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TECHNOLOGY DEVELOPMENT:
A Partnership That Makes Sense

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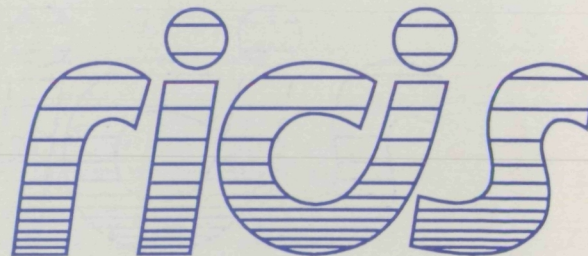*NASA/JSC*

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ricis

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The RICIS Concept

The University of Houston-Clear Lake established the Research Institute for Computing and Information Systems (RICIS) in 1986 to encourage the NASA Johnson Space Center (JSC) and local industry to actively support research in the computing and information sciences. As part of this endeavor, UHCL proposed a partnership with JSC to jointly define and manage an integrated program of research in advanced data processing technology needed for JSC's main missions, including administrative, engineering and science responsibilities. JSC agreed and entered into a continuing cooperative agreement with UHCL beginning in May 1986, to jointly plan and execute such research through RICIS. Additionally, under Cooperative Agreement NCC 9-16, computing and educational facilities are shared by the two institutions to conduct the research.

The UHCL/RICIS mission is to conduct, coordinate, and disseminate research and professional level education in computing and information systems to serve the needs of the government, industry, community and academia. RICIS combines resources of UHCL and its gateway affiliates to research and develop materials, prototypes and publications on topics of mutual interest to its sponsors and researchers. Within UHCL, the mission is being implemented through interdisciplinary involvement of faculty and students from each of the four schools: Business and Public Administration, Education, Human Sciences and Humanities, and Natural and Applied Sciences. RICIS also collaborates with industry in a companion program. This program is focused on serving the research and advanced development needs of industry.

Moreover, UHCL established relationships with other universities and research organizations, having common research interests, to provide additional sources of expertise to conduct needed research. For example, UHCL has entered into a special partnership with Texas A&M University to help oversee RICIS research and education programs, while other research organizations are involved via the "gateway" concept.

A major role of RICIS then is to find the best match of sponsors, researchers and research objectives to advance knowledge in the computing and information sciences. RICIS, working jointly with its sponsors, advises on research needs, recommends principals for conducting the research, provides technical and administrative support to coordinate the research and integrates technical results into the goals of UHCL, NASA/JSC and industry.

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Preface

The United States, along with other nations of the world, finds itself in an increasingly competitive world economic environment. U.S. organizations have instituted major efforts to increase their productivity as well as the overall quality of their output. These needs place a premium on the development of collaborative efforts among appropriate organizations to develop and apply "cutting edge capabilities" in critical categories of technology.

In this paper, the authors discuss an approach for how academic institutions, government entities and industrial organizations can work effectively to utilize their relative strengths to more effectively meet common goals. They relate this to an evolving UHCL RICIS program to bring about this type of triad in the Clear Lake Area.

The views and conclusions contained in this report are those of the authors and should not be interpreted as representative of the official policies of IBM Corporation, UHCL, NASA or the United States Government.

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Introduction

All too often we in government, industry and universities, find ourselves developing technology on a basis of perceived needs rather than being driven by specific needs. While this approach has its place, it can be a very wasteful approach in the area of applied research. This problem is compounded when groups across several organizations such as government agencies, industrial entities, and university groups are involved.

Historically it has proven difficult to bring together these distinctly different organizational cultures such that the benefits of collaboration are realized. However, evidence exists that there are advantages of cooperative efforts among professionals from academe, government and industry. There are a reasonable number of examples where effective collaboration of academe, government and industry have produced benefits ranging from significant to astonishing. One such example is the Land-Grant U.S. Agricultural System; this structure, comprised of government, academe and the agribusiness community is given credit for creating the most efficient and productive agricultural system in the history of mankind.

