'SUPPLIER RESEARCH AND DEVELOPMENT': HOW JAPANESE MULTINATIONAL COMPANIES ARE INNOVATING IN THEIR GLOBAL NETWORKS

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1.0 Introduction

Large multinational corporations ("MNCs") with strategies of seeking to operate across borders, whether between countries or across global regions (such as Asia, Europe and the Americas), have faced difficult decisions in operationalizing such globalization strategies, for difficult trade offs have had to be made between seemingly incompatible objectives. The need to have a set of operations that is globally efficient and competitive has been difficult to reconcile with the needs for local responsiveness and flexibility and to develop effective communication patterns between parts of the global network of operations, to ensure that new knowledge is leveraged across the MNC as a whole (Prahalad and Doz, 1987; Bartlett and Ghoshal, 1989).

Activities such as sales, marketing and manufacturing have been internationalized for decades, but research and development ("R&D") has proved more resistant to internationalization. Part of the problem has been that the heavy reliance on R&D for the generation of new technologies, products and processes has resulted in needs for highly effective communication between R&D and other activities and organizations within the MNC. On the other hand, R&D also depends on dense ties to, and legitimacy within, the local environment.

Especially in industries with a high reliance on continuous technological innovation, R&D has tended to be seen as a 'home country' function, as an important mechanism for headquarters' control of strategy and, in an important emotional sense, as the 'heart of the company': the source of future knowledge creation that will be the key to long-term competitive survival. Yet, managers are, at the same time, aware that the home country concentration of R&D may threaten the long-term survival of the MNC. Various technological, market, governmental and regulatory, and competitive factors have been driving the need to internationalize R&D (Westney, 1991). The question that management has had to address has not, therefore, been of whether to internationalize R&D, but of how this might be achieved, given the needs for global efficiency and cross-border learning.

This paper discusses some of the ways that Japanese high technology companies in the electronics industry have been trying to internationalize their R&D activities at the divisional or business (as opposed to corporate) unit level. Instead of indigenous offshore development by a division, or of acquisition of offshore R&D capabilities followed by subsequent mandated integration within the MNC network, some Japanese high technology MNCs seem to have been adopting a more localized strategy, through what I have termed 'supplier R&D'. The supplier R&D establishment process is one of acquisition of an offshore R&D capability followed by non-assimilation within the MNC in a formal sense. Put simply, the local MNC-owned organization retains nearly all of its pre-existing management systems and internal consistency, but nevertheless develops a strong and effective relationship with the Japanese parent. Four instances of supplier R&D organizations, ultimately owned by two Japanese MNCs, are identified and described in this paper.

To understand the supplier R&D relationships means moving beyond what is a narrow and overly theory-laden definition of an MNC as a hierarchical relationship based on fiat as the main control mechanism. By concentrating on the phenomenon, it is possible to reconceptualize the relations within MNC organizational units and between MNC units and the organizational environment in terms of relational networks, that are both socially and economically defined. From this perspective, dense and complex local environmental ties,
with considerable local power, do not imply that there are weak ties to other parts of the MNC: one does not come at the expense of the other or imply that the power of the headquarters is necessarily weak. A good isomorphic fit with, and dense ties to, the environment enhances across MNC network ties. A successful ‘local insider’ is a necessary condition to becoming an effective MNC insider in an offshore R&D organization. The two objectives are not mutually exclusive: one leads to the other in a causal relationship.

The explanation for this is that the main governing system in an MNC is not part of a set of narrowly conceived control mechanisms, such as fiat or contract law, but is significantly based on mutual trust and respect. As the more autonomous, effective and higher performing supplier R&D unit gains confidence, respect and trust within the MNC, based on the strength of its locally consistent management systems and ties to the environment, so this actually enhances relations across the MNCs interorganizational network. It is perhaps no more than an extension of the everyday observation that, if you are good at your job and effective, people want to talk to you and work with you. So, there is no inverse relationship between external linkage and internal communication.

For managers charged with the responsibility of responding to Westney (1991)’s drivers to internationalize R&D, the conclusion of this study is that they should adopt a two-stage strategy to accomplishing their task. Firstly, a local (offshore) R&D unit that is as closely integrated into the local environment as possible should be established - acquisition of a local high technology company is one way of achieving this. The second stage is one of non-formal integration. Human resource management, management accounting, and other management systems need not be integrated and a policy of non-interference in what is an internally consistent and locally appropriate management system may be needed, contrary to what might be the immediately obvious solution of interorganizational integration. This means giving primacy to the local R&D subsidiary to interact with, and respond to, the various isomorphic pressures of its environment without interference.

Instead, the headquarters role becomes more of a facilitator, by providing every reasonable opportunity for the offshore R&D center to gradually develop ties at multiple levels throughout the rest of the MNC. Trust and confidence are earned and have to be earned at all levels in the set of organizations in the MNC with which the supplier R&D subsidiary interacts. The alternative, of exercising hierarchical control through fiat, may destroy the local isomorphic fit and value of the local R&D center and undermine the objective of building a global network of distributed innovations.

2.0 Methodology

The research format consisted of multiple interviews at a number of US-based organizations with a significant R&D focus, where ultimate ownership was by a Japanese MNC. The interviews were of a semi-structured format. In addition to the four firms that are described in this paper as illustrative of the workings of a supplier R&D center, a number of other Japanese MNC-owned US-based R&D centers were visited and are not described here. These were either acquisitions that had been made and that had been followed by deliberate integration into the MNC network (in a way that the previous section warned against), or were ‘home-grown’ established offshore R&D centers by the parent company. What is reported here, therefore, is a distinct subset of findings from what was a wider research project. The R&D centers that are not reported here did, however, enable some general measures of the relative effectiveness of supplier R&D to be gained.

Research and development was taken to include basic and applied research in the sciences and in engineering and the design and development of prototype products and processes. The purpose was required to be either the purposive search for new knowledge, the
application of existing knowledge to problems involved in the creation of a new product or process or the application of existing knowledge to problems involved in the improvement of present products or processes. Basic research, of which none was identified in the interviews, was taken to be investigations directed to the discovery of new scientific knowledge with no specific immediate commercial objectives. Applied research added the requirement of commercial objectives and development included projects representing technical activity concerned with non-routine problems or services.

On an important conceptual point, it is not proposed that R&D is the sole source of the creation of new knowledge in an MNC. Rather, R&D, as a designated and institutionalized function, is but one of several possible sources of innovation in an MNC. Important sources of innovation might just as likely come from other functional areas, such as human resource management, financial management or manufacturing. As is explained below, there is a need for MNCs to create distributed innovations (Nohria and Ghoshal, 1992) and to maintain and develop the ability to learn within a global network of operations; R&D is an important part of this.

3.0 Building Strategic Capabilities in the MNC: Important Dimensions of Decision

Bartlett and Ghoshal (1992) have summarized the task of MNC management as the building of three strategic capabilities:

- global-scale efficiency and competitiveness;
- national-level responsiveness and flexibility; and,
- cross-market capacity to leverage learning on a worldwide basis.

This is undoubtedly a complex task, not least because MNCs must operate within and across very different and dispersed environmental settings which push, pull and coerce an MNCs constituent organizations in different ways. As a result of this, these local organizations will be differentiated in complex ways (assuming management is not willing to pay the high cost of environmental rejection!) and internal linkages and coordination mechanisms must develop to represent, and respond to, many different kinds and extents of dependency and interdependency in interorganizational exchange relationships (Ghoshal and Nohria, 1989). Ghoshal and Bartlett (1990) have applied the tools and techniques of network analysis to provide a framework that portrays the MNC, defined as a group of geographically dispersed and goal-disparate organizations, as a network of exchange relationships among different organizational units that are embedded in a structured context. For current purposes, this is a useful conceptualization of the goals and constraints of an MNC.

For the MNC manager, a number of disciplines have sought to provide prescriptions as to how to design and manage such an interorganizational network. Contributions have come from the fields of economics, strategy and international management, and from organizational theory.

Turning first to economics, writing in the Economic Journal as long ago as 1972, Richardson (p. 894) suggested that:

"...if the student closes his textbook and takes up a business history, or the financial pages of a newspaper, or a report of the Monopolies Commission.....firm A, he may find, is a joint subsidiary of firms B and C, has technical agreements with D and E, sub-contracts work to F, is in a marketing association with G - and so on. So complex and ramified are these arrangements, indeed, that the skills of a genealogist rather than an economist might often seem appropriate for their
Richardson (1972) went on to criticize the economists' production functions, which represent the maximum output that can be obtained from different input combinations, as abstracting totally from the roles of organization, knowledge, experience and skills and, therefore, being unable to construct a theory of industrial organization. Richardson (1972) prefers to consider organizations with 'capabilities', in which some organizations will specialize, so leading to activities that may be 'complementary' with those of other organizations.

The genealogy metaphor adds an historical dimension to the relationships that Richardson (1972) describes by stressing time. The implication from the notion of capabilities is that, over any given time period, it is the task of a management to build capabilities for the benefit of an organization's various stakeholders - including employees, suppliers, customers and shareholders. The issue for managers is how this is best achieved. The production function, at least, will be of little help.

Given this cry for more reality in theoretical analysis some 20 years ago, it is somewhat surprising that so little of the economics' literature since then has been oriented to understanding the nature of the relations within and between organizations and environments, or to how organizations build and create new knowledge and capabilities.

Instead, there have been undersocialized accounts of rational organizations 'exploiting givens' rather than on creating novelty (Hedlund, 1992). In transaction cost economics, which has been the emerging paradigm through which economics has sought to explain interorganizational linkages, complex and deeply embedded relations are reduced to a single transaction as the unit of analysis. Furthermore, the forms of these relations are optimized as either market or hierarchy, with some later tinkering to allow for the possibility of hybrid forms of organizing transactions, such as in joint ventures.

This break with neoclassical theory as a descriptor of economic organization had its origins with Commons (1925) and Coase (1937). By making the transaction the basic unit of analysis, economists sought to lay the foundations of a theory to explain situations in which firms and markets, as alternatives, would be appropriate governance structures. Williamson (1975, 1985) built on this transaction cost economics to argue that transactions that involve uncertainty about their outcome, that recur frequently and that require substantial 'transaction-specific investments' - of money, time or energy that cannot easily be transferred - are more likely to occur within hierarchically organized firms. In contrast, exchanges that are more straightforward and non-repetitive, and that do not need transaction-specific investments, will take place in a market.

When asset specificity exists, the inefficiencies of bureaucratic organization will be preferred to the relative greater costs of market transactions. These greater costs occur due to the dual effects of 'bounded rationality' - whereby a contract cannot handle all possible contingencies - and 'opportunism' by rational economic actors pursuing their own advantage. Asset specificity, in the transaction cost economics' framework, creates bilateral dependency and poses added contracting hazards; as asset specificity increases, so bilateral dependency deepens.

In its original form, the polar view of alternative forms of economic organization was much criticized as it neglected hybrids, especially at a time when the number of cooperative and strategic alliances was growing. Writers such as Contractor and Lorange (1988) devised rankings of various forms of cooperative agreement, described by legal definition and strategic impact, as a continuum between the two poles of market and hierarchy. In response
to the recognition that the world of exchange relations was, perhaps, more complex than
allowed for in the original theoretical formulation, Williamson (1985, p.83) was moved to
comment that:

"Whereas I was earlier of the view that transactions of the middle kind were very
difficult to organize and hence were very unstable, on which account the bimodal
distribution was more accurately descriptive (Williamson, 1975), I am now persuaded
that transactions in the middle range are much more common."

Williamson (1991) summarized the hybrid mode as being characterized by semi-strong
incentives, an intermediate degree of administrative apparatus, as displaying semi-strong
autonomous adaptation to price changes and semi-strong adaptations of coordinated
investments and realignments. It was a kind of halfway house. An outline of Williamson's
framework is contained as Exhibit I.

Teece (1987) uses the transaction cost economics' framework in his further consideration of
the notion of complementary assets, mentioned by Richardson (1972). Teece (1987)'s
concern is to identify the factors that determine who wins from innovation: the firm that is first
to market, follower firms or firms that have related capabilities that the innovator needs. His
view of innovation is that it represents partly tacit and partly codified 'know-how' that is used
in conjunction with other capabilities or assets. He cites, as examples, services such as
competitive manufacturing and marketing. Complementary assets may be generic,
specialized or cospecialized. Generic assets do not need to be tailored to the innovation,
specialized assets imply a unilateral dependence between the innovation and the
complementary asset, and cospecialized assets are associated with bilateral dependence.

In this framework, depending on the appropriability of the innovation, the optimum form of
relationship to organizations with complementary assets will vary. Teece's game has "three
classes of players" (Teece, 1987, p.82) - innovators, imitators and the owners of
complementary assets. For example, in a regime of tight appropriability (e.g. an ironclad
patent) and with generic complementary assets, a contractual relationship with the owners of
complementary assets may suffice and this is conducive to the viability of specialized R&D
firms. In an environment of loose appropriability, if the complementary assets are important,
ownership (hierarchy) may be warranted.

Teece (1987, p.85) joins the debate on market/hierarchy in his surmising that:

".....the real world is characterized by mixed modes of organization, involving
judicious blends of integration and contracting. Sometimes mixed modes represent
transitional phases. For instance, because of the convergence of computer and
telecommunication technology, firms in each industry are discovering that they often
lack the technical capabilities needed in the other. Since the technological
independence of the two requires collaboration among those who design different
parts of the system, intense cross-boundary coordination and information flows are
needed."

