The Components of Online Education

The Components of Online Education

Higher Education on the Internet

Byron Henderson

Centre for the Study of Co-operatives
University of Saskatchewan

Centre for the Study of Co-operatives
101 Diefenbaker Place
University of Saskatchewan
Saskatoon, SK, Canada S7N 5B8
Phone: (306) 966–8509
Fax: (306) 966–8517
E-mail: coop.studies@usask.ca
Website: http://coop-studies.usask.ca

Cover design by Byron Henderson
Editing, interior design, and layout by Nora Russell
Printed in Canada

CANADIAN CATALOGUING IN PUBLICATION DATA

Henderson, Byron.

The components of online education : higher education on the Internet

(Occasional papers series / Centre for the Study of Co-operatives ; 98–02)
Includes bibliographical references.
ISBN 0–88880–386–9

1. Internet (Computer network) in education. 2. Industry and education. 3. Education, Higher—Technological innovations. 4. Education, Higher—Computer-assisted instruction. I. University of Saskatchewan. Centre for the Study of Co-operatives. II. Title.

LB1044.87.H453 1998 378 C98–920216–X

Contents

Centre for the Study of Co-operatives

The Centre for the Study of Co-operatives was established in 1984 as a postsecondary teaching and research institute at the University of Saskatchewan. The Centre is supported financially by the University of Saskatchewan, major co-operatives, and the Government of Saskatchewan.

The objectives of the Centre are:

- to develop and offer university courses that provide an understanding of co-operative theory, principles, developments, structures, and legislation;
- to undertake original research into co-operatives;
- to publish co-operative research, both that of the Centre staff and of other researchers; and
- to maintain a resource centre of materials that support the Centre's teaching and research functions.

For more information on the Centre, please contact:

Centre for the Study of Co-operatives
101 Diefenbaker Place
University of Saskatchewan
Saskatoon, SK, S7N 5B8
Phone: (306) 966–8509
Fax: (306) 966–8517
E-mail: coop.studies@usask.ca
Website: http://coop-studies.usask.ca

Foreword

By Jeremy Roschelle

For better or worse, the institutions of formal education are poised for a period of radical and rapid transformation, riding successive waves of Internet innovation. The first wave of the Internet focussed on static web pages, ideal for a campus brochure. In less time than it takes from matriculation to commencement, a second wave emerged, focussed on any place–any time access to databases. This was nice for publishing the course catalogue, but hardly an educational infrastructure. And even before that wave has crested, we are now seeing a larger wave focussed on intertwined tools of virtual community, commerce, and collaboration. Many universities are seeing this wave as their future, and are planning their transformation based on distance learning, online courses, and tools for discussions and chat. Unfortunately, given the rate of evolution we are witnessing, any strategy based on the waves we can see today are bound to be short-sighted. Simply moving courses to the Web won't suffice.

In this paper, Byron Henderson looks behind the scenes at the component drivers creating the wave pattern: demographic, economic, and structural. He examines the rules of production, the kinds of leadership, and the nature of strategies that will condition success. The increasing capitalization of intellectual property, the decreasing need for physical co-presence, and the decoupling of the quality of work environment from the campus physical plant are changing all the rules. Understanding these driving forces, and not extrapolating merely from today's waves, is the best way to guide the university's future.

My own work resonates deeply with Henderson's analysis of these underlying drivers, and the direction in which they lead us. My primary project for the past five years—SimCalc—addresses the challenge of teaching much more mathematics to many more children. In the twenty-first century, it will not be enough to teach nineteenth-century mathematics more efficiently. Students will need to move beyond algebra word problems, and into mathematical understanding of complex dynamical systems, emergent behaviour, and the sciences of complexity. Further, a much broader and more diverse population of students will need these skills. Hence, SimCalc[1] is teaching the ideas of calculus starting in the middle school (i.e., junior high). Our field tests are all inner city, low socioeconomic status sites.

Calculus in the inner city, middle school—how is it possible? Clearly not by merely making the standard university course available on the Internet. Instead, SimCalc teaches the mathematics of change through a new kind of graph, in which students can directly drag the shape of piecewise functions with their mouse. Moreover, as they drag, they can see the effects of changes in velocity on a position graph, and vice versa. These graphs are linked to simulated worlds in which cartoon characters face challenges such as delivering pizzas up and down the floors of a building using a velocity-controlled elevator. They are also linked to the real world by way of motion sensors that can immediately graph the rate of a student's walk across the front of a classroom. The lesson of SimCalc is that computer technology changes not only how we deliver instruction; it also changes society's expectations for what students should learn, and requires rethinking the curriculum. What will universities teach when high-school students have mastered the concepts of calculus and the use of a computer algebra system such as Mathematica? Will today's efforts at "calculus reform" in the university course, or the ability to deliver that reformed course via the Web, really matter?

Indeed, much more than calculus is becoming possible at the middle school. The underpinnings of SimCalc lie in several decades of educational technology research, much of which has been underwritten by the US National Science Foundation. This research demonstrates the dramatic pedagogical gains that can be produced by appropriate uses of new technology. Common features of appropriate use include: (a) learning by doing; (b) broadening access to knowledge through simulation and visualization; and (c) supporting critical thinking (i.e., reflective) skills.

Learning by doing builds upon cognitive capabilities that far exceed our ability to gain knowledge by reading and listening. Computer technology enables learning by doing by providing smart tools. Students can compose music, for example, without learning the intricacies of standard music notation. Or a computer algebra system can allow students to construct a mathematical analysis of a rocket launch without as many prerequisite symbol-manipulation skills.

Simulation allows students to participate in much more complex and realistic situations of knowledge use, leading to rapid honing of skills and tuning of knowledge patterns. Computers can simulate and visualize an increasing range of phenomena, from flying a plane to the conditions that give rise to the formation of a tornado.

Supporting critical thinking skills accelerates learning by making students more aware of their own strategies and processes of learning. For example, a linked presentation of a historical event can allow students to consider it from a number of perspectives, moving from one side of the conflict to the other; or in the case of human migration, from the broad pattern to the details of a single personal experience.

In contrast to these advanced pedagogical methods, the modal university experience is still one of reading and discussing. Reading textbooks is now giving way to reading web pages. Discussing in a seminar is giving way to discussing in a chat room or threaded browser. By and large, universities have been too slow to innovate with technology in ways that connect to fundamentals of sociocognitive learning processes.

The component-based economy that lies at the heart of Henderson's analysis is likely to spur a new period of innovation, since components will lower the cost of combinatoric experimentation. Efforts such as SimCalc have been very expensive because each aspect of the software needed to be handcrafted to its purpose. Very few people had the resources and skills to assemble the software from raw lines of code. Emerging industry standards, however, such as Java, JavaBeans, and IMS metadata, are making it possible to mix and match prefabricated components to assemble a lesson-specific educational tool. For example, through the Educational Software Components of Tomorrow (ESCOT) project, which I co-lead, Stanford Research International (SRI) and its partners will create a collection of graphing, simulation, geometry, and algebra tools, notebooks, animations, etc., which can be flexibly combined to meet many of the needs of middle-school mathematics. Teachers will be able to plug and play components to form a lesson as easily as they can connect their VCR to a TV. ESCOT[2] is related to a broader effort—the Educational Object Economy[3]—which is making a huge freeware collection of Java components available in all subject areas.

Projects such as ESCOT and the EOE will also accelerate the rate of innovation by raising the level of the playing field and lowering the cost of admission. Rather than having to spend a million dollars to write a million lines of code, a teacher with a novel pedagogical approach will be able to draw upon existing parts to assemble a prototype. Components enhance the evolutionary possibilities, as the inventor of a better graphing tool, for example, can easily substitute that tool into a series of lessons without having to rewrite all the other tools involved in those lessons. Moreover, a web-based network of teachers can explore the benefits of all the combinatoric possibilities of components much more efficiently than a single organization.

Indeed, with the aid of an expanding global market-place, these projects bring to the fore a classical evolutionary paradigm of genetic variation (of educational components) and natural selection (of learning opportunities). Once component-based courseware takes centre stage, the variety of experiences that institutions can offer will rapidly diversify to include much more learning by doing, simulations and visualizations, and specific support for higher-order-learning schools. Moreover, as the SimCalc experience shows, these components will increasingly provide curriculum-specific tools for advancing learning, and the development of those tools will depend on strong disciplinary and pedagogical knowledge. As education and the Internet together enter this evolutionary phase, students will have increasing freedom to seek out the best learning environments.

One could say, in fact, that universities will prosper to the extent that they can capitalize specific disciplinary and pedagogical knowledge, by transforming intellectual property into educational components that can rapidly be assembled and customized to meet the needs and preferences of learners. The mission of this paper is to help educational leaders understand the forces of industrialization underlying this transformation.

Introduction and Summary

Higher education is not alone in the world of online learning. And the place where online learning takes place—the Internet—is not controlled by educators. Once the playground of higher education, the Internet is now the home of commerce and publishing as well as a place for research and exchange of ideas. The Internet's directions, for good or ill, will now be marked as much, or more, by economic factors, labour needs, and marketing goals than by the structures of the university.

Neither are the elements of online education production determined solely by educators. The components of online education are more than software tools. The choices to be made in producing courses for Internet delivery go beyond the simple binary options—Web/not Web; chat/no chat; discussion groups/no discussion groups—and much beyond the decision to post course outlines and reading lists in HTML form. Online education by higher education is part of a much larger whole in which the expectations, quality, communities, and content of online delivery are affected by the actions of approximately 100 million people who now make up the Internet world.

There is one core argument in this paper, linking and supported by three sets of arguments and data.* The central point is that the Internet is presently a powerful social factor, reflecting as well as leading a cultural movement towards networks and network models in theory, management, and technology. As the leading illustration and metaphor for networked structures, it has great power as both a mythic and practical force, shaping social expectations and evaluations through its increasing omnipresence. As it becomes the place where labour, entertainment, and social bonding all occur, its forms become those with which we will become most at home.

* My colleague, Murray Fulton, deserves credit for urging me to state this argument at the beginning of this paper rather than letting it go as an unstated but implicit part of the specific points made in the text. Jeremy Roschelle also made early and helpful comments and suggestions.

The core argument is highly speculative—essentially an implication—supported by data and analysis organized into three distinct sections.

Part One describes the online education industry: its demographics, its economics, and its developing structural features. Central to the discussion is a recognition that the Internet is a global, financially strong, and technically growing industry from whose all-pervasive influence online education cannot be separated. The most significant aspect of the Internet's social impact is its orientation to access at any time, from any place, to products and services that are timely, consumer-specific, and fully comparable to products and services delivered off-line, whether it be music or car deals or education.

Part One is deliberately one-sided, its conclusion seeming to suggest that higher education is doomed to follow industry online. There is no attempt here to pit the aims and strengths of education against those of the commercial Internet. That discussion is reserved for Part Three, which reviews the leadership strengths of higher education.

Part Two deals with the implication of any time/any place/highest quality/consumer-specific requirements. It points to the method and model the software industry has adopted to meet such demands: modular software "components," which can be delivered on demand, modified as needed, specified by the user, and which are just as, or more powerful than, their nonmodular forebears.

Part Three suggests that there are many features of higher education that naturally support work within the new networked structure of the Internet, and which can benefit from being reconsidered in light of the modular or component model. Balancing the weight of Part One, it shows how the traditional powers of higher education—communities of scholars, a commitment to liberating knowledge, sharing of knowledge and open deliberation, nurturing a refined understanding of complex processes or environments—are the core of its strength in online learning.

This Paper in Summary

- Higher education is becoming industrialized.
- The Internet will create the open market demand and competition for education and will effect broad changes in educational production systems.
- It is not technology driving the industrialization of higher education. It is demand.
- The Internet is a mainstream force in the world, having reached 100 million people to date.
- Online work will dominate work experience for prospective students.

- The experience of working and interacting online creates expectations (demand) for similar experience in education.
- These demands are new and cannot be met by diversion into traditional streams of classroom learning.
- Students represent 20 percent of the world's population.
- Education budgets amount to almost 10 percent of the GDP in the West.
- The production costs of online education are high—as much as $1 million per course.
- The ability of higher education to deliver online will be tested against online industry as much as against other education sectors.
- Industry is rapidly expanding into online commerce and is honing its skills and improving the quality of online delivery methods.
- The Internet is reshaping essential perceptions of where education will be delivered, its time of delivery, and the relationship between recipients and deliverers.
- The skills, production methods, and economic strength of online delivery are growing rapidly, leading to a projected $700 billion industry in less than four years.
- Bandwidth constraints on delivery methods and content are ending.
- Online products and services are delivered any time, any place, are customer-specific, and built as needed.
- Transforming education without the support of educators is an impossible task.
- Software that does not reflect and support current business processes is an impediment. An alternative is modular software components, which can be delivered over the Internet on demand and assembled as and when needed.
- Online education, designed and delivered as components, will be less expensive to produce, more easily modified and reused, and will allow custom, learner-determined content.
- In the decentralized, peer-to-peer, collaborative, and distributed environment of the Internet, higher education comes with three areas of strength: strength in community building; strength in alliance building; and strength in specialization.
- Many corporations, universities, standards organizations, and government agencies are working on ways to make components easy to build, use, and deliver over the Internet.

