SIMON FRASER UNIVERSITY

OFFICE OF THE VICE-PRESIDENT, ACADEMIC

MEMORANDUM

S.92-64

To:	**Senate**
From:	**J.M. Munro, Chair, Senate Committee on Academic Planning**
Subject:	**Institute of Micromachine and Microfabrication Research**
Date:	**19 November, 1992**

At its meeting on November 4, 1992, the Senate Committee on Academic Planning recommended the establishment of the Institute of Micromachine and Microfabrication Research.

Motion: **That Senate approve and recommend to the Board of Governors the establishment of the Institute of Micromachine and Microfabrication Research and the granting of a Charter to the Institute under the terms of Policy R. 40.01.**

J.M. Munro

Enclosure

PROPOSAL FOR AN INSTITUTE OF

MICROMACHINE AND MICROFABRICATION RESEARCH

The proposed Institute will stimulate, encourage, and enhance micromachining and microfabrication research, by providing a focus and resource base, for collaborative and multidisciplinary research, leading to new processes and new devices of benefit across a wide array of disciplines.

The Institute will be a schedule A centre. The administrative officer will be the Dean of Applied Sciences.

The Director of the Institute, nominated, elected, and recommended by members of the Institute through the Dean of Applied Sciences, will be a full time employee of Simon Fraser University, appointed by the President, upon recommendation of the Governing Committee for Centres. The term of the Director will be for three years, renewable.

The Director shall submit an annual report on all Institute activities, and a financial statement showing all revenues and expenditures; for the twelve (12) months ending March 31 of each year, no later than June 30 of each year.

The Institute will act in accordance with all university policies, and in a manner consistent with the goals and objectives of Simon Fraser University.

Membership shall be by application to the Director, and a majority vote of the membership, subject to appeal (for Simon Fraser University personnel only). Membership shall be for a three (3) year term, renewable at the discretion of the Director.

An Advisory Board representing a cross section of university administration, research, industry, and government personnel, will be assembled to provide guidance to the Institute.

PROPOSAL FOR AN INSTITUTE OF MICROMACHINE AND MICROFABRICATION RESEARCH

BACKGROUND INFORMATION

INTRODUCTION

The miniaturization of mechanics is transforming many areas of technology, from automotive design to biomedical research, with profound consequences for Canadian industry. The techniques of micromachining provide a new tool set that can be utilized by scientists and engineers in almost every field to produce advances in research and in product design. This gives micromachining research; an extremely broad application range, a strong bias towards multi-disciplinary research, and a poor fit with existing administrative frameworks.

Micromachining is unique among fast emerging generic technologies in not requiring massive investment to be a creditable player on the world stage. While multi-disciplinary research is essential, large consortiums of universities, government, and industry set up to spread the costs and benefits of pre-competitive research are not required. Small efficient research teams are producing remarkable results.

Micromachining is subject to the same technology transfer restraint as any other basic research, namely the knowledge gap between the university and industry. In a field as potentially prolific in new device development as micromachining, this could result in a tragedy of lost opportunities for Canadian industry. A linking mechanism is required to ensure that the knowledge gained in basic research flows smoothly into applied research, which can in turn more easily connect with industrial development programs.

The diverse applications, the multi-disciplinary nature of the research, and the potentially major economic impact across many industrial categories, demand that micromachining be given a focus, a higher profile, and a mechanism for interaction with other research groups and with industry. The Institute of Micromachine and Microfabrication Research proposed herein, is intended to meet these needs, and provide Canada with a strong and vital centre of research in a field of growing strategic importance.

OBJECTIVES

Consistent with the goals and objectives of Simon Fraser University, the particular objectives of the Institute are as follows:

1. To stimulate, encourage, and enhance micromachining and microfabrication research and development, by providing a focus and resource base for such collaborative and multi-disciplinary research.

2. To identify and articulate priorities for the application of micromachining, which will bring the greatest benefit through scientific research, and the creation of devices to aid human health, safety, and comfort with the minimum use of resources.

