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ABSTRACT

This report on technology in learning at the University of Alberta (Canada) presents a vision for the year 2005 and outlines the measures and leadership needed to achieve these goals. In the introductory chapter the report examines the university's current telecommunications infrastructure, looks at the need to integrate technology and teaching, and examines the effectiveness of computer-mediated learning. Next the report tries to predict the impact of new technologies. Another chapter examines the challenges technology poses for postsecondary education and raises issues of access to learning, program quality, cost effectiveness and affordability, competition for students, better client services, and other organizational issues. The final chapter calls for the use of technology to provide alternative methods of delivery; the need for academic vision and strategic planning; more systematic communication and coordination of efforts; and improved campus computing services. It also looks at several issues raised by respondents, such as faculty rewards and incentives, off-campus computing resources, courseware development, alumni allegiance, and social and legal issues. The report recommends creation of an Instructional Innovation Hub on campus and lists the many new opportunities for leadership that will exist. Appendixes list respondents, provide an overview of campus computing and networks, and a list of committees relating to technology and instruction. (Contains approximately 60 references.) (CH)

University of Alberta
Edmonton

Final Report

of the

Senate Task Force

on

Technology in Learning

September 22, 1995

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About the Task Force

The Task Force on Technology in Learning was established by the Senate in August, 1994. The political and economic climate for postsecondary education in Alberta has changed. Reduced funding, and increased expectations for access to and quality of university education, decreases in full time enrolments, and increasing competitiveness of institutions and private sector suppliers of education have stimulated creative thought and action toward making universities more efficient, service–oriented, collaborative and selective in their offerings. The needs of students are being considered more closely, and suitable opportunities for access to practical and effective education must be developed.

Technology has long been touted as a key to organizational efficiency. In the learning context though, there has been an unmet need to explore and capitalize on the full potential of technology. In 1994, the Senate Task Force report on International Dimensions of the University pointed to the potential of technology to significantly enhance the international experiences of university students. It was decided that the time was right to explore the potential of technology in this important aspect, but more broadly, as it applied not only to the full context of learning at this institution, but also to postsecondary education generally. The following terms of reference were developed by the Task Force and approved by Senate.

Terms of Reference

The task force will examine and make recommendations to the University community regarding:

- current technologies and future trends in education delivery;
- technology and the future of teaching and learning; and
- consequences and opportunities for postsecondary education.

Members of the Task Force

Dianne Storey, Chair
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Executive Summary

Student learning styles and needs are highly individualized. Universities are facing new challenges as they attempt to assess and meet growing demand for full- and part-time, distance and remote learning opportunities; internationalized curricula and study opportunities; work-based study and ongoing professional development; and special needs of disabled students. Interest in distance learning particularly is growing, and postsecondary institutions and the private sector are entering that market in increasing numbers. The resulting "mobility" of students is placing renewed emphasis on quality and suitability of the institution's programs to attract students.

Societal needs are also changing, bringing increased needs for lifelong learning and learning on demand. There are increasing pressures to provide affordable access for more students to postsecondary education. Under severe financial constraints, universities are being called on to deliver the very highest quality of education in more efficient ways than ever before.

The predominant face–to–face, contact–hour model of instruction has been effective in the past, but it cannot be scaled to accommodate larger numbers of students without increasing instructional hours, physical plant and capital resources. Alternative delivery methods are made possible by technology, and these, combined with new capabilities for student services and communication, may lead to a technology–enabled, learner–centred and learner–controlled paradigm of learning.

The University of Alberta is able to meet these challenges. Through telecommunications and information technologies, the University can remove barriers of time and space that are inherent in the face-to-face model. Through advanced instructional design and multimedia delivery, it can enhance effectiveness, quality and access to education. The options and opportunities have never been greater. To incorporate technology in teaching and learning successfully, the University will need to:

- commit firmly to the use of multimodal and technology–based educational delivery and support mechanisms to meet changing student needs.

- provide or seek partnership resources to meet the challenge.

- be willing to adapt organizational structures and services to provide flexibility in design, scheduling, delivery and accreditation of courses and degree programs.

- conduct ongoing research into the effectiveness of various modes of delivery and existing and emerging technologies for learning.

- work collaboratively with other institutions, governments and the private sector at local, provincial, national and international levels to facilitate development of infrastructure, resolve technology–related legal and social issues, and develop new funding and coordinating mechanisms for an evolving postsecondary education system.

It is the view of this Task Force that universities are on the brink of an education "revolution". Through technology, institutions can serve their clients in effective, exciting, and flexible new ways. Opportunities are emerging to share resources and vastly increase access to global knowledge. The technologies and the opportunities they create are already being incorporated by institutions which strive to be leaders in their selected fields. There is a window of opportunity for universities with the will and creativity to harness technology for the benefit of the student, the learning community and society.

Just as there are great opportunities for institutions that rise to the challenge, there will also be a cost to those institutions which do not. Students will "go" where education best suits their needs, and provides them the greatest return for their investment. The University of Alberta's success in meeting this challenge is critical to its future.

Recommendations

1 A Vision for the Future

The Task Force believes that technology goals should be based on organizational goals. The Task Force offers the following vision of the learning environment at the University of Alberta in the year 2005. This vision statement expresses what this Task Force sees as possible and necessary for the University of Alberta to achieve its overall mission of becoming an institution that is universally recognized for the excellence of its degrees in a knowledge–based global economy.

By the Year 2005...

The University of Alberta will incorporate a learner–centred instructional model which integrates multi–media and technology–based delivery methods with traditional classroom instruction to serve students who are locally, regionally, nationally and globally based. This model will feature a variety of opportunities for lifelong learning that are rich in content, widely accessible and affordable.

Learning will take place in an environment that emphasizes quality of instruction using research–based program content. The role of the teacher will increasingly be that of a learning facilitator and guide, within an area of subject expertise. Instructors will develop and use technology–based, learner–controlled educational materials and communications media. Through excellent instructional design, the time and expertise of the teacher will be used to the greatest advantage for the learner, the teacher and the institution. Through collaborations, exchanges and partnerships with other institutions, governments and the private sector, students will be given access to the best resources and learning opportunities available, both on and off the campus.

As more students choose to study from remote locations, on their own schedules and for individual purposes, course content, student–faculty interaction, library and other student support services will be provided electronically as well as in person. Programs will become more flexible to accommodate life–long learning for a variety of students: on–campus and distance learners, full– and part–time

students; those requiring ongoing professional development and those requiring special access due to disabilities.

Ongoing research into the feasibility and effectiveness of existing and emerging technologies and their applications in learning will be part of the University's commitment to lifelong learning, adding to the capabilities of University of Alberta faculty and to the body of knowledge available to global educators. Such research, together with leadership in technology–enabled teaching, will enhance the University's reputation as a globally–renowned centre of learning.

The University's administrative systems will accommodate and support both faculty and students in this technology–enabled, "learning–on–demand" environment. The Administration will ensure that the technology infrastructure is both functional and widely available to support its use by students and staff.

2 Realizing the Vision

In order to achieve this vision, the following measures are recommended:

2.1 Senior administration should formally state its commitment to the development and optimal use of technology to support a student–centred, technology–enabled learning environment.

2.2 Policies should be developed and communicated which reflect the commitment and intentions of senior management toward achieving the desired learning environment.

Examples of policy issues include:

- the University's commitment to reallocating resources and seeking partnerships and development support for production of technology–based learning materials and applications.

- the responsibility and accountability of faculties and individual staff members in implementing technology in the learning environment and curricula. This includes the need for academic staff to have sufficient skills to develop technology–based learning materials in conjunction with technical staff and to teach effectively using a variety of educational media.

- the acknowledgement, support and rewards that will promote teaching innovations and the development of effective and cost–efficient electronic resource materials and courseware, in keeping with the value that the University places on excellence in teaching, and in balance with the value it places on research.

- the ongoing institutional commitment to ensure that an adequate technology infrastructure is in place to support a technology–enhanced learning environment, and to ensure adequate, reliable access to that infrastructure from on and off the campus on a continuous basis.

- requiring students to purchase or arrange adequate access to computers and applications that are appropriate to their programs of study, and the commitment of the University to facilitate student access to computing resources.

2.3 Responsibility should be assigned within the Vice–President (Academic) portfolio for the development of a strategic plan to ensure that the institution's instructional vision and goals are clearly formulated, articulated and realized within its constituent faculties. The urgency of the need to make the transition to a multimodal, technology–intensive delivery model requires that the plan be developed and implemented quickly; however, the magnitude of change and the significant initial investments that are inherent in the transition may require that the plan take a phased approach where possible. Because the transition will affect all faculties and will pervade the campus culture and operations, there is a strong need to maximize commitment to, participation in, and support for this initiative among the majority of academic staff.

Elements of the strategic plan could address, but are not limited to, the following issues:

- learning and client–service goals of the institution that will be supported through technology.

- institutional performance measures which will be used in evaluating progress toward academic and program goals.

- roles and commitments of Deans and Chairs in designing and implementing faculty and department goals and strategies,

developing leadership teams, and fostering individual initiative in applying technology in learning.

- evaluation and alignment of existing service and educational delivery units in the University to improve cohesiveness, reduce duplication and improve service.

- the types, levels, priorities and methods of evaluating the computing and online services required by both the institution and the student to support alternative delivery, such as Internet access; email; off campus access to computing services; computer labs and walk–up connections to the campus backbone; library access; advice to students on computer requirements; and student information systems.

- training and support for faculty, including training in a variety of instructional media techniques and design, to enable them to teach effectively in a technology–enhanced environment.

- computer training and support for students.

- review and revision of hiring and performance evaluation criteria to reflect institutional priorities on effective use of technology for teaching, and to promote a better balance of reward structures between research and teaching activities.

- communication mechanisms and team approaches to promote interdisciplinary exchange of information and sharing of developed resources such as educational databases, software applications, course modules, and equipment.

- a plan for upgrading of classrooms, laboratories, workstations and other facilities to accommodate alternative delivery of course materials and lectures, and to allow staff and students to take full advantage of available and emerging technologies. Analysis of classroom requirements, ranking of needs, budgeting, and sourcing of significant funds for upgrading need to be part of the planning process.

- resource planning which identifies opportunities for reallocating existing resources, as well as potential development activities, partnerships, collaboration, grant opportunities, product marketing and other revenue–generating activities that will allow the University of Alberta to meet its academic goals.

- strategic alliances within the postsecondary education community, with governments and the private sector to support technology–enabled learning.

- collaborative development of research activities that add to existing knowledge about learning effectiveness using alternative delivery techniques.

- priorities and time frames for initial and subsequent development of the learning environment, teaching tools and technology–based curriculum, as well as for development of organizational supports and services.

3 Establishing Leadership

3.1 The University should immediately establish an "Instructional Innovation Hub" to promote initial leadership, coordination, staff training and demonstrations of technological innovation for teaching and learning. The Hub would promote campus–wide communication and information sharing among departments and faculties. Its goals would include promotion of self–sufficiency among faculties and departments in using technologies for effective learning.

3.2 The University should consider creating a multidisciplinary degree, for example, Technology Industry Studies, or Global Technology Studies, that would allow students to combine technology skills with subject knowledge, and permit them to enter the global knowledge industry from a variety of disciplines.

3.3 The University should consider adding a requirement within all doctoral programs that the student complete a course on effective instructional design using alternative delivery methods. This measure would place the University of Alberta in a leadership position, by being the first to place a priority on advanced pedagogical training in the use of technology.

Introduction

Humankind has historically measured its progress in terms [of] technology. From the earliest times, each age has overtaken us more rapidly than the one before. The Stone Age lasted for millions of years, but the Metal Ages that followed only lasted about 5,000 years. The Industrial Revolution occurred between the early 1700s and the late 1800s, roughly 200 years. The Electric Age occupied the 40 years from the turn of this century to the second world war. The Electronic Age lasted a scant 25 years and the Information Age is already 20 years old. It is time to rethink our world in terms of today's technology."[1]

—Frank Koelsch
The Infomedia Revolution:
How It Is Changing Our World and Your Life

Technology does more than influence the way we do things. It is a key enabler for the way we work, travel, and communicate, and a critical factor in the lifestyles we enjoy from food selections to entertainment. We marvel at computer–animated videos, pay electronically for our groceries and diagnose complex medical conditions with sophisticated computer–imaging equipment. Computer–based technology, over a few decades, has transformed our lives.

Military and business applications of data processing led us into the information age. The drive for economic efficiency and a competitive edge continually spurred new applications of technology and technology–based products. Today, governments, the information, entertainment and telecommunications industries and educational institutions are working together to create the Information Highway, a vast infrastructure that links networks of computers and information providers around the world with individuals in homes, offices and schools. Once again, we are on the brink of revolutionary change in the way we transfer information, goods and services in our society.

The University of Alberta is playing a significant part in creating this network infrastructure in Canada and Alberta. The University is a member of CANARIE, a national consortium developing the CA*Net, Canada's national high–speed telecommunications network, and we are the contracted operator for its Alberta connection.

At the provincial level, we are a participating member of the consortium developing north–south linkages through the Alberta Regional Network (ARNet), and a member of the Western Universities Research Consortium on High Performance Computing and Networking (WURCNet) which links eight western Canadian Universities. On a local level, the University of Alberta Library system was a founding member of the Edmonton Freenet. These and other network development activities are ongoing.

On campus, the University recently completed installation of a $1.5 million fibre optic "backbone" that provides high–speed network access from all buildings on the campus utility corridors, and will allow offices and individuals to participate in a distributed network, client/server environment. Development of this backbone is significant. The quality of its design and implementation has drawn international recognition to the University of Alberta. Its existence allows and should encourage efficiencies and innovation in teaching and learning, along with widespread use of computers and electronic communications tools by faculty, staff and administrators. It is a "launch pad" that allows us to realize the exciting potential of technology to change and improve the learning environment, to test new models and processes in teaching and learning, and to participate creatively in changes to the current postsecondary education delivery system.

Connectivity and Content–components of opportunity

On this campus, an underlying telecommunications infrastructure is in place and continues to develop. This is the "connectivity" part of the technology equation, which allows universities to communicate information in high volumes at high speed. Although there is much work to be done to expand the capacity and increase access to network infrastructures, we are technologically enabled to take the next step. There are many who would say that the challenge now facing this University and other educational institutions is to develop the "content" for the information highway—the data, text, images and sound that can be transferred among students, colleagues and institutions around the world. Universities are, by nature, spectacular repositories of information. Global knowledge is exploding. The raw material for high quality "content" exists here, or it is accessible here, using existing technology. It is a major challenge for faculties and individuals to incorporate technology into the process of learning for the benefit of students and society.

However, there is an institutional challenge that extends beyond this. The challenge lies in the opportunity to redefine a dynamic, technologically–enabled learning environment that is significantly student-centred, and promotes lifelong learning and learning on demand. It lies in the willingness and creativity of the organization to extend access to postsecondary education outside the constraints of time (class scheduling and availability of contact–hour teaching resources) and space (capacity of physical facilities and location of the student) that are inherent in current delivery models of face–to–face instruction. It lies in the ability of the organization to adapt its resource base, methods of instruction, institutional relationships and supporting mechanisms to a technology–enabled environment. It lies in the organization's ability to recognize and develop its comparative strengths, to deliver selectively high–quality educational opportunities within those areas of strength, and to develop collaborative relationships with other institutions that will provide, in a mutually advantageous way, access for learners to the strengths of other institutions.

The effectiveness of technologies used in learning will be measured in our "bottom lines": the quality of degrees offered; the satisfaction of the student and society; the ability to increase access to university education; and the efficiency and affordability of postsecondary education.