THE INDUSTRIALIZATION OF EDUCATION

HIGHER EDUCATION IS BECOMING INDUSTRIALIZED.[4] An essential source and resource of culture for almost a thousand years, it has been largely artisanal, its production methods and models keyed to themes of individual crafting, personalization, and the honouring of disciplinary traditions of delivery, language, style, craft, and even ornamentation.[5] Long protected against encroachment by a self-managed credential system, by state funding, and by geographically protected student markets, higher education is now finding itself on the verge of market competition at a time when the sectors of society first industrialized some two hundred years ago are encountering postindustrial forces.[6]

All of the factors that once afforded higher education a kind of tariff wall protecting local markets against competition are changing. Costs are rising, for example, for both housing and tuition; preferential funding by governments has been declining for years; high prestige and high earning potential compared to other learning systems are being eroded. Paralleling earlier periods of industrialization, tariff barriers are being identified and then removed as this new market is opened to competition. Even these changes, however, would not demand fundamental alteration of the production methods and market orientation of higher education were it not for the very new phenomenon of the broad-based Internet.

Although higher education is the first home and creator of the Internet, the corporate and home Internet will be the significant force driving the industrialization of higher education. The Internet alone can provide the global distribution system and the global marketplace that will create the demand and competition essential for broad changes to occur in education's production systems.

Higher education is awakening to the arrival of this new open market. It is becoming aware of its competitors, partners, and allies in ways never seen before. It is re-analysing its production methods, delivery standards, incentive systems, student recruitment strategies, marketing (or lack of it), asset base, and identity. Thousands of courses are now online. Many thousands are in preparation. Millions of dollars are being spent to integrate entire higher education systems online. Industrialization of higher education demands close study of all these factors and more. This paper will examine many of them, if only briefly. It is the production system of education, however, that will pose the most significant and immediate problems for online developers.

New distribution systems change just about everything: the numbers of purchasers (students); the cost of inputs (materials, supplies, physical plant, and teachers); speed of delivery; rate of renewal of production; and determinations of quality. It can be said with no exaggeration that the means of distribution often becomes the defining characteristic for a production system. Where the model involves one instructor physically present in a room holding five to five hundred students who live in the same location, production means are individual. Where the model is hundreds to many thousands of students competitively choosing from among thousands of worldwide offerings, the production model will be industrial. Academics will undoubtedly debate the desirability of this change for the next century.

In 1828, Jean-Baptiste Say had similar doubts about the technology of the age. After describing the English "steam chariots" he said, "Nevertheless…no machine will ever be able to perform what even the worst horse can—the service of carrying people and goods through the bustle and throng of a great city" (Braudel 1979, p. 539).

Industrialization in all of its forms is still being debated, yet as much as criticism has frequently been justified, the forces of industrialization have not disappeared under the barrage. In much the same way, the Internet is now a force in education that may long be debated but is unlikely to go away.

The academic world no longer controls the Internet, and in using the Internet, it cannot fully dictate its own standards of connection or assign its own production values. The quality, means, uses, and access factors surrounding the Internet are essentially out of the hands of the education community. Only the disappearance of the global Internet, or its replacement by something we cannot envisage, will change the terrain we now face.

This paper does not argue that the traditional model of individual course construction by individual educators, and classroom delivery, will or should disappear, or that its values are not worth retaining. I do assume the continued existence of the global Internet and will focus on the models of online education that are meeting online commerce on its own turf and drawing on the best of the "industrial" Internet: component methods and educational alliances.

The First Component

The Convergence of Internet and Education

There is much talk of "convergence" in the world of high technology. The most common examples are convergence of the Internet and broadcast media, or the Internet and the telecommunications industry, though it is unclear in what ways these industries or technologies are, or are thought to be, converging. Is it the technology, the business principles, the markets, the capital, or all of these? And which kinds of convergence are useful, necessary, or desirable? The term carries with it an aura of magic that industry and the media deliver on stage, but fail to explain.[7] It could be because our society is built on a culture of convergence. Perhaps we don't need to have it explained; we just "know" that it's a powerful force.

Pacey indicates that this same convergence is the notable feature of the first industrial period of the eighteenth century.

> There was…a convergence between two originally quite distinct industrial and technological movements [steam power and iron construction, applied to the factory-based textile industry] that contributed to launching both of them into a phase of accelerated expansion. It is this convergence and the consequent growth of new modes of production that more than anything else justifies the term "industrial revolution" (Pacey 1974, p. 166).

Industrialization is even a contentious term among historians. Braudel reports that during a 1970 conference on the Industrial Revolution, Jacques Bertin said, "I admit that I am still completely in the dark about what industrialization means" (Braudel 1979, p. 557).

Braudel is a highly eminent French historian and proponent of the study of the multiple, day-by-day strands that make up history: the boots without which the spade was useless in the tilling of soil, for corn introduced through the opening of trade routes necessitated by…

and on and on. Against the writer who said that history is just one damn thing after another, Braudel would amend, “many damned things all together.” If there was ever anyone to oppose the idea of convergence, it should be Braudel.

Not surprisingly, Braudel prefers a loose definition of industrialization. Where Pacey emphasizes the convergence that led to “accelerated expansion,” Braudel seems to suggest that only by the outcome—“simultaneous growth on all fronts”—can we identify the existence of the Industrial Revolution, the causes of which, for him, stretch far into the past and are all-encompassing (Braudel 1979, p. 539): “The Industrial Revolution means everything—society, economy, political structures, public opinion and the rest” (p. 557).

Notwithstanding learned head-scratching, our general understanding of industrialization seems to point to the factors noted by Pacey: factory systems, application of new technology, and new modes of production to serve expanding markets.

Expanding markets are the now-visible magnet for accelerated expansion in education. The educators’ phrase, which is the coded euphemism for this market recognition, is “life-long learning.” Only in a very limited sense, however, could the phrase embody the kind of resident learning that is the mainstay of current higher education. How many midlife careerist managers, for example, can spend a year, or even a month, in a classroom?

Life-long learning is a term that implies what was once called distance education, and what increasingly means online education. This is a market whose consumers are the population of the world at large and who are accessible through the technology of the Internet. But why is there a demand for this now? Haven’t people always wanted to learn all of their lives? Are there more of them now? Why are there more, and why now?

The short answer is that life-long learning appears to be needed to get a job, to keep a job, to get a new job. Where today’s students may expect to hold more than eight jobs in their working lives, and where the nature of those jobs is undeterminable at this time, life-long learning is not a choice, but a necessity.[8]

Industry is no different. Of the largest businesses in the US, only a handful existed in 1963. Frequent news reports tells us that industry cannot fill specialized jobs,[9] indicating that industry, too, needs life-long learning.

In this sense, it is not technology driving the industrialization of higher education. It is demand. Educators see technology as providing the distribution channel for their teaching expertise, and life-long learning is the target market. The essential point of this paper, however, is that Internet technologies determine production methods as much as they allow distribution. And both of these aspects are driven by consumer demand.

It is interesting to note Paul Bairoch as quoted by Braudel: “During the first decades of the Industrial Revolution, technology was to a much greater extent a factor governed *by* the economy than one governing the economy." Braudel continues, "Innovations were quite clearly dependent on the state of the market: they were introduced only when they met persistent demand from consumers" (Braudel 1979, p. 567).

Demand may well be the most significant force leading higher education to industrialization.

THE SECOND COMPONENT

THE SOCIAL AND ECONOMIC FORCES DRIVING CHANGE

BRAUDEL MIGHT ARGUE THAT IT IS FOLLY to identify a list of driving forces ("the Industrial Revolution means everything"), but even he was compelled to give way to analytic divisions in order to make any sense of the topic. My analytic divisions are as follows:

The Demographic Forces
The Financial Forces
The Structural Forces

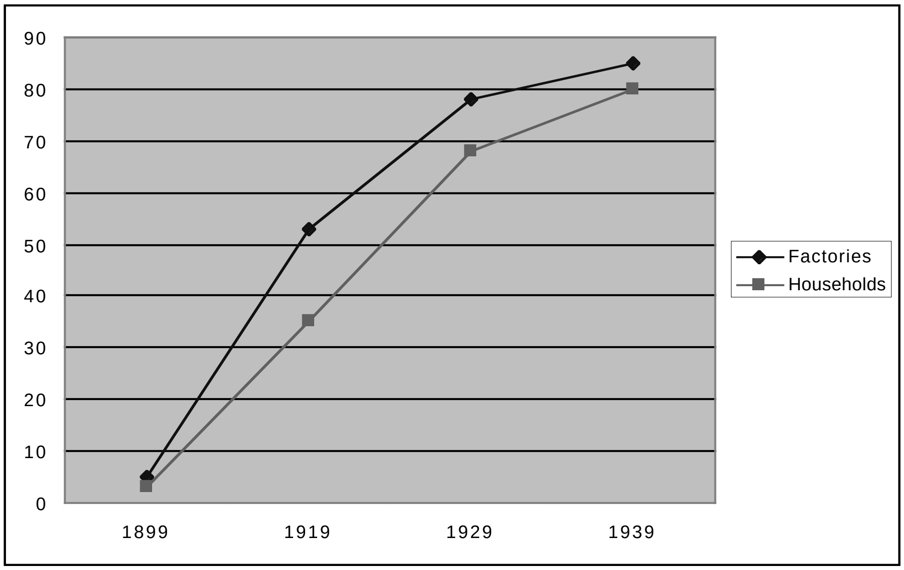
The Demographic Forces

Demand is the most important of the demographic forces drawing higher education to the Internet. In this case, it means the demand for life-long learning opportunities and the ungovernable effects that such demand will place on the creators of education.

One key aspect of demand for life-long learning is the drive for education delivered by new electronic technologies. The diffusion of technology—its speed, depth, and breadth of penetration—is an essential factor in understanding the extent of the demand on higher education. Has the technology really spread far enough, deep enough, and fast enough to be counted as a force shaping education?

The importance of demand, or a sufficient base of demand, as a driving force for change is well illustrated by the spread of electricity usage in the US. The following chart, from the US Department of Commerce study titled "The Emerging Digital Economy," shows that from a date twenty years after its inception, electricity took another forty years to reach the point of 80 percent diffusion.[10]

Figure 1. Diffusion of Electric Power in the US, 1899–1939



In the earliest years, the demand for electrical power was highly individual, and insufficient to be the cause of anything but individual—almost hobbyist—effects. There is a story of Thomas Edison that makes this point nicely. One day in the summer of 1884, Edison himself was responding to an emergency repair to the Vanderbilt house electrical system and also to a leak in New York City's delivery system (Cheny 1981, pp. 28–29). Thirty-five years later, only 35 percent of households were wired, and it took another twenty years for electricity to approach 100 percent of its potential consumers.[11]

By comparison, it took Ford only eleven years to capture a 48 percent market share (267,000 cars at the time) in competition with alternatives such as carriages (Lewis 1997, p. 38). And in roughly four years since Web browsers became available to the general public, estimated usage has gone from zero to between 50 and 100 million users.[12] Unlike the market for cars and carriages, there are no immediate market comparisons to Internet usage, but in 1996, for the first time, annual sales of computers in the US exceeded those of televisions.[13] The US Department of Commerce reports that in late 1997, 36.6 percent of all homes had computers and 18.7 percent had online access. In the three years from 1994 to 1997, e-mail access rose 317 percent, to 16.7 percent.[14] If that growth rate continues, e-mail access will reach 70 percent of American homes within two years. The only vaguely comparable radio industry took thirty years to find 60 million listeners; television halved that time to reach the same number of viewers; and it took the cable television industry fifty years to reach 70 percent of the US market.[15]

Annual doubling (as in the case of e-mail access) may be a rate that is difficult to sustain. But no matter how you scale predictions of computer ownership and online growth, the rate is unprecedented; the previous multigenerational change patterns for things such as electricity and cable television seem to have been reduced to half a generation, and in some cases, much less.

There are many aspects to an Internet demand base of such enormity. Higher education needs to develop an understanding of these and integrate them into its approach to online education. Considerations include consumer familiarity with the methods, installed base of software, installed connections, higher income, highly educated households, and so on.

The availability of Internet technology is only one aspect of demand "pull." Distance education, for example, has been working with video and television for the last thirty years, with minimal impact, notwithstanding the high degree of diffusion of television technology. The Internet may be a more flexible means of delivery than television, but there are many other forces working now to increase consumer demand for online learning.

One cluster of factors is related to education and work: the age of students in higher education; the numbers of jobs having online activity as a major component; and the increased number of jobs per career that current students may expect to have in their lifetimes.