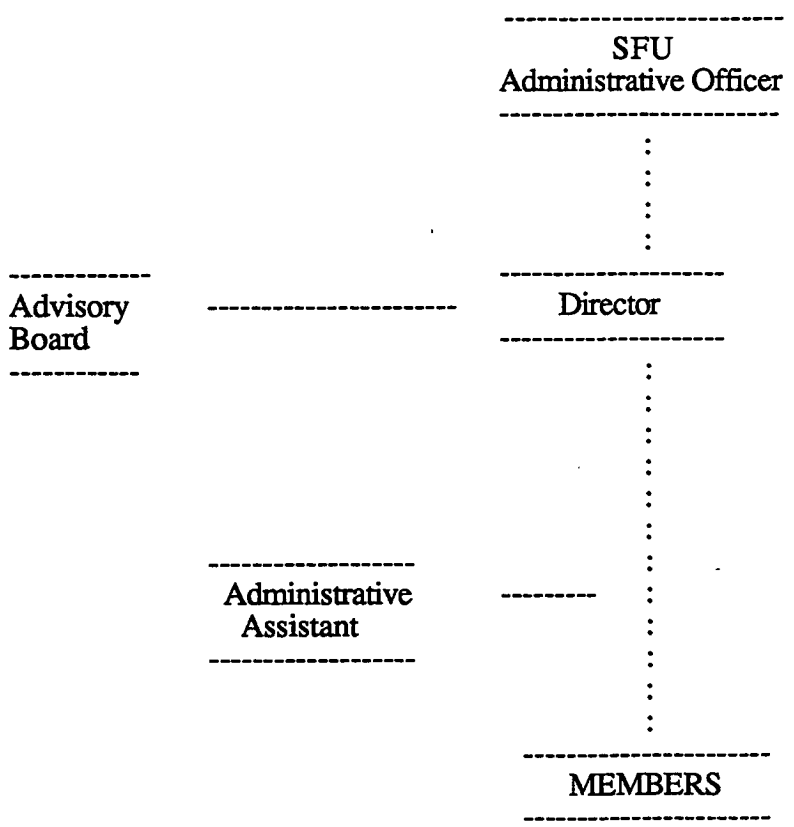
3. To create a research network within Canada and foster co-operation with major institutions around the world.

4. To establish an advanced micromachining and microfabrication process facility at SFU.

5. To promote the development of future research and development personnel with expertise in micromachining and microfabrication through a graduate program, prepared in conjunction with appropriate departments.

6. To promote the dissemination of knowledge in the broader community through short courses and seminars in cooperation with Continuing Education, and the provision of consulting services to industry.

ORGANIZATIONAL STRUCTURE



TERMS OF REFERENCE & MEMBERSHIP

1. Administrative Officer
   * Under Simon Fraser University policy AC35 for Centres and Institutes, the Institute will be a Schedule A centre with the Dean of Applied Sciences as the Administrative Officer.

2. Director
   * The Director is a full-time employee of Simon Fraser University, recommended by the Administrative officer. The Dean of Applied Sciences will use SFU Policy AC57 as a guide in identifying a person to be recommended as Director. The principle in appointing a Director will be that the recommended person will be nominated, elected and recommended by members of the Institute, through the Dean of Applied Sciences, to the Governing Committee for Centres.

   * The Director's term will be for a duration of three years, renewable.

   * The Director approves all contracts to be undertaken in the name of the Institute, in conjunction with the Administrative officer.

   * The Director submits an annual report on Institute activities, including a financial statement, to the Administrative Officer for the 12 months ending March 31, no later than June 30.

* At least twice a year, the Director calls a meeting of the membership to discuss policy and direction of the Institute, and any other concerns of general import.

3. Members
   * Membership shall be by application to the Director, and a majority vote of the membership, subject to appeal (for Simon Fraser University personnel only) to the Administrative Officer, whose decision shall be final.

   * Membership shall be for a three (3) year term, renewable at the discretion of the Director.

   * The Institute shall encourage the widest possible membership of qualified researchers, to promote the application of micromachining and microfabrication techniques in as many fields as possible, and to encourage the cross-fertilization of ideas.

   * Any member may withdraw from the Institute by delivering a written letter of resignation to the Director of the Institute.

4. Advisory Board
   * The members of the Advisory Board represent a cross section of university administration, research, industry, and government personnel assembled to provide guidance to the Institute.

