"Managing the Knowledge Asset Into the 21st Century: Focus on Research Consortia"

Proceedings from a Conference at Purdue University

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CRITICAL ISSUES ROUNDTABLE

Sponsored by:

Digital Equipment Corporation
Technology Transfer Society
Technology and Strategy Group

"Managing the Knowledge Asset Into the 21st Century: Focus on Research Consortia"

Proceedings from a Conference at Purdue University

April 28-29, 1987

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Sponsored by:

Digital Equipment Corporation
Technology Transfer Society
Technology and Strategy Group

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I The Imperative

"[Japan's] Technopolis program sheds invaluable insight into what makes Silicon Valley and American society tick. When I speak with Japanese business and government leaders, they are fascinated by the Yankee spirit for which this country is known. What are they attracted to? Our optimism and enthusiasm, creativity, individuality and personal freedoms, entrepreneurialism, venture capital, critical and unconventional thinking, openess to new ideas and people, excellent universities and colleges, life-long education, cross-fertiliztion of ideas between industry and universities, regional diversity, local initiative and grassroots organizing, informal networking, labor mobility, equal opportunity, ethnic and cultural variety, and other features of our open society. Indeed, we are blessed with such a deep reservoir of people and new ideas that we routinely take them for granted. Our problem is not a lack of resources, but our short-sightedness and inability to choose among the many opportunities available to us."

Sheridan Tatsuno,
The Technopolis Strategy

II Conference Synopsis

A. Project Background

On April 28-29, 1987, the Technology Transfer Society, with support from Digital Equipment Corporation and the Technology and Strategy Group, sponsored a Critical Issues Roundtable on "Managing the Knowledge Asset Into the 21st Century: Focus on Research Consortia."

The stimulus for this conference was a belief, shared by the co-chairs, that America's economic vitality is inhibited by inefficiencies in transferring new technologies to the marketplace. And although our laboratories and centers of technological innovation are strong and vibrant— particularly those efforts exhibited in a broad array of R&D consortia, the co-chairs drew attention (a) to the need to reconceptualize the working concepts of "technology transfer," and (b) to focus more attention on the need for breakthroughs in managerial technologies without which technology transfer processes cannot be accelerated.

Select leaders (see appendix) in the science and technological research community from government, industry, and academe were invited to participate in a two-day intensive discussion on the issues and opportunities confronting our nation on the viability of our economic competitiveness. Discussants analyzed the role and practices of research consortia in this country and their impact on technology transfer throughout the three stages of the process of innovation— defined as "invention," "translation," and "commercialization."

William C. Norris, Chairman Emeritus of Control Data, was presented the first annual Justin Morrill Award (see appendix) for the vision and leadership he has provided the nation in bridging the academic/business/government divide through a variety of novel research partnerships, such as the Microelectronics and Computer Technology Corporation (MCC) and the Mid-West Technology Development Institute (MTDI).

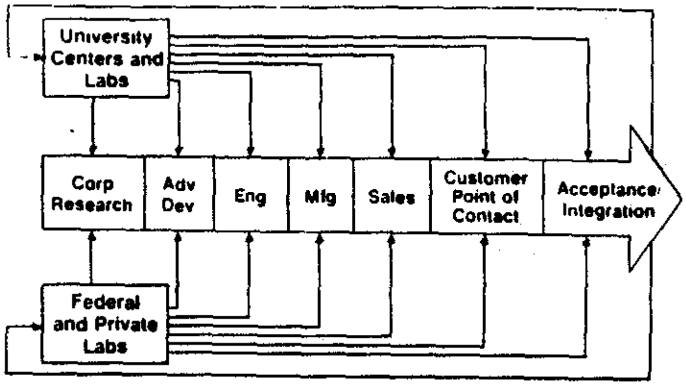
Sheridan Tatsuno, Senior Analyst at Dataquest, provided insight into the extraordinary research infrastructure that Japan has implemented to convert that nation from research "immitation" toward "innovation." This realistic picture of the *future* competitive threat provided a backdrop for three focus groups that analyzed strategies that ought to be initiated in this country to regain our competitive economic position.

What follows is a summary of the findings of that Roundtable, major papers delivered, program design, and list of attendees.

B. Conceptual Framework

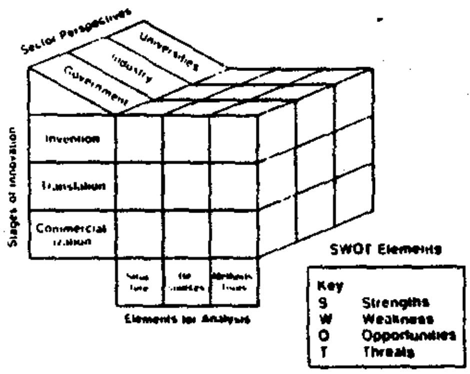
To provide a foundation to the conference, the co-chairs volunteered three conceptual constructs that are summarized here.

First, the T2 process was proposed as a continuum of interrelated events rather than as a chain of distinct and discrete events. In the new conceptualization, T2 is a process that happens continuously at all points and between academic, business, and government partners.



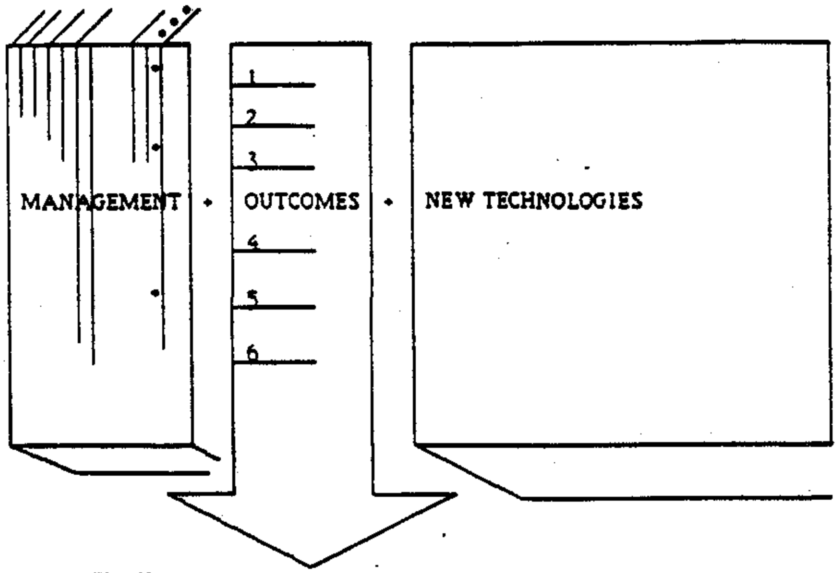
Technology Transfer Contiuum: Rethinking the Alliance (1985-2005)

Second, the T2 process was depicted as having a three dimensional matrix of intersecting variables. One axis represents the three evolution of the Innovation, Translation, and Commercialization. The second axis represents the academic, business, and government actors. The third focusses on (a) the organization structure of any given actor, (b) the resources available to it, and (c) the methodological tools available. An effective T2 process would optimise the interrelationship ‘‘ these variables at any given point.



Technology Transfer Framework: Elements for Analysis

And finally, it was suggested that the T2 process can only be truly effective if it responds to criteria established by the market. The latter were defined as performance "outcomes" expected of world-class competitors. These outcomes, once defined, are affected by new technology initiatives in various fields, (i.e., biotech, electronics, and materials). These outcomes also affect (or are affected by) new managerial technologies. The latter, is suggested, need to be reconceptualized if the T2 process is to beneficially affect the competitiveness of any singal firm, industry, or economic region.



C. Key Conference Findings

It was generally agreed, by the eighty-five national leaders from industry, academe, and government who attended the conference on R&D consortia and technology transfer, that a new conceptualization was needed. This became the focus of the panel discussions and focus groups.

Four broad primary themes emerged from the ensuing conversations.

1. The process of technology transfer (T^2) is *non-linear.* This perspective argues the more conventional view that the root of all technology is in laboratory-driven-science and that it moves in a neat progression through a series of identifiable steps. One contributor suggested, quite to the contrary, that technology is something that happens in numerous feedback loops through the proposed three stages of innovation: invention, translation, and commercialization. In this combined view, science is a pool of knowledge— to be tapped as needed— underlying all three stages rather than a single beginning point of a linear or sequential activity labeled "technology transfer."

   Old view: T^2 is a linear process
   New view: T^2 is a concurrent process with numerous feedback loops

2. A second key theme was that technology transfer is, at heart, a process of *human interactions* between what one contributor defined as "at least two consenting adults." This raised the immediate question of "who" should be involved in technology transfer and "what" qualifications they should have. The answer was that it should be the best, or most senior, person required to do the job. In contrast, the

conventional attitude views the transfer process as a secondary process to which the best people need not necessarily be committed or whose commitment cannot be afforded. Coupled with this understanding came the recognition that "technology" is not a deliverable that can be neatly packaged and forwarded. It is a process, and it travels best in the minds of people.

Old view: T^2 consists of discrete deliverables (papers, patents, etc.)
New view: T^2 is a continuous process of human interactions

3. A third theme, coupled to the prior one, was the general agreement that technology transfer must occur in a timely fashion. As one participant suggested, it is a *"real-time" process.* It is something that happens by people doing and exchanging ideas rather than by creating anonymous "deliverables." Another panelist volunteered his finding that "the key is in providing a constant stream of transfer at every single point before we can even think of calling it a technology." In short, if a firm commits resources to a laboratory (internal or external to the company), but does not commit the people to participate directly in the commissioned work *as* it is going on, there cannot be a timely or constant match between the sources of new knowledge and the problem in need of a solution. If anything, it was proposed, the corporate infrastructure has to be better nurtured to allow this process to occur efficiently. And, while there should be champions of this process, there should "multi-receptors" for the technology within each corporation.

Old view: T^2, is a sequential process from a to z
New view: T^2 is a "real-time" process that occurs at the source

4. A fourth dominant theme emerged which is central to the title of the conference: "Managing the Knowledge Asset." It was generally agreed that we have entered an era in which knowledge— itself a volatile and perishable commodity— is a critical competitive resource of most firms. The question of "how we are to manage our knowledge inventory" drew attention to the growing dependence of modern economies on this "abstract commodity." If this dependence is correctly analyzed, it is incumbent on firms to focus more specifically and urgently *how best to manage the creation and use of knowledge.* It was argued that Tayloristic principles are still a dominant reflex in most business enterprises and that they would have to be fundamentally altered if we are to manage knowledge (and the process of technology transfer) competitively. Defining *management itself as a new technology,* it was suggested, is necessary as a means of focussing creative energy on developing new principles of management. This would move us away from sequential processes that tend to serialize events to processes that encourage parallel or concurrent events— with numerous means for feedback.

Old view: T^2 can be managed hierarchically from the top down
New view: T^2 requires new management philosophy and tools

Follow-up

Although these themes only became obvious in retrospect as comments from panelists and participants were reviewed, it was concluded that *new models* were badly needed. Current ones are particularly inadequate in explaining the role of patents protection or the role of small companies in buying into consortia programs that today are largely the domain of large companies. In addition, there was a strong belief that current models offer little insight into how best to match the scientific capability of universities to the product and process needs of industry.

It was also felt that there was a strong need for *better or new definitions* on what exactly is meant by "technology transfer" and a variety of other terms commonly associated with it. This was fittingly stated by a panelist in a quotation of Senecca; "If we don't know which port we are sailing to, it doesn't matter how favorable the wind is."

The short duration of the conference and the liveliness of the discussions did not allow time for the participants to define the substance of the new models or to tackle the dilemma of redefining terms. The co-chairs will be taking these tasks as the departure point of a conference to be held in Aspen, Colorado, in early July, 1987, under the sponsorship of the National Academy of Science in behalf of the Jet Propulsion Laboratory.

C. The New Agenda

The four themes described, together with several insights and recommendations in Section III (i.e., Focus Group Reports), provide a good framework for building the foundation of what is being described by the Technology Transfer Society as "the National Campaign for Competitive Technology Transfer."

This National Campaign should provide a highly visible focus for a grassroots effort aimed at generating a broad understanding of the role of technology in economic competitiveness. It should serve as a catalyst for collaborations at all levels and across sectors. There is a need to increase productive innovation, to more effectively manage our knowledge assets, and more efficiently and effectively transfer technology into commercialized products that meet the needs of society and generate economic wealth. This campaign could be the long-needed "Call for Action."

III Focus Group Summaries

A. Focus on Policy: Howard E. Sorrows, Director, Office of Research and Technology Applications, National Bureau of Standards

The Charge: To recommend action policies that would improve the performance of individuals and organizations participating in alliances formed for the better management and transfer of technology. The effect of the policies should be to (1) promote U./S. industrial competitiveness, (2) strengthen science and engineering education, and (3) provide guidelines for the infrastructure services of government. The policies should provide bridges between the distinct roles and cultural differences among industry, academia, and government.

Some Policies Proposed for Consideration:

- The Technology Transfer Society should provide a forum for disseminating the national debate concerning the root causes and inherent implications of factors such as the national debt, imbalance of trade, and loss of market positions on the U.S. ability to manage and exploit technological advantage.
- Curricula in U.S. academic institutions should better address interdisciplinary training. Scientists, engineers, technicians, and business majors should not find communication difficult in an alliance.
- State and local governments should be applauded for, and encouraged to, continue their leadership in regional economic development through the promotion of technological alliances.
- Financial rewards and retention rights of educators and industrial or governmental employees who participate in the interdisciplinary research and technological transfer should at least match those of their peers who maintain disciplinary priority.
- Personnel policies of universities, industry, and government should protect the well-being and rights of talented participants in alliances who migrate in the search of exciting research and development as well as superior facilities.
- The Federal Laboratory Consortium should take advantage of the addition of Lee Rivers to expand their support of alliances.
- Alliances for technology management and transfer should be planned for the long-term with carefully drafted mechanisms for dissolutions when the alliance has run its course.
- Alliances should take due consideration of all of the steps leading to the commercialization of R&D.

- The Technology Transfer Society should expore the desireability and feasibility of compiling the resources, personnel, and facilities accessible to alliances, or available for incorporation into alliances. Various professional and trade associations, as well as the Federal Laboratory Consortium and the National Science Foundation, might be interested in collaborating.
- Alliances should be viewed as test-beds for studying contemporary management of technology through voluntary collaboration.
- Alliances should be carefully formulated to be synergistic efforts for mutual benefit.

B. Focus on Practice/Transformation: R.D. Haun, Research Director, Westinghouse Electric Corporation

Transformation is the stage of technology transfer that is between invention and commercialization. It is a *process* that extends over a considerable interval of time; it is not generally a "brief encounter." The process operates on an invention, or on a technology capability, to transform it into the definition of a product or service concept suitable for commercialization.

Success of the PROCESS:

- For successful technology transfer, it is necessary to accommodate to the criteria and biases of the human beings who can provide the resources for commercialization. They must be convinced of the potential for high payback.
- It is important, therefore, to include consideration of non-technology issues; an evaluation of the potential for payback from commercialization must be included in the Transformation Process.
- The decision about payback cannot be separated from the "champion" who will make that decision.
- It is necessary to continually work with the "champion," providing sustainable support and sound justification, even if that person originally asked for the work to be done.
- Don't rely on personalities— people may change.
- It is inevitable that the champion's viewpoint will introduce biases and other "distractions;" expect communication errors and wrong decisions needing correction.
- Champions can be developed and sustained if the opportunity is made attractive to them.

Given Consortia Are Good in Principle— What's Broke and in Need of Fixing?

- How do we create consortia?
- How do we make them operate effectively?
- The MCC experience, described in an earlier panel by Bill Stotesbury, seems to have valuable lessons for those who want consortia to be effective at technology transfer.
- The Digital External Research Program is an excellent example of infrastructure for industries and universities to establish channels for technology transfer; it includes both technology feeders and catchers.

Continuous of Discrete Process?

- The transformation process is primarily continuous, at least in the information interchange aspects; it is a two-way dialog process. Actual adoption may be a discrete event, but it results from drawn-out interchanges, compromises, and revisions.
- Industrial research staff should spend time working with the consortium staff; it is not sufficient for company staff to just visit the consortium researchers for review meetings.