Jensen and Meckling (1976) conceptualized of the firm as a "nexus of contracts", so that the
firm is very similar to the market in contractual respects. Williamson (1991) takes issue with
this, differentiating the hierarchical form of governance by its bilateral adaptation through fiat.
Market transactions cannot replicate the firm as they only have meaning in virtue of contract
law, from the point of view of contract resolution, whereas courts will not generally interfere in
disputes between divisions over technical issues. As Williamson (1991, p.274) states:

"Hierarchy is its own court of ultimate appeal."
The principal problem with the transaction cost economics' framework for current purposes is, quite simply, that the data don't fit with the theoretical argument. As will be shown, supplier R&D organizations are part of a 'hierarchy' in the Williamson sense that they are ultimately 100% owned by the Japanese parent, but the management mechanism is certainly not fiat. Others, including Dore (1987), have found inconsistencies in terms of matching data to Williamson's transaction cost economics' framework - it does not fit the institutionalized 'relational contracting' that Dore (1987) described - such that there must now be a real question as to whether the simple focus on a single transaction as the unit of analysis is helpful in the formulation of a theory of organizations.

From a theoretical point of view, the transaction cost economics' framework presents a number of problems. First, to repeat the Hedlund (1992) comment, the framework says nothing about how MNCs create the possibilities for new knowledge and learning. Second, the model says nothing about linkages between different subsidiaries, which may be more than simply dependent or independent, but interdependent, or reciprocal. Third, the complex and rich relationship between an organization and its environment, with its intertemporal processes and interdependencies, is reduced to the analysis of a single economic transaction as the unit of analysis.

These problems may have arisen because, in its original formulation, transaction cost economics was mainly concerned with economizing on transaction costs in multidivisional forms of organization. However, even in multidivisional forms of organization, mechanisms of control were more complex than the hierarchy/market dichotomy dictates. Granovetter (1985) has found, in a review of under- and over-socialized accounts of economic action, that Williamson has vastly overestimated the efficacy of hierarchical power. Powell (1990) - see below - has extended this criticism of the relevance of the transaction cost economics' framework as being of little help in conceptualizing of the relationships embedded in the networked MNC.

Bartlett and Ghoshal (1990) have argued that the linkage between ownership and hierarchical power (represented by fiat) is particularly weak in the case of MNCs, because of the large physical and cultural distances between the owned and the owning units. However, a more significant explanation is that (Bartlett and Ghoshal, 1990, p.607):

"The efficacy of fiat is particularly limited in the case of multinationals not only because some of the subsidiaries happen to be very distant and resource-rich but, more so, because they control critical linkages with key actors in their local environments, particularly the host government." [my emphasis].

This view has its origins in institutionalist theories of organizations, which consider organizations as open systems, strongly influenced by social and cultural pressures in their environments. Following the notable contribution of DiMaggio and Powell (1983), this body of theory has tended to stress isomorphic pressures on organizations from institutional sources, most notably from the state and professions. Through adaptive mechanisms and interpenetration, organizations mirror or replicate salient aspects of the environment in their structures.

In the case of the MNC, whilst its dispersed subsidiaries are likely to acquire attributes of, and be shaped by, their local environments (or 'organizational fields'), those environments are more likely to be dominated by fields of suppliers, consumers, competitors and other non-governmental interests, operating through both the local environment directly and through other parts of the MNC network. The host government may not, therefore, be the strongest source of isomorphism, as Bartlett and Ghoshal (1990) have proposed. When a Japanese MNC acquires a US R&D company and brings the organization into its network, it is
essentially buying into the local organizational field, an organizational field that may be as much or more shaped by the actions of other MNC organizations than by the state. Given the isomorphic fit of the organization to the environment, to interfere significantly in the organization would be to risk disrupting the embedded relationships between the organization and its environmental field. Westney (1992b) has suggested that, in addition to home and host country, large MNCs form a distinct third category of organizational field that may act as significant reference points.

Turning to the strategy and international management literature, much of this has been overly concerned with defending rights to extract short-term 'monopoly rents' (Teece, Pisano and Shuen, 1992) - through models such as Porter (1980)'s 'Five Forces Model' - or has resorted to games of product market positioning e.g. Larréché and Gatignon (1977), Day and Wensley (1988). Larréché and Gatignon (1977), following a convention in some of the economics' literature, define their 'learning curve' as productivity increases due to economies of scale and cost reduction.

What we have, therefore, from the economics and strategy literature, is a common tendency to adopt a model of the firm that focuses on one transaction as the unit of analysis - one transaction, one product, one advantage, a quantity of information and constant, 'given' knowledge (Hedlund, 1992). A short-term focus on exploiting existing advantages has a cost, as March (1991) has shown, in that it comes at the cost of exploring and inventing new technologies and knowledge. A balance is needed and a short-term focus on current potential and market control, rather than on seeking opportunities for the future is likely to be "self-destructive in the long run" (March, 1991, p.71).

The concept of strategy as a game has also permeated some of the international management literature. Prahalad and Doz (1987), for example, focus on the management of international cash flows and strategic coordination across a marketing system. They see this as a balance of having a multi-market presence to exploit the price asymmetries brought about by the competitive structure in various national markets, a brand presence that allows for price premium and a product family, in contrast to single businesses, and being in a position to leverage economies of scope, to control channels, and to provide opportunities for cross-subsidization across businesses and within a given market.

A number of writers have sought to move away from a narrow concept of strategy as concerned with building or maintaining short-term advantage. Foster (1986) posits innovation as central to what makes a firm successful, but still sees innovation more as a game to be fought in the market-place, rather than the developing of a sustainable capability. He cites (Foster, 1986, p.20) that:

"But for me innovation was and still is more than that. It was a battle in the marketplace between innovators and attackers trying to make money by changing the order of things, and defenders protecting their existing cash-flows." [my emphases]

If innovativeness and the building of technological capabilities and assets are 'givens' in standard economic texts, and have received scant attention, until recently, in much (but not all) of the strategy literature, they are seen here as very important dimensions to organizational capability. Hedlund (1992) has redefined the task of MNC management in these terms and puts forward five issues of concern for managers:
• the relative emphasis on creation and exploitation (the same concern as March, 1991);
• the degree of specialization in creating and exploiting, for MNC units and individuals;
• the level at which specialization takes place (countries, organizational units, groups, individuals);
• the methods of coordinating creation and exploitation with each other, given that there is some specialization; and,
• the sequencing of creation and exploitation activities.

The process of acquiring technology results from the way that organizations create new knowledge and disseminate it widely throughout the organization. This type of learning, according to Nonaka (1991), is distinct in Japanese companies, where knowledge is not just a matter of processing objective information, but results from exploiting the tacit, often highly subjective, insights, intuitions and hunches of individual employees, and from the making of those insights available for testing and use by the company as a whole.

R&D is an important part of this process, but the creation of new knowledge is not the exclusive domain and responsibility of the R&D function. The exploration of new possibilities takes place across the whole set of functions and activities in an MNC, through forms of communication within the MNC and with the external environment. 'R&D' is merely an administrative functional term adopted by nearly all MNCs (through isomorphic processes) to describe certain activities in the MNC that have specific mandates to explore new possibilities in the creation of new scientific and technological knowledge. The creation of that knowledge has been shown to be related to the density of communication between R&D personnel and their environments (Allen, 1977).

Abernathy and Clark (1985) have defined innovation in terms of a sequence of activities involving the acquisition, transfer and utilization of information. This notion of a technology sequence (from R&D to manufacturing and ever forwards into marketing) is characteristic of much writing on the innovation process. Pisano (1991), for example, uses it as the theoretical framework for his investigation into the various governance structures through which new biotechnologies have been developed and commercialized over the past decade and a half.

It is suggested that, while the notion of a technology sequence may be more appropriate for pure basic research than for applied development, even at the level of basic research, marketing considerations, for example, have a part to play and the process of basic R&D is as much a social organizational process as one confined to the internal cognitive processes of the basic research scientist. The relation between R&D and the external environment is crucial in the success of knowledge creation in 'R&D' as a designated function.

In what is, perhaps, an overly incrementalist view of the innovation process, but one that accurately describes the pattern of innovation in large Japanese companies over the past two decades, Aoki (1988, p. 247) found that:

"The strength of the J-firm lies in the design and production phase of the innovation process, since it makes effective use of short feedback loops (horizontal communications) from marketing to production and production to redesign and effectively exploits stored knowledge, in-house and at an outside source, with design and production phases of the innovation process." [my emphasis]

Aoki (1988, p.243) directly questioned the relevance of the hierarchical view of innovation:

"In other words, the production of new manufacturing knowledge (i.e. innovation) within the J-firm does not develop in a hierarchical order, stemming from the discovery of a new scientific principle and proceeding through sequential applications
to downstream engineering problems, ending with the production and marketing of new products. Rather, it is stimulated by the search for new economic uses for the accumulated in-house stock of engineering knowledge with the help of, and possibly the development of, scientific knowledge.”

The challenge for organizations is, therefore, to construct the optimal set of organizational arrangements that both facilitates the new integration and innovation processes (Bartlett and Ghoshal, 1989) and maximizes the benefits to be gained from innovation and learning. Accepting Westney (1992a)'s advocacy of "the integrated network model" as most appropriately descriptive of the new MNC in the international management literature, there is a need to examine the organizational relationships that bind together its constituent parts and that provide the links to the environment.

Measuring the importance of the links between headquarters and subsidiary, between subsidiary and subsidiary and within the subsidiary itself (Nohria and Ghoshal, 1992) begs a more detailed look at the nature of the relations represented by such links. To this must be added the environment, not as a contingent variable, but as a significantly causal influence on the nature of internal relations. It is not possible to consider an MNC's internal and external relations as distinct; in reality, the internalization process is significantly influenced by the form of internal and external relations.

The boundary between the organization and its external environment is permeable, such that the integrated network must necessarily include relations between an organization and all aspects of the environment, beyond even customers and suppliers. Von Hippel (1987) identified the extensive exchange of proprietary know-how by informal networks of process engineers in rival and non-rival firms, which he described as a "novel type of cooperative R&D" (Von Hippel, 1987, p.291). Similarly, Schrader (1990) found a positive link between the participation of a firm's employees in informal information-transfer networks and the economic performance of the firm. These informal network structures are crucial to the way that organizations acquire information. The internal relations, through, for example, motivational or demotivational forces, largely determine whether, and the extent to which, the new knowledge is transferred and operationalized.

The depth of knowledge transfer is a further dimension along which the innovation of an organization must be measured. Polanyi (1966) uses the term 'tacit knowledge' to refer to intuitive knowledge, that is more than orally expressed syntactic knowledge. Nonaka (1988) affirms the importance of this dimension when he states (Nonaka, 1988, p.68):

"The essential elements of intuitive and tacit knowledge - the creation, learning, or recognition of the new and unknown - are particularly important in the process of information creation leading to innovation."

What is key is how the new knowledge is internalized and spread throughout the MNC network. This depends on the dependent, interdependent and reciprocal relations across the various levels of the MNC and to the environment. Organizational theory has made a significant contribution to our understanding of how this works and to the efficacy of the supplier R&D organizations subsequently described.

4.0 Organizations and Environments

Westney (1991) discusses the forces, or drivers, of the globalization of technology, which put pressure on MNCs to create networks of R&D organizations, to tap into local R&D communities more effectively than could be achieved through alternative strategies of technology scanning and acquisition, or through strategic alliances with foreign partners.
Westney’s drivers of the globalization of technology are, as science and technology factors:

- growing science and technology parity across societies;
- complementarity of national strengths in science and technology (e.g. Japan in electronics’ hardware and the US in software); and,
- shortages of scientific and technical labor.

As market factors, she proposes the following:

- growing geographic dispersion of lead users; and,
- customization of products for local markets.

The state and regulatory factors are:

- standards setting, as firms seek to participate in national standards setting activities outside their home countries;
- research funding available from governments outside the home country; and,
- access to state-controlled and to state-regulated markets.

Finally, the competitive factors are:

- to follow the global dispersion of key competitors; and,
- image building - it may be important to be seen to have a full range of value-adding activities within major national markets, including R&D.

What is distinctive about this list is that the drivers all emanate from outside the MNC, in the environment. It is, perhaps, this that causes Westney to redefine R&D as a boundary-spanning and information value adding function, whose role it is to bring science and technology from the external environment across the boundaries of the firm, to add value to that information through its own accumulated knowledge and know-how and to pass the embodiment of that value-added information to the production organizations. The success of this depends upon the knowledge base of the R&D technical people, the research management system, and the quality and density of information flow within the organization, across the MNC and between the R&D facility and the external knowledge networks. These are the dimensions along which this research has sought to assess the R&D facilities visited.

It should be obvious, given this definition, that a single transaction is an impoverished way of conceptualizing of how R&D relates to the environment and to different parts of the MNC. Rather, the relationship between the R&D unit and its external environment is so dense and complex, that it may be more appropriate to consider the R&D unit as a separate organization embedded in its environment and linked to other organizations that collectively make up the MNC. To a significant degree, an R&D organization is determined by its environment.

Building on the DiMaggio and Powell (1983) notion of a highly structured organization field as having a homogenizing influence on local organizations, Scott (1987) proposed seven pressures towards isomorphism between organizations and their environments:

- the ‘imposition’ of organizational structure by powerful authorities, especially the state;
- the ‘acquisition’ of the patterns of organization of successful organizations in response to uncertainty;
- the ‘authorization’ of organizational form by normative processes, such as championing by professional organizations;
• the 'inducement' of organizational structure, when an organization that lacks the necessary power to impose offers inducements such as funding or certification;
• the 'incorporation' of salient aspects of environmental differentiation in organizational structure;
• the 'bypassing' of organizational structure, whereby institutionalized and shared values can substitute for formal structure; and,
• the 'imprinting' of some of the patterns institutionalized at the time the industry was founded.

