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THE UNIVERSITY-RELATED SCIENCE  
INSTITUTE AS A TECHNOLOGY  
TRANSFER AGENCY

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Presented at the Tenth Annual Meeting of the Institute of  
Management Sciences; Atlanta, Georgia - October 3, 1969

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Abstract

The increasing pace of technological development makes it extremely important for university and industry jointly to find a mechanism for transferring the basic research and technical skills born of university research to the industrial and government community. A few years ago, when the pace was not as swift, this mechanism was provided for by the normal process of educating students, who then went into the community and made use of their university skills. Today this mechanism is too slow. Governmental and industrial users have tried several techniques, each with disadvantages. Research contracts have been let directly with universities, but growing student and faculty disenchantment with secrecy of any sort has made it more difficult for universities to accept such work. Graduates from the university who go into industry do not provide for fast enough technology transfer, and are prone to lose contact with ongoing research when they take such jobs. Industry attendance at professional society meetings provides limited but insufficient technology interchange. Use of graduate student dissertations by governmental and industrial organizations usually is too specialized, and the organizations do not know what dissertation material is available. A solution which is becoming increasingly popular is the "university science center", which provides services of the university on a contract basis to government and industrial users. This paper explores the organizational problems, and the advantages and disadvantages of such university-affiliated institutions.

It is most confusing when one tries to determine the function of a university-related institution by either its name or its corporate structure. One university will have a separately incorporated entity with its own board of directors, but whose sole role is the internal administration of university research grants -- essentially a basic education function. Another may have a completely integral unit within a school or department, but which exists primarily to do the work of outside customers -- essentially an applied community service function. The picture is confused further in other universities by the existence of an institution which is completely the creature of the federal government but is managed contractually by one or more educational institutions. The most useful approach is to look past names or structures, and to classify such institutions in terms of which university role they support.

Before World War II this question of roles hardly arose. All except a handful of American campuses were peaceful teaching institutions in 1940, and neither faculty nor students expressed much audible doubt as to the rightness of the academic path. The war gave this peaceful pot a vigorous stirring, and in the process showed everyone that basic research could translate into complex products and techniques of tremendous value to the war effort. The lesson was not lost on postwar national science planners, and after the war a new era of federal support for university research set in motion tremendous changes in our beloved schools. Federal funds drew highly competent men, and they in turn attracted more talent; and thus began the clustering of academic talent in certain key regions of the nation. In short order thereafter began the clustering of innovative industries around these centers of scientific ferment and academic excellence.

By and large, it was the university-affiliated research centers which first assumed the applied research task of linking

the theoretical product of the universities with the practical technology of American industry. These centers attracted talent, dollars, and spinoffs in the form of new science-based industries. Since these new science-park communities were manned by entrepreneurs very sympathetic with the needs of the universities -- many of the enterprisers being fallen faculty members -- they found it quite logical to perform the valuable service of providing nearly full-time employment to many doctoral students, who thus continued their education and at the same time contributed to economic growth of the region. The campus was becoming the birthplace of a new industrial revolution, the key to which was an effective transfer mechanism for infusing basic university science into the bloodstream of industry.

Stanford Research Institute presents almost a classic pattern. Founded in 1946, in the very forefront of this post-war enthusiasm, it quickly became a major regional development institution by linking the university with government and industry. Today it performs some \$65 million a year of research and associated studies, about 70% of which is for government. In achieving this growth it demonstrated an extraordinary skill in adapting to the special postwar circumstances and taking full advantage of a changing environment which was not recognized generally. Strictly speaking, SRI is not owned by Stanford University, but since its trustees are named by those of the University it has appeared to students and the public as a wholly-owned creature of Stanford. Vice President Weldon Gibbons, SRI's oldest employe in point of service, stated recently that "the university-SRI affiliation is almost the essence of SRI." Despite a widely-held feeling that this is so, a dispassionate business analyst would have to conclude that the Institute carries on the majority of its work with precious little dependence upon its university parent.