What Is Important to Enable the Business Decision About the Invention?

- It is important to mix the research/business cultures.
- One aim of the research should be to develop agreements on the probable magnitude of the business payback.
- Each milestone in the Transformation process should reduce the uncertainty (range of probability estimates) of the estimates of technical, and hence, business success.
- Venture capitalists may help bridge the gap. They are generally better than academics at putting complex business ventures together. But their financial objectives may also get in the way.

Need for Consortia in U.S. Industry

- U.S. industry tends to play with consortia, often joining them for political or marketing reasons.
- U.S. industry needs to realize we are in a life or death struggle around technology transfer. We need to have a more visceral feeling about the importance of consortia as a tool to access research which could not be obtained economically in any other way.
- The group seemed to agree with one participant's expression of the opinion that many CEO's don't understand the management of technology. This may be especially true for modern technology which has advanced in the ten or twenty years since they were directly involved in technology management or practice. It was, therefore, concluded that not much could be accomplished by getting them together with university presidents, etc.
- There seem to be no forums for CEO's concerning the management of technology.
- Since the Business Unit Managers usually make the technology adoption decision, it is more important to work at that level within large corporations.
- Set up consortia at the working level to provide the information that the Business Unit Managers need for the decision.
- The need is to build U.S. industrial competitiveness, to make U.S. decision firms competitive on a world scale. Technology transfer is a means; not the end.
- We have to make the process better than Japan's; not just make improvements.

Industry University Interaction

- To identify the most significant issues, we need to establish channels for industry— research institute discussion of "needs" as well as "feeds." Business and academia have very different orientations; dialog between them provides a rich cross-learning experience. Agreements about what is important will set up good technology transfer conditions.
- Industry's proprietary considerations impose limits to what will be shared during these planning meetings. It is okay to discuss 5+ year trends but probably not the five year plans.
- Many members of the group feel that there is a good argument to use consortia for long-range generic research; this frees up industry's researchers for proprietary development.
- Too much communication (hundreds of pages of research proposals) tends to overwhelm industrial recipients. We need mechanisms to focus the communications. The aim of it should be to establish contacts between the researchers and the most appropriate "technology catchers" in industry.
- The natural tendency is for proposals simply to compete for attention; the first with an adequate proposal wins. Instead:

  universities could package their programs to simplify routing and decision making in the industry to which they are targeting the opportunity.

  industry could clump together and publicize their needs to help universities to identify and respond to a generic, critical mass of requirements for research.
- Consortia can be approached from two quite different directions:

  technology which can satisfy different needs of diverse industrial groups, or

  needs which are common to several members of an industry or industry groups
- Industry associations could help to identify and publicize such shared needs.
- Another role for industry associations (e.g., Industrial Research Institute) might be to publicize what universities have to offer.

Government Incentives

- There was insufficient time to discuss how government can effectively "incentivize" participation in consortia by industry.

Other Comments

- It was pointed out that, in some cases, consortia may appear to compete with internal organizations (e.g., central F&D participants.)
- Consortia are more likely to succeed if they involve all levels of the participating organizations than if they are initiated by top managment without the involvement of the working levels during the initiation process.

C. Focus on Analysis: Ronald G. Havelock, Center for Productive Use of Technology, George Mason University

This dicussion centered on the development of common terms of reference for R&D consortia. What are the essential dimensions of analysis? What are the major types of contortia that need to be differentiated? How can they be studied and compared?

The group was presented with a preliminary list of key question areas and asked to concentrate discussion only on those areas of highest current interest, due to the brief time alloted. Issues discussed, in order, were as follows:

-assessment and measurement of R&D consortia "success"
-generic barriers to technology transfer and how they can be overcome
-the desirability and direction of comparative study efforts

1. Assesment and Measurement Issues

It was generally agreed that the measurement of R&D consortium outcomes is complicated, not only by its intrinsic complexity, but also by the fear of members that important proprietary information will escape to potential competitors through the documented revelation of specific "successes." Evidence of resistance to sharing such data was cited by a number of participants, not only in this dicusssion, but throughout the two days. There was no easy and evident solution to this problem, which lies in the path of direct, rigorous, and comparative analysis of R&D consortia.

The group explored the distinction between *direct* and *indirect* measures of impact. Direct measures of investment, gain, and loss in quantitative terms, which result from involvement in R&D projects or use of consortium products, would be the most convincing evidence that R&D consortia are worthwhile ventures. Such evidence would also allow definitive judgements regarding which types of structures and strategies are most effective.

It was noted that there are a number of ways to assess the performance of R&D consortia other than these quantitative "direct" measures. Among indirect measures, the most obvious is the continued support and the level of support that is provided by private industry. Thus, even if members are unwilling to reveal specifics of what they gained by participation, the very fact that they continue and maintain a high level of involvement can be interpreted as evidence that they are getting a good return on their investment.

We also discussed the various forms of anecdotal evidence that are used to support the continued existence of these collaboratives. Anecdotal evidence is never conclusive, but often persuasive; sometimes even more persuasive than quantitative evidence, since the latter is subject to many kinds of distortions and can have multiple explanations.

Sorting out the real evidence from material which is primarily promotional and self-serving, is going to be a monumental task. It is also a task which probably requires a *national perspective.* Regional, state, and private interests are likely to be shorter range and particularized with regard to types of technology and applications. Only from a national perspective can we look at the very long term interests of the society and have a broad concern for the creation of a more satisfactory R&D infrastructure. At this level of analysis, it doesn't matter which company, or even which state, benefits the most as long as the country benefits.

It was also noted that a great deal of data relevant to R&D consortia performance is already being collected by the organizations themselves for various purposes. However, there has been no significant attempt thus far to aggregate such data. Until this aggregation is done, such data will be of little use either to public policy makers or to other consortium organizers.

2. Generic Barriers and Their SOLUTIONS

The group's discussion of generic barrier issues could be summarized under the three headings: connection, competition, and confusion.

The *connection* barrier has to do with managing the interface between major constituencies and professional interests. University research has its own traditions and norms, as does industry R&D, as do the manufacturing and marketing subdivisions within commercial enterprises. R&D consortia are intended to bridge the gap between these separate subsystems. However, there was some doubt among group members as to whether they actually do this. Rather, they may merely interpose another intermediary system without providing the basic stakeholders with any incentives to change their ways. It was noted that the technology transfer issues with which R&D consortia contend, and are set up to manage, also exist at the individual company level. If they are :ot solved at that level, the work of he consortium may be for naught. Consortia are by nature more public; the issues are more exposed, and hence, perhaps are more easily understandable and more easily resolveable. However, this doesn't mean that the members are necessarily resolving issues in-house and, if not, they still may not be able to make good use of consortium outputs.

Inter-company *competitiveness* is often seen as the most serious barrier to effective development and use of consortia *at their earliest stages* of development. Hence, these are the issues which are worked out first, sometimes in the form of joint agreements on patenting and licensing. The solution appears to lie partly in trust-building, i.e., learning through the experience of working together over a period of months and years, that sharing on several levels is mutually beneficial. The other factor may be identifying the aspects of research and technology that are essentially *pre-competitive* and then focussing the efforts of the consortium on those aspects.

A third barrier issue, which could be dubbed the *"confusion"* or *"chaos"* factor, was briefly discussed in the group. Due to the very rapid growth of consortia, the flood of new legislation, agency directives, executive orders, and myriad state initiatives, there appear to be a jumble of overlapping efforts. As one member put it, "there are many trees, no forest." Such confusion will inevitably make it more difficult for consortia to find appropriate niches without stumbling over one another and wasting resources with redundant efforts. It was perceived that Japanese efforts are far better organized and coordinated, so that whatever redundancy exists is purposeful, and so that there are few, if any, gaps in coverage. Without some national analytic-synthetic effort in the U.S., we are likely to continue in our present confused state.

3. Comparative Consortia Study Project

There was a fundamental disagreement within the group on the desirability of studying R&D consortia in any depth at this point in time. Some participants thought that the entire movement was altogether too new to be subjected to any kind of comparative scrutiny. One group member even likened the process to picking up a tree to examine its roots to see if it is growing properly. However, other members argued strongly that it is never too soon to start studying such an important development to see what lessons can be learned from the early starters to guide those who follow. These members also argued that there are many ways to study R&D consortia which are non-intrusive and fully protective of their interest.

What goals should be paramount if such a nation-wide analytic study is undertaken? Broadly speaking, the group concluded that the goals should be the following:

- to learn what are the best models for what purposes
- to provide guidance for public policy and actions
- to educate participants in present and planned consortium efforts regarding effective strategies and tactics

"The Competitive Challenge: Can America's R&D Consortia Respond"

by Dan Dimancescu

THE COMPETITIVE CHALLENGE:

CAN AMERICA'S R&D CONSORTIA RESPOND?

by

Dan Dimancescu

Partner, Technology & Strategy Group

(THIS IS A DRAFT OF EXTEMPORANEOUS COMMENTS)

Presented to the
T2S Critical Issues Roundtable
Technology Transfer Society
at
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April 28, 1987
(West Lafayette, Indiana)

THE COMPETITIVE CHALLENGE:

CAN AMERICA'S R&D CONSORTIA RESPOND?

by

Dan Dimancescu

One thing seems clear about the competitive challenge facing the United States. The rules of the game must change. The problem is that don't know quite how. And in those cases where we think we do, the inertia of ingrained habits may be slowing or stalling the process.

The general concern of this conference -- technology transfer and R&D consortia -- may be a case in point. Debra Rogers, co-chair with me of this conference, and I will be asking you to rethink some very basic concepts. To do so we will make some outright assertions as a means of inviting reconsideration of the rules of the tech transfer process.

> We will assert that there is something called the <u>Knowledge Asset</u> that is not acknowledged or well understood by corporate managers; yet managing it is emerging as a critical competitive skill for which few are prepared.

> We will assert that <u>Management is a Technology</u>; yet management is not treated by managers or business or engineering schools as a technology. We think of it as a technology for managing the knowledge asset.

We will assert that the language of Technology Transfer is wrong. It has become a fuzzy domain of academics concerned with theorizing its meaning; it should be a business of doers concerned with accelerating the commercialization of knowledge.

We will analyze these assertions through the particular perspective of industry, academic, and government participants in R&D consortia.

To provide some context to our exchanges tonight and tomorrow, I will touch on three themes. First by reflecting on recent American history, my goal will be to try and describe, albeit quite subjectively, some entrenched legacies. Indeed, the mini-thesis of my comments tonight is that it is those legacies that are causing a faltering of our economy.

Second, let me share a possible formulation of how we might conceptualize economic demands being imposed on our firms and academic institutions. This formulation provides a new context for discussing technology transfer.

And third, let me close by focusing on the role R&D consortia may, or may not, be playing in helping rewrite the rules.

ONE: A historical perspective

The twentieth century witnessed the blossoming of American enterprise. The foundations of that evolution were unique advantages of abundant resources, a vast and cheap labor supply generated by agricultural efficiencies and waves of immigrants, and an organizational technology born in the early 1900s that is better known as "scientific management."

The 1950s and 1960s may have represented the culmination of these resources. But we discovered, too, during the same 1950s and 1960s period, the economic potency of knowledge as a raw material. The birth of science driven missions during the second-war was translated into a science driven economy fueled by federal dollars during the post war period. Out of it were born the NSF, federal labs, and mission oriented agencies such as NASA.

The success of that twenty year period -- a fabulous story of unprecedented wealth creation -- was seen by the world as an awesome "American Challenge" to be feared and emulated if any other industrial nation wished to survive as a peer. No one stopped to consider the implications of what, in retrospective, is the obvious: The United States had no competitors. And by not considering even the remotest possibility that new competitors might someday arise, the U.S. economic machine was put on "automatic." It epitomized the "if it ain't broke don't fix it" ditty. Nothing changed -- and alot got worse.

Two things got worse. First, we started spending money faster than we were generating it. With the Gulf of Tonkin Resolution in 1964, the military wealth spending agenda took root alongside a growing social agenda. We remember this strategy best as Lyndon Johnson's "guns and butter" vision of an ever abundant America.

Second, what we were not noticing was a flatening of our economy as productivity starting lagging -- at the very same time that competitors were growing stronger. In 1964, Japan exported a grand total of 19,000 cars to the U.S. We joked about Japanese "chain-driven" cars. That year we produced almost 10,000,000 units. By 1980, Detroit was reeling with production down by almost one-half its peak! By 1986, in its first year of exports to the U.S. Korea's Hyundai sold 150,000 units. Our semiconductor industry cannot sustain its own suppliers of manufacturing equipment or retain export markets. Agriculture is now in trade deficit.

What we believed would sustain us hasn't.

1. We believed that a management formula -- summarized in the name "Taylorism" or synonymously "scientific management" -- could endure. Production focused on quantity alone wasn't working.

2. We believed (and still believe) that a science driven economy is indeed the key to success. It worked during the 50s

and 60s, we are reminded; it will work in the 90s and beyond, we are told. Why it didn't work in the 70s and 80s, isn't explained.

What we didn't want to believe is what has now passed us by.

1. We didn't want to believe that a management formula invented in the U.S. during the 20s and 30s in the Bell system -- otherwise known as Statistical Process Control as preached by Walter Shewhart, W. Edwards Deming and others -- could do better than Taylorism. We let it migrate to Japan in the early 50s. It now haunts us.

2. We didn't believe that there could be such a thing as a technology driven economic success story. Too enamored with the linear path that pushed ideas from labs through countless barriers to unknowing markets, we ignored the simple opposite that demand could itself pull technology into the economic mainstream.

Consider the implications of these legacies when it comes to conceptualizing the meaning of the phrase "technology transfer".

QUESTION: Would a science driven economy whose enterprises were founded on principles of scientific management not have a very different definition of "technology transfer" than an economy with a technology driven economy founded on a managerial process heavily influenced by statistical process control methodologies?

QUESTION: Can a definition of technology transfer tailored to the dynamics of a science driven federal lab have any meaning in a world economy that is not science but technology driven?

QUESTION: How would a manager conceptualize the process of technology transfer in a "tayloristic" setting characterized by functional barriers, manager/employee adversity, and strict hierarchical structure?

QUESTION: Would an academic whose reward system is founded on proving himself/herself in science based work not view the process and language of technology transfer from a very different perspective than one who believes that technology is a means and an end that may have little or nothing to do with science as it is commonly defined?

The differences are as night is to day. Yet a vast number of U.S. managers, scientists and engineers, policy-makers, and academics remain wedded to a view -- or to legacies -- of an earlier economic setting that no longer holds true.

TWO: A new context for T2

If, indeed, a now set of demands are being placed on our enterprises as a result of rising competition, what are they and how might they affect our conceptualization of the tech transfer process.

New knowledge must be developed for manufacturing science to advance -- or indeed for U.S. manufacturers to bounce back to world leadership. One challenge is to develop firms that interweaving all components of the manufacturing process into a single integrated system. Such a system, for it to be successful in today's markets, must be designed to make quick and effective adjustments to changes in world competition.

To date, however, rather than looking at the whole picture, most creative effort has been invested in addressing components of the system. The effect is a continuous stream of discrete technological innovations. Many go underused by firms too rooted in compartmentalized behavior. One effect is that our best innovations are migrating off-shore with increasing speed. In short: The technology transfer process is not working.

"DESIRED OUTCOMES: A New Focus

It would seem appropriate for manufacturing firms to define sets of "desired outcomes" required for them to remain competitive. Those outcomes, in turn, would rapidly define the optimal "technology research and transfer agenda."

For illustrative purposes, one formulation of an evolving chain of outcomes for durable goods manufacturers is described. This chain is presented as an evolution of outcomes to be mastered over time.

OUTCOME 1: Q — Quality of processes, products and services is the first outcome required for firms to be competitive. It is preceded by a mastery of high volume production at lowest possible cost.