   * The primary task of the Advisory Board is to help the Institute grow in size and scope, while remaining committed to its mission.

   * All Advisory Board meetings are open, and Institute members are encouraged to attend.

   * Advisory Board membership shall consist of: the Administrative Officer, the Institute Director, the Dean of Applied Sciences, two corporate members, two external researchers, one provincial government representative, one federal government representative, and such others as may be deemed capable of making an exceptional contribution to the activities of the Board.

   * Invitations for membership are issued at the sole discretion of the Institute Director, except for those positions specifically designated for Simon Fraser personnel.

   * Membership is for a three (3) year renewable term, except for designated personnel.

   * The Advisory Board bears no legal responsibility for the actions of the Institute, and exercises no direct control over the actions of the Director, Institute members, or staff.

MEMBERSHIP

The charter members of the Institute are listed below. Expansion of the membership through joint research with colleagues in other institutions and research fields is a high priority.

MEMBERS

Glenn Chapman
Associate Professor
School of Engineering Science, SFU

Albert Leung
Associate Professor
School of Engineering Science, SFU

M. Parameswaran
Assistant Professor
School of Engineering Science, SFU

Andrew Rawicz
Associate Professor
School of Engineering Science, SFU

Marek Syrzycki
Associate Professor
School of Engineering Science, SFU

Robin Turner
Assistant Professor
Dept. of Electrical Engineering, UBC

AFFILIATIONS

Since collaboration is a primary goal of the Institute, affiliations with other institutions will be sought, where such affiliation brings contact with exceptional research. This particularly holds true outside North America, where frequent casual contact is less likely. Preliminary enquiries have been made, and interest is evident.

THE ENVIRONMENT

The Institute will enter an environment of growth in the quantity and diversity of micromachine research around the world. A recent (1992) North American workshop on solid state sensors and actuators drew researchers from 36 universities and 38 companies based in North America. Four Canadian universities were represented and one government lab. There were no Canadian companies represented, and no Canadian company is known to be actively involved in micromachine R&D. Seven of the companies attending are exclusively or predominately in the business of manufacturing products containing micromachined devices. Comparisons with past workshops demonstrate steady growth in all categories. In the other major economic spheres, Europe and South East Asia, micromachine research is expanding, perhaps most rapidly in Japan, with overall quantity being roughly equivalent in the three regions at present.

The variety of the research is substantial, probably a necessary condition for growth, and reflective of the widespread impact of the technology. Trends evident include: a shift away from simple devices towards systems, a natural result of the maturation process; and a growing emphasis on actuators, necessary for the production of complex systems. One expected trend is not evident. Every general article on micromachining mentions the multi-disciplinary nature of the technology, noteworthy results are produced when collaborations between researchers of differing backgrounds occur, yet these are not the norm. The tool makers are not getting together with the tool users to the degree they should and this is inhibiting the growth and application of micromachined devices. This trait pertains much more to universities than companies, but

companies have until recently been restricted in another way. As a matter of necessity in smaller companies and policy in larger companies, micromachined devices had to prove their economic value in a particular existing application before venturing into new realms was allowed. Second, micromachining was a new technology applied by existing businesses with previously defined markets. Only recently have companies such as Motorola, making a profit from micromachined automotive devices, decided to explore other markets for possible applications.

Despite the widespread publicity for micromachines in the media, there is still little understanding of the potential of micromachining technology outside of select industries and research groups. This statement applies more to North America than the other major regions at present. Therefore micromachine research specialists, particularly in North America, will have to take the initiative in reaching out to researchers in other fields, until their capability becomes better known.

THE MARKET

There may be some puzzlement as to why a university based research institute should be concerned about the demand for its specialized expertise, or possible competitive pressure from other institutions, but the Institute of Micromachine and Microfabrication Research must face reality. Both government agencies and corporations base their funding decisions on perceived needs and priorities arising from those needs. The funding required for growth will come only if the Institute is seen as offering a unique service to fulfill an unmet need. The Institute must show that it will undertake research of scientific merit that will give Canada a leading position in a important technology, not being provided by any other Canadian institution.