Driven by need, organizations of the Clear Lake area formally initiated an effort in 1986 to bring academe, government and industry together to develop a long term focused research and professional level education program in "computing and information systems."

The Problem

Tremendous advancements in materials research, development and in the engineering of hardware components and systems for computing and information systems have been realized in the last four decades. On the other hand, the capabilities of mankind to engineer the instruction sets, commonly referred to as "software systems", have not kept pace with hardware development.

Moreover, the education programs required to produce software engineers are only now being seriously discussed. Adequate education programs to convert some percentage of the existing body of software practitioners to improved software engineering methodologies are similarly lacking.

To make effective use of cutting edge concepts, methods, and technologies in a timely way, the "concepts/methods" of academe need to be understood and supported by the "technology implementers" of industry in concert with informed requests by government agencies. The problem, then, is to determine how to recognize a specific need and focus the necessary resources from multiple institutions on fulfilling the need, without compromising the independence of the institutions.

A Specific Approach

In 1986 the University of Houston-Clear Lake (UHCL) formed the Research Institute for Computing and Information Systems (RICIS) as part of a cooperative program with NASA Johnson Space Center to jointly define and manage an integrated program of supporting research and professional level education in the computing area. Since its inception, RICIS has been responsible for more than 27 million dollars of research. RICIS has functioned as organizer and manager of a gateway to research organizations in universities and industry as well as conducting a significant portion of research and education activities with UHCL faculty and staff.

RICIS attempts to serve as a clearinghouse of research ideas, cutting edge methodologies and concepts, and software technologies that are, or should be, of interest to NASA; it facilitates the research selection process; it coordinates the selected efforts as they are conducted; and it disseminates the results.

Importantly, RICIS utilizes the gateway mechanism to explore the applicability of already existing research results to critical NASA needs (examples include research conducted by the Microelectronics and Computer Technology Consortium (MCC) and the Software Engineering Institute at Carnegie-Mellon University) and so helps facilitate the transfer of technology and knowledge into NASA.

The RICIS program is attempting to build on the strengths of government, academe and private industry to take advantage of computing and information systems know-how and technology for the benefit of all participating organizations:

- to create an environment to foster "continuing, working-level, people interactions",

- to "remove mystique and build mutual understanding and trust among participating university, NASA and industry staff and professionals",

- to identify and incorporate incentives to encourage this outreach,

- to build mechanisms to better effect knowledge/technology transfer/ infusion between universities and government,

- importantly, to avoid using universities as substitutes for industrial partners.

RICIS has adopted the "proven" government/university "Land Grant" model as the foundation concept for its program. NASA has adopted the "Cooperative Agreement" as the contract instrument to implement this program. Both NASA and UHCL/RICIS are as concerned about the "process" as well as the "content" of this collaborative effort.

Already a considerable amount of research results/knowledge and technology/know-how have been produced in the U.S. and around the world that needs to be better understood, appreciated and exploited (technology insertion). Hence considerable effort can be productively spent towards gaining the benefits of applications research.

Rounding Out the Picture

RICIS provides a necessary mechanism to work with government to plan and oversee needed research and professional level education. Figure 1 depicts a simple model of the NASA/UHCL cooperative association. The missing element is the view of industry, i.e., the government's contractors, who ultimately have the responsibility to insert technology into NASA's programs. While NASA and UHCL from the outset have envisioned industry as a third important element of the RICIS program, the initial emphasis was placed on developing the university/ government link. RICIS is now in a position to encourage industry to be a major partner in the program. A current major thrust is to develop this important element.

Following considerable dialogue between RICIS and various aerospace organizations, UHCL and IBM recently entered into a new partnership agreement. This is viewed as the first step in creating an "Industrial Affiliate component" of the RICIS program involving a number of interested industrial organizations in the Clear Lake/Houston area. The agreement covers five basic areas of cooperation as follows.