OUTCOME 2:	C	Lo-Cost is a corollary to understanding and achieving high standards of quality.
OUTCOME 3:	Run of One	Unit-of-one production is an idealized outcome of flexibly managed product production lines. It expresses perfect satisfaction of a single customer's needs.
OUTCOME 4:	Time = Zero	Time-zero is an equally idealized outcome of a competitively managed firm. The idea to sale and service cycle should be compressed to its minimum time requirements.
OUTCOME 5:	Nano	Nano-standards must be achieved in manufacturing processes for contemporary manufacturing firms to remain competitive. This requires quality and cost mastery of the atomic structure of materials, of molecules and genetic codes in biotechnology, nano-seconds in electronics, and bits in information processing. Achieving high quality, lo-cost, and compressed time cycle in nanofacturing remain an immense hurdle.
OUTCOME 6:	Perfect Info	Perfect-information creation and use is an idealized outcome necessary for firms to remain competitive. Intensifying competition is putting more and more of a premium on mastery of information, and hence knowledge, as the key to survival.

Achieving these desired outcomes will define winners and losers in world manufacturing. To master them, however, a new science must be conceived. That science has yet to be fully developed in the U.S. -- not to speak of being integrated into manufacturing firms. For now, though, it appears that the Japanese are moving more and more rapidly toward mastery of this progression of outcomes than we are.

To achieve these outcomes will involve designing two complementary research agendas: one agenda is alive with activity but poorly focused; the other is not commonly acknowledged or addressed.

AGENDA #1: New Technologies

To master the six suggested outcomes, new technologies must be developed and tapped. For example : What role will a particular ceramics research program play in achieving one or several of the outcomes? What importance might there be in developing new vision controls on production line machinery? What function might a particular CAD, CAM or CIM development have? What function might an expert system have?

By matching technologies against desired outcomes a comprehensive grid -- as detailed as necessary -- can be constructed that will pin-point needed research.

AGENDA #2: Management as a New Technology

If a new science of manufacturing is to evolve it must treat management itself as a new technology. Some observers, W. Edwards Deming being one, have long said that 80% of the manufacturing problem may have more to do with management than any other single factor. New and well-honed concepts, tools, and procedures for managing complex enterprises and technologies are needed.

It is the linkage between "outcomes" and these two agendas that represents the technology transfer process. T2 is the start-to-finish creation and flow of knowledge through the stages of innovation, transformation, and commercialization. (These will be described by Debra Rogers in greater detail).

THREE: R&D Consortia

All current R&D consortia -- and there are about fifty new ones created since 1980 -- have a single-minded mission: the pooling of resources to affect the creation of new knowledge. Most consortia were created as a result of competitive pressures. As a result most are aimed at producing direct economic benefits -- however poorly defined that goal might be. No two consortia are alike. Recent work I completed, that appears in a new book "The New Alliance," concludes that the search for single exemplary and replicable model of an ideal consortium is a futile and wasteful activity.

Do consortia work when it comes to judging whether or not they are "transferring technology?" On this point there is considerable disarray. With some exceptions, there is little agreement on what successful "technology transfer" entails. Further, beyond broadly stated goals of wanting to affect the competitive position of U.S. firms, there is little agreement on what "improved competitive strength" itself may mean.

To provide this conference with some benchmark -- or judgment -- from which to elicit commentary on the role of R&D consortia as a "response to the Competitive Challenge," I offer the following observations.

Recently created consortia may be the single-most (a) exciting or (b) inconsequential on-going experiment currently in place in the United States. Why?

- Pro: Consortia are the most effective mechanism for pooling industry, academic, and government resources toward solving well-defined technological problems.

  Con: However, consortia are highly vulnerable to inconsistencies in funding and leadership from each of the constituent institutions. Whether they can sustain long-term projects and build self-sustaining momentum is far from self-evident.

- Pro: Consortia offer an innovative and unique institutional setting for the technology transfer process (e.g. creation and movement of knowledge) to blossom.

  Con: However, there is little evidence that consortia are tackling the problem of treating management itself as a technology. As a result many member firms of consortia are ill structured to take full advantage of the technological outcomes from consortia.

- Pro: Consortia have the potential to change the rules of the game. They could be highly instrumental mechanisms for instituting radical structural changes within firms and within academic institutions.

  Con: However, there is enough evidence to suggest that consortia may be serving much more as "impedence managers" whose task is to keep the member institutions (industry and academe) from having to consider radical internal change. For academics this means buffering efforts to weaken rigid departmental barriers or the tenure system; for companies it may mean buffering pressures for a given firm to restructure or to invent more efficient internal operating systems.

CONCLUDING REMARKS

The American economy may still be riding on economic legacies that are either outmoded or ill-suited to affect the contemporary competitive environment. One legacy is the managerial dependence of scientific management principles; another is a continued belief in the linear concept of science-driven technology.

A second theme discussed in this presentation was the belief that firms must reconceptualize outcomes of their operations. Achieving them will then better focus technological research agendas as well as the need to treat management itself as a technology.

Finally, the phenomenon of consortia is treated as one of the most important economic events of the latter part of the century. But whether consortia will indeed exert the require influence on their members institutions remains highly problematic.

END

"The Collective Challenge: Optimizing The Technology Alliance"

by Debra M. Amidon Rogers

"The Collective Challenge:

Optimizing the Technology Alliance"

Presented by Debra M. Amidon Rogers, Digital Equipment Corporation at the Technology Transfer Society Roundtable

The purpose of this Roundtable is anything but modest— a whole new conceptualization of the technology transfer process and its impact on the competitiveness of this nation. The April 20, 1987, issue of Business Week featured a special report on "Can America Compete?" Several points are only too familiar:

> The fact remains that the U.S. is still a creative hothouse. Its laboratories churn out important advances and whole new technologies, from biotechnology and fiber optics to superconductivity. And foreign students flock to U.S. universities, where they now account for 20% of all students and a staggering 55% of those studying engineering. So the failure is not American technology - it is American manufacturing. U.S. industry has big trouble when it comes to transforming ideas into products that can be sold on world markets." [1]

The article describes how the Japanese have created a "manufacturing infrastructure that can respond with blazing speed to market demands and changing opportunities." It also provides a mixed review of America's R&D performance and references some fine-tuning needed to fuel our "industrial engine."

It was only one month ago that the Wall Street Journal revealed the swiftness with which the Japanese are prepared to capitalize on a technological breakthrough.

> "Four days after the Houston bombshell, Japan's Science and Technology Agency announced its intent to form a research consortium of Japanese companies, universities, and government labs. A week later the consortium was in place, including such industrial giants as NEC, Toshiba Corporation, Nippon Steel Corporation, and Mitsubishi Corporation." [2]

Although scientists in America (and abroad for that matter) may argue about how premature such commercialization techniques might be, the story is illustrative of the dicotomy between the Japanese and American responses. Although there are significant efforts underway within individual corporations and universities, and a bill entitled the "Superconductivity Competition Act of 1987" was filed in the Senate on March 30th, the reaction by the U.S. is somewhat modest in comparison to the Japanese initiative.

Some might suggest that this nation, indeed, is in crisis. I am hard pressed to argue the point, but if we look carefully at the Japanese symbol for crisis, we note that part of the symbol means opportunity.

Figure 1: Japanese Symbol for Crisis

In other words, the Japanese view crisis situations as opportunities to solve identified problems. This requires a real paradigm shift for us, as Americans, to think similarly. Our challenge today is none other than to seek that optimistic shift in thinking.

Purpose of the Roundtable:

This meeting was designed to bring together a cross-section of over 80 leaders in technological innovation to focus on how research consortia might enhance our efforts. Business Week entitled it "Science, Inc." [3] when it described the phenomenon of cooperative research activity such as that developed with the Cooperative Research Act of 1984. Since that time, at least 50 consortia have been formed and many more are on the drawing boards. Many of these consortia are represented by the people in this room. This number does not include the Engineering Research Centers. But, in the same time period, the Japanese have formed no less that 225+, according to a Dataquest report. [4]

At the recent IEEE Briefing of the R&D Budgets for the 100th Congress, one could hardly ignore the significant increase in research center activity proposed by the National Science Foundation and the Department of Defense. There was also considerable discussion about the anticipated "pork-barreling" effort of more resources being allocated accordingly, all in the name of industrial competitiveness.

As most consortia and research center directors have come quickly to realize, the heart of the problem (opportunity) is the management of effective technology transfer. It is plagued with mixed definitions (oftentimes conflicting), minimal understanding of the real issues, and a lack of candid discussion of the interdependencies required across the sectors (i.e., government, industry, and education). We need to address a range of structural issues, assess resource support, and identify what methods and tools are most effective. Thus, the idea for this meeting was born.

In testimony given to the House Committee on Science and Technology, Lee W. Rivers, on loan to the Office of Science and Technology Policy, stated that the time is past for studying industrial competitiveness.

> "We do not need more studies, we do not need more finger-pointing or fault-finding— we do need a national consensus that industrial competitiveness is essential to the key role each can play in the step-by-step process of regaining America's position of leadership in the global marketplace." [5]

A new research action agenda is needed that focuses on the transfer of knowledge across disciplines, across sectors, across industries, across the profit and not-for-profit organizations. This new agenda will have to transcend our current thinking and serve as a catalyst for establishing a new vision of cooperative alliances.

To that end, Dan Dimancescu and I, with the help of a small planning team, have brought together those of you we feel have experience and are in a position to exchange ideas on your perception of what the new R&D enterprise might be.

Our goal is to recraft a management agenda which defines the technology transfer process from idea generation to profitable commercialization.

Specific objectives include

- Optimized utilization of national resources
- Redefined concept of technology transfer
- Framework for a shared vision of the real barriers to effective transfer and new approaches for capitalizing on opportunities

Roundtable Agenda/Format:

This Roundtable is not designed as a series of canned presentations describing the various programs underway throughout the nation. Rather, the agenda calls for representatives from each of the three sectors (i.e., government, education, and industry) to provide their observations of what needs to happen to make us more internationally competitive and, specifically, the role that R&D consortia might play. All remarks will be taped, but only for the purpose of capturing an accurate record of the issues and strategies defined. No one will be quoted without permission, so we are hopeful that the dialogue will be open and candid.

This evening we will recognize the accomplishments of William C. Norris, Chairman Emeritis of Control Data Corporation. In the estimation of the Technology Transfer Society, Mr. Norris best exemplifies the legacy of Justin Morrill, a person who knew how to bridge alliances across the three sectors of this nation.

During tomorrow's lunch presentation, Sheridan Tatsuno, Senior Analyst, Dataquest, will enlighten us as to the status of the Technopolis Strategy, [6] the ambitious ten-year plan to transform Japan from a society of "imitators" to a society of "innovators," through the development of a "techno-state" of research cities throughout their country. Modeled on our own Silicon Valley, these technopolises will feature research universities, science centers, industrial research parks, joint R&D consortia, venture capital foundations, office complexes, convention centers, and residential new towns.

The heart of the Roundtable program is the three panels originally entitled Forecasting, Assessment, and Utilization. We decided instead to label them according to the Stages of Innovation defined by the U.S. Department of Commerce: Invention, Translation, and Commercialization. Later in this paper, the steps within each stage are defined to facilitate discussion.

Each panelist was asked to prepare about 15 minutes of catalytic remarks and then all Roundtable participants are welcome to participate.

In the afternoon, we will conclude with a work session focusing on three major areas that require some fundamental initiatives: Policy, Practice, and Review. The recommendations that surface in those discussions will help establish the framework for the National Campaign for Competitve Technology Transfer, which will be announced officially in June at the International Symposium of the Technology Transfer Society.

To help frame the discussion and optimize your input, I will offer some models that I have developed over the three years of managing technology transfer activities within the External Research Program at Digital. They are provided to guide, not limit, the dialogue.

The Technolgy Transfer Continuum:

First, let me describe my vision of the technology transfer process, represented here by a continuum. Several functional areas, from corporate research to final market acceptance, are identified in the model. It is intended to be somewhat dynamic, versus linear, in that feedback loops are provided.

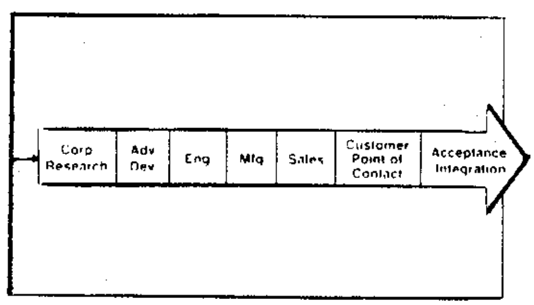

Figure 2: The Technology Transfer Continuum

Whether we refer to bringing research ideas into the corporation, moving them within line engineering groups, or integrating products through the manufacturing process, the issues (and opportunities) are still the same. Digital even offers an extensive six-week training course in artificial intelligence for customer point-of-sale people. The last two days of that course are dedicated to organizing technology transfer techniques to ensure marketplace adaptation.

The above continuum is depicted as a color spectrum. It is not clear exactly when the transfer takes place at each connect point in the transfer process. And it is difficult to assign specific steps, stages, or metrics of success as a product or process moves through each cycle. This is a challenge for all functional managers.

If we attempt to take a historical view of this continuum, one might suggest that during the post war period of 1945-1965, we could describe the timeframe as the "Basic Science Era." This represents a period of the founding of the National Science Foundation, Federal Laboratory initiatives and the relative non-competitive environment referred to by Dan Dimancescu earlier today. There are mixed reactions to the strength of the links between education and industry at this point, and federal links were primarily made with the large industrial corporations and elite private institutions.

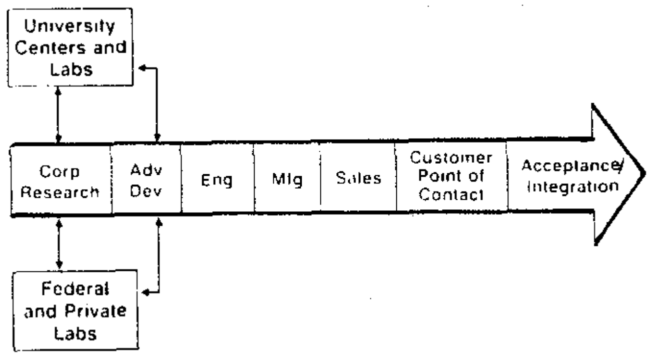

Figure 3: Technology Transfer Continuum: Basic Science Era (1945-1965)

The next period, 1965-85, we will entitle "The Entrepreneurial Phase," with the influx of venture captial activity, the efforts to commercialize the Federal laboratory's research, and a renewed focus on the needs of the marketplace. In this internal competitive environment, there was more focus on product than managerial processes. We witnessed an explosion of academic research foundations, research parks, RDLP's, incubator facilities, and the emergence of technology transfer brokerage functions. The focus during this phase was more to the end of the continuum, and we observed evidence of the basic research investment actually declining as a percentage of the federal budget.

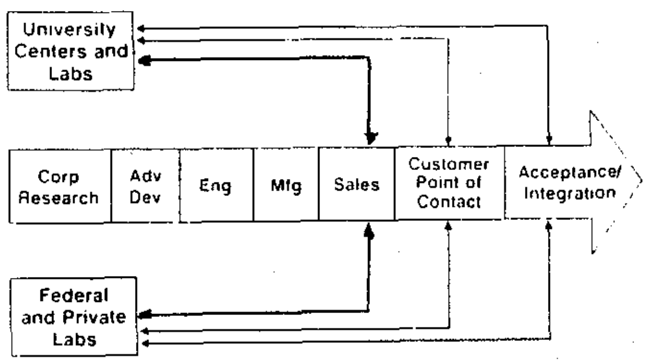

Figure 4: Technology Transfer Continuum: Entrepreneurial Phase (1965-1985)

In this new era in which we find ourselves, and through the beginning of the 21st century, we suggest that there is a need for "Rethinking the Alliances." We need to refocus on the total process as well as product technologies. A more careful utilization of resources (i.e., technical, financial, and human resource) across the sectors is required in order to ensure more profitable gain and optimal interaction.