In 1972, only 28 percent of US college and university students were over twenty-five. By 1980, the proportion of older students had risen to 34 percent. And in 1994, the last year for which statistics are available, the proportion reached 41 percent (*Forbes*, 19 June 1997). Older students tend to have prior work experience and will more often be in the workforce at the time of education, either as full-time workers and part-time students, or as part-time workers and full-time students. The university or college location is not their primary sphere of social interaction. Indeed, it will become increasingly difficult for student/workers to clearly identify any location as the setting for work.

The US Department of Transportation estimates that 15 million workers will be telecommuting in the next decade.[16] US service sector employment is approximately 100 million, soon making telecommuting the norm for 15 percent of the workforce. The numbers could be much larger.[17]

The Gartner Group, a leading technology research and consulting group, expects that 40 percent of white-collar work will be location independent by 2001. That means that *work* will no longer entail *place* of work. The figures are interesting because they subsume telecommuting, which usually has a fixed work location from which the person is connected by computer. Beyond computing from one fixed location to another is the Gartner-style worker referred to in the press as the "road warrior." Lewis relates the case of the Progressive

Insurance Company's adjusters, who work out of trucks "wired into a 24-hour computer that spits out settlements in minutes" (Lewis 1998, p. 26).

The data tells us that students are getting older, and increasingly, they are working on-line. These are important factors influencing the demand that students create for types of education. To these factors we should add the data from the US Department of Labor that "students will have eight jobs per lifetime." Educators should note these interesting shifts in demographics, which point not only to usage of computers, but also to changes in social and psychological expectations.

When church, school, family, job, shopping, and entertainment were in defined, single locations, the social and psychological expectation supported in-class schooling. When most people no longer identify any function or productive context in their lives with one physical location, then schooling that is resolutely fixed physically may well be seen as retrograde and increasingly out of touch.

Shifts in demographics and expectations are important for an analysis of demand, but they go much deeper. Or, rather, they *may* go much deeper. Educators have often in the past responded to changing social demands—more students in the sixties; more social criticism at the same time; more feminist studies in the seventies—and yet despite the considerable significance of these changes, they were not met by corresponding adjustments in the way higher education was delivered. Something more than pure demand must be at work for us to expect structural change in the way that education is produced and delivered.

Demand related to employment, comforts of life, and modes of entertainment and business have been determinative in our culture. Changes in work, the life of work, and the nature of work may well bring about deeper changes to education than the social changes of the past.

Students who in the future will increasingly divide their lives between the networked environment of work and the networked environment of school will judge the efficiency of education delivery in light of experience at work. Here is an example of what might happen.

For years the Gartner Group has produced and promoted the idea of the "total cost of networking," a collection of factors that indicates how expensive it is to provide network services—cost of computers, cost of software, cost of support, cost of network, etc. Adding all these together gives you a total cost of networking, and by implication, a cost for the *quality* of the network achieved. A low-cost network, for example, may well have clearly observable deficits in speed of access, bandwidth, or robustness. For someone whose work is dependent on the costs and efficiencies of a network, factors such as bandwidth, speed of connection, availability of connections, cost of nodes of connection, and flexibility of networked collaboration, become standard business (and perhaps, social) metrics of efficiency.

Just as the customer service model of efficiency has become a pervasive model even for government and social services, so too will network efficiency models influence education. When they do, the low bandwidth (e.g., amount of relevant data, its sources and currency) and intermittency of connection in the traditional classroom model will be questioned.

The pressures and expectations for online education are being formed not only in the workplace; they are also converging on higher education from within. In 1997, fewer than 10 percent of higher education students in the US were enrolled in online courses. Predictions place that number at 33 percent by the year 2000 (*Forbes*, July 1997), and if recent actions by community colleges are any indication, this number could well be higher. *EduPage*, the online education technology digest, recently reported that:

> The Community College Distance Learning Network is going national, complete with a media blitz paid for with $30,000 contributions from each participating college. The first ads will appear next month in Chicago and Los Angeles, targeted because of their large immigrant populations in the hope that they can attract international students to the more than 500 courses scheduled for this fall. Courses will be offered via Internet, via video-based "telecourses," or a combination of the two. Noting that this latest announcement merely underscores the heated competition for distance learning dollars among the higher education community, Jim Mingle, head of the State Higher Education Executive Officers, says, "It's Katie bar the door—everybody's in everybody's business" (*Chronicle of Higher Education*, 9 July 1998).[18]

Outside the community college system the story is the same. In 1993, *Peterson's College Guide* listed 93 "cyberschools." The 1997 *Distance Learning Guide* includes 762. More than 1 million students are now plugged into the virtual college classroom, which compares with 13 million attending as residents. Analysts predict that the number of online students will more than triple by the turn of the century (*Forbes*, 19 June 1997).[19]

If the Internet were limited to North America, that alone would be enough to bring important changes to education. But the Internet is a global phenomenon.[20] IDG, a major industry publisher (which includes on its list the ubiquitous —— *for Dummies* series of books), reports that US users of the Internet will soon be eclipsed by those of other nations:

> There are currently 60 million Internet users worldwide, of which 68 percent are in the US and Canada, a New York–based eMarketer said. Currently there are 23 million non-US users but they will number 143 million by 2002. Worldwide, the total number of Internet users will reach 228 million by 2002, according to the researcher—leaving the US with a 37 percent share of the users.…

> Internet users outside the US will grow with the deployment of higher bandwidth networks. For example, China has seen the number of Internet users jump dramatically in six months, from 500,000 at the end of 1997 to 1.17 million last month. Its fibre-optic infrastructure may give it a far superior system to the US in the next 10 to 20 years (Kathleen Ohlson, *Computer World Today,* 16 July 1998).[21]

There appears to be a pervasive demand for online education. The social and labour settings are already changing to reflect the extent of the Internet's influence on our lives. Education is just one more part of the same picture.

Summary

- Demand is the force of expectation on a supplier. In this case, the supplier is higher education and the forces of expectation all point in the direction of online learning.
- The Internet is a mainstream force in the world, having reached 100 million people.
- A major percentage of higher education's student population—white-collar workers —will be working online within five years.
- The experience of working and interacting online creates expectations (demand) for similar experience in education.
- Schools are increasingly offering online courses, and students are taking them in greater and greater numbers.
- These forces of demand are new and cannot be met by diversion into traditional streams of classroom learning. The demand will flow to those who meet the expectation, whether in higher education or industry.

The Financial Forces

Online learning is much more market-driven than traditional classroom learning. Until recently, with the insignificant exception of correspondence courses, a demand for higher education could be met only by selection of institution, not by selection of delivery method.[22] Only with online delivery is the student able to choose method of delivery first and institution second. Put another way, students now have a choice both of institution and means of delivery within that institution. One outcome will be that even students capable of becoming resident students may choose to become online students.[23] And a global market in which students are essentially unrestricted in their choices will place a much greater emphasis on competitive advantages among institutions. There are also signs that the online education market is now open to industry competition, unlike the brick-and-mortar institutions, whose capital and infrastructure base gave them virtual monopolies.

The following clipping from *EduPage* will throw some light on industry's education system, which parallels that of higher education and is now poised as a competitor for the first time:

> Ten years ago there were about 400 corporate universities—comprehensive training institutions operated by corporations—and that number has now grown to 1,600. Several of them, such as the Arthur D. Little School in Boston, have formal degree-granting powers, and many have forged alliances with nearby colleges and universities to enable students taking their courses to receive credits that count toward external degrees. But now that cozy relationship is crumbling, as corporate universities increasingly are under pressure from their companies to become self-supporting. That puts the corporate schools in direct competition with conventional universities in the fund-raising arena. A recent survey of 100 corporate universities showed that 10% planned to be self-funded by 2000. "As the funding model changes to be more self-funded, these universities are going to brand what they are doing and use their significant resources to go to the external market. At that point they are a significant threat," says a spokeswoman at Corporate University Xchange (*Financial Times*, 18 June 1998).[24]

However, the technical *possibility* of new competition from industry in online education does not mean that it *will* happen. Industry may choose not to enter the field. The technical possibility of competition based on new equality in means of delivery would not be enough to change the nature of the higher education landscape were it not for the massing of key financial forces. The most important of these is the size of the education market now opened to online competition.

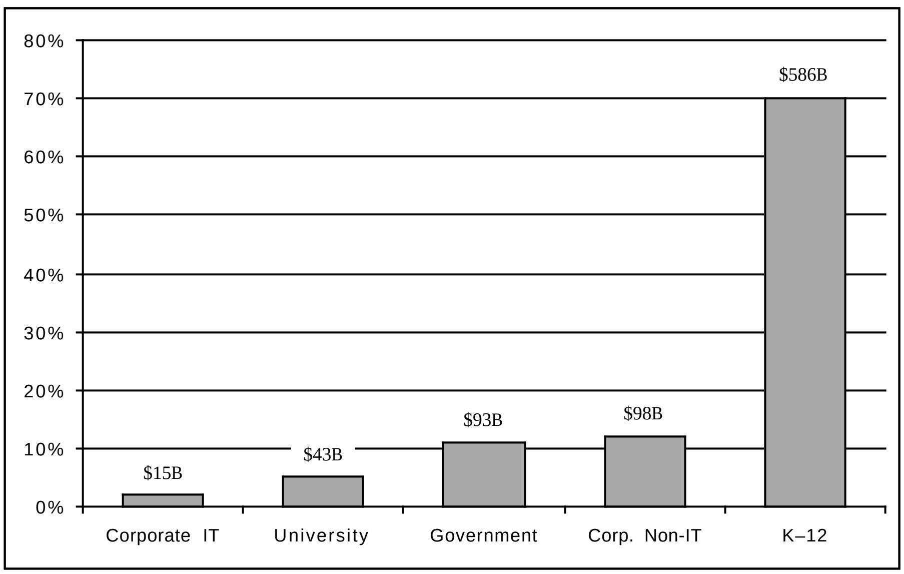
In the US, the amount of public money spent annually on all levels of education exceeds $500 billion. Canada's education bill—more than $50 billion a year—represents a larger percentage of GDP than that in the US. Interestingly, the estimated expenditures on corporate learning and training in the US are roughly equal to those for all public national education in Canada—$50 billion annually.[25] These noncorporate figures indicate public expenditures. If you add the money spent directly by students on tuition to both public and private institutions, the total annual market in Canada and the US may reach or exceed 10 percent of each country's GDP.[26]

A White Paper produced by Oracle Corporation notes:

> The corporate IT education market is only 2% of the worldwide education market. The total education market, including K–12, corporate non-IT, government, and universities, is enormous. If only 1 percent of this market is automated, it will be an $8 billion market.[27]

The following graph, from Oracle, illustrates the enormity they find so appealing.

Figure 2: 1995 Worldwide Education Market (US$835 billion)



Source: *Training Magazine*, 1995; IDC, 1996; QED, 1994; US Statistical Abstracts, 1995.

It might be argued that these large sums are not completely subject to competitive pressure and reallocation to online delivery, corporate or academic. The bulk of these budgets is spent on institutional salaries. Can these really be subject to competition? Oracle hopes for only 1 percent. Can larger percentages be expected? Perhaps not quickly, but consider only the simple question of what happens to an institution that over time loses 20 or 30 or 40 percent of its students to universities and colleges in the rest of the world, or to corporate providers. State budgets can be redeployed, and is it not likely that budgets will be redeployed to those institutions that prove themselves successful in attracting students?

Competition for students and tuition funds is not the end of the lure of the massive education budgets. Production of online courses is itself a new arena for competition. While there are wide variations in the quality of classroom teaching, these are nothing compared to those now opened by online production. Multimedia quality, currency of data used to update courses, peer-to-peer and student-teacher interaction, intelligent software agents, and testing, all exist in a vast array of technical forms, each with a cost attached. In the area of multimedia alone, creators of online courses plan for production costs in the range of $15,000 to $35,000 per course hour, with usual costs in the upper range and targets in the lower achievable only through drastic reductions in quality.[28] As a rule of thumb, these figures work out to approximately $1 million per course.

Faculty producing online education will be startled by these figures. "My courses don't cost near that amount," they will say. But apart from the need to compare similar kinds of multimedia delivery, the major costs of online education are now hidden. In higher education, these costs are now met through reallocation of faculty time to online production (effectively a reallocation of current salary costs). This pattern is increasingly unsustainable. First, online delivery requires a structure of support staff not present in most institutions. Second, reallocations of time can only poorly deal with the complexities and time-lines necessary for online production. Judith V. Boettcher and Rita-Marie Conrad of Florida State University give a useful summary of the requirements in a paper posted on Microsoft's website:

> For a formal launching of a distance learning program, a lead time of about 18 months is needed. Offering a course in this mode requires developing and requesting supplemental budgets; selecting the sites for any "residency" activities; hiring any additional personnel resources for preparing copies, digital or print, of course materials; getting approvals through curriculum committees; and for marketing of the program.… A development team for an asynchronous distance learning course usually consists of a project manager, faculty content experts, an instructional designer, the Webmaster, a content researcher, and a graphic designer. Personnel for assistance in the marketing, administration, and delivery of the course are also needed. This may also include support for handling copyright issues, student support, and other program support.… Generally speaking, a minimum of one year is required for the redesign of a three-credit course. If a course is to be totally asynchronous and packaged, a development time of 18–36 months is not unusual.[29]

While all, or most, of these skills, activities, and technologies are new and nonmainstream for educators, they are very much the opposite for businesses. Web-based business, with its need for data technologists, rapid renewal, consumer awareness, and high production value, is more and more suited to transfer its skills to educational endeavours. Later sections of this paper will detail the early signs of this movement.