Dr. David Johnston, Principal of McGill University and Chair of Canada's Information Highway Advisory Council puts it this way:

> *"In our knowledge–based society, universities are a prime engine. If ever there was a golden age for universities, it is now."*[2]

Technology and Teaching

The University's core functions, research and teaching, provide the content of learning. The pursuit of new knowledge is the feature of university teaching that distinguishes it from instruction offered by other types of postsecondary institutions and it is a strength of our institution. Although the sections that follow speak almost exclusively about teaching, they do so with an underlying assumption that effective teaching is founded on research, and that faculty duties include both teaching and research. One function interrelates with the other, each adding purpose and meaning to its counterpart.

Instruction has traditionally been delivered in face–to–face lecture

format. Alternative delivery strategies are emerging as beneficial tools for teaching. Their use does not imply that face–to–face instruction will no longer be offered, nor that it will be significantly devalued in the future. However, because of the prominent role that technology–enabled learning will likely play in the future, the teacher who combines strong research–based knowledge with technological proficiencies will be in the greatest demand. Those who are able to teach and provide support materials only in traditional formats will be at a disadvantage.

Technology will not replace the teacher any more than it will bring an end to face–to–face instruction. Instead, it should provide a means and an opportunity for instructors to make the best use of their time and expertise. With more options in the presentation of coursework and materials, instructors have greater opportunity to use precious contact hours to develop high– order skills such as problem solving, analysis, extrapolation and debate. Through asynchronous learning and communication, instructors may be more accessible outside of class time, which may restore some of the personal contact aspects of face–to–face instruction that are currently being threatened both by increasing class sizes and by decreasing numbers of available class sections.

Some instructors maintain that the face–to–face aspects of instruction cannot be replaced, and that residency, or at least a significant amount of time spent in on–campus activity, is a necessity. The Task Force agrees that the on–campus experience is important; however, for many students it is not possible, and it may not even be preferred. In the past, University was where students went before they went to work. Now it is something that many do while they work, nurture families, or contribute to their communities. Although the situation may be regrettable for some, there is a need for instructors to make use of alternative methods of personalizing instruction and creating meaningful interactions with non–traditional students.

Effectiveness of Computer–mediated Learning

There is much debate about how effective computer–mediated learning is for the student. At the heart of the debate is the complexity of the learning process itself, and the resulting difficulty in deciding which measures will be used to judge its success. The number and interrelationship of variables also makes it difficult to isolate indi-

vidual effects. Dr. Terry Anderson, the University's Alternative Delivery Specialist provides these comments:

> *... research over the past 70 years has generally concluded that there are no significant differences between face–to–face delivered learning and that delivered by media. This generalized result is used by media proponents to argue for the advantage of media delivery, since no human intervention was involved in the learning outcomes. Traditional delivery proponents have argued that since no improvements were noted, there is no compelling reason to change from time– proven face–to–face methods.*
>
> *So where do we go? Is it worthwhile pursuing learning delivered by media? Research to date suggests that quality learning can be delivered in many ways, by many media including face–to–face delivery. Given this equivalency of outcome, we can move to questions of cost effectiveness and of access... The long term survival of the University of Alberta is grounded in our ability to meet students' and societies' needs for learning opportunities offered in many different formats. We must develop the capacity to provide options and alternatives, if we are to survive as a primary source of quality, higher education in Alberta, Canada and the world in the 21st century."*[3]

What Technologies are Shaping the Future?

George Gilder, a futurist in the field of computers and telecommunication, in a keynote address at the 1994 Educom Conference summarized three major classes of technology that will shape the future of education: the technologies of sand, glass and air.

The Technology of Sand

"Sand" represents silicon, the substance of the computer chip and symbol of computer technology. This technology allows us, personally and corporately, to own enormous capacity to store, process and retrieve information, whether it be in data, text, audio or video form, or combinations of these.

Computer technology is advancing so rapidly that the lifespan of the average product has been reduced from five years to about 18 months. The rate of change is now beyond the ability of most individuals and organizations to assimilate and many organizations must now use a strategy of "leapfrogging" technologies.

Computer technology is integral to postsecondary education today. It is an essential tool in most research activities, and it is being applied in many aspects of teaching, learning, client service and administration. However, there is much room for further utilization of computer technology.

The Technology of Glass

The "technology of glass" refers to fibre optics, thin strands of glass that are capable of carrying huge volumes of data at high speeds to connect computers and people around the world. Where the computer provides the processing power, fibre optics provide connectivity. Development of extensive networks of fibre optic cable facilitates world–wide transfer of information, and is a key element in developing global, knowledge–based industries. Governments of many nations and leaders of economic unions are racing to complete construction of their national and international networks, to ensure early entry into knowledge–based industries and to derive a competitive advantage in a global economy.

In Canada, there has been a major commitment by governments and industry to construct national and regional networks, and as mentioned previously, the University of Alberta has been an active participant in the process. Because of the leadership approach taken by this University in developing a local fibre optic network on campus, we are in a position to take advantage of computer and telecommunications technologies, particularly for multimedia (the seamless merging of all forms of communications: voice, images, text and full–motion video), bandwidth– intensive applications, over the next several years.

The Technology of Air

The third major class of technologies is characterized as the "technology of air," and it refers to satellite or terrestrial broadcast of audio, video and data signals.

The most common educational use of this technology is in distance learning, to relay standard lectures from a central campus to remote sites. In a one–way format, the student receives the course material without the opportunity to interact directly with the professor. An example of this would be the transmission of telecourses on public broadcasting facilities to students registered in a correspondence course. In two–way or videoconference mode, the students can interact with the professor during or immediately following the lecture. The latter format requires special facilities and technical arrangements at both the sending and receiving sites.

There are several advantages provided by this technology at the present time. It allows institutions to make more extensive use of scarce teaching resources by expanding potential class sizes, or adding sections to classes that are oversubscribed. By providing access to instructors and instruction from several sites, it increases access for students who are geographically dispersed. It opens collaborative possibilities for universities to broaden individual programs and offer areas of study that are outside the direct resource base of the university. When it is used to replace face–to–face meetings with students or colleagues in other cities and countries, it can save substantial amounts in time and travel costs.

In Canada, wireless communication has been one of the fastest growing segments of the communications industry.[4] In the next two to five years, digital, wireless products and services for computing and advanced telephony are expected to provide the ability to send

voice, fax and data, and eventually images and video to and from any point in the world, with or without wired network access. The implications for education are significant.

Wireless technology may eliminate the need for fixed–location access points to computer networks and communication devices—terminal/modem hookups—to connect to a network or to transmit data, images and sound. It is reported that in the United States, some corporations are already using this technology to move away from individually allocated office space. Employees instead book time at fully equipped workstations in company offices for those hours that they are actually in the office[5]. In education, a parallel trend might see students and faculty increasingly able to work from remote locations, from their homes, or while travelling.

Wireless technology may hold further promise in development of alternative networking mechanisms. Students and colleagues in remote parts of Canada or other countries of the world where there is not a wired infrastructure will be able to participate in teaching, learning and research from their individual locations. Additionally, if wireless technology eliminates a need to wire or rewire existing buildings to provide or improve network access, there may be opportunities for substantial cost savings over current methods.

In summary, the technology of air has the potential to change significantly how we disseminate knowledge, and how we allocate our institution's resources. It bears watching and exploring.

The University of Alberta is at a key juncture in its use of technology. It has developed an underlying infrastructure that will support applications of technology in learning. A shift of focus is needed now to move from issues of connectivity to those of content and applications. The time is right to establish the priorities and directions that the University will take in weaving technologies into learning. Choices must be made regarding:

- the technological context in which learners will learn, and teachers will teach;
- the types of learning options and experiences that will be offered;
- the learning tools that will be used by instructors and students as they pursue knowledge; and
- the organizational and administrative structures and supports that will facilitate desired change.

Figure 1 illustrates how these technologies are being combined for learning, and for client services in postsecondary education.

Figure 2 provides just a few of many possible examples of learning opportunities offered by universities, private corporations and institutions across North America through television (cable television and satellite broadcast systems) and computer networks (multimedia, telephony).

Figure 3 shows a sampling of projects that are being carried out on campuses in Canada and the United States. These illustrate a range of possible educational applications of various technologies.

Figure 1: Technology Applications in Learning

"It is clear that there is no super-technology that is appropriate for all learning contexts. It is necessary to select a particular mix of technologies, and the particular mix will depend on the context"

-- from the Open Learning Agency's 1994 Submission to the Information Highway Advisory Council

Distance or Remote Learning

Where teacher and student are separated geographically. Learning may be syncronous or asynchronous, and one-to-one or one-to-many.

Learning may take place through any combination of materials: printed text, taped audio or video, live audio or video in one- or two-way format, computer-based instruction, computer conferencing or video conferencing.

Video conferencing has become a medium of choice, and it may be carried over:

- Standard telephone lines
- Integrated Digital Network Services (ISDN)
- Satellite broadcast
- Coaxial or fibre optic cable systems
- Multimedia (computer) workstations

Instructor-to-learner and learner-to-learner communication may be supported by any of the communications media descibed at right.

Student Services/Administration

- Student Information Systems
- Online registration, enquiry and counselling services
- Online Libraries - text and multimedia - provide access to local and networked resources
- Online calendar and curriculum information
- Computer labs and network access points on campus
- Modem access to campus computing and communications
- Online job registries and graduate resume postings

Computer mediated Communications

- Electronic mail
- Electronic conferencing
- Bulletin boards
- List servers
- Discussion/News groups
- Network services such as File Transfer Protocols, Telnet, Campus Wide Information Systems
- Local Area Networks
- Wide Area Networks

Instructional Technologies

- Multimedia materials: combinations of text, data, sound, graphics, and motion video for use on a computer platform
- Software for computer-mediated, computer-aided or computer-based instruction
- "Peripheral" technologies such as CD ROMs and Videodiscs
- Virtual learning environments: multi-user dungeons and multiple-object-oriented environments (known as MUDs and MOOs)
- Remote data sources such as Internet, World Wide Web Sites, and networked libraries
- Research tools: browsers and "search engines" such as Netscape, Mosaic, Medline and Synapse; online indexes and catalogues
- Multimedia-equipped, and Internet-connected classrooms
- Instructional design software
- Word processing, database, spreadsheet, presentation and desktop publishing applications

Figure 2 What others are doing... Learning offered via television and computer

Distance learning via television*

The Mind Extension University (MEU) video network televises classes on cable channels in the U.S. and ships cassettes to students who lack cable access. Lessons reach 23 million homes on 767 cable systems. About 36,000 people a year receive academic credit for completed courses. Lessons are created and degrees granted through the National Universities Degree Consortium, a group of 9 public universities who act as "hosts" to participating students. MEU expected to launch similar services in Taiwan and Thailand in early 1995.

Public Broadcasting Service (PBS)*

PBS offers a distance learning program via 20 public TV stations, offering courses from 60 community colleges.

Western Universities Teleconsortium (WUTC)

Eight Canadian universities and five cablevision companies have formed the WUTC to broadcast courses via satellite or cable networks to students anywhere in the prairie provinces or British Columbia. Participants include B.C.'s Open Learning Agency, the University of Victoria, Simon Fraser, University of Alberta, University of Calgary, Athabasca University, Brandon University and the University of Manitoba.

Online University courses and Programs*

The Electronic University Network can be accessed through America Online. Participating institutions include Michigan State University, UCLA, Rogers State College, Nova University, Saginaw Valley State University, Regents College, Thomas Edison State College, the California Institute of Integral Studies and Heriot-Watt University in Edinburgh, Scotland.

The New York Institute of Technology offers bachelors degrees in interdisciplinary studies, business administration and behavioural sciences.

The University of Phoenix, now a fully accredited University, offers bachelors and masters degrees in business.

Mount Saint Vincent Open Learning Program

Through its Open Learning Program, Mount Saint Vincent University offers courses to students in Nova Scotia and New Brunswick. The program uses audio-graphics linkages using computer and telephone connections to transmit voice and data. The program is a joint venture with Maritime Telephone and Telegraph, New Brunswick Tel, and the Nova Scotia and New Brunswick governments.

Intel and Computer Curriculum Corporation

Intel and Viacom-owned Computer Curriculum Corporation are planning to deliver educational multimedia courseware via cable to students in their homes. The system will monitor user responses and adapt instruction as necessary.

North Carolina/IBM Partnership

The Institute for Academic Technology (IAT) is a non-profit partnership between The University of North Carolina at Chapel Hill and IBM Corporation. IAT offers instruction for teachers in the use of computer and multimedia tools for learning.

Linked Electronic Classrooms

The Universities of Guelph, Waterloo and McMaster operate linked electronic classrooms enabling an instructor at one campus to conduct classes simultaneously with students at the other two campuses. The classroom is being used to transmit common curricula in physics, chemistry, philosophy, political science and music. It is in use approximately 20 hours per week.

*These items are adapted from John Naisbitt's Trend Letter. February 2, 1995. Other items are summaries from a variety of news sources.

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Figure 3 What others are doing... A sampler of projects and services using new technologies

Concordia University

... has developed an award-winning service for students in its campus book store. Students enter their student ID into a computer in the store to receive a printout of each course they are registered in, and the texts required for each course, and the status of the title--whether it's in stock or back-ordered, and if so, when it is likely to be available. The customized list was made possible by Concordia's online interactive student information system. In the future, the University expects to develop kiosks where students will be able to change addresses, order transcripts, and pay bills.

University of Minnesota*

... set up an electronic registration system. The system automatically emails confirmation and fee statements to students. The system allows departments to control enrolments in restricted courses.

Seneca College*

... has completed a pilot project to test productivity of technology in the classroom. Twenty students used palmtops, TV displays, and free Internet "Objectware". They received communications training supporting home access to interactive, student-based exercise in business management. Technology reduced the time spent on class segments from 10 hours to as little as two hours-- an 80% difference. The pilot far exceeded projected productivity increases of 30 %. The College will extend the techniques to the full business school operations.

New York University*

... has established an electronic database on funding for graduate students on its campuswide information system.

Carnegie Mellon University*

... recently conducted an email survey of 1,148 freshmen to learn about their level of computer ownership. Of the 934 (82 %) who replied, 42 % reported bringing a computer with them to campus. Another 16 % had bought one since arriving on campus or planned a purchase during the fall semester; only 16 % did not plan to buy a computer while at the University... Note: 75 % of the responses came in within nine hours of the survey message.

Virginia Commonwealth University*

... is extending its data network to residence halls on two campuses. Rooms will be equipped with two Ethernet, two video, and two telephone connections. Students will have easy access to unmoderated campus newsgroups.

University of Denver*

...hired ten students who live in residence and trained them as "resident computer consultants", to support 2000 new data jacks in ten residence halls. They install network interface cards and software in a variety of computer types, and connect the computers to the residence hall network and the Internet.

College of DuPage*

... will spend $3.1 million U.S. to provide a telecommunications network between its main campus and satellite locations in west suburban Chicago. The system--including video, data, and voice communication -- will enable students in outlying areas to participate in educational programs originating at Glen Ellyn campus. The network will have the capacity to link 69 other facilities in the future.

State of Alabama*

Last year, eight of Alabama's academic libraries linked their online catalogues into a seamless interactive network. Users can electronically browse and arrange shipping of more than 7 million books and 30,000 journals and magazines. The project builds on the Alabama's Supercomputer Network and links NOTIS library systems installed at Alabama A& M, Alabama State, Auburn, Jacksonville State Universities, and the Universities of Alabama, Alabama/ Binghamton, and North and South Alabama.

*These items are paraphrased from issues of the CAUSE Campus Watch electronic newsletter, published between December, 1994 and February, 1995.

Challenges in Postsecondary Education

Our postsecondary education system today is facing a number of issues that challenge traditional concepts and methods of operation: the demographic and geographic profiles of learners; the face–to–face classroom model of instruction; organizational structures based on single disciplines of study; funding structures; and inter–institutional relationships. These issues, coupled with the availability of enabling technologies, may lead to revolutionary change in the delivery of university education.