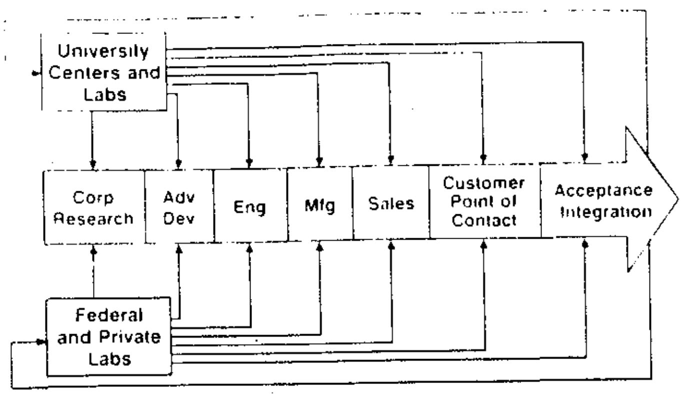

Figure 5: Technology Transfer Contiuum: Rethinking the Alliance (1985-2005)

This is the era in which we must carefully analyze our own strategies in light of the global economy. Our goal is not to emulate the successes of cultures abroad, but rather to fully comprehend their motives and techniques in order to position our own counteractive initiatives.

For example, according to Thomas Eager, MIT Professor, Japanese competitors aggressively pool resources and technical knowledge early in the research process in order to advance the state-of-the-art. Research studies are unified and shared widely. In a paper entitled "Technology Transfer and Cooperative Research in Japan," [7] Eager describes how this strategy avoids unneccessary duplication, ensures efficient and effective allocation of industrial resources, and results in the rapid dissemination of new research findings. There is no such systei,. within the United States that so effectively integrates new knowledge into the mainstream of our economy.

The Planning Model:

The process of harnessing creativity toward profitable innovation is a complex phenomenon. There are numerous players and factors involved that both hinder and enhance the process. Add to this scenario the three integral partners in the research enterprise— each with its own vision and paradigm— and we have a seemingly impossible task to ensure mutual cooperative activity.

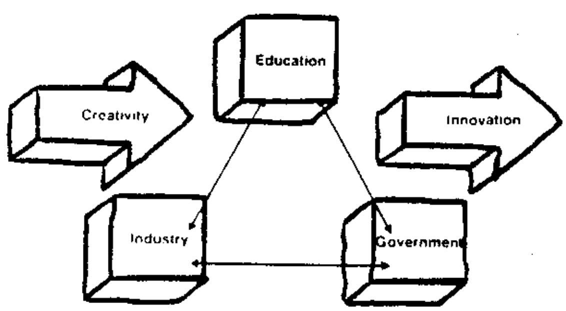

Figure 6: The Planning Model

In order to analyze the strengths and weaknesses of the existing research infrustructure, there are at least three elements worthy of careful attention: structure issues, resource issues, and methods/tools available for technology transfer. At the core of the assessment is the process itself.

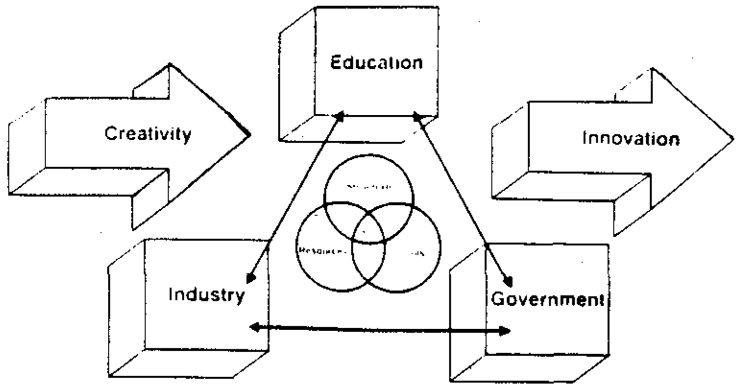

Figure 7: The Planning Model: Technology Transfer Elements

Each panelist was provided a copy of sample questions that could be addressed from each stage in the innovation process. The topics referenced include the roles of governing boards and participating companies, legal/contractual issues, the mix of staff/ research resources, planning techniques, return-on-investment metrics, the adaptation of electronic tools, and more.

The Planning Framework.

Looking at the analysis another way, a planning cube can represent more graphically the interdependencies of the sectors, and it forces, in a three-dimensional nature, a more complete assessment of the different roles each sector might play at any given point in the process of innovation.

The first dimension defines the three perspectives to be analyzed, each representing an integral sector which contributes to the research enterprise.

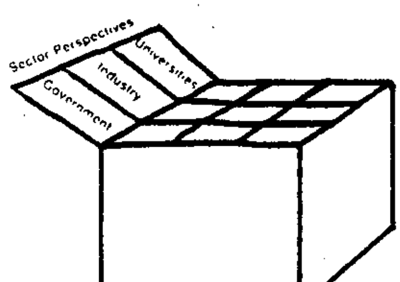

Figure 8: Technology Transfer Framework: Perspectives

In the government sector, we must examine both the federal and state initiatives designed to increase our economic development capacity. Federal programs include the NSF, Department of Defense University Research Initiatives (URI), and all the federal and national laboratories now part of the Federal Laboratory Consortium (FLC). On the state level, we might review state wide programs (e.g., Ben Franklin Partnership, New York Centers of Excellence, Ohio's Thomas Edison Program, et. al.).

In the education sector, we should examine both public and private education and the capacity to ensure our science and technological leadership for the next generation. This could include university-based research centers, cross-disciplinary research centers, multi-university research consortia, and the myriad of activities underway within the professional societies to strengthen the academic infrastructure through changes in the curriculum, new faculty development programs, and initiatives to upgrade research facilities that are becoming obsolete.

Finally, as we turn to the industry sector, we need to consider the R&D capacity nationwide across corporations and across industries. This would include corporate research laboratories as well as multi-corporation consortia (e.g., Microelectronics and Computer Technology Corporation, Semiconductor Research Corporation, and the Software Productivity Institute). Further review might include the activities and effectiveness of specific technical societies, the Industrial Research Institute, and independent research organizations.

The second dimension of the cube defines the basic stages in the process of innovation, originally defined by D. Bruce Merryfield. [8] They are Invention, Translation, and Commercialization— the focus of the Roundtable Panels. Each stage in the process has significant technology transfer implications. Responsibilities within each sector differ at the various stages of the process.

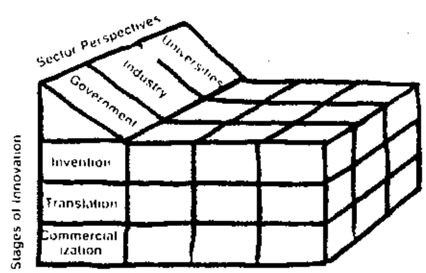

Figure 9: Technology Transfer Framework: Stages of Innovation

In an attempt to crystalize the different types of activities that might occur in one stage as opposed to another, I have developed the following diagram.

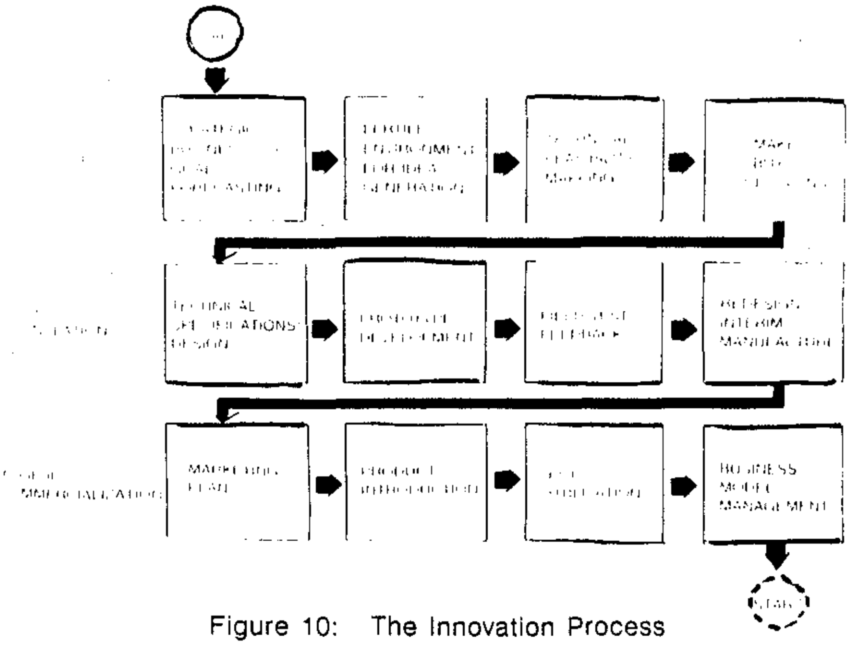

Figure 10: The Innovation Process

This flow chart was prepared to guide the discussion, not as a precise definition of the key steps. It is intended to force discussion at all levels of the process, rather than focusing on only those steps with which we are familiar.

The third dimension of the cube, which completes the design of the framework, refers to the parameters for analysis: structure, resources, and methods/tools utilized in the transfer of technology.

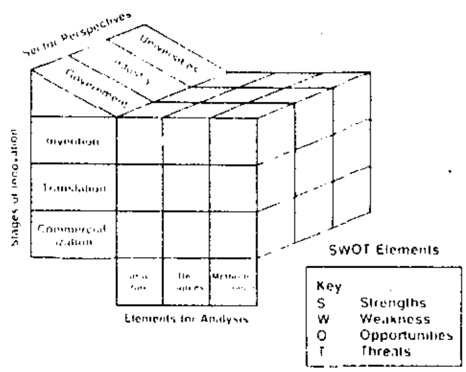

Figure 11: Technology Transfer Framework: Elements for Analysis

Structure issues range from organization design to policy decisions. There are resource needs, whether they be financial or human, required to ensure the success of any research alliances. Finally, there are methods and tools that can be used to enhance the process. Some are procedural, while others can be tangible vehicles, such as electronic communications, that can ensure the production of a profitable product marketed to the customer in a timely fashion.

Strategic Planning Model:

The cube provides a framework for analyzing some of the critical factors that should be evaluated when determining the viability of our research enterprise.

In fact, if we contrast one cube as a snapshot of the research capability today with a similar cube which represents a vision of a desired state, we can determine what strategies might be formulated to ensure our future success.

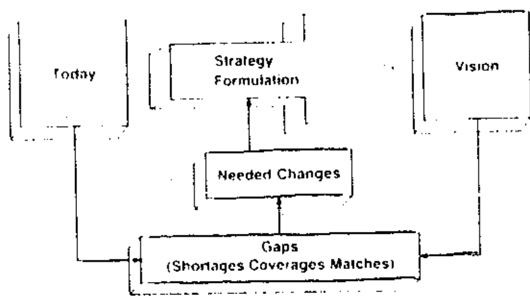

Figure 12: Strategic Planning Model

This type of strategic thinking is required not only for each university, corporation, or government entity. It is essential that we begin to focus on the research capacity nationwide. More importantly, we need to ensure that precious resources are being allocated wisely and, in truth, in the best interest of the whole enterprise.

In the newly released study by the National Research Council entitled *Management of Technology: the Hidden Competitive Advantage,"* [9] the authors define how "the current, intensely competitive global environment is demanding a renewed emphasis on effective technology management and a re-evaluation of traditional techniques."

They describe, in detail, the roots of the problem and offer a "problem-driven" research agenda which calls for an increased role for the National Science Foundation, the Department of Defense, and NASA in promoting public awareness and financing cross-disciplinary research on the subject.

This represents a good beginning.

In Summary:

If we can agree that the knowledge base of the United States is our most precious resource, then we can begin to manage it more effectively. This requires a re-thinking of how the intellectual capital of each sector— education, government, and industry— should be developed and applied to the dual goals of the advancement of science and technology, as well as international economic competitiveness of our nation.

Although there are several corporations, like Digital, which are commited to allocating more resources toward building the necessary R&D infrastructure, cash or equipment resources are not as critical as the technical talent required to sponsor, monitor, and transfer the research results back into the corporation. I suspect that any academic or government official might have similar opinions.

It is my hope that, by the end of the next 24 hours, each person in this room will leave with a greater understanding and appreciation for the real challenge ahead. As Dr. Peter Bridenbaugh, Vice President for Research at Aloca, recently said, "where we invest our intellectual capital and curiosity, technical transfer is not an issue." [10]

Quantum, rather than incremental, improvements are needed to optimize our R&D enterprise. This requires some real paradigm shifts that may have to occur in each sector to ensure that we are capitalizing on the relative strengths of each. It also requires a shared vision of what it means to collectively harness our own competitive advantage.

Momentum is building with recent legislation, new resource allocation strategies, and increased attention to the technology transfer process and its role through all stages of innovation. I am personally encouraged that, indeed, we are beginning to view the economic condition in which we find ourselves as an "opportunity to solve the problems."

As this symbol reflects,

橋

Figure 13: Japanese Symbol for Bridge

this Roundtable affords us one such opportunity to make some connections, intellectually and personally, that will evolve into some creative solutions for this country to regain its competitive position in the world.

Let us begin by building some bridges across the sectors that protect and leverage the technological brainpower that we treasure.

1 Port, Otis and Wilson, John W., "Making Brawn Work With Brains, *Business Week*, April 20, 1987, page 56.

2 Yoder, Stephen Kreidler, "Japan is Racing to Commercialize New Superconductors", *The Wall Street Journal*, March 20, 1987.

3 "Now, R&D is Corporate America's Answer to Japan, Inc.," *Business Week*, June 23, 1986, page 134.

4 Tatsuno, Sheridan, "Building a Japanese Techno-State: MITI's Technopolis Program Underway," *Research Newsletter*, Dataquest, 1987-3.

5 Rivers, Lee W., "Time is Past for Studying Industrial Competitiveness," *Research Management*, Volume 30:1, January-February, 1987.

6 Tatsuno, Sheridan, *The Technopolis Strategy*, Prentice-Hall Press, 1986.

7 Eager, Thomas W., "Technology Transfer and Cooperative Research in Japan," *Scientific Bulletin*, ONRE:10(3)85.

8 Merryfield, D. Bruce, "Forces of Change Affecting High Technology Industries."

9 Herink, Richie, et. al., *Management of Technology: The Hidden Competitive Advantage*, National Academy Press, 1986.

10 Bridenbaugh, Peter, Remarks at the Engineering Research Council Forum, American Society for Engineering Education, March 2, 1987.

"Better Managing Technology Through Technological Cooperation"

by William C. Norris

Remarks by

WILLIAM C. NORRIS

CHAIRMAN EMERITUS

CONTROL DATA CORPORATION

at the

TECHNOLOGY TRANSFER SOCIETY

CRITICAL ISSUES ROUNDTABLE

PURDUE UNIVERSITY

APRIL 28, 1987

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BETTER MANAGING TECHNOLOGY THROUGH TECHNOLOGICAL COOPERATION

IT IS A PLEASURE TO PARTICIPATE IN THE ROUNDTABLE ON TECHNOLOGY TRANSFER ISSUES. YOUR ORGANIZATION, WITH ITS OBJECTIVE OF IMPROVING THE MANAGEMENT OF OUR TECHNOLOGY, HAS A SIGNIFICANT ROLE TO PLAY IN A NATIONWIDE EFFORT TO INCREASE U.S. COMPETITIVENESS. IT IS DIFFICULT TO EXAGGERATE THE SERIOUSNESS OF THIS PROBLEM, CONSIDERING THAT MORE THAN 70% OF OUR DOMESTIC MARKET IS WIDE OPEN TO FOREIGN COMPETITION. THE PLAIN TRUTH IS THAT THE U.S. IS IN A GLOBAL STRUGGLE, THE COMPETITION IS FIERCE, AND IN INDUSTRY AFTER INDUSTRY, WE ARE LOSING MARKET SHARE (ATTACHMENT 1). EVEN IN HIGH TECHNOLOGY INDUSTRIES, WE HAVE LOST MARKET SHARE IN SEVEN OUT OF TEN SECTORS. ELECTRONICS POSTED AN OVERALL TRADE DEFICIT WITH JAPAN IN 1984 FOR THE FIRST TIME, AND WORSENED IN 1985 WHEN IT SURPASSED OUR DEFICIT IN AUTOMOBILES.

