phase V
All production in U.S.	Production started in Europe	Europe exports to LDC's	Europe exports to U.S.	LDC's export to U.S.
U.S. exports to many countries	U.S. exports mostly to LDC's	U.S. exports to LDC's displaced		

Source: L.T. Wells (ed.) The Product Life-Cycle and International Trade. Boston, Division of Research, G.S.B.A., Harvard University.

Both of the models discussed, however, share two characteristics which limit their value as models of TT. In the first instance, they do not begin to encompass more than a small part of the total complexity which inheres in issues of society and technology and, thus, in the issue of TT. On this point, the product life-cycle model is probably the more satisfactory of the two. In the second instance, both models conceptualize TT as a more or less 'natural' process, that is, as a process arising from existing environmental realities. This, of course, has (an intended) value in seeking the, or some of the, underlying environmental factors which favour TT. In fact, however, TT (along with industrialization, itself) has become one of the means consciously used by nations everywhere - often in spite of underlying realities inimical to the TT - to further extend or to initiate and maintain their industrialization.[17]

(c) Technology Transfer as Directed Change

In both developed and less-developed countries nations seek to shape their own destinies. In both cases technology plays an important role in national development policies which incorporate various laws, regulations, and incentives related to technological development. It is a fact that the bulk of modern industrial technology is possessed by a few developed nations and, of them, the US is by far the best endowed.[18] One study of 110 significant postwar innovations found that 60% of them were first commercially exploited in the USA.[19] Despite this, US dominance of world trade in manufactures has not increased but has, in fact, decreased somewhat, even in the 'science-intensive' manufactures, as a result of TT to the other developed countries.[20]

Among the developed countries at least, TT has been a fairly efficient activity.[21] In the less-developed countries, however, TT has been

complicated considerably by problems of 'social engineering' - such as those alluded to earlier (see pp. 4-6).[22] Increasingly of recent years, however, both developed and less-developed countries have concerned themselves not just with whether TT takes place but also with the form in which it takes place. While there are those who argue that the foreign direct investment form of TT may be the most efficient form[23] or even that in certain cases it may be necessary,[24] there is a contrary tendency for governments, increasingly, to encourage other forms of TT not involving foreign direct investment. This is, primarily, not a reflection of the technical efficacy or ineffecacy of the FDI mode of TT but, rather, of its association, real or imagined, with 'economic imperialism' and of the diminished sense of control engendered in governments and nations by the presence of foreign companies or their subsidiaries.[25]

As a consequence, governments are increasingly seeking, in their efforts at directed change of their societies, to ensure not only that appropriate technologies are transferred at the right time but also that they are transferred in a form which impinges as little as possible on feelings of national sovereignity and independence. In practical terms, this has been evidenced by a preference for TT which involves, not foreign direct investment, but the licensing of indigenous companies to use foreign-developed technologies. There has also been a parallel tendency, at least in the advanced developed nations, to try to encourage the developemnt of the indigenous capacity for technological innovation.

4. The Relevance of the Postwar Japanese Experience

Much has been written of the postwar Japanese "economic miracle", and understandably so. Not only is Japan the most recent addition to the ranks of the developed (some would say affluent) nations, but it is also

the first of the "non-western" nations to unequivocally reach that stage of development. As such, present day Japan has come to serve as an oft-used point of reference or "test case" for assessing the generality of theories and hypotheses as to the concomitants of the advanced industrial state. Similarly, the Japanese process of modernization and industrialization is examined for the clues it may provide regarding that process in general.

In either case, however, the importance of developments prior to World War Two quickly becomes apparent. As regards the Japanese adaptation to industrialization, there is continuing debate as to exactly when this can be said to have begun but, in any case, there is general agreement that it began at least as early as the late Nineteenth Century. Indeed, recent scholarship stresses the importance of social and economic developments during the period of self-imposed international isolation in the Tokugawa era (1600-1868) for the subsequent, and more obvious, process of modernization/industrialization.

Similarly, the importance of the importation of foreign technology to Japanese development is not of recent origin. Such technology transfers have had major impact since at least as early as the Seventh Century wave of T'ang Chinese influences which swept through Japanese society, irrevocably (though not immutably) altering it and influencing all subsequent development. Moreover, even if we confine ourselves to modern, industrial technologies we find the beginnings of such TT lie in the late Nineteenth Century and in some cases preceded the formal reopening of international contacts in the 1850's.

In short, considered from the broad standpoint of economic development and technology transfer outlined in the preceeding sections of this chapter, an examination of the postwar Japanese experience can only be a part of the

story. The threads of social, ideological, political, and economic change which trace Japan's modern development do not begin with nor were they severed by World War Two. But, granting some fundamental "seamlessness" to history, there remain persuasive reasons for focussing on the postwar period.

There is, first, the fact that the use of World War Two as an historical dividing line is more than a convenient convention. It reflects, rather, a major turningpoint in world political, ideological, and economic groupings which, in itself, would justify the treatment of the postwar period as a separate era. This is perhaps particularly true in the case of Japan which, as a result of World War Two, was for the first time in its history occupied by a foreign power and, moreover, by a power intent on effecting a fundamental transformation of Japanese society.

A second reason for focussing on the postwar period relates to the very drama and rapidity of Japan's postwar development which also tends to distinguish it from the prewar period. In part, of course this drama and rapidity are more apparent than real. The state of devastation and poverty from which Japan's postwar development began creates an artificial appearance of foreshortened, rapid, development from extreme poverty to affluence and obscures Japan's impressive prewar record of modernization and development. And yet, even allowing for the distortions arising from wartime destruction, Japan's postwar development remains a much more rapid and dramatic process than that of the prewar period. This is true not only as regards such gross aggregate indicators of development as GNP but also as regards structural and qualitative measures of development. Thus, for all its considerable industrial development, prewar Japan remained a largely agricultural society with as much as 50% of its employed population engaged

in primary industry as late as 1930. As against this, the percentage of persons employed in primary industries fell from 48% to 19% in the twenty years between 1950 and 1970. In fact, if we consider the structure of Japanese employment in terms of the three categories, primary, secondary, and tertiary, the primary industry group moved from being the most important (41%) to being the least important (25%) in the brief ten years from 1955 to 1965 (see table 1.).

Similarly, the content of Japan's prewar industrial output had never seriously challenged that of the developed western world in the international marketplace except where Japan's lower labor costs and/or lower quality (thus lower price) provided economic advantage in some few industries and markets. Again, the postwar record is startlingly different. Japan's ability to compete in export markets rapidly shifted from the relatively simple-technology products of light industry to complex-technology products of heavy industry in direct competition with a broad range of the industrial output of the developed western nations (see table 2.).

This second point suggests, or can be reformulated into, a third reason for focussing on the postwar period. Many non-western (and, for that matter, western) nations have launched development programmes aimed at attaining the levels of industrialization common in the western developed nations. Many of these, notably including prewar Japan, have made considerable advances along the path to industrialization. In all too many cases however, the gap between these countries and the advanced nations has remained relatively unchanged, or widened. Thus of all the "takeoffs" in industrial development, to borrow Rostow's term, postwar Japan is one of the very few to have arguably "arrived" at a point of equality with the advanced western nations. To focus on this "arrival process", on, that is, the postwar

Table 1

Trends in Employment by Industry Category: 1920-1970

Category / Year	PRIMARY		SECONDARY		TERTIARY	
	Employed persons	%	Employed persons	%	Employed persons	%
1920	14,672,164.	53.82	5,597,905.	20.53	6,463,586.	23.71
1930	14,710,820.	49.67	6,002,032.	20.26	8,836,206.	29.83
1940	14,392,482.	44.31	8,442.502.	25.99	9,429,391.	29.03
1950	17,208,447.	48.30	7,811,950.	21.93	10,568,475.	29.67
1955	16,111,216.	41.04	9,219,905.	23.48	13,928,005.	35.48
1960	14,239,420.	32.57	12,761,770.	29.19	16,703,590.	38.21
1965	11,737,950.	24.64	15,242,410.	32.00	20,622,955.	43.30
1970	10,087,190.	19.36	17,705,915.	33.98	24,297,675.	46.63

Source: Jinko Mondai Shingikai (Population Council).
Nihon Jinko no DoKo - Seishi Jinko o Mezashite
(Japanese population trends - towards a stable population).
- Japanese - 1974, pp.326-327.

Table 2.

Trends in the composition of Japan's "Top Ten" Export Items (1950 - 1971)

Year / Rank	1950	55	60	61	62	63	64	65	66	67	68	69	70		1971
1	Cotton Textiles														Steel
2	Steel														Automobiles
3	Non-Ferrous Metals														Ships
4	Silk (raw)														Metal Manufactures
5	Rayon Textiles														Radio Receivers
6	Marine Products														Synthetic Fibres and Textiles
7	Ships														Motorcycles
8	Clothing														Scientific Opticals
9	Metal Manufactures														Television Receivers
10	Silk Goods														Tape Recorders
	(New entries to Top Ten)	○ Rayon Fibres	▲ Scientific opticals ○ Radio receivers ◎ Toys	○ Automobiles		◎ Chemical Fertilizers	○ Synthetic Fibres and Textiles				○ Tape Recorders	◎ Television receivers	◎ Synthetic Plastics	○ Motorcycles	△ Television receivers	

Source: Hayashi, Yujiro ed., Sekai niKakeru Nihonuo Gijutsu (Japanese Technology Challenging the World - Japanese - Takyo, Kogakusha,1972. p.55

period, is to focus on a particularly significant stage in the development process and on the role that TT plays in that stage.

Finally, Japan's postwar transformation to advanced industrial status was, in fact, accompanied by major technological changes and importations of foreign technologies and these appear to have been not incidental but, rather, fundamental to that transformation. Moreover, while these imported technologies were increasingly sophisticated, state-of-the-art, techniques leading to increased Japanese ability to compete with their technology supplier-competitors in the developed nations, Japan managed to acquire them without any major penetration of its economy by foreign direct investment (see table 3 on page 23).

Thus the Japanese postwar experience with TT is of particular interest. It appears to be perhaps the most dramatic and successful example of TT in the service of national goals and aspirations in the postwar world. It can be argued, moreover, to illustrate a critical, and relatively unique, period in the development process - the transition from "developing" to "developed" status. At the same time, the apparent significance of technological change in postwar Japan suggests that an examination of the period from the standpoint of TT can yield useful insights into that period of Japanese history.

Table 3.

International Comparison of the Share of Enterprises with Foreign Ownership (E.F.O.'s) in Manufacturing Industry.

Country	Year	Share of E.F.O's(%)	% of Foreign Ownership	Parameters
Canada	1969	58.1	25%+	Sales
Japan	1970	3.0	20%+	Sales
Belgium	1968	33.0	n.a.	Turnover
Finland	1970	7.0	15%+	Turnover
France	1970	10.0(a)	20%+(a)	Turnover
Germany (West)	1970	21.3	50%+	Turnover
Netherlands	1971	18.9	1%+	Turnover
Sweden	1970	9.7	20%+	Turnover
Turkey	1968	7.6	10%+	Turnover
United Kingdom	1963	9.1	n.a.	Sales

Source: O.E.C.D. Interim Report of the Industry Committee on International Enterprises, Paris; Publications Centre, 1974, p.6.

Note: (a) estimate

II JAPAN'S POSTWAR RECOVERY (1945-1955)

1. Japan in Defeat

In the aftermath of World War Two, the Japanese faced an enormous task of reconstruction. If in the days immediately following surrender the capital city of Tokyo showed less evidence of destruction than many European capitals, it was only because the combination of wood construction and fire-bombing had made the destruction more complete and turned much of the capital city into a neat, but lifeless, plain of ashes. Very quickly, of course, makeshift buildings arose out of the waste as people struggled to establish and maintain a new subsistence for themselves.

While the majority of the Japanese concerned themselves with the immediacies of a catch-as-catch-can existence, those few who had the time, or responsibility, to consider the longer-term issues of postwar reconstruction were seldom optimistic about Japan's chances of returning to the status of an advanced industrialized nation. There was much to support such pessimism.[26]

The loss of the war meant the loss of Japan's major export markets and sources of supply as the 'Greater East-Asia Co-prosperity Sphere' was dismantled. The loss of overseas territories was also accompanied by the repatriation of 6,220,000 overseas Japanese expatriates between 1945 and 1949 - accounting, along with natural increase, for an increase in population density on the main islands during the same period from the prewar level of 145.9 to 211.9 per square kilometre.[27] At the same time, there had been considerable losses of industrial assets through

bombing and, in the overseas territories, through confiscation (see table 4 on page 26).

2. The Prewar Legacy

(a) National Ambition and Cohesion

Despite the considerable material and psychic damage suffered by Japan in its defeat and occupation by an alien army, the nation still possessed many resources and characteristics favourable to redevelopment. Perhaps foremost among these was the racial and cultural homogeneity and sense of nationhood which had played such an important role in Japan's prewar development. Allied with this was a national, or racial, pride which from the earliest days of Meiji set a national goal of equality with the advanced nations and which goal, in turn, both sanctioned and imbued with national purpose much of the prewar industrialization of Japan.

True, this same spirit of nationalism and ambition was strongly implicated in the rise of Japanese militaristic imperialism and, ultimately, in the agony of the Pacific War. It was soon to be evident however that defeat, for all the disrepute it brought down upon the militaristic leaders and their policies, did not diminish Japanese national ambition and fundamental cohesion but, rather, rechanneled it into a non-militaristic search for, first, recovery to prewar standards and, then, for equality in standard-of-living, if not in military power, with the advanced countries of the west.

Table 4

Japan's World War Two Losses of Assets

Losses of Assets as a Percent of National Total

	A	B
Overall	25.4%	101.1%
Construction	24.6	89.4
Harbors & Waterways	7.5	123.3
Bridges	3.5	121.2
Industrial Machines & Tools	34.3	180.6
Roads & Railways	7.0	106.6
Vehicles	21.9	92.4
Shipping	80.6	56.8
Electricity & Gas Plants	10.8	148.1
Telegraphs & Broadcasting Equipment	14.8	109.9
Waterworks	16.8	106.8
Personal Goods & Possessions	21.6	94.6
Furniture, Household Effects	20.6	93.7
Manufactured Goods	23.9	106.6
Precious Metals	4.5	35.7
Miscellaneous	20.0	190.3

A=direct & indirect losses as a proportion of total remaining assets at the close of hostilities.

B=total remaining assets at war's end as a proportion of total assets in 1935.

Proportional Losses of Industrial Assets

	High Rate of Loss		Others	
Power	Oil Refining	58.0%	Thermal Electricity	30.2%
Iron & Steel	Pig Iron	24.5	Carbon Steel	14.4
Nonferrous Metals	Aluminum	23.9	Electrolytic Copper	22.1
Machinery	Vacuum Valves	55.7	Machine Tools	25.0
Chemicals	Sulphur	54.1	Cement	27.0
Textiles	Carded Wool	42.4	Paper Pulp	10.4

Source: Yamamoto, Noboru

The Modernization of the Economy and Postwar Expansion

Tokyo, International Association for Educational Information, 1973. p.27.

(b) Government Initiative

Japan has been politically unified since the 17th Century and has a long history of strong central government as well as hierarchical traditions supportive of such centralized government. Since the Meiji Restoration of 1868, at the latest, one reflection of this has been a close involvement of government in the planning and implementation of Japan's industrialization and a high degree of government-business interaction. This tradition of central government guidance of the economy was reflected in a competent, and prestigeous, bureaucracy which was to prove a further asset in Japan's postwar reconstruction and developemnt. It is important to note, however, that the effectiveness of central leadership was not simply a function of prestige, competence, and power (though, especially in the early postwar period, it possessed an abundance of these) but also of a tradition and a capacity for consultation and compromise possessed by both the central political and bureaucratic leadership and by leaders in the business world.[28]

The initial goal of leadership was to recover Japan's political sovereignity and economic independence. To this latter end, plans were formulated to revitalize and modernize the basic industries (eg. steel, electric power) and to develop an export trade for light manufactures. In this connection, the technology gap between Japan and the developed nations of the West was officially recognized as early as the first White Paper on Science and Technology in 1949. This gap reflected in part the isolation of Japan in the 1930's and 1940's and in part the less advanced state of Japan's industrialization.

(c) The People

If Japan's industrialization was technically not as advanced as in the West, its social adaptation to industrialization was well advanced. Indeed, the disciplines and demands of the militaristic 30's and the Pacific War on both the military and civilian population may have served to further break down traditional attitudes antagonistic to industrialism. In terms of overall levels of literacy and education, Japan already ranked high compared to other countries. The educational system was of course not immune to the disruptions of wartime but, with the return of peacetime, Japan was providing by the end of the 1940's a compulsory, primary education to over 99% of school-age children (as had been done since as early as the 1920's) and, of these, well over 40% were proceeding to high-school studies.

It is true, of course, that the Japanese social adaptation to industrialization exhibits distinct differences from the "Western model". These differences are most remarked upon by foreign observers as regards the social organization of work. In contrast to the western tendency to emphasize individuality, emotional neutrality, fundamental equality, and universalistic performance standards, the Japanese work environment tends to emphasize group orientation, emotional commitment, hierarchy and particularistic performance evaluations.[29] For all that, however, it has proved to be an extremely viable form of adaptation to industrialism. Moreover, in all its essentials it was already a 'fait accompli' by the 1940's. Thus, in terms of the problems of social engineering which hinder development in much of the world, Japan was well situated at the

end of World War Two to close the technology gap with the West - given the opportunity to do so. On this latter point - the opportunities to be afforded Japan in the postwar era - much depended upon the policies to be adopted by the Occupation forces.

3. The Occupation, Redevelopment, and Technology Transfer

(a) Occupation Policies

The occupation authorities (nominally Allied, but in fact American) did not adopt a rapacious attitude towards Japan. Indeed, their policy objectives of "demilitarization and democratization" were probably as popular as any such externally imposed policies could have been. Nevertheless, the scope ofproposed reforms was extremely broad and, specifically, included policies aimed at 'economic democratization and demilitarization' which, however lofty their objectives, implied a further, postwar, rending of the Japanese social and economic fabric - rather than rapid recovery.

The most prominent of these economic policies was aimed at the dissolution of the 'zaibatsu' - financial combines - and other 'non-democratic' concentrations of economic power. The fundamental motivation for these policies was ideological and aimed at: ". . . transforming a small number of monopolistic combines into numerous competing units . . . (to) . . . erect a solid bulwark against the spread of ideologies or systems destructive of both free enterprise and political freedom under democratic capitalism." [30]

It was, however, for essentially the same sort of ideological reasons that many of the more sweeping reforms proposed were never, or only

superficially carried out. With the victory of the Chinese Communists and the emergence of the 'cold war' with the USSR, the value of Japan as an economically viable, non-communist, ally of the US took precedence over earlier concerns for a more sweeping reform of Japanese society. With this, the emphasis swung towards the encouragement of rapid economic revival of Japan and the outbreak of the Korean War in 1950 provided dramatic and immediate support for this.

(b) Demonstration and Linkage Effects

At many levels, the US presence in Occupied Japan (and, to a lesser extent, in post-occupation Japan as well) had a major impact on postwar Japanese technological development. Spencer,[31] who has investigated this aspect of the US military presence, makes a useful distinction between the unintended or 'demonstration effect' TT and the intended or 'linkage effect' TT which was related to the US military presence.

By his use of the term 'demonstration effect' Spencer intends: ". . . demonstration in some general connection with the military. Thus, the mere presence of foreign military units acts as a stimulant to emulative behaviour. Individuals see how the foreign individuals do things and copy them if they think the foreign way is superior or advantageous in some sense to them." [32]

In this regard he cites the adoption of equipment similar to that used in US military facilities by Japanese companies as well as the process of "reverse engineering" whereby a piece of equipment, introduced to the country in connection with the US military presence, is torn down, analyzed, and copied on the sole initiative of the would-be copier. Information

regarding such copying tends towards the anecdotal and, as might be expected, there is little hard, documented, evidence of its extent. Nevertheless, this pattern of unlicensed, and unintended, TT would seem to have been at least one characteristic form of TT in the early postwar period.

At a more general level, however, perhaps the most profound 'demonstration effect' of the US victory over and subsequent occupation of Japan (aside from its reinforcement of the longstanding Japanese view of the Americans as people from whom to learn) lay in its direct exposure of the Japanese to the 'American way of life'. The impact of the US occupation on Japanese culture can easily be exaggerated. Nevertheless, when one considers the fact that the Japan of the 1970's resembles, at the level of popular culture and consumers' goods, no other country so much as it does the US, it is difficult to avoid the conclusion that some of the main origins of Japan's postwar changes in lifestyles lie in the direct exposure to US lifestyles during the Occupation period.

In the context of Spencer's analysis, the 'linkage' (as opposed to the 'demonstration') effects of the US military presence refer to activities of the military intended to induce long-run effects in the civilian economy. These could involve TT which was not primary but, rather, incidental to the activity itself or, alternatively, TT in which the transfer of the technology involved was the actual focus of the activity . In either case however, such TT was explicitly intended. Incidental TT was associated with the need to supply and maintain the military presence in Japan, the Korean War effort, and US military assistance programmes to friendly countries in the Pacific area. "Special procurements" by the US, largely in connection with the Korean War, were a major factor in Japan's economic recovery in the first half of the 1950's. The total value of

these contracts for the period from June, 1950, to June, 1955, was over 1.6 billion US dollars and covered a wide range of goods and services.[33] Aside from the immediate economic impact on the supplier industries and in the economy as a whole, these "special procurement" contracts were also the vehicle for a great deal of such "linkage effect" TT. The forms or channels of such TT included direct hiring of Japanese personnel (by, say, a US supply and repair depot), 'labour contracts' under which a Japanese government agency arranged for contracts with Japanese companies to supply personnel to operate a US army facility, as well as the direct placement of procurement contracts with Japanese firms to manufacture items for the US Armed Forces. In each case, there was considerable US instruction, training, and monitoring of Japanese activities in order to enable and to ensure that performance specifications were met.

The types of technology transferred in this way were various and extended down to the procurement of daily necessities such as vegetables produced without the use of night soil. At the level of industrial technology, Spencer cites the transfer of plywood production technology in order to meet the construction needs of the US Armed Forces. He suggests that the present international competitive strength of the Japanese plywood industry has its origins in this early military-related TT.

In contrast to the above TT which was incidental to the primary purpose of meeting the needs of the US presence in the Pacific, there was also TT which had as its explicit purpose the upgrading of Japan's technological capabilities. The main vehicle for this latter TT was the Military Assistance Programme (MAP), under which a vast amount of military-industrial technology was transferred to Japan. One of the more significant areas of such TT was military aviation and this provided the first, early impetus to revival of

the Japanese aircraft industry as well as having 'linkage effects' of its own among a broad spectrum of related supplier industries.[34]

(c) Recovery to Postwar Levels

Aside from the global political and military developments discussed above which favoured Japan's redevelopment far more than any mere policy of development aid would have, there were of course domestic, civilian, measures which contributed to recovery.

The government's policy stressed the revitalization and modernization of basic industries - particularly electric power and steel. In both cases, TT played a major role. Administrative procedures to release foreign exchange for purposes of acquiring technology were set up upon proclamation of the Foreign Exchange Control Law (1949) and the Foreign Investment Law (1950). These regulations and the attitudes brought to bear in enforcing them will be discussed in more detail in chapter three (see especially pp. 54-55). Almost as soon as these provisions were set up those companies in the electrical equipment field with prewar ties to foreign companies re-established them.[35] A measure of the significance of the technological gap in this area is provided by a comparison of the efficiency rates of two hydroelectric generating plants opened in 1952. The one which used domestic technology had a 25.1% efficiency rate, while the other using imported US generating equipment achieved 33.0% efficiency.[36] The construction of hydroelectric dams, itself, introduced to Japan under technical assistance agreements with US companies new, large-scale construction project techniques as well as equipment (eg. power shovels, belt conveyors, dumptrucks, etc.) many times the capacity of existing Japanese equipment. In this way, even civilian projects may have had major incidental or secondary TT effects by demonstration of US, or other foreign, equipment and techniques in concrete projects.[37]

In the steel industry there was some delay in implementing efforts to rebuild the industry until the pressures of the 'cold war' removed initial occupation plans to severely limit Japanese capacity in this crucial industry. The First Steel Industry Rationalization Plan of 1951 mapped out the initial postwar modernization of the Japanese steel industry. The programme aimed to begin a catch-up process with the European and the US industries. In this regard, the biggest gap was in the area of rolling mill technology and, as a consequence, the representative TT of the early 1950's was of strip-mill technology and equipment. In addition, the large-scale introduction of Oxygen-process steel production technology began during this period - laying the foundations for the subsequent strong world competitive position of the Japanese industry. General steel industry equipment was also modernized and by around the end of the planning period, in 1955, about 30% of the thin-plate, open-hearth, and steel tubing manufacturing equipment and 50% of the thick plate and steel-rod equipment had been updated.[38] It is likely that a great deal of the TT of the period was related to this equipment renovation programme either directly or indirectly, via the manufacturing equipment industry.

By 1951 Japanese production had reached the levels of the immediate prewar period and, by 1954, consumption in both rural and urban areas had regained prewar levels. With this, the postwar recovery period could be said to be at an end. In the course of recovery however, Japan had not merely regained prewar levels of output and consumption but had also made major, fundamental progress in strengthening her basic industrial technology and plant. In this, TT had played a critical role but was, by and large, limited - both by necessity and design - to existing industries for which redevelopment and modernization was deemed basic to economic recovery. As such, it was only a prelude to the much more sweeping wave of technology transfer which

was to follow - touching on a broader range of existing industries, establishing new major industries, and shaping the massive transformation of the Japanese industrial structure which began in the latter half of the 1950's.

III STRUCTURAL TRANSFORMATION (1955-1963)

1. The Consumption Revolution

From the perspective of the 1970's it seems as though the Second World War stands as a divide between two Japanese national conceptions of the purposes of technology. If the prewar view can be characterized as 'national strength through technology', the postwar view is much closer to Dupont's old slogan 'better living through chemistry '. This postwar view of the purpose of technology as being a better way of life for the individual might best be viewed as a shift in emphasis - and one made possible, in part, by the postwar guarantee of national security implicit in the US' nuclear 'umbrella'. Whatever its origins, however, it was a change of fundamental importance to Japan's postwar development.

The initial period of postwar recovery neither required nor gave particular expression to this change. The natural and most pressing goals were to retrieve national sovereignity and some semblance of prewar standards of living and this, in itself, need not have involved any fundamental change in viewpoint as regards technology and the role of the consumer in the society. By 1955 however, 'postwar recovery' was at an end and the first glimmerings of the personal consumption boom began to appear.

With the completion of the postwar recovery process in the mid-1950's, the view that Japan's growth rate would inevitably slow down from the high rates that had prevailed since the Korean War was common. The 1956 Economic White Paper also reflected this view but, at the same time, pointed out where the sources of impetus for future growth would likely lie. In what was to become something of a catch phrase, the

White Paper declared 'The postwar era is already over' and went on to point out that economic growth based on recovery from the war was at an end and that subsequent growth would be a significantly different process. In particular, it stressed the future importance for economic growth of consumers' goods and, not unrelated, investment in technological modernization of the Japanese industrial structure. In the event, this was to prove a prophetic analysis - as is indicated by table 5 on page 38, showing trends in the diffusion rates for some major consumers durables.

The origins of this consumption revolution began modestly enough in the atmosphere of mild prosperity following on completion of postwar recovery. The initial objects of consumers' attention were primarily household furnishings beginning with such minor amenities as fluorescent lighting, radios, chests of drawers, electric fans and sewing machines. This soon expanded to include a broad variety of consumers durables including many items new to the Japanese consumer market such as washing machines, electric rice cookers, and television sets. Aside from the introduction of many new products, the enormous size of the emerging consumer market was in itself a stimulus to industry change. The cost reductions achieved through enlarged production scale and new technologies are aptly suggested by that most representative consumer good of the period - television. From a price level of 180,000 yen in 1954 (about $500 US, at the then current exchange rate), television sets were reduced in price to 80,000 yen in 1956 and to 60,000 yen in 1959.[39] Such price trends, of course, further enlarged the market for consumers goods.

Table 5.

Diffusion of Some Consumer's Durables

(% of surveyed households cities of over 50,000 populatio

Item \ Year	1958	1960	1965	1970	1974
Black and White Television	15.9	44.7	95.0	90.1	56.2
Colour Television	-	-	-	30.4	87.3
Stereo	-	-	20.1	36.6	50.4
Transistor Radio	-	16.5	55.8	76.0	79.4
Camera	43.1	45.8	64.8	72.1	79.4
Automobile	-	-	10.5	22.6	37.6
Electric Refrigerator	5.5	10.1	68.7	92.5	97.0
Electric Washing Machine	29.3	40.6	78.1	92.1	97.6
Vacuum Cleaner	-	7.7	48.5	75.4	91.5
Oil Heater	-	-	49.9	82.2	89.1
Room Air Conditioner	-	-	2.6	8.4	15.1
Electric Fan	27.6	34.4	77.3	88.5	94.4
Stainless Steel Kitchen Sink	-	-	24.2	49.1	71.1
Western Style Clothing Bureau	55.0	58.5	77.3	88.2	(94.3)*
Sewing Machine	66.3	69.5	83.9	84.5	83.7

* 1973

Source: Ando, Yoshio ed.

Kindai Nihon Keizaishi Yoran (A Handbook of Modern Japanese Economic History) - Japanese - Takyo, Tokyo University Shuppankai, 1975. p.187.

2. The Technology Revolution

(a) Changes in Industrial Structure

The 'consumption revolution' was, naturally enough, interwoven with fundamental changes on the production side. The amazing rates of growth beginning around 1955 in both the 'basic industries' - which had recieved earlier attention - and in many new industries is indicated in table 6 on page 40.

As discussed earlier, the steel industry had undergone considerable modernization and expansion during the early 1950's. The pace of modernization and expansion was quicker yet during the second rationalization plan period from 1956 to 1960. The number of hot strip mills increased from three to seven to rank second only to the US in number and in efficiency of operation second to none. At the same time, the industry expanded its product line into a large variety of new special steel products.

The electric power industry similarly expanded its capacity and, also began a fundamental shift away from hydroelectric and towards thermal-based power generation. Moreover, a shift away from coal and to oil-fired thermal generation reduced the costs of power generation.