Some of the challenges arise from social factors such as changing needs and expectations of students and society for postsecondary education, and changing demographics of the student population. Others arise from economic factors such as reductions and changes in funding structures, new competitive forces in the postsecondary education marketplace, the shift to a global economy, growth of knowledge–based industries, and the need to develop a highly skilled, highly trained work force.

The University of Alberta recognized the need to meet these challenges in *Degrees of Freedom*, its strategic plan to the year 2005.[6] It is committed to providing programs that will be acknowledged in Canada and around the world for their value, excellence, and ability to meet the needs of both the students and the communities that seek graduates. It discusses specific challenges in enhancing the quality of teaching and research at a time of severe budgetary stringency, and in providing increased access to education to meet student demand.

Access

In addition to meeting a projected growth in demand for access among the 18–24 year old student population, there is a need to provide increased access for many other learners.

Lifelong Learning and Learning on Demand

Lifelong learning will be needed to maintain knowledge and skills to keep pace with changes in society and the global marketplace. Skilled workers will need access to ongoing professional development and career training. The average Canadian may need to retrain for two to four careers in a lifetime. Social and economic pressures

will dictate that many students remain employed while continuing to upgrade education and training.

Learning on demand refers to the ability of the student to access learning resources when and where the student needs them. This type of learning is often self–initiated, self– directed, and tightly focussed on a task, skill or subject area. The student requires access to topical resources and expertise until the skill is mastered or the need for information satisfied.

Both of these trends will increase demand for learning opportunities different from traditional full–time enrolment: part–time learning, learning within the work place, short study programs, intermittent study opportunities, cooperative and practicum studies, distance learning and others. Programs will need to be increasingly flexible to accommodate a wide variety of highly individualized, lifelong learning needs. Learning on demand opportunities are likely to be short term, tightly focussed and possibly designed by the learner in conjunction with a faculty member.

Postsecondary education is often the last formal education experience of the learner. To facilitate lifelong learning and learning on demand, the skills imparted to the postsecondary student need to include research and independent study. In this aspect, the role of the teacher becomes that of a learning facilitator and guide.

Growth and Diversity in Student Populations

University undergraduate enrolment across Canada is reportedly down for 1995–96. This is reflected in decreasing full–time enrolments at all Alberta universities. The University of Alberta is not an exception, having experienced declines for the past two years. Possible reasons for the decline include increased tuition costs in combination with uncertain economic prospects for students and parents, and changing demographics among prospective student populations. The Office of the Registrar indicates that it is too early to determine if this is a short term anomaly or an emerging trend.

For the longer term in Alberta, the total number of students desiring access to postsecondary education is increasing, and the composition of the student population is expected to change.

An annual increase is predicted in full–time enrolment among the 18–24 year old student group to the year 2005[7]. Part–time

enrolment in postsecondary education has increased and is expected to continue to increase due to adult participation in lifelong learning[8]. Across Canada, the proportion of part-time (for credit) students out of total enrolments has increased steadily since the early 1970s, although Alberta's participation rate has been somewhat lower than the national average.[9] Composition of the student population is also likely to reflect an aging population, and increasing participation by disabled students. Learning opportunities need to be flexible and responsive to the special needs of these groups.

Geographic Diversity of Students

In the 1994 Graduand Survey published by the Office of the Registrar, 84% of students who responded indicated that proximity of the learning opportunity to home and community was the most important reason for choosing the University of Alberta.

Although the current model of university education is predominantly one where the student personally attends a centralized institution and receives face-to-face classroom instruction, many potential students are seeking remote or distance learning opportunities that will accommodate their physical location and needs.

Employment, family, and community responsibilities make it difficult for some students to leave home for extended periods of time. The costs of travel and living, added to the cost of tuition may be prohibitive. Commuting distances, especially in northern Alberta, may require that courses be taken via alternative delivery methods. In Senate meetings in rural Alberta, members heard that there is a preference for students to study in their own communities for these reasons.

A significant number of University of Alberta students are enroled in internship or practicum studies and may be physically located throughout Alberta, Canada or the world. These students need to maintain learning links while away from the University community.

Students may wish to pursue rare or excellent opportunities to take credit courses or short programs, or to study under a particular individual at another institution, without having to interrupt their studies, transfer or change residences. Students from other institutions may wish to pursue similar options at the University of Alberta. These arrangements may allow institutions to share instructional resources in programs where the field of study is highly specialized

and expertise is rare.

As a global institution, the University of Alberta both hosts and sends abroad international students. With a stated goal of 2,000 by 2000 (sending and receiving 2,000 international students annually on exchanges by the year 2000), the university is committed to continuing and expanding the international opportunities available to its students. International students in formal and informal exchanges may wish to continue a portion of their studies and maintain educational links with their home institution while they are abroad.

The Task Force believes that there are opportunities both to increase access to a variety of educational opportunities through distance learning and to increase the quality of the educational experience through remote access to learning resources.

Increasing Technological Skills of Students

The "technoliteracy" of students in the primary and secondary education systems is increasing and, with wide-scale introduction of technology in the K–12 system, it is expected to increase further. At the time of publication, more than 4,000 Canadian schools were connected to the Internet through SchoolNet, a joint federal, provincial and territorial initiative. The federal government will contribute $13 million annually over the next four years to connect all 16,500 Canadian schools and 3,400 public libraries to the Information Highway by 1998.[10] The Task Force received information and submissions from the Edmonton and Calgary Public School Boards, Elk Island Public Schools, and the GrandeYellowhead Regional Division, all of which indicated that they have made or are making significant investments in introducing technologies and Internet access to facilitate learning. University students of the future will not only be skilled in use of technology, but they will come to University expecting that learning technologies here will at least equal, and hopefully exceed, what has been experienced in grade school and in the work place.

> *"Students are receptive to new delivery formats, even more, they are expecting them and even sometimes demanding them, in that they expect learning to be delivered at the time and place that are most relevant and convenient for them... Students are very comfortable with the new technology and ready and eager to use it: we must take advantage of that eagerness, and we must not*

disappoint it— we must match in our instructional use of technology the level of expertise and virtuosity that students encounter in the entertainment field."

— Bernard Rochet, Director
Language Resource Centre, Faculty of Arts
in a submission to the Task Force.

Quality

Results of the Office of the Registrar's annual survey of undergraduate experiences indicated that most students expect University education to include both general education and job specific skills. The most important reasons for attending university, cited by all age groups, were personal development, acquisition of career or entry–level job skills, and career development. In the 25 and over age groups, changing careers was also a significant reason for attending.

The quality of programs was the second most important reason (after location) for attending the University of Alberta in particular (62%), with the availability of career–related programs listed third (60%). Variety and uniqueness of programs were cited by less than half of the students as their most important reason for attending.[11]

If the conclusion can be drawn from this survey that most students currently choose the University of Alberta on the basis of location, and if, as stated in *Degrees of Freedom*, we want more students to choose on the basis of quality of programs and degrees offered, then the University should explore avenues by which it can cost–effectively enrich and enhance the learning experience. Technology can provide leverage to existing strengths in research–based teaching, increase access to excellent resources, and increase the opportunity for students to interact with instructors and fellow students within the learning context.

Changing the Learning Paradigm

The prevalent model of instructional delivery has been the face–to–face contact–hour model. The instructor has been the primary director of learning, teaching from a personal knowledge base using locally resident library and research resources. Students attended lectures to gain information they would not otherwise receive, including administrative and procedural information about courses, electronic notes, etc.

Today, that model is losing some of its functionality. Class sizes are increasing, and although both professors and students know that it is vital to learning, one–to–one contact is necessarily limited by available instructional hours. The growing variety in learner demographics and locations, and consequent needs for individualized instruction also place pressure on the traditional model, which cannot accommodate highly individualized learning within large classes. Global knowledge, and access to that knowledge, are also growing rapidly, as libraries move from a "holdings" model to electronic access models, and as Internet access becomes more readily available. Students have access to a wide variety of resources through many different media, such as computers, television and distance learning programs. The sheer volume of knowledge accessible today makes it very difficult for even the greatest scholar to be the primary source of knowledge for the student in anything but a very narrow subject area.

It is clear that if the University of Alberta is to maintain, let alone enhance, quality in university education, it will need to accommodate alternative learning paradigms. The learning environment and processes will need to become much more learner–focussed, and learner–controlled. Students will increasingly need to be able to learn from their desired locations, on their own schedules, using a variety of cost–effective learning styles and media. Learning outcomes will need to include both a grounding in subject disciplines and mastery of the study skills required for lifelong learning following degree completion. To help the student cope with the vastness of the knowledge base, and to meet increasing needs for individualized instruction, the role of the instructor will increasingly be one of guide and facilitator of learning within a particular subject area, rather than being the primary source of content in a subject area. Teachers will continue to be essential to the learning process, but their roles are expected to change significantly. Cost–effective alternative delivery methods will be essential components of this new learning paradigm.

Enrichment of Learning

The quality of degrees is greatly affected by the opportunities provided for enrichment of learning. It is clear from the summary of reasons for attending university that students are seeking degrees that have considerable relevance for job and career prospects. In the Senate's previous Task Force on International Dimensions of the University, strong desires were also expressed for internationalized curricula and opportunities for international and multidisciplinary

studies. From interviews with faculty members and students for the current Task Force, it appears that there is continuing interest in international and multidisciplinary studies and, in the context of lifelong learning, experiential learning forms such as work–study placements, practicum study, internships and international exchanges.

"Making the Grade"[12], a survey of student opinion was released in January, 1995 by the University of Alberta Students' Union. It details a number of areas where quality improvements may be desirable. Relevant to discussions of technology in learning, students expressed dissatisfaction with both the availability of basic computer literacy courses, especially for part–timers and first– and second–year students, and with the level of computer literacy attained during their studies at the University (with the exception of the faculties of Law and Rehabilitation Medicine). The levels of dissatisfaction rose the longer the student had attended University, so increasing dissatisfaction appears to correlate with increasing specialization of study and, presumably, results from insufficient or inadequate use of computer–based instructional materials.

The report indicated that students "would certainly appreciate a greater opportunity to become computer literate. Many felt that it should be a goal of the University to ensure that it is producing graduates who are able to compete in the technology driven world". It also stated that "many students are graduating with an acceptable degree of computer abilities, but most claim these skills were developed outside of their actual studies (the university played no significant role in helping in this category). Numerous students indicate a level of dissatisfaction with the university for not providing the opportunity to improve computing skills."

The University needs to examine creative and cost–effective ways that technology and alternative delivery mechanisms can be used to meet individualized student needs, facilitate enrichment of the educational experience, and assist in developing more learner–centred, learner–controlled models of instructional delivery. Implementation and evaluation of these models will yield new knowledge regarding their effectiveness in learning and will facilitate further improvements in quality. In a technologically–enabled learning environment, consideration should also be given to defining both minimum and desirable computing skills for students and faculty, and to providing adequate training to enable both groups to meet and exceed minimum levels.

Affordability Through Cost Effectiveness

In an era of shrinking resources, enhancement of quality can be achieved in several ways:

- combinations of downsizing and rationalization—doing the same things in a smaller way, and carrying out existing functions in a more efficient way;
- specialization and collaboration— doing a limited number of things very well, and collaborating or sharing with other institutions to provide services outside our own areas of specialization; and
- renovation and innovation— finding new ways to carry out primary functions and apply existing resources.

Downsizing and Rationalization

The University has been in the process of downsizing and rationalization for the past several years. Organizational efficiencies have been achieved over this time. However, as we enter an era where the organization becomes more technology intensive, planners need to assess the operating costs of incorporating the new technologies. For example, Computing and Network Services (CNS) estimates that in a mainframe computing environment, the division of costs between capital and labour to maintain and operate the systems was 80% hardware and 20% labour. Under a distributed computing model, the proportion is now thought to be 15% hardware and 85% labour, with significant associated expenses in staff training and support.

In an alternative delivery model of instruction, there is a significant labour expense for the development of courseware and materials. Estimates from faculty members who are actively involved in design and delivery of alternative methods of instruction report a range of hours to develop electronically–based materials: from a minimum of five hours preparation time to one hour of equivalent instructional time for simply collecting and presenting existing materials, to periods of one to three years to develop complete courseware packages which require intensive planning, development, testing and updating.

Of concern to the Task Force is that at a time when labour–intensive computing activities appear to be increasing , the University is in a mode of staff reduction. The early staff– intensiveness of alternative delivery modes can be regarded as an investment, and the University

should look for alternative ways to offset the costs. One way might be through inter–faculty cooperation and collaboration; another through a degree of centralization of resources. The literature suggests that development of learning materials can be a very similar process across disciplines, and that high–cost equipment and production facilities can be shared. The learning curve of individuals in designing and developing computer–based resources can be significantly reduced by campus–wide communication, team approaches to development, and demonstrations or exhibits of effective projects. Ongoing research into the effectiveness of various types of technologies in learning should help to maximize the use of resources across faculties.

Specialization and Collaboration

The University has publicly committed itself to a principle of selectivity in pursuing its mission and vision within a collaborative framework of postsecondary educational institutions. Technology is a powerful enabler, but it requires institutions to develop such a collaborative framework to support innovative teaching, reduce cost barriers to innovative ventures, and facilitate new types and levels of service at new levels of affordability. Sharing of resources among institutions is possible in a variety of areas, such as:

- local, regional and international students can participate in learning opportunities that are offered by institutions away from the student's residence area. Collaboration may include provision of community–based learning facilities and services such as proctoring of examinations for remote students.

- teaching resources can be shared electronically, for example, when lectures by staff at one institution are made available to students at others.

- the cost of developing technology–based learning materials for common courses can be shared, freeing resources so that institutions may further develop their individual strengths.

- administrative and student service systems can be jointly developed to provide seamless or enhanced registration, course transferability, accreditation revenue sharing and collection and other services within a provincial and possibly national context.

Within a collaborative framework, institutions will be both suppliers and distributors of learning services. The student will have an increased range of choices and institutions will be able to stretch

limited resources and acquire services in areas which they otherwise could not afford to provide. To facilitate this type of exchange, sufficient technological infrastructure and communications capabilities must be in place to allow exchange of information among students and participating institutions.

Renovation and Innovation

As discussed in earlier sections there has been pressure to increase access to university education, to improve the quality of learning and the learning environment, and to improve the efficiency with which postsecondary education is delivered. The University's "business" continues to be to "serve our community by the dissemination of knowledge through teaching and the discovery of new knowledge through research."[13] What universities do has unique value; the most effective way to do it is now under scrutiny.

Constraints of time and space have placed boundaries on the efficiency of the face–to– face, on–campus model of instructional delivery, and have initiated a call for innovation in teaching, and to a degree, alternatives to the model.

One time constraint is available instructional hours. The face–to–face model is labour intensive and cannot be increased in scale to serve more students without increasing either the number of contact hours per staff member, or the number of staff. Class sizes have already increased to the point where one–to–one contact between student and instructor, which was a foundation of the original university education model, is increasingly being lost. The University cannot continue to accommodate more students without changing methods.

Another time constraint lies in the number of hours that the campus can feasibly remain open for teaching. Facilities are used primarily during core business hours, and for certain months of the year. It is not feasible to offer traditional classes or to staff the premises on a 24–hour basis.

In the face–to–face model, institutions can only accommodate as many students as their capital equipment and physical plant will allow. The number of classrooms, labs, study spaces, libraries, computer terminals and equipment items is finite. Upgrading of labs and buildings to accommodate technological advances is expensive, and the rate of change in technologies is escalating. Given declining capital budgets, and fixed or increasing acquisition and maintenance costs, the pressure on university facilities can only become greater.

Figure 4 Uses of technology to overcome constraints of time and space.