OF THE MANY ACTIONS REQUIRED TO RESPOND TO THE COMPETITIVENESS CHALLENGE, NONE IS MORE IMPORTANT THAN BETTER MANAGING OUR TECHNOLOGY SO THAT WE CAN EXPAND U.S. INDUSTRIAL INNOVATION ON AN UNPRECEDENTED SCALE TO MEET THIS SERIOUS CHALLENGE.

THE MOST PRODUCTIVE, AFFORDABLE, AND READILY AVAILABLE OPPORTUNITY TO EXPAND INNOVATION IS TO SUBSTANTIALLY INCREASE THE EFFICIENCY OF RESEARCH, DEVELOPMENT AND MANUFACTURING THROUGH PUBLIC/PRIVATE TECHNOLOGICAL COOPERATION. OUR EFFORTS TO WORK TOGETHER MUST INCLUDE COOPERATION WITHIN INDUSTRY, AMONG INDUSTRY, UNIVERSITIES AND GOVERNMENT AND AT THE COMMUNITY LEVEL AMONG ALL SECTORS. AS WE ACHIEVE THIS WIDE-RANGING COOPERATION, IT IS CRITICALLY IMPORTANT THAT THE SPECIAL NEEDS OF SMALL ENTERPRISE BE SERVED. ALSO, NEW INSTITUTIONS MUST BE ESTABLISHED TO BRING ABOUT THE MASSIVE INCREASE IN COOPERATION THAT IS REQUIRED. I WILL MENTION THREE ... THE MICROELECTRONICS AND COMPUTER TECHNOLOGY CORPORATION, A JOB CREATION NETWORK AND THE MIDWEST TECHNOLOGY DEVELOPMENT INSTITUTE, EACH OF WHICH I HAVE HAD A HAND IN DEVELOPING.

BESIDES THE ALL-OUT EFFORT TO EXPAND COOPERATION, THE UNITED STATES MUST MOVE AGGRESSIVELY TO ELIMINATE THE HUGE DISPARITY IN TECHNOLOGY FLOWS, WHICH IS A MAJOR FACTOR IN THE TRADE GAP BETWEEN THE U.S. AND JAPAN. A REPORT PREPARED FOR THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS ALSO ADDRESSED THIS ISSUE AND CONCLUDED THAT "A GLARING ASYMMETRY" CHARACTERIZES THE INTERNATIONAL FLOW OF TECHNOLOGICAL KNOWLEDGE AND THAT THE FLOW HAS BEEN PREPONDERANTLY "OUT FROM THE U.S."

EXPERTISE IN BIG BUSINESS IS UNDERUTILIZED. BY OFFERING THEIR UNDERUSED TECHNOLOGY AND IDEAS AND THEIR PROFESSIONAL AND MANAGEMENT ASSISTANCE TO SMALL COMPANIES, LARGE COMPANIES CAN REALIZE ADDITIONAL INCOME FROM PAST INVESTMENT -- AND, THROUGH EQUITY INVESTMENTS IN AND R&D CONTRACTS WITH SMALL COMPANIES, THEY CAN GAIN MORE ECONOMICAL ACCESS TO NEW PRODUCTS AND MARKETS.

SIX YEARS AGO, CONTROL DATA STARTED TRANSFERRING SELECTED TECHNOLOGIES TO SMALL STARTUP COMPANIES AND MAKING EQUITY INVESTMENTS AND PLACING R&D CONTRACTS WITH THEM. CONTROL DATA HAS DEVELOPED THIS COOPERATIVE RELATIONSHIP WITH MORE THAN 70 COMPANIES, AND WE ARE VERY PLEASED WITH THE RESULTS. A FEW OTHER LARGE COMPANIES ARE DOING IT TOO, BUT, IT'S CLEAR THAT THE PRACTICE IS NOT NEARLY AS WIDESPREAD AS IT SHOULD BE.

<u>INDUSTRY-UNIVERSITY-GOVERNMENT COOPERATION</u>: THERE ARE NUMEROUS EXAMPLES OF COOPERATION AMONG INDUSTRY, UNIVERSITY AND GOVERNMENT SECTORS. ONE IS THE MICROELECTRONIC AND INFORMATION SCIENCE CENTER FORMED IN 1980 AT THE UNIVERSITY OF MINNESOTA. ALTHOUGH SOME FUNDING HAS BEEN PROVIDED BY THE STATE OF MINNESOTA AND FEDERAL RESEARCH GRANTS, A SIGNIFICANT PART OF IT HAS BEEN FURNISHED BY LARGE COMPANIES. HOWEVER, OTHER ORGANIZATIONS, ESPECIALLY SMALL ENTERPRISE, HAVE ACCESS TO THE R&D RESULTS AND ARE PARTICIPATING IN SETTING RESEARCH DIRECTIONS. AS A RESULT, IT IS CONTEMPLATED THAT MANY NEW COMPANIES WILL BE SPAWNED.

THERE ARE OTHER EXAMPLES OF INDUSTRY-UNIVERSITY-GOVERNMENT PARTNERSHIPS, AND THEY ARE PRODUCING IMPORTANT RESULTS, BUT MOST OF THEM REQUIRE MUCH BROADER SUPPORT IF THEY ARE TO REALIZE FULL POTENTIAL. FURTHERMORE, THE OVERALL LEVEL OF EFFORT IS WOEFULLY SHORT OF THE VAST NEED FOR MORE TECHNOLOGICAL COOPERATION. THIS IS AN OBJECTIVE OF THE MIDWEST TECHNOLOGY DEVELOPMENT INSTITUTE.

<u>COMMUNITY LEVEL</u>: HOWEVER, BEFORE DESCRIBING THAT ORGANIZATION, I WILL REVIEW COOPERATION AT THE COMMUNITY LEVEL WHEREBY COMMUNITIES CAN MORE EFFICIENTLY UNDERTAKE INITIATIVES FOR EXPANDING INNOVATION.

ONE IMPORTANT PART OF A BROADLY-BASED COMMUNITY COOPERATIVE EFFORT IS TO HELP SMALL BUSINESSES START UP AND OPERATE SUCCESSFULLY.

TO FACILITATE THIS AND A NUMBER OF OTHER ACTIVITIES, A NEW TYPE OF INSTITUTION IS NEEDED CALLED A JOB CREATION NETWORK. MORE ACCURATELY, IT SHOULD BE CALLED A NETWORK TO FOSTER INNOVATION; BUT IT IS HARD TO INTEREST THE AVERAGE PERSON IN INNOVATION, WHEREAS EVERYONE IS INTERESTED IN MORE JOBS.

IMPLEMENTING THREE MORE. CANADA IS IMPLEMENTING FIVE WITH PLANS FOR MORE.

MTDI: THE THIRD INSTITUTION TO DISCUSS FOR ADVANCING TECHNOLOGICAL COOPERATION IS THE MIDWEST TECHNOLOGY DEVELOPMENT INSTITUTE (MTDI).

A GROUP OF NINE MIDWEST STATES UNDERWROTE THE ESTABLISHMENT OF MTDI IN 1985. MEMBERS OF THE BOARD OF DIRECTORS ARE APPOINTED BY THE GOVERNOR OF EACH PARTICIPATING STATE.

MTDI HAS THE THREEFOLD OBJECTIVE OF:

- EXPANDING TECHNOLOGICAL COOPERATION AMONG MIDWEST UNIVERSITIES AND INDUSTRY TO INCREASE THE EFFICIENCY OF RESEARCH AND THE COMMERCIALIZATION OF THE RESULTS;
- EXTENDING TECHNOLOGICAL COOPERATION TO INCLUDE UNIVERSITIES IN FOREIGN COUNTRIES;
- PROVIDING A MECHANISM TO INCREASE THE AVAILABILITY OF TECHNOLOGY TO INDUSTRY, ESPECIALLY SMALL BUSINESSES, AND TO ACHIEVE AN EQUITABLE TRANSFER OF TECHNOLOGY BETWEEN THE U.S. AND FOREIGN COUNTRIES.

MTDI WILL PROMOTE COOPERATIVE TECHNOLOGY DEVELOPMENT THROUGH THE ESTABLISHMENT OF A SERIES OF CONSORTIA, EACH FOCUSING ON A SINGLE AREA OF TECHNOLOGY WHICH IS SIGNIFICANT TO THE MIDWEST.

PLANNING IS UNDERWAY FOR TECHNOLOGY DEVELOPMENT CONSORTIA IN THREE FIELDS:

ADVANCED CERAMICS & COMPOSITES
ADVANCED MANUFACTURING, AND
FAMILY FARM TECHNOLOGY

THE MTDI PROGRAM FOR HELPING TO ACHIEVE THE EQUITABLE FLOW OF TECHNOLOGY BETWEEN THE MIDWEST AND FOREIGN COUNTRIES WILL INCLUDE INCREASED ACCESS TO U.S. AND FOREIGN TECHNOLOGY BY MIDWEST COMPANIES, ESPECIALLY SMALL COMPANIES. I WOULD LIKE TO BRIEFLY ELABORATE ON THE PROGRAMS FOR COOPERATION IN MANUFACTURING AND ACHIEVING EQUITABLE TECHNOLOGY FLOW.

Advanced Manufacturing: THE MAJOR THRUST OF THE ADVANCED MANUFACTURING PROGRAM IS THE ESTABLISHMENT OF ADVANCED MANUFACTURING CENTERS TO SERVE GROUPS OF COMPANIES, BOTH LARGE AND SMALL.

OBVIOUSLY, A VERY LARGE INVESTMENT WILL BE REQUIRED, AND THERE WILL BE A NUMBER OF DIFFICULT PROBLEMS ATTENDANT TO SUCCESSFUL

(3) SMALL U.S. COMPANIES ARE A MAJOR SOURCE OF TECHNOLOGY FOR JAPAN. THE TECHNOLOGY IS OBTAINED THROUGH ONE OF THREE METHODS: LICENSING, EQUITY INVESTMENT OR ACQUISITION OF THE TOTAL COMPANY BY A JAPANESE FIRM. U.S. ENTERPRISES ARE NOT USUALLY AFFORDED SIMILAR OPPORTUNITIES IN JAPAN.

(4) U.S. FIRMS HAVE NOT ACQUIRED THE RIGHTS TO TECHNOLOGIES DEVELOPED IN JAPAN ON THE BASIS OF U.S. SCIENCE.

(5) BY WHATEVER MEASURES USED, JAPAN IS NOT PERFORMING ITS FAIR SHARE OF THE BASIC RESEARCH TO ADD TO THE WORLD'S STORE OF KNOWLEDGE, YET JAPAN HAS VIRTUALLY UNLIMITED ACCESS TO U.S. RESEARCH.

(6) THE JAPANESE SEND THEIR BEST GRADUATE STUDENTS TO THE U.S. TO OBTAIN PH.D.'s. IN MANY INSTANCES, THE U.S. PROVIDES FINANCIAL AS WELL AS INTELLECTUAL SUPPORT FOR THEM.

(7) THE U.S. HAS NOT DILIGENTLY PURSUED THE ACQUISITION OF JAPANESE TECHNOLOGY.

THIS LITANY OF IMBALANCE ADDS UP TO BOTH A "CHEAP RIDE" BY JAPAN ON THE U.S. TECHNOLOGY SYSTEM AND, AS NOTED EARLIER, A MAJOR FACTOR IN THE TRADE GAP.

<u>CORRECTIVE ACTION</u>: WHAT'S TO BE DONE? FIRST, THE U.S. MUST RECOGNIZE THE SERIOUSNESS OF THE ADVERSE EFFECTS OF THE INEQUALITY IN TECHNOLOGY FLOW AND TAKE STEPS TO ELIMINATE THEM. FORTUNATELY, THERE IS PROGRESS IN THIS DIRECTION AS EVIDENCED BY TWO RECENT ACTIONS IN THE U.S. CONGRESS. ONE IS A PROVISION IN PENDING TRADE LEGISLATION TO ESTABLISH EQUITABLE TECHNOLOGY FLOW AS A PRIORITY NEGOTIATING OBJECTIVE IN BILATERAL AND MULTILATERAL TRADE NEGOTIATIONS. THE RESPONSIBILITY FOR MONITORING TECHNOLOGY TRANSFERS UNDER THIS LEGISLATION WILL BE ASSIGNED JOINTLY TO THE UNITED STATES TRADE REPRESENTATIVE AND THE NATIONAL SCIENCE FOUNDATION.

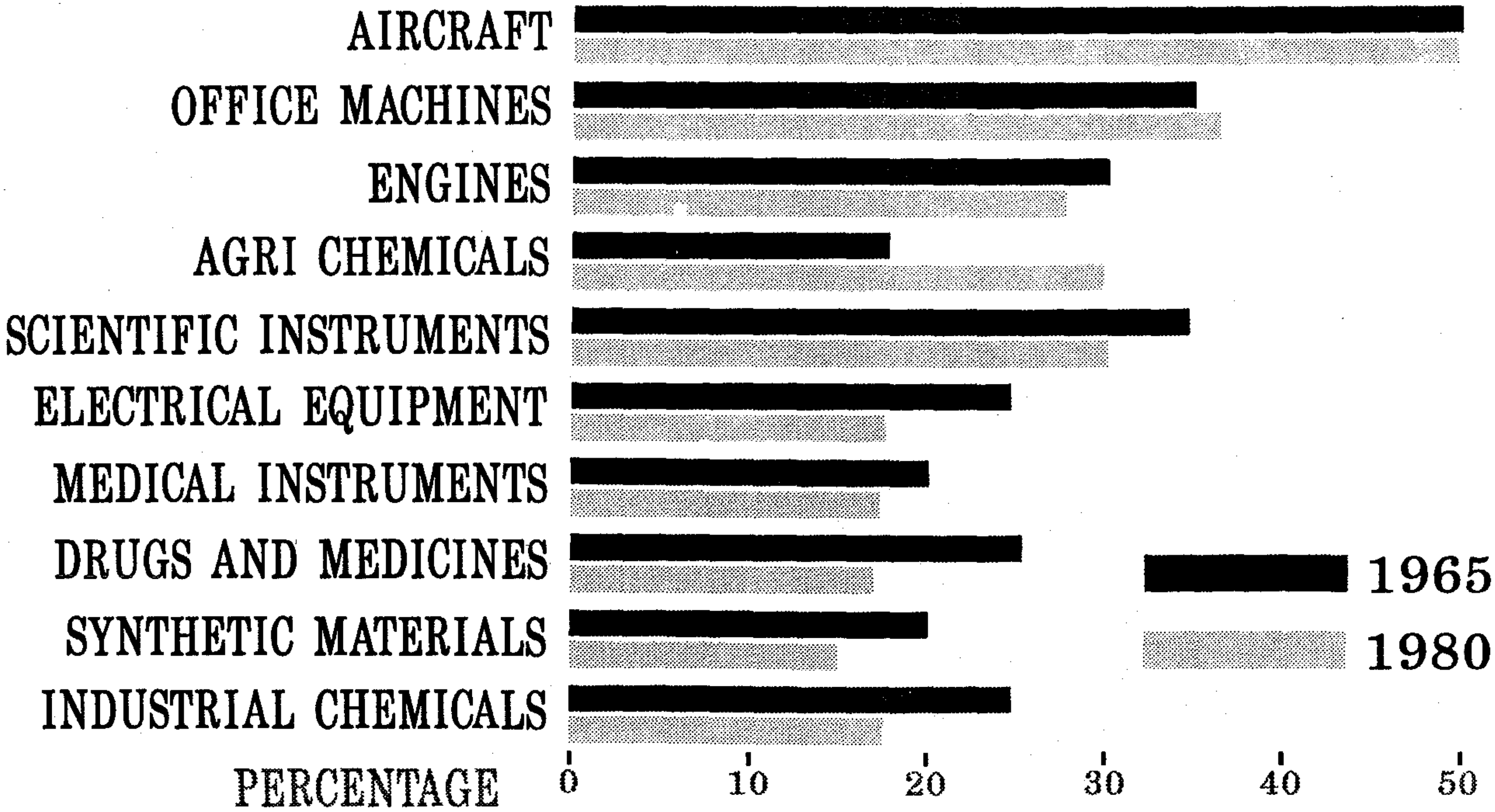
THE OTHER ACTION WAS LEGISLATION ENACTED INTO LAW LAST YEAR AMENDING THE STEVENSON-WYDLER INNOVATION ACT OF 1980. THE REVISION GIVES THE DIRECTORS OF THE MYRIAD U.S. FEDERAL LABORATORIES DISCRETIONARY AUTHORITY TO DENY ACCESS TO U.S. RESEARCH BY ORGANIZATIONS OF ANY FOREIGN COUNTRY WHICH DOES NOT GRANT SIMILAR PRIVILEGES TO AMERICAN ORGANIZATIONS.