This remarkable success pattern is hitting an unexpectedly rocky road today, as a result of the changing student and

faculty view as to the role of the university. The Palo Alto Times reported on April 30, 1969, that "Stanford Research Institute, one of the most eminent and highly respected organizations in the nation's contract research history, is being challenged to the very roots of its existence for the first time since its founding 23 years ago"; and on May 13 the trustees of Stanford University voted to end all ties with SRI and to find a buyer "mutually agreeable to the trustees, the university and SRI" -- and in the meantime to ban all research dealing with weapons development. Such a positive sentence of banishment, which would appear to have ended the matter once and for all, in fact seems to have exacerbated it in two respects. The first deals with perceptions of the activist students: having concluded initially that some of the SRI work was incompatible with scholarly study and thus SRI should be thrown out forthwith, they soon decided that instead it should be purged of the offending work and purified to a state that would enable the University to keep it on a close rein. The second deals with perceptions of the SRI professional staff: stung by attacks on what they considered reputable work, and irritated by having outsiders attempting to determine their future, they raised the interesting question of whether the University was in any position to tell them what to do.

Thus arises a most intriguing point. If a university spawns a separate corporate creature, and exercises control of its new child by appointing a safe panel of trustees, how will this apparent control survive a period of storm and turmoil? If the non-profit institute has no stock that can be owned, the university has no ownership, but is depending simply on the right thinking of interlocking trustees. In such a case, some resignations under fire at the crucial time can make the fancied control evaporate, and the institute will become in fact what it was said to be in form: independent. We can be sure that many institutional eyes are riveted on Palo Alto, to

see the ultimate outcome of this unexpected turn of events.\*

A very recent confrontation, though milder by far than the student-police melees of Palo Alto, took place at the University of Rochester, where the Faculty Senate had voted to have the University withdraw from management of the Center for Naval Analyses, and where President Wallis announced a month ago today that the University would not in the near future alter its relation to the Center. In his statement explaining his decision, Dr. Wallis said that "the hopes we had in entering the contract are materializing as fast as we had anticipated, perhaps a little faster", and that "the fears we had have not materialized." He cited the "hopes":

- improvement of the quality of CNA staff and work
- strengthening of CNA's independence and integrity so that it could provide genuinely objective and fearless studies
- acquisition from CNA of competence that would have significant value on the campus
- acquisition by University people of information not otherwise obtainable
- development of an outstanding systems analysis curriculum
- involvement of CNA to a significant extent in non-defense studies

He hinted at the fears lurking in the background, by stating wherein they had tended to show through:

"This is the spirit -- mutual respect and tolerance in the face of genuine and deep differences about matters of consequence -- which is the basis for a sense of community in the University...The University as an institution neither approves nor disapproves the policies of the government (and) loyalty to the University's policy of not taking an institutional position argues against taking an action at this time which would be interpreted universally as an institutional expression of disapproval of the Viet Nam War, as our withdrawal now from CNA surely would be interpreted..."

\* Philadelphia's non-profit University City Science Center would seem to have avoided this hazard of total independence, since under Pennsylvania's Non-Profit Corporation Law the 23 sponsoring institutions own all the voting stock. This may expose the other horn of the dilemma: inability to disclaim ownership if UCSC's conduct offends student notions of academic propriety.



It may be that the fears are somewhat more real than this hopeful and persuasive message suggests. Certainly the new concern of students with applied work on campus, and in particular with defense work, is showing no sign of diminishing with time, and it is probable that the Faculty Senate at Rochester will wish to make some further exploration of a matter where the administration decided to take a stand in direct opposition to its views.

Cornell Aeronautical Laboratory, a distinguished institution which has a separate corporate identity but shares some trustees in common with Cornell University, recently reacted to pressure from some academic groups (who felt that the applied tone of some of its work was not in accord with the University's educational role) and placed itself on the market. It was sold to a private profit-making company, EDP Technology, and the University approved the sale. The matter currently is in litigation over questions of whether sale to a profit-making company violates some terms of its initial charter or is in opposition to the intent of some later gifts; but it is clear that the administration was in enough agreement with the position questioning the appropriateness of applications work by a university so that it negotiated a sale to a private organization. The views of the many interested parties are not available here, but we should be able to conclude that it was thought such a private ownership outside the university would provide an optimum compromise between the choices of losing interesting professional opportunities for work by university people and of keeping applied tasks that were inappropriate for accomplishment by the university as an institution.