However the environment enters the organization, whether the 'initiative' comes from outside or within, it is clear that the environment significantly influences how an R&D organization should be formed so as to be in harmony with its environment, including the network of external agencies, suppliers, professional bodies and competitor organizations with which it interacts or relates to directly and which exert influence indirectly.

In R&D, as an activity which is more highly dependent on the external environment for its success in more complex ways than, say manufacturing, and where the output is less measurable by other parts of the MNC, there will be a tendency for the R&D organization to more closely match its environment. Using March (1991)'s terminology, it is suggested that this is also a function of the relatively greater emphasis on 'exploration' rather than 'exploitation' activities. For the MNC to successfully leverage this embedded environmental relationship will depend upon the extent to which it can build dependent, interdependent and reciprocal relationships with its local R&D organization, without disturbing the environmental embeddedness. The conceptual rationale for supplier R&D now becomes clearer as an interorganizational relation that gives primacy to the need to build the relationship between the R&D organization and its environment.

In an R&D organization, the interface with the environment is clear in the need, for example, to provide reward and career structures that match the local environment, and in the relative importance of professional identities and links to outside organizations, such as to leading research universities. The R&D organizations that this researcher visited heavily benchmarked themselves in terms of performance and organization by comparisons with local and industry competitors.

Powell (1990) has confirmed the need to move beyond the notion of organizations having strictly defined boundaries and highly centralized operations. He criticizes such 'academic pigeon-holing' as 'market versus hierarchy' and 'organization versus environment' and the idea that organizations are (Powell, 1990, p.301):

".....structured like medieval kingdoms, walled off and protected from hostile outside forces. Instead, we find companies involved in an intricate latticework of collaborative ventures with other firms, most of whom are ostensible competitors....In market transactions the benefits to be exchanged are clearly specified, no trust is required, and agreements are bolstered by the power of legal sanction. Network forms of exchange, however, entail indefinite, sequential transactions within the context of a general pattern of interaction."

In distinguishing networks as a more useful way of conceptualizing the nature of organizational relations, he proposes that, compared to hierarchies, networks are (Powell, 1990, p.303):

".....lighter on their feet....In network modes of resource allocation, transactions occur neither through discrete exchanges nor by administrative fiat, but through networks of individuals engaged in reciprocal, preferential, mutual supportive actions.
Networks can be complex: they involve neither the explicit criteria of the market, nor the familiar paternalism of the hierarchy. The basic assumption of network relationships is that one party is dependent on resources controlled by another, and that there are gains to be had by the pooling of resources.

Certainly, supplier R&D organizations do not fit the stylized categories of Williamson - indeed they defy the attributes of the poles that he describes. Moreover, the kinds of exchange of information (informal trading) described by Von Hippel (1987) and Schrader (1990), as examples, do not fit either hierarchy, market or hybrid categories. When describing the totality of a headquarters' relationship with a subsidiary, the relationships that exist between subsidiaries or between subsidiaries and the environment, it is the qualitative and quantitative nature of the trading relationships and communication that provide more useful measures of the nature of the relationships.

Powell (1990) suggests that the network is especially appropriate for the exchange of commodities whose value is not easily measured. In particular (Powell, 1990, p.304):

"Such qualitative matters as know-how, technological capability, a particular approach or style of production, a spirit of innovation or experimentation, or a philosophy of zero defects are very hard to place a price tag on. They are not easily traded in markets nor communicated through a corporate hierarchy. The open-ended, relational features of networks, with their relative absence of explicit quid pro quo behavior, greatly enhance the ability to transmit and learn new knowledge and skills."

Such networks are not just an ideal form of organization in high technology industry. Just as they have been characteristic of craft industries for centuries, they are defining the new borders in high technology industries within and between organizations.

Powell (1990) highlights three features as being critical components of network forms: know-how, the demand for speed and trust. Know-how is usually tacit, difficult to codify and not amenable to transfer in markets or hierarchies, as the assets are highly mobile and intangible (people walk). For speed, networks may be more effective, as (Powell, 1990, p.325) explains:

"Passing information up or down a corporate hierarchy or purchasing information in the marketplace is merely a way of processing information or acquiring a commodity. In either case the flow of information is controlled. No new meanings or interpretations are generated. In contrast, networks provide a context for learning by doing. As information passes through a network, it is both freer and richer; new connections and meanings are generated, debated and evaluated."

Finally, trust is a key element of networks; when repeat trading occurs, quality becomes more important than quantity. Bradach and Eccles (1989) suggest the need to consider three control mechanisms, namely price, authority and trust - which map on to market, hierarchy and relational contracting - and to pay special attention to the way that these concepts are combined. There is little trust in the market-place outside of the network - the exchange relation is governed by contract law. Hybrid forms of organization are notorious for a lack of trust between joint venture partners (or other hybrid formats) and, even within hierarchies, trust falls victim to internal rivalries and political pressures.

Trust is a key metric of innovativeness that the Williamson (1991) framework fails to take account of. For Arrow (1974), trust is the lubricant of a social system and there have been, and are, many examples of inter-organizational networks in existence where trust, goodwill and personal obligations are the guiding principles.
Before moving onto consider the examples of US small high technology companies that were
the subject of this study, it is necessary to consider one further dimension that mediated the
relationships - that of the differing organizational capabilities and managerial approaches of
Japanese and US organizations and of the role of differences in culture at the national and
organizational levels. This is briefly addressed in the next section.

5.0 Japanese Large Firms at the International Interface

Japanese companies face especially difficult organizational challenges as they seek to
internationalize their operations, even in companies where export penetration has been a
successful strategy in recent years. Japanese MNCs operate in a home country environment
comprising a distinctive labor market and industrial relations, have very different internal
organizational structures from US companies and have a unique industrial organization set.
For this reason, it is very difficult, if not impossible, to export the internal organizational
structures that are embedded in this home country environment. Indeed, at an international
level, Japanese MNCs may be suffering as much in the current economic downturn from
problems of organizational capability as much as from global economic weakness or
particular product market factors. Bartlett and Ghoshal (1991) have identified organizational
capability as the need to manage globally, while retaining market sensitivity, innovativeness
and flexibility. This is an important challenge for Japanese MNCs.

Japanese MNCs have, in the view of Bartlett and Yoshihara (1988), until recent years, been
prisoners of their historical development and national origin. They have been able to
internationalize through export rather than foreign investment, with the help of trading
companies in the early years, and so were able to keep intact a highly culture-specific
management system. Decision and collaboration among individuals with identical values in a
carefully managed system of human resource management, reinforced by more general
social homogeneity, such as in education, were conducive to highly efficient management in
the home country. Export growth was additionally fueled by Japanese lean production
techniques (Womack, Jones and Roos, 1990) and by careful coordination of the supply chain
(Nishiguchi, 1992).

As Thurow (1992) points out, these prior strengths now present fundamental barriers to
future Japanese economic hegemony. Specifically, Thurow (1992) identifies the need for
twenty-first century managers to integrate workers from other countries into homogeneous
teams and the lack of new product innovation. He considers that Japanese MNCs are failing
along these two critical dimensions. Given the importance to the creation of new possibilities
of dense communication and ties within the MNC (between its constituent organizational
units) highlighted in the previous section, and the vulnerability of large MNCs in high
technology areas to technology discontinuities, or radical innovation (Abernathy and
Utterback, 1988), then Japanese MNCs have to try to maintain innovation in imaginative
ways if they are to maintain hegemony. The international trends that pose emerging
challenges include the reduction of minimum efficient scale due to the adoption of flexible
manufacturing processes, which facilitates a trend towards locally differentiated products.

Bartlett and Yoshihara (1988) have identified three barriers to the ability of Japanese MNCs
to respond to current global environmental trends:

- Constraints of the Japanese organization process. Specifically, the people-dependent
  and communication-intensive management processes are not easily stretched over
  barriers of time, distance, language and culture. As a result of this, top positions in
  Japanese companies abroad contain a relatively disproportionate weighting of, if not
dominance by, Japanese nationals.
Based on the employment experience of this author in a large Japanese financial services MNC, however, even more important than this is the failure of a high percentage of Japanese expatriate nationals to adapt to the environment outside of Japan. Fear and worries dominate the lives of many Japanese expatriates as they desperately try to avoid a life of ‘overseas banishment’. In order for the executives to be judged ‘fit’ to be reincorporated back into the domestic organization and into what, in all Japanese MNCs, is the main (domestic) career track, many go out of their way to show to their domestic counterparts that they have not lost any of their ‘Japanese-ness’ in management style and personality. When expatriates return to the home country, they may go to extraordinary ends to demonstrate that they have retained their Japanese ways of thinking and behaving, such is the need for internal homogeneity for career progression in the home country.

This does not create an environment outside of Japan that is conducive to recruiting locally, and retaining, first-rate international managers. Moreover, there is no opportunity for local managers to become involved in the complex, culturally-based decision processes, to build an internal network of contacts, nor to communicate intensively in Japanese (one of the world’s more difficult languages).

From the perspective of a US-based R&D organization that is owned by a Japanese parent, the internal management systems of the home country headquarters and subsidiaries are so at odds with the prevailing organizational management systems and the environment in the US that, given the need for R&D to ‘fit’ with its local environment, something other than organizational transfer from the home country or marginal adaptation of the home country system is needed.

- Limitations of the traditional strategic assumptions. The early Japanese formula of concentrating first in developing markets and meeting local demand with the more basic and mature products, delivered through local sales pipelines, worked well. Subsequently, however, the strategic roles of the overseas subsidiaries never developed in ways that enabled them to innovate locally and to become locally responsive. The headquarters-dominated strategic posture is defined by the centralized decision-making processes of the MNCs and is, as Bartlett and Yoshihara (1988, p.29) pointed out:

  ".....defended by the many vested organizational interests whose power base rested on their ability to support and control overseas operations."

- Barriers due to a management mentality that resisted change to Japanese strategies, products or organizational demands. This home country bias is easy to understand given the successful history of export-led growth and, as Bartlett and Yoshihara (1988) have noted, is embedded in the minds of the younger and mid-level managers, including technical staff, who remain convinced about the superior ‘Japanese way’. This bias was visible in the relationships that this researcher encountered between some of the offshore ‘supplier’ R&D centers and the technical staffs in Japan. Deals often seemed to have been consummated by senior management with an awareness of the demands of the new international operating environment, especially for local responsiveness. However, there seemed little understanding of this in the lower layers of management, where people who were usually responsible for implementing deals struck by senior management did not always appear to share the strategic vision that shaped the deal.

The solutions advocated by Bartlett and Yoshihara (1988) to these barriers to developing a transnational network form of organization included making the organizational system more penetrable to ‘outsiders’ and breaking off the dependency of the foreign operations on the center, so that they are able to contribute to strategy.
At a higher and more significant level, embedded differences between cultures and human relations in American and Japanese organizations remain a more fundamental and pervasive barrier to the ability of Japanese MNCs to internationalize and create distributed innovations. Despite a belief, in the 1980's, that American and Japanese management systems could be combined, such as in "Theory Z" proposed by Ouchi (1981), as Schein (1981) has pointed out, such blending ignores both the uniqueness of Japanese culture and the particular technological and environmental conditions. If Japan's management style and organizational arrangements are reflections of historical, economic, sociocultural and political factors, then the adaptation of either the American or Japanese models may be rendered ineffective by the movement away from culturally-specific, internally consistent systems. Schein (1992) has suggested that lifetime employment is based on the underlying assumption that employees are 'owned' by the company, with a consequential loss of individual liberty. It seems difficult to find a compromise on this issue.

In this author's view, change will only come about when, reversing a common prescription for more directed leadership and control, foreign operations can demonstrate that they are making an effective contribution to the global operations of the Japanese MNC. From this perspective, the priority of Japanese MNCs should be to find novel international arrangements that permit non-domestic parts of their networks to be successful, so as to earn the respect and trust of the domestic component of the organization. Governance through fiat, as presented by the market/hierarchy theorists, will not lead to change in the desired way in a Japanese 'hierarchy'. What is suggested here is that Japanese MNCs give primacy to tailoring the offshore subsidiaries so that they 'fit' their respective organizational environments, especially in the case of R&D, where the social context exerts significant influence on the local MNC-owned organization. This is explained in the next section.

6.0 Supplier R&D

The supplier R&D creation process is one of acquisition of an offshore R&D organization, followed by non-assimilation within the MNC in a formal sense. The local MNC-owned organization retains nearly all of its pre-existing management systems and internal consistency, but nevertheless develops a strong and effective relationship with the Japanese parent, to which it supplies a product in the form of R&D output. The local R&D organization remains completely isomorphic with its environment, which will include its organizational set of competitors and other environmental organizations that may not be geographically local, but with which the R&D organization has relationships. The maintenance of this isomorphism is the overriding management priority.

In the cases reported in this study, the process of creating supplier R&D organizations has been through acquisition as a means of buying into a set of local environmental relations and skills, rather than a set of transactions. In mergers and acquisitions terminology, the acquirer is buying significant goodwill over and above the cash flow of the R&D unit, although the price paid may not reflect the value of the supplier R&D organization to the MNC, given the ability of the MNC to leverage its new subsidiary's relations throughout its network in future years. There is no reason why a supplier R&D organization could not be established as a new venture, although this may be harder to achieve, given the difficulty of restricting the imposition of MNC home country organization systems of management, routines and norms in such circumstances.

To understand the supplier R&D relationships means moving beyond what is an overly theory-laden definition of a hierarchical relationship based on fiat as the main control mechanism. By concentrating on the phenomenon, it is possible to reconceptualize the relations both within MNC organizational units, and between MNC units and the organizational environment, in terms of primarily relational networks that are socially and
economically defined. From this perspective, dense and complex local environmental ties, with considerable local power, do not necessarily imply that there are weak ties to other parts of the MNC: one does not come at the expense of the other or imply that the power of the headquarters is necessarily weak.