IMPLEMENTING EQUITABLE TECHNOLOGY FLOW AGREEMENTS WITH OTHER COUNTRIES WILL REQUIRE THAT THE UNITED STATES KEEP TRACK OF TECHNOLOGY TRANSFER. IN THE PAST, RELATIVELY FEW STATISTICS HAVE BEEN COMPILED IN THIS AREA. ADEQUATELY MONITORING TECHNOLOGY FLOW WILL BE DIFFICULT, AS IT IS NOT POSSIBLE TO MEASURE IT WITH GREAT PRECISION; BUT FLOW CAN BE APPROXIMATED WELL ENOUGH FOR DETERMINATION OF EQUITY AND FOR GENERAL PERSPECTIVE.

ATTACHMENT 1

WORLD MARKET SHARE

UNITED STATES SHARES OF WORLD HIGH-TECHNOLOGY EXPORTS 1965 AND 1980



Source: President's *Commission* on Industrial Competitiveness

'09-29-86

NETWORKS FOR JOB CREATION

Baltimore, MD
Baton Rouge, LA
Bemidji, MN
Birmingham, AL
Champaign, IL
Charleston, S.C.
Chattanooga, TN
Crookston, MN
Enschede, Netherlands
Fergus Falls, MN
Florence, S.C.
Galesburg, IL
Hutchinson, KS
Iron Trail Communities, MN
Liege, Belgium
Macomb, IL
Minneapolis - St. Paul, MN
Monmouth, IL

North Augusta, S.C.
Omaha, NE
Philadelphia, PA
Pueblo, CO
Québec City, Québec
Quincy, IL
Rock Hill, S.C.
Rotterdam, Netherlands
St. John's, Newfoundland
San Antonio, TX
South Bend, IN
Spartanburg, S.C.
Stevenage, U.K.
Sydney, Nova Scotia
Toledo, OH
Vancouver, British Columbia
Winnipeg, Manitoba
Winston-Salem, N.C.

"The Technopolis Strategy: Implications For The United States"

by Sheridan Tatsuno

Research Newsletter

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BUILDING A JAPANESE TECHNO-STATE: MITI'S TECHNOPOLIS PROGRAM UNDERWAY

SUMMARY

In 1980 the Ministry of International Trade and Industry (MITI) announced the Technopolis Concept, an ambitious plan to build a Japanese "techno-state" of research cities dispersed throughout the country. Based on Silicon Valley and the Tsukuba Science City, these technopolises are designed to become centers of Japanese scientific and technological research in the 21st century. They will feature research universities, science centers ("techno-centers"), industrial research parks, joint R&D consortiums, venture capital foundations, office complexes, international convention centers, and residential new towns.

Since passage of the Technopolis Law in 1983, prefectural governments have made significant progress in rallying local industries and universities around their technopolis plans. They have prepared 20-year development plans, formed 225 R&D consortiums, and begun construction of highways, airports, industrial parks, and new towns. MITI has approved 20 regions and is currently reviewing six more sites, as shown in Figure 1. In May 1986, the Japanese government approved MITI's Regional Research Core Concept, which calls for establishing research centers in 28 regional cities. This research city policy is MITI's response to the rapid exodus of manufacturing plants overseas, better known as the "hollowing out" (kudoka) of the Japanese economy, which has been caused by the rapid yen appreciation.

In this newsletter, we examine the following developments in the Technopolis program and Japanese high-tech infrastructure policies:

- Chronology of the Technopolis program (1980 through 1986)
- MITI's Regional Research Core Concept

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- Status of four leading technopolises (Okayama, Hiroshima, Ube, and Kumamoto)

- Activities in the 20 Technopolis regions (R&D facilities, information centers, joint R&D programs, land development projects, and large-scale infrastructure)

- The new ¥3.6 trillion ($22.7 billion) prime-pumping package recently announced by the Japanese government

Dataquest observes that Japanese regions, faced with declining exports due to the "yen shock," are seeking ways to reposition their industries to meet the growing Asian challenge. They are moving up the technology ladder to higher value-added products and services, and promoting creative research. The Technopolis program is the centerpiece of this new Japanese industrial strategy.

Figure 1

TECHNOPOLIS AREAS

Source: MITI

CHRONOLOGY OF THE TECHNOPOLIS PROGRAM

Since 1980, MITI has worked closely with prefectural governments to develop the Technopolis program. In 1981, 38 of the 47 prefectures volunteered to become Technopolis sites, forcing MITI to establish a screening process. In March 1983, after conducting detailed surveys overseas and discussions, MITI issued the following selection criteria:

- Completion of Technopolis construction by 1990
- Development areas of less than 500 square miles
- Location of the Technopolis within a 30-minute commute of a regional city ("mother city") of 150,000 people

These guidelines were incorporated into the Technopolis Law, which was passed by the Japanese Diet in April 1983. Under this law, the Technopolis regions are promoting five major development policies:

- Integrated development of industry (san), research universities (gaku), and housing (juu)
- Close ties between the technopolis and its "mother city" (botoshi)
- Balanced development between new high-tech industries and technological upgrading of existing industries
- Transfer of high technology to existing industries (transfer R&D) and creative research in frontier fields (frontier R&D)
- Regional uniqueness in high-tech research and industrial development

In 1983, 19 regions were given preliminary approval by MITI, which requested detailed development plans, as shown in Table 1. Since 1984, MITI has given final approval to 20 regions (Nagasaki was added to the list) and is considering six additional sites. The approved Technopolis regions are eligible for national tax incentives and special depreciation allowances.

Table 1

CHRONOLOGY OF THE TECHNOPOLIS PROGRAM

Date	Activity
03/80	Technopolis Concept announced in MITI's Visions for the 1980s
07/80	Survey by Local Industrial City Concept Study Group
06/81	Survey by MITI's Technopolis '90 Committee
03/82	Technopolis basic plans established
06/82	Interim Report by Technopolis '90 Committee
05/83	Technopolis development plans completed by prefectures
07/83	Technopolis Law enacted by Japanese Diet
10/83	Development guidelines announced by MITI
03/84	First-round approval of development plans for Niigata, Toyama, Shizuoka, Hiroshima, Yamaguchi, Kumamoto, Oita, Miyazaki, and Kagoshima prefectures
05/84	Akita and Tochigi prefectures approved
07/84	Hokkaido Prefecture approved
08/84	Okayama Prefecture approved
09/84	Fukuoka and Saga prefectures approved
03/85	Nagasaki Prefecture approved
04/85	1st Technopolis Symposium held in Tokyo ("Technopolis: MITI's 21st Century Super-Vision")
08/85	Aomori Prefecture approved
09/85	Hyogo Prefecture approved
12/85	Kagawa Prefecture approved
04/86	Cabinet ministerial meeting on "yen shock" comprehensive counter-measures (promotion of Technopolis Concept)
05/86	Miyagi and Fukushima prefectures approved
05/86	Private Investment Law (Regional R&D Core Concept) passed by Japanese Diet
09/86	Economic stimulation package adopted by Japanese cabinet (Technopolis Concept as vehicle for rural and regional development promotion policy)
11/86	2nd Technopolis Symposium held in Kumamoto City
12/86	Miyagi (Sendai) and Fukushima (Koriyama) prefectures approved

Source: MITI
Dataquest
January 1987

MITI'S REGIONAL RESEARCH CORE CONCEPT

Until early 1986, the Technopolis program was primarily aimed at relocating high-tech manufacturing from Tokyo and Osaka to the regions. Due to the "yen shock," however, Japanese companies have been shifting their production facilities overseas instead of to the technopolises. To counter this offshore movement, MITI developed the Regional Research Core Concept to promote the regionalization of high-tech research and to strengthen local R&D facilities. This program, which was passed by the Japanese Diet in May 1986, promotes four types of research facilities:

- Open experimental research institutes for joint industry-academic-government research
- New research training and education facilities
- Conference halls, exhibition halls, and data base systems for improved access to technical information
- Venture business incubators

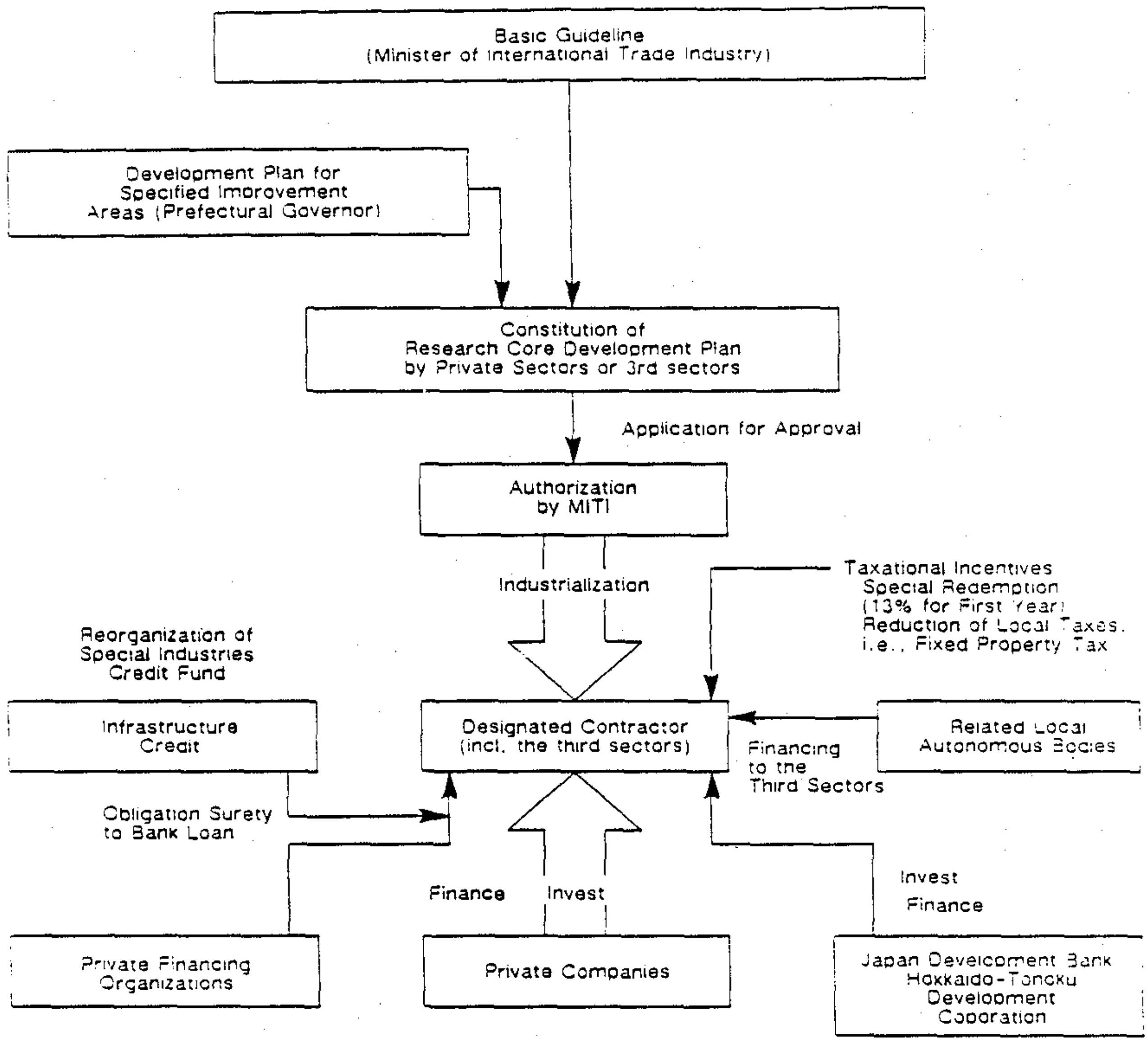
Using Silicon Valley as a model, MITI is also promoting support facilities, such as business complexes for service industries, venture capitalists, legal and accounting professionals, and "think tanks." The private sector will be encouraged to participate in developing local Research Core plans according to MITI guidelines, as shown in Figure 2. Research Core cities will be eligible for tax benefits, insurance guarantees, and financing loans from the Japan Development Bank (JDB) or Hokkaido-Tohoku Development Corporation.

MITI is studying 28 regions for the Regional Research Core Program, as shown in Figure 3. As listed in Table 2, 18 of the Research Core projects are also technopolises. The following is a short description of three Research Core Projects:

- 21st Century Plaza (Miyagi Prefecture)--This ¥34 billion ($213 million) complex will feature two zones: a "Technoculture Zone" consisting of research institutes, information centers, venture business incubators, computer shops, and an "International Convention Center Zone." Construction will begin in fiscal 1987.
- Technovalley Intelligent Core (Niigata Prefecture)--Located in the Nagaoka Techno-Valley Technopolis, this ¥16 billion ($100 million) project will consist of the Nagaoka Regional Technology Development Promotion Center, International Communication Plaza, Education Plaza, and venture business incubators. Construction will begin in 1988.
- Kurume Techno Research Park (Fukuoka Prefecture)--This ¥20 billion ($125 million) Technopolis project will feature a research center, industrial parks, and venture business incubators. Construction will begin in fiscal 1987.

Figure 2

RESEARCH CORE PROJECT PROGRAM



Source: MITI

Figure 3

MAIN CANDIDATES FOR RESEARCH CORE PROJECTS

Note: * Technopolis regions

Source: MITI

Table 2

CANDIDATE SITES FOR RESEARCH CORE PROJECTS

	Name of Project	Location
1.	Eniwa High Complex City	Eniwa City, Hokkaido
2.	Aomori Future Park	Aomori City, Aomori Pref.
3.	Technopolis Support Core	Morioka City, Iwate Pref.
4.	Akita Core City Key Area Industrial Support Development Project	Akita City, Akita Pref.
5.	21st Century Plaza ($213 million)	Izumi City, Miyagi Pref.
6.	Yamagata International Industrial Communication Plaza	Yamagata City, Yamagata Pref.
7.	Koriyama Regional Technopolis Industrial Support Functions Development Project	Koriyama City, Fukushima Pref.
8.	Technopolis Center	Utsunomiya City, Tochigi Pref.
9.	Hitachi-Naka International Bay Park City "Business Pleasure Hitachi-Naka"	Katsuta City, Ibaragi Pref.
10.	Kazusa New Development and Research City Plan "Academia Park"	Kisarazu City, Chiba Pref.
11.	Kanagawa Science Park	Kawasaki City, Kanagawa Pref.
12.	Science Park (21st Century Industrial Park)	Kofu City, Yamanashi Pref.
13.	Technoculture Zone	Nagano City, Nagano Pref.
14.	Technovalley Intelligent Core Project Plan ($100 million)	Nagaoka City, Niigata Pref.
15.	Toyama Intelligence Corridor	Toyama City, Toyama Pref.
16.	Cosmopolis Plan (Research Park)	Kishiwada, Izumi-Sano, Izumi Cities, Osaka Pref.
17.	Okayama Triangle D&R Project Plan	Okayama City, Okayama Pref.
18.	Hiroshima Central Technopolis Innovation Park	Higashi-Hiroshima City, Hiroshima Pref.
19.	Ube New City Techno Center	Ube City, Yamaguchi Pref.
20.	Tokushima Prefectural Industrial Research Core	Tokushima City, Tokushima Pref.

(Continued)

Table 2 (Continued)

CANDIDATE SITES FOR RESEARCH CORE PROJECTS

Name of Project	Location
21. Techno Plaza Ehime	Matsuyama City, Ehime Pref.
22. Kurume Techno Research ($125 million)	Kurume City, Fukuoka Pref.
23. Saga Research Core	Saga City, Saga Pref.
24. Creative Area Project	Nagasaki City, Nagasaki Pref.
25. Kumamoto Creative Area	Kumamoto Pref.
26. Ohita Intelligent Zone	Oita City, Ohita Pref.
27. Miyazaki Sun-Tech Park	Miyazaki City, Miyazaki Pref.
28. New City Center	Hayato Cho, Kagoshima Pref.