- IBM, as the first Industrial Affiliate, will help UHCL define how industry can help carry out the RICIS role. The initial thrust is to
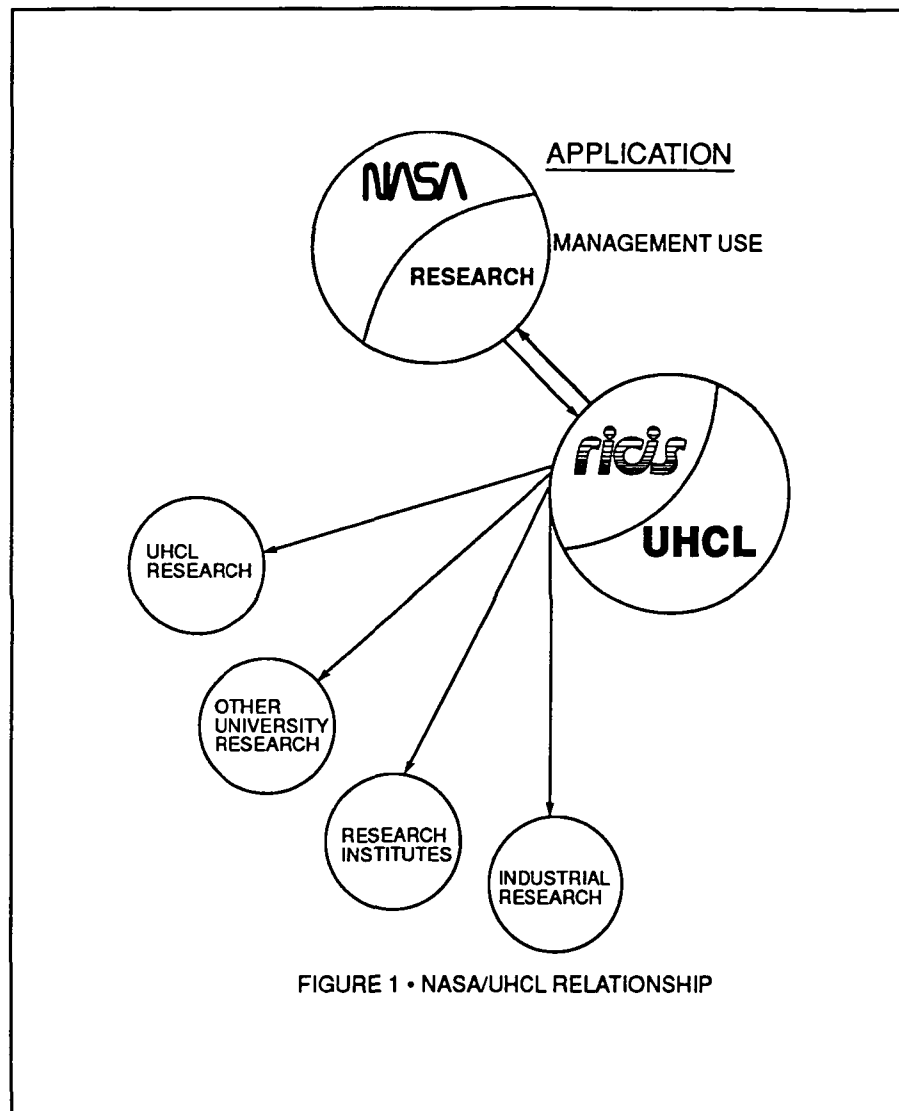
(3)

FIGURE 1 • NASA/UHCL RELATIONSHIP

serve in an advisory capacity on a planning board structured for this purpose. Other Industrial Affiliates will be invited to serve in a similar capacity.

- IBM will assist UHCL/RICIS in providing a series of credit and non-credit classes in the area of Project Management to the RICIS community at large.
- UHCL/RICIS and IBM will conduct cooperative research in the area of Group and Organizational Analysis. Initially, this will concentrate on interviewing techniques in support of Information Engineering, Knowledge Engineering, and Management Consulting.

- UHCL/RICIS and IBM will investigate other areas of joint interest for possible collaborative work (e.g., Space Station Data Management System, image processing and engineering of reusable software components).

(4)

- IBM will assist UHCL/RICIS in bringing other Industrial Affiliates into a collaborative program.