The explanation for this is that the main governing system is not part of a set of narrowly conceived control mechanisms, such as fiat or contract law, but is based on mutual trust and respect. As the more autonomous, effective and higher performing supplier R&D unit gains confidence, respect and trust within the MNC, so it is this that acts to enhance relations across the intraorganizational network. It is no more than an extension of the commonsense observation that, if you are good and effective at your job, people want to talk to you and work with you. So, the relationship between the density of external linkages to the environment and interorganizational communication within the MNC is not necessarily inverse.

Of the offshore 'supplier R&D' centers described, two are owned by Fujitsu Ltd. and two by Toshiba Corporation. One of the Toshiba Corporation centers, Toshiba America MRI, Inc. is described as illustrative of the results of cross-cultural hierarchical assimilation and it has been included as its contrast with the experience of Vertex Semiconductor shows how Japanese management has begun to pay special attention to the need not to impose Japanese management styles on localized operations, or even to 'blend' systems.

Finally, the term supplier R&D should not be confused with the supplier relationships that exist within large Japanese industrial groups in Japan. In those cases, there is usually only a minority shareholding in the supplier organization by the consumer organization and the supplier may have incorporated significant structures and processes from the buyer. In the Japanese situation, there is more direct control over the pyramid of supplier organizations from the apex. One similarity with the Japanese pyramid supplier, however, is that the resource flow is not only one way (from US subsidiary to Japanese parent). As the US-based R&D suppliers of Japanese MNC's gain in legitimacy across the MNC organizational network, so they receive (are 'supplied to') communications and resources that assist in the more effective conduct of their research and development tasks.

In discussing the supplier R&D organizations, by way of a brief background, some general information is provided on the two owning MNCs, Fujitsu Ltd. and Toshiba Corporation.

7.0 Fujitsu Ltd.: US Supplier R&D

7.1 Company Description and Activities

Fujitsu was established in Japan in 1935, although its origins go back to 1875 and Furukawa Co., Ltd., which was primarily focused on copper mining. It remains, today, part of the Furukawa Group of companies, which comprise 44 companies in total and include The Dai-Ichi Kangyo Bank, Ltd., Asahi Mutual Life Insurance and Fuji Electric Company, Ltd.

Fujitsu's businesses revolve around interlinked technologies in three main areas, technologies that fuel the product ranges that Fujitsu is developing and marketing at any point in time. Firstly, in computers and information processing systems (69% of 1991 sales), Fujitsu is a producer of supercomputers, general purpose computers, office processors, workstations, personal computers, Japanese word processors, peripherals and terminals. Secondly, in telecommunications (15% of 1991 sales), Fujitsu manufactures switching systems, telephones and submarine, fiber optic, radio and satellite transmission systems. Finally, in electronic devices (4% of 1991 sales), Fujitsu's products include compound
semiconductor devices, integrated circuits, microcomputers, keyboards, connectors and relays.

Fujitsu first entered the US by setting up an office in New York in 1967, which was followed by the establishment of Fujitsu California Inc. in 1968. Fujitsu currently operates an extensive global network of business operations and its US operations are divided between those that report directly to an American holding company and those that report directly to the operating divisions in Japan.

The US holding company is primarily responsible for bringing together the technologically more mature, revenue-generating parts of the organization. This division achieves three purposes: first, it facilitates greater market coordination across existing product lines, second, it protects the US operation from the negative cash-flow of younger businesses and, third, the removal of the US holding company filter for newer businesses enhances communication between Japan and the US where technology and product development is occurring.

In Japan, Fujitsu's corporate R&D is focused through a special purpose company called Fujitsu Laboratories Ltd. Fujitsu Laboratories was established in 1968 through a merger of R&D sections previously managed by separate technical divisions. Initially based at Kawasaki, a second location, at Atsugi, was established in 1983. Currently, some 1500 employees come under the Fujitsu Laboratories umbrella, of which 57% are based at Atsugi. The division of R&D responsibility is that Kawasaki contains the Communication and Space Division, the Information Processing Division, the Personal Systems Division and the Information Processing Center. Atsugi contains the Electron Devices Division, The Electronic Systems Division and the Materials Division. The largest R&D area, involving some 27% of Fujitsu Laboratories' employees, is in electronic devices, at Atsugi, followed by 21% in information processing at Kawasaki. All basic and most applied research is conducted at the corporate level in Fujitsu Laboratories, with development work left to the divisions or shared between the corporate and divisional levels of the organization.

In the US, Fujitsu's business has grown through the main business divisions in Japan setting up local (US) operations. Exceptions to this include Fujitsu's 44% ownership of Amdahl Corporation and its acquisition of Poqet Computer Corporation, both of which contain R&D functional operations.

In addition to this, Fujitsu has acquired two US companies outright (100% equity ownership) that bring to Fujitsu primarily US-based R&D capabilities. These are Open System Solutions, Inc. and Intellistor, Inc. (incorporated within Fujitsu Computer Products of America, Inc.). To gain a clear understanding of the significance of this new form of offshore R&D sourcing, each of these Companies is examined in more detail. Despite their position, by ownership, in the Fujitsu hierarchy, both companies are more like R&D suppliers working under strict contractual conditions for the parent company in Japan.

7.2 Open Systems Solutions, Inc.

The main activity of Open System Solutions, Inc. ("OSSI") is in computer software development. OSSI was acquired by Fujitsu Limited in August 1991 for $2.3 million and is run by Fujitsu as a captive R&D organization that is wholly concerned with R&D in the area of software operating systems and some basic applications. OSSI was known as Unisoft Corporation before the Fujitsu acquisition. It's acquisition was related to the strategic decision by Fujitsu to move from its own proprietary operating system in computer software to follow the emerging world standard for large computers i.e. to an 'open system'.
Fujitsu had already announced, in August 1990, UXP/M, the world's first operating system for mainframes and supercomputers that complied with UNIX System V Release 4, the international standard for the next generation. Work on both this operating system and application packages are being used to expand the use of UNIX systems, ported in Fujitsu centers in Japan and in the US. The work of OSSI is oriented to generating generic SPARC UNIX implementation for System V Release 4.

UNIX is owned mainly through AT&T through its substantial shareholding in USL and it is representative of an emerging standard in computer software operating systems for minicomputers and upwards based on the UNIX system. Standardization creates better connectivity among computer systems and more revenues for those that follow the standard. Continuing refinements are made to UNIX, such as Enhanced Security Desk Top, the latest version.

The US is, therefore, the strategically critical location in this product area; it is in the US where all the UNIX industry associations and skilled engineers are to be found. OSSI, therefore, represents Fujitsu on a number of UNIX and SPARC international coordination committees. In computer software, all applications - such as graphics - also have to be made to international and industry standards.

Unlike some other US subsidiaries of Japanese MNC's, the task of the OSSI is to develop technology that will be sold globally - some of its developed products are, for example, already being sold in Japan. It operates as a service company to Fujitsu, working on a contract basis with Japan. R&D is on a project by project basis under contract from Japan. The work done by OSSI is part of the strategy of Fujitsu to source from outside Japan its software technology. In this situation, OSSI works closely with the Fujitsu majority-owned ICL in the UK. ICL is responsible for the Enhanced Security portion of the system and OSSI for the Desk Top portion.

OSSI is part of the "Open Systems Group" at Fujitsu, which has locations at Kawasaki, Aichi and Minami Machide in Japan. This Group has various sub-groups, such as for UNIX development, which collectively represent the range of systems necessary for open systems porting. The head of Open Systems Group in Japan subsequently became President of OSSI.

The budget and financial planning at OSSI are prepared annually and the Company employs 20 software engineers and 10 support staff. It was said to be in the nature of the business that there are very few Ph.D. employees, since work experience is more important.

The founder and head of OSSI, who had spent five years working in Japan, observed that the difference between Japanese and US engineers is primarily in methodology. Japanese engineers are more company-oriented than people-oriented and there is, therefore, a problem of interaction between them.

In cross-border project management, communication was the biggest issue confronting OSSI. The problem is one of distance and of cross-cultural understanding. It was noted that the Japanese do not easily or immediately say what they are thinking and some interpretation was inevitable. In addition, the junior staff rarely spoke up and so it was difficult to build relationships at the lower levels. In contrast, US engineers are used to interaction. The main effect that this had on OSSI's operations was to 'force [them] to be more concrete ahead of time'. There was a single Japanese Executive Vice President at the local operation, but this was not an answer to building better horizontal communication between engineers on a project basis. OSSI was operating a system of inviting assignees to its operations in an
attempt to try to overcome this. In addition, weekly meetings were held from the parent's video teleconferencing center, some 40 miles distant from OSSI itself.

In terms of other differences between the engineers, it was noted that whilst Japanese engineers are very good in their specialty areas, they are slower. This reinforced a common theme of higher cost, but higher productivity R&D in the US. It was pointed out that, although the cost of a US engineer may be twice that of a Japanese engineer, if the job is done in half the time in the US, there is actually no additional cost. R&D in the US has much higher productivity than in Japan.

The feeling of OSSI was that, notwithstanding the shortage of suitably qualified engineers in Japan and the fact that Japan, in many areas, lags the rest of the world in the development of standardization, Japanese companies would not ever locate offshore significant R&D for reasons of pride. Fujitsu had a lot of software facilities in Japan and OSSI was the exception rather than the rule. Neither could OSSI ever become an insider in the Fujitsu system; it would continue to develop useful products, but outside the system. Moreover, the US advantage in software development was explained as having developed for cultural reasons. At the time, software development was still an art. The observation was made that, as advances were made toward the development of more advanced fifth and sixth generation languages, so software development would become more of a science. As this happens, so the US would lose its competitive edge in software development.

At Fujitsu's headquarters, the justification for OSSI was explained as follows:

"I think that, as a general trend, Fujitsu will try to distribute development centers worldwide and that is happening. For instance, in OSSI's case, Fujitsu has been developing a Fujitsu proprietary system in the past, not an open system. So that means that we have limited engineering capability in the UNIX area. Of course today we have some skilled UNIX engineers in the Fujitsu organization, but still the number of skilled UNIX engineers is very small in the Fujitsu organization. We can get many skilled UNIX engineers in the US, so rather than train new hires in Japan in the UNIX area - which is very common (graduates from universities) in Japan - we can catch up very quickly by establishing a company like OSSI and meet users' requirements for an open system. Probably, that trend will continue for the next ten years or so."

Of particular interest regarding OSSI were the following observations:

(i) OSSI had been acquired specifically to supply certain (software) technologies to the Japan MNC and to other organizations in the MNC network, such as ICL in the UK. For Fujitsu, OSSI offered the chance to become a local insider through indirect representation on the UNIX and SPARC coordination committees. Additional reasons included, most significantly, the need for skilled labor that was not available in the home country, partly because of the emerging trend towards open systems computing. Acquisition of the Company had also been to save time, or to catch up in the move to an open system in software development. There was limited in-house experience in Fujitsu Japan in the UNIX operating environment and the related standards' organizations were based in the US. The US organization was supplying a skill that had a unique value to Fujitsu; it had dense ties to the local (US) environment.

(ii) Partly for this reason, there was no attempt by Fujitsu to interfere in management of the local operation. Perhaps to reinforce this, the physical location of OSSI, at some distance from the other Fujitsu operations in Silicon Valley, had been kept after the August 1991 acquisition. Whilst the President of OSSI was from the headquarters in Japan, his was not a significant operational role. For the US employees, it was as
though this was a US company that just happened to have an important Japanese client. There was no 'Fujitsu' sign anywhere on the premises.

(iii) The contract form of work was similar to that used with other corporate acquisitions, including Intellistor, Inc., part of Fujitsu Computer Products of America, Inc., described below. Moreover, the overall management mechanism of OSSi by the MNC parent was hardly fiat, as defined by transaction cost economics' theory. The Executive Vice President and Chief Operating Officer of OSSi was on the relevant industry standards' committees and controlled these critical linkages for Fujitsu. Moreover, the special skills of OSSi and the part that it was playing in the transition of Fujitsu to open systems computing were consistent with the considerable local autonomy and power that were observed. Hierarchical authority coexisted with this strong local autonomy and 'fiat' as the dominant, or even a partial, control mechanism did not exist. The power of OSSi was related to its dense ties to its environment and to other parts of the Fujitsu network, such as ICL; these relationships are not adequately taken account of in transaction cost economics.

(iv) Communication problems arose for three reasons. Firstly, it was noted that Japanese were less people- and more company-oriented. Secondly, there was a noted tendency of Japanese researchers not to say what they think - something that Americans are very good at. Finally, the junior Japanese staff would say almost nothing, making working relations difficult to develop horizontally between researchers. These are structural differences that are deeply embedded in the Japanese and US cultural systems. In other supplier R&D situations, such as that of Vertex Semiconductor described below, these problems were being overcome. OSSi had completed a number of contracts for Fujitsu and was trying to develop boundary spanning behaviors that would improve communication without compromising on the two (Japanese and US) internally consistent systems.

(v) In terms of local hiring practices, there was a strong preference for people who had a professionally relevant qualification, but experience was said to be more important. In OSSi's area, Japanese engineers were not so expensive to hire, but were probably not as efficient in working, so the cost advantage may actually still lie with the US.

(vi) Whilst the US had a clear advantage in software development for a variety of reasons, including language, as sixth generation programming languages are developed and programming becomes more of a science, so the US advantage was projected to diminish. In these circumstances, it is not clear that an acquisition such as OSSi would be made.