Developments in the steel and power industries had repercussions for all of Japanese industry but those in the steel industry had particularly strong impact in the industrial machinery and shipbuilding industries as well as over a wide range of consumers goods. Changes in the electric power industry, in addition to assuring a stable supply of low-cost energy through conversion to oil-firing (at least until the 1970's!), combined with an increasing level of motorization in Japan

TRENDS IN OUTPUT OF SOME PRINCIPAL PRODUCTS (1934-1974)

Product / Year	Electric Power (million KWn)	Coal (1000 M.T.)	Heavy fuel oil (1000 Kl.)	Crude Steel (1000 M.T.)	Electric Refrigerator (1000no)	Passenger Cars (no.)	Steel Vessels completed (1000G/T)	Polyethylene (M.T.)	Viscase Rayon Fabrics (1000 m^2)	Synthetic Fabrics (1000 m^2)
1934	19,799.	35,925.	225.	3,114.	-	-	145.	-	419,987.	-
1935	22,349.	37,762.	329.	3,737.	-	-	142.	-	611,510.	-
1940	30,720.	56,313.	454.	4,522.	-	1,479.	307.	-	528,135.	-
1945	20,982.	29,879.	100.	898.	-	-	608.	-	5,176.	-
1950	39,123.	38,459.	807.	3,483.	5.	1,593.	227.	-	331,846.	-
1955	54,917.	42,423.	4,408.	9,408.	31.	20,261.	735.	-	647,006.	54,187.
1956	62,652.	46,555.	5,982.	11,106.	81.	32,056.	1,759.	-	769,823.	90,507.
1958	74,701.	49,674.	7,938.	12,118.	415.	50,643.	2,012.	-	676,106.	136,647.
1960	101,292.	51,067.	16,723.	22,138.	908.	165,094.	1,759.	41,179.	770,729.	423,886.
1962	122,446.	54,399.	24,025.	27,546.	2,671.	268,784.	2,182.	142,512.	660,104.	644,511.
1964	154,435.	50,929.	38,865.	39,799.	3,205.	579,660.	4,079.	289,385.	421,970.	1,052,829.
1966	181,723.	51,347.	53,705.	47,784.	2,565.	877,656.	6,396.	556,383.	382,772.	1,443,063.
1968	227,032.	46,569.	74,468.	66,893.	3,471.	2,055,821.	8,481.	856,623.	399,491.	1,893,075.
1970	288,923.	39,694.	101,575.	93,322.	2,631.	3,178,708.	9,917.	1,304,770.	354,065.	2,746,149.
1972	336,756.	28,099.	118,702.	96,900.	3,455	4,022,289.	12,834.	1,480,225.	264,405.	2,717,931.
1974	---	20,333.	136,763.	117,131.	4,312.	3,931,842.	--	1,897,047.	200,862.	2,621,793.

Source: Nihon Ginko, Tokei Kyoku (Bank of Japan, Statistics Department).

Keizai Tokei Nempo, Showa 49 nen (Economic Statistics Annual, 1974)
-Japanese - Tokyo, 1975
PP. 227-232.

to produce a rapid increase in consumption of petroleum products and act as a spur to modernization and expansion in that industry.

Among the newly developing industries, the major growth and diversification was in the chemical industry. From around 1955, the nature of the industry began to shift its emphasis from agricultural chemicals to high-polymer petrochemical products. In 1953 nylon production began - followed, in 1955, by vinylon and, in rapid succession, by polyethylene, polyacrylic, polypropylene and, concurrently, a wide variety of synthetic fibre-, rubber-, and resin-based finished goods.

Many, if not most, of these developments in industry implied and were, in fact, associated with technological change. Moreover, TT was a major element in this process.

(b) The Role of Technology Transfer

The basic data on numbers of approvals of TT (table 7 on page 42) over the period 1950-1973 indicate that, in the aggregate, TT paralleled the general developments in Japanese industry with the major flow of TT being to the chemical industry and to the various equipment and machinery industries. Similarly, the dominance of TT from the US is clear in the data on country of origin (table 8 on page 43).[40] A much more dramatic indication of the sudden spurt in TT activity and of its close relation to the major trends in Japanese industrial activity is provided, however, by data on the payments made to acquire technology (see table 9 on page 44).

The yearly payments for technology in the chemical industry were double the 1954 figure in 1955 and had increased by a factor of ten by 1960. Somewhat smaller, but still impressive, increases appeared in

Table 7

Post-war Japanese Technology Importations (1950-1973)
by Field of Technology (number of cases approved)

Fielf of Technology	Type of Technology	YEAR 1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	TOTAL 1973
Chemical	A	8	23	16	14	21	17	34	27	11	27	64	33	46	71	66	67	97	115	210	189	223	229	202	199	2009
	B	24	37	41	45	60	49	86	66	59	78	91	100	100	146	156	116	122	153	109	36	94	108	93	86	2055
Petroleum and Coal	A	-	1	14	-	-	3	5	2	2	5	8	4	3	2	7	1	16	10	26	20	31	47	52	49	308
	B(1.)																									
Metals and Metal Products	A	3	12	18	8	3	7	19	10	17	23	23	34	25	42	46	29	77	52	68	79	77	85	100	87	944
	B	4	15	25	35	33	24	42	40	41	37	49	59	51	63	71	42	52	104	101	22	14	20	14	13	971
General Machinery	A(2)	8	24	36	15	15	15	19	21	26	39	65	81	87	201	155	125	173	161	253	309	324	419	460	450	3481
	B	17	19	24	16	4	19	11	7	10	55	54	60	140	190	137	182	215	185	239	223	112	99	85	122	2225
Transportation Equipment	A	2	8	20	6	6	6	12	5	5	6	16	25	15	16	22	31	27	33	60	58	69	78	90	108	724
	B	-	-	-	3	4	4	5	6	4	2	1	1	16	8	4	6	3	3	6	17	8	22	39	32	194
Electrical Machinery and Products	A	4	15	21	45	23	17	16	29	17	30	101	64	83	142	79	101	71	109	195	188	188	226	320	305	2389
	B	2	5	11	16	10	3	4	5	2	8	12	11	17	25	27	25	31	37	61	37	41	31	29	62	512
Textiles and Textile Products	A	-	4	5	7	8	1	14	8	3	7	8	23	15	18	19	14	14	29	49	66	103	105	171	232	923
	B	-	-	-	-	-	1	5	-	6	4	7	4	24	34	43	58	58	82	81	86	90	94	107	91	875
Other	A	2	14	12	7	6	5	24	16	9	16	42	56	54	72	106	104	126	129	200	245	315	357	521	501	2939
	B	2	11	9	18	20	13	14	12	30	41	47	46	81	107	103	57	71	93	86	54	79	87	120	113	1314
TOTALS	A	27	101	142	102	82	71	143	118	90	153	327	320	328	564	500	472	601	638	1061	1154	1330	1546	1916	1931	13717
	B	49	87	110	133	131	113	167	136	152	225	261	281	429	573	541	486	552	657	683	475	438	461	487	519	8146
	A+B	76	188	252	235	213	184	310	254	242	378	588	601	757	1137	1041	958	1153	1295	1744	1629	1768	2007	2403	2450	21863

Source: Kagaku Gijutsu cho (Science and Technology Agency).
Gaikoku Gijutsu Donyu Nenji Hokoku, Showa 48 Nendo (Importation of Foreign Technology Annual Report, 1973).
Tokyo, 1975. pp.34-37 and 42-43.

Note: 1. No entry for Class B Petroleum and coal technologies. These, if any, may be included in "Other" category.
2. Excludes petrochemical plant engineering which is included in "Other" category.
Inall, such T.T. amounted to only 180 cases.

Table 8.

Post-war Japanese Technology Importations (1950-1973)
By Country of Origin (Number of cases approved)

Country	Type of Technology	YEAR 1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	TOTAL 1950-1973
U.S.A.	A	21	74	97	71	58	44	84	61	63	92	200	181	203	355	274	265	329	388	602	598	745	825	1010	988	7634
	B											136	171	203	261	212	223	215	288	309	185	181	219	234	269	5806
CANADA	A	-	-	8	4	1	2	3	2	2	2	2	7	2	4	6	8	39	10	13	12	12	24	24	25	212
	B											1	2	4	8	2	8	3	6	14	6	5	4	5	4	72
UNITED KINGDOM	A	-	1	3	3	1	3	11	3	2	7	12	16	12	36	49	40	46	57	105	108	108	139	154	175	1091
	B											11	7	21	36	44	39	67	50	39	33	30	38	48	35	498
WEST GERMANY	A	-	-	12	6	5	8	11	7	6	16	45	40	46	64	60	55	66	69	150	146	189	213	228	224	1666
	B											58	51	99	124	134	88	108	156	140	92	65	56	50	48	1269
FRANCE	A	-	2	5	4	1	4	6	4	1	7	5	10	8	25	15	21	33	29	37	62	73	88	150	193	783
	B											17	12	36	49	57	45	56	50	53	65	72	76	73	66	727
SWEDEN	A	-	6	5	-	1	1	1	2	2	3	8	8	6	6	5	3	5	2	11	20	16	39	43	30	223
	B											-	1	5	3	1	6	9	2	3	10	11	3	9	9	72
HOLLAND	A	-	-	1	-	-	1	2	18	-	9	7	7	13	15	9	22	16	8	23	44	23	22	33	31	304
	B											2	3	1	11	6	4	10	16	14	7	8	6	13	14	115
OTHER	A	6	18	11	14	15	8	25	21	14	17	48	45	38	59	82	58	67	75	120	164	164	196	274	265	1804
	B											36	34	60	81	85	73	84	89	111	77	66	59	55	74	984
TOTALS	A	27	101	142	102	82	72	143	118	90	153	327	320	328	564	500	472	601	638	1061	1154	1330	1546	1916	1931	13717
	B	49	87	110	133	131	113	167	136	152	225	261	281	429	573	541	486	552	657	683	475	438	461	487	519	8146
	A+B	76	188	252	235	213	184	310	254	242	378	588	601	757	1137	1041	958	1153	1295	1744	1629	1768	2007	2403	2450	21863

Source: Kagaku Gijutsucho Gaikoku Gijutsu Tonyu, op.cit. pps. 38-39 and 44-45

Payments for Transferred Technology; by Field of Technology and Year 1950-1960 (in million Yen)

Time Period / Type of Technology	Y E A R											Totals	No.of Cases
	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960		
Textiles	-	-	21	66	92	164	203	383	428	556	749	2,663	37
Paper, Pulp	-	2	7	5	1	3	5	7	8	16	29	84	4
Printing	-	-	2	2	2	2	4	4	2	3	3	24	2
Chemical	34	345	391	903	1121	2498	3600	5982	5481	5082	12438	37,875	148
Oil Refining	14	-	108	1657	173	505	511	268	756	565	1498	6,122	19
Rubber, Leather	-	81	217	288	287	285	488	605	540	772	781	4,344	19
Glass , Ceramics	-	-	7	16	50	26	62	141	161	412	497	1,372	17
Steel	-	149	136	166	271	412	578	831	930	1054	1544	6,070	55
Non-Ferrous Metals	-	9	1	4	11	11	37	20	44	64	129	331	17
Metal Manufactures	-	-	-	1	1	44	60	74	78	111	128	495	11
General Machinery	63	271	607	1011	966	1187	1978	2954	3040	3873	6258	22,208	231
Electrical Machinery	36	281	642	1062	1278	1553	2344	3042	4840	6792	8541	30,409	190
Transportation Equipment	-	17	33	282	473	384	830	1226	1333	1324	1930	7,831	78
Nuclear Power	-	-	-	-	-	-	-	-	44		136	180	2
Construction	-	-	114	121	63	12	54	125	129	142	93	854	7
Other	-	-	5	21	2	6	28	46	27	44	64	243	7
Total	146	1155	2291	5607	4792	7091	10851	15705	17796	20852	34818	121,104	859

Source: Tsushosangyosho, KigyKyoKu (M.I.T.I.,Enterprise Bureau),

Gaikoku Gijutsu Donyu no Genjoto Mondaiten (Present Conditions and issues of foreign Technology Importation) 1962. pp.14-17.

Note: Class A technologies only. Based on a 1961 survey. These are before-tax figures and do not correspond to Bank of Japan figures.

other growth industries of the period such as steel, electrical and general machinery and transportation equipment.

The figures for the petroleum refining industry are surprisingly low but may reflect the uniquely high level of foreign ownership in this industry (over 50% of total sales) and a resultant high capacity for informal transfer of technology, a relatively high pre-existing level of technology, and as well, the use of 'nominal' pricing in formal TT agreements.

With regard to the payments made explicitly for the purpose of TT it is important to note that, while they may indicate trends in the general level of TT activity, they cannot be viewed as representing the total costs of the transferred technology to the recipient companies. Technology transfer commonly, if not invariably, involved other, hidden, costs often in the form of contractual obligations to buy parts and raw materials from the technology-supplying company. One survey indicates that expenditures for such purchases may have amounted, in the aggregate, to some multiple of the explicit payments for TT (see table 10 on page 46). The proportion of these payments which represents a premium over market prices and thus can be viewed as an additional cost of the TT, per se, is however unclear.

During the latter part of the 1950's and during the 1960's, government and public interest in TT led to a number of special government studies, the results of which were published. These studies shed further light on the nature of TT over this period. The majority of this data relates only to Class A technologies - which, in essence, are those technology transfers involving payments of foreign exchange over a period in excess of one year (the distinction between class A and class B TT is discussed at greater length, below). While there is no certainty in the matter,

Table 10.

T.T. - related Machinery and Equipment Imports and Total Machinery and Equipment Imports.

(Technology Importing Companies only) 1950 - 1960 (in million Yen)

Industry	(a) T.T.-related Machinery and Equip. Imports	(b) Total Machinery and Equipment. Imports	a/b (%)	Number of Companies
All Industries	77,186.	177,219.	43.6	192.
Manufacturing	73,984.	163,709.	45.2	183.
Food Products	174.	916.	19.0	3.
Textiles	2,402.	6,998.	34.3	20.
Wood	532.	532.	100.0	2.
Paper, Pulp	9.	793	1.1	1.
Printing, Publishing	149.	623.	23.9	2.
Chemicals	17,030.	22,456.	75.8	43.
Petroleum, Coal Products	6,514.	9,316.	69.9	9.
Rubber	2,148.	2,341.	91.8	5.
Glass, Ceramics	484.	644.	75.2	6.
Steel	24,858.	64,894.	38.8	13.
Non-ferrous Metals	1,386.	5,898.	23.5	10.
Metal Manufactures	43.	281.	15.3	2.
General Machinery	1,085.	6,783.	16.0	20.
Electrical Machinery	6,785.	9,430.	71.9	23.
Transportation Equipment	9,577.	28,881.	33.2	17.
Precision Machinery	701.	2,671.	26.2	4.
Other Manufacturing	106.	252.	42.1	3
Other Industries	3,202.	13,510.	23.7.	9.

Source: Gaikoku Gijutsu Donyu noGenjo to Mondaiteu, op.cit.

pp.70-71.

the fact that government interest invariably centered on such class A TT probably indicates, in itself, that such TT was not solely of special concern because of its impact on foreign exchange reserves but also because it was generally of greater significance to Japan's technological development than was most class B TT.

One such study compared the'vintage' of technologies transferred to Japan in 1956 and 1966. As table 11 (on page 48) indicates, in both 1955 and 1966, there were some inter-industry differences in the time-lag between the period of original innovation and the time of initial TT to Japan. At the same time, however, the results of the study tend to confirm that the transfer of prewar technologies was a major factor in the 1950's but declined in importance, as the earlier technological gap with the West was narrowed, and became relatively unimportant during the 1960's. This trend is clearest in the chemicals industry - precisely where Japanese development of the latter 1950's was most remarkable and the volume of TT among the highest of all industries.

This suggests one simple, but important reason for the high level of TT activity in the chemical industry over this period - the fact that there was a major 'backlog' of technological innovations available. Simply put, TT itself depends on prior technological innovation and we would therefore expect TT activity to highest in those industries where innovative activity is, or has been, high. However, even though table 11 indicates that a considerable amount of prewar technology was still being transferred to Japan in 1966, this data makes no attempt to distinguish between 'major' and 'minor' items of technology. Watanabe's study of the Japanese chemical industry[41] attempts to make such a distinction, and his outline of the major postwar innovations in the Japanese chemical

Table 11

Japans Technology Imports* by Industry and by Period of Initial Industrial Application of the Technology - 1956 VS. 1966

(% of Total for industry)

	I N D U S T R Y											
	Machinery		Electrical		Metals		Chemical		Other		Total	
Period of original "Innovation"	1956	1966	1956	1966	1956	1966	1956	1966	1956	1966	1956	1966
Prior to or during 2nd World War	42	18	42	11	35	6	64	24	35	14	48	16
Post-War	58	82	58	89	65	94	36	76	65	86	52	84

* Class A Technologies only

Source: Kagaku Gijutsucho (Science and Technology Agency). Gijutsu Donyi Hokoku (REport on Technology Importation)

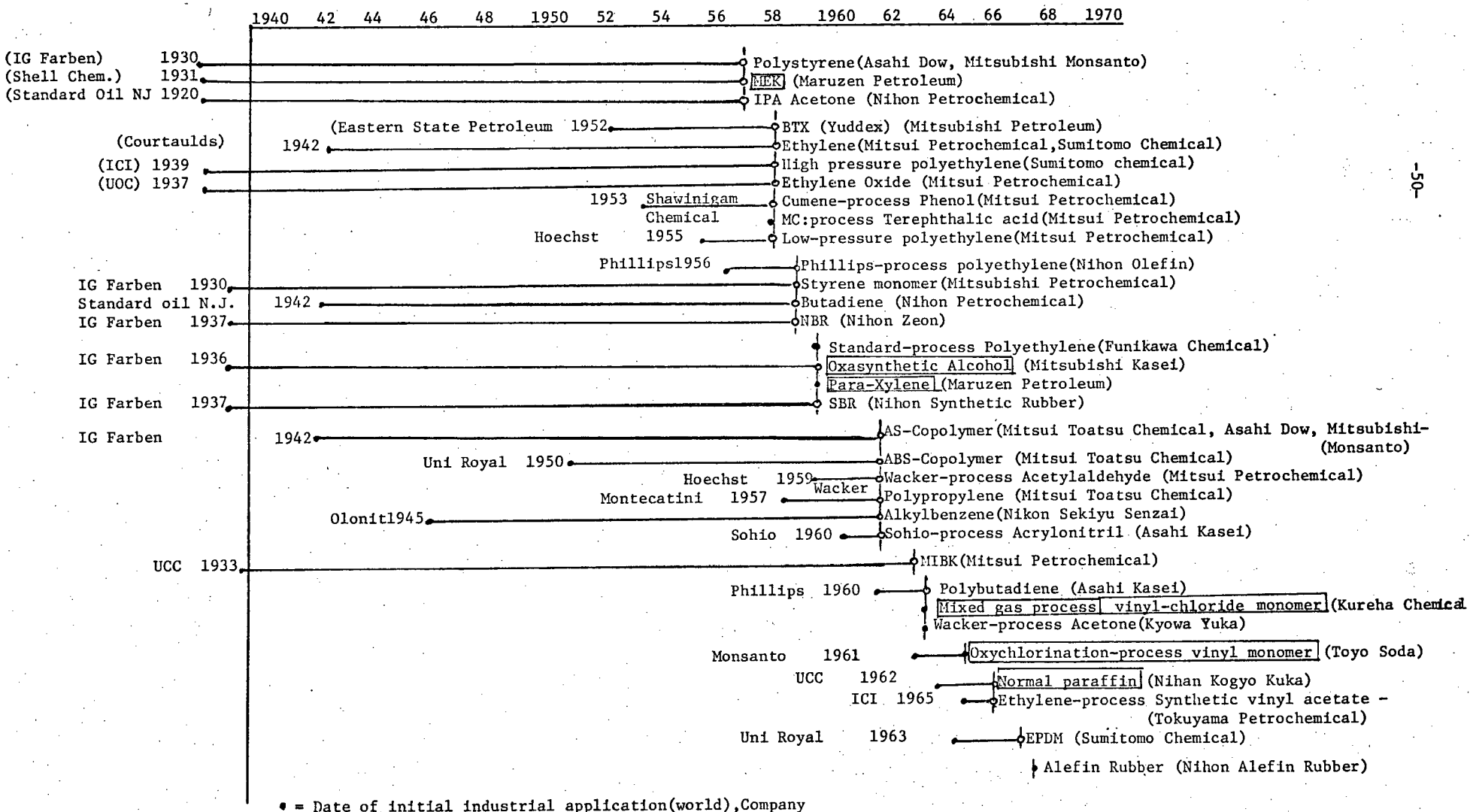
- Japanese - Unpublished, internal report of Science and Technology Agency, 1966, p.31.

industry is reproduced here as table 12 (see page 50). As the diagram indicates, there was an enormous flow of major chemical technologies in the late 1950's, but probably by 1960 most of the main prewar innovations in chemical technology had already been transferred to Japan. As the diagram also indicates, by 1960 the Japanese industry had already progressed to the point where it was developing its own unique technological innovations (Maruzen Petroleum - Paraxylene).

Another study examined the type of technologies transferred in a sampling of postwar class A TT. As table 13 (on page 51) shows, in the aggregate and for most individual industries TT by the early 1960's was already primarily of new or improved "product-technologies". There are some major, and understandable, exceptions to this in the large process industries of steel, chemicals, and oil refining where production process technologies predominated but, even in the first two of these, TT of new product technology accounted for a significant proportion of the total. In some industries, such as the electric machinery industry, the TT of new product technology was probably quite directly related to the ongoing revolution in consumers' demand (eg. household electrical appliances). In many other industries, however, the connection was undoubtedly less direct - with the 'new product' a new or improved item of industrial equipment resulting from a TT which was importantly, but only indirectly, related to the evolving consumer market.

The low level of transfer of management technology shown in table 13 requires some comment. First, it should be pointed out that even the small number of cases indicated may not represent actual transfers of management technology. They may, rather, reflect the nominal use of a management contract to disguise payments relating to other activities -

Table 12. A COMPARISON OF JAPAN AND WORLD INITIAL INDUSTRIAL APPLICATIONS OF PETROCHEMICAL TECHNOLOGIES



• = Date of initial industrial application(world),Company
o = Date of initial industrial application(Japan),Company
□ = Japanese developed technology

Source: Watanabe, Tokuji Nihon no Kagaku Kogyo. (Japan's Chemical Industry)-Japanese Tokyo, Iwanami Shoten, 1974, pp.61-62.

Table 13.

Type of Technology Transferred by Industry

(Post war Class A T.T.'s 1961 Survey)

Nature of Technology Transferred / Industry	New Product	Improved Product	Production Process	Equipment	Management	Comprehensive	Other
Textiles	14	15	19	3	-	7	-
Paper, Pulp	6	6	-	-	-	1	-
Printing	2	-	1	-	-	-	-
Chemicals	114	39	136	40	6	29	7
Oil Refining	2	5	34	14	2	4	-
Rubber, Leather	12	5	13	3	2	7	-
Glass, Ceramics	7	5	6	3	-	3	1
Steel	29	8	40	9	4	-	1
Non-ferrous Metals	6	1	6	7	-	5	-
Metal Manufactures	7	-	2	1	1	2	1
General Machinery	142	79	55	20	4	48	1
Electric Machinery	154	62	52	8	3	20	4
Transportation Equipment	46	16	18	3	3	15	1
Nuclear Power	-	-	-	-	-	1	1
Construction	2	-	1	1	-	-	2
Other	7	1	3	2	-	-	-
Total	550	242	386	114	25	142	19

Source: MITI,

Gaikoku Gijutsu Donyu no Genjo to Mondaiten

1962, op.cit. pp.10-13

such as ownership ties or the prior or concurrent transfer of new product - or new production - technologies. In any event, the fact that the figures are low (and may be lower than indicated) is not too surprising. A great deal of what is termed 'management expertise' or 'management technology' is either culture-specific or else is such an organic and inextricable part of the firm which possesses it that it cannot or cannot easily be commercially packaged and sold. This, indeed, is one of the explanations (or justifications) often offered with respect to foreign direct investment.[42] Either because of its inappropriateness to the Japanese environment or the Japanese antipathy to foreign direct investment (a point to be discussed below) one would not expect much of this sort of management technology to be transferred.

There is, however, a large body of management technology which consists, in the main, of abstract, analytical or control methods and which is both separable from the overall activities of any given firm and of fairly universal applicability. By and large, such technologies exist as unprotected intellectual property and are widely diffused on a non-commercial basis through books, journals, conferences and personal observation or contacts. At this, non-commercial, level there has apparently been a considerable amount of TT. In the late 1950's a large number of organizations developed to improve management techniques in Japan. These included the Japan Productivity Center, the Japan Management Association, the Japan Marketing Institute and Japan Industrial Engineering Institute. In addition, the book Keieigaku Nyūmon, "Introduction to the Science of Management" (Tokyo; Kobunsha, 1958) by Fujiyoshi, Sakamoto quickly became a best-seller in the late 1950's and so marked a general, popular, interest in management which continues to date. The major influences came (and continue to come) from US theory and practice, and the initial tendency was to 'swallow it

whole'. Later however, in the early and mid-1960's, an increasingly clear distinction began to be made between, on the one hand, the subject areas and techniques identified (eg. long-range planning, market and organizational analysis, inventory control) and, on the other hand, the philosophy - especially vis-à-vis personnel management and human relations - imbedded in the foreign theory and practices. Increasingly, Japanese firms separated out and adapted the former while adopting a more critical attitude towards the relevance of the latter in the context of the Japanese organizational environment.

The fact, as just discussed, that management technology was transferred primarily by means other than foreign direct investment is also, in part, a reflection of one, pervasive aspect of Japan's postwar TT - government regulations and controls on TT. We turn now, therefore, to a more detailed examination of government involvement in postwar TT.

3. Regulation and Control of Technology Transfer

Government involvement in postwar TT was evidenced by a large body of formal laws and regulations. Some of these related to TT, per se, while others were of significance to TT only when it was associated with foreign direct investment. These are discussed, in turn, in section (a) (Formal Laws and Regulations) below. In addition to these formal manifestations of government control of TT - which changed very little until liberalization began in the 1960's - it is necessary to look beyond these to the underlying attitudes which influenced their administration. The relative importance of these various attitudes and concerns of the government and the bureaucracy varied over time and, thus, this subject is discussed by time periods in section (b) (Administrative Attitudes).

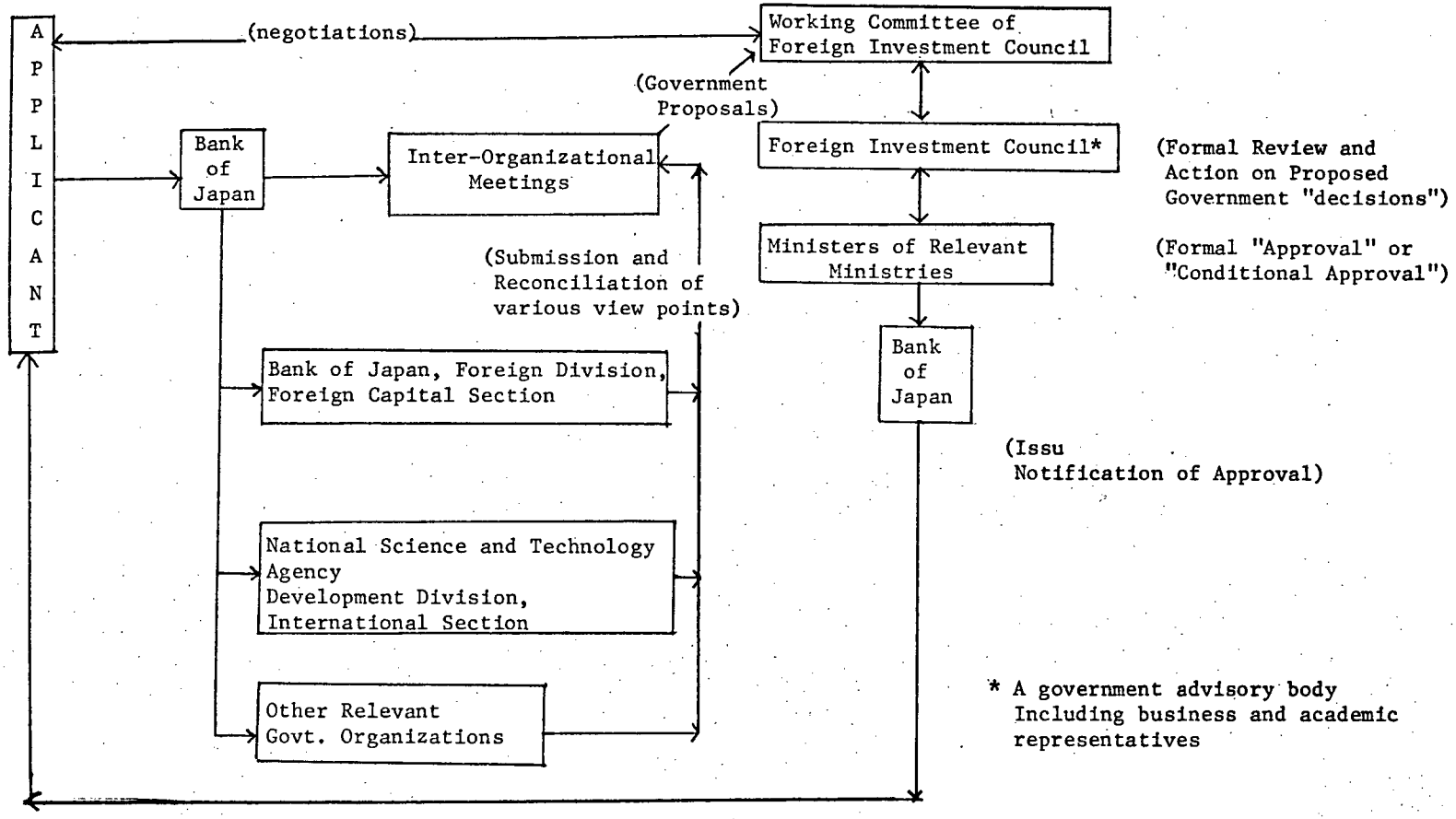
(a) Formal Laws and Regulations

The formal laws and regulative procedures bearing on TT in the postwar period remained little changed until the advent of liberalization measures in the early 1960's (this will be discussed in the following chapter). Commercial TT was subject to the provisions of either the Foreign Exchange Control Law (established in 1949) or the Foreign Investment Law (established in 1950). The former is a general law regulating foreign exchange transactions and was too restrictive for all but the most (monetarily) trivial TT transactions. The latter law provides for payments of larger amount or of longer duration (in excess of one year) and for transactions involving the acquisition of assets in Japan by a foreign company or individual. Technology transfers under the former law are termed 'class B' TT and those under the latter, 'class A'. The administration and records-keeping provisions for these two types of TT were somewhat different. In particular, class A technologies were viewed as being of more importance and as a result more detailed records were maintained on them and, as well, any special government surveys and studies that occurred tended to concentrate on them.

The review and approval procedures for proposed class A TT, circa the early 1960's, are indicated in figure 2 (see page 55). The procedures for class B technologies were somewhat less complex. In either case, however, there was ample opportunity for inter-departmental consultation and compromise in the handling of any given application for approval of a TT agreement or, more precisely, for approval of the release of foreign exchange funds required by the TT agreement. While formal responsibility for control of foreign exchange funds lay with the Ministry of Finance,

Figure 2.