The Massachusetts Institute of Technology was the scene of a rather uncharacteristic demonstration on April 22, 1969, when campus pickets marched on the Instrumentation Laboratory to protest work on the Navy's Poseidon missile by a MIT internal activity. Three days later, MIT's president appointed the Pounds panel of students, faculty, alumni and trustees to

determine what MIT should do about its present role as the Pentagon's largest campus research contractor. The panel, while refusing to recommend any radical shift, called for the following reforms:

- a better balance between military- and civilian-oriented research
- increasing educational interchange between laboratories and the main campus
- reduction in security barriers
- review of all research proposals at the Lincoln and the Instrumentation Laboratories

but dropping the four-month moratorium on new classified research.

The panel stated that "the country's scientific and technological base rests in large part with the universities, and this base should be available to support advances in defense-related fields," but acknowledged that heavy emphasis on defense research "detracts from similar efforts aimed at other urgent needs of society", and at MIT has produced a bias working against unclassified research.

When laboratories get as large as MIT's Lincoln and Instrumentation Labs or the Stanford Research Institute, they become national assets of a sort, and the universities find some of their usual options somewhat foreclosed. Dr. Lee DuBridge, the presidential science advisor, states that classified research on campus is inconsistent with the normal spirit of free educational institutions, but notes that the larger labs "are not part of the normal training function of the university...I see no reason for closing them out." And AEC commissioner Francisco Costagliola, taking note of the Stanford and MIT recommendations for curtailing classified research, has informed both institutions that he will try to withdraw all the AEC's unclassified research funds if they decide not to take on classified military research.

Philadelphia's University City Science Center, created by 19 (now 23) educational institutions in and about Philadelphia -- but largely the brainchild of the University of Pennsylvania -- experienced a student occupation at about the same time MIT was

dodging epithets from its Spring protestors. The president of Penn, Dr. Gaylord Harnwell, found himself rather deeply embroiled in the discussion of whether this nominally independent research institute (of which his university owned less than a twentieth part) should work on weapons of war. He was bearded on another issue as well: his protestors demanded that the university find adequate low-cost housing for slum dwellers evacuated by the City when it was clearing land for the non-profit Science Center.

Clearly there is developing a significant shift in attitudes in the university community, and while some of the most violent complaint is voiced against military or other classified research, this is to a great extent a reassertion of the university's primary concern with fundamental research rather than with applications. In some of the cases cited above the administration has felt strong enough to buck student or faculty pressures, but this may be only the first round in a continuing argument over a point of constant contention. It would appear that university ownership of applied research organizations which do generalized work is under terrific pressures which may lead to major changes in such relationships.

Thus a vital linkage, and one which has played a primary role in our economic growth since the war and even before, is being degraded seriously. The importance of this linkage is expressed in a recent article, Universities as Innovators:

"It is not just the university, the Ph.D.'s, the science-based industry, or the existence of research parks that is critical. It is the linkage that brings these elements together -- as a part of a productive interdependent system which creates new information.

This linkage prepares people to see even more new information, which through other people transmits the information into production enterprises, which in turn widens the economic base on which the total system rests. The basic reality for the community is that it must contain or develop all or most of these elements if it is to remain viable in the science-based economy."

The total level of university research in 1969 is estimated at about \$3.8 billion, of which about 25% constitutes operation

of federal contract research centers, and this is growing at about 15% a year over the long run. Thus university research is a major growth industry, and the value of its product is very large in absolute terms. But the value of its product as a catalyst to industrial growth is even larger. The nation is dependent on basic science for much of its economic progress, and university research is the major ingredient in this needed scientific progress. Most of the university research is in the public domain; even in classified government research, the basic techniques and knowledge which must be learned to proceed with the specific research projects overflow into the general pool of basic university science. In theory this capital of knowledge is available freely to all who need it. The problem, of course, is one of accomplishing this technology transfer between the faculty and student researchers who have developed the basic knowledge and the vast pool of potential users beyond the university walls who operate the economy. The giver, inside the university, doesn't know where it might be used and isn't motivated to the finding of applications in any case. The receiver, out in industry or government, has little notion what may be available or how to find it, and has the additional problem of recognizing that he has a need at all.