7.3 Intellistor, Inc.

Intellistor, Inc. was incorporated within Fujitsu Computer Products of America, Inc. ("FCPA"), one of two subsidiaries created in the second half of 1991, as part of a major reorganization of Fujitsu America, Inc., the holding company for Fujitsu Ltd.'s computer and telecommunication subsidiaries in the US. The reorganization was designed to create greater autonomy and customer responsiveness within the individual product groups. FCPA contained Fujitsu's computer peripherals business in the US and had 1,100 employees in total. FCPA was actively involved in global R&D projects in areas such as disk and tape drive products. Senior management cited, as an example, the 2.5 inch disk drive and high-speed controllers for the two-gigabyte Winchester Drives that had been co-developed by FCPA's Intellistor subsidiary in Longmont (CO) product development center with its counterpart in Japan, at Yamagata research center. The 2.5 inch disk drive co-developed by
Intellistor in Longmont was used in Fujitsu laptop and notebook computers with up to 90 megabytes of storage. At 17 millimeters high, it was the most compact in its class and used proprietary power management technology to maximize computer battery life. A key part of FCPA was based at Longmont, Colorado, and provides a good example of an acquisition of an offshore R&D facility by a Japanese MNC.

The American founder of Intellistor, currently the President of FCPA, had graduated originally from the University of Colorado in 1968, with a Degree in electrical engineering. He then joined IBM in the Longmont area, before founding Intellistor in a spin-off in 1983. There were other IBM spin-off companies, such as Storage Technology, in the area. Intellistor had started with $0.5 million of capital and had raised $3 million in March 1984. Its products developed were two products that would enable IBM system computers to do an automatic back-up and restore without interrupting the CPU cycles (which were precious then). There was an 18-month development cycle and the product was distributed through OEM channels, including Memorex and Olivetti. However, this was a complex system-level sell which IBM had not been in favor of, as it preferred to sell more CPU’s. In the first year, sales were only $8 million compared to a projected $18 million, so the staff was cut from 130 to 45 (all the non-engineers were laid off) and Intellistor sought contract product development work for other companies. Included in this round of visits was the VP in charge of R&D planning at Fujitsu.

In March 1985, Fujitsu had visited the facility in Longmont and, in November 1985, it returned and asked if Intellistor would like to negotiate a development contract to develop a high performance disk controller. Intellistor was given $250,000 to do a feasibility study and, three months later, had converted this into a $3,000,000 development contract (early 1986). Later that year, Intellistor was given a development contract for VLSI chips and for a new interface for tape subsystems.

Then, on November 23, 1986, Fujitsu acquired the company as its only offshore computer peripherals' development center. Intellistor’s founder had previously tried to sell the Company, but none of the offers interested the venture capital backers (e.g. they were share deals not cash). For Fujitsu, the acquisition complemented its existing skill set, gave them an IBM compatible design, human resources and visibility. For Intellistor, the deal gave it resources for product customization, so that it could move from just assembly to full service work.

Currently, Intellistor’s founder reports formally, as President and CEO of FCPA, to a Director of Fujitsu Ltd. in Japan who is the General Manager of the worldwide OEM business of Fujitsu. However, the real power - and the "real" boss - is the General Manager of the Information Processing Devices Group of Fujitsu Limited in Japan.

The creation of FCPA brought together marketing and sales, manufacturing liaison and engineering (run by a Japanese executive) that controlled a manufacturing facility at Hillsboro in Oregon, human resources and Intellistor. Intellistor had separate links to Fujitsu Microelectronics, Inc., from which it got its chips. Only the head of the manufacturing liaison and engineering group and the CFO of FCPA were Japanese executives. The feeling of the President of FCPA was that greater integration within the US meant that FCPA could give a better service to a customer, rather than having, for example, sales reporting direct to Japan. This form of organization was more conducive to serving customers. This was contrary to the view that had been expressed by a senior Japanese executive within the Fujitsu organization, who had seen the reorganization as causing greater direct links between the divisions in Japan and their US units. It is probable that the new American companies existed supposedly to coordinate, but that their powers to interfere in the day-to-day operations of the subsidiary companies was limited.
Although Intellistor had no Japanese name and no Japanese culture or management practices, it was 100% owned by Fujitsu America. It became, in 1989, the MNC's main disk drive device (meaning electro-mechanical) R&D center. Of the 180 employees, 150 of these were in engineering and 95% of these were in product development work, with the remaining 5% in research. There were many engineers with Masters degrees and only two with Ph.D.'s.

Intellistor's activity could be best described as "advanced directed development". A typical task might involve being asked to develop a product, with some technology transfer from Japan, and then to develop say between 50 and 700 units at Intellistor, to show that production was feasible.

Speaking at the Media and Storage Conference in January, 1992, the President of FCPA noted that, in his view, it was the responsibility of the individual subsidiaries to customize products for local market consumption and commercial applications. Today's business users wanted "solutions not simply products", he noted. In recognition of a more sophisticated user community, FCPA specialized in value-added technology solutions, such as tape drives bundled with software drivers for Sun Workstations and printers customized with utilities.

It was considered that solution-specific products required a diversified, value-added distribution strategy, such that FCPA was partnering with VAR's, customers and suppliers in key markets, providing additional technical support through a quality reseller program and teaming with other manufacturers to provide total system solutions. Some joint work was carried out by Intellistor, such as with the peripheral products division of Unisys.

Performance was measured by the ability to get projects done on budget and on time. The working arrangements with Fujitsu were that Intellistor was paid a cost sum, plus a 5% profit or success bonus, under contractual arrangements that were of a market/commercial form. Within this overall constraint, Intellistor, Inc. worked to its own schedules entirely.

At the time, Intellistor was moving from an entitlement-based system of remuneration to an "earned"-based system and one that stressed more team effort. It was observed that there was insufficient (negligible) difference between development teams that brought projects in on budget in on time and those that did not. In terms of recruiting, Intellistor had a tremendous local network and mainly recruited by word of mouth. The founder of Intellistor and President of FCPA felt that he was as high as he would ever go in Fujitsu.

Provided Intellistor was on budget, it was considered that Intellistor would retain complete autonomy. There were only four Japanese staff based at Longmont - two to assist on design and two to help in communicating. There were currently five Intellistor engineers in Yamagata in Japan, working on a hand-off. There were no Japanese managers in Intellistor and never had been during the five years that it had been a Japanese subsidiary.

Intellistor was definitely aware of some of the "Not Invented Here" syndrome (Allen, 1977) in joint projects, especially in the hand-off stage as was now occurring at the Yamagata factory in Japan. Typically, it showed itself by one of the receiving team saying: 'I would have done it this way and used this supplier'. The Yamagata engineers came over before a small slip in the development program occurred, but they should have come over from the inception of the program. Intellistor has put its own people in Yamagata and found it is hard for them to become integrated. Moreover, in joint development, in the event of delay, it was Fujitsu who held the hammer. Who was the cause of the delay? It was easy to blame an outpost which had no voice with which to fight back.

Intellistor's considered that its main achievement to date had been having secured recognition by Fujitsu as a top-notch development organization. Fujitsu was, it was
considered, getting a significant return on its investment. A significant element of the value of Intellistor to Fujitsu was its employees (intangibles) and only one person had left because he did not want to work with 'the Japanese'. Intellistor had developed several products that had made Fujitsu significant revenue, such as small-form factory tape, advanced VLSI circuits and it was now pioneering an array disk technology for Fujitsu. It developed a firmware simulator in software - a technique that saves schedule time and manpower. This was transferred to Japan.

Intellistor, Inc. and Fujitsu in Japan were still learning how to communicate. At the level of top management, communication was considered to be satisfactory, perhaps because of the longevity of the relationship between the founder of Intellistor, Inc. and Fujitsu and because this relationship was at the level of the (more senior) executives that had consummated the deal with Intellistor, Inc.

However, communication was more difficult at the layer of mid-manager, where the engineers were frequently too busy to communicate. There was a problem, therefore, at the level of project manager, where communication was poor. It was definitely felt that it would have helped a great deal if the American researchers had been able to speak Japanese. Intellistor had two main divisions with direct counterparts in Fujitsu Laboratories at Kawasaki, Japan. Intellistor's Systems Division liaised with the File Systems Division of Kawasaki and the Disk Division liaised with the Small Devices Division in Japan. To try to improve communication, every three months, the teams from each would get together for three days to discuss progress on joint projects.

For the purposes of the current discussion, the following points were of significance:

(i) The relationship of Intellistor, Inc. to the main parent in Japan was formalized through project development contracts that were strictly adhered to. The contracts contained the usual commercial penalties for late delivery. The relationship at a working level was, therefore, similar to that which might be expected in a market relationship rather than in a wholly-owned subsidiary company. This was an arrangement that seemed to suit the seemingly irreconcilable needs of Fujitsu to protect against technology 'leakage' from Intellistor, Inc. and not to disrupt the home country (Japan) corporate hierarchy by suddenly bringing in and legitimizing an outside supplier, even though it was at the leading edge in its area.

(ii) Intellistor was an example of an offshore subsidiary involved exclusively in product development work. The facility had been acquired by Fujitsu and had retained its autonomy intact. There had been no attempt to blend cultures and there were none of the problems of having two cultural systems operating side by side as occurred in more home-grown offshore R&D centers. The only change to Intellistor's operations from the time of the Fujitsu acquisition had been to guarantee and alter the form of contract work. It seemed that, having invested in an American product development operation, Fujitsu had realized that, to protect its investment, it should not interfere in the organization's affairs. However, it was considered that this would continue only as long as Intellistor continued to bring in projects on budget and on time. Non-interference by the Japanese parent was seen as the main objective and motivation in getting contracts completed on budget and on time.

(iii) Intellistor was an offshore Japanese-owned R&D center with no Japanese name, management practices or culture. It was only at the level of joint project development with Japan that the absence of any attempt to integrate the organization and cultures had been a problem. However, this had not prevented Intellistor from becoming a 'top
notch' development operation and its performance as adjudged by Japan had been satisfactory, one measure of which was the total absence of any Japanese managers.

(iv) In joint work, to avoid the 'Not Invented Here' problem, Intellistor, Inc. considered that, in future, internal customers involved in a hand off, should be involved at the beginning of a project. This would also reduce the chance of criticism if a project was not on time.

(v) The experience of Intellistor, Inc. emphasized that, in any acquisition, the real challenge is not so much in the agreement of terms and the conclusion of the deal, but that success or failure results from the extent that middle managers and project engineers are able to communicate with their counterparts in the parent/subsidiary company.

In this case, the Japanese did not automatically accept the acquired company into the Fujitsu family. Rather, even though the senior executives at Fujitsu had done the deal, at a lower level in the organization, credibility could only be earned. In part, this is inevitable where acquisition of offshore R&D is for reasons of skill shortage in Japan rather than for any reason of decentralization. Loss of face, jealousy and other feelings are bound to show.

(vi) Intellistor was working with different parts of Fujitsu in Japan under different contractual arrangements. There was, in short, no unique home country headquarters in the sense of being able to manage by fiat even if this was possible. Rather, under its various contractual obligations to different parts of Fujitsu in Japan, Intellistor was entrenched in relations to different parts of a network. For Intellistor, Fujitsu Japan was a set of relationships that crossed different levels rather than a single source of control by fiat.

8.0 Toshiba Corporation: US Supplier R&D

8.1 Company Description and Activities

Toshiba Corporation is the second largest diversified electrical machinery maker in Japan. In 1991, 50% of its net sales came from information/communication systems and electronic devices, 20% from heavy electrical apparatus and 30% from consumer products and other business activities. Toshiba is part of the Mitsui Group of companies.

The information/communication systems and electronic devices businesses include information processing equipment and systems, telecommunications equipment, medical systems, semiconductors, electron tubes and other electronic components. The heavy electrical apparatus businesses include those related to power plant systems, industrial electrical apparatuses, transportation equipment and machinery. The consumer products and other businesses include video products, audio products, household products, lighting equipment and materials. Over the past four years, the contribution of information/communication systems and electronic devices to sales risen from 41% to 50%.

Toshiba's US operations come under the umbrella of Toshiba America, Inc., which is the holding company for five independent subsidiaries in the US and coordinates the companies' overall business operations. The five companies contain a number of subsidiaries and, for historic reasons, Toshiba America, Inc. also owns some smaller subsidiaries directly:

Toshiba's R&D is divided into three layers, according to the time horizon of the research before the technology or product is expected to get to market. At the highest level are the corporate laboratories in Japan, with a research time horizon of between three and ten years. The next layer of research center comprises the group laboratories, which belong to the 11
groups around which Toshiba's businesses are organized. Their time horizon is between one and three years. Thereafter, each group is split into a number of divisions, and each division has R&D facilities with a time horizon of less than a year.

Toshiba does not have a very significant R&D presence in the US. However, the two facilities that this researcher was able to visit were acquisitions of previously independent US companies and there is evidence to suggest that the main drive of Toshiba's R&D offshore has been through such other hybrid (between market and hierarchy) alliances, including non-equity alliances with GE and Siemens.

Some evidence of R&D within the US was the June 1991 announcement of a new PBX system, designed through a joint Japan/US R&D effort. This, the 'Perception 4000', was hailed as the result of a major R&D effort outside the US. The research facility from which this came is reported to have been established in Irvine, California, in 1985, and to have grown to some 150 employees. Its division of labor is that the American engineers worked on software, or programming instructions, while the Japanese engineers developed hardware, or the electronic innards of the telephone system.