Example 1

It is conceivable that in the face–to–face model, 10 different instructors could present 10 sections of an identical course in 10 identically-equipped classrooms at 10 different times. Students might experience differences in quality and content from one instructor to another— some being more knowledgeable or interested in certain aspects of the curriculum, some being better teachers than others. Computer–mediated instruction, when used to supplement face–to–face instruction, can help in several ways. It can provide uniformity in repetitive presentations of core content to a wide audience. In its most basic form, it accommodates drills and repetitive tasking, without tiring or becoming bored. More advanced applications allow students to construct or modify their own learning materials, and they promote critical thought and analytical skill. Evaluation of student progress can be built into the instructional materials, providing students with options to repeat material that is not clearly understood or to delve deeper into areas of interest. With the instructor freed from repetitive tasks and some aspects of student evaluation, class time and office hours can be used for discussion and exploration of issues, problem– solving and enriched learning. If the instruction modules were offered in a distance format and supplemented with personalized instruction, some classrooms and equipment could also be freed for other uses.

Example 2

Where one instructor might lecture to a course section of 100 to 200 students, there is little opportunity for interaction during class time and office hours may be insufficient to handle student enquiries. Electronic mail and bulletin board systems can provide asynchronous access to professors and colleagues— questions can be asked and answers given at the convenience of the participants. Frequently asked questions can be posted with answers to an electronic news group. Announcements of schedule changes, class cancellations, new learning resources, examination schedules and results can be sent electronically to individual students. The "office hours" of the professor are effectively extended, and the student has better access to information. Instructional time may also be freed for teaching in smaller groups that can be much more personal and effective than classes of a hundred or more students.

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Affordability Through New Revenue Sources

Funding for postsecondary education currently comes from three primary sources: government grants (including enrolment and research), tuition fees and private support. Creation of a technology–based learning model opens several revenue–generating options for the institution within these three major categories.

Increasing Enrolments

Distance and remote learning can allow the institution to enrol more students, increasing tuition and government grant revenues without necessarily developing additional classrooms and related facilities.

As the student base of the University expands to accommodate remote learners, part–time and business/professional learners, the alumni base of the University will also expand. With lifelong learning, the satisfied student is a potential "repeat customer"and long–term supporter. Special efforts need to be made to ensure that students develop a strong sense of identity with the institution, and that the relationship is seen to be lifelong.

Research Funding

Introduction of alternative delivery methods and the need to test their effectiveness for learning provides abundant opportunity for research. Private and public sector sources of funding are likely to become more widely available for this as the infrastructure and technologies come into widespread use. With rapid changes in technology, it is expected that the variety of research opportunities and funding will also expand.

Product Development and Marketing

A university's comparative advantage is the strong research base which underlies its teaching, and its expertise in the ability to collect and present learning materials in a variety of effective formats. Accumulated global knowledge, the raw material for teaching, will eventually become accessible to everyone through the thousands of networks comprising the Internet. Over time, those universities that excel in generating, selecting and effectively presenting learning resources will attract the best students.

Institutions may choose to become net sellers or net purchasers of courses and services. There is a current shortage of high quality learning materials in electronic and alternative delivery formats, and this shortage is expected to continue for the next several years.

There is considerable opportunity to develop marketable courseware at the university level, and adaptations of that courseware for markets outside universities, and outside Canada. Marketing of courses and training modules may offer significant revenue sources as the worldwide demand for education and training increases, and as technology facilitates widespread, rapid, low–cost distribution of learning materials.

To preserve its reputation for excellence, it is imperative that the University develop materials in areas of strength. Consequently, it should not develop courseware for every class and program. Rather, it should develop top quality materials in areas of strength, and purchase materials where they are readily available and of top quality, or where it is not cost–effective to develop new material.

Partnerships With Other Institutions and the Private Sector

Selectivity in offering programs while remaining a full–service institution may necessitate sharing, exchanging or purchasing learning resources within the postsecondary education community. The high initial costs of development of individual course materials will encourage institutions to seek partnerships to share costs and reduce development time through various means, including joint ventures, and the sale of administrative systems and courseware to other institutions.

Private sector providers of electronic hardware, educational materials and devices are already aware of the growing market prospects arising from lifelong learning. Many are eager to develop, test and market new products, and to introduce students and staff to product lines and innovations. The breadth of opportunity and the potential for joint ventures, collaborations, experiential learning programs and corporate sponsorship to further institutional and student goals should be explored. To facilitate development, marketing and distribution of new materials and courses, and to take advantage of existing expertise, universities should consider the potential of partnerships with publishing houses and telecommunications carriers.

Competition for Students

Although universities are generally regarded as having a unique advantage in research–based teaching, predictions are being made that there will be intense competition for students over the next ten years. Where will this competition come from?

Competition from the Private Sector

One of two major changes in the provision and delivery of adult learning opportunities, as noted by Alberta Advanced Education and Career Development, is "Increasing involvement by private providers in the form of business and industry supporting education and training for employees, and private companies providing education and training services to other companies or individuals."[14] Statistics Canada reports that in 1990, employers provided 23% of the education and training courses taken by adult Canadians (excluding full–time students), and community centres, trade unions and professional associations provided an additional 22%.[15]

The home–based learning market is also being sized up by major corporations in the entertainment, telecommunications and publishing industries. Companies such as Scholastic Inc., Time Warner, Telecommunications Inc., Intel, Viacom and others have indicated intentions to move into the home and work place learning markets via television, or computers and telephony. In Alberta, ACCESS Television, now Learning and Skills Television of Alberta (LTA), has been privatized and will offer home–based learning through cable television systems, beginning with high school upgrading for adults and expanding to include courses for degree credit. The agreement to establish LTA included production of learning materials.

At various times, Senate has heard formal and informal comment from the private sector that businesses seek education and training from universities, but that in the absence of suitable opportunities for their employees and managers, they seek these services from other institutions or from private–sector suppliers. "Profile and Trends", a discussion paper from Alberta Advanced Education and Career Development notes "... education and training are increasingly viewed as major contributors to economic competitiveness. As a result, post–secondary education and training systems are under pressure from business and industry to anticipate the skill and knowledge requirements of the economy and to produce the appropriate number, type, and mix of graduates required by the labour market." If universities are not appropriately responsive to the needs of students by providing education that is relevant for careers, they risk declines in enrolment as other institutions and businesses fill the gap.

Competition From Other Postsecondary Institutions

Another source of competition for students is other postsecondary institutions. The availability of university education via distance delivery is a growing reality.

- Several Canadian universities, including Athabasca locally and the University of Western Ontario nationally, are actively marketing distance management degrees in a variety of formats requiring minimal attendance at the institution. Many other institutions, alone or in partnership, offer distance courses and degrees in engineering, occupational health, nursing, arts and sciences. The same technology that makes it possible for us to link ourselves with the University of Calgary (two– way videoconferencing) makes it possible for Princeton or MIT or Stanford to set up a presence on our doorstep.

- In Alberta, the Department of Advanced Education and Career Development has authorized creation of "applied degrees," which will be offered through colleges and technical schools. This type of degree is under development at the present time.

- At the time of writing, 43 private and public postsecondary educational institutions were authorized to offer university credit courses in Alberta. Some of these are Alberta–based: four public universities, four private universities, seven colleges and five technical schools. The remainder were based outside of Alberta. This list is currently under review.

- The Task Force heard that some American universities are actively pursuing and have successfully completed exclusive agreements with major corporations to provide in–house, company–supported employee education, and non–residence degree programs.

- More Albertans go to other provinces to study than students from other provinces come to Alberta. In 1991–93, approximately 5,000 Albertans studied in other provinces while approximately 3,400 came to Alberta.[16] Canada annually runs a deficit with the United States. In 1992, we sent 10,000 more students than we received.

- An article in "Trusteeship" magazine reported in March 1995 that about one quarter of all American higher educational institutions belong to the United States Distance Learning Association, and each year, about 40 colleges and universities receive grants through the federal government's National Telecommunications Information Agency to establish satellite networks and develop televised curricula. The article also states, "...colleges and

universities that overlook or misread the potential of these technologies may find themselves losing students and revenue not only to other education institutions but also to corporate competitors. Clearly, boards cannot afford to delay developing an effective policy on education telecommunications in coordination with their institution's overall strategic objectives."[17]

"It is likely that these new media, properly used, will attract students from other cities, provinces, and even countries. Without proper development, other universities located outside the province could attract an Alberta clientele to the detriment of the local universities."

—Department of Computing Science
submission to the Task Force.

These trends have important and sobering implications for the University of Alberta. If students can obtain a high quality, affordable university education via distance learning without leaving their communities, and user–friendly technology is making electronic learning easier and possibly better, there is significant potential for the University of Alberta to see declines in its predominantly local, full–time student population. There is also the possibility that it will not realize an appropriate share of the expected demand for lifelong learning opportunities.

More than ever, there will be pressure to compete on the basis of quality, affordability, and responsiveness to student needs. There will be increasing emphasis on the satisfaction of students with their university experiences and the services they receive.

On the other hand, there is growing opportunity for universities that are willing to respond to the call for increased quality, affordability, relevancy and adaptability of learning to student needs. The increased demands for various forms of delivery present valuable opportunities to increase enrolments and facilitate lifelong learning. There is opportunity to improve the responsiveness of programs by reducing the time frames and administrative procedures needed for establishing new courses and programs.

The existence of competition is not necessarily a threat. It bodes well for the formation of partnerships in learning, because competitors share common or complementary goals in delivering products or services. The strength of its research base makes this University a

potentially excellent partner in developing courseware and learning materials. The view of the University in evaluating the potential for partnership activities should be the effectiveness of the partnership in meeting the University's academic goals, including its commitment of service to students— its primary clients.

Client Services and Administration

It is evident that there has never been a greater need for postsecondary institutions to be service–oriented, flexible, responsive and innovative in meeting the needs of students. At the same time that students now have more options in obtaining postsecondary education, the University of Alberta also has a much wider range of client–service options available, using technology and alternative delivery techniques. However, the recognition of the need, and agreement that something must be done are not sufficient by themselves to bring about a new learning environment. The decision to pursue innovative teaching must be accompanied by the willingness and commitment of the institution to change its service and organization structures to accommodate new clients and methods of teaching.

Services must be easy to access, easy to use, and effective for learning. Service planning needs to focus on the end user of technologies, and not on the technologies themselves, or on the skill levels or convenience of technicians who develop, purchase or maintain them. This is especially important where learning from remote sites will be enabled by technology.

Communications and Access to Computer Services

High quality interaction among instructors, teaching assistants and students, in both face– to–face and alternative modes, is crucial to the effectiveness of the learning process, to the satisfaction of the student with the learning experience, and to the identification of the student with the University as an alumnus of a supportive institution. High quality interaction can be facilitated not only by the instructor personally, but by institutional services such as:

- issuance of email/user ID accounts for all students, faculty and staff.

- adequate, affordable connections to campus computing, including access for students and faculty from off campus, and continuously and easily accessible network connections on campus.

- online access to registration services, transcripts, course standings, fee information and counselling.

- use of electronic bulletin boards, news services, interactive and virtual learning environments to support instruction and administration.

- online access to library resources and information and online search capabilities.

- computing and telecommunications training and support. To ensure that all students are able to take advantage of online resources and electronic forms of learning, training must be available for students below minimum proficiency levels. Because students will access course materials on a 24–hour basis, support services such as help lines should be provided on a 24–hour basis. Clear, easy–to–follow printed and online documentation should also be provided. Assistance with configuration of software to the student's equipment may also be needed.

- electronic publication of a directory of student and faculty email addresses, with updates provided online at the time an account is issued or changed.

Curriculum and Programming

The increasing variety of learning needs will bring changes in curricula and programming. Curricula will need to be adaptable to varied modes of presentation, according to the student's physical location, schedule, preferred mode of reception, and style of learning.

Student Advisory and Training Services

Faculties will need to determine the requirements for hardware and software for specific programs, the advisory services that will be needed to help first–year students obtain appropriate computers and applications, and the minimum computer skills that will be needed by incoming students .

Students who do not meet minimum computing skill levels should have access to pre– attendance training in the University computing and communications systems. Training should familiarize students with use of the University's computing and library services, and help them meet their individual program requirements for computing skills.

Student Tracking and Accreditation Systems

The ability of students to take courses and programs from institutions world–wide without leaving home, and to take courses from more than one institution simultaneously, will require enhanced methods of tracking and accreditation. Alberta's accreditation system, under the Alberta Council on Admissions and Transfer, is exemplary. It facilitates portability of credit through negotiated transfer agreements between institutions. However, a number of questions are raised when students may attend more than one institution at one time, or several institutions in a lifetime of study. Whose students are they for purposes of issuing multi–institution degrees and receiving government grants per enrolment? How will accreditation from possibly thousands of institutions world–wide be handled? If education truly becomes a global exercise, institutions will need not only provincial, but national and international accreditation systems.

Student Evaluations and Reporting of Results

Remote learning raises questions about examinations and other forms of student evaluation. Instructional design will need to include the form that student evaluation will take, whether there will be an in–person element which verifies that the registered student is actually the person completing the course and writing the examinations, or whether completion and mastery of the course may be evaluated in part or wholly through the computer. Although proctored examinations offer a solution to problems of remote learner evaluation, convenience for the student, the availability of supervision and facilities are prime considerations.

Privacy and Security of Information

With convenient electronic access to student information, electronic mail, and online services come the issues of privacy and security of information. Privacy ensures that communications are received and read only by intended recipients. Access to student records, grades, financial and other privileged information is only by permission of the student or their authorized agent. Students have the right to expect that privacy of electronic records will be protected by the institution. When privacy of communications cannot be expected, the student should be advised. This might occur by such simple means as brochures or postings to the student's computer account which describe privacy issues and the level of privacy which can reasonably be expected with various forms of electronic communications and data transfer.

Security refers to the risk of unauthorized access and use of information such as student records and examinations. Breaches of security by computer "hackers" do occur, and they pose a problem in that the culprit may do all kinds of damage: altering individual records or entire databases, infecting systems with viruses, and bringing down entire systems. In a distributed computing environment, many users of the system are not technically trained, and may not be aware of security procedures and measures, so Universities need not only to provide central security, but to assist LAN users in developing appropriate security measures and contingency procedures.

Revenue Administration

Changes to funding structures, a new collaborative framework, new opportunities for revenue generation through creation of courseware, and presentation of learning modules outside of the institution will bring new challenges in revenue administration. Partnership and marketing activities may add to the complexity of accounting systems. Revenue distribution systems for electronic copyrighted material will need to be aligned with distribution systems covered by the University's current patent policies. Collection activities may include user fees for courseware; partnership and marketing revenues; and online receipt of tuition and other fees from foreign and other distance students. The challenges presented by technology may be resolved through the use of technology.

Organizational Issues

Since the new paradigm of learning is both a goal and a result of widespread, effective use of instructional technologies and alternative delivery methods, the organization should focus on encouraging and empowering faculty to implement the technologies. Since the changes inherent in a new model of learning will pervade an organization's operations and culture, there has to be a high degree of support and participation from individuals and faculties. The University of Alberta will need to approach the process with a well thought out and coordinated plan for managed change over a period of several years—a plan that will encourage optimal development within and among its highly diverse academic units. Keys to the process will be leadership, reallocation or procurement of resources, and rewards and incentives for faculty and staff that are appropriate to the institutional values placed on excellent teaching.

Leadership

A first important step will be senior management's firm, public commitment to using advanced technology in creating learner–centred, learner–controlled alternatives within the educational environment.

Encouraging Participation

Effective communication of the benefits and opportunities provided by the use of technologies will encourage interest and vital grass–roots support. Well–targeted demonstrations of effective applications of technology, and discussion about the techniques and problems encountered by early participants will widen the campus understanding of the process, and should influence more faculty to participate in pilot projects and further development. In a rapidly changing environment where many undertakings have a significant risk of initial failure, there must be encouragement and support for risk–taking.