Last December the National Science Foundation published an IITRI study (under Contract NSF-C535) entitled Technology in Retrospect And Critical Events in Science, giving it the symbolic acronym of TRACES. Its purpose was to explore the direct contribution of the research process to the welfare of society, and to ascertain the role of research in the overall process which eventually leads to technological innovation. Starting with the theory that technological innovation represents the final capstone of a broad pyramid of general and specific knowledge, in which each research building block plays a necessary role, it attempted to validate the theory with specific case studies, and to provide information on the types of institutions and research required for innovation.

The researchers wished to select a representative cross-section of research and development, and to provide data in a form that would be suitable for analysis in terms of the relationship of research, development and innovation. It was decided that these goals would be achieved best by selecting a representative group of technical innovations, and by tracing back the significant events over time which bore on each of the innovations. The final selection, deemed to embody these requirements best, consisted of the following five "tracings":

- magnetic ferrites
- video tape recorder
- the oral contraceptive pill
- the electron microscope
- matrix isolation

The origin of a historical tracing is marked by the research milestone or milestones marking the beginnings of the distinct lineages of scientific specialty contributing to the innovation. The end of a tracing is the point at which the first generation of acceptable commercial items appears. Count data was taken in the form of key events in the evolution of the appropriate scientific areas and the subsequent technological innovation. The researchers placed the key events in three categories:

- Non-mission research, accomplished with no thought of any consequent useful product or phenomenon
- Mission-oriented research, in a basic area but motivated by need for more basic knowledge to contribute to some specific payoff
- Development and application

Study of these five cases convinced the researchers that, whereas earlier industrial development has proceeded from new raw materials, exploitation of the labor markets, or infusion of large amounts of capital, much of our current economic progress is dependent upon the creation of wealth through exercise of intellectual and logical powers. The product of non-mission research is analogous to capital wealth, in that we establish a fund of knowledge against which innovators make withdrawals

at the rate demanded by society.

The significant findings of the study are set forth below;

1. In all cases, nonmission research provided the origins required to make the innovations possible.
2. Approximately 70% of the key events were nonmission research, 20% mission-oriented research, and 10% development and application.
3. The university performs the great majority of nonmission research: 76%, versus 14% for government laboratories and institutes, and 10% for industry.
4. Excluding development and application, the university performs two-thirds of all research leading to important innovations.

This study makes abundantly clear the preeminent role of the university in bringing to life the innovations on which our society depends. It points up two other things as well. One is the slowness of the overall process of bringing a new discovery to the service of mankind. The other is the essentially helter-skelter nature of the process, with the academic cast in the role of reluctant bride, and with the potential users standing (to mix a metaphor) blind in the midst of plenty.

How will these blinders be removed from the potential users for this vast storehouse of university-generated basic knowledge? What is the best way to achieve the process that is starting to be called popularly the "transfer of technology"? In testimony before the Subcommittee on Science and Technology of the Senate Select Committee on Small Business (90th Congress, First Session on Policy Planning for Technology Transfer), the former head of both IITRI and SRI discussed the special kind of institution required to provide this service successfully. Mr. Hobson pointed out that only the largest and most experienced companies have the skill to define their problems and to find the opportunities for the adaptation of technology. The rest, he testified, need assistance in identifying their problems and

opportunities, in seeing where existing technology can be used or adapted to meet their needs, in knowing when to call on existing sources of technological information, what to look for, how to ask for the information, and then how to use it when they get it.