Research is occurring throughout the world in micromachine technology, in universities, institutes, and corporations. Some specialize to a degree in particular applications, or particular research topics. Corporations are much more likely to be application specific, academic institutions tend to focus on the research topics of interest to individual professors, which fluctuate over time. The existing research group at Simon Fraser has expertise in a variety of areas, such as using standard CMOS processing technology and in wafer scale integration, but does not have the depth of personnel, or the facilities to claim and hold supremacy in a particular technological niche. Even attempting to do so has dubious value in a research field rich with unexplored possibilities.

An enduring institution must have a defining characteristic which transcends any particular research topic of the moment. Micromachine technology is fundamental and rich enough to endure, and some institutions can and do devote themselves to staying on the leading edge of development across the broadening spectrum of micromachine research. Such a goal requires a state of the art facility, a large staff, and a substantial budget. Luxuries that the Institute of Micromachine and Microfabrication Research will not have for some years. This problem is common in Canada, and has engendered a distinctive Canadian solution, the network of excellence. This idea has an exceptional relevance for micromachining, and far more than compensating for a lack, will give a rare strength to the Institute.

Research in micromachining creates tools for the microscopic machine shop and trains machinists in their use. Researchers bring their own ideas on potential devices, depending on their backgrounds and other research interests, but inevitably these represent a very small fraction of the potentially valuable devices. When Institute members collaborate with researchers from differing backgrounds significant advances can occur in each field. For example, micromachined devices are

expected to cause advances in medical research and clinical applications, at the same time demands from medical researchers and clinicians will push micromachinists to new discoveries.

Combining the multi-disciplinary nature of micromachining with the network of excellence idea gives the Institute a rationale, and a route to distinctiveness. Functioning as a node of machining skills in a highly diversified group of research personnel from many fields, the Institute for Micromachining and Microfabrication Research can grow quickly to the leading site for innovative expansion of the field of micromachining. No other institution is known to make collaboration with researchers from other fields their prime function.

By keying on the value of micromachine techniques to other research fields, and the multi-disciplinary nature of the technology, the Institute can establish a unique and fruitful role for itself, while at the same time, leaving the Institute members free to pursue any topic within the field that arouses their interest. The only restriction is an obligation to seek out research personnel in other fields, who can make use of their results, or collaborate with them in new device development. As knowledge of the Institute and its capability spread, members can expect to be sought after, obviating the need to seek.

While membership is expected to spread across many institutions and disciplines, members within the School of Engineering Science have a distinct role. Their research advances the processes and techniques of micromachining and they remain the core of the Institute. Other members utilize these processes and techniques to achieve advances in their own research disciplines.

A subsidiary benefit from the strategy of seeking out members in other fields, is the creation of a de facto centre of excellence based at Simon Fraser. Once the Institute is established and functioning in this manner, it will have a very strong case to make to the federal government, that the Institute should be formally recognized under the Centre of Excellence program or successor programs, and provided with substantial funds for upgrading the facilities.

Another aspect of the Institute will be in regard to its technology transfer function. Once the Institute is established, it is expected that industry will take an interest in some of its capabilities to produce micromachines that are capable of being marketed. To aid this endeavor, the Institute will work through the University/Industry Liaison Office and SF Univentures to coordinate the necessary detail to ensure successful technology transfer. The University/Industry Liaison Office, supported by the B.C. Ministry of Advanced Education, Training and Technology, assists faculty and staff in establishing ongoing working relations with business and industrial partners. This office operates as a service organization, advising and assisting faculty, students and staff with disclosures, intellectual property options and market assessments.

BUDGET

The Institute initially requires no budget save for minor publicity costs, since research activities utilize existing facilities, personnel, and funding. However as the Institute grows, several objectives require funding over and above existing levels. These include exchange of personnel with other institutions, establishment of a research chair for the director, maintenance and use of new capital equipment and a new, larger research facility.

Start-up funding from the Faculty of Applied Science is covering the initial costs associated with

organizing the Institute. All subsequent funding for the Institute, which is incremental to existing levels of support, should come from sources outside Simon Fraser University. The exception being the normal internal applications for funding to which all personnel, groups of personnel, and institutes are entitled to apply.