Supporting Participation

Institutional rewards, incentives, hiring criteria and faculty training should reflect the value that the institution places on technology–based innovation and improvement in teaching. These should also reflect that the incorporation of technology in learning is expected of both faculties and individuals. Rewards and incentives will need to take into account the varied nature and length of time to complete activities, which range from computerized class notes to fully interactive multimedia packages for a specific subject area, and from email contact between instructors and students to fully interactive videoconferencing with several sites. Hiring criteria should reflect the university's expectation that new faculty members will need to have skills in use of technology, and in many cases, instructional design for technology–mediated learning. Training should be supported and provided for existing staff whose technology skills are below a base level. Further, doctoral programs should consider incorporating components of technology–mediated instruction and/or instructional design into degree requirements.

Both in the literature and in interviews with the Task Force reward structures were emphasized as being crucial to effecting change. Faculty level evaluations, rewards and incentives might include criteria such as collaboration among departments and across disciplines; cost savings arising from use of technology; increasing access to learning resources through technology; innovation and quality in technology–enhanced teaching; and research into the optimization of technology–based courseware.

Empowering Individuals and Faculties to Participate

To permit individuals and faculties to participate in the transition to a new paradigm, training and resources should be made available to staff—the person doing the job must have the right tools for the task. Training should include a grounding in the use of technologies themselves, and in instructional design for various learning media.

Because of the blend of subject expertise and technical skill that is required in many initiatives, it is not practical to expect every academic to become an expert in every technology. Instead, team approaches where faculty members and technical experts work together toward well defined educational goals promise to be most effective.

Where departments or offices do not have resources to hire in–house technical expertise, consultation might be made available from a central registry or pool of computing and media expertise. Another option might be to establish a campus–wide development centre to help individual faculty members gain expertise which would then be applied within their respective departments. Similarly, centralized equipment and production services may be advisable, where the cost of procurement or the degree of use does not permit ownership by individuals, departments or faculties.

Because many learning design programs and software tools apply equally well to a wide variety of subject disciplines, communication and sharing of information is important to avoid unnecessary duplication of effort, to promote synergy in the creation of new learning materials, and help control costs. Mechanisms for collaboration and for sharing tools, information and ideas should facilitate the incorporation of technologies by individuals in a cost–effective manner.

While estimates vary widely, the initial costs of developing courseware and assembling learning databases can be relatively high, and the process is time consuming. Institutions need to view these initial costs as investments which may be recoverable through repeated in–house use and through sales to others by the university independently or in partnership with electronic publishers and software vendors.

Collaborative development of a strategic plan to introduce technology should maximize potential "buy–in" at all levels. Responsibility and accountability for the process should rest with the person and position responsible for ensuring that technology furthers the insti-

tution's academic goals and not within administrative support or technical and computing support. As a rule, responsibility and accountability of those units for incorporating technology are not linked primarily to academic goals, but to administrative and technical efficiencies. The Task Force believes that the strategic plan should be developed by the Office of the Vice-President (Academic) in collaboration with faculties, departments, and administrative units.

As the number of issues raised in this section illustrates, very few areas of a university's operations and administration will be unaffected by the widespread use of technology in learning. From curriculum and program development, to student services, revenue administration, and alumni relationships, the University will change. There is urgency in anticipating the challenges that we will face, in order to avoid offering "too little, too late". The institution must rise to these challenges creatively, or face substantial consequences both in declining enrolments and quality of applicants.

Alternative Delivery at the University of Alberta

Use of technology in learning at the University is not new. There is a history of involvement spanning more than twenty years. Although several recent projects such as installation of interactive classrooms and development of specialized learning laboratories have had high visibility and received significant institutional resources, a large number of projects have been smaller in scale, primarily the result of individual initiative, and without major institutional support.

A significant number of early adopters perceived the advantages of particular technologies for their particular discipline or student group and developed specific projects and applications, often at state–of–the–art levels. Some endeavours were prompted by curiosity about the power of the technology to provide a new learning platform, while others were designed to meet course–specific instructional goals.

There is an emerging perception on this campus that technology will be a great asset to learning, and that creation of academic content will be a major arena for systems development in education and the private sector. Interest among staff is increasing, as evidenced by over–subscribed workshops, seminar attendance, the appearance of new bulletin boards, creation of task forces, and organization of technology fairs and conferences. There is also a sense of urgency about becoming institutionally and personally involved. This may be arising from a fear of being left behind, when one sees the level and variety of activity that is being carried out by other institutions, as much as for the perceived advantages in effective learning and efficient teaching.

Academic Vision and Strategic Planning

At the University of Alberta, there has not been a unified vision for the use of technology in the learning environment. Absence of vision has resulted in fragmentation of effort and it has placed the University in a position where technologies and administrative efficiencies are leading academic applications, rather than systems development being driven by academic needs and goals. Without clear strategic directions, individuals, and in some cases departments, continue to set priorities, work in relative isolation, and receive varying levels of institutional support and recognition for their work.

Responsibility, Accountability and Leadership

Submissions also indicated that although technology implementation should be carried out within an overall institutional framework, faculties and departments need to be responsible and accountable for implementing technology in accordance with their respective academic goals and disciplines. A small number of Faculties such as Law and Rehabilitation Medicine have developed technology strategies to support directly their own vision and academic goals. Some faculties and departments, such as Agriculture, Forestry and Home Economics, Arts, and Family Medicine have hired technical support staff, part or all of whose function is to work with subject area specialists to develop teaching innovations. Technical staff liaise and consult with administration and CNS technical support staff according to project requirements. The Task Force heard that this team approach is very successful, especially when academic goals are clearly defined and central to the process. Several respondents suggested that although CNS would continue to provide technical consultation to such faculty–based leadership teams, its involvement in alternative delivery was likely to decrease due to the distance of its mandate from academic goals and student needs, and insufficient resources to provide a range of needed services.

Respondents to the Task Force indicated that although senior management should lead and be accountable for strategic planning, there were strong feelings that faculty and department staff need to provide leadership to and feel ownership in the process. Participants also indicated that accountability and responsibility for implementing technology in the learning environment, developing alternative delivery methods and evaluating their results should be placed at the faculty and department level.

Funding for Innovation in Teaching

Strategic planning should include funding for innovation in teaching. Until recently there have been very limited funds available. In 1990 the University Teaching Research Fund (UTRF)was created as a new category under the Endowment Fund for the Future. The UTRF allocates approximately $60,000 per year to projects designed to enhance the level and quality of teaching research and curricula development in the University. The Alternative Delivery Initiative was funded with $250,000 over a two year period, and in May, 1995, the Board of Governors approved a hard allocation of $565,000 in recognition of the "critical importance of innovations in instructional delivery, and the new costs that will need to be incurred if this initiative is to be pursued aggressively."[18] Details

about the use of those funds were not available at the time of publication.

Faculties have options to apply to external funding sources such as the Province's Access Fund, and the national Networks of Centres of Excellence program. There have also been many collaborations among our faculty members and those at other institutions, focussing on development of networks and infrastructures and including major projects to produce shared courses and materials. Partnerships between the University and private agencies have brought additional resources to the campus, especially in the area of laboratory and computer equipment. Total funding from outside sources for innovation in teaching and development of infrastructure for teaching and learning could not be ascertained, because it was not possible to inventory all projects. Effort should be made to identify and pursue opportunities for funding from external sources.

Development of Instructional Computing

The Task Force heard that development of instructional computing should be included in academic strategic planning, including items such as provision of off–campus access, provision of computer labs, and help–desk services. For development of courseware, respondents emphasized the need for desktop computing tools that are readily accessible, easy to use, and available according to departmental schedules and priorities. There was consensus that facilities and service provision need to anticipate demand, rather than follow it. Concern was also raised that small offices in a distributed computing environment are not likely to have sufficient resources to hire in–house technical support, and that there will be a need to provide those offices with access to technical advice and support.

Training Needs

Although there was significant interest shown by staff in participating in alternative delivery, there was a strong concern about the wide differences in technological proficiency among faculty and students. There is a strong need and desire for training, to at least a certain base level to ensure, for example, that staff and students know how to use email, how to access or provide electronic course materials, how to use bulletin boards, and conduct online searches. Such training would go a long way to increasing awareness of the potential of technology in learning, and would signal the University's expectation that technology will be used in teaching and learning. The University may need to develop mechanisms to evaluate the technolog-

ical skills of incoming students in accordance with program needs, and provide appropriate training opportunities. Some training is already provided by several departments and by Academic Counselling Services. As students become more accustomed to using computers in primary and secondary school environments, at home and in the workplace, it is expected that the need for entry–level training will decrease.

Strategic Alliances

The costs of developing courseware and upgrading it as new knowledge becomes available are very high in the initial stages, but are offset by economies of scale and, potentially, by subsequent marketing of courseware packages. The costs of staff training, equipment procurement and upgrading, infrastructure and facilities development and maintenance are also significant. The University may offset or share these costs by seeking mutually beneficial relationships with other universities and corporations as key partners in delivery of postsecondary educational services to students anywhere, any time. At the provincial level, the University should continue to work with government and other postsecondary institutions toward a collaborative educational delivery model and to examine issues such as accreditation; equitable student funding formulae; increasing access through a variety of shared technology applications; development of a provincial network infrastructure and tariffs that favour learners. At the federal level, the institution should continue work on issues such as infrastructure development and public access; copyright and intellectual property; and privacy of information. The University should seek both federal and provincial funding for research into effectiveness of learning using various media and alternative delivery techniques..

Measures of Success

Successful implementation of the strategic plan may be measured via learning and service outcomes. Examples of measurable learning outcomes might include examination results, student satisfaction levels, and graduate placements, while service outcomes might include an increased range of electronic course offerings, increased availability of student information online, improvements in off–campus access to computing services, or increases in accessibility of online library services. In the early stages of implementation, success may generally be seen as increases in availability of learning opportunities. Gradually, performance measures may shift to increases in quality and variety of courses, programs and services.

Communication and Coordination of Efforts Toward Alternative Delivery

A lack of systematic communication and coordination has meant that individuals and departments are not benefitting from the experience of others. Some people are experiencing the same learning curve as did the early adopters of technology, because they have not been aware of others who had been through similar processes of experimentation and discovery. Mechanisms for sharing experiences would significantly reduce the time for individuals and units to achieve proficiency and reduce the risk factors in trying new approaches.

Lack of coordination and communication has also resulted in some duplication of effort and, possibly, failure to realize opportunities for leadership and major funding, even though the expertise on campus is considerable. Such duplication is evident in the proliferation of task forces and study groups that have been established over the past two years to study the impacts of technology in learning. Although each has had a slightly different focus, the terms of reference and reports that this Task Force has seen have been quite similar.

Alignment of Services to Optimize Effectiveness

The establishment of the Alternative Delivery Initiative in 1994 has provided a degree of leadership and visibility, and has facilitated communication across campus. While the Initiative appears to be having very positive effects, there are several other operating units on campus that have overlapping, campus–wide responsibilities and interests in promoting alternative delivery. They include:

- Faculty of Extension
- University Teaching Services
- Canadian Centre for the Development of Instructional Computing (CCDIC)
- Faculty of Education' s Division of Technology in Education
- CNS

When there are so many points of activity, there is bound to be some loss of focus for potential participants. As one respondent put it, "At present there is probably no one person or office within the University aware of all, or perhaps even a majority, of the ongoing projects in the use of instructional technology." It is timely that potential

overlaps and duplications in service roles be examined, with a view to optimizing and coordinating efforts in the pursuit of shared academic goals and organizational effectiveness. Such a review may lead to a more unified, productive and focussed approach to instructional innovation.

Need for a Hub of Information and Activity

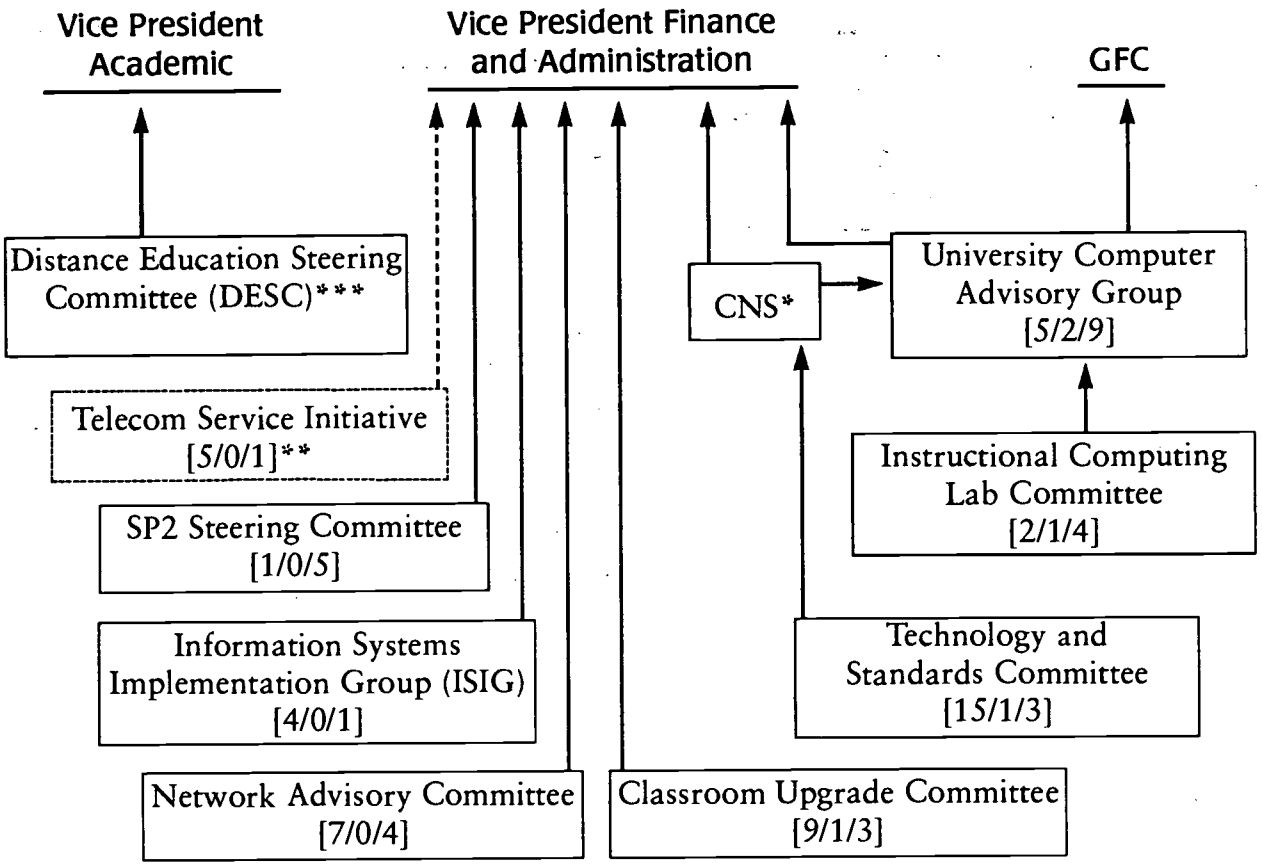
The need for collaboration and communication was also of concern to respondents. Mechanisms would be needed to ensure that colleagues, departments and faculties take advantage of cross–disciplinary commonalities in courseware and materials development. This entails sharing of experiences and information, and ensuring institutional efficiency in meeting the costs of major equipment and services. There was sentiment that there should not be a central, controlling office that would create another layer of management. Instead, the focus should be on creating a clearinghouse for information such as the availability of new products, innovations on campus, and techniques that have been tried or tested here and elsewhere. A clearing house could also facilitate communication, locate or arrange training opportunities, seminars and guest speakers, all aimed at promoting technological proficiency and self–sufficiency within the departments. Operation of such an office was likened to the hub of a wheel, with spokes linking faculties and departments.