Who will provide this assistance in the adaptation of technology? Mr. Hobson had the following to say:

"In my opinion the universities are not usually the best sources for this kind of assistance. The business of the university is to generate or create, transmit and store knowledge. The business of the university is not primarily to search out problems and fit possible solutions to those problems. In my opinion both the professors and the graduate students have other, more pressing interests, and they frequently do not have the broad interests and experience which includes the commercial aspects of the marketplace, the mechanism of the production process, as well as a familiarity or contact with the wide scope of technology which is available.

"I would like to remind you that in the field of agriculture it was necessary for us to invent and to develop a new device, the agricultural extension service, to link the research laboratory of the agricultural experiment station with the producers and the processors of agricultural materials.

"I believe that the organization that we have available in this country which is best suited to bridge this gap between the existing technology and the need for its adaptation to the marketplace is the research institute, either a nonprofit or profit organization..."

We are not speaking here and now of the technology transfer operations initiated by various federal agencies, such as the Armed Forces Technical Information Agency, the NASA Regional Dissemination Centers, the Federal Clearinghouse, the National Referral Centers for Science and Technology, or even the State Technical Services Centers. By and large these deal with making available a smorgasbord of technical data which is usable chiefly by technical personnel with a specific need and with the expertise to hunt up a solution. NASA has put a great deal of effort into its Technology Utilization programs, and its continued study of the mechanism for technology transfer

provides a valuable addition to the field. Already we are seeing crossover of NASA-generated technology into such highly improbable areas as urban management.

What we are seeking is a way to place at the service of the community that two-thirds of available basic knowledge which resides in the university -- and to see that not only is it available but it is used and used correctly. How can the university respond to increasing community demands that it be responsive to their needs, but without involving itself in internal confrontations and divisive arguments, and without losing sight of its primary educational goals?

Many city universities have decided that they cannot remain deaf to the demands of their metropolitan neighbors that they involve their resources in the solution of pressing urban problems, but they dread the concomitant likelihood of becoming involved thereby in heated community issues which will spill over onto the campus. Columbia University's upheaval certainly sprang in part from the University's seeming isolation from community issues under its very walls. When a university decides it must respond to such pleas, it finds its resources remarkably slim. The administration cannot mobilize faculty on such a project unless it pays them for the work, which is virtually impossible since it would constitute dual compensation. Perhaps it would have difficulty in mobilizing faculty even then, for it is not the academic style to allow one's research interests to be selected by the administration. The best solution appears to be the separate-but-owned Research Institute (Research Triangle Institute, Rensselaer Research Institute, Syracuse University Research Corporation, University Circle Research Center, University City Science Center, IIT Research Institute, Auburn Research Foundation, Institute of Industrial Research, etc.), which can ante up funds to pay faculty for research and consulting, but which appear to offer the device to keep the university both "in it"



(in the sense of showing university responsibility in responding to community demands) and "out of it" (in the sense of not doing unacceptable categories of research within the university proper.

This convenient duality does not appear to be working. Pressure groups within the university persist in considering such separate corporations as integral parts of the university, and the administration is squarely in the middle. If this separate Institute takes on weapon system work (quite difficult to define), it draws down on the administration an aroused group of students and faculty; if it forbids it, it arouses a different group which values the opportunity to work in the "state of the art" and resents prohibitions on such professional pursuits. This emotion-charged controversy has no permanent solution as long as the Institute is a university enterprise. If the Institute is not, the whole controversy disappears; for no professor, however liberal, would dream of abridging the academic freedom of colleagues to work on anything they wish; but the same professor would protest violently if such questionable work is done by a university agency (and thus implicitly by himself as well, though without his permission).

University trustees can find themselves attacked as know-nothings, warmongers and worse, for condoning actions of a separately incorporated (but university-owned) research center about which they are told little and which they consider remote from the mainstream of the university. They can look forward to enough criticism for the university proper in the coming years -- an area where they do accept responsibility -- without adding insult to injury. An April 12 editorial in the Palo Alto Times said of the SRI sit-ins and demonstrations, "Stanford ought not to have to endure such embarrassment nor defend research decisions made by government units in Washington, Sacramento or some city hall or county seat. A university's primary concern, along with education, is fundamental research,

not applications." Since a university-related science center, if it is to work on high-technology scientific applications or involve itself in crucial social problems, will stir up mixed feelings in these emotion-laden areas, the trustees can anticipate continual turmoil on its behalf. Good trustees are too hard to entice in these days as it is; we should not lose them on account of issues outside the university proper to which they need never have been exposed.