Diagram of Technology Transfer Approval Procedures (ca.1960)



Source: Gaikoku Gijutsu Donyu Yoran - Japanese - (Foreign Technology Importation Handbook). Tokyo, Jukagaku Kogyo Tsushinshia, 1965, p.58

in the case of technology transfers because of the direct connection with Japan's technical and industrial development, the primary responsibility for review of proposed TT agreements lay with the Ministry of International Trade and Industry (MITI) which decided whether or not a recommendation for release of funds should be made to the Ministry of Finance. In practice, therefore, the approval of MITI was a necessary and, usually, sufficient condition for approval of a TT. Theoretically, any ministry might claim an interest in a TT but, in practice, the ministries other than MITI which might have an involvement in a TT approval were generally the Fair Trade Commission, the Ministry of Forests and Agriculture, and the Ministry of Finance, itself. The extensive provisions for inter- and intra-ministerial consultation and compromise and the fact that, at least until the early 1960's, approval was on a case-by-case basis meant that the ease with which a proposed TT received approval depended less on the complexity or simplicity of the formal regulations than it did on informal considerations and administrative attitudes to be discussed below.

What we have discussed so far relates to the formal procedures for commercial TT not involving foreign direct investment (FDI) in Japan. In many cases, however, FDI would form part of the proposed TT and in such cases the regulations governing FDI, per se, had a bearing on the TT approval. Table 14 (see page 57) indicates the regulations applied to FDI as of the late 1950's and early 1960's. Again, as formal procedures, these changed very little over the whole of the postwar period until the liberalization measures adopted in the 1960's.

There appear to have been, despite formal invariance in government regulation and control of TT, major differences over time in the spirit and intent with which these formal means of control were applied. It

Table 14

Controls on Foreign Direct Investment (ca. 1959-1960.)

Category	Investor		Currency	Requirements: Existing Shares	Requirements: New Shares
Capital, Profit Repatriation Guarantee Desired	Foreign Investor		Foreign	Approval	Approval
			Yen	Prohibited	Prohibited
Capital, Profit Repatriation Guarantee not Desired	Foreign Investor National of a "Designated Country."(1)	Uncontrolled Industry	Foreign	Open	Open
			Yen	Open	Open
		Controlled(2) Industry	Foreign	Approval	Registration
			Yen	Approval	Registration
	Foreign Investor: All other Countries		Foreign	Approval	Registration
			Yen	Prohibited	Registration

Source: Tsushosangyosho, Kigyo Kyoku (MITI, Enterprise Bureau).

Daishi Donyu: SonoSeido to Jittai (Induction of Foreign Investment: Procedures and Status).

Tokyo: Tsushosangyosho, Chosakai, 1960. p.57.

Note: 1. "Designated Countries at this time were; Finland, Greece. India, Holland, Sweden, Switzerland, Thailand, U.S.A., Uruguay, Yugoslavia, Norway, West Germany and Taiwan.

2. "Controlled Industries" included; Utilities, Transportation, Finance, Ship construction and Mining.

will be useful, therefore, to outline some major, characteristic, administrative attitudes brought to bear in their implementation and offer some suggestions as to which of them predominated at various times.

(b) Administrative Attitudes

Of the multitude of attitudes (not seldom contradictory) that enter into policy formulation and implementation in any large bureaucracy some more than others can be attributed to the overall bureaucracy. Among such 'administrative attitudes' in postwar Japanese government and the bureaucracy (primarily MITI) at least five appear to have borne importantly on postwar TT. These are:

1 Concern over control and conservation of foreign exchange reserves;

2 Desire to mesh TT with basic industrial policies;

3 Desire for general technological development;

4 Concern over maintenance of intra-industry harmony;

5 Antipathy to foreign direct investment, which will be discussed at greater length in chapter four.

At a higher level of abstraction, all of these attitudes existed against the background of a desire for economic growth and independence. It is important also to recognize that while there were differences over time as regards which of these administrative attitudes most characterized the spirit and intent with which TT was controlled and regulated, all of them were of some importance at all times, and any one of them might be of decisive influence in a given case of TT. Thus, for example, scarce foreign exchange reserves were a matter of considerable official concern

until at least the middle 1960's and bore importantly on TT policy throughout most of the postwar era.

Bearing the above qualifications in mind, however, the patterns of change in the administrative attitudes which characterized TT policy up to the liberalization measures of the 1960's can usefully be summarized as follows.

Postwar recovery period (1945-1955)

The concern over control of foreign exchange reserves seems to have most strongly characterized TT policy in the early period of economic recovery. This is understandable given the shaky state of Japanese finances - especially prior to the Korean War boom. The preamble to the Foreign Investment Law makes reference both to an intent to ' . . . (limit) the induction of foreign investment to that which will contribute to the self-support and sound development of the Japanese economy' and the aim of '. . . providing for remittances arising from foreign investment and . . . adequate protection for such investment.' [43] In fact, however, the emphasis was less on inhibiting foreign investment - which, in any event, was not flocking around Japan at this time - than on limiting government commitments to provide for repatriation of profits. This was indicated by Prime Minister Ikeda in a 1950 speech in New York where he said;

> Of course, everybody is welcomed in so far as he does not demand a prior commitment of the Government for transfer. It is however, much more advisable that he tells the Government beforehand about his investment and sees how much the Government guarantees to transfer out of the profit. . . . This checking system is by no means intended to create red tape. It is the device of a poor but honest borrower who does not want to cheat creditors. [44]

During this period, in fact, many foreigners established (usually quite

small) "yen-base" companies which were subjected to much less control and regulation but which lacked guarantees of profit and capital repatriation.

Thus, in intent - if not in effect - the laws and procedures controlling TT were not the tool for inhibiting such investment that they were to become later.

One consequence of this concern over scarce reserves of foreign exchange was a tendency to strongly favour the transfer of only those technologies consistent with the overall industrial development plans of the time. As a practical matter, this meant that approval was more likely if the TT related to the development of the basic industries discussed earlier or would contribute to the development of export industries.

Period of structural transformation (1955-1963)

In this period, the changed industrial policy favoured the development of consumer goods industries and a broader modernization of the industrial structure than in the earlier period. Thus, the desire to mesh TT with industrial policy took on much less restrictive implications. This was reflected in the actual course of TT during the period which became much more active over a broad range of industries and especially so in consumer goods industries and in the officially favoured new "basic industry" chemicals.

At the same time, concern over maintenance of intra-industry harmony came to be a major factor in determining the handling of applications for TT. With freedom to acquire technology from abroad spreading to a number of new industries and with the burgeoning consumer goods market holding

out prospects of considerable competitive advantage to those firms doing so, government handling of TT applications took on a new and potentially disruptive potential to influence the competitive positions of firms. Thus, the concern for maintenance of industry "harmony" - the concern that a firm not gain a decisive advantage over its competitors solely on the basis of the exclusive possession of an imported technology - came to be a more important consideration in TT policy.[45] This would not, of course, always be an important factor in a TT decision but, where it was, it led to the official encouragement of non-exclusive or multiple licensing arrangements or, in other cases, to the approval of a TT to one company greatly increasing government inclinations to approve transfer of similar technology to other companies in the industry, should they apply for such approval.

Another aspect of government control of TT was official monitoring of and concern for the contract provisions of the specific TT agreements initially negotiated between buyer and seller. This concern was not unique to the period 1955-1963 but it is reasonable that, as a practical matter, it gained in importance during this period as the number and diversity of firms involved increased and it became less feasible to exert governemnt influence during the early technology selection and negotiation phases of a TT. There is evidence that a fairly detailed, and yet 'informal' and unpublished, set of guidelines regarding contract provisions for various technologies and various industries evolved during this period (see appendix 1 for a concrete example involving such guidelines). The extent to which these guidelines were 'indicative' rather than 'compulsory' is unclear. There are numerous stories of the frustrations visited by such informal guidelines upon foreign businessmen

attempting to negotiate TT agreements. On the other hand, Japanese businessmen familiar with the TT negotiation process at the time recall that it was not unheard of for the Japanese side to a transaction to use the MITI and their 'guidelines' as a "bogeyman" in order to strike a better bargain for themselves. Moreover, in my one case study which explicitly touches upon such guidelines (see Appendix 1), MITI appears to have interpreted the guidelines quite flexibly. It may be that, in the aggregate, the potential for government disapproval of contract provisions had more impact on the TT agreements actually negotiated than did any overt government actions.

Some authors[46] have analyzed such Japanese government intervention in the TT negotiation process[47] in terms of Stephen Hymer's theory of international operations.[48] By this analysis, Japanese government behaviour is interpreted as intervention consciously aimed at reducing the monopoly advantages of the technology possessors vis-a-vis the large number of potential Japanese purchasers. In fact, however, it seems likely that in all but a few exceptional cases the foreign seller possessed nothing like a monopoly and that the Japanese purchasers, especially into the mid- or late-1960's, had a number of alternative US, or other, potential suppliers of the same or similar technology.

Thus, one might more simply - and at least as validly - ascribe Japanese intervention as being motivated by a long-range concern over Japan's foreign exchange reserves which were viewed as chronically scarce until the mid-1960's. Such a long-range and national concern would, naturally, not be fully shared by the Japanese purchasing companies and likely accounts substantially for government intervention in this area.[49]

The question of intra-industry competition has already been alluded to

a number of times. In fact, this issue warrants some separate discussion, to which we now turn.

4. Inter-firm Competition and Technology Transfer

One cannot really begin a discussion of inter-firm competition in Japan without reference to the Japanese system of employment to which it is closely related. The fact that Japanese industry widely practices a system of 'permanent employment' is, by now, quite well known in the West.[50] Under this system one typically enters a firm immediately upon leaving school and remains with that firm until eventual retirement. Changing employers - voluntarily or involuntarily - is rare and is viewed as aberrant behaviour. Partly as a reflection of this, both the economic and the social[51] aspects of the employees' life tend to be centred on the firm.

This pattern of lifelong membership in a group which combines both the social and economic aspects of life finds many correlates in Japanese history - particularly in the patterns of social organization prior to Japan's industrialization. It cannot, however, be dismissed as a 'feudal remnant' which is out of place in present-day Japan. In fact, this employment system has been conducive to the formation of the intimate interpersonal relations and individual feelings of group membership in which the Japanese work most effectively. As such, it can be seen as a highly functional cultural adaptation to the demands of industrialization.

Because this system of permanent employment both reflects and serves to maintain[52] a low rate of employee mobility between firms, for practical purposes, an employees' economic well-being and social status are no more or less than that of the firm he works for. Also, because of the long-term

nature of the employment relationship, the time horizon of relevance to the economic aspects of the corporation are often longer than in other countries. This is combined with a strong tendency for the social status and prestige of a company and its employees (as well as corporate access to financing) to be closely related to its absolute size and, within an industry, to its market share. As a consequence, there is a strong tendency for corporations to engage in vigorous competition to increase their size and, more particularly, their market share - often despite immediate economic considerations. This frequently takes the form of competitive expansion in manufacturing capacity which exceeds the existing market demand and has been, at times, the root cause of 'dumping' complaints levelled at Japanese industry by Japan's trading partners.

In a period of change in the industrial structure, such as began in the mid-1950's, this competition can also be revealed in a different pattern as companies scramble to gain a strong position in emerging new industries or in industries undergoing drastic change. The low level of worker mobility and the concentration of access to financing on established firms not only facilitates but requires existing firms efforts to seek entry into new growth markets and industries as they arise. Only by so doing can they hedge against the future and insure the well-being, not to say viability, of the corporate group and the employees who constitute it.[52]

The main arena for this inter-firm competition has been the domestic market. In the latter 1950's and early 1960's, as one aspect of this competition, the importance of TT increased. Because TT is in many respects analogous to, and in concrete cases often inseparable from, equipment investment it is not surprising to find overall trends in TT

and equipment investment closely correlated (see figure 3 on page 66). The relative importance of TT when compared to total machinery and equipment investment is, however, difficult to assess. One survey[54], done in 1961, indicated that purchases of TT-related equipment accounted for about 22% of total equipment investment for those firms which imported technology but only for 4.7% of all industry equipment investment (figures relate to the period 1950-1960). It is important, however, to note that, while TT related equipment investment by industrial equipment manufacturers may have accounted for only a small part of total equipment investment, the subsequent TT-based output of new industrial equipment by these Japanese firms likely accounts for a much larger proportion of total Japanese equipment investment. The same survey indicated that TT expenditures, on average, amounted to slightly less than 50% of the (separate) research expenditures of surveyed firms. Perhaps more indicative of the significance of TT are the results of a separate survey comparing the start-up and R & D expense and the total sales attributable to items of technology from different sources. As table 15 (see page 67) shows, transferred technology was both more costly (in terms of R & D and start-up expense) and generated more sales on a per-case basis than did domestic technological innovations. As the survey was done in 1963 - after considerable Japanese technological development had already occurred - it can easily be imagined that the implied importance (again, on a per-case basis) of TT would have been greater had such a survey been done, say, in 1955. Finally, there is evidence that TT had an impact not only on longer-term goals of increased market share and entry to new domestic markets but also that it had concrete, favourable, impact on shorter-term, profit goals (see table 16 on page 68).

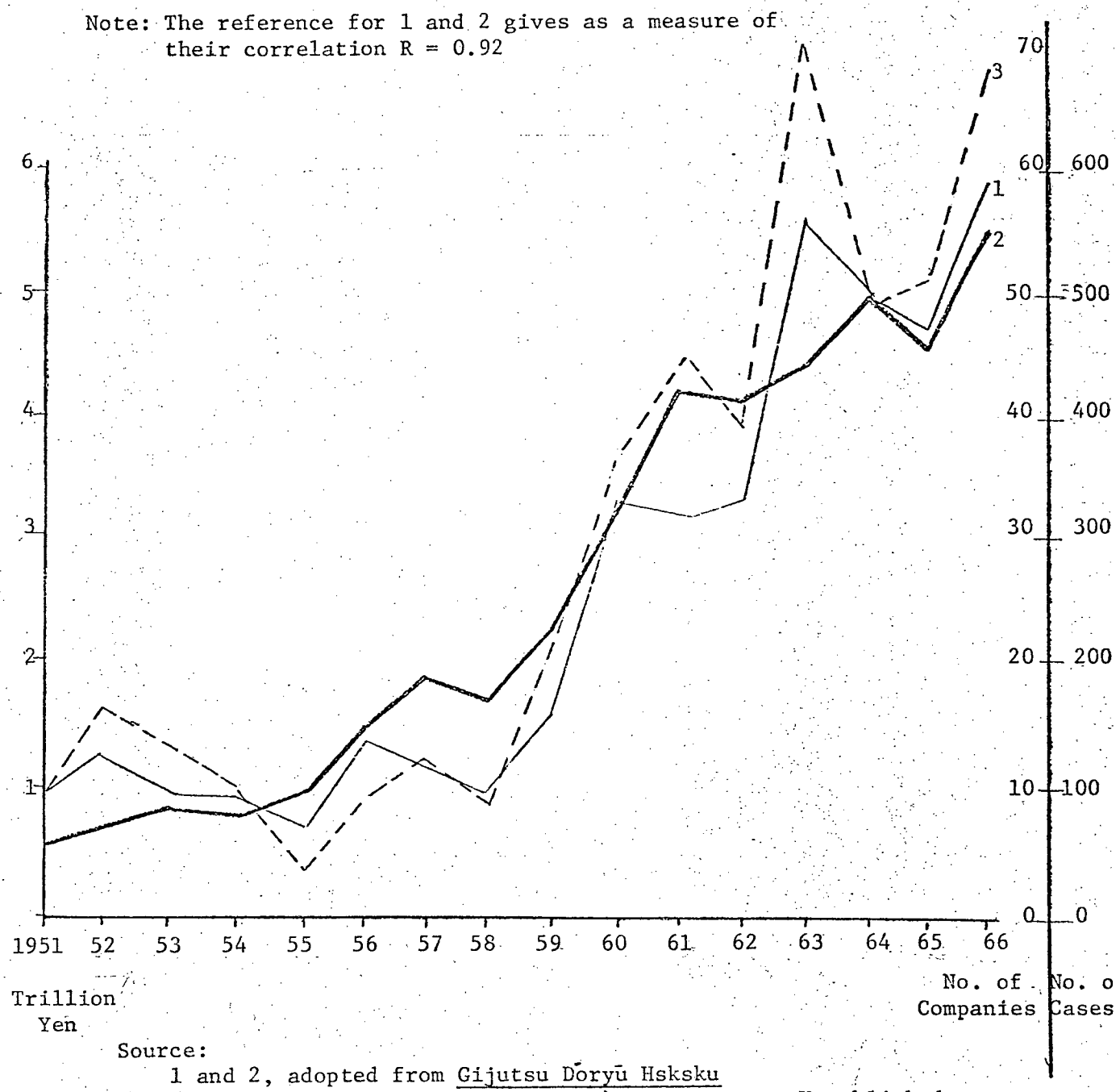
Thus it is reasonable to conclude that one of - or perhaps 'the' -

Figure 3.

Trends in Technology Imports, Private Equipment Investment and Foreign Direct Investment - (1951-1966)

1. ——— Class A Technology Imports (No. of Cases)
2. ——— Private Equipment Investment (Trillion Yen)
3. ----- New Foreign Capital - related Enterprises (No. of Companies)

Note: The reference for 1 and 2 gives as a measure of their correlation R = 0.92



Source:

1 and 2, adopted from Gijutsu Dōryū Hsksku (Report on Technology Importation) - Japanese - Unpublished internal report of Kagaku Gijutsu chō, 1966. p.39

3. Tsūshōsangyōshō, KigyōKyoku (MITI, Enterprise Bureau). (Gaishikei Kigyō - Sono Jitta: to Eikyō (Foreign Capital related Enterprises: their status and impact) Japanese . MITI, 1968, p.268.

Table 15.

Development Time, Sales, R & D and Start-up expense by Source of Technology (1957-1961)
(1962 survey)

Item \ Technology (including new product technology) Source		Self-Developed Tech.		Import		Co-operative Development		Other		Total	
		Aggregate	per case	Aggregate	per case	Aggregate	per case	Aggregate	per case	Aggregate	per case
Total Sales, 1961	(b) Amount	(53.0%) 5,428.	4.5	(33.7%) 3,445.	9.0	(9.8%) 1,006.	3.8	(3.5%) 361.	3.8	(100.0%) 10,229.	5.3
	No. of Cases	1,194		382.		262.		95.		1,933.	
R & D Expense	(b) Amount	(50.2%) 249.	0.2	(25.8%) 128.	0.5	(20.2%) 100	0.5	(3.8%) 19.	.2	(100.0%) 496.	0.3
	No. of Cases	1,061.		128.		216.		88.		1,603	
Start-up expense	(b) Amount	(35.8%) 1,266.	1.5	(49.5%) 1,750.	6.3	(6.8%) 242.	1.3	(7.9%) 278.	3.3	(100.0%) 3,536.	2.6
	No. of Cases	819.		279.		180.		84.		1,362.	
Average Development time	in years	2.35		2.50		2.24		2.21		2.35	
New technology (including new products) by Source-All Industry(a)	percent of total	60.4		20.8		18.8				100%	

Note: (a) These percentages for new technology by source are based on a more inclusive sample and thus differ slightly from any of the figures variously implied by the "No. of Cases" indicated for the sales, R&D. expense and start-up expense rows.

(b) In one hundred millions of Yen.

Source: Tsushosangyosho, Kogyo Gijutsuiin (MITI, Industrial Technology Board). Gijutsu Doko Chosa Hokokusho (Technology Trends, research report) Tokyo: Jigyo Kohosha, 1963, pp. 11 and 126.

Table 16.

Effects of Transferred Technology on Recipient Company

(1961 Survey, post-war T.T.'s

Response Item \ Type of Response / Total Number of Responses (%)		Remarkable	Considerable	Unremarkable
Increased Sales	790	37.5	42.2	20.3
Increased Profits	736	28.7	41.7	29.7
Increased Reliability	752	50.4	36.8	13.0
Increased overall corporate technological level	745	39.9	42.2	17.9
Significance in gaining entry into a new domestic market	734	40.9	40.9	18.2
Effect in displacing competitive products	501	29.8	42.7	27.5
Increased domestic market share	648	31.0	43.2	25.8
Increased Exports	433	19.6	33.7	46.7
Significance in gaining entry to new Export Markets	368	16.8	31.8	51.8

Source: MITI,

Gaikoku Gijutsu Donyu no Genjo to Mondaiten, 1967.

op.cit., p.74.

major sources of initiative for much of Japan's postwar TT was competition among Japanese firms contending for a larger share of the rapidly growing and evolving domestic market. The government, for its part, appears to have played more the role of a mediator than of an initiator of TT.[55] At the same time, foreign possessors of technology appear not to have been major sources of initiative in transfers of technology.[56] This and some other aspects of what we have discussed in this section are fairly well illustrated by the case study forming appendix 1 of this paper.

This issue of domestic competition between Japanese firms continued to affect TT but, in the early 1960's, the broader issues of international competition and trade and demands by Japan's trading partners for liberalization measures came to affect it even more. It is this subsequent period of internationalization and liberalization which is the focus of the following chapter.

IV LIBERALIZATION AND INTERNATIONALIZATION (1963-1973)

1. Rapid Economic Expansion

Japan's rate of economic growth in the 1960's ranged, in real terms, between 10% and 16% annually - with the exception of the two recession years of 1962 (6.4%) and 1965 (4.6%). These growth rates were even higher than those of the latter 1950's but were founded on the massive structural transformation that had begun in that earlier period. The output of the new and renovated industries of the latter 1950's grew not only in quantity but also in quality and sophistication throughout the 1960's - notably in the electronic consumers goods and automobile industries. Increasingly, as income levels rose, even the lower-income groups were able to participate in the consumption boom while middle- and upper-income groups upgraded their purchases to stereos, living-dining room sets and automobiles.

Even in the early 1960's, before the rapid period of growth that make her unequivocally one of the world's major economic powers, Japan's rapid development was attracting a mixture of admiration and concern from the international community. This was particularly true of the developed countries. Between 1958 and 1965 Japan's share of world exports increased by 66% and of world imports by 52% (see table 17 on page 71). Aside from the imbalance in the increases in exports and imports the content of Japan's imports continued to consist mainly of raw materials and semi-finished goods while her exports were increasingly of sophisticated, high value-added manufactures (table 2 on page 21). As might be expected, an increasing proportion of these exports were in direct competition with the output of manufacturers in the developed countries. In fact, the

Table 17.

Trends in Japans Share of World Trade: 1938-1972

(in million U.S. dollars, current prices)

	IMPORTS (c.i.f.)			EXPORTS (f.o.b.)		
ear	Japan[1]	World[2]	Japan/world	Japan[1]	World[2]	Japan/world
938	1,070.	25,400.	.042	1,109.	23,500.	.047
948	684.	63,500.	.011	258.	57,500.	.004
958	3,033.	114,100.	.027	2,877.	108,200.	.027
963	6,736.	162,400.	.041	5,452.	154,100.	.035
965	8,169.	197,400.	.041	8,452.	186.400.	.045
967	11,663.	226,600.	.051	10,442.	214,500.	.049
968	12,987.	251,900.	.052	12,972.	239,100.	.054
969	15,024.	285,800.	.053	15,990.	272,600.	.059
970	18,881.	327,500.	.058	19,318.	312,000.	.062
971	19,712.	364,100.	.054	24,019.	348,100.	.069
972	23,471.	427,500.	.055	28,591.	412,400.	.069

Notes: 1. Beginning 15 May 1972 including trade for Okinawa prefecture. Prior to 15 May 1972, all figures adjusted to approximate trade of 1971 census area.

2. Excluding trade among: China, Mongolia, Democratic People Republic of Korea, and Democratic Republic of Vietnam and trade between the Federal Republic of Germany and German Democratic Republic.

Source: Kokusai Rengo (United Nations), Sekai Tokei Nenkan - 1973 (Statistical Yearbook - 1973) Tokyo: Havashobo, 1974. pp.394-401.

trend throughout the 1960's was for an increasing percentage of Japanese exports to be directed precisely at the home markets of these developed countries (see table 18 on page 73).

2. Japan in the International Economy

(a) Pressures for Reciprocity

Not surprisingly, Japan's increasing share of world trade and her inroads into the domestic markets of the developed countries were of concern to her trading partners. In addition, foreign firms were becoming increasingly aware of the potentials of the booming Japanese domestic market and increasingly frustrated by Japanese government regulation of entry into that market. There were therefore growing demands that Japan provide to foreign goods and investors reciprocal ease of access to her markets. Thus was set one of the major themes of Japan's international relations in the 1960's and early 1970's; the tug-of-war between her trading partners, who wanted the liberalization process speeded up and Japan, which sought to proceed only at such a pace as would assure the prior development of a Japanese industry capable of resisting both the blandishments and competition of foreign investors and products. Of the two, foreign investment and foreign goods, it was the former which was the most problematic as well as being the most closely related to TT - as the major alternative to acquisition of technology via licensing. Thus, the problem of foreign direct investment warrants some separate discussion here.

(b) Antipathy to Foreign Direct Investment

The fact that antipathy to foreign direct investment was one of the attitudes importantly effecting the pattern of postwar TT to

Table 18.

Japan's Imports by Provenance and Exports by Destination: 1963 - 1972.

(F.O.B. value in million U.S. Dollars)

	Provenance / Year	WORLD	Developed Market Economies	%	Developing Market Economies	%	Centrally Planned Economies	%
I	1963	5,550.	3,210.	57.8	2,110.	38.0	235.	4.2
M	1965	6,790.	3,620.	53.3	2,730.	40.2	435.	6.4
P	1966	8,140.	4,240.	52.1	3,310.	40.6	590.	7.2
O	1967	9,890.	5,250.	53.1	3,960.	40.0	680.	6.8
R	1968	10,740.	5,770.	53.7	4,270.	39.8	690.	6.4
T	1969	12,510.	6,770.	54.1	5,060.	40.4	680.	5.4
S	1970	15,280.	8,700.	56.9	5,850.	38.3	730.	4.7
	1971	15,730.	8,350.	53.0	6,540.	41.5	840.	5.3
	1972	19,470.	10,410.	53.4	8,010.	41.1	1,050	5.4
	1963	5,450.	2,650.	48.6	2,550.	46.8	250.	4.6
E	1965	8,450.	4,350.	51.5	3,620.	42.8	480.	5.7
X	1966	9,780.	5,060.	51.7	4,120.	42.1	600.	6.1
P	1967	10,440.	5,350.	51.2	4,570.	43.7	530.	5.1
O	1968	12,970.	6,810.	52.5	5,580.	43.0	580.	4.5
R	1969	15,990.	8,410.	52.6	6,810.	42.6	760.	4.7
T	1970	19,320.	10,540.	54.5	7,730.	40.0	1,050.	5.4
S	1971	24,020.	13,180.	54.8	9,690.	40.3	1,150.	4.8
	1972	28,650.	16,170.	56.4	11,040.	38.5	1,450.	5.1

Source: Kokusai Rengo (United Nations), Sekai Tokei Nenkon, Showa 49 nenpan
(U.N. Statistical Yearbook - 1973 - Japanese edition)
- Japanese - Tokyo, Harashobo, 1974.
pp. 402-404.

Japan was mentioned in chapter three. The reason for its importance is, of course, that flows of technology and investment (as well as of goods and equipment related to these) are not necessarily and, in fact, often are not separate processes. Rather, they are frequently part and parcel of a single business proposal. Nevertheless, as regards foreign direct investment (FDI), the Japanese have never welcomed such foreign involvement in their country and this is reflected - to this day - in the low level of such foreign investment (see table 3 on page 23).

With the pressures for reciprocity and liberalization of Japan's regulations regarding foreign investment an increasingly lucid rationale for Japanese reluctance took shape. First, it is argued, foreign ownership implies foreign management participation. This raises the spectre of foreign owners deciding, in their global interest, to suddenly close down a factory or lay off workers, for example. Given the Japanese system of permanent employment (and the attendant difficulties in finding new employment having once entered into a company) such action would have profound implications for the Japanese citizens thus affected.

Secondly, the informal consultation and guidance between government and business in Japan is an integral and major aspect of managing the Japanese economy. Foreign management has neither the capacity to participate nor an incentive comparable to that of 'Japanese companies' to co-operate in this process. Thus FDI impairs the ability of the government to manage the economy.

Thirdly, and more directly related to technology, in many instances foreign firms have a technological advantage over their Japanese counterparts which would enable them to quickly dominate the industry. Aside from the implications of this for the Japanese companies and their 'life-long'

employees, this inhibits development of an indigenous Japanese capacity for technological innovation.

The first of these three arguments regarding FDI (and, to a lesser extent, the second as well) have some claim to the status of "special Japanese circumstances" - deserving, and to a large extent receiving, special consideration by Japan's trading partners. The third is perhaps a more universal concern of countries regarding FDI [57] - though not, by reason of that, any the less a legitimate matter of concern.

Whatever the rationale offered however, the level of antipathy to foreign investment in Japan is disproportionately high. Some countries simply exhibit a higher sensitivity to a foreign commercial presence than do others and the explanation for this is not likely to be found entirely in the rational and objective. [58] In the case of Japan this sensitivity is high and probably but one manifestation of the 'fortress mentality' growing out of centuries of separation from major outside influences and the concurrent (though not necessarily inevitable) development of a culture which places central emphasis on 'in-group' and 'out-group' distinctions.

(c) Formal Entry into the World Economic Community

The demands by Japan's trading partners that she liberalize her restrictions on foreign trade (including investment) were, in effect, demands that she abandon the protectionist stance of a poor, underdeveloped nation and forge new trade relations on a basis of equality with the developed nations. This is an important point for, from the earliest years of Meiji, the goal of equality with the advanced nations has been the most constant theme of modern Japanese history. Thus, it should be

appreciated that at the same time as there was concern over the impact of liberalization (as discussed above) there was a concurrent desire to proceed with it because of the recognition of Japan's equality which it implied. For similar reasons, Japan's role as host of the 1964 Tokyo Olympics and the international attention which it attracted imbued the enterprise, for many Japanese, with a sense of symbolic reacceptance into the international community of advanced nations.

Of greater importance, however, was Japan's entry in April of the same year into the OECD (Organization for Economic Cooperation and Development) - the major international economic body of the advanced, industrialized nations.[59] The importance of this step lay not only in its symbolic significance as recognition of Japan's advanced stage of development but also in the fact that entry formally committed Japan to liberalization of its trade relations.

3. The Course and Impact of Liberalization on Technology Transfer

(a) The Stages of Liberalization

Liberalization of trade relations had broad implications - extending to the use of import restrictions on foreign goods. We will here, however, concentrate on liberalization as it affected TT, per se, and the related activity, foreign direct investment.