One of the reasons that Toshiba has been relatively slow to locate R&D in the US is the view held in Japan, widely reported in the press, that Japanese engineers could design products for any market. There appears to have been a battle between a conservative faction within Toshiba in Japan and its chief representative in the US, Mr. Kiichi Hataya. On January 14, 1991, the Orange County Business Journal reported that Mr. Hataya was fighting in Japan to give his Toshiba unit in the US more autonomy. He admitted that:

"In R&D, we have a big argument with Japan."

Mr. Hataya's case was that, without its own R&D staff, the US division would never realize its full potential. He stressed the importance of researchers being close to the US manufacturing process and to local markets. Moreover, he considered that Toshiba could benefit from areas in which US research is considered to be ahead of Japan's, such as in software development.

On May 26, 1991, The Washington Post published a contrasting account of the R&D of Toshiba in the US and of Thomson, the French engineering and consumer products company. It was reported that:

"By far the biggest contrast between Toshiba and Thomson in the United States is their drastically different commitment to local research and development. Thomson has some 350 engineers working in a TV research facility in Indianapolis. Their jobs include designing circuitry in semiconductor chips, trying to improve manufacturing efficiency, styling cabinets and deciding on the number of buttons to put on remote channel hangers.

Toshiba does that mainly in Japan. Its US design staff consists only of half a dozen people who make cosmetic changes to designs created in Japan. One of their jobs is restyling Japanese models to fit American tastes, which include a partiality to wood instead of plastic casements."

The same article reported that Toshiba was setting up a laboratory in New Jersey, to employ 15-20 people, which would have as its main purpose the tracking of technical standards and American developments in HDTV.
Toshiba has, however, created a US R&D capability through acquisition. As with Fujitsu, the operations are ultimately 100% owned by the parent in Japan and the R&D work is carried out under contract in a similar manner to a market operation. Of the two examples considered, the first, Toshiba America MRI, Inc., is an example of an unfortunate attempt to integrate what was a successful high technology medical devices' company into the Toshiba corporate network. It represents a first generation attempt to internationalize R&D by acquisition and assimilation with Japan. In the second case, with Vertex Semiconductor, the new approach to handling internal offshore R&D ('supplier R&D') is outlined.

8.2 Toshiba America MRI, Inc.

Toshiba America MRI, Inc. ("TAMI") was once the magnetic resonance imaging division of Milpitas-based Diasonics Corporation, a medical equipment company. In March 1989, Toshiba Corporation acquired it for a price of $167.5 million. In addition, Toshiba assumed $22.5 million of Diasonics' debt. At the time, Diasonics, which is reported to have sold the unit because it foresaw stiff competition from bigger firms such as GE Medical Systems of Milwaukee, Siemens Medical Systems of West Germany and Philips Medical Systems of Holland, announced its intention to focus on developing its other existing ultrasound, X-ray and lithotripsy technology. Diasonics stock is still traded on NASDAQ. In its last year of ownership by Diasonics, its MRI unit had generated about 40% of Diasonics' $300 million in sales.

Medical resonance imaging ("MRI") makes it easier to see inside a person's body without radiation, chemical dyes or surgery. Instead of radiation, MRI uses a massive magnet and FM radio frequencies to produce extremely accurate, high contrast images - especially in soft tissue - which before could only be imaged in rougher forms by passing radiation through them - as in a CAT scan - or bouncing waves off them. The powerful magnetic field around the patient forces hydrogen atoms to align. A burst of radio waves then causes the hydrogen to "relax". When the atoms realign, they emit their own radio signals, an echo, as they move. Measuring the echo and digitalizing the information leads to detailed pictures of what's going on inside a body. The price of a magnet ranges from $1 million to $2 million, depending on its power. The only synergy with other areas of Toshiba's business was the magnet - and the magnet that was used by Diasonics came from Sumitomo. The new one came from Toshiba.

Following the acquisition, there was a disagreement between Diasonics and Toshiba relating to accounting aspects of the acquisition, following which Toshiba paid an additional $13.5 million to Diasonics. After the acquisition, Toshiba restructured its US medical operations. Essentially, all marketing, sales and service activities at the new TAMI were made part of the immediate parent, Toshiba America Medical Systems, Inc. ("TAMS"), leaving TAMI as solely a manufacturing, engineering and R&D Company. TAMS was Toshiba's US-based existing manufacturer of X-ray diagnostic equipment and MRI systems. Since TAMS is based in Tustin, south of Los Angeles, the manufacturing and engineering functions of TAMI are separated from the sales, marketing and service functions at TAMS by firstly, geographic distance (some 450+ miles) and by an inevitable political situation arising where the sales force of a company (TAMS) with an inferior product is asked to sell the successful product of a newly acquired company (TAMI), previously a competitor.

"The Japanese think, I gather, that splitting a company up and putting engineering and manufacturing in one area and marketing in another......but nobody here has ever worked with a company split that way before. The people in southern California didn't want the purchase, didn't like the people. We were competitors up here. So, there has been antagonism all along between the two. They were handed more products to sell that they didn't like and the transfer price is the key to whole business. They used to get a transfer price directly from Japan. Now, the product comes from here
and they get a transfer price from us that is higher than they used to get before. So, from their point of view, their business has gone to hell. Down there there are one or two Japanese at the top and the rest are Americans."

In effect, what Toshiba was trying to do was to use the sales force from its existing (less successful) MRI unit to sell the superior product of the newly acquired TAMI. So, the marketing and sales units were responsible for selling both the MRI systems of the newly acquired company and the old (inferior) systems. The success of this strategy might be measured from the April 1991 announcement of 39 manufacturing and engineering layoffs at TAMI's South San Francisco unit. The result of the acquisition and the division of responsibilities between the two companies was described as follows:

"Toshiba had two versions of the product; Diasonics had two versions. Now Toshiba has four versions that they are selling except one they have stopped manufacturing. So we have got all of the problems of one company buying a competitor, merging product lines and confusion and politics. The whole shooting match has been going on since I have been here."

After the acquisition by Toshiba, all the Diasonics executives had left the Company except for the head of manufacturing. They were not replaced as the functions were absorbed by the TAMS headquarters in Tustin. At the time of this research, only the President and the head of finance at TAMI had come from Japan.

There were 110 engineers at TAMI and 110 other employees. The latter included 50 manufacturing employees (which was reducing) as well as the finance, human resources and the management information systems groups. Of the 110 engineers, 12 were involved in early stage development work that was not directly related to products and 12 were 'sustaining' - at the other end of the spectrum i.e. fixing problems in existing products (patching software bugs etc.). The remainder were involved in developing and engineering new products, refining existing technology - what was described as hard-core engineering activity: trying to make it cheaper and better. There were approximately between ten and eleven Ph.D.'s - mostly in physics - and they were all scientists. Of the balance, only ten were Master's degree holders and the rest, the bulk, were first degree holders only.

As mentioned above, there were only two or three people out of the 110 from Toshiba in Japan. Communication was facilitated with Japan by people going back and forth, rather than by a system of assignees.

At the time of the acquisition of the Company by Toshiba, both Toshiba and the former Diasonics' MRI unit were both developing new generation products (new computer hardware and software). Now it had become a common effort between the engineering team in Nasu, Japan, Toshiba's central medical research facility, and the engineering team at TAMI. The business is part of the medical systems division of Toshiba.

The users of the products in the US had a different set of requirements than the users in Japan. US users demanded high image quality whereas, in Japan, the driver is cost. The result was different specifications for each market. For example, in user interfacing, the Japanese wanted only old-fashioned user interfaces, whereas the US buyers wanted mouse-driven kinds of interfaces. The US market requirements were more stringent and forward looking. If the system performance met US product performance requirements, it fitted in Japan easily. On the other hand, the product that had been developed in Japan did not meet the market requirements in the US. In terms of joint product development:
"We have a work sharing program and we spend time talking about how we are going to share the engineering work. How it is broken out right now is that the group here does software, systems integration and some electronics work. The group there does electronics and mechanical development and they build the hardware. The Japanese look upon the US as being some of the best software and systems people and they are trying to take advantage of that."

At TAMI, the President was fairly high in the MRI business and was fairly strong and so he kept control of budgets at South San Francisco. A new budget was made every six months and yearly and fitted in with a three-year mid-term plan; it had to be approved by Japan. TAMI was working on a new generation product that even the President of the main Company was aware of. It had such strategic importance that the budget for it was not touched. That was the main mission of the facility - Japan had assigned it to the unit to help build it. TAMI was still, nevertheless, under pressure to make a profit. It was, therefore, in the process of downsizing, as existing products were not selling out of Tustin. All of the revenue at TAMI came from transferring the product to Tustin. So, there was no sense of TAMI being an independent company - it was more of an engineering and manufacturing function.

The funding of the engineering function was that a check was sent over from Nasu in Japan. The figure was arrived at through very complex negotiations.

The Japanese parent measured performance mainly by the engineering product, such as designs, prototypes, and so on. At any one time, the engineering function would have a portfolio of projects in hand; at the time of the visit, it was 28. Performance was assessed against each engineer by objective deliverables.

Another element to the operation was the University of California. Diasonics was described as a small, fast-moving company, so when the new (MRI) technology came along 10 years' ago, it paid a University of California at San Francisco ("UCSF") research group - the Radiological Imaging Laboratories - to develop its product for it. There were about 30 people there. Diasonics, therefore, had a strong UCSF-based team, just one mile away. UCSF was responsible for developing the technology to the prototype stage and then the Diasonics group would manufacture it. Toshiba in Japan contracted with the same group, transferred their technology and bought their patents, so the Japan-based group got a lot of technology from UCSF. That was before the acquisition of Diasonics MRI unit and with the knowledge of Diasonics, who got paid for it.

After the merger, the UCSF laboratories still existed and, out of the 110 people, 13 were stationed at UCSF as part of that team and 14 more people, who were UCSF employees, were all working on the new generation MRI technology. Most of TAMI's scientists were stationed at UCSF.

"The one thing that Toshiba considered and that they did not want to lose was that lab. They placed a lot of importance on the people up there. That is their brain trust. That is another thing that they want to hang on to at all costs: the UC scientists... They look upon it as, and list it as, one of their research labs in this medical business."

Toshiba's medical division also funded, out of Tokyo, the National Magnet Laboratory at MIT, with a small donation, but there were no other strategic alliances in the medical business.

There was no formal competitive benchmarking and the engineering function was trying to do more of this as it was not getting the feedback from marketing; yet its products were not
selling in the US, although they were selling well in Japan. The engineers had no idea if it was a performance issue or due to some other reason:

"I was in the same business when I was in Technicare. I lived with the marketing guys and I lived with the sales guys when I was in engineering. They were constantly giving me feedback about what was and wasn't needed. Yet here, there is no interaction. There are some of the old marketing people here from the old Diasonics, but they have been suffering through attrition."

Being a Japanese company had made no difference to the operation.

There was no recruitment strategy as such, but TAMI was always looking for good, mature and experienced software people and some electrical engineers. Recruitment was through a wide variety of sources. There were no training programs as such. All of the engineers had the same kind of compensation structure except for the researchers at UCSF. There was a merit bonus and promotion. A management bonus had been stopped and the merit increase had been stopped for VP's and directors. There were two career ladders - engineering and management. There had been very little attempt by Toshiba to change the human resource aspect of Diasonics after it had been acquired by Toshiba. Only three engineers were paid by Japan.

Since the acquisition, the annual rate of resignations in engineering had risen to 17 from a total headcount of 124 in 1991, but had dropped to 12 people per year in calendar year 1992. This was much higher than before the acquisition.

The major communication link within the engineering and R&D function that was a problem was the across the Pacific Ocean - to Japan. A data link had just been established to Japan whereby software, for example, could be sent across by computer. Communication was horizontal - engineer to engineer. The Japanese gatekeeper at the facility was estimated to handle about half of the communication with Japan. On the difficulty of project management:

"I would have used the word frustrating - and difficult - because it is a cultural problem and I am learning slowly. It is one of those things that is never visible. You never know why you are having a problem, but you finally realize that you are thinking different ways about things. One problem that I have is that there is no feeling of control of the product. It is the only time that I have ever developed a product where I wasn't in control. With this, I can't change the direction. We work in such different ways. Diasonics' engineering team has traditionally....you go this way and if the conditions change you go a different way. The group in Japan is: 'What are you talking about......we have already decided that.' So, they won't revisit decisions. One of the difficulties, for instance, is that they are building units and they will build a unit and ship it to us roughly on a schedule. We won't know what it is until it gets here. And then we still don't know because they don't do system planning. They build by just building it. And then they will build it again......and again. And each version - we are supposed to integrate it. So, there is a real disjointedness about this. A couple of engineers will come with it. It will be full of bugs and won't work and doesn't fit with our software. We are just learning how to deal with this. And if we decide that we want to do it a different way, we don't have the communication and discussion mechanisms. And the whole thing is pretty much in the head of the one engineer who is here. A brilliant guy......but he doesn't believe in paperwork or systems planning or any of the project management tools that I am used to. It's all verbal and he spends a lot of time on the 'phone with Japan......But there is no ill-will. And that has been a surprise to me. Everybody really tries hard and everybody really likes everybody. They send their software people over here and it drives our software people crazy.
because they have such a different style and attitude. But our software people take the visitors skiing and out to restaurants. There is a lot of goodwill." [my emphasis]

An important difference between the Japan-based and South San Francisco-based organizations was in the organizational structures. In the US, there was a functional breakdown into a software group, a mechanical engineering group, an electrical engineering group and so on. Japan, however, organized by project and reporting was organized by a project system. Engineers were assigned to a project for the duration of the project which might be a year or so. This was a source of continual confusion, for example, as when Japan would ask for team lists.