A university-related science center cannot exist without the general approval of the universities and their faculties and graduate students. It must be sufficiently motivated to represent the university family and support university aims vis-a-vis the community so that it meets a real need (one that the university is importuned to meet otherwise), and it must have a clear understanding of this role so that it does not intrude upon legitimate university domains or impede the university in any sense. But when the interrelationship goes beyond this unstructured accommodation, both Center and University find their purposes impeded by too much control. The transfer of technology concept, so vital to our economic and societal progress, implies a total willingness to make available to the outside community of industry and government the whole of new scientific thoughts and discoveries spawned within the universities, without imposing any prohibitions other than those established by the good sense of the Center's own management. (This important principle is called, within the university, "academic freedom")

A restriction on weapon research tends to be artificial. Clearly it is not the role of special university groups to prohibit any properly constituted agency of government from accomplishing the tasks assigned it by the electorate. It is quite appropriate, however, for such groups to protest the accomplishment of such work by the university itself, for such tasks are foreign to the designated purposes of a university. If a Center is part of a university, therefore (and separate

incorporation doesn't change the reality of university ownership), the overriding interests of the university dictate that the Center refuse most weaponry tasks -- and this is true even though many faculty members and graduate students (possibly even a majority) find the technical challenges highly attractive and do not find the area repugnant.

Restrictions are likely to go further than a ban on weaponry. In many faculty senates there is strong pressure to prohibit secret research altogether, on the admittedly reasonable grounds that everything the university learns ought to be available for the freest possible scholarly interchange. But this can throw out the baby with the bathwater. Intensely interesting toxicological studies funded by pharmaceutical houses, for instance, are put in universities under conditions of proprietary privacy. Why is this so? If a drug company testing a new drug for potential side effects finds that it may cause hair to fall out, and if disclosure of such results of university tests leads to a catchy little news item about the "Baldness Pill", no one will listen to the drug company argue that the tests are precisely to determine whether such side effects exist -- and that there isn't going to be any baldness pill, because the tests have shown that the drug is unacceptable on this account. Drug companies have no desire to risk such misleading publicity, so they tend to insist on "secret research". If a company considering expansion in Argentina commissions an economic forecasting study which shows a good opportunity in some industrial sector, the company is understandably reluctant to have this published, because it carries the clear intelligence to competitors that the company contemplates a major commercial move in the sector indicated. Companies will not undertake such research unless the results are kept in confidence.

Note that this secrecy does not, and should not, extend to the methods, but only to the results. If the new forecast-

ing model embodies a significant advance in the econometric art, the technique of constructing it ought to be available to the university people (and thus in the public domain); but the specific numbers contained in this particular run of the model are not of legitimate public interest and it is completely appropriate to keep them confidential.

There are still other restrictions that a university may wish to impose, besides bans on weaponry and secrecy. If a university-owned research arm draws on faculty skills and prior research to conduct social science studies in sensitive public areas, the implied university sponsorship of unpopular findings and recommendations can embarrass both administration and trustees. There will be a strong consequent tendency to avoid these areas. Sociological studies of the effect of penal institutions on rehabilitation, or a systems analysis of the apprehension and deterrence process in crime control, can imply serious criticism of present methods in the university's home city; a city father on the university's board of trustees might find this both embarrassing and inappropriate. Indeed, it might raise political questions that could involve the size of state appropriations for university support, or could extend to a punitive discussion of the tax-free status of university property. While we would expect the university administration to present a vigorous defense in such cases, such crusades are time-consuming and wearing; the temptation to avoid them is understandable, if not always excusable.