The formal laws and regulations bearing on TT up until liberalization were discussed earlier, in chapter three. In essence, these regulations called for a 'case-by-case' handling of all proposed TT. Even prior to formal entry into the OECD there was some administrative relaxation of procedures.[60] For example, the basic criterion that TT make a 'positive'

contribution to Japan's balance-of-payments, public utilities, or major industries was relaxed to the requirement that TT simply not have an adverse effect in these areas. With entry into the OECD however, two new, more liberal, categories of TT procedures were formally established.

The first of these we will here term 'Bank of Japan-Approval'. Under this procedure an application for TT, in principle, was approved within one month of application in the absence of a specific objection or interjection by a concerned ministry. As was mentioned earlier, the phrase 'concerned ministry' was not a restricted or defined term but would always include MITI and the Ministry of Finance and, depending on the nature of the TT, perhaps the Ministry of Agriculture and Forestry or the Fair Trade Commission.

The second new approval procedure we will term 'full liberalization'. This, too, was administered by the Bank of Japan but approval was automatic and the procedure was represented as more of a registration system than an approval procedure.

The implementation of these two new approval procedures did not have major impact until the formal announcement of a specific set of liberalization measures in 1967 and their implementation beginning in June 1968. In brief, the liberalized regulations for TT provided as follows:

1. TT involving payments of under US $50,000 (from December 1973, under $30,000) were 'fully liberalized' - except for TT which involved establishment of a new company or a cross-licensing agreement.

2. TT other than that falling under the provisions of 1. or 3. (below) was moved to a 'Bank of Japan-Approval' basis.

3. TT related to the following seven fields remained subject to a case-by-case review: aviation, firearms, explosives, atomic energy, outer space, computers, petrochemicals.

Even with this, however, Japan remained the only OECD member country with such overt controls over inward flows of technology and continued to receive pressures for fuller liberalization. As a result, a schedule for further liberalization was settled upon in July 1972. This schedule provided, roughly, as follows:

1. TT related to aviation, firearms, explosives, atomic energy and outer space were moved to a 'Bank of Japan-Approval' basis.

2. Petrochemicals-related TT was moved to a 'full-liberalization' basis except for TT relating to 'derivative products' - manufacturing technology which was to be fully liberalized as of January 1973.

3. The treatment of computer-related TT was to vary with the content and value of the transfer. Excepting the transfer of software technology exceeding (US) $50,000 and hardware technology exceeding $100,000 in value, TT was fully liberalized. The excepted categories of computer-related TT would all be moved to full liberalization as of July, 1974.

As a result of these further steps, "pure" (i.e. uncontaminated by FDI) TT to Japan was, by and large, all 'fully liberalized' as of 1974.[61]

We have suggested already that liberalization of foreign direct investment was more problematic than that of TT, per se. In fact, it has proceeded at a slower pace than has TT liberalizations. Nevertheless, the 1967 liberalization measures were also a significant step forward regarding FDI in new enterprises (the purchase or acquisition of shares

in existing firms remained - and remains - more carefully controlled).

These liberalization measures established two categories of liberalized industries; Class 1, industries, where foreign participation was limited to 50% and Class 2, industries, where 100% foreign ownership is permitted. Significantly, the latter category consisted mainly of industries in which Japanese international strength was already high (eg. motorcycles, pianos) or in which Japanese companies were already either strongly entrenched or of declining international importance (eg. ordinary steel, rayon, cotton fibres).

The industries initially included in the more restricted Class 1. (33, in all) included agricultural chemicals, radios, television, and watches. Again, these were in many cases industries in which Japanese companies were already highly competitive and the group did not include many industries of highest appeal to prospective foreign investors (computors, drugs, hydraulic equipment, retail trade, etc.).

In subsequent years however, a schedule of gradual expansion in the number of liberalized industries was established and, by May 1976, almost all industries will be open to 100% foreign ownership in new enterprises. Remaining exceptions will include agriculture, forestry, fisheries, leather and leather by-products, retail trade exceeding 11 stores in number, and the oil industry. In addition, foreign investment in existing enterprises remains subject, in all cases, to government approval and in certain restricted industries - such as finance, utilities, transport, and communications - is subject to statutory limitations or prohibition.[62] (Domestic, Japanese, takeover bids are also subject to stringent controls, both formal and informal.) On this latter point, of course, Japan is not unique and many countries impose similar statutory limits or prohibitions

on certain specific, critical, industries. Moreover, Japan's maintenance of controls over foreign investment in existing enterprises, also, is not out of tune with the times as even in the USA (with the sudden emergence of oil-rich Arab countries looking for investment opportunities) there has been increased talk of adopting some form of monitoring of foreign takeovers. Thus, Japan can fairly be said to have completed a process of formal liberalization and internationalization. Moreover, while informal impediments may remain, these are likely to pose few serious obstacles to the flow of technology.[63]

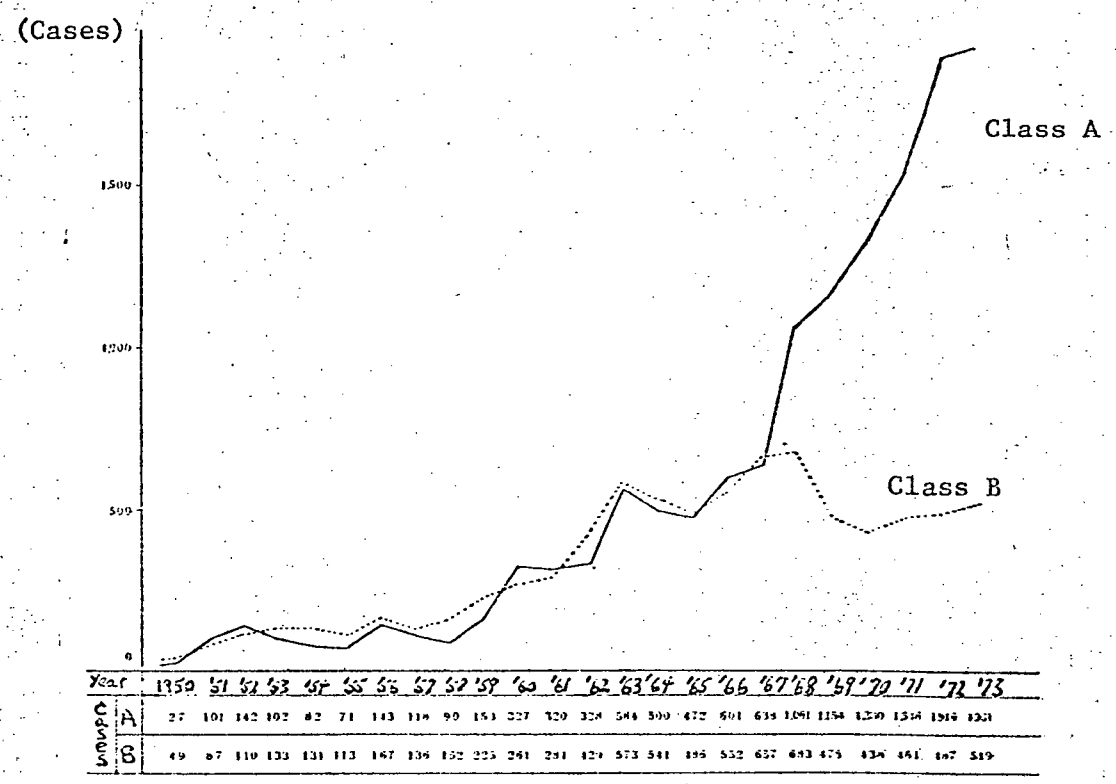
(b) The Impact of Liberalization on Technology Transfer

As figure 4 (see page 81) shows, there was a fairly steady and rapid increase in TT beginning in the early 1960's and the pace of TT quickened with the liberalization measures of 1967-1968. The increases in TT activity cannot be entirely attributed to the liberalization measures. Japan's further economic expansion and development towards affluence, as well as the rapid increase in Japan's foreign exchange reserves (from around 1965) all favoured increased TT activities. Nevertheless, even prior to the formal liberalization measures in 1968, informal response to demands for liberalization contributed to the surge in TT.

The formal liberalization measures of 1967-68 are, of course, most clearly causative of the concurrent overall increase in the yearly rate of TT. More dramatic than this, however, is the sudden shift from class B to class A TT agreements. It seems clear that the liberalization measures not only encouraged more TT but that (recalling that the main distinction between the two types of TT was whether payments exceeded one year in duration or not), they also encouraged companies to enter into agreements of a longer-term, more ongoing nature.

Figure 4

Approvals of Technical Assistance Agreements, 1950 - 1973



Source: Kagaku Gijutsu cho (Science and Technology Agency)
Gaikoku Gijulsu Donyu Denji Hokoku
(Annual Report on Foreign Technology Importation)
- Japanese - 1975, p.5.

Ozawa, goes further and suggests that this sudden turning away from class B towards class A TT: ". . . may signal a turning point in Japan's postwar technological progress; its technical capacity had substantially advanced to such an extent that industry became less dependent on incidental technical assistance from the West." [64]

A reduction in dependence on the West for 'incidental technical assistance' had undoubtedly taken place. On the face of it, however, it seems highly unlikely that a major turning point coincided with the 1967-68 liberalization measures and, moreover, occurred in all industries at about the same time (see table 7 on page 42). What's more, as was pointed out earlier, the distinction between class A and class B categories of TT does not bear any necessary relationship to the 'technical' content of the TT. An item of class A TT may transfer only the rights to use a brand name while class B tt often involves precisely such 'incidental technical assistance' in the form of short-term consultation or advisory services.

In the final analysis, the significance of this change, in terms of the content - as opposed to the duration - of TT agreements, probably cannot be established without a detailed examination of specific contracts both before and after the liberalization measures. Unfortunately, no such study appears to have been carried.out. It seems likely that, were such a study done, it would reveal a close connection between the rapid trend to class A TT agreements and the increase in foreign direct investment activities - which were also affected by the liberalization measures. That is to say, as more foreign firms opted for FDI in Japan there would, naturally, be an upsurge in the number of class A (longer-term) TT agreements between the Japanese venture and its foreign parent

or partner. Such longer term and more comprehensive agreements appear to have taken the place of many of the, earlier, class B TT activities of these same companies.

(c) Liberalization and Foreign Direct Investment

The strong connection between FDI and TT, as a general phenomenon, has been discussed earlier. In the Japanese case the connection appears to have been particularly strong and important. In fact, the rapid increase in FDI in the 1960's can be largely viewed as an exchange of technology (or the legal rights to use it) for access to the Japanese market. This view is supported by studies published by MITI in 1968 which indicate this to have been the case both as regards the subjective motivations for entry into a joint venture (see figure 5 on page 84) and in the respective contributions actually made by the partners at the time of formation of a joint-venture (see table 19 on page 85).

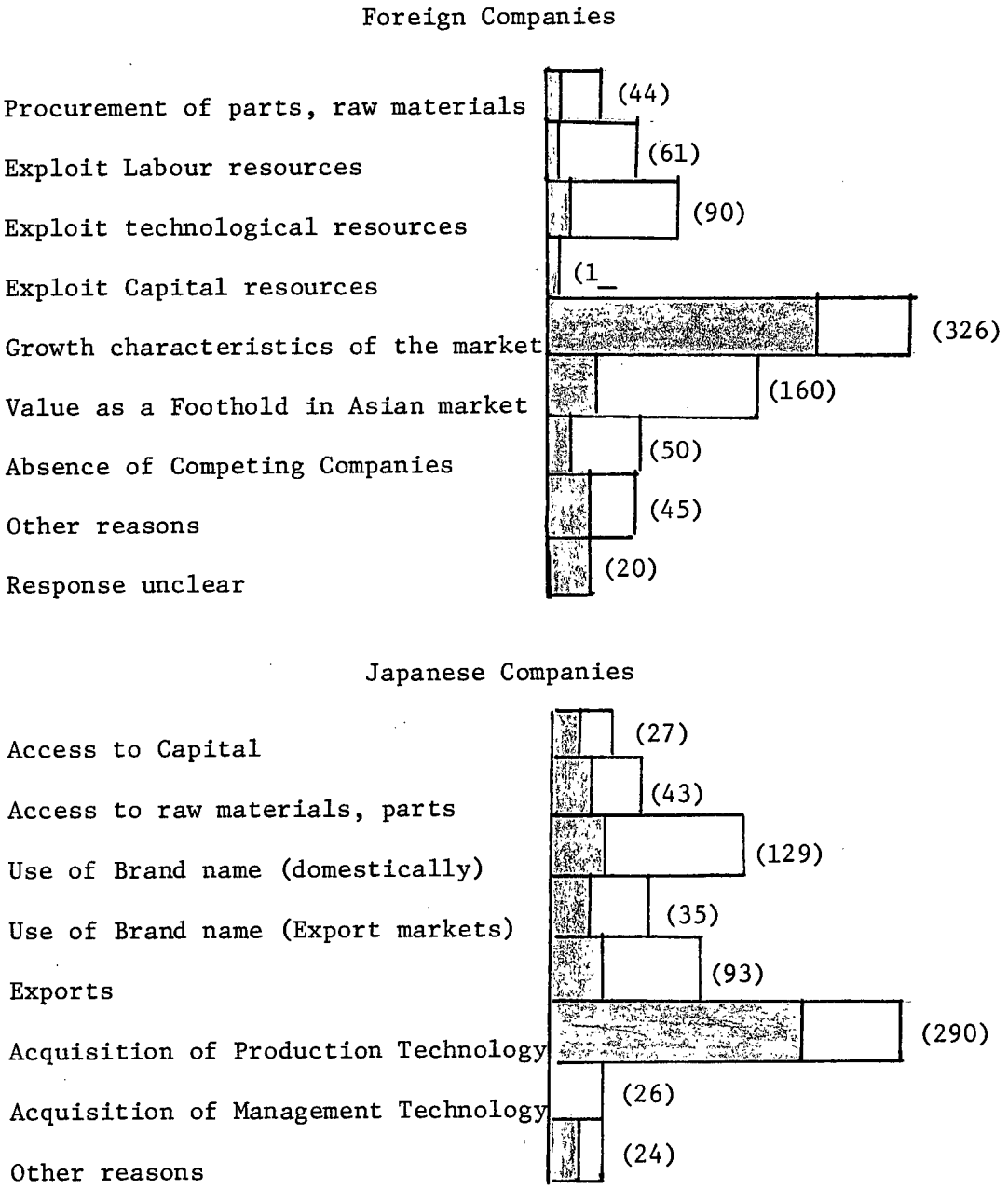
As figure 3 (on page 66) indicated, FDI, in terms of numbers of cases, roughly paralleled trends in Japanese private equipment investment and trends in TT, per se, though it was increasing at a slightly faster rate. The liberalization measures of 1967-68 gave FDI even more impetus and the annual rate of new joint-venture formation was running above 200 cases per year by 1970 - more than double the figure in 1967 (see table 20) The 1960's witnessed a considerable increase in the proportion of joint-ventures engaged in non-manufacturing activities and likely, therefore, to be less associated with TT. In terms of capitalization, however, there remains an overwhelming dominance of manufacturing concerns (see table 21 on page 87). As table 21 indicates, the average level of foreign ownership for FDI in Japan is only slightly over 50% and this

Figure 5

Motivation for Involvement with
Foreign Direct Investment in Japan

( ) = No. of positive responses

▒ = Proportion giving this as the most important motivation



Source: Tsūshōsangyōshō,

Gaishikei Kigyō Sono Jiffai to Eikyō, op. cit.

pp. 31 and 34

Table 19.

Joint Ventures in Japan: A comparison of the respective contributions of Japanese and Foreign partners at Start-up and over time.

Investor		Investment	Number of Investors	Total Investment	%	Respective share of Total Investment (%)	Cash	%	Equipment	%	Technology	%	Other	%
At Time of SURVEY (1967)	JAPANESE	Actual Number	2,212.	101,027,587.	100.	60.3	94,360,203.	93.4	3,862,436.	3.7	26,995	0.	2,777,953	2.7
		No. of Respondents	285.	-	-	-	285.	-	7.	-	2.	-	7.	-
	FOREIGN	Actual Number	326.	66,499,547.	100.	39.7	54,978,319.	82.8	205,211.	0.3	9,151,900.	13.8	2,064,117.	3.1
		No. of Respondents	285.	-	-	-	270.	-	4.	-	31.	-	7.	-
At Time of Start-UP (Various)	JAPANESE	Actual Number	1,608.	35,701,667.	100.	55.8	31,665,573.	88.7	3,862.971.	10.8	26,995	0.1	146,128.	-
		No. of Respondents	281.	-	-	-	279.	-	8.	-	2.	1	1.	-
	FOREIGN	Actual Number	327.	28,303,412.	100.	44.2	19,878,701.	70.2	115,211.	0.4	8,309,500	29.4	0.	-
		No. of Respondents	283.	-	-	-	258.	-	3.	-	31.	-	.0	-

Source: Tsuchosangyosho (MITI), Gaishikei Kigyo - sono Jittai to Eikyo (Foreign Capital-related Enterprises: their Status and Impact) - Japanese - Tokyo, 1968. pp.272-273.

Table 20.

Establishment of Joint Ventures (Number of Cases) by Main Industrial Categories: 1950 - 1971

Industry / Year	All Industry	Machinery	Metals	Chemicals	Textiles	Petroleum	Other Manufacturing	Commerce and Trade	Other
50-53	70	21	4	10	4	5	9	12	5
1954	6	1	1	3					1
1955	2	1		1					
1956	5	1		2			1		1
1957	7	4		2					1
1958	1			1					
1959	10	5	2	1			2		
1960	12	4	1	6					
1961	19	10	1	3	2	1	2		
1962	22	12	1	8	1				
1963	53	23	3	11	1	1	7	4	3
1964	77	24	5	11	2		12	15	8
1965	69	18	4	13	1	1	7	14	11
1966	78	18	1	19	1		10	20	9
1967	93	29	6	12	3	3	6	29	5
1968	106	28	1	11	2		8	44	12
1969	174	41	9	29			15	54	26
1970	209	42	5	28	4		25	64	41
1971	217	37	10	18	3	1	30	77	41
1971 dist)	(100.0)	(17.1)	(4.6)	(8.3)	(1.4)	(0.5)	(13.8)	(35.5)	(18.9)
Total 1950-1971	1,230.	31.9.	54.	189.	24.	12.	135.	333.	164.
% of Total	100.0	25.9	4.4	15.4	2.0	1.0	11.0	27.1	13.3

Source: Fujiwara, Ichiro Shihon Jiyukato Takokusekikigyo (Capital Liberalization and Multinat-onal Enterprise)-Japanese-Tokyo,Nikon Keizai Shimbunsha, 1973. p.100.

Notes : 1. This data is not restricted to newly established companies and includes agreements between foreign investors and existing Japanese companies.

2. Includes Yen-base companies

Table 21.

National Origin of Foreign Direct Investment in Japan
by amount of Investment (as of 1971)

Home Country \ Industry, Capital, % of total	All Industry		Manufacturing	
	Capitalization (100 mil.Yen)	% of Total	Capitalization (100mil.Yen	% of Total
U.S.A.	1,535	68.5	1,350	73.4
Europe	572	25.4	373	20.2
England	222	9.9	83	4.5
Switzerland	169	7.5	146	7.9
West Germany	50	2.2	35	1.9
France	35	1.5	33	1.8
Other Europe	96	4.3	75	4.1
Canada	108	4.8	108	5.9
Other	28	1.3	10	0.5
Foreign Capital, Total (A)	2,243	100.0	1,841	100.0
Total Capitalization of Foreign Capital-related Enterprises(B)	4,109	-	3,674	-
A/B x 100 (%)	54.6	-	50.1	-

Source: Tsushosangyosho, KigyoKyoKu (MITI, Enterprise Bureau). Gaishikei Kigyo no Doko (Trends in Foreign Capital-related Enterprises) - Japanese - Tokyo, p.29.

reflects the fact that the most common form of FDI is the joint venture (see table 22 on page 89). The USA is the largest direct investor in Japan and accounts for about 62% of total companies and 68% of total capitalization (tables 21 and 22). This US dominance of FDI is high but not uniquely so - an OECD study indicates an even stronger US domination of total FDI in Canada and the UK.[65] In view of the strong historic, linguistic and (in the case of Canada) geographic ties between these latter two and the US and the corresponding lack of such ties between the US and Japan however, the high Japanese figures suggest that the postwar ties forged between Japan and the US have had particularly strong impact on the propensity for US FDI in Japan (the same OECD study showed, for example, that US FDI accounts for only about 44% of total FDI in the other high-growth postwar economy, West Germany).

(d) Liberalization and Domestic Firms

As we have already indicated, liberalization led many Japanese firms to enter into longer-term and closer relationships with foreign companies. There were also, however, other and more generalized effects following on liberalization which had significance for TT.

In the first place, the trend towards liberalization increased - or threatened to increase - competition in the Japanese domestic market from foreign products and firms. As a consequence, there was considerable official and public concern over 'rationalization' of Japanese industries so that they might more effectively meet the forthcoming "face-to-face" competition from large international firms in their home market. In the main, the envisioned rationalization process implied a reduction in the numbers of firms in various industries so as to develop an industry

Home Country of Foreign Investor

Type of Company and Home Country of Foreign Investor	TYPE OF BUSINESS							
	All Enterprises		Manufacturing		Commerce		Other	
	No. of Cos.	% of Total	No. of Cos.	% of Total	No. of Cos.	% of Total	No. of Cos.	% of Total
TOTAL	1,006	100.0	565.	56.2	323.	32.	118.	11.8
Type of Company	-	-	-	-	-	-	-	-
Totally Foreign Capital	274.	27.2	45	4.5	163.	16.2	66.	6.6
Joint Venture Co.	650.	64.6	474.	47.2	130.	12.9	46.	4.6
Foreign Capital-Importing Japanese Company	82.	8.2	46	4.6	30.	3.0	6.	0.6
Home Country of Foreign Company	-	-	-	-	-	-	-	-
U.S.A.	620.	61.6	414.	41.2	135	13.4	71.	7.1
Canada	24.	2.4	14.	1.4	8.	0.8	2.	0.2
Europe	288.	28.6	129.	12.8	127.	12.6	32.	3.2
England	50.	5.	24.	2.4	19.	1.9	7.	0.7
France	29.	2.9	11.	1.1	12.	1.2	6.	0.6
West Germany	70.	6.9	36.	3.6	28.	2.8	6.	0.6
Switzerland	67.	6.7	32.	3.2	31.	3.1	4.	0.4
Other Europe	72.	7.1	26.	2.6	37.	3.7	9.	0.9
Other	74.	7.4	8.	0.8	53.	5.3	13.	1.4

Note: "Foreign Capital-importing Japanese Company" indicates a Foreign entity has purchased shares in an existing Japanese company. This category implies that there is no definite management participation by the Foreign investor. Where there is clear evidence of such participation the firms are reclassified as a joint venture. "Joint Venture", except as implied in the preceeding, indicates a company originally established in partnership with a foreign investor.

Source: MITI, Gaishikei Kigyo so Doko, op.cit. pp.32-33.

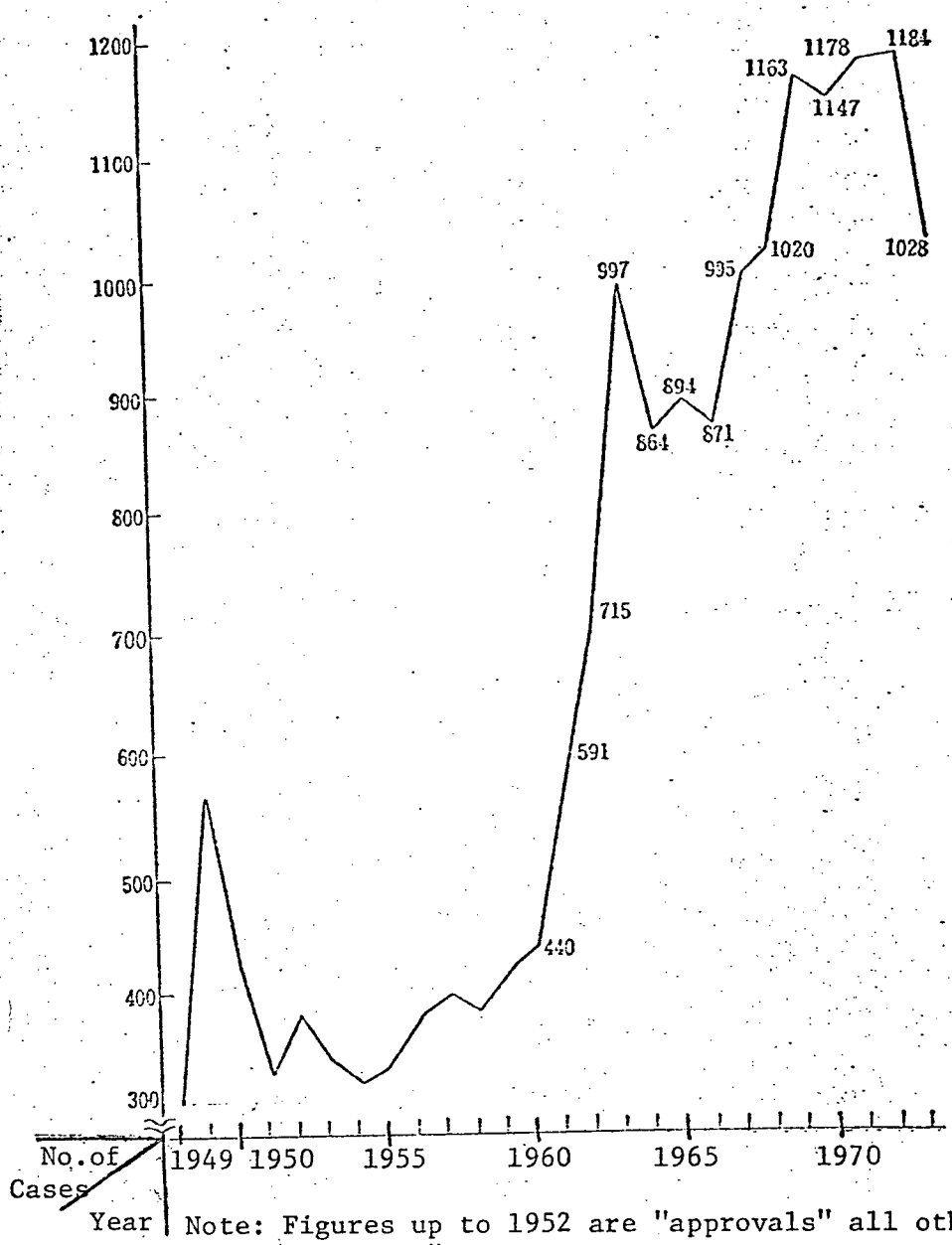
structure composed of a smaller number of larger firms. This, it was felt, would produce more efficient industries capable of technological scale economies and, in the longer run, technological innovative abilities comparable to those of large international firms.

This concern, and the remedy proposed, reflected the fact that in many of the boom industries of the 1950's there were a large number of marginal, small-scale, producers many of which had poor access to financing due to the highly centralized Japanese financial system. Thus industry consolidation would also improve the financial ability of Japanese industry to compete. The amendment of the Anti-Monopoly Law of 1947 to permit what were termed 'recession and rationalization cartels' provided a useful means of providing official encouragement towards inter-firm cooperation and eventual industry consolidation.

Aside from whatever impact government encouragement of industry consolidation may have had, there are indications that the rigours of the market-place, itself, began to enforce a consolidation process on industry as the weaker firms in many cases became less and less able to keep pace with expansion and technical change in their industry and their market shares dwindled (appendix 1. provides a rather extreme example of industry 'crowding' in the late 1950's). An even sharper spur to reduction in the number of firms in the various industries was provided by the severe recession years of the early 1960's. Thus, from a combination of official encouragement and market forces, the 1960's was marked by a considerable degree of consolidation in Japanese industry. This process is reflected in the sharp upturn in the number of mergers per year beginning in 1960 and continuing through into the 1970's (see figure 6 on page 91).

Figure 6

Trends in Annual Number of Mergers



Note: Figures up to 1952 are "approvals" all others are "reported".

Source: Dosei Torihiki linkai (Fair Trade Commission).

Dokusen Hakusho, Showa 49 Neupan

(Monopoly White Paper, 1974 Edition) - Japanese- 1975, p.308.

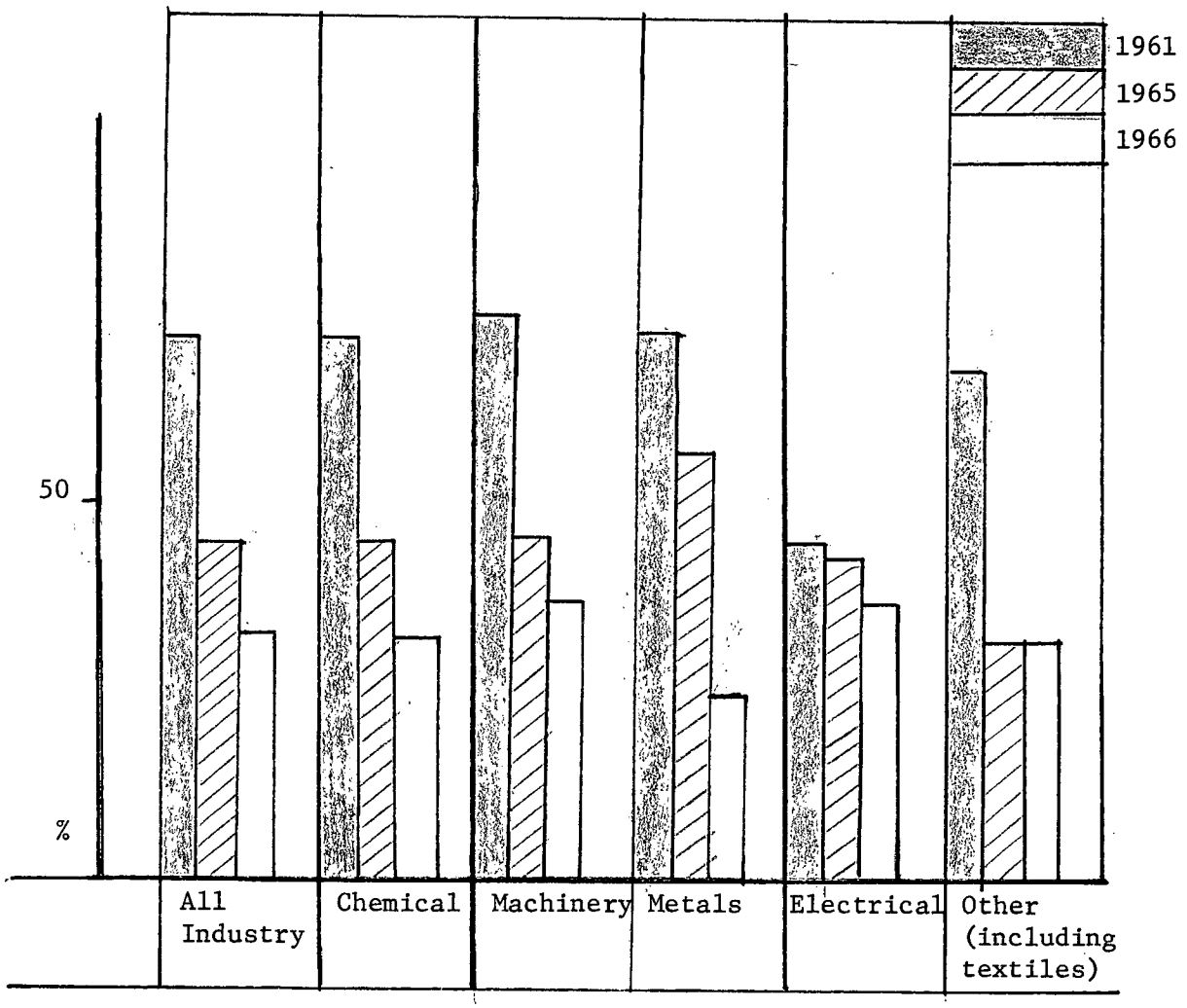
Another, possibly related, development of the 1960's may have been an increasing technological 'equality' among Japanese firms. As figure 7 (see page 93) indicates, the proportion of 'new' technology, that is, technology not previously imported into Japan, declined fairly steadily. Conversely, this implies that an increasing proportion of the (increasing amount of) TT in the 1960's was of technology already possessed by one or more of the importing companys' competitors. Overall, this meant a levelling of the technological capabilities among Japanese firms and, at the same time, an increase in industry average technological capabilities.