Campus Computing Services

Service Planning and Coordination

CNS is responsible for coordination, planning, implementation and maintenance of the University's computing services. That unit currently reports to the Vice–President (Finance and Administration), though in the past it has reported to the Vice–President (Academic) and more recently to the Vice–President (Student and Academic Services). Numerous standing committees have been set up over time to advise CNS and senior administration on appropriate directions for various significant aspects of systems development. Figure 5 shows some of the existing Committees, their composition and reporting relationships. Brief descriptions of the Committees' functions are provided in Appendix III.

Figure 5 Some University of Alberta Committees Relating to Technology and Instruction



* CNS (Computing and Network Services) is represented on all but ISIG and DESC.
** Bracketed numbers give approximated Committee membership ordered as follows: technical and administrative staff, students, professors.
*** Here, distance means a few metres or thousands of kilometers. DESC has focused on alternative, technology-assisted instruction; although it appears to be "technically" and literally "out of the loop," it has given rise to the Alternative Delivery Initiative which is intended to promote technology-enhanced instruction campus-wide. During the early months of 1995 President Fraser met with representatives from DESC and initiated a process for encouraging many faculties to plan promptly to address alternative delivery issues.

The above structure reflects significant technological, financial and administrative facets of technology/computing-assisted instruction, but it does not suggest a strong institutional academic commitment.

The Task Force has two concerns in presenting this information. First, that the reporting structure for the current committees does not reflect a strong academic focus or commitment to academic content, which is expected to be the main area of growth in computing applications over the next several years. Only one of the committees reports to the Vice–President (Academic) and the remainder report directly or indirectly to the Vice–President (Finance and Administration). Second, leadership of these committees is primarily from technical and administrative staff. Although the process of development of computing systems is collaborative by nature, it is widely acknowledged that the process must be driven by the needs of users. Without wide representation and leadership from academic user groups, faculties and departments, the results may not adequately reflect pedagogical principles, or learner needs and preferences.

The organization and structure of computing standing committees should more closely serve the need for senior administration to encourage leadership, accountability and responsibility for developing an interactive learning environment within the departments and faculties.

Access to Computing Services From Off Campus

CNS provides central modem pool access to campus computing services and the Internet. Over the past two years, this service has been overtaxed by exponential increase in demand. In September and November, the modem pool was expanded at a cost of approximately $300,000 for capital acquisition and $20,000 operating. The service currently consists of 148 lines from 4:00 am to 6:00 pm and 235 lines from 6:00 pm to 4:00 am, accommodating various modem speeds. The service is full from 8:30 am to 1:30 am every day. The session time per connection is expected to grow from the current 35 minutes to up to two hours in duration as students make more use of connections to access online learning materials.

Access has been very limited with the current modem pool, with frequent day–time busy signals and very small chances of success in connecting between 5:30 pm and 10:30 pm. Complaints about access difficulties were often heard, and difficulties were also experienced by members of the Task Force. CNS estimates by monitoring busy signals, and estimating demand and load patterns, that a pool of 1,500 modems would be required. The estimated cost of the service would be $800,000 capital, $400,000 in line costs, $100,000 staff costs, and $300,000 to refurbish equipment on an ongoing basis.

To build such a modem pool on a cost recovery basis, users would have to pay $12 to $15 per month, and an administrative system would have to be created to handle billing and collection of 20,000 to 35,000 accounts. CNS does not plan to expand the modem pool in the foreseeable future due to high investment and operating costs that would result in a higher user fee than was available from the private sector connection services.

As an alternative strategy, CNS has arranged with ED TEL to provide a *U of A Modem Pool Access Service* (a modem connection only service) for the September 1995 term. The service will provide a higher grade of modem access to the University computing facilities, including the University's Internet connection. The service will be available in the metro Edmonton and Extended Flat Rate Calling Area. Cost of the service is expected to be $8.95 per month for a SLIP/PPP connection to a maximum 28800 baud rate. With the flat rate, users receive up to 20 hours connect time per month, and they will be charged $1 per hour after that. Procedures are being set up with Physical Plant *Telecommunications* that will allow ED TEL to add connections to departmental phone bills. CNS will support connections through its Help Desk. This arrangement is subject to approval by the CRTC. Users will also have the option to contract service with other Internet connection services at their respective market rates.

Despite this measure to increase modem access to the University's resource, the Task Force has strong concerns about the decision not to expand the campus' own modem pool *at all.* The modem pool did not adequately handle 1994–95 winter term traffic on the network, and student access needs will increase significantly in September, 1995. At that time, every student will receive a Logon ID (computing account), and could therefore need network access. Four Biological Sciences courses will go partially online in September, requiring specific access for those courses for about 5,000 students several times weekly. A distance course in Agriculture will be offered in full online format, affecting remote students enrolled in the course who may be outside the ED TEL service area. These examples illustrate how demand for connectivity will grow to an unprecedented high.

There are only about 750 workstations in on–campus labs, so a large majority of students will need off–campus access to course materials. Even if staff demand were shifted to the remote access pool, there would still be a potential need to serve up to 25,000 students on a regular basis. CNS will need to ensure that ED TEL con-

nectivity provides hassle–free, reliable operation. Failure to do so will be tantamount to shirking its responsibility to its clients in CNS's primary service area.

The Task Force is concerned about affordability for students and the perception of services offered by the University. When students already pay a campus computing fee, how will they perceive the additional charge for remote access? Will they be able to afford the extra modem charge? If they cannot afford it, will there continue to be access problems? Arguably, there is still a need to upgrade the modem pool in increments to a point where users who cannot afford to pay can still obtain a reasonable level of service, such as dialling no more than three times to get a connection.

Another concern is that staff who are employed by the institution may be required to pay for access that should be provided by the employer. If remote access to computing capabilities are part of the job and will benefit the University, should the cost not be borne by the University? If it is not, the effect will be that a financial obstacle has been placed in an area where the University needs to encourage greater staff involvement.

Help Desk Services

CNS operates a staffed telephone help desk Monday to Friday, during University business hours. For a small fee, it provides a brief manual giving basic instructions to new users, and information such as how to access the Internet. It offers an online help service and news groups for those who already know how to access the network.

In the spring of 1995, CNS published a discussion document entitled " A Network Services Architecture" which states a goal to "provide users reasonable support facilities such as 'help' for seven days a week and for twenty–four hours each day even when the functions are not manned." The Task Force believes that the hours of staffed help services should be increased, especially at the beginning of each term, at exam times, and when CNS launches major new software or services. As technology–enhanced instruction increases, CNS and the academic units will need to coordinate provision of help services.

Electronic Mail Directory

Currently, the University directory is not updated in print or electronic form more than once a year, and is usually not available until November, more than half way through the first term. This publica-

tion system is out of step with the speed and flexibility offered by computer technology, and it has been a source of frustration for people who are eager to use electronic communication. Online access to up–to–date information is needed.

Computing Labs and Facilities

The current model for computing laboratories at the University is to provide clusters of workstations in a single room on campus. To use the labs, the student must come to the campus. Computing facilities may be block–booked for use in classes and tutorials, limiting their availability to students who are not in that class.

There are no "walk–up" connections where the student could simply plug into a connection point similar to a phone jack and use a portable computer to enter the University's virtual environment. Providing this type of on–campus connection could encourage students to use portable equipment and reduce the strain on dial–up access through the modem pool. The Task Force believes that the model currently used for lab development should be reviewed in the context of strategic planning for both student services and for construction or upgrades of buildings, to ensure that the model optimally serves academic and organizational goals.

With alternative delivery methods becoming more common, there will be a need to upgrade all or most of the classrooms on campus to provide network access and multimedia capabilities. Concern was expressed that current budgets for upgrading would not accommodate needed connections and facilities. Respondents suggested that mutually beneficial alliances with hardware and software vendors, publishing firms or other private sector interests could help to provide upgrades.

Standards for Hardware and Software

On the campus, there is a wide range of equipment in use, of varying ages and platforms, using a very wide variety of software, also of varying ages and capabilities, much of it purchased by individuals out of their own pockets. Several issues arise from this situation.

First, the proliferation of platforms and software raises the issues of interoperability and staff portability from one office to another, and from one work station to the next. A staff member who changes offices may be required to learn an entirely new computer platform and software requirements, even though the job itself may be related. Temporary staff on campus are required to learn the systems

of each office in which they work. The variety of software in current use, including many programs which perform similar functions, makes it difficult for the organization to provide adequate user support. Technical staff are hard pressed to be familiar with every package or to remain current on upgrades to each supported package. These situations reduce productivity.

Aging equipment also creates issues of maintenance. When equipment is more that a few years old, its compatibility and suitability to new systems and applications, including high–speed LAN connections, decreases and eventually becomes problematic. User support also becomes difficult. As older software and hardware fall out of general use, technical expertise often becomes unavailable. Because a significant amount of computer equipment (personal computers, software, peripherals) used by faculty members has been purchased out of their own funds, upgrading may not be considered until the unit is completely dysfunctional. This situation hampers the advancement of an interactive learning environment.

The Task Force also believes that in the interest of efficiency, consideration should be given to introducing campus standards for power and platforms of office equipment, and for common purpose software, even if the standards are set for individual faculties. Policies and schedules for equipment procurement and replacement should be developed where they do not exist.

Issues Identified by Respondents

Faculty Rewards and Incentives

The majority of respondents reported to the Task Force that their innovations were not recognized by colleagues and management as legitimate scholarly activity, and that faculty evaluation criteria did not place a high value on technology–enhanced teaching initiatives or provide recognition for electronic (as opposed to printed) publications. These were the most frequent and strongest concern brought to the Task Force by presenters.

Several faculty members commented that there were significant disincentives to intensive focus on teaching and development of teaching materials, at least until tenure had been granted. Some told us that they had been advised by senior faculty members to avoid alternative delivery because it would take away from their research and publication activities, and hence, jeopardize their careers. Some said

that they would advise young professors not to pursue technologies until they were tenured. Others said they felt they had sacrificed personally or had been denied promotion because they chose to pursue innovation and excellence in teaching over traditional forms of publication and intensive research.

> *"At the present time there are no rewards from the university for doing this, just the satisfaction of seeing my students do better. Since I am spending more time on teaching, and thus less on research, I can expect this university to penalize me for this. Thus, my only recourse is to sell the material I'm developing. This dose of reality will happen across North America over the next few years. Just like we now pay a premium for good textbooks, we will soon pay for good electronic course material."*
>
> —Mark Green
> Department of Computing Science
> is a submission to the Task Force.

These observations are not new. In 1993, a University of Alberta Task Force[19] recommended that "Professors who undertake technological or other innovations in university pedagogy should be recognized for the scholarly contribution they are making, and should be given support for their particular innovations... In the interests of increasing teaching effectiveness at the U of A, the Task Force urges FECs to encourage research–based teaching innovation by rewarding demonstrable cases of success." This recommendation was based on a survey of 554 faculty members, wherein 92 respondents (16.6%) indicated that such innovations were used to evaluate research in their unit.

The most frequent recommendation of respondents was that faculties and departments be required to review their criteria for tenure, promotions, and merit increments to reflect more appropriately the values of the institution with respect to excellence and innovation in teaching, and to promote the development of innovative learning materials. Several respondents extended this recommendation to include a review of hiring criteria for future staff, to reflect the increasing importance of technology competencies of faculty members. Incentives, they said, might be as simple as release time to allow project development to take place. Rewards may simply be recognition at Faculty Evaluation Committees that innovation can contribute to teaching or to research, or to both.

"Present practice— in spite of pious statements to the contrary— is totally steeped in publications as the only criterion for assessing the worth of the faculty, and the term "productivity" has become a synonym for the number of publications written by a given staff member, to the exclusion of any other activity. This leads to the silly but often observed situation whereby faculty members who have produced innovative instructional materials of high quality can be labelled "unproductive"— and consequently left unrewarded— by their Faculty Evaluation committees (FEC's) unless they have published some articles, even articles that merely describe their instructional materials. The result is that, because software development is very time consuming, but does not pay, the field is littered with articles about unfinished, or even often not yet produced courseware."

—submission by Bernard Rochet, Director
Language Resource Centre, Faculty of Arts
in a submission to the Task Force.

The incongruence of current reward structures to goals of excellence in teaching is not an issue for the University of Alberta alone. It was a common theme in the literature the Task Force reviewed, and it is becoming a key issue for universities that seek to use alternative delivery strategies to enhance teaching and learning. If institutions place a high value on enhancing the quality of learning and on accommodating more students, then rewards and incentives will need to reflect that value.

The Task Force also heard that department– and faculty–level incentives and recognition should be structured to promote strategic collaborations among disciplines and between institutions, and to reward both cost savings and enhancements to learning. Incentives described by respondents included access to computer programming services and specialized equipment, allowances of teaching time to develop alternative materials, opportunities for information–sharing and collaboration, and funding for research into the effectiveness of learning innovation.

Access to Computing Resources From Off Campus

Access to computing resources from off campus was the second most frequently raised issue, after faculty rewards structures and incentives. Both students and faculty have experienced severe frustration at being unable to connect to university computers for hours at a time due to busy signals at login. Staff expressed their frustra-

tion, asking why they were making the effort to put learning resources on computer if the students might not have access to them anyway. This concern points out that if the University wishes to become a full service, electronically-enabled institution, it must ensure that service capacity precedes demand. This issue becomes more urgent as student options to attend other institutions become wider, for if good service is not provided here, students will go elsewhere.

Buyers or Sellers of Courseware

Staff expressed a sense of urgency in developing "content." They stressed that in the future, universities will not be able to afford face–to–face instruction in every class, or the intensity with which it is currently used. Computer–mediated learning forms provide a less labour–intensive alternative, but because of the high cost of development in this type of instruction, universities will be unable to afford to produce courseware and materials for every course.

The question for the University of Alberta, with its strength in research and teaching, is whether it will be a net buyer or a net seller of courseware and materials. Some suggested that we cannot afford to be general consumers any more than we can afford to continue to use only traditional methods. If we are a net consumer, what will distinguish our teaching from that of colleges? If we are a net producer, then integration of research into teaching will continue to be the distinguishing feature. In this way, being a producer or a consumer of learning materials can either strengthen or weaken the linkages between research and teaching.

Staff also asked whether we will be early to market or late. Early producers will have ready access to publishers and distribution systems, and publishers are already seeking high quality materials. Being early to market with high quality materials will enhance the reputation and extend the reach of the institution, increasing the perceived value of its degrees while helping to recover the costs of development.

Flexibility and Responsiveness

Comment was received regarding length of time and number of steps it takes to introduce new courses and programs. As society's needs change, and as new industries and multidisciplinary studies increase, institutions need to be able to respond quickly and effectively. As competition among institutions and the private sector

increases, those institutions whose programs are seen to have the greatest relevance will be those who attract the best students. Respondents recommended that the process be shortened to permit the university to respond to perceived opportunities.

In a similar vein, respondents stressed the need to move to an instructional model that provides learning asynchronously and on demand, and accommodates lifelong learning. They recognized that organization structures and services will need to change to accommodate a new delivery model and a new learning environment, and indicated that there would need to be willingness by both individuals and management to try new things, to take risks and to accept failures as part of the evolutionary process. They stressed that technology's capacity to disseminate knowledge rapidly and widely can reinforce the linkages between high quality research and high quality teaching, and give our students an advantage over others by providing immediate personal access.

Staff also expressed the opinion that we should not wait until we collectively become experts in the use of technologies before we begin to implement them on an individual basis. They stressed that the technologies are changing rapidly and if we wait to develop institution–wide expertise, some technologies will be obsolete by the time they come into use. The onus is, therefore, on the individual to incorporate technology in teaching and learning.