It is noteworthy that President Wallis of the University of Rochester, in listing the hopes for their evolving relationship with the Center for Naval Analysis, included "strengthening of CNA's independence and integrity so that it could provide the Navy with genuinely objective and fearless studies, analyses, evaluations, and recommendations." He meant, of course, that the University of Rochester is sufficiently independent of the Navy, even though it works on Navy contracts,

to be insulated from pressures that could emanate from Navy pressure groups to reach a predetermined conclusion or to avoid a controversial study. (There is reason to think that the permanent CNA staff, which has seen management agencies such as Rochester come and go over the years, rates this as the primary "hope".) What his September 3 statement tends to gloss over is the crucial one of CNA's "independence and integrity" from pressure groups within the university itself. This is the Achilles' heel of university research centers, as we have pointed out above.

An alternative approach is for a university to develop informal associations with a neighboring private consulting organization. In one case involving a major university and a nationally known private consulting and research company, it is not unusual for faculty recruiting to be sweetened by the offer (made by the university department head direct) of some regular consulting employment by the private company. At the other end of the spectrum are the very small private companies, consisting of a handful of faculty members in each, which typically draw on their colleagues to do work known to be of interest; these can vary widely, from groups quite close to departmental chairman and deans (and cooperating with them in all matters), to maverick organizations who look on the university as a convenient recruiting ground and who work entirely apart from university goals. A primary disadvantage for any of these is the lack of a steadfast and explicit institutional commitment on the part of the private organization to operate at all times in consonance with university interests. Therefore the relationship provides no real substitute for a research applications institution with more dependable ties to the university, and one that can be counted on to behave accordingly.

There is another institutional form. Consider a science center whose officers are faculty members of the university, and with strong university representation on its governing board,

but with the corporate form of a profit-making company. Other members of its governing board are individuals with a civic commitment to the community. The Center commits to operate as closely as possible to the university-owned separate corporation insofar as university interests are concerned, but the university assumes no responsibility for its actions. The Center seeks to apply university technology to community uses (thus helping the university to be a good neighbor), and it conducts no programs competitive with the university or likely to cause the university harm. By providing consulting income for faculty and graduate students, it supports the university drive for high quality personnel.

Such a Center operates primarily with part-time professional staff. It complies with the university policy on out-of-hours outside work: typically this means that it will not take on tasks which will require faculty members to commit more than one weekday per week, on the average, because to do this would imply that the consulting work was beginning to displace the university as the locale of the faculty member's primary job. As a matter of fact, if the Center keeps its eye on the source of its real strength, it would not want to distract the faculty members from their primary employment -- for that is where they develop the basic technology and knowledge which the Center is transferring. Without a recognition of this fact, the Center is transformed into just another private research and consulting institute -- and the university is back where it started, with its basic need still unsatisfied.

What if the Center feels its oats, and begins to operate contrary to university interests? The university withdraws its expressed approval, in the form of board memberships, and department heads and others begin to indicate a lack of favor for the Center. The special relationship evaporates, and the Center ceases to exist as a university-related institution. The university retains all the positive advantages of control, but can disavow the Center if its actions appear inappropriate.

We can say, in summary, that a number of conclusions emerge -- some with more force than others. We conclude that the university store of basic science and knowledge, constantly being replenished by new academic work, constitutes a primary source of intellectual capital to spark innovations in our society. Some linkage between university and community is essential if this capital is to be tapped effectively. The university can provide the linkage in-house (it makes little practical difference whether as a separate corporation owned by the university, or as an integral department or laboratory on campus), but two difficulties arise: one is the growing university distaste for applications work within the academic organization; the other is the existence of such conflicting views as to the type of outside work a university should accept. The university can allow outside research institutes to carry the load (it makes little practical difference whether profit or non-profit), but by and large the outside institutes operate with permanent staff, so they really don't serve as linkages so much as they provide substitute technology -- and studies such as the NSF study cited herein indicate that the substitute is neither as plentiful nor as good as the real thing.

An interesting middle ground is the private "university science center", operated by faculty members and subject to informal but adequate university control, but capitalized privately. It appears to get around many of the disadvantages of the alternatives, and to provide a number of the advantages.