Thus, the reality and the 'threat' posed by the movement towards liberalization in the 1960's helped spur on industry consolidation and technological development over the same period. In any event, by the latter part of the 1960's, the increasing sophistication of Japan's existing technological capabilities led to an increase in the amount of development efforts Japanese firms were making at the technological 'frontiers' of their respective sciences. With this, the role of TT, while still of major importance, is coming to be subordinate in official and popular thinking to the growing emphasis on the development of the independent technological innovative capabilities of Japanese industry. This, ongoing, transformation in the role of TT which began in the late 1960's and early 1970's is one theme of the following chapter discussing "TT and Japan today".

Figure 7

Trends in the Importation of "new" *technology as a component of Total Technology Imports - by industry

(Class A Technology only)



Source: Kagaku Gijutsu cho,

Gijutsu Donyu Hokoku, 1966. op. cit. p.32

* "New technology" refers to technology of a type not previously imported into Japan.

V TECHNOLOGY TRANSFER AND JAPAN TODAY

In Japan in 1975 the themes of the recent past outlined in the previous chapter still persist. The purpose of this chapter, in contrast to that of chapter four, is not therefore to outline the course of major change over time in the pattern of TT to Japan in the past few years but, rather, to provide a statement of the current status of Japan vis-à-vis TT and to suggest what may be the major related themes in the near future. In this respect, relatively recent developments of the past few years have probably served to clarify what these themes will be.

In particular, the growing problems of 'over-industrialization' in Japan, the energy and resources crises, and major changes in Japan's foreign relations are all recent changes which have implications for Japan and TT and which have served to clarify some of the likely developments in this area over the near and medium-term future.

1. The Changing Characteristics of Technology Transfer to Japan

The tendency noted earlier (see figure 7 on page 93) for multiple transfers of a given technology to more than one Japanese company would seem to have evolved into a new, standard pattern in which TT is 'clustered' around significant new innovations as they occur. This impression is particularly strong in industries in which Japan's technological level is high. Thus, in 1973, 168 of the total of 305 transfers to the Japanese electronics industry were 'multiple' - with one technology alone accounting for 24 of the transfers.[66]

In terms of the content of TT agreements themselves, the growth to affluence during the 1960's has created in Japan the world's second largest mass-consumption market (after the USA). Thus, there is and

should continue to be a major market in Japan for TT related to the fashion, sports, leisure, and service industries. In this connection the rapidly increasing flow of textile and textile-products-related technology which began in the latter 1960's (see table 8 on page 43) likely reflects the saleability of fashionable foreign brand names and clothing designs in contemporary Japan - rather than any more clearly "technical" reliance on foreign technologies. One special source of impetus for such TT may be the increasing amount of foreign tourism by Japanese. As table 23 shows (see page 96), the number of Japanese going abroad as tourists increased by a factor of more than 10 between 1968 and 1974. As these hordes of conspicuous consumers return to Japan laden with their usual mass of souvenirs (and knowledge of others they didn't return with) they sew the seeds for additional 'fads' in foreign-inspired consumers goods and prepare the way for further TT. Thus, one major and growing area or type of TT to Japan, both now and in the future is far less related to the technical than it is to the fashionable - to the special cachet of a foreign brand name or design.

There are, of course, areas where TT of a more clearly technical nature is and is likely to continue to be active. These would prominently include the areas of energy, information processing, and pollution control, including recycling techniques. This latter category is a particularly interesting area. It may be a field where a cycle of technology import-technology self development-technology export will occur in a rapid, foreshortened form due to the rapidity with which the industry developed and the severity of the pollution problems (and regulations) in contemporary Japan (see appendix 3. for a case study of TT in this field).

Table 23.

TRENDS IN JAPANESE OVERSEAS TRAVEL

a) Yearly Totals 1950 -1974

Year	Total	Year	Total	Year	Total
1950	8,922.	1960	76,214.	1970	663,467.
1951	20,011.	1961	86,328.	1971	961,135.
1952	25,597.	1962	74,822.	1972	1,392,045.
1953	34,813.	1963	100,074.	1973	2,288,966.
1954	34,593.	1964	127,749.	1974	2,335,530.
1955	42,900.	1965	158,827.		
1956	35,803.	1966	212,409.		
1957	45,744.	1967	267,538.		
1958	49,263.	1968	343,542.		
1959	57,194	1969	492,880.		

b) Composition (category definitions underwent minor change over time)

Year	Business	Academic	Tourist	Other	Total*
1965	66,752.	2,526. (sic.)	49,468.	44,164.	162,910.
1968	122,754.	5,393.	152,513.	62,407.	343,067.
1971	241,540.	2,244.	638,489.	78,862.	961,135.
1974	375,171.	5,324.	1,882,415.	72,620.	2,335,530.

*Differs from figures in a) due to difference in data collection procedures.

Source: Unpublished data received from the Japanese Ministry of Justice, Immigration Department, June, 1975.

2. Growth in Cooperative Ventures

The technological capabilities possessed by Japanese firms - and the competitive necessities they face domestically and internationally - increasingly mean that technological advance implies advance at the frontiers of their respective sciences. Due to the often major costs and almost invariably unpredictable results of research at this level there is considerable appeal in 'hedging one's bets' by entering into some form of cooperative agreements with other organizations engaged in similar research. This can take many forms; from joint development, to cross-licensing, to 'mere' information sharing.

Considerations such as this can lead of course to cooperative agreements among domestic firms. Indeed, such considerations have played a part in, for example, the formation of Japanese computer firms into two groups of cooperating companies (following considerable, strong, government encouragement). Moreover, there are indications that the 1970's will see a broad and continuing effort on the part of both business and government to encourage such domestic cooperative efforts at technological development.[67] Ozawa has argued that Japan may, in fact, possess an advantage in this area for,

> As the complexities of the problems to be dealt with and the scale of research increase, a systems approach and interdisciplinary teamwork are required. Here the Japanese may have an advantage, since they can mobilize the devoted efforts of a group of researchers of diverse backgrounds in relative harmony. A strong group orientation is a peculiarly Japanese characteristic.[68]

In fact, however, while Japan may possess advantages they are unlikely to lie in the ability to 'mobilize the devoted efforts of a group of researchers of diverse backgrounds' - precisely because of a 'strong group orientation'. That is to say, except in unusual circumstances (as in

wartime or some other situation which expands group identification beyond normal bounds), the tendency of a group of Japanese, researchers or not, is to remain highly aware of 'diverse backgrounds' and to respond and behave as members or representatives of their primary group. To the extent that research demands the repetitive formation and dispersal of project-oriented research 'teams', the Japanese are more likely to possess a disadvantage than an advantage.

There is the further fact that in both the general case and (perhaps particularly) in the Japanese case there is a tendency for firms to view all relevant domestic organizations as major competitors. This can make firms more willing to enter into cooperative agreements with foreign firms rather than with domestic 'rivals'. In some countries, including Japan, there is also the possibility that anti-trust laws and regulations can act to make such cooperative agreements easier to form with foreign than with domestic firms.

In fact, for whatever combination of reasons, there is already an indication that cooperative agreements with foreign firms are of growing importance as regards TT to (and from) Japan. This is reflected in a growing number of cross-licensing agreements with foreign firms. In the majority of cases to date however, such agreements have been linked to payments by the Japanese side - suggesting that the foreign firm remains technologically dominant in such cooperative relations.

In the extreme, such 'cooperative agreements' take the form of joint-venture companies in Japan (or elsewhere). In this regard, the increase in FDI in Japan witnessed in the 1960's, and early 1970's, is likely to continue and to maintain the characteristic joint-venture form. There

will not likely, however, be any further major, formal, liberalization measures in the near future[69] - especially as regards foreign 'takeovers' of existing firms.

3. Expansion in Technology Exports

Perhaps the major Japanese development vis-à-vis technology transfer in the 1970's has been and will continue to be the expansion in Japanese exports of technology - in, that is, 'outward' TT.

One of the major forms of such outward TT has been, in the Japanese case as in the general case, foreign direct investment. Japanese FDI has grown rapidly in recent years and in reflection of this MITI, in 1971, began publication of an annual report on Japanese FDI.[70] There has been some amount of Japanese FDI since the early 1950's but major growth didn't begin until the mid-1960's and, as of March 1974, about three-quarters of total Japanese FDI (around US $10,270 million at that time) had been invested in the immediately preceeding four years.[71] Not all of this FDI can be readily equated with TT and a great deal of it is in commerce and finance rather than in the more clearly TT-related manufacturing industries. Moreover, a considerable proportion of this FDI is in developed countries over which Japan possesses no major technological leads.[72]

In fact, as of 1974, the largest single geographic area of Japanese FDI was North America, which accounted for 23.6% of total investment and for 29.8% of the total cases of Japanese FDI; followed by Asia, 23% and 35.9% and by Central and South America, 17.6% and 11.7%. As might be expected, investments in North America are primarily in commerce, finance, and other non-manufacturing industries which account for 60% of the total (the balance being largely composed of investment in resource

development fields such as pulp, forestry, and mining).

Not surprisingly, the comparable data on Japanese FDI in the less-developed nations of Asia and the Americas imply a higher level of TT. Investment in manufacturing and resource development account for about 80% of total Japanese FDI in Asia and for a similar proportion of investments in Central and South America and, to date, a majority ownership position has been the norm.[73]

A 1971 study of Japanese FDI[74] indicates that, overall, Japanese motivations for such FDI are little different from those of businessmen from other countries (eg. protection or development of the local market, advantages of production in proximity to the market, utilization of local, lower-cost labour resources). An examination of FDI in the extractive and food-related primary-industries indicates, however, that an extremely high percentage of such investment is aimed at securing resources for Japanese secondary- and tertiary-industries. This reflects the high level of Japanese dependence on foreign sources of supply.[75]

An examination of the data on Japanese explicit receipts for TT also indicates that Asia is the major customer for Japanese technology. The figures for 1972[76] show that Asia accounted for 50% of all receipts and 48% of all cases of explicit Japanese TT in that year; followed by Europe (24.3% and 22.6%) and North America (14.9% and 17.2%). The less-developed countries should continue to dominate in Japan's export trade in technology over the next ten years or so but the pattern and nature of that trade should undergo some significant changes.

First, the ownership percentage held by the Japanese side in its FDI activities will likely decline as opposition to foreign majority ownership and indigenous technical and management skills increase. Secondly, the

importance of areas other than Asia should rapidly increase (as it has already done for the Mid-East and may do for China and the Eastern USSR). Thirdly, the range of technologies exported will likely expand rapidly into a wide range of heavy manufacturing industries. This trend is especially evident in the petroleum-producing countries which have launched ambitious industrialization plans requiring massive amounts of foreign technology. Japan is liable to figure importantly into, for example, their plans for developing the petrochemicals industries.

As regards exports of technology to the developed nations, there should be less explosive but steadier and, in terms of Japan's technological development, more significant growth. Here the opposition to FDI - especially to Japanese FDI - should be less severe than in many developing countries and the amount of Japanese FDI in manufacturing industries in the developed countries may well increase significantly. The amount of TT such FDI will implicitly represent is likely to increase as compared to the recent past but to still represent only a small proportion of Japan's overall technology exports. Perhaps a more likely form of increased TT to the other developed nations will lie in the commercial sale of incremental technological advances to existing manufacturers in developed countries. As table 24 (on page 102) indicates, the Japanese chemical industry has already successfully sold major items of chemicals and synthetic textiles-related technology abroad, primarily to the US and Western Europe. In this regard however, longer term success is likely to hinge on Japanese efforts to strengthen their ability for independent technological innovation.

4. The Search for 'Technological Independence'

Japan in the years since World War Two has transformed itself -

Table 24.

Japan's Exports of Major items of Chemical and Synthetic Textiles - related Technology: 1950-1972.

Time period / Area	1950-1963	1964-1967	1968-1972
United States	3.	7.	14.
Western Europe	13.	11.	13.
South-East Asia	6.	5.	3.
Other	1.	3.	3.
Total	23.	26.	33.

Source: Watanabe, Tokuji Nihon no Kagaku Kogyo (Japan's Chemical Industry) - Japanese - Tokyo, Iwanami Shoten, 1974 (4th edition). pp. 64-65.

with the help of a great deal of foreign technology - into one of the world's more efficient 'factories'. As a consequence, it is now one of the world's most affluent nations and the second largest mass consumer market. At the same time, however, it has come to suffer from some of the world's worst urban and industrial overcrowding and lags far behind other developed countries in many social capital items (such as roads, sewers, parks, etc.). Thus, there is a growing consensus that emphasis should shift towards improving the quality of life in Japan by increased emphasis on developing such social capital.

It is further recognized, however, that little improvement in the quality of life in Japan can be achieved without major adjustment to the very industrial structure which made postwar development possible - and at the same time created critical and pervasive pollution problems. Moreover, further pressures to revise the industrial structure arise from difficulties in meeting the massive raw materials demands implied by the present structure now and in the future. These difficulties appear likely to be even greater in the future - with or without Japanese economic growth - both because of absolute limits on resource supplies and because of a growing desire on the part of resource producing nations to expand their processing and manufacturing industries. Because of her high level of dependence on foreign suppliers of resources this creates an especially precarious situation for Japan.

Thus, the existing Japanese industrial structure poses both domestic, environmental problems and problems relating to the international vulnerability of the Japanese economy to emerging trends among resource suppliers. There are, therefore, compelling domestic and international pressures for restructuring Japanese economic activities and the

implied direction of structural change is towards a low-pollution, resource-conserving, and knowledge-intensive industrial structure. Again, as in the mid-1950's, the Japanese bureaucracy and government seem to have fairly accurately and explicitly identified the problems and pointed out the direction in which a solution should lie. Unlike the situation in the 1950's however, there is no vast stock of foreign technology readily available to assist in this transformation. The areas, and levels, of technology development of most concern in Japan today are, by and large, the same as those in the other developed countries (eg. pollution control, atomic and other new energy sources, ocean resources exploitation, computers, information systems, etc.). Because of Japan's circumstances, however, development in these areas is perhaps more critical than in other developed countries.

In this regard, it is important to reiterate that Japan's postwar success to date has been less founded on the discovery of technological innovations than it has been on the inventive and rapid application of innovations discovered elsewhere. It is true that Japan's expenditures on R & D have increased over the 1960's and early 1970's but in 1970 they still only amounted to 1.66% of GNP - compared to USA 2.7% (1970), UK 2.1% (1970), West Germany 2.0% (1969), and France 1.9% (1970).[77] Moreover, the vast majority of Japanese R & D is performed by companies and with relatively little government subsidization of R & D. Not surprisingly therefore, Japanese R & D efforts have been concentrated on applications and development work and not on basic research (which accounted for only 8.1% of the total in the 1972-1973 fiscal year).[78]

This accounts, in part,[79] for the status of Japan's balance of international receipts and payments for technology which showed only

gradual improvement over the 1960's (table 25 on page 106) and still lags well behind those of other developed nations (table 26 - also on page 106). There is, therefore, considerable concern and effort in Japan today being directed towards the strengthening of Japan's independent technological capabilities.

Thus, there are at least two aspects to the 'search for technological independence' now underway in Japan. The less obvious but probably more important of the two has to do with the vulnerability of the present industrial structure to emerging trends in the resource-producing countries - particularly those of the less-developed world. 'Technological independence', in this sense, implies a technological transformation of the existing structure towards one which is less dependant on offshore resource suppliers. Fortuitously or not, this same implied technological transformation will likely serve also to meet some part of the domestic environmental problems created by the existing industrial structure.

The second aspect of this 'search for technological independence' has to do with Japan's capacity for independent development of the technology related to this technological transformation of the industrial structure. There is no intent, here, to imply that Japan is or should be seeking total independence in technological development. That is not a serious proposition for any country, including the US. In large measure, the needed technology will undoubtedly continue to be available through transfer from other developed countries. But, because some of Japan's present and future technological needs cannot be met by any available technologies, there is a necessity for independent technological development capacity if Japan is not to be forced into a passive posture of waiting for appropriate developments to occur elsewhere in the developed world. In

Table 25.

Trends in Japans Balance of International Technology Payments
1950-1973

Item \ Year		1950 - 1955	1956 - 1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Total 1950 - 1973
Technology Imports payments (Millions of $)		68.9	280.5	113	114	136	156	166	192	239	314	368	433	488	572	715	4355.4
Tech. Imports No. of Cases	Class A	525	831	320	328	564	500	472	601	638	1061	1154	1330	1546	1916	1931	13717
	Class B	623	941	281	429	573	541	486	552	657	683	475	438	461	487	519	8.146
	Total	1148	1772	601	757	1137	1041	958	1153	1295	1744	1629	1768	2007	2403	2450	21.863
Technology Exports Receipts (Millions of $)		0.7	4.3	3	7	7	15	17	19	27	34	46	59	60	74	88	461
Ratio of Receipts to Payments (%)		1.0	1.5	2.7	6.1	5.1	9.6	10.2	9.9	11.3	10.8	12.5	13.6	12.3	12.9	12.3	10.6

Source: Kagaku Gijutsucho (Science and Technology Agency). Gaikoku Gijutsu Donyu Nenji Hokoku, Showa 48 Nenpan (Importation of Foreign Technology Annual Report, 1973) - Japanese - Tokyo, 1975, p.56

Table 26

International Comparison of Balance of International Technology Payments

Country	JAPAN			U.S.A.			UNITED KINGDOM			FRANCE			WEST GERMANY		
Item / Year	Receipts A	Payments B	A/B	Receipts A	Payments B	A/B	Receipts A	Payments B	A/B	Receipts A	Payments B	A/B	Receipts A	Payments B	A/B
1963	7	136	0.05	1163	122	10.38	-	-	-	138.6	188.7	0.73	50.0	135.3	0.37
1964	15	156	0.10	1314	127	10.35	123.2	115.1	1.07	144.0	191.0	0.76	62.0	153.3	0.40
1965	17	166	0.10	1534	135	11.36	133.8	128.5	1.04	168.0	213.0	0.79	75.3	165.5	0.45
1966	19	192	0.10	1682	140	12.01	160.1	132.4	1.21	180.0	243.0	0.74	73.3	175.3	0.42
1967	27	239	0.11	1836	166	11.06	175.5	164.6	1.07	195.0	230.0	0.85	89.8	192.0	0.47
1968	34	314	0.11	2000	186	10.75	204.5	185.0	1.11	164.5	275.2	0.60	98.5	219.5	0.45
1969	46	368	0.13	2183	221	9.88	211.9	212.4	1.00	193.3	305.5	0.63	96.5	251.3	0.38
1970	59	433	0.14	2502	225	11.12	263.5	239.3	1.10	214.4	349.9	0.61	118.6	307.1	0.39
1971	60	488	0.12	2787	241	11.56	282.7	264.7	1.07	395.3	464.1	0.85	148.9	405.2	0.37
1972	74	572	0.13	3078	296	10.40	295.7	297.6	0.99	576.0	578.7	1.00	209.2	465.5	0.45
1973	88	715	0.12	3578	384	9.32	-	-	-	-	-	-	-	-	-

Source: Same as above, p.57.

addition, there is the further point that, because Japan's technolgoical needs exist at essentially the same frontiers as do those of the other developed nations, there is and will be a competitive necessity, as well, for Japanese industry to achieve independent technological advances in at least some areas if it is to maintain its international competitive abilities.

Thus, in summary, there is one overriding technological theme which seems likely to dominate the next ten or twenty years of Japanese development. This theme will lie in the orchestration of a dual process of, on the one hand, "selling" existing industrial technology to developing nations (partly to acquire, in the short term, access to raw materials for Japan's existing industrial structure and partly as a business in its own right) while, on the other hand, staving off the ultimate impact of rising competition from these same countries by carving a niche for Japan in the "post-industrial" world via independent development of appropriate technologies.

In this, Japan is not without advantage. Her population which is among the world's largest, is also one of the most literate and highly educated. Given a consensus on a new vision of Japan's future, and there are signs this is evolving, the basic cohesiveness of Japanese society should, again as in the past, prove a valuable national asset. Moreover, if some form of knowledge-intensive, post-industrial society does prove to be 'the wave of the future', Japan may possess the ironic advantage of 'urgency' more than do many other potential candidates - possessing larger domestic resources and/or less pressing pollution problems. For, if necessity is not inevitably the mother of invention, it is almost invariably its midwife, nurse, and patron.

VI THE POSTWAR JAPANESE EXPERIENCE WITH TECHNOLOGY TRANSFER: CONCLUSIONS

The preceeding study of the Japanese postwar experience with TT suggests that it was a function of a variety of factors. Some of these, if not exactly unique to Japan, are, at least, less universalistic than are others. We will, therefore, first discuss these 'special characteristics' of the Japanese experience. This will be followed by a discussion of the insights or 'lessons' the Japanese case may hold as regards some of the more universal questions related to TT. Finally, there is a brief discussion of areas for future research.

1. Special Characteristics of the Japanese Case

(a) Favourable Domestic Environment

Examination of postwar Japanese TT points up the importance of Japan's earlier, prewar, development which made for an environment highly favourable to TT. Despite the destruction of wartime, Japan remained a nation of considerable capacity and possessed still, the national cohesiveness, pride, and ambition which had spurred Japanese development since the Meiji Restoration. In fact, the hardships of a subsistence level of existence in the immediate postwar following on the destruction of much of Japan's industry was, itself, dramatic evidence of the extent to which the nation had both adjusted to and come to depend on industry.

Thus, both a strong desire and the capacity to acquire advanced industrial technologies was present - added to which was the necessity to 'refit' an industrial plant heavily damaged in wartime. All of these factors created an environment particularly favourable to TT.

(b) Benign International Environment

The central role of the USA in Japan's postwar international environment was favourable to TT. The importance of TT associated with the US military presence has been mentioned, but even in the broader, geo-political sense the Japanese alignment with the US seems to have supported TT to Japan. Certainly, the US, even granting its technological superiority, would seem to have supported Japanese technological development more than the USSR has supported that of its allies, which have experienced pressures to make their development complement and support that of the USSR. So too, the US support of relatively free international trade may have helped Japan secure access to offshore markets for the output derived from new, imported, technologies. Finally, international business in the 1950's and early 1960's seems to have been far less attuned to the business potentials in non-western countries than now. This may have facilitated Japanese acquisition of technology on its own terms; that is to say, via licensing rather than foreign direct investment.

(c) Large Size of the Domestic Market

The large population of Japan can be viewed, of course, as a potential or actual burden. In the event, and given its high levels of education and adaptation to industrialization, it has probably been a blessing as regards postwar TT. In any case, it played a major role in shaping postwar TT. For, as Japanese postwar development progressed, Japan came more and more to present an environment amenable to the kinds of large-scale, mass-production, and consumer-oriented technologies evolved in the developed countries, most particularly in the USA. Thus, while many countries possess the technical expertise to acquire many advanced US-developed technologies they often do not have the potential

mass market to justify doing so. In contrast to this, Japan has, by now, reached the point where most significant US commercial innovation can immediately find a place in Japanese industry.

(d) Antipathy to Foreign Direct Investment

The high level of Japanese antipathy to foreign direct investment has been much remarked. So too have been official efforts to limit and control such investment and the actual low level of FDI in Japan. As we have indicated, foreign indifference to the Japanese market as well as rather high cultural and linguistic barriers have also inhibited FDI. Clearly, however, Japanese antipathy to FDI has played a major role in limiting that form of TT and in encouraging the use of licensing arrangements.

The official manifestation of this antipathy in rules and regulations limiting FDI were, however, only a reflection of a much more pervasive and enduring antipathy to 'outsiders' which exists at the level of the individual and group throughout Japanese society. Thus, even if there had been an absence of formal and official controls on TT via the FDI mode, there has been, and remains, a pervasive and emotional antipathy to FDI which inhibits it. This antipathy extends to (or is, perhaps, rooted in) the psychological and economic attitudes of the individuals who would be the prospective employees of foreign subsidiaries. Thus, its impact has been far greater than would be that of an antipathy grounded solely in economic theory or ideological nationalism and manifested merely in formal laws and regulations or in the attitudes of a leadership 'elite'.

2. "Lessons" from the Japanese Experience

Many aspects of the Japanese experience with TT - including some

of the "special characteristics" discussed above - seem to provide insights of some generality. The following seem particularly significant.

(a) Technology Transfer and National Identity

Clearly, Japan has undergone an enormous amount of change in the thirty years since the end of World War Two. This is most clearly evident in the material and popular culture and in the pattern of daily life. To some major extent these changes are related to Japan's postwar technological development and the TT which helped to fuel it. Indeed, as regards the major postwar cultural change, to a mass-consumer society, the link with imported technology is extremely close.

While Japan has changed however, it has not in any fundamental sense become less 'Japanese'. In some cases the traditional ways have undergone only superficial change while, where there has been more substantive change, it has by and large been adaptable to the existing institutional framework. Thus, gifts, for example, continue to be given for traditional reasons to the traditional persons - with the substitution of imported whisky for Japanese 'sake'. Again, while the aspirations and expectations of young men of today may differ widely from those of their fathers 25 or 30 years ago, the vast majority still seek to fulfill them within a corporate environment providing 'lifetime' security and a degree of close and emotional interpersonal content not found in other developed nations.

Just as earlier Japanese development provided the most dramatic evidence that industrialization allows for considerable cultural diversity, so too, the postwar transformation to affluence suggests a tendency to cultural diversity rather than cultural convergence even at the frontiers of the development process.

(b) National Goals and Technology Transfer

The Japanese postwar experience reinforces the view that technological development and TT is facilitated by the presence of clear and articulated national goals. Perhaps the most striking example of the official articulation of such goals was the 1956 Economic White Paper which emphasized the importance of developing the consumers goods industries and heralded the start of the postwar revolution in consumption. More inportant, however, was the fact that the goal of achieving the affluent consumer-oriented society typified by the USA was not merely an 'official' goal imposed from above but was, rather, a goal widely accepted throughout the nation. The importance of such broad support for - and, thus, assurances as to - the basic direction of development to those immediately concerned with TT decisions in the business world was undoubtedly great. In particular, such assurances would have reduced - though certainly not eliminated - the perceived risks of importing technology much more than would mere 'official', governmental assurances.

The Japanese case would suggest, therefore, that broad public support, and not mere goal setting by the government or bureaucracy, is of importance in encouraging TT appropriate to those goals. Thus, in the absence of such support, importance should be attached to 'selling' those goals and plans not only to those who will be directly involved in the related TT but also to the public at large.

(c) Licensing versus Foreign Direct Investment

Japan in the postwar period managed a major process of inward TT primarily by means of licensing and without any large-scale foreign direct investment. It does not, however, stand as an unmitigated testament

to the feasibility of a national policy to encourage TT while inhibiting FDI.

In the first place, of course, most of the less-developed countries do not possess anything near the technological and industrial background possessed by Japan at the end of World War Two. For them, some form of longer-term foreign presence -whether through FDI or by means of some other, more limited, form of management presence - is probably inevitable if TT is to take place at all.

However, even where the necessary industrial and technological prerequisites are present, as in most of the developed countries, the rapid internationalization of business in the 1960's may have made many potential suppliers of technology less willing than in the earlier postwar period to settle for a simple licensing arrangement without first considering the FDI alternative more seriously. Thus the potential supply of some technologies for transfer via license may be smaller or more constrained than has been the case in the past.

Finally, and most generally, many technologies require access to a large market if they are to be efficiently employed. In many cases as well, a technology will require a supporting international network of information and resource supply if it is to operate efficiently. Where these conditions do not exist, the only feasible form of TT may be one involving some form of FDI and participation in the worldwide production and marketing network of a multinational firm.

In the Japanese case, the large size of the domestic market served, in this sense, to make TT via licensing more feasible. In addition, the central role played by the Japanese trading company in her international trade (see table 27 on page 114) may have provided many of the multi-

Table 27.

Japan's Top Ten General Tradng Companies:
Share of Exports and Imports, Turnover as % of G.N.P.

a) Share of Exports

Year	Exports (A)	Exports via "Top Ten"(B)	B/A
			%
1960	14,817	6,924	46.7
1961	15,555	7,304	47.0
1962	18,032	8,861	49.1
1963	20,289	10,370	51.1
1964	25,873	13,480	52.1
1965	31,406	16,581	52.8
1966	35,848	18,636	52.0
1967	38,786	19,726	50.9
1968	49,381	23,783	48.2
1969	60,523	28,395	46.9
1960-1969	(4.08)*	(4.16)	

b) Share of Exports

Year	Exports (A)	Exports via Top Ten(B)	B/A
			%
1960	16,776	10,134	60.4
1961	21,632	13,394	61.9
1962	20,239	12,724	62.9
1963	26,089	16,439	63.0
1964	28,515	18,094	62.0
1965	30,301	19,569	64.6
1966	36,068	23,416	64.9
1967	43,423	28,252	65.1
1968	47,844	30,191	63.1
1969	57,618	35,878	62.3
1960-1969	(3.44)	(3.54)	

c) Comparison of Turnover with G.N.P.

Year	G.N.P. (A)	Turnover of "Top Ten"(B)	B/A
			%
1960	162,070	39,808	24.6
1961	198,528	50,089	25.2
1962	216,959	52,483	24.2
1963	255,759	67,344	26.3
1964	295,305	79,164	26.8
1965	326,504	86,543	26.5
1966	381,179	106,146	27.8
1967	447,668	117,213	26.2
1968	527,803	133,746	25.3
1969	625,500	167,062	26.7
1960-1969	(3.86)	(4.19)	

* Figures in brackets indicate ratio 1969/1960.