This thrust adds a new dimension to the model already established. A view of the new relationship is presented in Figure 2.

APPLICATION

NASA

MANAGE USE

NEED

MANAGEMENT

ADVICE   KNOWLEDGE
                POOL

IBM   TRAINING   UHCL

PROTOTYPING   TECHNOLOGY

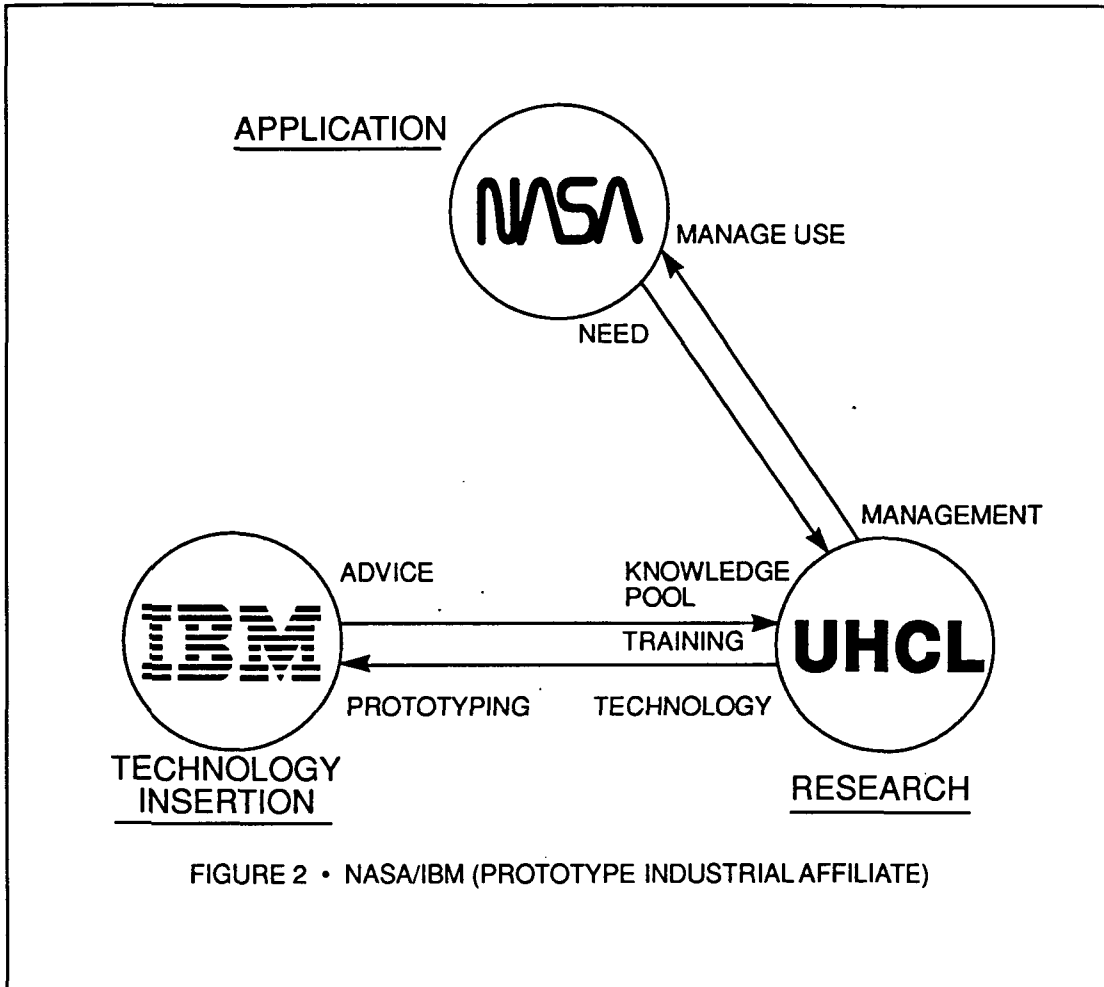TECHNOLOGY
INSERTION   RESEARCH

FIGURE 2 • NASA/IBM (PROTOTYPE INDUSTRIAL AFFILIATE)