Requiring Students to Own Computers

Submissions to the Task Force suggested that in future, students will need to have continuous access to a computer to complete most courses and programs of study. The value and increasing use of computers as a learning medium are undisputable. As the University of Alberta continues to introduce technologies in the learning environment, ownership or access to computers is becoming a key issue. Although it is not mandatory that a student own a computer to attend the University of Alberta, it is a requirement at the University of Lethbridge, and it is becoming more common on campuses across North America.

When respondents were asked whether students could afford to purchase a computer, the response often was "Can they afford not to?" Recognizing that the cost of a suitably– equipped computer is in the order of $2000 or more, the requirement to purchase a computer may become a barrier to University education. At the same time, not owning a computer can become a barrier to learning, and not hav-

ing computing skills can become a barrier to career employment. Since University resources are not available to provide every student with personal computing capabilities, it was suggested that the University facilitate group purchase, lease–to–own arrangements, sponsorship of equipment, or other means of minimizing the financial impact on students. It was also recognized that departments have varying requirements for computing platforms, processing power and software. If students are required to have specific equipment, departments and faculties need to provide that information to students upon confirmation of registration.

Faculty Work Stations

If students are required to own or have access to a computer, should there not be an equal commitment for faculty? Currently, some staff do not use computers. Others are using equipment that is too old to be supported and does not have sufficient processing power to handle connection to a local area network. This aging equipment will not provide the communication services that are becoming the norm for students, and it will not support the professor trying to develop electronic course materials at the desktop. Others still have invested substantially from their own funds in state–of–the–art equipment.

If professors are required to use computers for instructional and communication purposes, the issue arises as to what type of equipment will be required, and who will pay for it. Just as department requirements will vary for students, requirements will vary for professors. Units will need to advise, in a timely way, on the type and power of equipment that will be needed.

The issue of who pays is somewhat more complicated. Many of the computers in use on the campus have been purchased by individuals out of their own funds. If upgrades are required, or if new equipment is needed, should that be at the expense of the professor who may be willing to carry on with current machines? Should workstations be supplied to new professors? Should workstations be supplied for all faculty?

If an interactive learning environment and computing skills are future directions and requirements of the University, then adequately equipped workstations are necessary tools for the worker. The Task Force believes that the financial commitment to provide suitably–powered workstations should be viewed as an investment in the future of the University. Consideration should be given to how workstations may be purchased, serviced and upgraded regularly to

ensure that equipment is adequate for instructional use and interoperable with technologies in use across campus.

Alumni Identity with the University

The nature of the campus experience will be fundamentally altered for some students who attend electronically, or "virtually". Close attention will need to be paid to ensuring that there is still a strong personal and social quality to their experience with the University, through the services they receive, and through their interactions with teachers and other students.

The allegiance of some alumni to their alma mater will need to be developed in new ways, since a growing number of students will be on campus only for a short time, or in some cases, not at all. To promote a lifelong association with the University, and to cultivate their willingness to be "repeat customers," the University might consider creating ongoing opportunities for interaction and increasing alumni benefits. For example, alumni might be given the opportunity to participate in learning–related events such as interactive lecture series or mentoring current students. Ongoing communications such as electronic postings of events, speeches, news releases and university publications may increase interaction. A variety of measures could be developed by faculties, central administration and the Alumni Association to address this issue creatively.

Social and Legal Issues

Social and legal issues were raised, including copyright law and intellectual property rights in electronic publication; the need for network access and telecommunication rates that favour education; the need for industry standards to insure interoperability of networks; and security and privacy of electronic information. The University is monitoring or actively involved in public discussion on most of these issues and it provides a powerful voice in Canada for academic concerns. It should continue its activity in providing submissions and participating in public debate, to ensure that its institutional and postsecondary educational interests are represented.

Another issue that was discussed was the creation of an information elite among learners who have access to computers, while socially or economically disadvantaged learners are left behind. The University may wish to review its support for students in need, and extend scholarship or other forms of assistance to include procurement of computer equipment needed for the student's particular department.

Opportunities for Leadership

Several opportunities for leadership by the University of Alberta were identified in the course of the Task Force deliberations.

Creation of an Instructional Innovation Hub

Creation of an Instructional Innovation Hub on the campus would provide leadership and visibility to a new academic vision, and would facilitate implementation of that vision within the campus community. Since there is urgency in commencing the transition to a technology–enabled learning environment, a well–networked hub could provide immediate assistance with:

- developing strategic plans for implementing technology in learning
- stimulating technological innovation by providing faculties, departments and individuals with information, ideas and advice about alternative delivery methods and effective uses of technology in learning.
- assembling training courses and information for departmental and faculty leadership teams, who would in turn provide training and information to their own staff, with a goal of eventual self–sufficiency
- monitoring the rapidly changing technology marketplace for educational software and applications
- acting as a clearing house for information related to new technology and learning applications, learning effectiveness research and activities across campus
- procuring and managing specialized production facilities and equipment that may be needed only periodically or are too costly for individual faculties to purchase
- identifying external sources of funding and actively assisting project developers and researchers in completing proposals and applications for such funding
- facilitating pilot projects, testing and demonstrating new applications and techniques in alternate delivery methods.

Some of these functions are currently within the mandate of the Alternative Delivery Initiative. However, that Initiative does not have sufficient resources to meet the needs of all faculties. Additional resources need to be allocated or reallocated to ensure that the Hub has sufficient capacity to be effective in its proposed role.

Creation of a Multidisciplinary Degree

To serve Canada's need for technologically–skilled workers and to help meet the University's commitment to prepare highly skilled

graduates for productive careers, the University should consider creating a multidisciplinary degree that combines technology studies with subject disciplines. Such a program would demonstrate responsiveness of the institution and could provide a model program for learning in a technology–enabled environment.

The flexibility of a multidisciplinary degree program is well suited to an emerging industry. It provides flexibility to both the institution and to the industry in quickly adapting to changing needs. To the information technology student, it offers the option to enter the information industry through virtually any discipline, from drama to law.

Many faculties and departments could make special and significant contributions to such a degree from their existing expertise and continuously developing knowledge base. Examples of these contributions might include:

- Art and Design: Visual presentation of electronic resources, computer animation, simulations and modelling
- Business: Management of technology–based enterprises, electronic marketing techniques, organizational design in high–tech environments
- Computing Science: Information management techniques, computer architecture, smart technologies, computer security, telecommunications management.
- Drama: Theatre technology
- Education: Instructional design for electronic media, for adult and child learners, evaluative techniques for computer–based learning
- Humanities and Social Sciences: Economic, political and social effects of technology on society and individuals
- Law: electronic copyrights and licensing, contracts and commercial arrangements, "cyber" criminal law, international law and the information industry
- Library Sciences: Management of information resources in the information age
- Medicine: Specialized applications of technology in medicine such as diagnostic techniques, and medical research
- Physical Sciences: Technology applications and information management needs in specific fields, such as earth sciences

Obviously, this list is not exhaustive, but it does indicate the variety and applicability of available or adaptable course work to this industry. The student could take a specified number of courses from

a range of core offerings, and by selecting a specified number of options from any of the participating disciplines, produce a truly individualized program. Such a program would be distinctive. Its overall quality would flow from the quality of its individual component courses, which would need to be current with market conditions and technological changes. Such a degree could provide an opportunity for the University to create, test and market a unique degree which would be unequalled in the flexibility and responsiveness it would provide to students seeking careers in the information industry.

Because of the unique nature of the degree and its potential to attract students, we believe that access funding or development support should be made available to develop and test it. We strongly encourage the Administration to investigate the potential of such a degree program.

Instructional Design Training Within Doctoral Programs

Incorporation of training in instructional design for alternative delivery into all doctoral programs at the University of Alberta would add value to our degrees, enhance the skill sets of our students, and make a major contribution to the future of university education.

Research

Research opportunities will abound in an emerging model of education delivery. Investigations into the effectiveness of various techniques and combinations of delivery methods on student learning and satisfaction would strengthen the University's teaching function and make a valuable contribution to the educational community.

Preparing to Implement Technology on a Broad Scale

Strengths of the University of Alberta in preparing to implement technology on a broad scale include the extensiveness of the research base underlying its teaching, and the systems and networking infrastructure that will permit remote learning and alternative delivery. Added to this, there is considerable expertise in alternative delivery in many academic units. At the individual level, there is strength in the people who are willing to be leaders and innovators among their peers. The examples which follow only touch on the assets that we saw.

In the Faculty of Extension, there is strength in experience. Its central focus has been on meeting needs of part–time and lifelong learn-

ers and staff routinely anticipate and respond to changing learner needs . It has valuable experience in the creation and cost–recovery marketing of programs both locally and remotely. The Alternative Delivery Initiative, resident in Extension, is a major advantage for the University.

Faculties, including Education, Nursing, Engineering, and Science have significant experience in operation of field experience, cooperative, work/study and practicum programs that would be useful to others in developing programs and courses to meet individualized and remote learning needs. Faculties such as Medicine, Law and Business have experience in providing ongoing professional development programs on a part-time basis for employed professionals.

Leadership has been shown in a number of other areas. The establishment of a Masters level program in Educational Technology, distance degree programs by the Faculties of Engineering and Nursing, a new degree in Theatre Technology—the only one of its kind in Canada—and of Executive MBA and multidisciplinary degrees by the Faculty of Business are examples of responsiveness to learner needs and alternative delivery in action.

The Division of Technology in Education and the Canadian Centre for Development of Instructional Computing, both based in the Faculty of Education, have accumulated equipment, facilities and expertise in the effectiveness of individual media for learning, and in production of learning materials in many formats, including computerized multimedia and broadcast technologies. Their expertise is already being shared among the campus community.

University Teaching Services has facilitated learning opportunities in alternative delivery techniques, and has expertise in creating training modules and obtaining training services. University Libraries, a leader in Canada, has developed access to an extensive virtual library system and continues to work on connectivity to other libraries. Both the Libraries and the Academic Support Centre provide training for students and staff in use of online resources.

Technical staff and faculty members are valuable resources who can share skills, demonstrate successful ventures and encourage participation by colleagues. Creativity and ingenuity at this level have produced applications such as Dr. John Martin's AMTEC award–winning simulation models (Chemistry), Dr. Edo Nyland's electronic course notes (Physics), Dr. Dorian Smith's spectacular Geology CD–ROM software, Dr. Mark Green's pairing of computer science

classes between Canada and Japan(Computing Science), and Dr. Wesley Cooper's MUDs and MOOs (Philosophy). These are only a few examples, but they demonstrate a breadth of experience that is both inspiring and exciting.

The University has a range of strengths, including staff and infrastructure that can work effectively together to achieve organizational goals. It remains for senior management to provide the overall vision and strategic directions that need to be taken. With those clearly in mind, organizational units and services can be empowered to maximize progress toward stated goals and objectives.

Appendix I List of Respondents

Mr. Wilfred A. Allan, Director, Alberta International
Dr. Terry Anderson, Alternative Delivery Specialist, Faculty of Extension
Ms. Janine Andrews, Director, Museums and Collections Services
Dr. W.A. Armstrong, Professor, Department of Computing Science
Mr. David Barnet, Chair, Department of Drama
Mr. A.W. (Tony) Bates, Executive Director Strategic Planning, Research and Information Technology, The Open Learning Agency
Mr. Terry Butler, CALL Humanities Computing Coordinator, Faculty of Arts
Dr. Linda Cocchiarella, Director, Occupational Medicine Research, Public Health Sciences
Dr. Wes Cooper, Professor, Department of Philosophy
Mr. R. Grant Crawford, Manager, Workstations & Distributed Computing, CNS
Dr. Marion Croft, President, Centre for Continuing Education, Laurentian University
Dr. Carl Cuneo, Program Co–leader, Technology–based Learning Network Canada
Dr. J.D. Dale, Professor, Department of Mechanical Engineering
Dr. C. Descheneau, Professor, Department of Computing Science
Dr. James Downey, President, University of Waterloo
Mr Will English, Director, Computing and Network Services
Dr. B.W. Fisher, CLINT UAH Coordinator, University of Alberta Clinical Informatics Network Project
Dr. Roderick Fraser, President, University of Alberta
Dr. Mark Freeman, Associate Professor, Department of Physics
Dr. Brian Gaines, Co–leader, Technology Based Learning Network Canada, c/o Knowledge Science Institute, University of Calgary
Ms. Galia Gil, Undergraduate Student
Mr. Gavin Godby, Programmer Analyst, Department of Agricultural, Food and Nutritional Science
Dr. R.G. Goebel, Professor, Department of Computing Science
Dr. Mark W. Green, Professor, Department of Computing Science
Dr. Gary Griffin, Director, Teaching Resources & Continuing Education, University of Waterloo
Mr. Phil Haswell, Student Advisor, Department of Electrical Engineering
Dr. Margaret Haughey, Director, Education Policy Studies, Faculty of Education
Dr. Patricia Hayes, Acting Associate Dean, Faculty of Nursing

Mr. Brad Hestbak, Supervisor, Graphic Design Services, Technical Resource Group
Dr. John Hoddinott, Professor, Department of Biological Sciences
Dr. Kyril T. Holden, Chair, Department of Slavic & East European Studies
Dr. D.P. Hube, Associate Chair, Department of Physics
Dr. Helen Ilott, Associate Dean, Undergraduate Student Services, Faculty of Education
Mr. Ernie Ingles, Chief Librarian and Director of Libraries, University of Alberta
Mr. Hal Jackson, Account Executive, AGT
Dr. David Johnston, Chair, Information Highway Advisory Council (Canada)
Ms. Dale Karpluk, Principal, Jasper Junior/Senior High School, and Senate member
Mr. Kyle Kasawski, VP External (1994–95), University of Alberta Students' Union
Dr. John Kennelly, Professor, Department of Agricultural, Food and Nutritional Science
Mr. Frank Koelsch, Senior Vice President, The Transition Group Inc.
Ms. Pat Larson, Co–chair, Alberta–North, Alberta Advanced Education and Career Development
Dr. Jeremy Leonard, Chair, Department of Agricultural, Food and Nutritional Science Teaching and Learning Committee
Mr. Marko Mah, Undergraduate Student
Ms. Georgia Makowski, Marketing and Account Manager, Health Knowledge Network, John W. Scott Health Sciences Library
Ms. Mary Marshall–Gardiner, Industry Canada (Schoolnet)
Dr. Ian Martin, Chair, Department of Pharmacology
Dr. John Martin, Professor, Department of Chemistry
Dr. Ann McDougall, President, Association of Academic Staff: University of Alberta
Dr. Gordon McIntosh, Assistant Dean, Field Experiences, Undergraduate Student Services, Faculty of Education
Dr. B.K. Mitchell, Professor, Department of Biological Sciences
Ms. Lori Morinville, Administrative Officer, Confederation of Alberta Faculty Associations
Mr. Tony Myers, Director, Office of Public Affairs
Mr. Jason Nyez, Undergraduate Student
Dr. Edo Nyland, Professor, Department of Physics
Dr. M. Tamer Özsu, Acting Chair, Department of Computing Science

Dr. Lucille Pacey, Vice–President, Education and Television, The Open Learning Agency
Mr. Roger Pederson, Director, Research & Development, AGT
Ms. Susan Peirce, Director, University of Alberta Alumni Association
Dr. Andrew Penn, Head, Synapse Publishing Project, Assistant Professor of Neurology
Mr. Brent Poohkay, CAI Specialist, Faculty of Law
Dr. Glen Rainbird, President & CEO, Telecommunications Research Laboratories
Dr. Bernard Rochet, Director, Language Resource Centre, Faculty of Arts
Mr. Ed Rodgers, Programmer Analyst, Faculty of Rehabilitation Medicine
Ms. Bente Roed, Director, University Teaching Services
Ms. Vera Sanger, Manager, Research Projects, AGT
Dr. Rodney E. Schneck, Dean, Faculty of Business
Dr. Ralph L. Shienbein, Director, Planning Services, Elk Island Public Schools
Mr. Brian Silzer, Associate Vice–President and Registrar
Mr. Ian Simpson, Manager, Network Services, Computing and Network Services
Dr. Robert C. Sinclair, Professor, Department of Art & Design
Mr. Terry Singleton, Lab Supervisor, Department of Physics
Mr. Adrian Smith, Programmer Analyst, Department of Family Medicine
Dr. Bill Sproule, Associate Professor, Department of Civil Engineering
Dr. R. Stinson, Director, Medical Laboratory Science, Department of Laboratory Medicine and Pathology
Mr. Keith Switzer, Manager, Data & Networks, CNS
Dr. Frances Swyripa, Assistant Professor, Department of History and Classics
Dr. Michael Szabo, Professor, Department of Educational Psychology
Mr. John Travers, Alberta Education
Ms. Marion Vosahlo, Director, Office of Services for Students with Disabilities
Dr. Anil H. Walji, Associate Dean, Undergraduate Medical Education, Faculty of Medicine
Dr. Nicholas Wickenden, Professor, Department of History and Classics
Dr. Marilynn J. Wood, Dean and Professor, Faculty of Nursing

Appendix II Overview of Campus Computing and Networks

Campus Computing Recent History and Growth

1984 There were few personal computers on campus

1989 There were only four Local Area Networks and no Internet connections on campus. A first proposal for an FDDI Network was rejected; the need for it was not apparent.