Source: Arita, Kyosuke Sogo Shosha (General Trading Companies)- Japanese - Tokyo, Nihon Keizai Shimbunsha, 1970. p.21.

national capabilities demanded by imported technologies which would otherwise have made TT via simple licensing arrangements infeasible.

It is this latter point - the implied potential for a small number of large, indigenous, trading companies to develop and provide to industry some of the special expertise and capabilities possessed by multinational companies - which may hold the most general lesson for nations seeking to encourage technological development while, at the same time limiting the inroads of FDI.

(d) Competition and Technology Transfer

The extremely competitive domestic business environment would appear to have been one of the prime motive forces encouraging postwar TT to Japan. While some of the origins of this competitive spirit lay in such unique, Japanese, factors as the lifetime employment system (and the commitment to the firm which it creates) the fact that a competitive environment encouraged TT has relevance beyond the Japanese case.

It is true, of course, that restrictions of market size and on the available trained personnel may make a competitive, multi-firm industrial structure infeasible in many nations. Moreover, there is no reason to believe that strong central government efforts to see that technological development is maintained in a specified and limited number of crucial industries cannot be successful, even in a monopolistic environment - given the administrative and other resources necessary to impose such an effort.

Nevertheless, the Japanese case would suggest that, if a widespread and ongoing process of technological upgrading is desired, nothing is so certain

and efficient a means to promote it as the development and maintenance of a competitive environment - whether the origins of that competition are domestic or international.

(e) Technology Transfer and the Role of Government

Government and the bureaucracy have played a very prominent role in postwar Japanese development. It is clear, too, that the intent of government activity was to encourage technological development and the TT which this implied. The extent to which the high level of TT which, in fact, took place can be viewed as a 'result' of government technology development policies is less evident - if only because such policies were only one of the factors which impinged on TT decisions.

Moreover, in terms of what might be generalized from the Japanese experience, the close and complex interactions which characterize Japanese government-business relations seem to be much more an aspect of the Japanese cultural milieu than they are a general "formula" for application in other settings. They do suggest however the value of having government policy-making take place so far as possible, not in a bureaucratic vacuum but in close consultation with the persons and industries that will be affected - and which, in the final analysis, will determine the success or failure of those policies.

Another aspect of Japanese government policy - the willingness to be discriminatory and selective in the encouragements given to industries - also seems to be instructive. While there were some general, broad-spectrum, policies which undoubtedly encouraged technological development and TT in most, if not all, of Japanese industry it is not these but, rather, the more focussed efforts of postwar policy to give special

consideration and attention to selected industries which seem most characteristic.

In this respect, the presence of large, multi-industry corporate groupings in Japan may have made such discriminatory policies more feasible. Such corporate groupings, in-so-far as they receive both the adverse and the favourable impact of selective policies, are more liable to support them than is the industrial "establishment" in many other nations.

Nevertheless, given the necessity of focussing industrial and technological development policies, the Japanese experience urges the view that, first, discriminatory policies are adviseable and, second, that potential opposition to such policies should not be mollified by weakening the selective impact of policy but, rather, by co-opting the potential opposition to policy by emphasizing, or creating, an interest in it for them.

3. Future Research

This research has, perhaps, raised more questions that it has answered but, in so doing, it has indicated some question areas to be of more fundamental importance than others. Two such question areas seem particularly appropriate for further research and study and deal, first, with the relative importance of government policy and 'market forces' in stimulating TT and, second, with the relative importance of domestic and foreign sources of technological change. We conclude, therefore, with a brief discussion of these two issues.

(a) The Relative Importance of Government Policy and 'Market Forces'

Japan's postwar development is reputed to owe much of its

success to the policies of the Japanese government and bureaucracy. As regards the specific area of technological development and TT as well, the present study has shown a high level of central government interest and involvement in these specific areas. A multiplicity of laws, regulations, tax provisions, and other instruments of policy bearing on TT were devised and implemented in the postwar period.

There would appear, however, to be no single policy or set of policies which substantially accounts for the high level of TT and technological advance experienced in postwar Japan. As was suggested earlier, this may be because much of the apparent success of central government policies owe more to the organic process of consultation and consensus-building which constitutes Japanese policy making than it does to any of the resultant polices, per se.

Alternatively, however, the answer may lie in the impact of such policies having been far less than the impact of other, more general and pervasive factors impinging on the propensities of Japanese industry and foreign suppliers to engage in TT. Some such factors are suggested in sections 1. and 2. of this chapter. To those we might add those government fiscal, monetary, and other policies which - while not aimed primarily, or perhaps even consciously, at TT or technological development - may have had market implications for them far exceeding those of policies more explicitly concerned with TT and technological development.

It may be feasible to sort out in an econometric or quantitative fashion the likely relative impact of factors bearing on Japan's postwar TT and to draw some conclusions as to the role of government TT policy. It seems however, that one is likely to shed more direct light on the nature and relative importance of the factors in postwar TT decisions by

the development of a body of case studies of concrete examples of TT (the case studies appended to this paper are one result of a pilot study for such a project).

Whatever approach is adopted, however, it is only by such assessment of the various factors which, in fact, impinged on TT decisions and their relative impact that we can evaluate the putative importance ascribed to government policy in Japan's postwar technological development. At the same time as it clarifies the Japanese case such analysis should add substantially to our understanding of the general case and of the extent to which the Japanese experience holds lessons for others.

(b) The Relative Importance of Domestic and Foreign Sources of Technological Change

A second, and more fundamental, area for research relates not to the identity and relative importance of factors impinging on TT - but rather, to the importance of TT, itself, as a causative factor in Japan's postwar economic growth.

As table 27 (see page 120) indicates, one conventional approach to the assessment of technological change as a factor in economic growth measures changes in a set of factor inputs (eg. labour, capital) and compares them over time with changes in some measure of aggregate output (eg. GNP). Growth in output unaccounted for by changes in factor inputs is assumed to reflect 'total factor productivity growth' or, in other words, change in the aggregate production function due to technological advance.[80]

Such analyses of postwar Japanese experience indicate that technological change has been a major, if not the primary, source of Japan's postwar economic growth. The question therefore arises as to the origins of this technological change.

As this paper has indicated, one major source of technological change

Table 28.

Economic Growth Rates by Country and Contributions of Component Sources

(Annual Rates of Change in Percent)

Country, Time Period / Growth Variable and Component Source	Japan 1955-1968	W.Germany 1950-1962	Italy 1950-1962	France 1950-1962	U.S. 1950-1962	U.K. 1950-1962
National Income Growth	10.1	7.26	5.96	4.92	3.32	2.29
Labour Input Contribution	1.31	1.37	.96	.45	1.12	.60
Capital Input Contribution	2.72	1.41	.70	.79	.83	.51
Total Factor Productivity Growth Contribution	6.1	4.48	4.30	3.68	1.37	1.18

Source: Kanamori, Hisao

" Nihon no Keizai Seichoritsu wa Naze Takai Ka"
("Why is Japan's Growth Rate High?")

Keizai Bunseki No.31 (Oct. 1970) Tokyo, Economic Planning Agency, 1970. p.4.

has probably been the importation of new technologies from abroad. It is, however, by no means proven that this was the major, let alone the sole, source of postwar technological advance. Before one can so conclude it is logically necessary to examine potential domestic sources of technological advance.

In this regard, though no systematic attempt to do so has been made by this writer, it seems very likely that such an examination of the major new developments in industrial technology in postwar Japan would support the view that it was TT - and not domestic inventive activity - which was the primary source of technological change. The thus far unimpressive improvement in Japan's international balance of payments for technology, referred to earlier, provides indirect evidence of this.

There is, however, another, less dramatic, source of overall, aggregate, technological advance which may have been of major importance - the diffusion of existing technologies to a broader segment of Japanese business and industry. The inter-related processes of urbanization, clustered industrial development, and improvement in communications and distribution flows that have characterized postwar Japan would seem to be particularly conducive to such diffusion of the technological 'best' (or 'better') practices. To the extent that such a diffusion process has raised the 'average practice' to a technologically more advanced level, TT does not account for Japan's postwar 'total factor productivity growth'.

Because such a diffusion process can be part of a subtle, organic, process of structural change it is undoubtedly more difficult to assess than is the explicit, discrete, commercial transfer of new industrial technologies from abroad - particularly so, given the large body of official

data available regarding the latter. A promising approach to the problem may lie, however, in the analysis of overall structural and technological change in specific categories of business and industry in the postwar period. In particular, some form of 'total factor productivity growth' analysis - disaggregated to the industry level - might be valuable. If such an analysis did not reveal some positive relation between total factor productivity growth and the amount and quality of transferred technology it would constitute indirect evidence of the importance of other, domestic, sources of technological change.

NOTES

1 Kosobud, Richard 'The role of international transfer of technology in Japan's economic growth' in Technological Forecasting and Social Change 5 1973, pp 395-406 (p 399).

2 See, Schumpeter, Joseph The Theory of Economic Development (Cambridge; Harvard University Press, 1934).

3 A similar view is implicit in much of Karl Marx's writing - which is, however, much more explicitly concerned with the social consequences of technological change. For some relevant excerpts from Marx on this, see Burns, Tom (ed.) Industrial Man (Harmondsworth; Penguin, 1973), pp 35-42.

4 See, for example; Adelman, I. and Morris, C.T. 'An econometric model of socio-economic and political change' in The American Economic Review, Vol LVIII No. 5, part 1 (Dec. 1968), pp 1184-1217; Harbison, Frederick H., et al, Quantitative Analysis of Modernization and Development (Princeton, 1970); Sigelman, Lee 'Lerner's model of modernization: a reanalysis' in The Journal of Developing Areas 8, July 1974, pp 525-536.

5 For an exceptionally lucid account of this process in Tokugawa Japan, see Smith, T. C. The Agrarian Origins of Modern Japan (Stanford; Stanford University Press, 1959).

6 Almond, G. A. and Powell, G. B. Jr. Comparative Politics: a Developmental Approach (Boston, Little, Brown, 1966), pp 22-24.

7 On this see Hoselitz, Bert F. 'Nationalism, economic development and democracy' in Feinstein, Otto (ed.) Two Worlds of Change (Garden City,

New York; Anchor Books, 1964), pp 249-267.

8 Perhaps the most influential example in the post-World War Two era has been, Rostow, W. W. The Stages of Economic Growth, see Second edition (Cambridge; Cambridge University Press, 1971).

9 On this, see for example; Neghandi, A. R. (ed.) Environmental Settings in Organizational Functioning (Kent, Ohio; Kent State University Press, 1970); Hall, Edward T. The Hidden Dimension (New York; Doubleday, 1966) espec. pp 131-164; Almond and Powell Comparative Politics, op cit.

10 For a thesis along these lines; see, McLelland, David C. The Achieving Society (Princeton, N.J.; Van Nostrand, 1961).

11 Moore, W. E. Social Change, Second edition (Englewood Cliffs, N.J.; Prentice-Hall, 1974), pp 92-93.

12 There is, however, a view which argues the desireability of the LDC developing their own forms of industrial technology. See, for example; Giral, Jose 'Development of appropriate chemical technology: a programme in Mexico' in Choice and Adaptation of Technology in Developing Countries (Paris; OECD, 1974), pp 182-186 and 'Review of discussions' ibid. pp 79-85.

13 It is interesting to note that transfers across cultural boundaries need not be international. It was reported in the Vancouver Sun of March 10, 1975 (p 25) that native indians working on highway construction in northern Canada have some difficulty in adjusting to the idea of a fixed quitting time because, '. . . they have been used to doing things like skinning a moose. And when you are skinning a moose you keep on going until the job is done.'

14 See, for example; Hahn, F. H. and Matthews, R. C. O. 'The theory of

economic growth: a survey' in Economic Journal, Vol. 74, 1964, pp 825-850; Solow, R. M. 'Technical change and the aggregate production function' in Review of Economics and Statistics, Vol, 39, 1957, pp 312-320; Schmookler, J. 'Economic sources of inventive activity' in Journal of Economic History, March 1962, pp 1-20; Ruttan, V. 'Usher and Schumpeter on invention, innovation, and technological change' in Quarterly Journal of Economics, November 1959, pp 596-606. For a dissenting view which minimizes the importance of technological change vis-à-vis economic growth see Jorgenson, D. W. and Griliches, Z. 'The explanation of productivity change' in Review of Econometric Studies, Vol. 34, 1967, pp 249-283.

15 For a detailed discussion of the product life-cycle approach see, Wells, Louis T. Jr. (ed.) The Product Life-cycle and International Trade (Boston; Division of Research, G.S.B.A. Harvard University, 1972).

16 Vernon, R. 'International investment and international trade in the product cycle' in Quarterly Journal of Economics, Vol. LXXX, May 1966, No 2, pp 190-207 (p 190).

17 As a separate but related point, Vernon, himself, has suggested the product life-cycle approach may be losing what descriptive and predictive value it may have as a result of multinational corporations and their world-wide operations and information networks. On this, see Vernon, Sovereignity at Bay (Harmondsworth; Penguin, 1973), pp 109-236.

18 See, Gaps in Technology: Analytical Report (Paris; OECD, 1970), espec. pp 180-236.

19 Ibid., p 198.

20 Ibid., p 257, pp 237-274 in passim.

21 See, US Dept. of Commerce, Factors Affecting the International Transfer

of Technology Among Developed Countries (Washington; US Government Printing Office, February 1970), p 9.

22 An indication of the variety of issues and the country to country variations in their particulars can be obtained from the following: Kojima, K, and Wionczek, M. S. (eds.) Technology Transfer in Pacific Economic Development (Tokyo; Japan Economic Research Center, 1975); Korean National Committee, 22nd Session Committee for Asian and Far Eastern Affairs - International Chamber of Commerce, Texts of Speeches and Reports and Investment and Transfer of Technology (background paper, Doc. No. 520/XXII/1.) (Seoul; ICC-Korean National Committee, 1974); OECD, Development Centre, Choice and Adaptation of Technology, op cit. and Transfer of Technology for Small Industries (Paris; OECD, 1974).

23 In this regard, it should be noted that some writers suggest foreign direct investment may be the most efficient form of TT. See, for example, Caves, Richard E. 'Multinational firms, competition, and productivity in host country markets', in Economica, Vol. 41, No. 62, May 1974, pp 176-193.

24 See Vernon, Sovereignity, op cit, pp 256-257.

25 See ibid. for one of the more recent and lucid discussions of these and related issues.

26 This is discussed in Kobayashi, Yoshiaki Shōwa Keizaishi (An economic history of the Shōwa era) - Japanese - (Tōkyō; Sottekusha, 1975), pp 57 ff.

27 The figures in this paragraph are from Yamamoto, Noboru The Modernization of the Economy and Postwar Expansion (Tōkyō; International Association for Educational Information, 1973).

28 A more detailed discussion of business-government interaction can be

found in Kaplan, E. J. Japan: the Government-Business Relationship (Washington; US Department of Commerce, 1972) and also in Yoshino, M. Y. Japan's Managerial System (Cambridge, Mass.; MIT Press, 1968), espec. pp 162-195.

29 See, for example; Abegglen, James The Japanese Factory (Glencoe; Free Press, 1958); Yoshino, M. Y. op cit; and Cole, Robert E. Japanese Blue Collar (Berkeley; University of California, 1971). A standard Japanese-language book on the subject is Hazama, Hiroshi Nihon Teki Keiei (Japanese Management) (Tōkyō; Nihon Keizai Shimbunsha, 1971).

30 General D. MacArthur, quoted in Livingston, J. et al (eds.) The Japan Reader (New York; Random House, 1973) pp 104-105.

31 Spencer, Daniel L. 'An external military presence, technology transfer and structural change' in Kyklos, Fasc. 3., 1965 (Basel, Switzerland), pp 451-474.

32 Ibid., p 455.

33 See, Ando, Y. Kindai Nihon Keizaishi Yōran (A Handbook of modern Japanese economic history) - Japanese - (Tōkyō; Tōkyō Daigaku Shuppankai, March, 1975), p 154.

34 See for example, Hall, G. R. and Johnson, R.E. 'Transfers of United States aerospace technology to Japan' in Vernon, R. (ed.) The Technology Factor in International Trade (New York; Columbia University Press, 1970).

35 Specifically, Mitsubishi Denki-Westinghouse, Fuji Denki-Siemens, and Toshiba-G. E. Following this, in 1953, Hitachi purchased thermal generator construction technology from G. E.

36 Arisawa, Hiromi et al Nihon Sangyō Hyakunenshi - Gekan (A 100 year industrial history of Japan, Vol 2) - in Japanese - (Tōkyō; Nihon Keizai Shimbunsha, 1967), p 42.

37 It should also be mentioned - though, for obvious reasons it is difficult to document - that there is reputed to have been a considerable amount of outright, unlicensed, copying of foreign technology. A project, for example, might require seven machines one of which would be purchased from a foreign supplier with the others being produced by a Japanese manufacturer - using the foreign original as a model. The extent to which this took place is unknown. It may be, however, that this pattern was most typical of the immediate postwar period before there were provisions for releasing foreign exchange to acquire foreign technology (i.e. before 1949-1950). This is, of course, the civilian, public works, analogy to the similar 'copying' reported by Spencer (note 31.) in connection with the military.

38 Arisawa, Hiromi et al. Nihon Sangyō Hyakunenshi - Gekan, op cit, pp 47-48.

39 The material in this paragraph draws heavily on the discussion in Arisawa, Hiromi et al, op cit.

40 In this, Japan is not necessarily unique. Other data indicate that the US was the major supplier of technology to the world in the postwar era (see, for example, OECD, Gaps in Technology, op cit). In the case of other developed countries however, TT was most commonly in the form of foreign direct investment. Thus an examination of data on US receipts for licenses and royalties, alone (see for example, Ozawa, Terumoto Japan's technological challenge to the West, 1950-1974 [Cambridge, Mass.; MIT Press, 1974], p 28) can lead to an unsupported conclusion that Japan was by far the major foreign user of US technology.

41 Watanabe, Tokuji and Hayashi Yūjirō Nihon no Kagaku Kōgyō (Japan's Chemical industry), Japanese, fourth edition (Tōkyō; Iwanami Shoten, 1974), p 28.

42 For this reason, any serious attempt to measure the TT of management technologies would have to take account of foreign direct investment.

43 Ozawa, op cit, cites an English-language version of the law: Law concerning foreign investment, the regulation relating to the enforcement of the law concerning foreign investment and foreign investment commission law (Tōkyō; Industrial Bank of Japan, 1950).

44 Quoted in Ozawa, op cit, pp 17-18, and reprinted in full in A Guide to Investment in Japan (Tokyo; Ministry of Finance, Japan, 1950).

45 It is interesting to note that John E. Tilton in his International Diffusion of Technology: The Case of Semiconductors (Washington; Brookings Institute, 1971) suggests a different interpretation. He points out that FDI proved to be a major factor in discouraging technological stagnation and encouraging technological development among indigenous semiconductor manufacturers in Europe. Thus, in light of Japanese restrictions on FDI, government administrative action of this type could be interpreted as being aimed at the maintenance of a 'creative level of competition'. However, as will be argued later in this chapter, other factors (Tilton, himself, points out the high degree of international competition in export-oriented product groups) tended to keep competition at a high level and, thus, maintenance or creation of a 'creative competition' is not a convincing interpretation of government motivations in this area.

46 For example, Ozawa, op cit, pp 54-55.

47 Another potential form of government intervention, the provision of direct incentives for TT, appears to have been little used. Of course, many of the incentives provided for industrial development and

modernization were tantamount to a TT incentive. With the promulgation of the Industry Rationalization Law of 1952, for example, there were provisions for special accelerated depreciation of up to 50% on equipment for the modernization of industries and, as well, a reduction in the tax rate on industrial assets. In addition, fuller use was made in the postwar period of an earlier, prewar, tax exemption system of similar nature for designated 'major manufacturers'.

In the case of goods deemed of special importance to the national economy, a three year tax-holiday system was devised for mining and manufacturing income derived from new equipment investment. There were also provisions for exempting from customs duties equipment and machinery intended for industrial modernization. Aside from the direct effects of these programmes on the costs of TT, they served to enlarge the market for new producers' goods and thus had the secondary effect of encouraging TT by manufacturers of such producers' goods. This topic is discussed at some length in Arisawa, Hiromi et al, op cit.

48 The original source on this is Hymer's oft-cited but unpublished, International operations of national firms - A study of direct foreign investment (Phd dissertation, MIT, 1960).

49 Developments from 1963 and on are the subject of the following chapter and, accordingly, we will not dwell, here, on the administrative attitudes characterizing TT policy during that period. In brief, however, the period of internationalization and liberalization from 1963-1973 (discussed in chapter four) seems to have witnessed the emergence of a basic antipathy to FDI. This needs some qualification however. The basic antipathy, itself, was present from the earliest days of the postwar period and, it is argued in chapter four, can even be viewed

as reflecting a national Japanese characteristic. Moreover, the 'emergence' of this antipathy was far less a matter of change on the part of the Japanese than it was on the part of foreign firms. Simply put, as the Japanese market became more appealing to foreign firms in the early 1960's more and more of them became interested in direct investment in Japan thus arousing the underlying antipathy. As a consequence, Japanese antipathy to FDI became one of the central issues of the 1960's and 1970's.

50 There are, of course, other and inter-related peculiarities of the Japanese employment system which have attracted Western attention - notably the use of a fairly rigid seniority system and of a 'consensual' decision-making process. See, for example, the references in note 29.

51 Cole, op cit, cites the example of workers from two nearby factories playing 'catch' side-by-side at lunch hour for years without ever becoming acquainted with one another.

52 There are some indications that a growing number of young people in the postwar period are finding some aspects of this system (notably, seniority) less compatible than it was to earlier generations. As regards the 'permanent employment system', itself, however, it is important to recognize that - even for a person whose personality is ill-suited to this system - there are powerful economic reasons, given the Japanese business environment, for remaining in one firm for the duration of one's working life. Thus, while the system will undoubtedly change over time it will likely do so only slowly.

53 This tendency for many firms to almost simultaneously enter newly emerging or growth industries has been supported by parallel competition among financial institutions - especially the large 'city' banks. The

high debt-equity ratio in Japanese companies both reflects and maintains close ties between banks and their corporate customers. Particularly in the late 1950's and early 1960's, there was considerable inter-bank competition in which each bank sought to ensure that the cluster of corporations dependent upon it for financing included a 'full set' of the newly emerging industries and, moreover, that its group held a major market share in those industries.

It appears that in recent years these bank-centered groups have declined somewhat in importance in part because the size of some firms has come to exceed the capacity of any one financial institution to meet its needs and because of the growing importance of internal financing.

54 See, MITI, Gaikoku Gijutsu Dōnyū no Genjō to Mondaiten (Present conditions and issues of foreign technology importation) - Japanese - (Tōkyō; MITI, 1962), pp 62-63.

55 The characterization of the government's role vis-à-vis TT (or, even, vis-à-vis business in general) as that of a mediator is perhaps instructive. While MITI, for example, has the prescribed responsibilities and power to take strong unilateral action affecting the business community (though perhaps less now than in the period up to the mid-1960's) it has not characteristically done so. One can view this as a manifestation of the Japanese tendency to avoid direct confrontation and to seek consensus - even on the part of a responsible government agency. In this, one would not be totally wrong. There is, however, another - and perhaps more important - aspect to the 'low key' behaviour of MITI vis-à-vis the business community.

To a very real extent the pervasive and profoundly personal

implications of inter-firm competition to the companies and employees involved is conducive to extreme forms of competitive behaviour which are dangerous to all those involved and yet, again, because of the highly charged nature of the competition are difficult to terminate. Thus, there is a need for some mediative third party - preferably one to whom all parties acknowledge some degree of allegiance or subordination. It is precisely such 'mediative' work which forms a large part of MITI's role vis-à-vis business.

As a corollary of this mediative role and the (non-dictatorial) superior-subordinate relationship it reflects and reinforces the mediator takes on a degree of responsibility towards the contending parties as regards the success of compromises arrived at and, by extension, as regards subsequent difficulties of whatever proximate cause. The upshot of this is that government-business relations tend to be ongoing and organic in nature rather than intermittent and discrete with problem areas usually becoming a subject of concern well before they reach a critical condition conducive to open confrontation and conflict between government and business.

56 A 1963 report indicated that less than 20% of Japanese firms who had imported technology had received a proposal from a foreign company prior to their taking the initiative. See, Science and Technology Agency, Gijutsu Dōkō Chōsa Hōkokushō (Technology trends: research report) - Japanese - (Tōkyō; Jigyō Kōhōsha, 1963), p 59.

57 See Vernon, Sovereignity, op cit. The Japanese concern regarding loss of control over direction of the national economy is but one, special case, of the more generalized concern of most nations regarding multinational business.

58 Vernon discusses this in op cit, pp 189-223.

59 Concurrently, Japan acceded to Article 8 status in the International Monetary Fund.

60 The case study which forms appendix 1. of this paper suggests that such informal relaxation of regulations was evident as early as the late 1950's.

61 A summary of the history of TT liberalization forms a part of the introduction to the yearly Japanese-language publication of the Science and Technology Agency, Gaikoku Gijutsu Dōnyū Nenji Hōkoku (Importation of foreign technology: annual report) - Japanese - (Tōkyō; Ministry of Finance, various years).

62 A brief, but useful, English-language reference on these regulations is Setting up in Japan (Tōkyō; Institute of International Investment, 1973).

63 Perhaps foremost among the more intractable informal obstacles to the true 'internationalization' of the Japanese economy is the Japanese character, itself. Despite the traditional Japanese willingness, and ability, to accept foreign 'technics' there is the distinct lack of any corresponding willingness and ability to accomodate a foreign presence into the structure of Japanese organizations. The internationalization of Japan, in this sense, has some distance to go. Domestically, this is liable to pose far more of a problem for foreign firms doing business in Japan than it is for the Japanese - despite their fears to the contrary. Internationally, however, and particularly in the less-developed countries where Japanese FDI has been heaviest, this is liable to pose a major problem for Japanese management in the years to come.

64 op cit, p 18.

65 See OECD, Interim Report of the Committee on International Enterprises (Paris; OECD, 1974).

66 Science and Technology Agency, Gaikoku Gijutsu Dōnyū Nenji Hōkoku, 1973, op cit, p 13.

67 In fact, the Nihon Kōgyō Shimbun newspaper of August 5th, 1975 reported on a technology management conference (attended by representatives of 52 major Japanese companies from a broad spectrum of Japanese industry) at which it was agreed to implement plans aimed at upgrading the technological level of Japanese industries by means of such cooperative activities. This would seem to be a difficult goal to achieve in Japan especially in the more hotly competitive consumers goods industries and success will probably depend a great deal upon the extent to which the industries, as a whole, feel threatened by technological developments among foreign competitors.

68 Ozawa, op cit, p 110.

69 With the possible exception of some fields in distribution - especially retail trade - as Japanese 'rationalization' takes hold or concern lessens.

70 See, for example, MITI, Wagakuni Kigyō no Kaigai Jigyō Katsudō, Shōwa 49 Nenpan (Overseas business activities of Japan's enterprises - 1974 edition) - Japanese - (Tōkyō; Ministry of Finance, November 1974).

71 Figures are from ibid., pp 75-77.

72 Interestingly, one recent study has suggested some transfer of 'management techniques' from Japan to the USA. See Johnson, R. T. and Ouchi, W. G. 'Made in America - under Japanese management' in Harvard Business Review

September - October, 1974, pp 61-69.

73 See Nihon Kigyō no Kokusaiteki Tenkai (The international advance of Japanese enterprise) - Japanese - (Tōkyō; Ministry of Finance, 1973), pp 13-17.

74 Ibid, pp 44-56.

75 Japan depends on foreign sources for 83.5% of its total energy needs (1970) as compared to the US's 9.9% and West Germany's 45.0%.

76 Science and Technology Agency, Kagaku Gijutsu Hakushō, Shōwa 49 (White Paper on science and technology 1974) - Japanese - (Tōkyō; Ministry of Finance, 1974), p 300.

77 Science and Technology Agency, Kagaku Gijutsu Yōran, Shōwa 48 (Science and Technology Handbook 1973) - Japanese- (Tōkyō; Ministry of Finance, 1973), pp 74-77.

78 Bureau of Statistics, Office of the Prime Minister, Kagaku Gijutsu Kenkyū Chōsa Hōkoku, Shōwa 48 (Report on the survey of research and development in Japan 1973) - bilingual - (Tōkyō; Nihon Tōkei Kyōkai, 1974), pp 116-117.

79 The international comparative figures are likely quite misleading. Payments for technology received via the FDI form of TT are reflected poorly, if at all, in the data on explicit payments for TT. Such TT forms a high proportion of the total TT to the developed countries of Europe and a low proportion of the TT to Japan. Similarly, a high proportion of Japanese outward TT - which has rapidly increased in recent years - is in the form of FDI and is not fully reflected in explicit receipts for TT. Thus, data on explicit payments and receipts for TT tend to understate the 'payments' of developed European countries and to understate recent improvements in Japan's 'receipts'.

80 That such discrepancies can be interpreted as reflecting technological advance is by no means a settled question. A good, brief, discussion of the issues involved is provided in the Kosobud reference (see note 1) and a more rigorous critique can be found in the Jorgenson and Griliches reference (see note 14).

TECHNOLOGY TRANSFER CASE STUDIES

Case 1

Plas-tech Company *

* disguised name

HISTORY OF SPECIFIC TT (technology transfer)

Company Background

In 1960, Plas-tech Company of Tokyo, Japan, was one of Japan's largest and most diversified producers of plastics products. The company was founded in the immediate postwar period and had grown rapidly - particularly in the latter half of the 1950's, when the company acquired a reputation as one of Japan's foremost 'high growth' companies.

Decision to enter Vinyl Floor Tile Industry

Many of the company's products (eg. PVC pipe, adhesives, plastic panelling) found application in the Japanese construction industry - which was experiencing a period of rapid growth. In 1958, the company decided to enter the vinyl floor tile industry because of its rapid growth and the company's existing experience with similar technology. Although the technology involved was not particularly complex and the company already possessed the necessary expertise, it was decided to buy out an existing manufacturer in order to more rapidly enter production. Accordingly, in September, 1958, the company purchased the equipment and took on the personnel of a small producer, Japan Tile Company. The personnel and equipment of Japan Tile was incorporated into the company's Building Materials' Division - where the initiative to enter the vinyl tile industry had originated.

The management of this division had the primary responsibility for originating development and expansion plans for the company within the broad area of 'building and construction'. This division was also to be the impetus behind a subsequent (1959-1960) decision by Plas-tech to enter

the prefabricated housing industry.* This decision was preceeded by development within the Building Materials Division of a prototype house incorporating many novel uses of plastics. This prototype development project, itself, had been inspired by the unveiling by Monsanto (U.S.A.) three years previously of an 'all-plastic' display house.