Before we turn to the internal financial forces drawing universities and community colleges to online delivery, there is one last external factor that bears noting. As students find themselves increasingly online in jobs, in school, in entertainment, and as consumers, the line between education and the market blurs. And as industry enters the education sector as a primary provider, or in alliances with primary providers, it is inevitable that the distinctions will blur even more.

Students are a market in all senses. The US Department of Education reports that 20 percent of the world's population are students. In the US alone, the higher education market includes 13 million students in full-time attendance (*Forbes,* 19 June 1997). Better, faster, cheaper access to this market through the channel of online courses will be a financial carrot too hard to pass up for both industry and universities who have not begun to capitalize on their access to student markets (the brouhaha over contracts tying one cola brand or another to particular universities notwithstanding). Online courses make economic tie-ins easy. Need a book for a course? Add a clicker to Amazon (the Internet bookseller). Need access to current business news for your finance class? Add a clicker to free student subscriptions to *The Economist.* Are you an electrical engineering student? Learn about your prospective employer through classes offered in alliances with that very company.[30]

All of these connections pale when you consider the higher education student pool as a source of data, "free" research, sampling, market testing, online community formation, and short-term labour—once it is rendered easily accessible by online education.

Which raises the question: Is online education production at this level possible for universities and community colleges? Are they capable of delivering multimedia, online education with the production values (i.e., quality of production) that will be delivered by industry and other competitors?

From a purely financial perspective, the picture is not rosy. Not only does higher education not readily produce new revenues that can be allocated to online learning, its costs are rising for the traditional forms of classroom delivery to which it is already committed.

Between 1980 and 1990, college and university enrolment increased 24 percent in the United States, but the cost of that traditional education rose three times faster. Adjusted for inflation, the average cost of educating a student for a year at an institution of higher learning increased from $5,000 to $11,000 in the same period. And while enrolments and tuitions have risen, some two hundred college campuses closed for good—twice the number that ended operations during the decade before (*Forbes,* 19 June 1997, July 1997). Whether online education improves this picture or makes it worse is yet to be seen.

So, while online education is an attractive goal for universities, its production costs, staffing needs, budget reallocations, and potential impact on existing systems and methods make most educators cautious.

Summary

- Online education is highly demand driven, and that demand is recognized by both higher education and industry.
- Students represent 20 percent of the world's population and education budgets amount to almost 10 percent of the GDP in the West when public, private, and industrial education revenue streams are combined.
- The production costs of online education are high—as much as $1 million per course.
- The ability of higher education to deliver online education with high production values is limited by existing budgets, increasing costs of higher education, and lack of contact with the leading edge of online production.
- Industry is rapidly expanding into online commerce and is honing its skills and improving the quality of online delivery methods.

The Structural Forces

The previous two sections identified two basic points: the shape of online education will be strongly determined by the forces of demand and the standards of production in the Internet at large; and business is being drawn into online education at the same time as higher education faces escalating production costs and tight budgets.

These arguments fall short of dealing with an important issue. It may well be that online education is *attractive* to business, but just how *capable* is business of adapting to online education? And just how influential will general Internet models be on the style and production methods of online education? Put another way, if the Internet is a passing fad, or a costly by-way for industry, then the business-driven Internet will be of little consequence for educators.

There are other questions that run deeper than issues of demand and expectation: Is the Internet reshaping essential perceptions of where education will be delivered, its time of delivery, and the relationship between recipients and deliverers? These issues question whether the structural forces underlying the Internet are deep enough to affect education, and whether the social expectations (demands) it brings about are basic enough to cause educators to take notice.

Even a short year ago, the power of university online production was significant compared to industry. That might be changing. The power and penetration of the Internet in industry is only now becoming apparent, in its third year of real existence in that world. Until very recently, "experts" could still be heard to comment that "no one has made money on the Web." But industry's ability to link commerce with online access has matured. The US Department of Commerce reports these findings:

- Fewer than 40 million people around the world were connected to the Internet during 1996. By the end of 1997, more than 100 million people were using the Internet.
- As of December 1996, about 627,000 Internet domain names had been registered. By the end of 1997, the number of domain names had more than doubled, reaching 1.5 million.
- Traffic on the Internet has been doubling every 100 days.
- Cisco Systems, a major network company, closed 1996 having booked just over $100 million in sales on the Internet. By the end of 1997, its Internet sales were running at a $3.2 billion annual rate.
- In 1996, Amazon.com, the first Internet bookstore, recorded sales of less than $16 million. In 1997, it sold $148 million worth of books to Internet customers. One of the nation's largest book retailers, Barnes and Noble, launched its own online bookstore in 1997 to compete with Amazon for this rapidly growing online market.
- In January 1997, Dell Computers was selling less than $1 million worth of computers per day on the Internet. The company reported reaching daily sales of $6 million several times during the December 1997 holiday period.
- Auto-by-Tel, a Web-based automotive market-place, processed a total of 345,000 purchase requests for autos through its website in 1996, for $1.8 billion in auto sales. As of the end of November 1997, the website was generating $500 million a month in sales ($6 billion annually) and processing more than 100,000 purchase requests each month.[31]

Business Week's annual report on information technology tracked many of the same examples as did the Department of Commerce. In June 1998, the magazine reported:

- Cisco Systems is booking $11 million in orders per day on its website. Cisco calculates that it saved $363 million in tech support, distribution, and marketing costs in the last year using the Web.
- Amazon.com is projecting sales of $400 million this year.
- Dell Computers is now posting daily online sales of $5 million.

- The online trade journals reported in July 1998 that sales of cars online had reached 200,000 in the prior month (*Business Week*, 22 June 1998).

The numbers quoted from the Department of Commerce and *Business Week* for individual companies could be an aberration based on a selection of particularly successful businesses. They aren't.

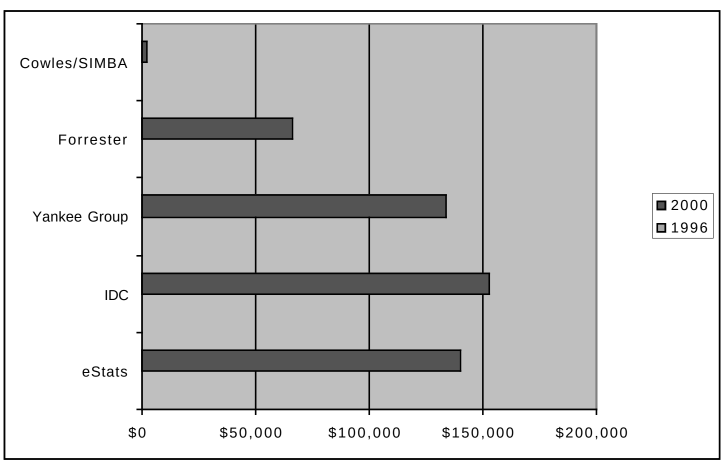
There are two segments in the Internet commerce market-place: consumer sales and business-to-business sales. A look at some sector numbers tells the same story as shown by the selected Commerce examples.

Figure 3: Comparison of Online Consumer Revenue Projections, in Millions, by leading Internet Research Companies

Year	e-land	Forrester	Multi-Media Research Group	Jupiter	Cowles/SIMBA	IDC
1995	$450	na	$350	na	$614	$1,000
1996	$750	$518	$520	$575	$993	na
1997	$1,500	$1,138	$850	$1,250	na	na
1998	$3,700	$2,371	na	na	na	na
1999	$6,100	$3,990	na	na	na	na
2000	$10,000	$6,579	$6,500	$7,300	$4,270	$117,000

Source: eStats

Figure 4: Business-to-Business e-commerce Projections, in Millions (1996–2000)



Figures for 1996, almost too small to register on the graph, are as follows (in millions):

Cowles/SIMBA:	$569
Forrester:	$600
Yankee Group:	$125
IDC:	$210
eStats:	$500

Notwithstanding the numbers in Figure 4, *Business Week* reports Forrester Research as predicting that business-to-business e-commerce will top $327 billion by 2002. *Business Week*'s own figure for consumer e-commerce is a similar $349 billion by 2002, for a net domestic economic gain of $10–$20 billion. (Net gain refers to the fact that most online commerce will be a transfer of commerce that previously took place off-line.)

The skills, production methods, and economic strength of industrial online delivery are clearly growing rapidly, fertilized by the billions of dollars that the online commerce market now represents. Tuned to billion-dollar revenues, the increasing production values of online technology will put further pressure on higher education's limited funding.

Many billions of dollars are currently being invested in online production, but that does not tell the full story of how production values are changing. After all, if the basic capacity of the online system is limited, then all the money industry can throw at it will not change its maximum capabilities. In the 1930s, for example, no amount of money invested would have allowed radio stations to deliver high fidelity music to listeners. The technical capacity of the radio system was the limiting barrier. Similarly, the Internet has, until recently, placed a technical barrier on quality—a barrier that could not be removed merely with money. The technical barrier was bandwidth, or the amount of data that could be transferred in a second. Bandwidth is generally referred to as a "speed" factor (e.g., one megabit per second), but is really a function of the volume of data for a given time-period. Using the common plumbing metaphor, you could say that higher bandwidth is like a larger pipe capable of delivering more liquid each second.

In the ancient past of the Web—two or three years ago—bandwidth was a problem. Slow modems, slow telephone lines, and "slow" computers (in the dark days of sub-100Mhz processors) limited online production values to carefully selected images and lots of text. In that circumstance, big-budget, online producers had no particular advantage in online education. Bandwidth is, or soon will be, less of a problem. The Gartner Group, looking at office needs for remote bandwidth, reported the following:

> Emerging high-speed connection technologies and services based on ADSL and cable modems are poised to offer upstream connection speeds from 128 Kbps to 768 Kbps and downstream connection speeds from 1.55 Mbps to 36 Mbps. Thus, users migrating to "high-speed" remote status with applications originally designed to be used in an office LAN will notice a degradation in network performance, but the difference may be small enough that these users can work productively without major modifications to applications and workstations. (J. Girard, "Online Remote Bandwidth: Feast, Famine and Compromise," 29 May 1998).[32]

The speeds quoted are approximately equal to those now available within university internal networks.

While North America has been the first home of high-speed access, and intercontinental speeds have been limited by old telephone cable infrastructure, two major world fibre-optics projects are changing that. The most recent and aggressive, called Project Oxygen,[33] promises to change not only Internet access, but also the way telephone service is managed globally.

> In three years the carrier business will be significantly different. Phone calls will be charged on a fixed monthly price from any country in the world, and we will see a video-based Internet with 10,000 channels to choose from (*EETimes*, 18 May 1998, issue 1007).[34]

Project Oxygen is now funded, and the plan is for a "first phase to be operational by 2000," with a mainly "undersea cable [that] would extend 275,000 kilometers and transmit data at a minimum of 100 Gbit/second, with speeds eventually reaching 1 terabit/second" (*EETimes*, 1 December 1997, issue 983). Current university internal connections run at just over one megabit per second. A gigabit per second is 1,000 times faster and a terabit is 1,000 times faster again.

Data speeds deal with the flow of data on the Internet. But what is all this speed used for in education, and how will increased speeds affect online education?

Speed on the Internet buys immediacy and currency, translating directly into immediacy of experience and indirectly into currency of information.

Education is an experience of learning in a defined context. The types of educational experience lie on a continuum from solitary reading to active immersion in a practical environment led by a teacher and supported by a community of learners. Classroom learning sits somewhere in the middle of the spectrum. Correspondence learning sits somewhere near individual book learning—perhaps lower than self-directed book learning for many people who would give special weight to the greater freedom to explore inherent in unstructured learning. Online learning can exist anywhere along the continuum. To a large degree, where it sits is a function of band-width. If bandwidth, or speed, is poor, then online learning will look a lot like correspondence school: lots of text, linear delivery organized around course outlines and reading lists, linear exams, and little contact with instructors. If bandwidth is greater, online learning can reach and exceed classroom immediacy: active video links, multiparty teleconferencing, multiparty simulations (e.g., in chemistry or physics), collaborative research and writing, testing that involves immersive simulations, and collaborative projects.

If learners can choose from a full spectrum of learning contexts, will they choose online learning? Will they choose it even if the experience provides a less socially meaningful setting than resident learning? Will they choose it if it is more expensive? There is little information to help us answer these questions. After all, there have been very few alternatives to resident learning. Those that have existed have been limited offerings: nondegree programs, post-graduate training programs, and the like.[35]

We are not totally in the dark, however, as other social sectors have been facing these very issues for years. Educators today are well aware that they do not exist in isolation from their social and economic setting, and that the forces on education are the same as those on banking or advertising or car manufacturing. Lessons from those industries are a useful pointer in our society's increasing emphasis on common technologies and around intangible products—of which education is one among many.