There was no especial problem with the 'Not Invented Here' syndrome. Japan was never satisfied with products, but it was pointed out that this was due to lack of communication:

"The engineering team here accepts what they get from Japan pretty much without question or complaint. And the group here should say: 'We could have done it better'. But they are a little bit too passive for my liking. Since we are doing a piece of the project, some of the pride in the product as a whole has gone. Since we are doing a piece of it, we are handed a piece of the project and told what it is and accept it. If we were doing the whole product here, you would see people working weekends and you don't see that now."

To improve project management, two changes were considered that might help. Firstly, the project management teams in Japan and the US might spend a week together every couple of months. The other change was between the academic group at UCSF and the engineering group at TAMI. These were different cultures and better linkages were also needed at this interface:

"Sometimes I think that there is more cultural difference between the academic and the engineer here than there is between the engineer here and the engineer in Japan. Because the engineers here and in Japan have very similar attitudes and interests."

Hand off was being prepared for, with a group of nine from manufacturing working in the engineering function. They were going to go back to manufacturing with the product. The product would also be transferred to Japan for manufacture there, which was anticipated to be straightforward as a lot of the hardware was being developed there.

The following were some of the most interesting conclusions about the TAMI operation:

(i) The TAMI company had evolved as a Toshiba subsidiary through the acquisition of an overseas competitor that was producing a superior product, which had been followed by integration with the existing Toshiba US-based company. Diasonics had superior technology and market and environmental penetration than TAMS, including to the University of California at San Francisco.

(ii) After the acquisition, TAMI was effectively cut up - all functions but some manufacturing capability and the engineering and R&D functions were moved away from the South San Francisco location. Responsibility for the marketing function was given to a group that was geographically remote and that seemed to have had every incentive to want the acquired company not to do well. In product development work, changing market requirements need to be gauged closely. Communication was so poor between R&D and marketing that the new products were no longer selling in the US. By cutting TAMI off from its market environment, the internal consistency of the former
Diasonics organization was destroyed. Morale quickly worsened and some of the best engineers had left the organization. Other R&D units visited were isolated from marketing, but in this case the consumers were hospitals, rather than OEM's, and an insensitive attempt at integration had left TAMI with no real means of gauging how user requirements were changing.

(iii) Problems of project management were compounded by the different organizational forms in Japan (by project) and in the US (by function). Moreover, the different ways of project managing (the more formal systems of the US against the 'in the head' Japanese engineers) added to the problem, as did the classic product split between hardware (Japan) and software (US). However, the research engineers still seemed to get on well and the greater difference with the researchers at the UCSF laboratory put the international communication problem into perspective.

(iv) Toshiba had attempted to create a supplier R&D unit out of TAMI, but this was not succeeding. The reason was an excessive use of headquarters power, that had failed to recognize the strength of ties between TAMI and its environment. It is, perhaps, an example of the misplaced exercise of hierarchical power into what should have been treated as an extension of a network, a network in which the success of TAMI was contingent upon the harmony of its human resource management system with the local market and competitor environment and upon the retention of a complex set of relations with its environment. TAMI had its roots cut off by headquarters - through 'fiat' - and much of the value of the organization has undoubtedly been lost.

8.3 Vertex Semiconductor

Vertex Semiconductor ("Vertex") is a wholly owned subsidiary of Toshiba America Electronic Components, Inc., one of the main operating companies in the US of Toshiba Corporation. Toshiba had originally acquired a 14% stake in the Company, then known as Integrated CMOS Systems, in December 1989 for $4 million, although the two companies had had a relationship regarding technology exchange going back to the inception of Integrated CMOS Systems. The outright acquisition occurred in April 1991, following an approach by the cash-strapped Vertex. Toshiba then purchased the remaining shares in the Company for about $16 million. Vertex had its origins in 1974 as a Storage Technology spin-off, called STC Research, which foundered when Storage Technology filed for protection under Chapter 11. It was set up by the original managers of STC Research, who raised some venture money to license some of the technology from the old company.

Under the 1989 agreement, the two companies had agreed to joint development of gate arrays and system-oriented design tools and Toshiba was to provide foundry operations to Vertex. Toshiba also, at that time, licensed Vertex's FASCAN technology, which included a set of CMOS circuits and methods of operation that were said to facilitate ASIC testing at the device, card and system levels.

Vertex was a San Jose (California) based company that used CMOS ASIC (application specific integrated circuit) technology to design and manufacture high-performance, multi-chip ASIC's for high gate count, performance-driven electronic systems. It was the only company focused solely on the high performance end of the market. In the ASIC business, Toshiba had been very successful in the mainstream of the market where local engineering skills were not as important. At the high end of the market, however, because of complexity, a lot more engineering value added was needed in terms of circuit technology, software, and so on. Toshiba had never been successful in that part of the market because all of that work was done in Japan and there was an enormous time lag to get the simplest question answered. Customers would not tolerate this delay of months getting simple questions
answered. Vertex plugs that gap by having a substantial engineering capability in the US to serve the needs of the high-end customers. As one example of its products, in November 1991, it introduced the Vertex TC165G/E gate array and embedded array family. At this time, Bruce Bourbon, President and CEO of Vertex, was quoted as saying:

"The TC165G/E family exemplifies Vertex's core strengths in system-level design, performance optimization and DFT methodology coupled with Toshiba's world-class process technology and manufacturing. TC165G/E customers therefore gain the full benefits of a system-level design approach."

Vertex was part of Toshiba's ASIC group in the US. It had a product line that it had developed that suited the high end of the market. To support that business it had key R&D activities. The largest R&D functional area within Vertex was electronic design automation software work, which involved taking commercial tools and adding value to them and creating very good design methods that allowed it to do very complex designs that came out right the first time. Allied with that was the ASIC development activity and associated software technology. Those activities were funded out of Toshiba's R&D budget. In the acquisition, part of the negotiations had been in deciding the size of those R&D efforts in the first year and so there had been no normal budgeting process in 1991.

The current year was, therefore, the first time that Vertex had encountered the "realities" of the Toshiba planning process:

"The realities are that for each of the projects, we need to go talk with the responsible managers in Japan for the subject areas of the R&D, such as software and ASIC technology and negotiate with them as to what is the role of the R&D planned for here in the next fiscal year and what kind of levels of funding is appropriate. It is very much an interactive discussion process which, this year because all of the Japanese companies are under terrific margin pressure, was especially grueling because it took heartburn to get to the point where we had consensus. Once that is reached, then it is fairly straightforward. Then we go into more of a project planning process where you are given a certain budget amount and a certain set of objectives for the year and products to be produced. We get into assigning resources at a very detailed project level. The functional managers in Japan have allocated to them a certain budget, which they are responsible for either spending through allocations or through their own groups. The semiconductor group [in Japan] has a planning and finance department that is responsible for bringing together the entire plan for the semiconductor group and then that gets rolled up to corporate. It is that group that seems to be extremely involved in allocating the budget out to the various functional groups. If there is a gap between the amount that the functional group may think that they have available to support R&D activities here and the amount that we think is necessary to accomplish the work that seems to be necessary, then my observation this year was that the finance group would get involved in helping try to deal with closing that gap. A sort of a mediator in the process. Being an outsider, it is a little difficult to really understand all of the details."

Vertex was, it believed, an experiment for Toshiba, in that it was the only US subsidiary not to have Japanese people at the top. It was driven by the head of the ASIC group in Japan who believed very strongly that there was a lot of talent in the US, certainly in Silicon Valley, that it was not possible for Japanese companies to build; talent to work in areas such as circuit technology and software. He, and others, had also observed over the years that, when a US subsidiary was established in the US and Japanese nationals were brought in to manage it, it inevitably took on a Japanese management style and it was extremely difficult to
get competent US managers into such an organization. "Too high a percentage of second-class citizens", as it was described.

Vertex was an experiment to see if that mold could be broken. It was not easy, as all of the control was still in Japan and Vertex had found terrific cultural inertia there - the cultural momentum was continuing in the same direction as always at Toshiba and so the new ideas on how to compete more effectively globally, by taking advantage of technology and resources in local areas, were things that did not "compute very well for many people".

Vertex was just beginning working on a new product development project that would require stronger integration with Japan, between a group in San Jose, a group in Irvine and another in Japan. The project management of that project would, it was believed, force integration. It had not been necessary to integrate to date, as the US had the most advanced complex ASIC market in the world and what Vertex had done had not been done elsewhere in the Toshiba Group. The highly complex ASIC market was just beginning to emerge in Japan. Integration had, therefore, to date been only achieved in terms of budgeting and the allocation of resources by the functional managers.

Toshiba was believed to have a long term plan to move the ASIC business to the US. It was believed to have purchased some land up in Oregon for the construction of a fabrication facility. The vision was believed to be one of not so much establishing the US as a global ASIC base, but of making it more independent in ASIC - more self-contained. This would have fitted in with the ASIC market requirements, which are that it was essential to have close customer relations in ASIC, as the customer and the vendor shared the design responsibility.

With communication, there had been a problem in sending faxes to Japan:

"Various people here would send faxes to Toshiba Japan with various requests for this or that and the wording of the fax would be fairly typical American - abrupt, concise, direct in asking for something. Not much or any explanation of why this information was needed. Limited politeness in the address. And, predictably, the response was that these notes were really rather rude and why were we asking this and we would get these requests back asking for more information. I think that we have got all that under control. There is, however, a radical difference...I am not sure how pervasive this is among the Japanese. But in Toshiba, there is sort of a need to know information process where they let people outside Japan know only that information which they judge is necessary for the subsidiary to do its function or particular job. That causes the demand for detailed explanations so that I, in Japan, can judge whether this an acceptable request. The language barriers are also fairly substantial because no matter how much you try to scrub your language of idioms, it is amazing how many we use and they don't translate. So there has been every kind of communication problem that you could imagine."

Vertex considered that information transfer could only really occur effectively after face to face contact had occurred. The problem with that was, however, that in a Japanese company, people change jobs very often - every April 1.

The plan for Vertex was that the R&D group would stay intact and self-contained, but that the ASIC part of the business would become absorbed into the larger Toshiba America Electronic Components, Inc., currently only a marketing arm. The business would, therefore, split, leaving an R&D group in the US reporting directly back to Japan. In the long run, if Toshiba wanted, it was felt that the center could become the global R&D center for electronic tool design automation development. ASIC technology would always be shared. The ASIC
market was driven primarily by manufacturing skills and there was no reason to locate it away from Japan. The high end of the market was driven more by engineering skills and it was considered by Vertex that it would make sense for that to be located in the US - for all markets.

Within Toshiba, there were layers of R&D in Japan. In the semiconductor group itself, were the people that were worried about the revenue stream over the next one to three years. Then, there was some mid-term laboratory work done that was working on things some three to five years out and then, there was some long-term research activities. Toshiba had a problem taking things out of the latter two laboratories and getting them to the point where they were commercially ready. That process was seen to be very hard for Toshiba and many of its international alliances were designed to “shake lethargy out of that process”. It was not possible to set up competing laboratories, as with IBM, but the alliances achieved the same ends. This was alliances as an internal motivater to get it together and work out how to transfer some very good technology that they had developed. Offshore investments at Toshiba were presented as a means of pushing and prodding the internal organization. There were, of course, some occasions where there were very direct expectations for the technology.

Vertex had an agenda of two types of R&D: one that which Toshiba had asked it to carry out and one that Vertex proposed and Toshiba did not concern itself about, except for budgeting purposes. Toshiba’s corporate strategy was for each of the main groups to plan its R&D operations worldwide. A semiconductor group mission was for a strong R&D emphasis in the US, and Vertex was to be the US center.

Vertex felt that their business had been helped by having Toshiba as a parent, as it meant that there was less chance of them being scratched from vendor lists by ASIC customers. Vertex’s strengths with the characteristics of products were complemented by Toshiba’s reputation for quality of components and for production timeliness. Recruiting was almost easier than for a start-up with an uncertain future, where joiners had none of the potential of the original founders - as start-ups tend to plateau after four or five years or so.

The Toshiba culture was of lifetime employment and of certain career structures, which made it difficult for them to recruit the right people in the US. To protect against this and any change in Vertex, Vertex and Toshiba had taken certain steps to formalize and reinforce its culture. Examples included the compensation scheme, which had been if anything exaggerated in terms of paying top performers well and the poorer performers not so well. It had also paid out a retention bonus for people who stayed after the Toshiba acquisition.

Out of 100 employees in total, 65 were engineers and there were about a half dozen with Ph.D.’s and 80% of the rest of the engineers had MS degrees. There were no Japanese employees, unlike other Toshiba US subsidiaries. Turnover had been very low since the acquisition, by an almost exaggerated compensation policy oriented to keeping key people, significantly at variance with Japanese remuneration practices and within Toshiba more generally.

The human resources’ strategy had included to increase the number of Ph.D.’s in the software area, and Vertex had recruited from specific universities with research programs that were complementary to its own (e.g. University of Illinois, University of California at Berkeley). It had been looking for management skills on the product development side as well as hardware skills in particular technology areas. Having the appearance of an American company helped in the recruiting process and this was a significant issue in terms of changing the name to a Toshiba company. As it was explained:
"Unfortunately, there are many Americans who feel that there is a ceiling to how far they can advance in a Japanese-managed company and so if you are recruiting against a Hewlett Packard or an IBM or a Sun, as we frequently do, you will lose out if you present a strong Japanese face as they will say: 'Well, I can't have a career in a Japanese company'. When we go in as Vertex, we say that we have US management, we have a clear career path right up through the senior levels of the US company. We get very few candidates who want to move into corporate centers in Japan. We have been trying to help Toshiba to find some. I think that Toshiba has been extremely wise not to bring in a large component of Japanese management as it has helped us to pull some people who otherwise we may not have been able to."