Plas-Tech, like the other Japanese manufacturers, was producing a non-patterned, 'utilitarian' tiling. This was largely a reflection of the market they were serving. Vinyl floor tiling had, thus far, found its major market in institutional construction (offices, schools, etc.) - where utilitarian considerations were dominant. There was a much smaller market in private housing. This was partly because private housing had, to date, received less emphasis by government in Japan's postwar reconstruction than had institutional construction. In addition, however, it was a reflection of the Japanese style of living within the home.

Flooring for Japanese Private Housing

The traditional Japanese flooring material for homes is either bare wood or 'tatami' - a thick, somewhat 'springy' straw matting. Tatami was typically used in the 'ima' (an all purpose room combining the functions of living, dining, and bed- rooms) because it provided a softer surface than wood and was less chilly in winter. These characteristics were particularly desireable because the Japanese customarily do not wear shoes inside the home and, traditionally, sit directly on the floor or on thin cushions.

The typical Japanese house being constructed at the time consisted of a toilet, bathroom, dining-kitchen, entryway, and 'ima'. Some of the larger

* The division could be said to have been quite aggressively expansion-minded at this time (in common with much of Japanese industry). The housing subsidiary, Plastech Homes, had become one of Japan's largest producers of prefabricated housing by the 1970's.

houses might also include an 'ōsetsuma' - which might be compared to the western living-room, in that it would be used for entertaining guests.

Vinyl tile had become the material of preference for the entryway and dining-kitchen. In those relatively few houses incorporating an osetsuma there seemed to be a trend for this to be decorated as a 'western-style' room with sofas, chairs, etc. and in these cases, there was some demand for vinyl floor tiling due to its image of 'western modernity'.

As both the quantity and quality of private housing was generally deemed to be inadequate, it was felt within the construction-related industries that Japan's rapidly increasing prosperity would soon lead - not only to a rapid increase in the amount of private housing construction - but also to a qualitative shift away from the utilitarian, with fashionability and style playing an increasingly important role.

Some of the vinyl tile manufacturers (including Toyo Linoleum - one of the largest companies in the industry) felt that this would lead to a greatly increased private housing market for vinyl tile.

This expectation was based not only on an anticipated increase in the number of housing starts but also on an expected increase in the popularity of western-style 'osetsuma' - where the traditional tatami flooring was unsuitable both in terms of style and ability to support heavy furniture. This was part of a more general expectation that there would be increased emphasis throughout the house on style - including entryways and dining-kitchens, where vinyl tile was already in common use.

Decision to Acquire Technology

The manager of the Building Materials Division, Mr Y, was a member of the Board of Directors (as were all other division managers). In this

dual capacity, he made occasional trips abroad to survey developments in the building materials industry. During these trips he had been struck by the popularity and luxurious appearance of the multi-colour, patterned tiling being produced in Europe and the U.S.A.

In view of the expected changes in the Japanese housing market, Mr Y felt it would be wise to seek a quick competitive advantage over the company's many competitors by qcquiring the necessary technology to produce patterned tile in advance of the soon expected shift in market demand.

The 'Make' or 'Buy' Decision

The company felt it had been a little late in entering the vinyl tile industry. As a result, it was eager to 'make up for lost time'. This attitude accounts for the earlier decision to 'buy-out' an existing manufacturer and was also a factor in the decision to purchase rather than develop (over an estimated period of two or three years) their own technology to produce patterned tile.

In addition, the company felt that the market for vinyl tile would change very soon (to an emphasis on private housing) and result in a substantial competitive advantage for those manufacturers capable of producing a more stylish or luxurious product. This implied that time was of the essence and therefore favoured TT rather than development.

Another factor was the uncertainty associated with the development process. In particular, there was concern that even if the development project was technically successful, the product, itself, might not be as successful in the market as would be tiles with the status or 'prestige'-value of having been produced by imported technology and designs.

Accordingly, Mr Y recommended to the board that the company attempt to

acquire foreign technology to produce patterned tile and this recommendation was approved.

Investigation and Assessment of Technology

Role of the Trading Company ('shosha')

On the basis of catalogue information from a trading company it was decided to limit the serious investigation of available technology to two US companies - Johns-Manville Company and Eagle Floor Products Company - neither of which were known to be interested in selling their technology. The responsibility for making the detailed investigations and assessment was given to Mr Y's assistant manager, Mr M.

Mr M, like Mr Y before him, was faced with considerable problems on a business trip abroad. Like most Japanese businessmen, he had little experience abroad - for one thing, government foreign exchange controls limited the possibilities for frequent business trips abroad. In addition, Plas-tech, at the time, had no overseas subsidiaries or sales outlets whose staff could be called upon for assistance. A more fundamental problem was the language barrier. While Mr M had studied English at school and had a working knowledge of written English within his field, he had almost no facility at all with the spoken language.

Plas-tech's capacities for conducting business abroad were in sharp contrast to the various Japanese trading companies, or 'shosha'. These companies typically had offices throughout the world staffed with men who were both relatively knowledgeable regarding business and business practices in their region and capable of conducting business in English.

One of the functions of these overseas staff of the shosha was, in fact, to expedite and assist in the business activities abroad of businessmen, such

as Mr M - who represented client (or potential client) companies for the shosha's Japanese domestic marketing and other services. Plas-tech used a variety of such shosha to market many of its existing products and expected to continue to do so.

Accordingly, one of these shosha was contacted and during and prior to Mr M's two trips to the U.S.A. (in 1960) the shosha provided the necessary introcution, interpretation, and other services. The 'unspoken assumption' was that this shosha would, by reason of having provided these services, have the inside track for providing domestic services to Plas-tech in marketing the new tile. All of the costs associated with this assistance to Plas-tech were, however, borne by the shosha without any guarantee that the venture would lead to an ongoing role for a shosha or, if it did, that they would get the business.

Assessment of the Technologies

Having assembled the necessary data and samples during his two trips to the U.S.A., Mr M had then to assess the relative merits of the technologies.

The main points he felt he had to evaluate were:

1 The appearance of the final product;

2 The production process characteristics and feasibility;

3 The characteristics of the patented (as opposed to the non-patented) technology involved;

4 Relationship to existing Japanese technology.

Points 1 and 2 were directly related to usual business considerations. That is, to the marketability of the product and to the feasibility and economics of the production process involved - especially vis-a-vis Plas-tech's existing production process.

Points 3 and 4, however, were more closely related to Japanese government policy with regard to TT. Purchase of foreign technology required the release of foreign exchange funds which were felt to be in short supply. Without the recommendation of MITI (Ministry of International Trade and Industry) it was a foregone conclusion that the necessary approval for release of foreign exchange would not be granted.

In this regard, the amount and quality of the patented (as opposed to non-patented) portion of the total TT 'package' seemed to be a significant factor in determining MITI's attitude towards any given TT proposal. In addition, approval was more likely to be forthcoming if the technology was dissimilar to that existing in Japan and would make a significant contribution to Japanese economic growth.

Considered in this light, the two technologies did not differ significantly on points 1, 2, and 4. With regard to point 3, however, a portion of the Eagle Floor Products technology was patented - while none of the Johns-Manville technology was patented. This implied that a proposal for a TT from Eagle Floor Products was more likely to receive the necessary support from MITI.

Finally, Eagle Floor Products was prepared to discuss immediate TT whereas Johns-Manville - while not ruling out TT - was not prepared to proceed immediately. In view of Plas-tech's intent to gain an advantage over competitors by moving into production of patterned tiling as rapidly as possible, this effectively ruled out a TT from Johns-Manville and it was decided to open contract negotiations with Eagle Floor Products.

Contract Negotiations

Negotiations were conducted initially by letter via the shosha and, in the later stages regarding the royalty, by telephone directly from Plas-tech. The

major sticking point in the negotiations was the level of royalty to be paid. Eagle Floor Products was determined to get a running royalty of 5% on yearly sales up to a specified volume and this posed an obstacle to the negotiations. In the first place, there was, of course, Plas-tech's normal desire to pay as low a rate as possible. In this respect, the company viewed the royalty to be paid not only as being the most flexible or 'negotiable' of the costs of acquiring the technology but also as having the greatest absolute significance in terms of its impact on the ultimate profitability of acquiring the technology (as opposed, say, to the costs of equipment and new plant construction which were also envisioned). There was another, and more clearly crucial obstacle posed by Eagle's insistence on a 5% royalty however.

This obstacle took the form of MITI 'guidelines' for royalty payments. These guidelines varied depending on the field of technology involved and - while they had no official status - were generally viewed as an effective upper limit in the majority of cases. In the case of plastics products production technology this 'unofficial' guideline was 3% - considerably less than the 5% demanded by Eagle.

In the event, Eagle convincingly asserted that it was not interested in selling its technology for less than a 5% running royalty and the negotiations produced, essentially, the contract sought by Eagle (see page 148).

It may have been merely a bargaining strategy but it is interesting that Eagle, which had had no prior interest in the Japanese market, hinted broadly during negotiations that they were in a position to proceed with serious negotiations with other potential Japanese customers for their technology if the Plas-tech negotiations didn't go well. Thus, the initial approach by Plas-tech to Eagle may have had the incidental effect of 'sensitizing' Eagle to opportunities in the Japanese market.

MITI Approval of the Contract

The contract was submitted to MITI for consideration and received MITI recommendation and the subsequent approval for release of funds under the Foreign Exchange Control Law. This MITI recommendation was despite the facts that:

1 The royalty provisions exceeded the MITI guidelines and

2 the technology, itself, was

(a) not very dissimilar to existing Japanese technology (i.e. the differences were only important in-so-far as the goal was to produce patterned rather than non-patterned tile);

(b) not of any major, direct, relevance to Japan's overall economic growth.

In the veiw of Plas-tech, there were three major reasons for approval in spite of the above adverse factors.

1 The government was, as a matter of policy, encouraging the development of the Japanese petro-chemical industry. This implied similar encouragement of the downstream users of petrochemical products - which group included the plastics and plastic-based products manufacturers. It is felt by Plas-tech that these sorts of considerations led to a more lenient attitude towards TT guidelines than would have been the case had there been no backward 'linkage' to a priority industry.

2 Eagle Floor Products had been convincingly vigorous in its assertions that it would not settle for any less favourable terms. It is felt by Plas-tech that MITI recognized, therefore,

OUTLINE OF TT CONTRACT PROVISIONS

Date of contract:
February 18, 1961, to be effective from the date of approval of the contract under the Foreign Exchange Control Law (in the event, September 5, 1961).

Duration:
Ten years from effective date.

Acquired by Plas-tech:
The right to produce and sell (within Japan and South and East Asia) PVC floor tile using technology developed by Eagle Floor Products (specified in more detail in the actual contract).

Compensation to Eagle Floor Products:

1 License Fee: $50,000 (US) payable in each of ten successive years from the effective date.

2 Royalty: as per the following schedule:

Gross Sales per year			Royalty Rate
From NIL	to ¥	360,000,000.	5% *
from ¥ 360,000,000.	to ¥2,160,000,000.		3%
from ¥2,160,000,000.	to ¥5,760,000,000.		2%
from ¥5,760,000,000.	and above		1%

Miscellaneous
There were various other supplementary provisions relating to the rights and obligations of the two companies. Among these were provisions requiring Eagle to supply advisors to Plas-tech - should Plas-tech require such assistance during construction and start-up. This provision also specified the per diem cost of such services to be paid by Plas-tech.

* The royalty on the initial ¥360,000,000 of sales each year to be applied in reduction of the License fee for that year. At the then current rate of exchange (¥360 per $1 (US)) this would, at the maximum, exactly equal the License fee of $50,000.

that disapproval of the proposal would not likely result in a return to the bargaining table but, rather, bring an end to the negotiations. This may have tempered any MITI inclinations to hold to the 3% royalty guideline.

3 Plas-tech, itself, had a record of rapid growth and capable management. The Plas-tech management felt that this record of success somewhat reduced the inclination of MITI to impose guidance on the company both in the particular case and in general.

The Process of Transfer

Shortly after approval, a group of three technicians (headed by Mr M, the assistant manager of the Building Materials Division) went to Eagle Floor Products in the US for a period of about one month. During this period they mastered the basic principles of the technology and its use and, as well, acquired the necessary plant layout, formulae, and process control data. The English-language ability of these three technicians was quite low but their ability to understand what was said to them was greater than their ability to speak and their ability to read English was greater still. Thus, while there were problems of communication there were no insurmountable difficulties.

Meanwhile, in Japan, Plas-tech was establishing a separate, 100%-owned subsidiary, Odaira Plas-tech Company to take over all of the company's existing and future tile production. A parcel of land was purchased of which half was to be used for the new tile plant and half earmarked for future expansion.

The decision to establish a new plant and subsidiary company was due to the overcrowded conditions of the existing divisional facilities and the

desirability of a separate operating unit - given that it would now be necessary to provide data re: output, prices, etc. to an outside company, Eagle Floor Products.

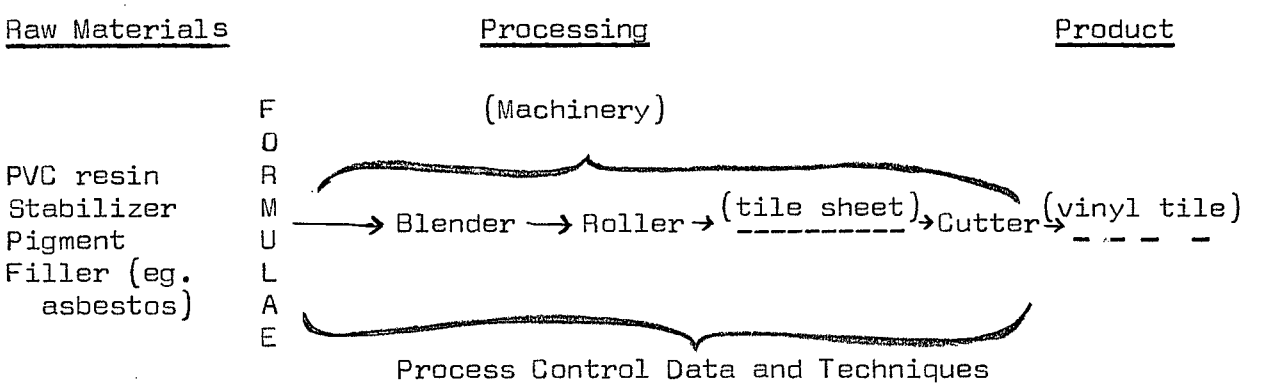
The contract with Eagle provided for them to assist Plas-tech in acquiring any necessary equipment not readily available in Japan. In the event, no such assistance was required.

Eagle was also to provide consultant services in the event Plas-tech experienced difficulties with plant construction or start-up. In fact, Plas-tech experienced no major difficulties and a little over one year after approval of the TT production of patterned tiles was begun.

Description of the Technologies

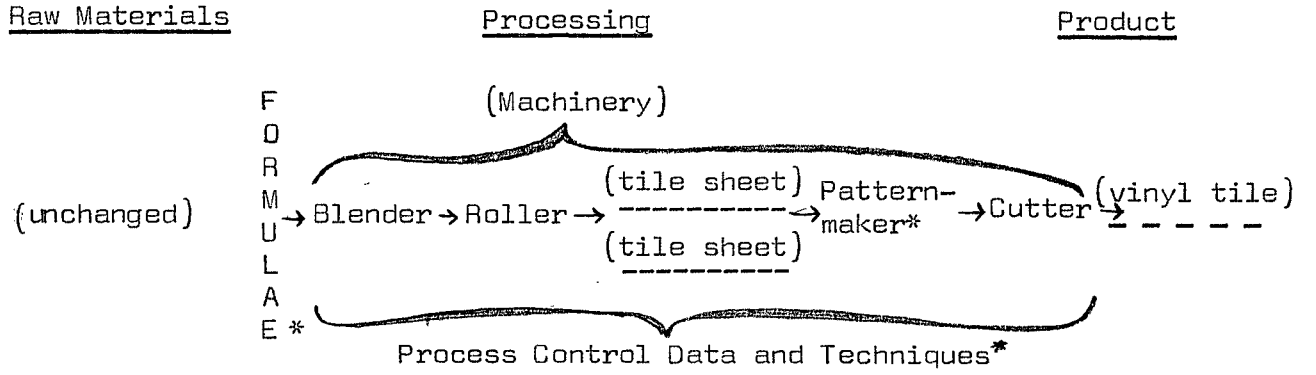
Existing (prior to TT) Technology

The existing production process technology is outlined in the following diagram:



New (Post-TT) Technology

The new technology was different from the existing technology primarily in that it introduced a new stage into the production whereby two (or more) differently coloured sheets of tile could be combined in a predetermined pattern prior to being introduced into the tile cutter. The need to manipulate and bind more than one sheet into a single pattern required however, different raw material formulations and process controls. The new technology is indicated in the following diagram with the significant differences from the earlier technology indicated by asterisks:



Floor Tile Industry

Background

The immediate antecedent of the vinyl floor tile industry was the asphalt tile industry which arose, initially, in response to the demand created by the post-war construction of US military bases in Japan.

The development of vinyl floor tile technology in the US reached the stage of economic production around 1952-1953 and in 1956 production of vinyl tile began in Japan. The initial participants in the industry all had previous experience as suppliers to the Japanese construction industry. As a result, they had long-established relationships with the larger contractors in the construction industry. The strongest participant companies had a background in asphalt roofing materials (eg. Fujimuri Kogyo Company, and Tajima Oyo Kako Company) or in linoleum flooring (eg. Toyo Linoleum Company).

The industry grew rapidly and soon attracted many new entrants with a variety of backgrounds but many of them being, primarily, medium and small-sized rubber goods manufacturers.

Industry Structure

At the time of the TT the number of firms in the industry had grown to approximately 60. In terms of market share; the two largest firms (Toyo Linoleum and Tajima Oyo Kako) held about 25%-30% each followed by a small number (three or four) of medium-sized firms holding 5%-10% market shares.* Plas-tech was in this latter group. The remaining firms in the industry held extremely small and tentative market shares of 2%, 1%, or less.

* estimates.

Research and Development

The majority of firms in the industry engaged in no R & D activities. Some of the medium and large-sized firms, however, had R & D projects underway. These were, typically, aimed at 'refining' the existing product by, for example, reducing shrinkage and lifting of the tiles after installation. The basic production technology was well-established and didn't seem susceptible to major innovative improvements. The major concern of firms in the industry was not R & D or production but, rather, sales and marketing.

Markets and Marketing System

Markets

As mentioned earlier the major distinction in the market for vinyl floor tile was between 'institutional' and private housing applications of the product.

Institutional Market

Institutional customers included offices, factories, schools, hospitals and the like. The appeal of vinyl tile in these applications lay in its durability, ease of upkeep, and neat appearance. Such institutional construction was encouraged both by government policy and by the rapid growth in the Japanese economy. It constituted about 50% of the total construction market at the time.

Private Housing

Private housing construction had been receiving low priority in government planning but, nevertheless, accounted for the remaining 50% of construction.

In contrast to the approximately 50:50 split of the construction market

between these two types of construction however, the institutional market was the dominant customer for floor tiling with private housing accounting for relatively few sales.

There was, however, a general feeling in Japan that private housing was highly inadequate - both in quantity and in quality. In addition, rising prosperity was putting the prospect of new (or better) home ownership within reach of an increasingly large number of people.

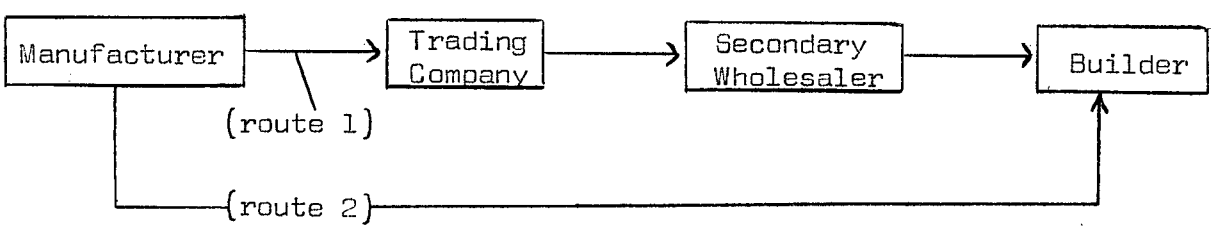
As a result, it was generally expected that the developing emphasis on private housing would soon reach boom proportions with a rapid increase in both the quantity and quality of private housing.

To the companies in the vinyl tile industry this indicated a rapid increase in demand for tile from the private housing sector. Some firms in the industry also felt that, aside from a quantitative increase in demand, the trends in private housing would also lead to a qualitative change - away from utilitarian tiling and towards more decorative or 'luxurious' tile.

The actual tile supplied to the institutional and private housing sectors at this time was essentially the same. The distinction between the two sectors was more significant in terms of the distribution channels used.

Marketing System

The marketing systems for flooring materials had been highly stable over time. There were two major distribution 'routes' as indicated in the following diagram:



One major route was from the manufacturer via intermediaries to the builder. This route was the normal one for sales to smaller contractors and private home construction.

The other major route was from manufacturer directly to the builder. This route was common for volume sales to major building contractors engaged in large-scale construction (offices, factories, etc.).

The firms which had long been in the business of supplying flooring materials to contractors (eg. Toyo Linoleum and Tajima Oyo Kako - both of which had been doing so in one form or another for about 45 years) held entrenched positions in route 2, based on strong ties with the larger contractors built up over many years of supplying, first, asphalt or rubber-based and, later, PVC-based flooring materials. Their many years in the business had created confidence in their product quality while their high volume and direct sales contributed to lower delivered costs and prices.

The newer entrants to the field, such as Plas-tech, typically had far weaker (or no) existing relations with general contractors. In addition, operating on a lower-volume/higher-cost basis without established reputations they faced severe difficulties in establishing such direct relations.

Route 1 was, of course, also used by the large makers as their route to supply the smaller, low-volume customers. Here, their competitive advantage was less as a small difference in price did not make a major increment in the contractors' return because the amount involved (in, say, a house) was minor - both in absolute and, often, in relative terms - compared to the amount involved in a large-scale construction project. In addition, the reputation of one of the intermediary companies involved in distribution was often of more importance to the final customer than was that of the original manufacturer, in this sales channel.

Plas-tech was not totally without connections with the large general contractors because of its position as one of Japan's major producers of plastic pipe. These relations were relatively weak, however, for two major reasons:

1 The company was relatively young and, therefore, the relations which existed had been of short duration;

2 The relations which existed were not direct supplier-customer relations but rather took the form of occasional contacts as 'technical advisors-propagandists' for new plastic pipe products and applications. The actual day-to-day sales were handled via plumbing contractor-suppliers who handled all types of piping and plumbing materials.

The rather remote nature of Plas-tech's relations with general contractors by reason of its pipe production is a reflection of the fact that the contractors' interest in the product and in direct relations with the manufacturer was highest when the product affected the appearance of the building. For other products; provided that they met the required standards and a reliable supply was available, there was no tendency for contractors to want direct dealings with the manufacturers.

TECHNOLOGY TRANSFER CASE STUDIES

Case 2

Sharp Corporation

Company Background

Sharp Corporation is the present name of the former Hayakawa Electric Company whose founder, T. Hayakawa, invented a mechanical pencil which he marketed as the 'Ever-Sharp Pencil' in 1915. As he expanded into the electronics field the 'Sharp' product name was used for other products and in 1929 was registered as a brand name. The product brand name eventually came to identify the company, itself, and in January 1970 the company's name was formally changed from Hayakawa Electric to Sharp Corporation.

The company had a long history of 'firsts' in introducing new technology into its product line - including Japan's first radio (1925) and television set (1951). By the late 1950's the company was producing a broad range of household electronics and appliances and was beginning to expand into the development of other, more specialized electronics goods (eg. electrocardiograph, electric scalpel, solar battery, etc.).

Decision to enter the Desk-top Calculator Field

In 1960, the company decided to enter the computer field because of its present and potential growth and the suitability of the company's existing technological capabilities to this field. Development of the computer industry was a priority of government and the industry was being monitored and guided by MITI (Ministry of International Trade and Industry). It was, in fact, necessary for the company to obtain approval from MITI for its entry into the field. As there were many companies seeking to enter the industry, MITI was concerned about 'overcrowding' in the industry and did not approve of Sharp's entry into the field.

In lieu of entry into the computer industry therefore, the company began thinking in terms of using and developing their technology in somewhat related areas. One such area was billing machines (which had been the

object of some earlier attention by the company concurrently with their attempt to enter the computer field). Another area which seemed to be promising was desk-top calculators (hereinafter referred to as 'DTC'). To date, DTC had been mechanically driven but the company felt that the application of electronics technology developed in and for the computer field would produce a highly competitive machine which was quieter and more trouble-free than existing machines.

In 1961, therefore, the company decided to begin development of an all-electronic DTC and in 1964 the company introduced the world's first solid-state ('transistorized') DTC - the Sharp 'Compet'. This was followed, in 1966, by the first IC (integrated circuit) - applied DTC and, in 1967, by the first application of MOS (metal-oxide semi-conductor) - IC technology to DTC.

Decision to move to LSI (large-scale integration) technology

Around 1967, LSI technology was beginning to be applied to the computer field. While LSI technology had not yet been applied to other fields (excluding the US space and defence programmes), it seemed clear that there was enormous potential in other fields - notably in electronic calculators - for cost reduction, further miniaturization, and increased reliability by application of LSI technology.

In reflection of this, Japanese domestic LSI production capability was the object of much government attention at the time. MITI was providing 'fairly substantial' subsidies to manufacturers for the development of LSI technology and the industry was engaged in a major effort to reach the levels of technological capability attained in the USA.

As one of the aspects of this effort, there was a cooperative research

development programme aimed at developing LSI technology for application in DTC. The programme brought together both Japanese semi-conductor manufacturers and DTC manufacturers. The cooperation took the form of information exchange and feedback among the participants rather than the establishment of an independent, jointly-staffed research group.

Sharp's participation in this included the establishment in April 1967 of a project team assigned the task of developing a logic circuitry design for an LSI suitable for use in DTC. The LSI design was completed in early 1968 and, given the 'state-of-the-art' at the time was quite complex - though no more so than (though different from) some of those already being produced for special computer applications. As a semi-conductor device for application in DTC, however, it was far more complex than anything thus far used.

Decision to use MOS-LSI rather than Bi-polar LSI

While both of these types of LSI were being used in the computer field the bi-polar type was by far the most common and was likely to remain so due to its higher 'speed' of operation.

MOS-LSI technology was, moreover, at an earlier stage of development and there were many outstanding questions regarding its ultimate feasibility. MOS semi-conductors, at the time, suffered from poor reliability and are, in any event, inherently 'slower' in operation than bi-polar types. In DTC applications, however, speed is of less importance than in the case of computer applications. In addition, the MOS-type's potential for a higher degree of miniaturization and lower cost production was particularly attractive for DTC applications. Sharp had, therefore, designed its proposed LSI with the aim of using MOS-LSI technology in mind.

Sharp's design for a DTC-applications LSI was, however, just that - a design. The overall cooperative research project had generated some advance in a technical sense but, in terms of production technology had not succeeded in devleoping a means of economically producing the desired LSI for application in DTC.

Decision to move into production of semi-conductor devices

About this same time, Sharp began to consider not simply using LSI in its DTC but also acquiring manufacturing capability for LSI. The reasons for this were related not so much to the inability of present Japanese manufacturers to meet Sharp's needs as they were to a growing perception of the implications the advent of LSI technology might hold for the relevance and value of Sharp's existing technological expertise.

Sharp first used semi-conductor devices in its radio and television sets - initially, transistors and, later, IC's. These were purchased as parts from semi-conductor manufacturers and used in circuitry designed by Sharp. In the case of IC's, of course, some of the circuitry was contained in the IC, itself, and therefore, in some cases, the IC were custom-ordered from the manufacturers while in other cases IC containing standardized circuitry were purchased as freely available parts.

Reliance on outside suppliers for semi-conductors devices (even though in some cases custom-ordered) also characterized the company's DTC production. The company's considerable commercial success in the field had been largely a function of its product design, logic circuitry expertise, and production techniques. The advent of LSI technology, however, appeared to hold grave implications for the relevance of these company capabilities to future success in the industry.

That is to say, with transistors and, to a somewhat lesser degree, with IC there is still a major portion of the total technological expertise and manufacturing inputs held by the DTC manufacturers. With the introduction of LSI technology, however, a far greater proportion of the total inputs into the final product would be contained in the LSI 'chip', itself. With this, the determinant design and production would largely be in the hands of those companies producing the LSI's. Moreover, the DTC manufacturers - no longer holding the relevant technological expertise - would be dependant upon the LSI producers for subsequent technological and design advances in their field.

As a consequence of this analysis of the implications of LSI for the DTC industry, the company decided that, not only would it have to move to the use of LSI but that it would also have to acquire an LSI production capability in order to maintain its capacity for innovation and control of technology in its products.

The Decision to approach North-American Rockwell

As the company had no background in the field of semi-conductor manufacturing it was clear that it would have to acquire the necessary technology from an outside source. The company's goal in this respect was not simply an ability to produce LSI such as those already being produced by semi-conductor manufacturers but, rather, the technology required to produce LSI for DTC application such as its logic circuitry experts had designed.

Quite aside from the likely reluctance of existing Japanese semi-conductor manufacturers to help establish Sharp as a competitor in their field, it was already clear from the result of the joint research project that

domestic manufacturers were some distance away from developing the particular capability which Sharp wanted to acquire.

On the other hand, Sharp was already aware of the news that North American - Rockwell Corporation of the USA (nowadays and hereinafter, 'Rockwell Corporation') had had impressive results in the development of MOS-LSI technology to meet the needs of the USA Apollo Space programme. Accordingly, it was decided in the latter part of 1968 to have a Sharp representative take the Sharp-designed LSI circuitry along with him on his next regular trip to the USA and combine a visit and preliminary discussions with Rockwell with his tour of Sharp representatives in the USA.

Negotiations with Rockwell

At this time, Rockwell was a leader in the field of MOS-LSI technology but MOS-LSI, themselves, had yet to find any major applications outside the military and space programmes in the USA. As a result, while Rockwell possessed a strong capability in the production of the complicated 'masks' required to produce LSI, neither it nor other companies had developed large-scale production techniques for LSI. In effect, then, what Sharp was proposing was that Rockwell work with them to develop one of the first civilian applications of MOS-LSI technology to a mass-produced product. This implied considerable development of production techniques because the required higher volume and lower costs of production were beyond the capabilities of existing production techniques. After considering Sharp's proposal and studying their proposed LSI design, Rockwell advised that it felt development was feasible given further joint development work. As a result concrete contract negotiations were begun.