In his 1987 study of industry in the (then) early years of the information economy, Harvard's Stan Davis said:

> Resources are generally finite, but information is infinite, and the greatest value-added in today's new economy.… Information is the major fuel that provides energy for the new economy. Furthermore, knowledge is the principal product produced by this fuel (Davis 1987, p. 101).

Many industries are reshaping themselves to fit the new economic mould. Davis claims that one of the features of the new mould is the concept of "any place": "Any product that is information based, whether in the form of sound, image, words, or data, can probably be adapted to any time, any place delivery" (p. 49). Even products that do not obviously seem to fit the category are changing. Health care, for example, is becoming, in some ways, an any-place product.

> Home health care is a $14 billion-a-year service that is based on shifting the place of delivery from the producers' to the consumers' domain. In our grand-parents' time, most health care took place at home. Then, with technological advances, the locus of health care shifted to the hospital…. Medical care is coming home again (pp. 49–50).

Beyond the comparison of hospital and home care, the home pharmaceutical, herbal, and alternative medicine industries are all examples of the same phenomenon. Medical care in the doctor's office or the hospital is being overshadowed by care at the time and place of the consumer's choosing. Online pharmacies and online access by patients to lab results are available and challenge the dominance of the doctor's office.[36]

The same trajectory of home, to institution, to home again, might be applied to education. Not long ago, education was also the province of home. Even more recently, schools were fully community institutions, only one step removed from lessons at the kitchen table. In rural North America, "local school boards basically could hire whomever they wished at whatever was the going wage, for standards of training and certification were low or non-existent.… Farmers on school committees selected teachers in rather the way they would choose a hired hand or a servant to help in the house" (Tyack and Cuban 1995, p. 127).

Home schooling is on the increase now, counting approximately 1 million students in the US. Like home health care, education is becoming an any-place phenomenon. And the essence of online education is any place.[37]

The twin concept to any place is "any time," and Davis provides many examples of industry marching to the combined rhythm of these information economy concepts. ATM machines in banks, car phones, and Domino's Pizza thirty-minute delivery were in evidence in 1987. But Davis could not foretell ATM machines in gas stations or Amazon.com or buying a car over the Internet. Still, the details are not so important, and his conclusion continues to be supported by the evidence: "The practical message is that consumers are more likely to use the products they can have with them wherever they are than competing products they have to go to in order to use" (p. 53).

Any time and any place are fundamental demands and expectations. They shift control from deliverer to user, from seller to buyer, from educator to student; more significantly still, from preordained and hierarchical to unplanned and networked.

> The network is the institution of our time: an open system, a dissipative structure so richly coherent that it is in constant flux, poised for reordering, capable of endless transformation.
>
> This organic mode of social organization is more biologically adaptive, more efficient, and more "conscious" than the hierarchical structures of modern civilization. The network is plastic, flexible. In effect each member is the center of the network.
>
> Networks are co-operative, not competitive. They are true grassroots: self-generating, self-organizing, sometimes even self-destructing. They represent a process, a journey, not a frozen structure (in Davis, p. 92).

The network model will be discussed more fully in the final section of this paper.

The notion of any time infers something like timeliness, at a "chosen" time, but on its surface it says nothing about content—the "what" of time's "when." Educators to this point have been safe with "what" and less concerned with issues of "when," taking refuge in the idea that content will always be more important than minor issues of style or delivery schedules. But content is also becoming affected by timeliness—a blurring of the boundary between when and what. An abstract idea, perhaps, but meaning nothing more than the simple notion that content is also valued by its timeliness.

For companies such as GM, Dell, or Apple, timeliness *is* content. Dell and Apple deliver computers ordered over the Internet. The ability to select and buy at any time is more than a feature; it is part of the product. At GM, "just-in-time" delivery of parts to the worksite is so much at the core of the product that its assembly lines rely on a three-day inventory. For these companies, timeliness and product are no longer divisible.

Information, too, has a just-in-time quality. There is an information shelf-life; drug patents, for example, last for seventeen years. Knowledge changes, but forms of content change even more (e.g., paper-delivered concepts become simulations demonstrating concepts); how content is created changes (e.g., by teachers or by interactions among students). If we can expect information and its form to change rapidly, then we must develop methods to deal with these expectations. A networked model of content delivery for networked distribution is necessary. The section called "The Fourth Component" will deal with this aspect of online education.

Summary

- There are structural forces underlying the rise of the Internet.
- Internet commerce is a major part of the economy, reaching almost $700 billion in three years.
- Bandwidth is increasing internationally.
- Greater bandwidth will drive greater demand for multimedia online.
- Online learning will be shaped by demands for any time, any place delivery, as is commerce.
- Networks are structures conducive to any time, any place delivery.

The Third Component

Counter-Currents

The forces driving online education are significant. Demand from students and employers, competition from new avenues, and new technology all seem to align to bring undeniable pressure on higher education to transform its production and delivery methods. Yet there are equally significant counter-currents in education.

> A recent survey of faculty at Florida Gulf Coast University—designed and built as a testing ground for Internet-based distance learning—found 54% of faculty disagreeing with the statement: "At FGCU, distance learning is an effective alternative to traditional instruction." "I was surprised to see that," says the school's dean of instructional technology. "It surprised me even more…because it was made very clear to faculty who were hired here that distance learning was going to be a very important part of the way we conducted courses." Professors' complaints focused on the extra amount of time teaching a distance learning class requires, primarily due to voluminous e-mail exchanges, and their feeling that not all courses, especially those that require hands-on training, are appropriate for the distance learning format. In addition, concerns have been voiced that intellectual property rights are less clear-cut in cases where a course's syllabus and lecture notes are placed on the Web by the professor with the assistance of university software designers. "It's a very important issue nationwide, and in particular here," says one professor. "If (FGCU administrators) are going to fight us and say, 'This is our stuff,' they're not going to be able to attract faculty" (*EduPage, Wall Street Journal*, 15 July 1998).

Faculty concerns over appropriateness of online delivery, quality of educational experience, and intellectual property are real issues that are not easily met, and yet transforming education without the support of educators is impossible. There are already signs that faculty are actively resisting the industrialization of higher education. In May 1998, nine hundred faculty members of the University of Washington signed a letter of protest against their state's move to online education.[38]

Tyack and Cuban in their award-winning 1995 book *Tinkering Toward Utopia* detail the promises and failures in a century of attempts to reinvent schools. While their work is directed towards primary and secondary schools, most of what they say is also applicable to higher education. One of the early cases they point to is Thomas Edison's own great belief in the power of the motion picture to change education. "I believe," said Edison, "that the motion picture is destined to revolutionize our education system and that in a few years it will supplant largely, if not entirely, the use of textbooks" (Tyack and Cuban 1995, p. 111). The authors go on to quote a mocking teacher's response to the great Mr. Edison:

> Mr. Edison says
> That the radio will supplant the teacher
> Already one may learn languages
> by means of Victrola records.
> The moving picture will visualize
> What the radio fails to get across.
> Teachers will be relegated to the
> Backwoods
> with firehorses
> and long-haired women.
> Or perhaps shown in museums.
> Education will become a matter of
> pressing the button.
> Perhaps I can get a position
> on the switchboard. (p. 111)

In the last century, technology has driven very few teachers to the switchboard.

Film, radio, and television have all had their day in attempting to "modernize" education. Systems promising transformation have generally been ill-received, except perhaps for one. Tyack and Cuban recount the early promotional rhetoric surrounding one of the first scientific breakthroughs in education: "The inventor of the system deserves to be ranked among the best contributors to learning and science, if not among the greatest benefactors of mankind." The authors go on to say, "The time was 1841. The 'system' was the blackboard" (p. 121).

What is at the root of the immovability of education? Does our system resist change because it is naturally strong and effective, fending off foreign organisms like a healthy immune system shrugs off a flu bug? Or is it the hard core of hierarchy, disciplinary division, and privileged isolation that gives unbalanced power to educators?

It isn't that teachers have rejected all technology; "[they] have regularly used technologies to enhance their regular instruction but rarely to transform their teaching" (Tyack and Cuban 1995, p. 122). The authors go on to elaborate:

> But perhaps the most fundamental block to transforming schooling through machines has been the nature of the classroom as a work setting and the ways in which teachers define their tasks. We have suggested that the irregularities of institutional structure and of teacher-centered pedagogy and discipline are the result of generations of teachers' experience in responding to the imperatives of their occupation: maintaining order and seeing that students learn the standard curriculum (p. 124).

Higher education may perhaps avoid some of the imperatives of maintaining order and teaching the standard curriculum, but teacher-centred pedagogy and "irregularities" of institutional structure dog it as well.

What are the prospects for online learning to bring about change where so many promising innovations have failed?

One difference this time around is an altered landscape of demand for, and breadth of usage of, online technology, which was detailed in the second section of this paper. Tyack and Cuban summarize a similar demand—the demand for computer knowledge—this way:

> Computers are tools that are sweeping across workplaces as diverse as offices, stores, airlines, steel plants, hospitals, and the military. Increasingly, families use computers at home for a variety of tasks. Citizens have put pressure on schools to familiarize the young with the uses of this powerful new tool, believing that if they do not, the next generation will be handicapped in getting jobs in an age of information. No public urgency compelled such attention to the media previously used in schools (pp. 124–25).

Demand for online education, or demand for computers—on either argument the prospects for online education are much different from those of, say, television in education. While television is pervasive—in most every home and dentist's waiting room—very few people *work* with television; it has not changed job prospects or ways in which goods are produced. The Internet has done all of those things. Nor do the production methods or production values of television transfer readily to settings outside the television studio. Those of the Internet do—just consider how quickly e-mail and web-delivered course outlines have moved into the practices of higher education.

It is impossible to say that online education is purely a force for good in higher education. Nor can one say that even if it were such a force, that it alone has the power to transform education standards, methods, and delivery. One cannot say, either, that educators alone can, should, or will dictate the way that online education is introduced into higher education.

Just maybe, however, the immovable object has for once met the irresistible force, and the two together will bring about the changes that neither alone can deliver.

The Fourth Component

New Objects of Production

Educators are not alone in online learning; other groups will have a hand in shaping what is delivered as online education, how it is produced, and the production standards that define its creation. Online education will be driven by what drives the Internet. Much of the earlier sections of this paper has been devoted to the production systems of the Internet and the user demand that drives those systems. Deeper than production and demand, however, is the logic of the network: decentralized, peer-to-peer, organically growing, distributed intelligence, and distributed resources. This is the deep structure of the Internet and the deep force that affects even the economics of Internet growth.

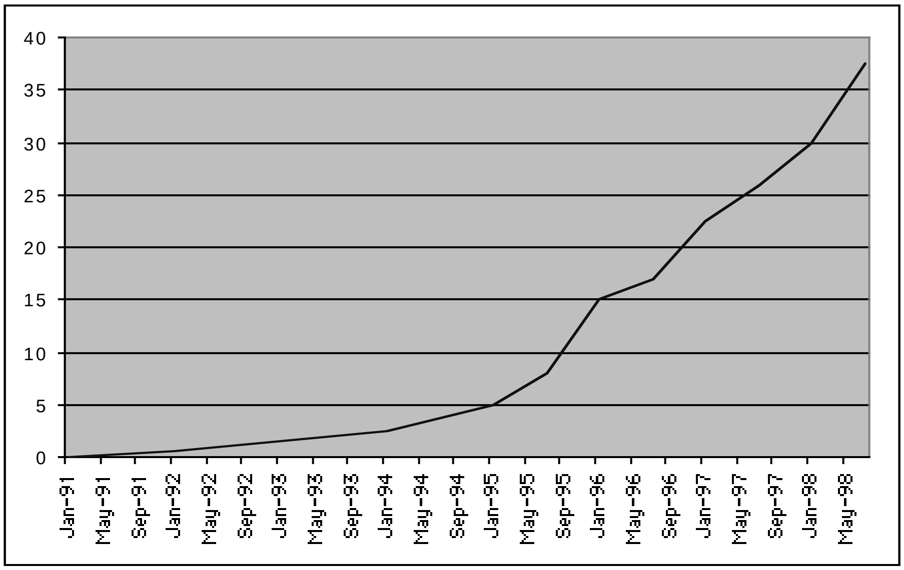
A small Internet can afford to ignore the logic of its own structure just as a single-storey house can be designed without much regard for the inherent strengths or suitability of materials (plywood geodesic domes come to mind). Perhaps a more appropriate analogy would be to Howard Hughes's airplane, *Spruce Goose*, a massive transport prototype made of wood, which flew barely enough to meet the minimum contract requirements of its defence sponsors. Size and speed both impose structural demands. The chart opposite shows that the number of Internet hosts grew from just more than 5 million in January 1995 to much more than 35 million in September 1998.

The stresses of size and usage require that the structure of the Internet be aligned with its essential quality as a distributed network.