The final step is a formal interface between IBM and NASA. Such an interface exists already in the form of contracts which govern the work that IBM does for NASA. These contract relationships can be used to recommend and accept technology insertion based on prototyping done in support of research accomplished through the RICIS/NASA relationship. Hence, the RICIS industrial affiliate program will provide the missing link between the existing NASA/ IBM contract relationship and the NASA/UHCL cooperative relationship. This provide closure for all the relationships required to generate and evaluate research for the NASA community. All of the required interfaces are shown in Figure 3.

(5)

FIGURE 3 • NASA/IBM RELATIONSHIP
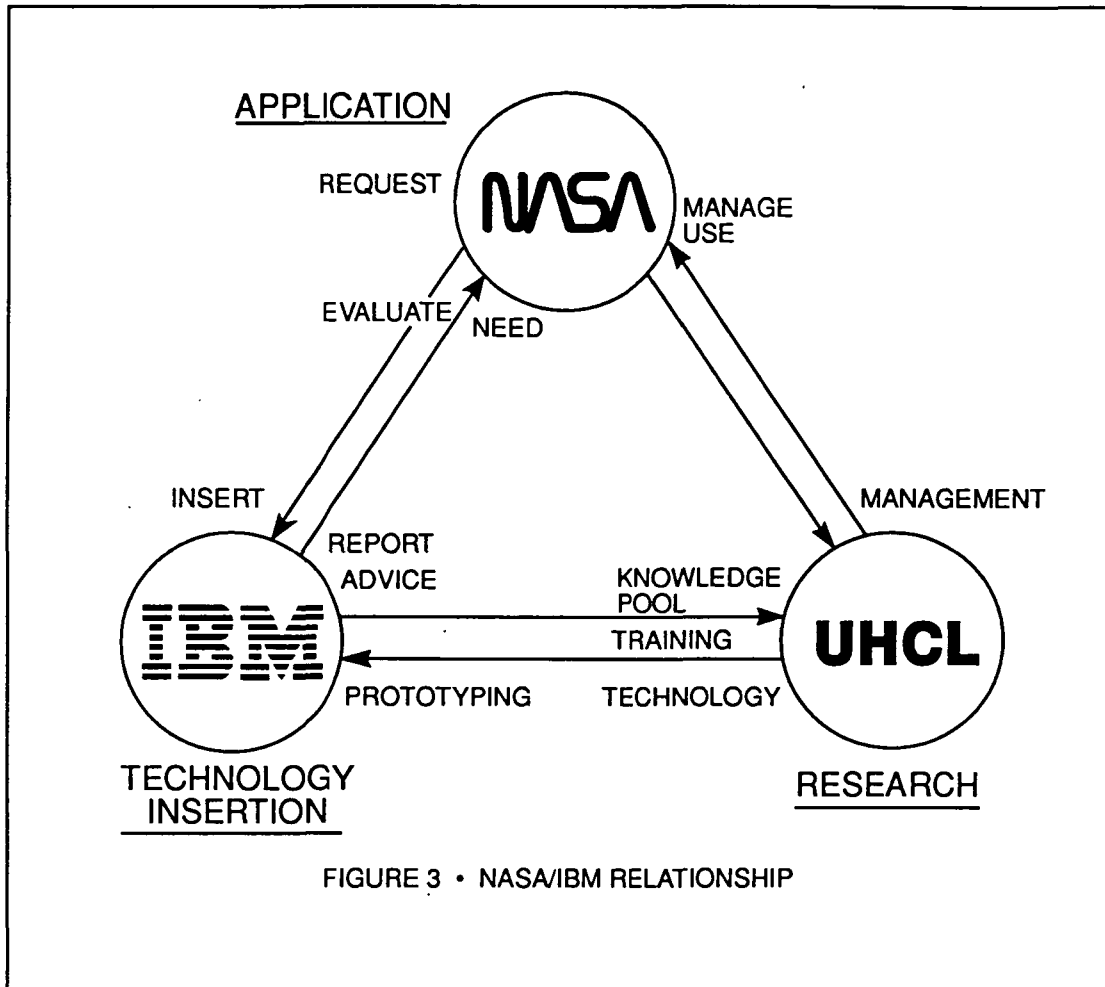
A General Model