There were dual career ladders in Vertex, with two or three moving up from technical staff to Senior Scientist and then Vertex Fellow. The management equivalents were Department Manager, Director and then Vice President. It was very much the IBM model. The right mix would be about one third of the people going up the technical ladder.

Performance was measured by staff turnover - the number and rate of people who left was monitored closely. This was one of the ways that Toshiba measured the performance of Vertex. The right mix would be about one third of the people going up the technical ladder.

A interesting view of the parent was that:

"Toshiba America was Toshiba's first experiment in trying to grow in the US. They did it by bringing a whole boat load or airplane load of Japanese management in. When they acquired us, their comment to us - which just blew me away as being very candid for a Japanese company - was that 'we have only been able to recruit second rate staff. The hiring that we have done has not produced the innovation that we wanted in the US. We want to take a second approach. So you are our restart.' So that is the good news. They are going to have us be an American look and feel. Fine. But how do they understand that now? It is far away. It is very foreign. How do they deal with it. They talk this localization, about Toshiba being a global Company. But they don't know how to do that. Everything still goes through Toshiba Japan and I am not sure how they are going to be able to be able to do it without sending people over here to experience it. And if they send people over here to experience it, they will kill it. So, they are in a real double bind. They have to learn how to manage those foreign operations and get comfortable with the foreign-ness of those operations. If you look what happened in IBM, they had to split into IBM and IBM World Trade, because they could not figure out how to live with the foreign-ness of these non-US subsidiaries. Toshiba is going through exactly the same thing. We have had all of the comic-book interactions, with people writing us from Japan saying: 'We can't deal with your last fax because it is rude.' And we stand around and no one can figure out how it is rude.

Their concept of consensus building is not as difficult as one would expect as it is well known in the US that that is how they make decisions. What we find difficult is: 'Who? Who? Who do we have to get consensus with. Where are these people we have to get consensus with? You moved them all on April 1. It is going to take us until August to find them all.' The people who we deal with are considered very maverick by the rest of the Toshiba group, as they push through decisions much faster for us. So, we have created dissension in Toshiba Japan, as the semiconductor group there understands our needs, and it therefore seems foreign to the rest of Toshiba Japan. For all the huge size of the Company, Toshiba is still a
Japanese company that would like to be an international Company. We are part of that experiment." [my emphases]

What the Vertex experiment shows, for the purposes of this discussion, is the following:

(i) The problem of recruiting offshore has often been portrayed as a problem uniquely experienced by American and other non-Japanese firms seeking to establish themselves in Japan. The experience of Toshiba prior to the Vertex acquisition suggests that Japanese firms have experienced the same problems in the US. Moreover, the Toshiba/Vertex relationship had existed for many years prior to outright acquisition, long enough for Toshiba to gauge the performance differences between the two organizations. That Vertex was assisting Toshiba in its recruitment drive is indicative of the problems that Japanese firms have in establishing successful R&D operations in the US, in the face of strong competition from American firms. That one of the main ways of Toshiba assessing the performance of Vertex as being the measurement of its staff turnover rate confirms these recruitment difficulties.

(ii) Toshiba appears to be establishing offshore R&D centers in the US according to a new strategy of acquisition and non-assimilation. The UCSF laboratory in medical resonance imaging was one example, but Vertex provided another. After the ASIC R&D had been stripped out and merged with the TAEC operations, what would be left is a self-contained R&D group.

(iii) The rationale for Toshiba setting up a series of alliances with large European and US companies as competitors and motivaters to its internal R&D operation suggests that there may be communication and hand-off problems within the internal laboratory hierarchy in Japan. Whilst outside alliances and acquisitions, such as Vertex, are one answer, they risk failure if the domestic R&D operations refuse to cooperate with such competitors. Given the significant decentralization of power within Japanese organizations, it is to be expected that the reality of day to day communication cannot be conditioned by the senior executives of the Japanese parent responsible for the outside link.

(iv) In the areas of R&D covered by Vertex, we see again the importance of working closely with lead users in high technology areas (e.g. high value added ASIC's). The need to be in the US as an effective R&D operation is, therefore, not only to participate in this market, but also to be able to participate domestically when the higher level technology moves to the home country.

(v) That there were still communication problems between Vertex and the Japan-based units was not surprising, given that this study of Vertex was carried out barely a year after the acquisition. There were signs, however, that the difficulties were being overcome. Most significant was the effect that Vertex appeared to be having within the semiconductor division in Japan. As a measure of just how much trust and respect had developed in the year, Toshiba Japan was experiencing dissension as the semiconductor group within Japan was adjusting its working patterns to conform to those of Vertex.

Instead of a US organization being imposed on by a Japanese organizational system, we now have a situation where the Japanese headquarters is incorporating patterns of behavior, routines and norms from the Vertex external environment into its organization. If we think of Vertex as being to a significant degree organized to match its organizational set of competitors and all aspects of the local environment, then these were being incorporated into Japan through the medium of the US-based
organization. A part of Toshiba in Japan was becoming 'Americanized', or isomorphic with the US organizational set of relations of Vertex. This has only been possible because of the fact that Vertex has not just maintained, but built on its dense network of ties after the Toshiba acquisition. The split within the Japan-based organization can also be seen as the movement away from a hierarchy to a network within the home country itself.

9.0 Concluding Observations

The first attempts of Japanese MNCs to internationalize their R&D operations experienced great difficulty, as the rigid ethnocentric home country hierarchy stifled, demoralized and in some cases destroyed offshore operations. What this researcher found was a new attempt to build an international network, in which each R&D organization in the MNC network is embedded in a dense set of relationships with its environment. This results from a management strategy of giving primacy to the need for legitimacy and local isomorphism in each host country environment, rather than of maximizing the density of ties to other subsidiary organizations in the MNC or to the headquarters.

The tailoring of the local organization to its environment is entirely compatible with the optimization of technical and economic considerations if an MNCs strategy is conceived of as not just exploiting old certainties or 'economizing', to use the language of the transaction cost economists, but of creating new possibilities (March, 1991). Trust and confidence cannot be built by fiat, decree or order down some hierarchy, especially across borders. Individuals, groups and organizations work well together when they have developed reciprocal respect and trust. What the Japanese MNCs were beginning to do was to create the conditions for the network of local offshore R&D organizations to build that trust.

Whilst the local R&D suppliers all brought identifiable capabilities to the MNC, based on needs that Westney (1991) identified as drivers of the globalization of technology, it is the organizational arrangements that are novel. They are not likely to lead to the degree of trust that is required to transfer tacit knowledge immediately, but the inhibiting factors to localized innovation associated with hierarchy, market or hybrid are less marked. The possibilities for local innovation are retained through maintenance of the localized incentive systems and through the feelings expressed by many employees that they somehow had the 'best of both worlds' by retaining independence, agility and responsiveness, in the knowledge that, when it mattered, such as in the matching of complementary assets, or when it was convenient to be part of an MNC, a different face could be presented to potential recruits, customers, suppliers and financiers.

Integration that interferes with the integrity of the MNC-owned R&D organization and its isomorphism with its local environment, risks destroying the innovativeness that is desired. This aspect was very important for the organizations that were the subject of this study: both the parent and the local organization recognized the need to keep the management systems of the R&D organization intact and to maximize the opportunities for transfer of knowledge to other organizations within the MNC network, as well as from the network to the local organization. The network gained through increased knowledge and the R&D organization through the awareness that, by such transfer of knowledge, it was both maintaining its value and leveraging its knowledge throughout the MNC network of operations.

In the R&D centers that were the subject of this study, outright ownership by the Japanese parent should imply governance by fiat under the narrow conception of hierarchy put forward by the transaction cost economists, yet the actual form of the relations was established by a basic contract, or a set of contracts, that set out general obligations. These contracts were
more in the nature of guidelines; in the event of a dispute, recourse to the enforcement remedies and procedures of contract law would have been unthinkable.

What held the organizations as a whole together were trust and personal relations; *trust* was a word that frequently arose in conversations as the principal basis for the organizational arrangements. The power of the US R&D organizations vis-à-vis the rest of the networks - power that defied authority by fiat - was that fiat would have destroyed the supplier R&D centers' innovativeness. Fiat and the imposition of Japanese home country management systems into Silicon Valley would not have assisted in the retention of highly valued R&D scientists and engineers.

Furthermore, rather than simply allowing greater flexibility of operation in a technological environment requiring rapid adaptation, the role of trust had an additional critical significance. It was the basis of a form of network communication, rather than a governance structure as such, that maximized the ability of the MNC as a whole to benefit and learn from distributed innovations. Whereas the particular relationships in this study were mediated by the differing Japanese and American cultures and management systems, it is considered that the relationships described could exist across other technological and cultural divides.

On the timing of the supplier R&D acquisitions, any venture capital firm goes through a cycle, whereby the original founders often make their highest return to equity in the early years of operation, and it is worthy of note that in each of the cases studied, this high motivation had already been removed at the time of the linkage with the MNC. It is considered unlikely that a new (start-up) R&D organization would offer the same potential to an MNC.

Despite some early problems of communication to other parts of the MNC, the evidence suggested that these were being overcome. The most significant factor in this process was the respect that the US R&D organizations were earning from the tangible results that they produced. Rivalries and competition existed, such as inevitably results from the use of the Japanese management tool of redundancy (Nonaka, 1991), whereby there is a conscious overlapping of company information, activities and responsibilities, in contrast to the sharpened ax of the Western MNC manager and supporting consultants. Despite these difficulties, there was, nevertheless, a framework in place for trust to develop.

It might seem that a strategy of giving primacy to the importance of dense ties to the local environment, rather than between units of the MNC, would be at the expense of intra-MNC organizational linkages and control by headquarters. However, the supplier R&D firms that this researcher visited were closely linked to other parts of the MNC and, whilst the MNC headquarters retained important elements of ultimate control, this was never exercised; the supplier R&D units retained significant structural power. In the case of Vertex, this even resulted in the incorporation into Japan of some of the local (US) organizations routines and operating procedures.

For managers charged with the responsibility of responding to Westney (1991)'s drivers of the internationalization of R&D, the conclusion of this study is that they might well consider taking a two-stage strategy to their task.

The first stage is to establish a local (offshore) R&D unit that is as closely integrated into the local environment as possible - acquisition of a local high technology company is an expedient way of achieving this. The second stage is one of non-formal integration. This involves deliberate avoidance of integrating human resource management, management accounting or other systems, or otherwise interfering in what is an internally consistent and locally appropriate management system, contrary to what might be the most immediately
obvious solution to interorganizational integration. The local R&D subsidiary can hereby respond flexibly and autonomously to the various isomorphic pressures of its environment.

The parent MNC in this context acts as a *facilitator*, by providing every reasonable opportunity for the offshore R&D center to develop ties at multiple levels throughout the rest of the MNC, but tries to ensure that horizontal communication develops in tandem with concrete results from the interorganizational linkage. There may be occasions when the supplier R&D organization should be denied communication with other parts of the network until sufficient trust and confidence have been *earned* and this has been recognized at the various levels of the MNC's constituent organizations.

The alternative, of exercising hierarchical control through fiat, may well destroy the value of the local R&D center and undermine the objective of building a global network of distributed innovations. Being a successful 'local insider' is a necessary condition to becoming an effective MNC insider in an offshore R&D organization. The two objectives are not mutually exclusive: one leads to the other in a causal relationship.

Japanese senior management seemed to understand the organizational constraints under which they operated. By giving the offshore operations the opportunity and corporate framework to demonstrate to Japan-based technical managers that they were able to make a valuable contribution to the innovation process, there was an improved prospect that they would earn respect in Japan and so, it was hoped, a truly global network of local innovation would develop. Time will tell how the supplier R&D centers evolve. The evidence is that, as ever, the Japanese MNC managers are taking the long-term view to building their global network of distributed innovations.

Finally, this study has focused on Japanese MNC-owned R&D subsidiary organization in the US. The management strategy might just as easily apply to US MNC-owned R&D subsidiaries in Japan; Westney and Sakakibara (1985) have identified some of the isomorphic pressures in Japan, to which some US MNCs did not respond sufficiently, such as the need to collocate manufacturing and marketing activities in Japan so as to present localized patterns of career development to potential employees. There clearly will be circumstances when local isomorphism will not be as important, in which case greater weight will be put on economies of scale and scope, but the principal message to managers from this research is to 'go native' and let interorganizational communications develop from a solid foundation of highly effective local insiders. There are techniques that managers can use to facilitate and build interorganizational communication, such as groups of boundary spanners that understand differing norms and rules across organizations in diverse organizational environments, but this must be the subject of a separate study.
EXHIBIT I:
Distinguishing Attributes of Market, Hybrid and Hierarchy Governance Structures

<table>
<thead>
<tr>
<th>Governance Structure</th>
<th>Attributes</th>
<th>Market</th>
<th>Hybrid</th>
<th>Hierarchy</th>
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<tbody>
<tr>
<td>Instruments:</td>
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<tr>
<td>Incentive intensity</td>
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<tr>
<td>Administrative controls</td>
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<td>Performance attributes:</td>
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<td>Adaptation A</td>
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<tr>
<td>Adaptation C</td>
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<td>++</td>
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<tr>
<td>Contract Law</td>
<td>++</td>
<td>+</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- ++ = strong; + = semi-strong; 0 = weak

Notes:
1. Williamson is of the opinion that adaptability is the central problem of economic organization.
2. 'Adaptation A' is the extent to which changes in the demand or supply of a product are reflected in price changes.
3. 'Adaptation C' is the efficiency with which internal coordinating mechanisms can cope as the needs for coordinated investments and uncontested (or less contested) coordinated realignments increase in frequency and efficiency.

REFERENCES