Online standards, methods, tools, skills, and organizational models are the components of production for the Internet. And all of these components are taking shape in industries that operate at Internet speeds—in web-years, where each calendar quarter stands for twelve months.

An industry that has risen from nothing to billions of dollars in revenue and a hundred million consumers in about four years is no longer a haphazard affair; the stakes are just too high and the competitive speeds too great for online standards and methods to be left to undirected growth. Unlike the time of Standard Oil or IBM, however, no one company—not even Microsoft—can provide all of the tools, standards, and methods.

Figure 5: Internet Domain Survey Host Count (in millions)



Source: Net Wizards

Imagine a building industry where no board, no nail, no piece of wiring was manufactured uniformly. Imagine having to build a skyscraper out of raw materials taken from the ground and processed on site. Imagine every builder going through the same procedure, and then imagine that competitive pressures shorten the builder's time to build by 50 percent and then by 50 percent again. An impossible situation. Yet that is something like the state of the software industry at the time the Internet emerged into public view. Happily, there are signs that the Internet is changing this, too, and that industry is taking to heart the message of an old movement within the software business.

For more than twenty years, software designers have known that the methods used to produce software were in a sorry state. Original design and production methods, often loosely referred to as "procedural methods," made it difficult to modify and repair software. In many ways, the problems associated with the "Year 2000" problem—where dates after 1 January 2000 may not be correctly stored or referenced by software—are made more difficult by the procedural methods used to code software over the past decades. But the problems with this software legacy go much deeper than the Year 2000 crisis.

> The world has inherited well over 70 milliard lines of COBOL code [a programming language long used in industry]: 7x1010. It is indisputable that the vast majority of those lines of COBOL are very bad code indeed, leading to huge maintenance problems. We are also building new systems because of new demands.… As the business environment becomes more intricate, rather than just bigger, the complexity of the systems that we build has to reflect that increased complexity (Graham 1995, p. 6).

Repairs, upgrades, testing, and improvement are all made difficult by procedural methods—something akin to restoring an old house whose door knobs, mouldings, heating, and plumbing are either difficult to reach or impossible to replace. The modern business environment is driving industry to adopt new methods as well.

Steve Mills of IBM has said, "The problem with software, other than being a medieval art form, is that everything we build today is monolithic" (Orfali et al. 1996, p. 15). Or, as Orfali and his co-authors illustrate:

> To give you an idea of the magnitude of the problem, consider that it took WordPerfect just under 14 developer years to upgrade their product from version 3 to version 4. However, it took 250 developer years to move the same product from version 5 to version 6. If things continue at this rate, it could cost them as many as 4,464 developer years to move the product to version 8. WordPerfect realized that the monolithic approach to application development is simply no longer feasible (p. 29).

Monolithic, costly to build, and daunting to repair. These problems with our mainstream software design methods are exacerbated by the forces now brought to bear on industry:

> Taylor identifies four "wedges" or forces for change in modern business: globalization, decentralization, customization and the acceleration of the rate of business change itself caused by technological, social and organizational factors.… These forces underpin the need for a software technology that can deliver extensible, tailorable, modular products and do so without hitting insuperable complexity barriers, as current [procedural] techniques have been show to do (Graham 1995, p. 4).

Moreover, as these changing currents move business in one direction and then another, business processes—product development, customer service, etc.—also change. A new vision, driven by the global Internet, has emerged to offer a change from the sorry state we seem to be in. “Chunks” of software located anywhere on the Internet will be summoned by users’ computers to be joined with other chunks, forming new applications or adding new data. Other “smart” chunks will live their “lives” roaming the Net for data their “owners’” desire (truer than fiction, these software robots have existed for years now in the form of search “spiders” that work for companies such as AltaVista). These chunks, more commonly known as “objects,” will “understand” how to interact and share resources. They will communicate with old-fashioned “legacy” software that doesn’t share their object freedom, and they will allow software to be designed, built, modified, expanded, contracted, and to take on roles unknown when the object was first created.

This new software vision is variously referred to as Object Oriented Programming or Object Methods, and its larger context, in which objects and their delivery systems and interactions are combined, is often called Component Methods. These component approaches, whatever their name, offer a way out of the dilemma of old software and old methods on the high-speed Internet. Component approaches call for broad, worldwide standards by which objects will be created, exchanged, and joined. They do not demand that software be the same, just that it be able to work with other software. Components that are created to global standards of delivery and interaction may be later modified without rewriting the entire application. They may be combined in ways unplanned when they were first created, and they may be reused, thereby speeding production and reducing cost.

Where does online education fit in the component methods world?

In the case of education, one of the major “monoliths” referred to earlier is the course —the present integral property of a discipline and the primary unit of education delivery. These monoliths present all the problems of their software mirror image: they are complex, costly to maintain, idiosyncratic in their construction, and inflexible in their response to changes in their environment—all characteristics that will find no end of educators willing to rise to their defence.

Whatever the undoubted value of the course as an encapsulation of learning, it is a difficult and unwieldy unit for Internet delivery. The “objects” of online education will be smaller chunks of practice, experience, research, and collaboration. They will be capable of being joined and taken apart; their use in one class will carry with them—should the teacher choose—the appropriate units of testing, grading, support, and administration.

As educators increasingly become designers of Internet education, the desirability, if not necessity, of objects, will be unavoidable, just as it is for Internet software.

It has taken many years, but the “object” alternative is emerging, and the software industry has developed a particular jargon and style of speaking about it. A technologist will say that the new software alternative is made up of software designed as modular *objects,* linked through a *component* infrastructure, and delivered across distributed *networks*. The words are all computer buzz, but they refer very much to their noncomputer cousins.

Objects are the self-contained chunks of software referred to earlier, like the Lego blocks they are often described as resembling. Components are a kind of *super object*, but they can't be defined so neatly. They combine many features, and everybody's set of features is a bit different. Minimally, they are self-contained; must be combined with other components to do useful work; can be used in ad hoc combinations; have well-defined means of connection, one to another; are system independent; are an extended *object* in the sense that they are fully capable of interaction with other components without the addition of supplementary software resources (Orfali et al. 1996, pp. 34–35).

In the world beyond the software designer, all this means is that component software is more flexible, reusable, higher quality (through improvements after reuse), faster in development, scalable (made larger or smaller), more easily maintained, and better meets the current needs of business processes (Graham 1995, p. 30).

While these benefits have been known and debated for many years, it was really only the Internet that made industry take notice. There are many reasons why—the way software designers were trained to disparage code reuse; legacies of code with their consequent capital investment; mainframe computers and centralist mentalities that went with them; longer business cycles than we find in the Internet world—many reasons.

Earlier this year, Bill Gates said in an article in *Byte:*

> Companies will have to do more with less. To a large degree, this means moving away from custom applications toward the integration of existing components, solutions and business processes.…
>
> In the next decade, developers seeking to create integrated solutions will demand as much convergence of object models as possible across all applications [agree on what an object is and how it relates to others].…
>
> In the future, a component's location on the network must become as irrelevant to the developer as its source language is today.…
>
> Components must be able to describe the data they contain when interrogated, and this data must be easily manipulated, regardless of its source [components must be fully open for interaction with any other components, not just components made by the same supplier].…
>
> Another important aspect of componentization is the ability to combine components into new components [customizable and scalable]. (March 1998, p. 70. Notes in square brackets are mine.)

Component production is not assembly-line production, but it is industrial production. By contrast, procedural production of software is much closer to the type of cottage industry that predated the steam age (a tone conveyed by Steve Mills's earlier reference to the medieval nature of software). Components are not standard in their operation, but they are standard in the ways they interconnect (just as all plugs on all light cords fit all wall sockets—at least in the same country). They are standard in their ability to be distributed in common ways (principally over the Internet). They are standard in their indifference to their source of construction (just as a two-by-four of lumber is indifferent to its source of manufacture). And they are standard in their indifference to being used in large or small assemblages (they are "scalable," just as a steel I-beam can be used as the supporting beam in a bungalow or a wall member in a skyscraper).

The Internet demands all of these features. Electronic commerce will not exist in larger and more pervasive forms without them. Online education demands no less.

Around the world, universities, research groups, companies, government agencies, standards committees, and alliances of all of these together, are creating the component systems that will drive the Internet and online education in the coming decades.

Exactly how a component-oriented approach will affect online education will take some time to become clear. The general aims, however, are clear, and they are the educational equivalent of the aims of the component software industry. They include enhanced development of educational software; efficient integration; sharing among institutions; and use of distributed networks. Instructional Management Systems (IMS), one of the leading educator groups in this field, has defined them this way:

> Development of software tools for teaching and learning and their integration into the learning environment have historically been hampered by the lack of a commonly accepted specification that would permit them to be readily shared among institutions and across a wide range of technical environments. Given the rapid transition in the information technology environment from a PC-based model to a network-based model, coupled with a shift in pedagogy from teacher-centered to learner-centered paradigms, the development of a non-proprietary industry-standard specification can overcome this limitation and improve the effectiveness of technology as a means of enhancing learning (IMS *Specification* 1997, see p. 55 of this document).

The Fifth Component

Strategies for Educational Leadership

Scott McNealy, CEO of Sun, is frequently quoted as saying, "The network is the computer." He is usually interpreted as striking a combative stance in relation to Microsoft. If the network is the computer, then all of the current generation of desktop computers are small parts of the global, network "computer." And if that is the case, then the software that links the network is much more important than the operating system on each machine. The software through which networked computers exchange files, through which they pass data to devices such as printers, and by which they assemble application software and store it on databases is, in effect, the operating system of the network. That is the hype and promise of JAVA and JINI, both Sun creations. Combative or not, McNealy could be more right than even he suggests. In the global Internet, the network is not only the computer, it is also the organizational structure and the conceptual model.

Most of us know the story of the original Internet. Built at the behest of the military to withstand atomic Armageddon, it was designed according to a decentralized model. Like a strand of (modern) Christmas tree lights, its builders wanted one light after another to be removable without darkening the whole strand. The Internet is a set of Christmas lights (nodes or "hosts" in Internet speak) with millions of bulbs, all wired one to another so that none is essential, yet all are valuable. It grows at the rate of 10 million hosts a year without central direction, additions and deletions handled organically by the software "nervous system" that all hosts share.

An e-mail message from my home in Canada to my friend in Hong Kong may be routed on one occasion through hosts in Minnesota, Washington State, and California before reaching Hong Kong; and the next, through New York and London, then Delhi, Singapore, and Hong Kong. No route can be predetermined or "preapproved"; all hosts must always be ready to handle my message. At each host, the network adds "value" or "intelligence" to my message—routing, verifying, assembling. This value is in the form of delivery managed and guaranteed by the network, all without any control or oversight by me or my machine.

The value and intelligence of the network lies in this ability to allow use without cost, restraint or permission, its common software tools, and common methods of recognition and handling of common data types (e-mail, for example). My easy reliance on the network resides in this set of standard abilities and behaviours.

This paper earlier made some basic arguments about the way online education would be influenced by trends in Internet growth:

- Online education is demand-driven by expectations created by Internet use;
- Online production values and production methods will determine those of online education;
- Businesses have highly developed skills in online delivery and many are becoming involved in online education;
- Online delivery demands the use of components; and
- Many organizations are actively creating the basis for component construction in online education.

All these points are linked and driven by the logic of the network: decentralized, peer-to-peer, organically growing, distributed intelligence, and distributed resources. Here is how the above arguments can be recast in this light:

- A decentralized, organic network elevates the importance of user demand by blurring the distinction between user and producer; by increasing the importance of pure numbers of users; by making user "demand-clustering" easier and faster to produce; and by increasing the expectation that custom, individual delivery is the norm.
- A network systems model does not isolate certain types of use (e.g., educational) into hard-to-reach pockets. By making access to all and any node easy, it makes comparison easy. By making the delivery and production system common to all users and producers, it removes arguments that education is entitled to different standards of production.
- A network system—hierarchically flattened, removing distinctions between user and producer, equalizing delivery methods—also tends to weaken distinctions between "appropriate" and "inappropriate" providers of education, making it easier for industry to enter education.

- The Internet is about "Net-work," not "Net-delivery." The Internet is not just a delivery system for data, and its nodes are not simply carriers and containers of value created somewhere else, but a system in which nodes add value and intelligence to the overall work of the network. A system designed with this view of the world will necessarily gravitate towards greater and more complex forms of node value and node intelligence. That is really what the component methods movement on the Internet is all about.
- Behind the component methods talk of greater efficiency, lower cost, and greater robustness (all true), is the logic of the Net—the neural capacity of which increases through increased power in all of the nodes. It is the combined power of equally, and increasingly, powerful nodes that provides the evolutionary strength of the network. This logic of network evolution will move us to components and component assembly, which is the only way to increase the intelligence of a network.
- By contrast, monolithic software—and monolithic online education—are inconsistent with the inherent logic of the network. In other words, monolithic, centralized approaches attempt to "dumb-down" the Internet to a simple delivery system in which nodes do nothing more than relay blocks of centrally created material.