In general, the industrial contracting community needs to function in the role to be prototyped with IBM in the academe, government, industry triad. One could replace IBM with industry contractors and this model works well as a cooperative model for NASA, UHCL and industry. If we look beyond this specific situation we see, moreover, a general model of cooperation among any government agency, or major customer, and its university and industrial counterparts. This general model is presented in Figure 4.

FIGURE 4 • GENERAL COOPERATION MODEL
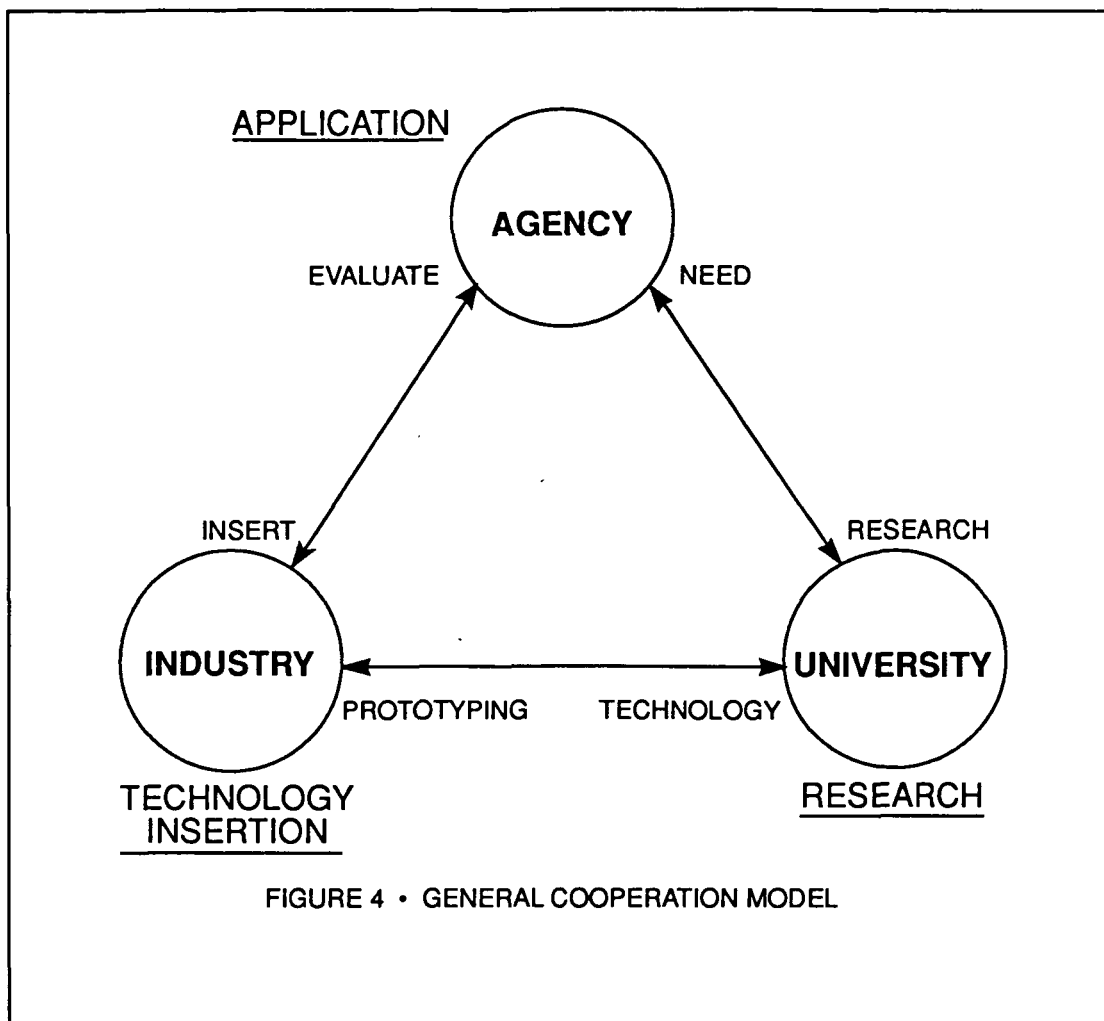
Perspectives