Source: MITI

STATUS OF FOUR LEADING TECHNOPOLISES

In November, Governor Morihiko Hosokawa of Kumamoto Prefecture sponsored an International Technopolis Symposium, which Dataquest attended. Prior to the symposium. Dataquest toured four technopolises in western Japan: Okayama, Hiroshima, Ube (Yamaguchi Prefecture), and Kumamoto. These sites are being developed according to plan, but the "yen shock" has slowed plant sitings and forced local governments to emphasize new research facilities. The following is a summary of our observations.

Okayama

Okayama's Kibi Highland Technopolis has the goal of becoming the biotechnology center of Japan. In 1985, Okayama University formed the Biotechnology Research Lab, which has 20 researchers pursuing fermentation research. In 1986, 300 industry and government researchers established the Biotechnology Research Association with Okayama University's Pharmaceutical Department to build a Biotechnology R&D Center in the Kibi Highland Technopolis by 1990. Currently, Hayashibara Biochemical (which supplies 50 percent of the world's supply of interferon) is building an interferon production plant and developing semiconductor bio-resists with Matsushita Electronics. The prefecture recently built a $10 million Life Science Center next to the Japan Industrial Worker Rehabilitation Center. The Matsushita video plant nearby is specially designed for physically handicapped workers. Located an hour west of Osaka on the bullet train, Okayama will be the crossroads to Shikoku island when the Seto Inland Sea Bridge is completed in 1988. The New Okayama Airport is being built on a plateau within the Kibi Highland Technopolis.

Hiroshima

The Hiroshima Central Technopolis is focusing on five new strategic industries: electronics, mechatronics, new materials, biotechnology, and new energy development. In 1982, the engineering and science departments of Hiroshima University were moved to the new Kamo Science City, which is located in the hills 25 miles east of Hiroshima City. A new Biotechnology Center is currently under construction. The prefecture will complete its master plan this year and begin constructing a Techno-Plaza (a venture business incubator offering training programs and technical advice) in 1989. Expressways and roads are being built to improve access, and a new bullet train terminal will be completed in 1988. The New Hiroshima Airport will be built by 1993. The prefecture is also preparing a Marinopolis plan to promote marine research.

Yamaguchi

The Ube Phoenix Technopolis is promoting a broad range of fields, including electronics, mechatronics, polymers, biotechnology, fine chemicals, marine resources, energy development, and software. In April 1987, Yamaguchi University will open a $2.6 million research facility and international exchange center. Recently, the university established a Mechano Technology Center for graduate students and professors who will be free to conduct their own creative research outside the constraints of the university research system. Yamaguchi Prefecture, which plans to build a new research city of 24,000 by 1991, was given a boost when MITI selected Ube as a Regional R&D Core City this year. The new city will cost ¥160 billion ($1 billion), of which half will be spent on sewers and utilities. Currently, MITI, the Ministry of Transportation (MOT), Ministry of Agriculture, Forestry, and Fisheries (MAFF), and local companies are planning marine R&D laboratories for Ube's Marinovation Program.

Kumamoto

Kumamoto Prefecture's Governor Morihiko Hosokawa is one of the strongest advocates of the Technopolis program. Patterned after the Research Triangle in North Carolina, the Kumamoto Technopolis will focus on automation, biotechnology, computers, and data processing. The region is located at the heart of Kyushu, better known as "Silicon Island" because it produces 40 percent of all Japanese semiconductors. NEC, Matsushita, and other IC makers are located in the area. In April 1985, the Applied Electronics Research Center was opened next to the new Kumamoto International Airport to conduct semiconductor-related research. A new IC start-up, Digital Design Systems (DDS), is developing gate arrays and PLDs at the center. In 1986 the Technopolis Center was completed nearby to conduct training classes and provide on-line technical information to local companies. Kumamoto, which introduced a private videotex "KINGS" system in 1985, was recently designated a Teletopia site by the Ministry of Posts and Telecommunications (MPT). The region also plans to develop a "Software Forest" and a "Biotechnology Forest" to conduct basic and applied research.

Generally, Dataquest was impressed by the progress made by these four technopolises, which are systematically building their research networks and infrastructure to support innovative research in the 1990s. They are representative of the 20 technopolises currently under construction. In the following section, we provide an update on Technopolis research activities and infrastructure development nationwide.

TECHNOPOLIS R&D CENTERS

Since 1982 the technopolises have strengthened their public and private research institutes to raise the technological level of local industries (called "level-up"), transfer technology from Tokyo and Osaka, and conduct independent research. Twenty-one research facilities have already been built, and there are plans for 19 others beginning in fiscal 1986. Table 3 lists 13 of the 21 new facilities.

Table 3

NEW TECHNOPOLIS R&D CENTERS

Region	Research Facility	Date
Hakodate	Hokkaido Industrial Technology Center	03/86
Akita	Akita Technical Center	10/82
Nagaoka	Nagaoka Technology Development Center	03/84
Hamamatsu	Mechatronics Research Institute	03/84
Toyama	Toyama Technology Center	07/86
Okayama	Kibi Highlands New Science House	10/85
Okayama	Biotechnology Research Laboratory	04/85
Hiroshima	Innovative Technology Center	04/85
Hiroshima	Techno-Plaza	FY89
Ube	Yamaguchi Mechatronics Technical Center	03/87
Ube	Ube Techno-Center (MITI R&D Core Program)	FY87*
Kurume-Tosu	Kurume Techno-Research Park (MITI R&D Core Program)	FY87*
Kenhoku-Kunisaki	Oita Prefecture Advanced Technology Development Research Institute	06/84
Kumamoto	Applied Electronics Research Center	03/85
Miyazaki	Miyazaki Joint R&D Center	10/84
Kokubu-Hayato	Kagoshima Fine Ceramics Products R&D Institute	10/84

*Begin construction

Source: MITI
Dataquest
January 1987

ON-LINE INFORMATION CENTERS

Prefectural governments are building "Techno-Centers," which will provide technical information through on-line data base networks, conduct training programs on data processing and communications systems, and act as information clearinghouses. To date, 23 centers have been created; 12 others will be established in fiscal 1986. Table 4 lists the major centers.

In addition, Japan Technomart Inc., a newly formed technical information service, has opened local offices in Hamamatsu, Toyama, Hiroshima, Kurume-Tosu, Kumamoto, Sendai, Yamagata, Asama, and Ehime to link these cities with Tokyo and Osaka.

Table 4

TECHNOPOLIS ON-LINE INFORMATION CENTERS

Region	Center	Opened
Hamamatsu	Information Technology College	04/85
Hamamatsu	Local Technology Development Center	03/85
Toyama	Toyama Information and Training Center	10/84
Toyama	Toyama Technical Exchange Center	05/85
Hiroshima	Kure Personal Computer Center	04/85
Ube	Mine Industrial Technology Center	03/85
Nagasaki	Nagasaki Prefecture Venture Business Information Center	04/85
Oita	Oita Soft Park	03/85
Kagoshima	Data Processing Training Center	04/86
Kumamoto	Kumamoto Technopolis Center	09/86

Source: MITI
Dataquest
January 1987

TECHNOPOLIS FOUNDATIONS

In each region, technopolis foundations are being established to promote technopolis construction and introduce advanced technologies to local companies. These foundations act as research debt guarantors and organizers of training seminars and trade shows. To date, they have achieved the following:

- Underwritten ¥1.3 billion ($7.9 million) in low-interest loans and interest subsidies to 73 companies nationwide for new technology and product development (as of fiscal 1985)
- Sponsored 363 engineering and executive training programs in 18 regions (as of fiscal 1986)
- Studied new social systems for the technopolis regions
- Introduced technical information services, such as JOIS and PATOLIS, to local companies
- Formed researcher talent data bank services
- Numerous Technopolis Fairs and high technology trade shows

Generally, the boards of these foundations consist of the governor, local mayors, industry leaders, university professors, media executives, labor union leaders, and others. Dataquest observes that these "high-tech chambers of commerce" tend to be more internationalist than their local constituencies, and they welcome foreign investments in their regions.

REGIONAL JOINT R&D PROJECTS

The technopolis regions are actively promoting joint research projects and inter-industry exchanges to raise the technological standards of local companies. By fiscal 1986, there were 255 joint research projects among the 18 regions, involving local companies, universities, public research institutes, and national testing laboratories. These projects focus on applied research and technology transfers from Japan's national R&D laboratories. However, the Regional Frontier Technical Development Project, financed by MITI's Small and Medium Enterprises Agency, focuses on region-specific research. Table 5 lists the major R&D projects underway.

Dataquest believes the following projects will have a major impact on the semiconductor industry:

- Utsunomiya--Automotive electronics and production technology
- Kagoshima--Fine ceramics production research with Kyocera and over 100 regional ceramics makers
- Hamamatsu--Optoelectronics for factory and office automation
- Nagasaki--Electronic controls for new material production
- Oita--Vision and other sensor technology
- Kumamoto--Semiconductor applications

Table 5

JOINT GOVERNMENT-INDUSTRY-UNIVERSITY RESEARCH PROJECTS

Region	Project	Research Focus
Hakodate	Hakodate Regional Technology Promotion Committee	Marine resources and equipment Food processing
Aomori	Absorptive Ceramics Development Project	Advanced applications
Akita	Akita Prefecture Technology Frontier Project	Automatic selection system for multicolor picture processing
Nagaoka*	Regional Technology Development Committee	Precision machinery and information control
Utsunomiya*	Applied Electronics Research Association (6 IC companies), Fine Ceramics Research Association (11 materials companies), CAD/CAM Research Association (8 carmakers)	Production process technology for next-generation automotive design, bodies, and electronics (see JSIS Bulletin, March 5, 1986)
Hamamatsu*	Applied Phototechnology Production Process R&D Solar Research Laboratory Medical Equipment Technology Research Laboratory	Optoelectronics for factory automation Solar batteries and cells Artificial organs and medical
Toyama*	Aluminum Research Association Hokuriku Machining Center Research Association	Flexible manufacturing system (FMS) response technology; plastics molding simulation system
Nishi-Harima (Kobe area)	Hyogo Mini-Frontier Project	New ceramics and amorphous metal conferences
Kibi Highlands* (Okayama)	Biotechnology R&D Association Precision Process Association	Fermented food technology Home care robots and precision appliances for handicapped and elderly
Hiroshima*	Advanced Material Processing Technology Association	Carbon fibers

(Continued)

Table 5 (Continued)

JOINT GOVERNMENT-INDUSTRY-UNIVERSITY RESEARCH PROJECTS

Region	Project	Research Focus
Ube (Yamaguchi)	Ube New Frontier Project Fine Stone Plate Research Association; Fly Ash Research Association	Automated die manufacturing technology; fine stone plate; fly ash
Kagawa	New Ceramics Products Development Research Association	Fine ceramics
	Applied Microbiology Technology Research Association	Biotechnology
Kurume-Tosu*	New Ceramics Material and Products Research Association New Technology Development Research Association	Fine ceramics
Kan-Omurawan* (Nagasaki)	New Materials Research Association; Nagasaki Advanced Technology Development Council	Applied electronics control technology for new materials
Kenhoku-Kunisaki* (Oita)	Oita Prefecture Technical Exchange Plaza; Oita Personal Computer Research Association	Sensor applications, especially vision sensors
Kumamoto*	Applied Semiconductor Technology Research Association	Semiconductor applications
	Biotechnology Research Research Association	Biomedicines
Miyazaki*	Fermentation Research Association; SPG Applied Technology Research Association	Advanced fermentation Volcanic ash applications
Kokubu-Hayato* (Kagoshima)	New Ceramic Products Research Association; Kagoshima Natural Resources Development Council	Fine ceramics applications Natural resources

*Local Frontier Technology Development Project financed by MITI's Small and Medium Enterprises Agency

Source: Dataquest
January 1987

LAND DEVELOPMENT PROJECTS

In order to attract high-tech industries, the technopolises are actively building new industrial parks located near airports, expressways, and bullet train stations. By Fiscal 1985, about 4,360 hectares (10,770 acres) of land had been prepared for 58 industrial parks; another 2,470 hectares (6,095 acres) will be prepared for 61 more industrial parks from Fiscal 1986 and beyond. Table 6 summarizes the major industrial land development projects.

Table 6

MAJOR TECHNOPOLIS LAND DEVELOPMENT PROJECTS

Region	Development Project	Completion
Akita	Nanamagari Industrial Complex (near Akita airport; part of site already for sale)	FY1988
Nagaoka	Nagaoka City High-Tech Park (southern industrial complex)	FY1986
Toyama	Toyama-Yatsuo Central Industrial Complex	October 1983
West Harima (Kobe)	West Harima New Science Town; East Harima New Science Town	FY1988
Kibi Highland (Okayama)	Kibi Highland New Town (industrial sites for Matsushita, Hayashibara Biochemical and others)	FY1987
Ube	Yamaguchi Techno-Park	FY1991
Kumamoto	Kumamoto Techno-Research Park	April 1986
Miyazaki	Miyazaki High-Tech Park	Start FY86

Source: MITI
Dataquest
January 1987

LARGE-SCALE INFRASTRUCTURE PROJECTS

Large-scale infrastructure projects are also being built to support the new Technopolis research centers and industrial parks. As shown in Table 7, the technopolises are busy constructing new "techno-roads," water and sewer systems, highways, bullet train terminals, airports, recreational parks, housing, telecommunications networks, community centers, and other public facilities. MITI's goal is to have the prefectures build and finance their basic infrastructure by 1990. Four areas of activity are particularly noteworthy:

- Regional electric power companies (Kyushu Electric Power and Tohoku Electric Power), which have benefitted from the windfall of cheap oil, are expanding their electricity networks and aggressively promoting technopolis construction.

- MITI, the Ministry of Construction (MOC), and the Ministry of Transportation (MOT) are implementing a Commuter Airport Program to link the technopolises and regional cities to Tokyo and Osaka.

- MITI and the Ministry of Posts and Telecommunications (MPT) are competing to introduce new telecommunication networks (MITI's New Media Community Concept and MPT's Teletopia Concept).

- Japan National Railway (JNR) is planning to extend the bullet train (Shinkansen) to southern Kyushu and from Osaka to Nagaoka.