Once again, Marshall McLuhan had it right; the medium is the message. In this case, the medium is the network and the message is decentralized, increasingly powerful nodes.

In this new medium, the early power is in the hands of industry, but higher education has long-term strength. Industry may set the technical standards for multimedia production, component interaction, and database support, but education is much more adept at building distributed resources, peer-to-peer systems, mutually beneficial alliances, and at committing long-term energy towards advancement of knowledge. On these strengths, higher education can gain leadership in the new medium of online education.

To take advantage of these leadership strengths, higher education will have to undergo a perceptual shift in its thinking about online education. The most common Net-delivery mindset currently says that online education is like distance education: the delivery of course material over a new distribution path. This impels educators to think of life-long learning as the delivery of educational materials to people wherever they happen to be, at any point through their lifetime. The core perception of Net-delivery and distance education is that central teachers provide materials to students who are receiving from a distance.

The Net-work perception of online education says that online education is distributed education, not distance education. The Net-work perception of the Internet places collaboration at the centre. It looks to build on strengths found in the ways in which education is a process distributed between teachers and students; for ways in which it is part of a peer-to-peer system of participants who are now creators, then consumers; for ways in which its design can be shared, its delivery distributed, its methods standardized, and its growth based on mutually beneficial alliances.

Stan Davis puts the distinction made here between online learning as collaborative learning, and online learning as a means of distributing educational materials, in more familiar business terms:

> Defining businesses from the producers' point of view, as was done in the industrial economy, is simply no longer workable. One hallmark of the ambiguous, new economy is the need to define businesses in terms of the customers' changing needs.
>
> ....
>
> The mechanistic approach attempted to understand…the component parts at the expense of their interactions.…
>
> In a holistic [Davis's synonym for network] model, the whole is…the sum of the parts and their interactions (Davis 1987, pp. 195–200).

Online education is a view of education in which understanding of interactions (the transactions of collaboration) counts more than the producers' point of view alone.

In the decentralized, peer-to-peer, collaborative, and distributed environment of the Internet, higher education comes with three areas of strength: strength in community building; strength in alliance building; and strength in specialization.

Strength in Community Building

Communities are the prototypical human network: organic, diffuse, linked by norms/traditions/customs, resilient survivors, distributed. Within them may grow up hardened structures of civic government, economic systems, and educational institutions, and while these crack under shocks such as earthquake or flood, the community remains firm in the interactions between people.

As much as businesses embrace community-building notions,[39] they are more often too highly focussed on the goal of profitability to permit the "looseness" of purpose that real community demands and which allows community to withstand long waves of change. For this reason, community, for corporations, becomes an operating goal leading to increased profit rather than a structural model leading to changes in management.

Higher education, for all its rigidity in operation, is enclosed in natural communities. Scholars and students move from physical locations but remain within disciplinary communities. Researchers collaborate in human networks. Communication among thinkers occurs in centuries-long chains of tradition and transmission from mind to mind.

Communities of scholarship are a bond and an attractor for students and academics. Traditions within disciplines mark thinking and styles of dispute. A personal linkage to an institution with a grand tradition of scholarship—an Oxford or a Sorbonne—is more than choice of a good "brand."

Even if Oxford is more tradition than brand, however, it is also a good brand. One of the early competitive advantages of the university, as compared to business, is its brand—a point not lost on industry, which seeks to form alliances with higher education, in part for this very reason. *The Industry Standard* quotes an officer of OnlineLearning.net, a private company that holds an exclusive contract with UCLA Extension to deliver its courses over the Internet.

> The company is pursuing a branding strategy, hooking up with well-known universities like UCLA, whose names carry educational cachet. "The adult continuing-education student is looking for brands. We're going to be looking at academic diversity of brands, the geographical diversity of brands" ("Higher Earning: The Fight to Control the Academy's Intellectual Capital," 28 June 1998).

Universities can avoid a lapse into seeing their options reduced to marketing their "brand." Too often, educators imagine that life-long learning is about courses, a view that sells short the strength of academic communities. The power of life-long learning for higher education resides in its ability to tie a life to the traditions of scholarship and the richness of great institutions bound by great histories of thought.

Online learning is not just a way to deliver courses. It is a way to tie the student and graduate scholar (now in a job) to the ongoing community of scholars in which the student found her way as an academic.

When educators discover how to think of their online work as part of the transmission of their community rather than a means by which to deliver their instruction, then universities will prove they have a strength not in the hands of industry.

This paper earlier referred to students as a latent market of talent and consumption. These are the easy fruits that even business can harvest. And not at all incidentally, when university communities are found online, then too, students will prove to be a treasure of new thought, new programs, even new "products."

Strength in Alliance Building

Improvements in information economy networks and in "old" industrial economy forms of organization, such as most businesses, occur in very different ways. Stan Davis says that the industrial model of improvement involves "cooking resources down, like a good French sauce, to their essences" (Davis 1987, p. 72). Efficiencies in information economy networks demand "not downsizing, but quantum leaps in size" (p. 72).

Efficiency in the industrial system is epitomized by the assembly line, in which "enormous numbers of uniform products can be produced inexpensively, by relying on the machinery and other productive assets in the factory" (Peppers and Rogers 1993, p. 139). This is economy of scale in which the "cooking down" is found in the uniformity of design and construction, the standardization of parts, and the elimination of wasteful movement by man or machine, matched to ever-increasing production, determined by ever-increasing demand, leading to ever-decreasing cost.

Efficiencies in the information economy involve economies of *scope.* More information about smaller "market segments" is more efficient in an information economy than less information statistically spread over a larger market. Niche markets are based on this concept—that more about less is more valuable.

It may well be that 51 percent of North Americans are male. That is a small bit of information about a large "market." More valuable is the information that a particular 1 million males all purchased a particular brand of car in the last year. Even more valuable is the knowledge that 500,000 of these males purchased a particular brand of car *and* a particular brand of beer.

In order to achieve quantum leaps of scope, businesses (and all organizations) must look beyond internally generated sources. Increasingly, they look to alliances, or as they are generally called in this context, "strategic alliances."

Higher education is good at economies of scope and poor at economies of scale. Academic disciplines are all about more information, more depth, more specificity. And they are criticized for their inability to develop means of aggregation and common production systems.

As universities turn to online learning, they will find themselves struggling to contain high costs of production. They will be able to reduce those costs to some degree by using the tools of assembly-line production. They can centralize production in the university. They can draw on specialist support technologists (either in the university or in industry) who can better produce consistent, high-quality products. They will attempt to break down the production and delivery process, employing itinerant academics, or graduate students, for much of the business of testing, student contact, and content assembly. They will attempt to standardize their tools such as online chat, discussion threads, and online testing. To a large degree, modular software can help this assembly-line efficiency by allowing reuse and modular building.

In this effort to achieve industrial efficiency, alliances will be formed between industry and education. IBM's Global Campus program, profiled in the next section, is a highly notable instance. The tendency is global and not confined to technical assistance. *EduPage* has reported:

> A new study out from Queensland University of Technology in Australia says that major media companies don't really want to replace colleges and universities as educators of students, but are more interested in supplying the technology needed for distance learning programs. The one area where corporations such as Microsoft, McGraw-Hill and News Corp. might want to compete is in technical training, where many of them have already established programs for employees. Meanwhile, technical training is also attractive to academics, because it tends to be more profitable than undergraduate teaching. The study is available at http://www.deetya.gov.au/divisions/hed/ (*Chronicle of Higher Education,* 13 February 1998).

As logical as these alliances and production efficiencies seem, they give academics the tremors. A recent article in *The Industry Standard* lists some of the early university efforts towards "lower cost" means of production and towards retaining and reusing some of the intellectual property capital that goes into a course:

> OnlineLearning.net has come under attack for a 1994 agreement with UCLA Extension that required instructors to assign rights to their courses to the company. President and CEO John Kobara says that provision has been discarded. "We don't own the copyright, the University of California owns the copyright," says Kobara, a former UCLA vice-chancellor and cable television executive. He acknowledges that intellectual property rights will have to be resolved for the online education market to grow. But, he says, "What gets overshadowed is our academic success. The fact is that in California we don't have the infrastructure to educate the next generation of college students. There are not enough campuses, and the adult learners far outnumber the capacity of the institutions."
>
> ....
>
> Colorado professors who teach online sign "work-for-hire" contracts with

> the university that give the school the copyright to online courses and bar instructors from using the online version of the course in class lectures, consulting work or at other institutions without permission. Academic departments must approve any courses developed for the Internet. If the online course is sold, the professor receives 10 percent to 15 percent of the profit. "It's a sticky issue," Schlenker says. "Some faculty feel threatened by it as something that will change the way they teach." The actual management and packaging of online courses is handled by Real Education, a Denver company that runs the online programs for 29 schools (28 June 1998).

Earlier in this paper, it was noted that nine hundred University of Washington academics had signed a letter protesting their State's online education initiatives. It is clear that the introduction of production efficiencies on the industrial assembly-line model will be hard fought in universities. It is also clear that they will be attempted, and in many places, they will succeed. Where they succeed, they will serve as models for how efficiencies of production can be managed. They will be needed.

Many of the most successful of these alliances whose aim is production efficiency will be with other academic institutions, some within the same system, such as the new alliances within California's Community Colleges (@One) and within California's State Universities (MERLOT). But even collaborations among purely academic institutions will not come easily. A *New York Times* article tracks several interesting examples:

> Four years ago, LeBron Fairbanks, the president of a small, distinctively Christian liberal arts college in Mount Vernon, Ohio, had an inspiration. Budget cuts were threatening his institution, but, he figured, he could save "bushels of money" by combining resources with neighboring colleges.
>
> The idea was daring for an institution like Mount Vernon Nazarene College, which is committed to its religious traditions and wary of blurring its identity. Nevertheless, Fairbanks came up with a proposal in which Mount Vernon and five other Ohio colleges would seek ways to combine administrative tasks. He found a receptive ear for his experiment at the Teagle Foundation, a midsize private philanthropy that was just then shopping for a way to make a significant contribution to higher education.
>
> Teagle so liked the idea (and trusted Fairbanks, as an earlier grant recipient) that it set up the Collaborative Ventures Program and has issued more than $4 million in grants to help colleges set up money-saving collaborations.
>
> While only a handful of such consortiums existed in 1995, today there are at least 21 representing more than 125 colleges and universities. They range from

> the elite Five Colleges Inc. (Amherst, Hampshire, Mount Holyoke, Smith and the University of Massachusetts at Amherst) to the Montana Consortium of American Indian tribal colleges (Rocky Mountain, Salish Kootenai, Little Big Horn and Fort Peck Community College).
>
> The appeal for Five Colleges was not just to save money but also to enrich academic programs. Specialized courses like Arabic, early music and astronomy rotate among the Five Colleges campuses, which individually might not be able to afford such unusual offerings. Students are encouraged to register for the shared courses at member institutions for no additional fees, and free inter-college bus service is provided.
>
> ....
>
> "A great many of these small institutions are being caught in a squeeze," said Richard W. Kimball, president of Teagle. "On the one hand, their costs are going up because education is labor-intensive, and on the other they can no longer continue to raise tuition faster than the rate of inflation because the public won't stand for it. They've got no alternative but to reduce costs."
>
> ....
>
> Lorna M. Peterson, the coordinator of Five Colleges Inc., also expressed the need to proceed with caution. "We don't want this to become a threat to the distinctiveness or autonomy of the members," Ms. Peterson said. "The whole is smaller than the sum of its parts."
>
> Kimball said Teagle did not use the word "merger." "If we use that word, we're dead," he said with a smile. "We don't want them to lose their identity, but does that mean they all need to cut their own grass?" (12 August 1998)

This set of examples doesn't relate to online education, but the point is the same. No one wants to lose their identity, but does that mean they all have to run their own online chat rooms?

Beyond the expediency of shared production, academic alliances offer a deeper advantage for higher education. The best examples of strong alliances will be the result of natural collaborations around specialties or traditions of joint research: alliances of seed geneticists; alliances formed through long-term, common research projects. These are the kinds of alliances that only higher education can bring to online education. And these will prove to be the asset that universities hold over their business competition.

Strength in Specialization

Specialization is both a strength and a barrier in higher education. As a strength, it brings continuing advances in knowledge, finer skills of discrimination and enquiry, research funding, refinement of disciplinary traditions, new graduate students, and institutional renown. As a barrier, it brings disciplinary narrow-mindedness, social irrelevance, distance from new learners, and organizational inflexibility. As both a virtue and a vanity, higher education has lots of it. On the positive side, specialization can be brought to the service of online education.

In the rapid leveling of offerings on the Internet, specialization will provide a means of distinguishing the ordinary from the desirable. When all of the introductory liberal arts courses, their reading lists, their assignments, and their course notes are openly available online (as not even passworded protection will prevent in time, leaky as our communications systems are), then all will be as common as chalk. Only rarely will there be cheese.

Specialization in the tools, simulations, models, and interactive environments that academics bring from their research work is what will mark the difference between competitive online education and just another "McOnline" course.