NASA

The initial stimulus for the joint NASA/UHCL cooperative program was a recognition by JSC of a need for a forward-looking, longer-term engineering research and continuing education program in the rapidly evolving fields of computer and information sciences and engineering. JSC, as a major space engineering center and a major developer and user of computing and information systems, has a clear need to stay at the forefront of the concepts, methods and technologies rapidly emerging from these fields. In 1984 the Mission Support Directorate of JSC began an effort to formulate and plan for the initiation of such a supporting research and continuing education program. That program included provisions for the UHCL to create RICIS -- an "institute without walls".

While the total program represented by the JSC/UHCL Cooperative Agreement NCC 9-16 is broadly based on the computing and information fields, much of the attention and efforts of research and education has been directed to issues of the newly emerging field of software engineering. Many of us at JSC strongly believe that we need to be at the forefront of modern software engineering methodologies and practices if we are to achieve NASA's missions and goals.

(7)

UHCL

The primary mission of a university is education. In order to stay abreast in educating its constituents, a university must establish and maintain a strong research component. The Clear Lake community is a science and engineering community with ever increasing demands for advanced computing and information technology. With this in mind, UHCL, in the early '80's, set out to encourage NASA/JSC and local industry to provide support, including sharing personnel and facilities as well as contributing funds, for research and education in computing and information systems.

The resulting discussions led to UHCL establishing RICIS in cooperation with NASA/JSC. As pointed out previously, RICIS is now positioning itself to establish stronger ties with the industrial community. With the 'triad' in place, the community will be better served by the university.

Importantly, the university will derive tremendous benefits as well. The expertise of faculty and professional staff will be further developed by exposure to complex problems. The faculty will have the opportunity to stay at the cutting edge of research and contribute to the scientific body of knowledge. The results of the research will find its way into the classroom enriching the educational experience. Moreover, such a relationship will provide research as well as educational seasoning for UHCL students.

A relationship involving UHCL with industry and NASA, and potentially other government agencies, will lead to establishing new degree programs as the needs of the community are better understood. An example is the newly established master's degree program in software engineering science. RICIS was a major factor in establishing the rationale for getting the needed support for developing this program.

IBM

Research is essential if an industry is to remain viable. However, topics for research are many and the money to be invested from profits is not adequate to cover all of them. By participating in RICIS, IBM can direct funds into topics based on the needs of the agency that it primarily serves in the Clear Lake area. Access to research directed by RICIS also enables each industrial affiliate to not duplicate work already performed by others and invest in complementary work.
Work with UHCL gives IBM access to research skills in the university to complement its own. It also gives IBM access to training associated with research of interest. IBM also provides prototyping opportunities in real projects to prove the value of technology under study at UHCL through RICIS.

Finally, since IBM is a NASA contractor, it can react sensibly to technology insertion requests in NASA RFP's if prior prototyping has been accomplished through the RICIS mechanism. This final contracting mechanism completes the picture of cooperative research: the need for the research, a conducive atmosphere for its completion, prototyping to show viability, and a mechanism for inserting the technology into programs.

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Summary

What has been developed here is a combination of the interfaces among three entities to function as a whole. We feel that this is a necessary mechanism if the institutions involved are to maintain their technical vitality. Each of the interfaces must remain independent to maintain a healthy counterbalance of the respective entities. However, each entity can and must understand the entire mechanism to exploit each interface to the fullest. Only through such cooperation can the continued technical success of the NASA/Clear Lake area be assured and continue to contribute to the technical acco plishments of the nation as well.