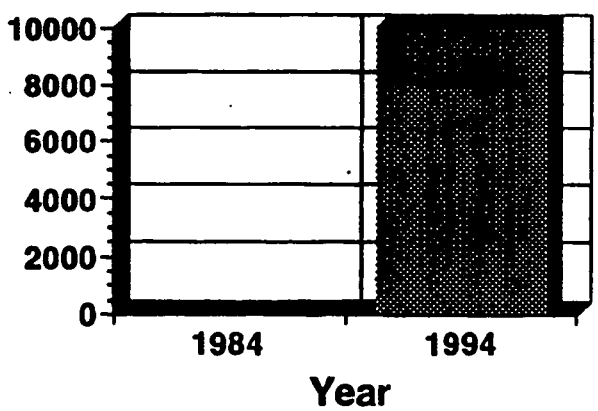
1991 A second FDDI proposal was backed by high end researchers, the departments of Computing Science, Electrical Engineering, BioChemistry and CNS. Funding was made available largely by transferring CNS operating funds to capital acquisition.

1992 Funding of $2.8 million was approved by the Board of Governors.

1994 The project was completed in December, for a total expenditure of $1.5 million. The design merited international recognition and was completed on time and under budget. There were an estimated 10,000 personal computers in use at the University.

1995 High speed networking to the IBM SP2 is now on order. Work continues on providing high speed, high volume connections to provincial, regional and national network infrastructures. Growth of Local Area Networks (LANs) on campus has shifted demand for infrastructure development from inter–office connectivity to providing access from off campus to the University's systems.

Campus Growth in Computing: PCs on Campus



Source: Computing and Network Services

A Distributed Computing Environment

The University's computing environment is a distributed processing environment. Instead of computing power being concentrated on a mainframe computer, it is spread across specialized systems which perform specific tasks. Some processing services are provided centrally, in cases where the information to be processed is used enterprise–wide. Other applications are processed locally on departmental computers or at individual desktop workstations. The University operates on a Client/Server architecture. Typically, an individual using a computer (a client) will retrieve information that is resident on a remote system (a server), process it or use it in some way, and then may or may not transmit revised data back to the remote system. Any computer in this environment can be a client, a server, or both; the machine on which the information resides is known as the "server", and the requesting system is the "client".

Client/server computing is the most common framework for distributed computing. Design of the overall framework is a collaborative effort between users, who must decide where (on which 'host') a function will be performed, and which services will be provided locally, and technical staff, who are responsible for procurement, installation and maintenance of servers, networks and the interoperability of system components. Underlying the development of this framework is the University's FDDI backbone which provides campus, provincial, national, and international connectivity to high speed, high volume networks.

Fibre Distributed Digital Interface (FDDI) Fibre Optic Backbone

Features

- 6 km of 24-strand multimode fibre, with 8 entry points, FDDI concentrators and routers located in the General Services machine rooms
- connects the University to CA*Net, ARNet, WURCnet and Internet
- provides network services including Netnews, electronic mail, Campus Wide Information (CWIS), FTP (File Transfer Protocol), Telnet, GATE (University Libraries) and UNIX/Lynx connections
- connects 30 PC, MAC, and UNIX computing laboratories containing 750 machines
- connects approximately 200 departments in 40 buildings—representing approximately 5,000 workstations

Advantages to the University Arising From the FDDI Network

- Permits network access for all buildings on the campus utility corridors
- Provides access for a majority of people on campus to participate in a client/server, distributed computing environment
- Enables the University to participate in the Western Canadian high speed test bed (ATM network)
- Enables the University to participate in a distance education pilot project which allows high speed, high quality transmission of lectures to a 300–seat theatre (Physics 126) on the ATM test bed
- Will allow redevelopment of the University's IMS–based applications into the relational environment of today
- Allows University Libraries to operate a Cdplus server from their facilities, with performance equal to that of a dedicated server.

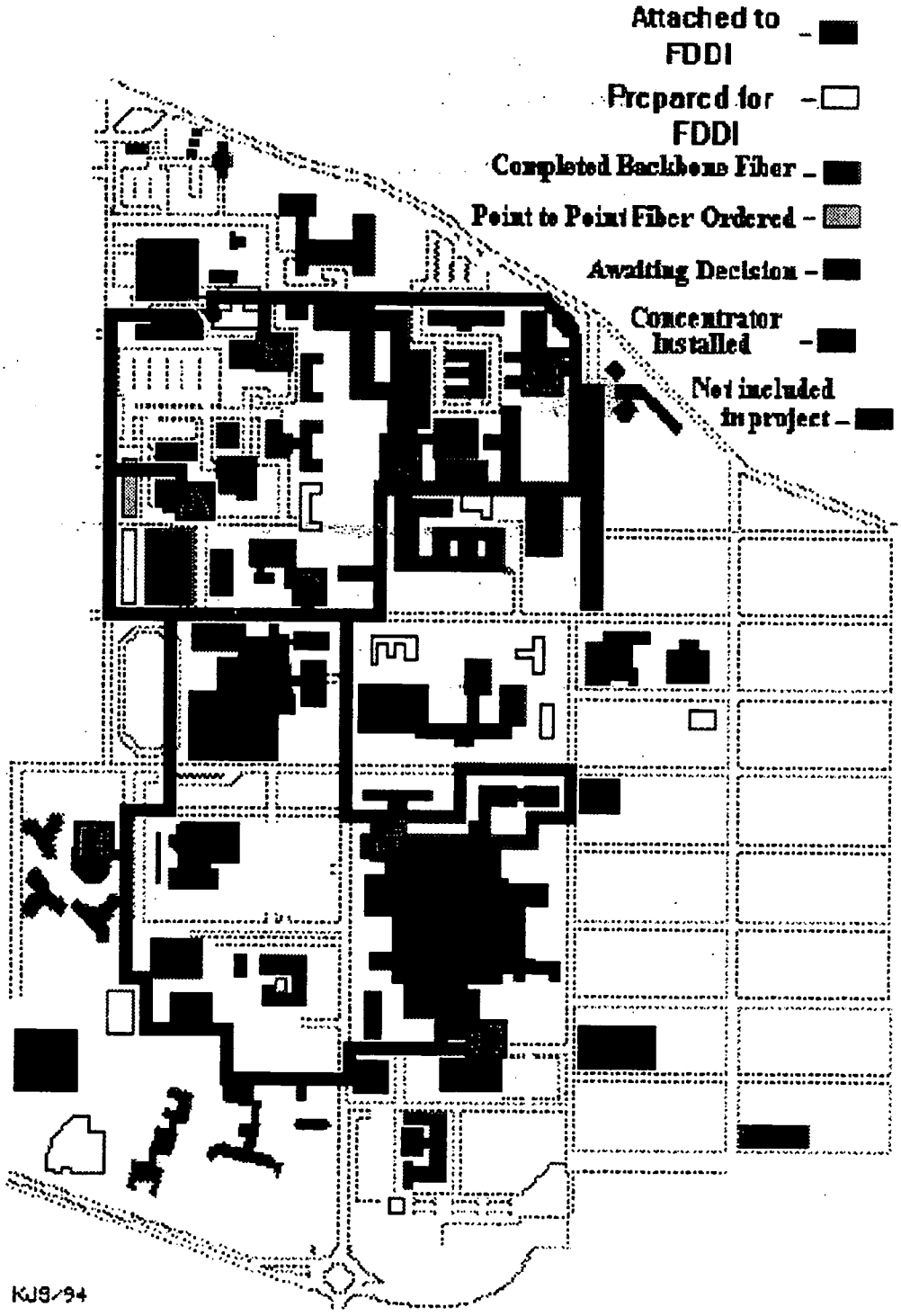
Computing Labs

There are 30 computer labs on campus, housing approximately 750 workstations. About $1 million per year is allocated to lab development and upgrading in four categories: new labs; major upgrade and replacement; minor upgrade; and "seed".

Strategic development of computer labs is the responsibility of the Instructional Computing Lab Committee, a subcommittee of the University Computing Advisory Group, reporting to the Vice–President (Finance and Administration). This group currently comprises four faculty members, one Students' Union representative, and two CNS staff members. The group is responsible for developing strategic plans, setting priorities for both specialized (discipline–specific) and general access labs. They also set policy for block–booking lab facilities.

A number of specialized lab facilities in various faculties provide unique services. In the Faculty of Arts, specialized labs assist students in design, graphics, music, digitized image retrieval and language acquisition. In Rehabilitation Medicine, therapists learn to use computer devices to assist disabled persons in becoming more self–reliant, and in cases of the severely disabled, to communicate with others through electronic devices. Computer–assisted learning labs also exist in the Faculties of Engineering and Education and are being considered by a number of other faculties.

UofA Fiber BackBone Progress to: December 21, 1994



Networked Classrooms

There are two interactive videoconference classrooms on the campus, each linked to a similar site in Calgary, and they can be linked by a minimum of two telephone lines to any similarly equipped site in the world. A third video–linked, 300–seat lecture theatre is equipped for one–way video transmission and two way audio transmission. Each classroom is linked to the FDDI backbone and to the Internet and can integrate a variety of audio and visual inputs from taped, live and computer sources. Plans are being made to upgrade linkages to multiple sites. A number of other classrooms on campus also have FDDI connections to the Internet.

Online services

- User accounts with CNS. According to Computing and Network Services staff, about 4,000 computer accounts were in use on campus in September, 1994. By May of 1995, about 15,000 were active. In September, 1995, all students (approximately 24,000 full–time) will be issued accounts. If all faculty and staff had email accounts, approximately 35,000 people would need to be served. This does not take into account any increases in part time and remote learners. The Task Force heard conflicting opinions about whether the central servers (computers) can cope with the volume of traffic that this will generate.

- Library services. The University of Alberta Library's network leadership and participation allow members of the campus community to access government information, library catalogues, holdings of partner libraries, and electronic discussion groups. Catalogues and periodicals databases are held locally and remotely. The Library is installing a multimedia computer laboratory to enable students to access information in audio and video formats in addition to text. Currently, the university has online search capabilities to all holdings, and particular applications and search engines are being developed for specific data bases and holdings (e.g. the Health Knowledge Network.). Access to library resources is provided to the public at no charge through Edmonton FreeNet, of which the University of Alberta Libraries was a founding member.

- Registration and student information. Voice response technology currently permits telephone registration, advice on admissions status, access to grades and other information, and the Office of

the Registrar participated in a pilot project this year to provide online registration from Alberta high schools. Major upgrades to the Student Information System are now in process to incorporate electronic registration and electronic gradebooks for instructors. These will come on stream for the 95/96 academic year.

- News and information services, and online help. The University recently created home pages on the World Wide Web (a subset of the Internet) to provide information about the University generally, and about administrative offices in particular. Many departments, faculties, professors and students are developing their own World Wide Web home pages, providing accessibility to computer users. CNS also uses bulletin boards and electronic help desk services to provide students and faculty with advice and updates on services. Bulletin boards and news services are coming into more frequent use and are being tested as a means of increasing student interaction in several courses.

Access to Computing Services From Off Campus

Modem speed	Lines available from 4:00 am through 6:00 pm	Lines available from 6:00 pm through 4:00 am
2400 baud	56 lines*	56 lines*
9600 baud	19 lines	19 lines
28800 baud	73 lines	73 lines*
		87 swing lines
Total	148 lines	235 lines

*Reduced by 16 lines at the start of each term
Swing lines are desktop lines swung to the modem pool at night.

A Network Services Architecture

On May 10, 1995, the Task Force received a discussion document from Computing and Network Services entitled *A Network Services Architecture* which records the results of a small focus group on the current and future services and development of computing services on campus. Comment on the document is being invited from the campus community. The group identified 30 specific issues and goals, and the Task Force commends several of these which concur with information it received in the course of its own interviews and fact–finding.

Appendix III Committees relating to technology and instruction

Information Systems Implementation Group (ISIG)

A coordinating group whose mandate is to oversee the implementation of re–engineered administrative applications: student, financial, human resource, and alumni/fund development systems. Chair: Associate Vice–President Finance. Reports: Vice–President (Finance and Administration)

Telecommunications Service Initiative

The Senate is given to understand that this committee is ad hoc. The initiative will develop a needs–based vision and strategic recommendations for developing a cost–effective telecommunications services across campus. Chair: Chief Librarian and Director of Libraries. Reports to: Vice–President (Finance and Administration)

University Computing Advisory Group

The group is intended to provide a forum for academic staff, students, and administrators to discuss emerging technology, new applications, directions in computing, and other matters. May propose policy and strategies for effective provision of computing services. Advises Senior management and General Faculties Council on matters related to computing. The committee, in practice, is a medium for presentation of current technologies and review of serious problems of the user community. Chair: Vice–President (Finance and Administration)

Instructional Computing Laboratory Committee
(Subcommittee of the University Computing Advisory Group)

The committee develops strategic plans for developing, upgrading, and using graduate and undergraduate computer labs. Sets priorities and allocates $1 million annually among projects. Chair: currently, Acting Dean, Faculty of Engineering. Reports to: Vice–President (Finance and Administration)

Classroom Upgrade Committee

This committee has increasingly become involved in requests for technological retrofits to existing classrooms. Chair, Mr. Dan Pretzlaff, Physical Plant. Reports to: Vice–President (Finance and Administration)

Network Advisory Committee

The committee was formed to advise CNS on networking needs and to formulate appropriate networking plans for the campus. It coordinated the implementation of the FDDI backbone. It has also taken a coordinating role in developing electronic and network connected classrooms, but has not formulated a comprehensive plan for such developments. Meets to allocate remaining funds for campus connections to the backbone. Chair: Registrar. Reports to: Vice–President (Finance and Administration)

UA SP2 Steering Committee

This group is charged with promoting high–performance parallel computing. Its mandate includes the development of policies to foster 100 per cent utilization of all central processing (CPU) time. Chair: Dr. John Samson, Department of Physics Reports to: Vice–President (Finance and Administration)

Technology and Standards Committee

This committee was establishes and monitor computing standards, and assess strategic technology issues and opportunities for the University. Chair: Director, Technical Services. Reports to: Vice–President (Finance and Administration)

Distance Education Steering Committee

This committee, formerly known as the Alternative Delivery: Off–Campus Committee, led to the establishment of the Alternative Delivery Initiative. Since its original mandate is essentially fulfilled, it is not known whether this committee will be disbanded or its focus altered. Chair: Dean, Faculty of Extension. Reports to: Vice–President (Academic)

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4. BCE Inc. (1994). *The Shape of Communications to Come* (Annual Report).
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