Table 7

LARGE-SCALE TECHNOPOLIS INFRASTRUCTURE PROJECTS

Region	Infrastructure Project
Hakodate	Improvement of national highway Route No. 5
Aomori	Construction of national highway Route 102 bypass
Akita	Construction of Akita New Town (began FY1983), Akita Airport (complete by fall 1987), and Yuwa-Iwaki local road
Utsunomiya	Construction of Hoshakuji Industrial Complex (completed in FY1986) and Utsunomiya-Karasuyama local road
Nagaoka	Construction of $425 million Nagaoka New Town (population of 40,000); Joetsu bullet train line (opened in November 1982); Kanetsu Expressway to Tokyo (opened in 1985); Hokuriku Expressway to Osaka (opening in 1988); completion of Saizu Industrial Complex (1979) and Nagaoka Central Industrial Complex (FY1983)

(Continued)

Table 7 (Continued)

LARGE-SCALE TECHNOPOLIS INFRASTRUCTURE PROJECTS

Region	Infrastructure Project
Toyama	Construction of national road No. 359 (partially opened 1985)
Hamamatsu	Sewer system construction in Seien area (partial use in FY1986)
West Harima	Construction of West Harima New Town (land sales in FY1985)
Kibi Highlands	Construction of Kibi Highlands New Town (completion by 1987); Seo-Otsu local road (partial use in FY1985), Mitsu Industrial Park (underway), and Okayama Airport (completion by April 1988)
Hiroshima	Kamo Academic Town for Hiroshima University (FY1985); construction of West Takaya New Town (began FY1986) and new bullet train terminal (by April 1987); Hiroshima Expressway (by April 1988); plans for new Hiroshima Airport (1992)
Ube	Construction of Aratani Dam (by FY1987); Ube New Town (by 1989); construction of Ube Techno-Road to Kure City
Kagawa	Construction of New Utatsu City (land sales from FY1986) Completion of Ota Industrial Park (Phase 1 in FY1986)
Kurume-Tosu	Construction of Karao Hirokawa road (began in FY1985)
Kan-Omurawan	Construction of Hajinoo Dam (completed in FY1986); completion of offshore Nagasaki Airport (1984)
Kumamoto	Partial use of Mashiki-Otsu main road (FY1986); expansion of Kumamoto International Airport and airport research park (1985)
Kenhoku-Kunisaki	Completion of Bungo-Takada Aki Techno-Road (FY1985)
Miyazaki	Construction of Miyazaki Academic Town (land sales from FY1982)
Kokubu-Hayato	Partial use of national highway No. 10 (FY1986) and improvement of national highway No. 3; extension of Kagoshima International Airport runway to 2,500m (1984)

Source: MITI
Dataquest
January 1987

JAPANESE GOVERNMENT UNVEILS PRIME-PUMPING PACKAGE

Recently, the Japanese government announced a set of fiscal and monetary policies designed to counteract the recessionary effects of the "yen shock" and to boost domestic demand as recommended in the Maekawa Report. Dataquest believes that these measures will strongly affect industrial development in the technopolises. The specific policies include:

- Lowering the prime rate to 3 percent

- Offering special low-interest loans and easing industrial regulations for ailing manufacturers

- Increasing public works spending and encouraging more private investment

In September 1986, the Japanese government unveiled a comprehensive investment program that calls for ¥3.636 trillion ($22.7 billion) in increased public and private spending. As shown in Table 8, the Japanese government has allocated ¥3 trillion ($18.75 billion) for housing loans, highways, sewers, and other social infrastructure. About ¥133 billion ($830 million) in new construction bonds will be issued to finance this increased public spending. Under the new Private Sector Vitality Law (Minkatsu Law), private industry will be encouraged to invest ¥636 billion ($3.98 billion) in urban redevelopment, international trade fairs, and other commercial projects. The Economic Planning Agency expects this public-private investment program to have a net stimulative effect of ¥4.9 trillion ($30.6 billion), or 1.5 percent of the fiscal 1986 GNP.

Local prefectures will spend about ¥800 billion ($5 billion) of this total package, or about $106 million per region. Since Technopolis sites are located in 26 of the 47 prefectures, Dataquest believes that the technopolises will benefit from $2.8 billion in public and private investments in fiscal 1986.

Although the United States is urging Japanese consumers to spend more on foreign imports, Dataquest notes that the new economic package emphasizes productivity-boosting investments in public works and high-tech infrastructure. Due to the emphasis on private investment, we believe that there are many investment opportunities for multinational companies. In particular, the Japanese government is promoting the following types of public and private investments.

Table 8

JAPAN'S NEW DOMESTIC SPENDING PROGRAM

Investment	Focus	Billions of Yen	Millions of Dollars
Public			
Public Works	Bullet train extensions, airports, sewers, highways	¥1,400	$ 8,750
Fiscal Investment and Loan Program (FILP)	Japan Highway Public Corp. project expenses	100	625
Local Government Projects	Roads, sewers, industrial parks, housing, Technopolis program	800	5,000
Housing Loans	Raise Housing Loan Corporation loan ceiling for home financing from 180 to 200 square meters	700	4,375
Private			
Capital Investments	Electricity and gas companies, KDD, NTT, etc.	400	2,500
Private Sector Vitality Promotion	Financial support for FY86/FY87 projects	116	725
Small and Medium-Size Enterprise Policy	Low interest loans	100	625
Efficient Use of Government Land	National and prefectural public land	20	125
Total		¥3,636	$22,725

Source: Economic Planning Agency
Dataquest
January 1987

Large-Scale Projects

Japanese ministries and local governments are promoting large-scale projects to boost local demand and create new jobs.

- Large-scale public facilities, such as the Kansai International Airport (¥1 trillion/$6.25 billion), Trans-Tokyo Bay Highway (¥1.15 trillion/$7.19 billion), and Makuhari New Metropolis (¥1 trillion/$6.25 billion)

- Over ¥110 billion ($688 million) in investments by electrical power and gas companies in fiscal 1986 and front-loading of ¥200 billion ($1.25 billion) of their orders in fiscal 1987

- An extra ¥50 billion ($313 million) in capital investments by telecommunications companies in the last half of fiscal 1986

Private Sector Investments

Under the Private Investment Law, the private sector is being encouraged to reinvest in the domestic economy, not only overseas.

- Relaxing of Japan Housing Corporation loan provisions to allow for larger homes and more rental housing

- Promotion of plant construction and expansion in technopolises and other designated industrial parks

- Construction of international trade fair and conference halls, disaster prevention systems, on-line data base systems, "intelligent buildings" designed with telecommunication networks, underground shopping malls, land rezoning, and regional development

- Special urban and port development zones, such as the Kansai Culture and Science Research City in the Osaka area or the Port Future 2000 (Minato Mirai 2000) in Yokohama, which will be eligible for financial assistance, low interest loans, and special tax depreciation (20 percent)

New Research Centers

Besides Technopolis, other high-technology infrastructure projects are being planned in major cities.

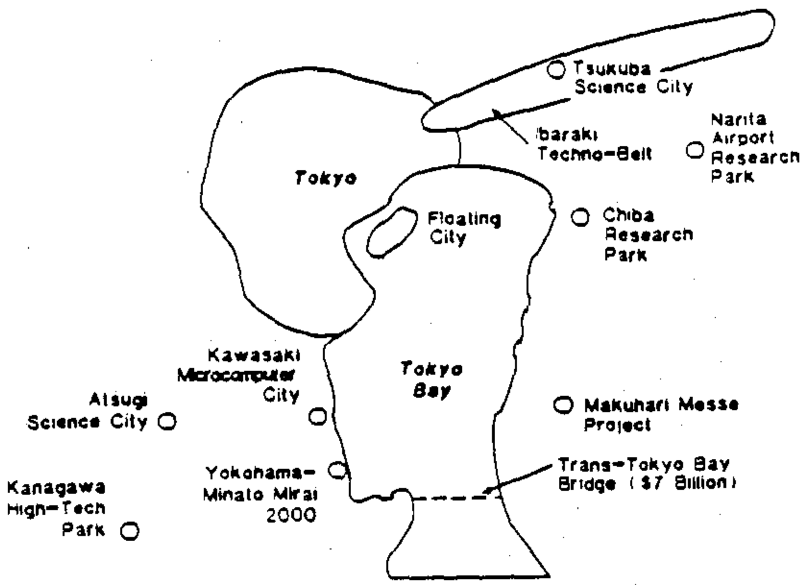
- Regional R&D core cities consisting of new research centers, joint R&D projects, and venture business incubators located in 28 regions

- Development of new high-tech research cities in the Tokyo and Osaka regions, as shown in Figures 4 and 5

- Construction of regional software development centers by major Japanese electronics companies

Figure 4

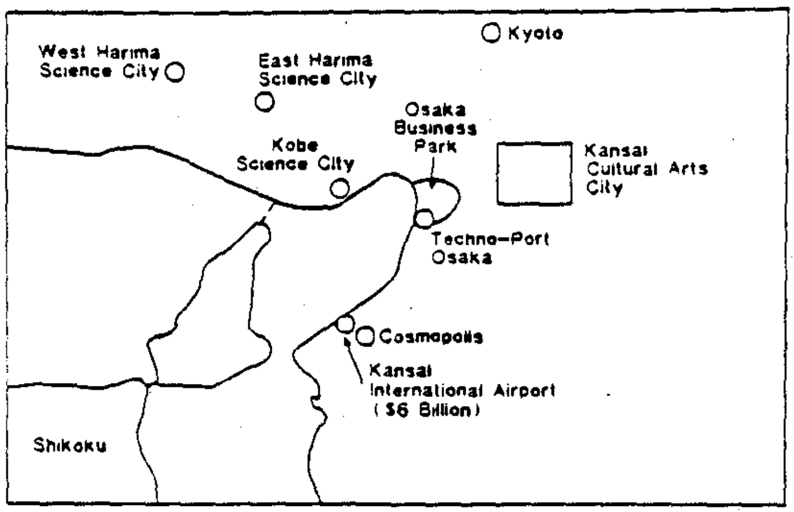
TOKYO HIGH-TECH CITIES



Source: Dataquest
January 1987

Figure 5

HIGH-TECH CITIES IN THE KANSAI REGION



Source: Dataquest
January 1987

Deregulation

As in the United States, privatization and deregulation are seen as ways to increase economic efficiency and reduce budget deficits.

- Deregulation of the aviation industry, gas station construction and services, charter bus and taxi licensing

- Privatization of Japan National Railway (JNR) and development of under-utilized land for office and commercial use

Assistance to Small Businesses

The Japanese government is assisting small businesses which have taken the brunt of the yen shock.

- Temporary financial aid, credit insurance, and loan programs for company restructuring, research, and repositioning

- Government bank lending (Japan Development Bank, Long Term Credit Bank of Japan, etc.)

- Jointly-sponsored excess equipment sales programs

- Subcontractor protection policies to prevent contracting companies from taking advantage of subcontractors

These measures are being coordinated by the national and local governments in conjunction with the private sector.

DATAQUEST CONCLUSIONS

Since last fall, MITI has introduced major policy changes in the Technopolis program, which are rapidly being implemented by local governments. Initially, many Technopolis plans looked like idealistic "paper dreams," but we observe that the prefectures seriously view them as long-term regional business plans. Of course, there is no guarantee that all of the technopolises will succeed, but they have few options given the "yen shock." Their industries must move up the technology ladder as quickly as possible if they are to remain internationally competitive with the emerging Asian countries in the 1990s.

Dataquest believes that we are seeing the regionalization of high-tech research in Japan, a major policy shift that will have strong impacts on the global economy. We expect to see creative research and innovative new products coming from these technopolises and research core cities by the mid-1990s, if not sooner. For multinational companies following Japanese technology, now is the time to become involved with these emerging technopolises.

Sheridan Tatsuno

Appendix

ROUNDTABLE AGENDA

"Management of the Knowledge Asset: Focus on Research Consortia"

DAY ONE

"The Competitive Challenge:
Can America's R&D Consortia Respond"
Dan Dimancescu, Technology & Strategy Group

"The Collective Challenge:
Optimizing the Technology Alliance
Debra M. Rogers, Digital Equipment Corporation

Presentation of the Justin Morrill Award
William C. Norris, Control Data Corporation

	Panels	Education	Government	Industry
DAY ONE	Stage I: Invention	Carnegie Mellon University	National Science Foundation	Semiconductor Research Corporation
DAY TWO	Stage II: Translation	Washington University	Benjamin Franklin Partnership (TBA)	Microelectronics and Computer Technology Corporation
	Stage III: Commercial-ization	Auburn University	National Aeronautics & Space Administration	Cincinnati Milacron

DAY TWO

"The Technopolis Strategy"
Sheridan Tatsuno, Dataquest

Focus Groups

Policy	Practice	Review
National Bureau of Standards	Westinghouse Electric Corporation	George Mason University

"Forming an Action Agenda"
Dan Dimancescu, Technology & Strategy Group

"Management of the Knowledge Asset: Focus on Research Consortia"

Possible Panel Discussion Items:

The contextual parameters that have been defined to analyze the strengths and weaknesses of the technology transfer infrastructure include three major elements: Structure, Resources, Methods/Tools. Panel members are asked to consider which elements apply to the particular Stage of Innovation addressed by their panel: Invention, Translation, or Commercialization. Do not feel confined to the items referenced below.

Structure

- The ability to receive or deliver technology from or to the other stages of the innovation process?
- The value of a centralized versus decentralized organization?
- The role of governing boards having total versus no control?
- The types of consortial partners invited to participate (e.g., many versus few, complementary versus competing, large versus small corporations, single-industry versus cross-industry focus, etc.)?
- The leadership required in terms of source of funds (industrial versus state or federal) and the type (strong versus diffused)?
- The legal/contractual policies around intellectual property rights, personnel, inclusion/exclusion of foreign nationals, etc.)?

Resources

- The relative merits of having a new research facility versus distributed research activity?
- The balance of senior engineering managers versus junior scientists and whether they are permanent or loaned residents, etc.?
- The size and leverage factor of challenge grant programs and the value of multi-year contracts?
- The size and allocation of staff resources (i.e., technical, administrative, transfer experts, etc.)?
- The mix of expertise (e.g., legal, marketing, finance, manufacturing, systems, etc.) available for the task at hand? At which point are which players consulted?
- The utilization of resources of participating organizations in terms of facilities, technical talent, library sources, budget, etc.?

Methods/Tools

- The planning methods for technological forecasting, assessment, mapping with business goals, timing for commercialization, market acceptance, etc.?
- The variety and depth of transfer mechanisms utilized to communicate knowledge and know-how (e.g., seminars, courses, research services, resident programs, et. al)?
- The pro's and con's of defining the qualitative and quantitative measures of the return-on-investment of research dollars?
- The focus of the research agenda (i.e., pure research versus product development, long-term versus short-term goals, proprietary versus non-proprietary research, cross-disciplinary versus narrow disciplinary focus, etc.)?
- The adaptation of electronic tools to transfer information (e.g., networks, electronic bulletin boards, conferencing, satellite training, etc.)?
- How each sector interacts with the other to ensure maximum synergy of ideas toward technological advancement and profitability?

—- NEWS RELEASE —-

NORRIS FIRST RECIPIENT OF NEW AWARD

Mr. William Norris, Chairman and founder of Control Data Corporation (Minneapolis), will be the first recipient of the newly established "Justin Morrill Award." Presented by the Technology Transfer Society, the award will be made on April 28th at Purdue University in West Lafayette, Indiana.

An evening ceremony is planned during which President Steven C. Beering of Purdue University will read a citation (attached) and present the award to Mr. Norris. The award is named in honor of Justin Morrill, a Vermont congressman, to whom passage of the Land Grant College Act (1862) is credited. That act was later amended to create agricultural extension stations focused on transferring new technologies into the economic mainstream.

"Morrill's legacy," says Mr. Nat Kessler, President of the Technology Transfer Society, "is more pertinent than ever. Our designation of this award is intended to affirm the vital contemporary importance of rethinking technology transfer and its impact on our economy. We cannot think of a better first recipient of this award than William Norris. Not only is his work exemplary but it has touched all aspects of or lives as Americans."

This event coincides with the publication of a new biography, *William Norris: Portrait of a Maverick*, by James Worthy (Ballinger/Harper & Row, Cambridge, Massachusetts). Advance copies will be available at the ceremony.

Mr. William Norris, born into a farming tradition, was drawn through his WWII naval service into the germinal stages of the computer industry. Throughout his career as an industrialist, he remained deeply committed to ideals and actions reflected in Justin Morrill's legacy:

> ...A person who excelled in his competence as a merchant-industrialist and who generously shared his knowledge with others.
> ...A person who served the national economic interest through consistent, creative and dedicated effort.
> A person who made enduring contributions to education and its role in society.
> A person who cemented new alliances, bridged diversity of opinions, and sought to be conciliatory in finding common cause

The award precedes a conference on "Managing the Knowledge Asset Into the 21st Century: Focus on Research Consortia" sponsored by the Technology Transfer Society, Digital Equipment Corporation, and the Technology & Strategy Group. Control Data Corporation, at Mr. Norris' urging, was a leader in establishing the Microelectronics and Computer Technology Corporation (MCC) consortium located in Austin, Texas. He was instrumental, too, in helping to establish the Computer Integrated Design, Manufacturing, and Automation Center (CIDMAC) at Purdue University.

For details call:

Debra Rogers, conference co-chair, at Digital Equipment Corporation (617 568-6567)
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Vide Beldavs, Executive Director of the Technology Transfer Society (317 262-5022).

Headquartered in Indianapolis, Indiana, the Technology Transfer Society is a society of professionals and organizations involved in technology transfer. It is dedicated to effective transfer of technology to promote economic development.

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