Sharp evaluated the proposed technology development and acquisition project

in terms of a five year time-frame. In addition, the company assessed the proposed project and the value of acquiring LSI technology solely in terms of its DTC production and without any reference to its many other product lines. The resulting agreement provided for;

1 An initial development period, followed by production by Rockwell of the LSI for use in DTC assembly by Sharp, and, finally, a three-stage transfer of the LSI production process to Sharp.

The stages of TT envisioned at this early stage were:

i) Techniques for assembly of LS I;

ii) fundamental design technology for MOS-LSI (abstract rather than specific, applied technique);

iii) transfer of the new technologies resulting from the initial development period.

Each stage had a set, negotiated, fee-for-service associated with it but there was flexibility as to what parts of each stage Sharp would, in the event, choose to acquire under the terms of the contract from Rockwell.

2 Sharp was to send, at its expense, logic circuitry experts to Rockwell to assist in the development programme for the LSI.

3 Rockwell was to provide (for a fee) all necessary assistance and advice to Sharp during the period of ultimate plant construction and start-up in Japan.

Approval of the contract had to be obtained from MITI and this posed no major problems though it involved about two to three months (concurrent with other related activities) of discussions and negotiations. MITI raised a question regarding level of the royalties specified in the contract and, as a result, they were lowered. In the event, the receipt of approval from

MITI also took place in stages with approval of the transfer of LSI assembly technology being obtained in February of 1969 and two later approvals being obtained in June and August of 1971 for subsequent technology transfers.

Joint Technology Development

As had been agreed, Sharp sent two logic circuitry experts to Rockwell to assist in the development programme. The English-language ability of these two technicians was limited to that acquired up to the university level in Japan - neither of them had been abroad before. In essence, this meant that they could read English-language material (especially in their field of specialization) quite well, understand spoken English not so well, and speak English only poorly at the time they were sent to the USA. They had been chosen on the basis of their relevant technical expertise and because of their prior participation in the earlier technology development programme (discussed earlier). By coincidence, both were bachelors and thus there were no complications relating to wives and children to hinder their spending an extended period of time abroad.

During the succeeding year (late 1968 to 1969), these two engaged in joint development activities with their counterparts at Rockwell. After the first six months an initial design was settled upon (it was quite different from that originally proposed by Sharp). Following a further six months of refinement and development of production techniques the necessary 'mass-produceable' LSI and related technology was established.

During this period the two Sharp technicians - though their expertise was not in production technology - in the normal course of events were exposed to and developed their abilities to work within the developing LSI production technology.

Actual Transfer of Technology

With the establishment of the production techniques for the LSI, Rockwell began to supply the finished LSI for assembly in Sharp's DTC. At the same time, Sharp sent a production specialist to Rockwell for a period of six months to familiarize himself with the production process.

Following the return to Japan of this production specialist, Rockwell in mid-1970 sent the necessary plant layouts, operational data and two advisors to Japan to assist Sharp with the plant construction and with equipment procurement and installation. One of the two advisors sent to Sharp by Rockwell (a nisei, or ethnic Japanese) spoke quite good Japanese while the other spoke Japanese only poorly.

The necessary equipment for the plant was in accordance with specifications laid down by Rockwell. Some of this equipment was acquired from Japanese sources and some from US sources. In the case of US suppliers, Rockwell in some instances actually placed the orders on behalf of Sharp.

It was during this period of plant construction and start-up (first, of LSI assembly, then, of LSI production) that the most explicit process of TT occurred. In retrospect, Sharp feels that this period was important because of the knowledge it acquired regarding the basic engineering of an LSI production plant and because of the insight provided by the Rockwell representatives, as to the present and future potentials of the equipment involved.

In terms of the three-stage transfer process envisioned in the original contract (see above), the equipment and layout-related technology associated with stages i) and ii) were formally transferred. Viewed from a slightly different perspective, the total package of technologies involved can be said to consist of three main types: i) assembly techniques, ii) logic

design, iii) wafer design. All of these were transferred but, whereas the assembly techniques can be said to have been transferred explicitly and in total, only the fundamental, general techniques associated with ii) and iii) were explicitly transferred. There was, that is, no need for the explicit transfer of 'new technologies'.peculiar to the specific LSI initially designed. This was largely because the close involvement of competent people from Sharp in the design process at Rockwell made such an explicit TT of this knowledge unnecessary.

Results of the TT

The MOS-LSI production facility was established as a separate division within the company. It produces a limited range of LSI and IC, specializing in devices incorporating circuitry devised for use in Sharp's DTC. About 80% of the division's output is used within the company in its calculator and television set production. The remaining 20% is sold to outside customers consisting largely of other DTC manufacturers.

About 1 year after the start-up of Sharp's 'ELSI' plant for the production of MOS-LSI and IC, the Japanese domestic semi-conductor manufacturers reached a comparable level of technology in the production of MOS-LSI for use in DTC. This advance in their technological capabilities was primarily due to the development programmes begun in 1967 (in which Sharp had participated) and to the strong impetus for development of LSI for DTC-applications once the enormous size of the potential market became apparent.

Partly due to this technological advance among domestic Japanese manufacturers, and partly because it wasn't feasible for Sharp to produce all of the various types of LSI and IC which it needs, the company has continued to use outside sources for a major portion of its total requirements.

At present (1975) approximately 20 - 25% of requirements for DTC LSI and IC are met by the 'ELSI' plant with the balance being procured from outside sources.

The company's requirements for LSI and IC for its television set production are met 90% by the 'ELSI' plant but the absolute numbers are a very small proportion of the total plant production (about 10%).

Sharp's in-house MOS-LSI production technology has advance since the TT. One simplified measure of this is the fact that the present techniques can 'pack' about ten times the circuitry into an equivalent-sized LSI.

This advance subsequent to the original TT has been a result of self-generated technological advance rather than of any subsequent explicit transfer of technology.

On the other hand, whereas the LSI being produced at the time of start-up of the 'ELSI' plant was the world's most advanced for use in DTC, the presently produced LSI are not the most advanced.

Retrospect

Effect of the TT on the Environment

While it might have been expected that the introduction of LSI into the DTC field would reduce the strength of those DTC manufacturers without an LSI production technology this was not, in fact, the case.

There was an initial period of about two years during which manufacturers with such a capability held a slight advantage over those without because they were not dependant on outside semi-conductor manufacturers for supplies of the necessary LSI.

The use of LSI in DTC led, however, to extreme reductions in calculator size, power consumption, and costs and, very quickly, created a much larger market than had previously existed. As a result, there was a large demand for MOS-LSI for use in the standard types of DTC and the semi-conductor manufacturers moved quickly to fill that demand. Such 'standard' LSI soon became freely available and relatively cheap 'part' incorporating almost all of the advanced technology and most of the 'manufacturing' processes needed to produce the final product.

This made entry into the DTC industry much easier than it had been in the past and manufacturers with their own LSI production facilities quickly lost any initial advantage they might have held in the market for the standard types of electronic calculators.

In addition, with the advent of the LSI, the high technology component of DTC became 'built-in' to the LSI chip itself and could readily be exported to low-wage areas in the less-developed countries for final assembly and re-export to the consumer markets. This injected a new competitive element

into the industry. Sharp, itself, partly for these reasons and partly to avoid trade restrictions imposed by the European Economic Community began an assembly operation in Korea to supply foreign consumer markets.

On the other hand, ongoing technological development in the field of LSI has steadily reduced the amount of time required for assembly-type operations in the production of the finished DTC, With this, the merits of locating such separate assembly operations in low-wage areas in the less developed countries has also diminished. An example of this sort of advance would be the so-called 'calculator-on-substrate' (COS) technique whereby the entire calculator (excluding the case and power source) can be produced on a single 'part'. As a result, the most recent trend of thought in the industry seems to be back towards integrated manufacturing operations emphasizing sophisticated, capital-intensive, equipment operations and involving very little manual labour.

In conclusion, therefore, despite the fact that the originally anticipated competitive advantage to be gained by the technology transfer proved to be evanscent, over the longer term the acquired capacity for independent technological development in the field of LSI is likely to prove of major, ongoing importance to the company.

TECHNOLOGY TRANSFER CASE STUDIES

Case 3

Pollution Control Technology

TT (technology transfer) of Pollution Control Technology

A. General Background

1. Industrial Machinery Industry

The "industrial machinery industry" is a rather loose concept incorporating a wide variety of companies. These companies can, however, be usefully grouped into three major categories, as follows:

(a) 'Standard' machine tool producers

(b) Specialized plant equipment producers

(c) Industrial plant manufacturers.

One significant difference over these three categories is in the amount of 'working capital' required to support a single unit of production. This is, obviously, extremely high in the case of companies contracting for the construction of entire industrial plants. It is, typically, much lower in the case of standard machine tool and specialized industrial equipment producers.

As a consequence, industrial 'plant-makers' almost invariably have strong ties to and a relatively high degree of dependence on outside organizations for financing during the period of construction of an industrial plant. These relationships are usually with a limited number of such outside organizations and are often accompanied or affirmed by ownership ties and/or marketing agreements between the manufacturer and an outside company or group of companies.

Within the 'plant-maker' category one can make further distinctions between participant companies on the basis of the type of industrial plant (petro-chemical, pulp and paper, food processing, etc.) in which they are

specialized. The growth rate of individual plant-makers is, of course, highly sensitive to growth rates in their client industries and would vary somewhat between individual companies on that basis. In general, however, the 1960's was a period of growth and prosperity for most plant-makers - as a consequence of Japan's overall economic growth and prosperity during that period.

2. The Pace of Technological Change

The rate of technological change is not uniform over all industries. However, during the late 1950's and the 1960's there seemed to be a generalized quickening in the pace of technological change.

The significance of this for the industrial machinery industry lay in the fact that the life-span of their products or plant designs was shortened - by one estimate, from an average of 10 years in the mid-1950's to an average of 3 years in the early 1970's. The tendency seemed to be towards a pattern of the rapid introduction of new technology, followed by a brief period of sales based on that technology, followed by a further introduction of new technology which, if it did not make the existing product or plant design obselete, did call for extensive redesign or modifications. As a consequence it became increasingly less possible for a firm to acquire a state-of-the-art technology and then be able to concentrate on production and marketing based on that technology for an extended period of time.

As a related development, this trend created a new (or strengthened an existing) dependency by many participant companies on outside organizations for information regarding technological developments, analysis of future market needs, and assistance in gaining access to patent and license rights for relevant proprietary technologies. This dependency was greatest in the case of small and medium-sized companies in the industry as they,

typically, tended to limit their capabilities to the production aspect of manufacturing for the domestic industry and to be more highly specialized as to client industry or product line - thus, both more vulnerable to and less able to anticipate and cope with technological change.

Among the strategies adopted by small and medium-sized firms, the polar cases seem to be, on the one hand, to seek a small share of a large, diversified market (eg. production of exhaust fans for use in a wide variety of industrial settings) and, on the other, to seek a large share of a relatively narrow, specialized market (eg. precision instruments for specialized industrial applications). Of these two strategies, those companies adopting the latter would be more vulnerable to the effects of technological change and more in need of timely access to new technologies in their chosen fields.

One consequence of this increased dependence on outside organizations during the 1960's may have been a growth in the importance of the Japanese trading companies (with their world-wide information networks and specialized research divisions) in monitoring technological developments abroad, assessing the market for these technologies in Japan and - where indicated - facilitating the transfer of technology to such small and medium-sized Japanese companies.

One particularly good example of such a trend might be the formation in the mid-1960's of the Z joint-venture Company by Y Trading Company and X Company of the USA. X Company is a large, high-technology company with a heavy R & D commitment in a variety of fields. The Z joint-venture Company was formed with the express purpose of facilitating the marketing of X Company's technology in Japan by making ongoing and coordinated use of the Y Trading Company's capabilities for analysis of and marketing to prospective Japanese customers.

3. The Emergence of the Pollution Control Industry

The pollution problems associated with intensive industrialization became increasingly evident in Japan during the later 1960's. By and large, however, such pollution was an external diseconomy to the polluting firms. That is, they incurred no measurable costs due to the pollution nor would they reap any measurable benefits by reducing or eradicating it.

It was not, therefore, until the proclamation of the Basic Law for Environmental Pollution Control, in 1967, that there began to be any clear incentives for the adoption of pollution control techniques by Japanese industry. Even then, the force of the law was considerably diminished by the inclusion of a clause calling for ensuring 'harmony with the sound development of the nation's economy'. Growing public pressure (and some dramatic civil suits brought by victims of industrial pollution) led, however, to an extensive revision of pollution control laws in 1971. This included a deletion of the above-mentioned clause as well as much more explicit and stringent provisions regarding a variety of forms of pollution.

With this, the adoption of pollution abatement techniques and equipment became a practical necessity for a large sector of Japanese industry and the Japanese industrial equipment industry was quick to see the opportunity in this new market. Moreover, as the pollution control regulations typically provided a schedule of limits on pollution which became increasingly severe over time, this market was likely to be a continuing one as new, more advanced, equipment became necessary to meet the progressively restrictive anti-pollution regulations.

B. The Specific Technology Transfer

1. The Role of Z Joint-venture Company

In 1972, the X Company of the USA, feeling there was a potential market in Japan for its air-scrubber technology (a technique for reducing the discharge of paritulates into the atmosphere by industrial plants), made the suggestion to Y Trading Company that the air-scrubber technology be marketed in Japan through their joint-venture, Z Joint venture Company.

The Y Trading company determined that there was a potentially lucrative market for the technology in Japan and felt that it could be best exploited via one of its subsidiary manufacturing companies. Accordingly, companies A and B - both subsidiaries of Y Trading company - were approached. As it happened, both of these companies were already producing air-scrubbers using self-developed technology. As a result, even though the X Company technology was more advanced and enabled the production of a more compact air-scrubber, neither of these two companies was willing to produce a scrubber under license from Z Joint-venture Company - preferring, instead to exploit their self-developed technology. As a result, the effort to market the X Company air-scrubber technology in Japan was temporarily 'shelved'.

2. D Manufacturing Company - Background

D Manufacturing Company was founded in the 1920's and was operated during its first 30 years or so as a boiler-maker, subcontracting to larger companies. In the mid-1950's, however, a decision was made to break the pattern of dependency associated with subcontracting by developing a capacity to do business independent from a larger manufacturing company.

The management felt that its current activities in a relatively low-technology, labor-intensive, industry offered little hope of escaping from their dependence on larger manufacturers. It was decided, therefore, to try to move the company into a more promising field, industrial plant construction

and, to do that, it was felt that the company would have to develop a greater independent technological capability.

To this end, the company adopted a policy of investing more heavily in technical personnel by recruiting increased numbers of engineers and other technically-trained people in its annual recruitment of new graduates. Partly as a result of this policy, the company was able, by the early 1960's, to evolve into a plant-maker (building industrial plants to order for corporate customers) with a specialization in pulp and paper plants and, as well, was producing a limited range of specialized industrial equipment.

In the course of this corporate evolution it was necessary to form close relations with outside organizations for the purposes of obtaining financing marketing services, and, increasingly, access to technology for the company's products and plant designs. Accordingly, the company established such relationships with a small number of trading companies - the most important of which, by far, being that with the Y Trading Company.

3. D Company's Decision to Enter the Pollution Control Field

Towards the end of the 1960's and in the early 1970's D Company was experiencing a general slowdown in its orders for new plant construction. There was, moreover, a growing feeling that the rapid and repetitive increases in industrial plant capacity which had characterized much of the 1960's would not soon, if ever, be repeated.

Accordingly, the company began to place increasing emphasis on its production of specialized industrial equipment. The sudden emergence of a large market for pollution-control equipment in the early 1970's naturally, therefore, attracted the company's attention as a possible source of future growth and profits.

As the company had no experience in producing pollution-control equipment it had to look to outside sources for the necessary technology and for technical and market assessment of any given item of such technology.

Therefore, in 1973, D Company approached Y Trading Company to seek their assistance in moving into the production of air-pollution control equipment. At this, the effort to market the X Company air-scrubber technology, which had been 'shelved' in 1972, was reactivated and negotiations were begun between the various companies concerned.

4. The Actual Transmission of Technology

The two principals involved in the marketing of the air-scrubber technology in Japan were X Company of the USA and Y Trading Company. The vehicle for marketing the technology was Z Joint-venture Company. It was decided between these companies to license two Japanese manufacturers - with restrictions on their respective markets such that they would not compete with one another.

D Company was assigned the rights to produce the air-scrubber for the pulp and paper industry and C Company - a member of the large corporate group centered on Y Company - was assigned the rights to produce for sale to the petrochemical and metal refining industries.

In November 1973, D Company signed agreements with Z Joint-venture Company to produce the air-scrubber under license and with Y Trading Company to handle the marketing of D Company's output of air-scrubbers. The decision of D Company to enter into these agreements was made mainly on the strength of the technical evaluation and market forecasts of Y Trading Company and a 'brochure' describing the air-scrubber and its operation. This probably reflects a considerable amount of confidence by D Company in both X Company

and Y Trading Company - due to their large size and established reputations - as well as a feeling that there was a strong communality of interest of all the parties involved.

Contract Provisions

In exchange for acquiring a license to use X Company's air-scrubber technology, D Company was to pay to Z Joint-venture Company 2% of the sale price of each unit sold. There was no 'initial' license payment required. The actual sales were to be handled exclusively by Y Trading Company for the standard commission of 3% of total sales. In addition, however, the agreement signed obliged the company to purchase one particular part (required for each air-scrubber) exclusively from X Company in the USA. The price specified for this part was (at least in the view of D Company) in excess of the going market value and thus this represented an additional 'hidden' cost of acquiring the air-scrubber technology. At the time of this writing (late 1975), however, negotiations were underway between D Company and X Company regarding their joint production of this part in Japan.

Transmission of the Technology

In February of 1974, D Company sent three engineers to X Company's pilot plant in the USA. The group of engineers spent three weeks familiarizing themselves with the air-scrubber and its construction and, on their return, brought back detailed plans and operating manuals.

In September of 1974, X Company sent three engineers to D Company in Japan where they assisted in the construction and testing of the initial air-scrubber. This required only about one month, in all.

The construction of the air-scrubber called for no special new plant

expansion or construction by D Company however it was necessary for the company to acquire some special (Japanese-made) tooling equipment.

Incidental Cost of acquiring Technology

Some costs were incurred in the translation of technical material and preparation of blueprints etc. as well as for the construction of sample parts and of a prototype machine. All these costs were borne, explicitly or implicitly by D Company - as were the costs of sending their engineers to X Company's plant in the USA. In addition, although the costs associated with the one month stay in Japan of the three engineers from X Company were the responsibility of X Company, D Company estimates that it (of its own volition) incurred entertainment expenses, for each of the three, of about 10,000 yen (around $33.00) per day.

BIBLIOGRAPHY

1. English-Language material

(a) Books

Abbeglen, James. The Japanese Factory. Glencoe; The Free Press, 1958.

Almond, G.A. and Powell, G.B. Jr. Comparative Politics: a Developmental Approach. Boston; Little, Brown, 1966.

Burns, Tom ed. Industrial Man. Harmondsworth; Penguin, 1973.

Cole, Robert E. Japanese Blue Collar. Berkely; University of California Press, 1971.

Feinstein, Otto ed. Two Worlds of Change. Garden City, N.Y.; Anchor Books, 1964.

Hall, Edward T. The Hidden Dimension. New York; Doubleday, 1966.

Harbison, Frederick H., et al. Quantitative Analysis of Modernization and Development. Princeton, N.J.; Princeton University Press, 1970.

Industrial Bank of Japan. Law concerning foreign investment, the regulation relating to the enforcement of the law concerning foreign investment and the foreign investment commission law. Tokyo; Industrial Bank of Japan, 1950 (cited in Ozawa, Japan's Technological Challenge).

Institute of International Investment. Setting up in Japan. Tokyo; Institute of International Investment, 1973.

Kaplan, E.H. Japan: The Government-Business Relationship. Washington; US Department of Commerce, 1972.

Kojima, K. and Wionczek, M.S. eds. Technology Transfer in Pacific Economic Development. Tokyo; Japan Economic Research Center, 1975.

Livingston, J. et al. The Japan Reader. New York; Random House, 1973.

Mclelland, David C. The Achieving Society. Princeton, N.J.; Van Nostrand, 1961.

Moore, W.E. Social Change, Second edition. Englewood Cliffs, N.J.; Prentice-Hall, 1974.

Neghandi, A.R. ed. Environmental Settings in Organizational Functioning. Kent, Ohio; Kent State University Press, 1970.

Organization for Economic Cooperation and Development. Gaps in Technology: Analytical Report. Paris; OECD Publications Centre, 1970.

_____. Interim Report of the Committee on International Enterprises. Paris OECD Publications Centre, 1974.

Organization for Economic Cooperation and Development, Development Centre. Choice and Adaptation of Technology. Paris; OECD Publications, 1974.

_____, _____. Transfer of Technology for Small Industries. Paris; OECD Publications Centre, 1974.

Ozawa, Terumoto. Japan's Technological Challenge to the West, 1950-1974. Cambridge, Mass.; MIT Press, 1974.

Rostow, W.W. The Stages of Economic Growth, Second edition. Cambridge; University Press, 1971

Schumpeter, Joseph. The Theory of Economic Development. Cambridge, Mass.; Harvard University Press, 1934.

Smith, T.C. The Agrarian Origins of Modern Japan. Stanford, California; Stanford University Press, 1959.

Tilton, John E. International Diffusion of Technology: the case of semi-conductors. Washington; Brookings Institute, 1971.

United States, Department of Commerce. Factors Affecting the International Transfer of Technology among Developed Countries. Washington; US Government Printing Office, February, 1970.

Vernon, R. Sovereignity at Bay. Harmondsworth; Penguin, 1973.

_____ ed. The Technology Factor in International Trade. New York; Columbia Univeristy Press, 1970.

Wells, Louis T. Jr. ed. The Product Life-cycle and International Trade. Boston; Division of Reaearch, Graduate School of Business Administration, Harvard University, 1972.

Yamamoto, Noboru. The Modernization of the Economy and Postwar Expansion Tokyo; International Association for Educational Information, 1973.

Yoshino, M.Y. Japan's Managerial System. Cambridge, Mass.; MIT Press, 1968.

(b) Articles

Adelman, I. and Morris, C.T. "An econometric model of socio-economic and political change", The American Economic Review, Vol. LVIII, No. 5, part 1 (December 1968), pp 1184-1217.

Caves, Richard E. "Multinational firms, competition, and productivity in host country markets", Economica, Vol. 41, No, 62 (May 1974) pp 176-193.

Giral, Jose. "Development of appropriate chemical technology: a programme in Mexico" in OECD. Choice and Adaptation of Technology in Developing Countries. Paris; OECD Publications Centre, 1974.

Hahn, F.A. and Matthews, R.C.O. "The theory of economic growth: a survey", Economic Journal, Vol. 74 (1964).

Hall, G.R. and Johnston, R.E. "Transfers of United States aerospace technology to Japan" in R. Vernon ed. The Technology Factor in International Trade. New York; Columbia University Press, 1970.

"Highway Construction . . ." Vancouver Sun, 10 March, 1975. p 25.

Hoselitz, Bert F. "Nationalism, economic development and democracy" in Otto Feinstein ed. Two Worlds of Change. Garden City, N.Y.; Anchor Books, 1964.

Johnson, R.T. and Ouchi, W.C. "Made in America - under Japanese Management", Harvard Business Review, September - October, 1974, pp 61-69.

Jorgenson, D.W. and Griliches, Z. "The explanation of productivity change", Review of Econometric Studies, Vol. 34 (1967), pp 249-283.

Kosobud, Richard. "The role of international transfer of technology in Japan's economic growth", Technological Forecasting and Social Change, 5, 1973, pp 395-406.

Ruttan, V. "Usher and Schumpeter on invention, innovation, and technological change", Quarterly Journal of Economics, November 1959, pp 596-606.

Schmookler, J. "Economic sources of inventive activity", Journal of Economic History, March, 1962, pp 1-20.

Sigelman, Lee, "Lerner's model of modernization: a Reanalysis", The Journal of Developing Areas, No. 8, July 1974, pp 525-536.

Solow, R.M. "Technical change and the aggregate production function", Review of Economics and Statistics, Vol. 39, 1957, pp 312-320.

Spencer, Daniel L, "An external military presence, technology transfer, and structural change". Kyklos, Fasc. 3. Basel; 1965, pp 451-474.

Vernon, R. "International investment and international trade in the product cycle", Quarterly Journal of Economics, Vol. LXXX, No. 2. (May 1966), pp 190-207.

(c) Miscellaneous

Japan, Ministry of Finance. A Guide to Investment in Japan. Tōkyō; Ministry of Finance, 1950.

_____, Ministry of Foreign Affairs. Foreign Investment in Japan. Tōkyō; Public Information Bureau, Ministry of Foreign Affairs, 1968.

Hymer, Steven. "International operations of national firms - a study of direct foreign investment", Phd dissertation, MIT, 1960.

International Chamber of Commerce, Korea National Committee. Investment and Transfer of Technology, Background paper, Doc. No. 520/XX11/1. Seoul; I.C.C., Korea National Committee, 1974.

_____, _____, Texts of Speeches and Reports, 22nd Session, Committee for Asian and Far-Eastern Affairs. Seoul; I.C.C., Korean National Committee, 1974.

2. Japanese-language material

(a) Books

Andō, Yoshio, ed. Kindai Nihon Keizaishi Yōran. (A Handbook of modern Japanese economic history). Tōkyō; University of Tōkyō, 1975.

Arisawa, Hiromi ed. Nihon Sangyō Hyakunenshi - Gekan. (A 100 year industrial history of Japan - volume 2). Tōkyō; Nihon Keizai Shinbunsha, 1970.

Arita, Kyōsuke. Sōgō Shōsha. (General trading companies). Tōkyō; Nihon Keizai Shinbunsha, 1970.

Fujiwara, Ichirō. Shihon Jiyūka to Takokusekikigyō. (Capital liberalization and multinational enterprises). Tōkyō; Nihon Keizai Shinbunsha, 1973.

Gaikoku Gijutsu Dōnyū Yōran. (Foreign technology importation handbook). Tōkyō; Jūkagaku Kōgyō Tsūshinsha, 1965.

Hayashi, Yujirō, ed. Sekai ni Kakeru Nihon no Gijutsu. (Japanese technology challenging the world). Tōkyō; Kōgakusha, 1972.

Hazama, Hiyoshi. Nihonteki Keiei. (Japanese management). Tōkyō; Nihon Keizai Shinbunsha, 1971.

Kanamori, Hisao. Keizai Seichō no Hanashi. (On economic growth). Tōkyō; Nihon Keizai Shinbunsha, 1962.

Kobayashi, Yoshiaki. Shōwa Keizaishi. (An economic history of the Shōwa era). Tōkyō; Sotekkusha, 1975.

Kokusai Rengō, (United Nations). Sekai Tōkei Nenkan - 1973. (Statistical yearbook - 1973). Tōkyō; Harashobo, 1974.

Watanabe, Tokuji and Hayashi Yujirō. Nihon no Kagaku Kōgyō. (Japan's chemical industry). Tōkyō; Iwanami Shoten, 1974.

(b) Government Publications

Note: Except where otherwise noted, all government publications listed below are published by Ōkurashō, Insatsukyoku (Ministry of Finance, Printing Office) and only their date of publication is given. The official outlet for current Japanese government publications is however not the Ōkurashō Insatsukyoku but, rather, Seifu Kankōbutsu Sābisu Sentā (Government publications service centre), Chiyoda-ku, Kasumigaseki 1-2-1, Tōkyō.

Jinkō Mondai Shingikai (Population council). Nihon Jinkō no Dōkō - Seishi Jinkō o mezashite. (Japanese population trends - towards a stable population), 1974.

Kagaku Gijutsuchō (Science and technology agency). Gaikoku Gijutsu Dōnyū Nenji Hōkoku. (Importation of foreign technology, annual report) various.

_____, Gijutsu Dōnyū Hōkoku. (Report on technology importation). Unpublished, internal report - a copy of which is held in the Kagaku Gijutsuchō

Library in Tokyo, 1966.

Kagaku Gijutsucho, Kagaku Gijutsu Hakusho Shōwa 49 nen. (White Paper on science and technology, 1974) 1974.

_____, Kagaku Gijutsu Yōran Shōwa 48 Nenpan. (Science and technology handbook, 1973), 1973.

Keizai Kikakuchō, Chōsakyoku (Economic Planning Agency, research bureau). Shōhi to Chochiku no Dōkō. (Trends in consumption and savings). Various years.

Kōsei Torihiki Iinkai (Fair Trade Commission). Dokusen Hakusho, Shōwa 49 Nenpan (Monopoly White Paper, 1974 edition), 1975.

Sōrifu, Tōkeikyoku (Office of the Prime Minister, bureau of statistics). Kagaku Gijutsu Kenkyū Chōsa Hōkoku, 1973. (Report on the survey of research and development, 1973). Bilingual. Tōkyō; Nihon Tōkei Kyōkai, 1974.

Tsūshōsangyōshō, Kigyōkyoku (Ministry of international trade and industry - "MITI" - Enterprise bureau). Gaikoku Gijutsu Dōnyū no Genjō to Mondaiten. (Present conditions and issues of foreign technology importation). Tōkyō; Sangyō Kyōkai, 1962.

_____, _____. Gaishi Dōnyū: sono Seido to Jittai. (Induction of foreign investment: procedures and actual status). Tōkyō; Tsūshōsangyōshō, Chōsakai, 1960.

_____, _____. Gaishikeikigyo no Dōkō. (Trends in foreign capital-related enterprises), 1973.

_____, _____. Gaishikeikigyō: sono Jittai to Eikyō. (Foreign capital-related enterprises: their status and impact), 1968.

_____, _____. Nihon Kigyō no Kokusaiteki Tenkai. (The international advance of Japanese enterprise), 1973.

_____, Kogyōgijutsu Iin (Industrial technology board). Gijutsu Dōkō Chosa Hōkokusho. (Technology trends, research report). Tōkyō; Jigyō Kōhōsha, 1963.

_____, Sangyō Seisakukyoku (Industrial policy bureau). Wagakuni Kigyō no Kaigai Jigyō Katsudō, Shōwa 49 Nenpan. (The overseas business activities of Japan's enterprises, 1974 edition), 1974.

MITI -- see Tsūshōsangyōshō,

Nihon Ginkō, Tōkeikyoku (Bank of Japan, statistics department). Keizai Tōkei Nenpō. (Economic statistics annual). Tōkyō; Nihon Ginkō Tōkeikyoku, various years.

(c) Miscellaneous

"'Gijutsu Nibante' dappi e" (Outgrowing 'hand-me-down' technology), Nihon Kogyō Shinbun, August 5, 1975.

Kanamori, Hisao. "Nihon no keizai seichōritsu wa naze takai ka" (Why is Japan's economic growth rate high?), Keizai Bunseki, Vol. 31, July 1970, pp 1-9.