There are already simulations of black holes for physics students, satellite-pictured and computer-modelled world weather patterns for new geographers, and ballistics simulations for grade school.[40] The online world draws this work forward; gives it a place to be displayed; allows complex work to be presented in approachable ways; lets specialists speak to the student just coming to an understanding of the discipline.

Industry does not have this strength. Or rather, very few businesses do. The largest research labs—IBM, Dupont, AT&T—can hold their own, but which of these will be harnessed to online education? None. The lost value in diverting them from patentable products will be too great. Only higher education can afford to bring the tools and discoveries of specialization to the common online classroom.

Research work brought to the common classroom, driven there in fact by university and educator need for distinction and recognition in the online world, will make specialization something more than what goes on behind closed laboratory doors. It will help even the beginning student to learn the lessons of the discipline by illuminating them with the best work the university can produce.

THE SIXTH COMPONENT

LEADERS IN COMPONENT METHODS FOR EDUCATION

THIS SECTION PROFILES THE KEY ORGANIZATIONS that are shaping online education, and that have a strong orientation towards component methods and object models. Not every organization active in this arena is listed. Nor does each organization listed represent an equivalent stage of activity in component methods. Some institutions are dealing with the broadest kinds of educational components —courses—while others are dealing with the highly technical mechanisms by which objects will be interchanged: OMG, Jini (see pp. 56 and 60–61); or retrieved: NIST, W3C, IEEE (see p. 57).

The selection preference is for those that are commonly identified with these approaches and whose activities will influence the shape of component-based online education in the future.

The Educational Object Economy Foundation (EOE)

PROFILE	
Number of members	285 (individual, institutional)
Nonprofit/for profit	nonprofit
Area of primary activity	education
Alliances/sponsors	California State Universities, California Community Colleges, Sun, Oracle, Netscape, IBM, Apple, International Co-operative Alliance, University of Michigan, Advanced Distributed Learning, Instructional Management Systems, and many more
Website	www.eoe.org; eoe.apple.com
E-mail	info@eoe.org

The Educational Object Economy Foundation (EOE) is a nonprofit research institute organized to explore online learning communities of educators, software developers, and businesses. The EOE is devoted to improving the quality, quantity, and availability of educational software. The foundation grew out of a National Science Foundation (NSF) project hosted at Apple Computer from 1994 to 1998. Original funding equalled more than $6 million and the project went through two distinct phases. The first researched the development of easy-to-use authoring tools for educational software, and the second, the use of distributed collaboration over the Web as the medium for educators to build and share common educational software resources.

Educational software has been plagued with problems of difficulty, cost of development, and lack of distribution beyond the institution that creates it. One of the central factors in its cost is the virtual nonexistence of reusable software. In other words, software designed for one course or curriculum cannot generally be broken down into components that can be applied to different purposes or curricula.

In its first phase, the EOE project created a consortium of educational institutions, software developers, and publishers of educational material to address themselves to these issues. Their approach for two years was to create tools that would make the development and reuse of software much easier—in fact, to allow the building of software by teachers and students. This phase was a success to a large degree, although the conclusion was that only a limited group would use even the easiest tools, because few educators want to, or can, devote the time it takes to become proficient.

At this point, the World Wide Web and the Java language rose to prominence, and the nature of distributed educational software appeared ready to take a huge step forward. For the first time, it seemed possible that educational software might quickly improve by placing all educators and students in a worldwide environment as co-developers of software—provided that the basic software could be delivered as small components that were relatively easy to build and assemble one with another. The Java language and its component design methods offered the opportunity to achieve these aims.

The EOE project then moved into its second phase with three goals: to create a community of educators, developers, and institutions (educational, publishing, and commercial) that would be joined through the Web; to create and assemble Java educational objects that would be shared by the community; and to demonstrate the economic structures, business models, and intellectual property mechanisms that would make such an online community viable beyond the research and development environment.

The EOE Foundation has now been formed to expand on the work of the successful NSF project period. It has created a community of almost three hundred members and an exemplar website to which all members may add a variety of multimedia educational resources. Principal among these is the world's largest repository of Java objects for education—now numbering almost three thousand—in all disciplines from religion to physics to computers to music.

The EOE Foundation is committed to alliance-based growth of communities for educational development in which online learning and authoring communities, knowledge networks, networked improvement communities, and information-age co-operatives apply their experience to maximize opportunities for innovation in education.

Educational Software Components of Tomorrow (ESCOT)

PROFILE	
Number of members	five institutions
Nonprofit/for profit	nonprofit
Area of primary activity	middle-school mathematics education
Alliances/sponsors	National Science Foundation; Stanford Research International; U. of Colorado, Boulder; The MathForum, Swarthmore College; U. of Massachusetts, Dartmouth; Show Me Center, U. of Missouri
Website	http://wise.sri.com/escot/
E-mail	webmaster: roschelle@acm.org

The ESCOT project is investigating how software innovations can accumulate, integrate, and scale up to meet the needs of systemic reform of K-12 mathematics and science education. The goal is not a single software product, but an understanding of how "integration teams" comprised of developers, authors, teachers, web facilitators, and others could compose lessons by combining graphs, tables, simulations, algebra systems, notebooks, and other tools available from a shared library of reusable components. Integration teams will draw upon Java versions of such powerful tools as SimCalc, MathWorlds, Geometer's Sketchpad, and AgentSheets to begin addressing the needs of five new middle-school mathematics curricula for web-based learning technology.

Instructional Management Systems (IMS)[41]

PROFILE	
Number of members	n/a
Nonprofit/for profit	nonprofit
Area of primary activity	education
Alliances/sponsors	thirty companies and organizations
Website	http://www.imsproject.org/

The IMS project is an international co-operative research project sponsored by Educom; it includes many of the major technology companies, academic institutions, and government agencies. Its goal is the widespread adoption of a technical standard for interoperability of instructional systems and content. The IMS group released a draft specification and sample implementation of their standard early in 1998.

The specification falls into two general areas: a specification for the educational objects, and a specification for the tools that organizations will use to manage these objects. Educational organizations will be enabled, using nonproprietary, web-based tools, to combine content with administration of educational delivery. Similarly, producers of educational content, whether educators or businesses, should be able to distribute content that will be assured of operating within an IMS-compliant organization.

The IMS management specification is designed to allow students to carry a profile of themselves as a learner from place to place. This profile will contain grades, certifications, even their preferred learning style, and will permit the student to control who can access their profile or parts of it.

The specification also provides for the ways in which any IMS-compliant content can connect to external services such as student records, as well as to electronic commerce systems that permit authors and publishers to charge for their content.

Most significantly, IMS content ensures that educational objects can be combined with others into larger units. Large combined units can be distributed and then broken down into elements that can be recombined (to the extent allowed by the author). Small content blocks, as well as combined units, will carry codes that will provide crucial data on ownership, educational objectives, age level, language, and learning style.

Object Management Group (OMG)[42]

PROFILE	
Number of members	eight hundred
Nonprofit/for profit	nonprofit
Area of primary activity	promotion of component software
Alliances/sponsors	n/a
Website	http://www.omg.org

With a membership of more than eight hundred software vendors, software developers, and end users, OMG moves forward in establishing CORBA (Common Object Request Broker Architecture) as the "Middleware That's Everywhere" through its worldwide standard specifications: Object Services, Internet Facilities, and Domain Interface specifications. Established in 1989, OMG's mission is to promote the theory and practice of object technology for the development of distributed computing systems. The goal is to provide a common architectural framework for object-oriented applications based on widely available interface specifications.

Learning Objects Metadata Group (LOMG) and related projects

PROFILE	
Number of members	n/a
Nonprofit/for profit	nonprofit
Area of primary activity	metadata research
Alliances/sponsors	n/a
Website	for information see http://www.eoe.org
E-mail	webmaster@eoe.org

"The problem with the Internet is that you can't find anything." Such is the common refrain of pained users. Perhaps the problem is that we can find too much. Perhaps we can't find it fast enough. However the problem is phrased, the fact is that data on the Web cannot be easily retrieved. As massive as the problem is with 100 million users who are also data providers, there is real progress being made. And access to content is one of the key requirements for a viable online education sector.

The Learning Objects Metadata Group, World Wide Web Consortium (W3C), National Institute of Standards and Technology (NIST), International Electrical and Electronic Engineers (IEEE), and many other organizations worldwide are working to create standards for the ways in which data of all types (audio, video, text, numeric) and in any format (e-mail, spreadsheet, etc.) can be indexed, stored complete with its index, searched for, and retrieved over the Web. The name for this type of index is "metadata."

Like the Dewey Decimal System or the Library of Congress system for books, there are many ways in which digital information might be labelled or indexed. Each group proposes a slightly different scheme. One of the LOMG's aims is to bring some coherence to this work; to unify the many valuable efforts.

California State Universities—MERLOT[43]

PROFILE	
Number of members	344,000 students; 38,500 faculty and staff
Nonprofit/for profit	nonprofit
Area of primary activity	education
Campuses	twenty-three
Website	http://www.calstate.edu

MERLOT stands for Multimedia Educational Repository for Learning and Online Teaching, a name reverse-engineered for its resonance with the Sonoma campus setting.

The purpose of MERLOT is to support faculty, student, and staff use of the Internet for learning and teaching, and to share resources more easily among all members of the California State Universities (CSU) online learning community. Valuable instructional courseware, modules, elements, components, and objects are available on the Internet, but they are often difficult to find. MERLOT will use the Internet and the Web to create a virtual collection of materials that reside at distributed sites across the CSU and around the world, and will provide a systematic way to find them. It will also provide a mechanism to collect the pedagogies used with these materials and facilitate discussions among teachers, learners, and support staff about their effective use.

Advanced Distributed Learning (ADL)[44]

PROFILE	
Number of members	n/a
Nonprofit/for profit	n/a
Area of primary activity	Defense Department education
Alliances/sponsors	n/a
Website	www.adlnet.org/
E-mail	secretariat@adlnet.org

The ADL Initiative grew out of a US Defense Department interest in modernizing traditional training by applying information and learning technologies. Part of an effort to work collaboratively with the public and private sectors to develop a new learning environment, ADL is built around common standards that enable platform neutrality and reuse, and networks to distribute information whenever and wherever it is required.

ADL will promote the development of a common framework for an object-oriented, open-architecture environment. Part of that effort is a partnership between ADL and IMS for the development of metadata standards and a common object model.

ADL has established ADLNet as a forum for the discussion and development of standards and guidelines, the creation of collaborative courseware development groups, and the development and testing of learning objects. In addition, the forum will serve as a clearinghouse for information on the technology, standards, business models, research and development, and other aspects of ADL.

ADLNet will begin hosting a number of collaborative forums for content and tool development, beginning in the medical area and expanding out across a wide number of domains. Using the IMS metadata specification as a starting point, the Defense Department will propose a common set of guidelines and specifications for ADL that will be co-ordinated across the public and private sectors.

IBM

IBM is a massive and diverse business organization. Its work crosses many of the dimensions of education and component software. Three of these are of immediate interest. On the education side of their activities, IBM has a business area called IBM Global Campus, which is termed "a breakthrough education and business framework that helps colleges and universities use computer networks to redesign learning, teaching, and administrative function." The Global Campus website lists thirty-five affiliated colleges and universities worldwide. These are alliances in which IBM provides the technical infrastructure through which the institutions' content flows. That content can be courses as well as administrative material such as general information, student aid, applications, enrolment, and interaction with other students and faculty.

PROFILE

Number of employees	269,465
Nonprofit/for profit	for profit
Area of primary activity	hardware and software
Revenue	$78,508 million in 1997
Website	http://www.ibm.com
Global Education Web access e-mail	http://www.hied.ibm.com/contact.html

IBM Global Campus offers technology as well as consulting services, and it is likely that synergies will emerge between its base of alliances and its work in component software for business. Within IBM's component software efforts there are two interesting programs: the IBM Worldwide Emerging Markets Partnerships, and the IBM San Francisco project/VisualAge programs, all of which aim to bring component methods and component software to businesses small and large.

The Emerging Markets Partnership brings one of the least-identified aspects of component software to the spotlight. Components, ideally, should allow teams of software developers to work together, but at a distance. Noncomponent methods make such work risky and difficult due to the fact that the software is not modular and is therefore difficult to exchange in collaborative settings. The IBM Partnership brings together groups from India, China, Latvia, and the UK in a twenty-four-hour development team.

The aim of the Partnership is to produce component software called VisualAge PartPaks, the construction of which is intended to ensure that "any component of one PartPak can be easily adapted and plugged in alongside any of the other components."

Oracle

PROFILE	
Number of employees	36,802
Nonprofit/for profit	for profit
Area of primary activity	database software
Revenue	$5,684.3 million in 1997
Website	http://www.oracle.com
Oracle Education e-mail	webed@us.oracle.com

Oracle is a database company with an eye to the network. Networks, and that includes the Internet, are driven by the power of databases. No commercial website or online learning centre can exist without a database at the core of its primary structure. Only databases can provide the just-in-time, unstructured delivery of information required by online business and education. Websites are increasingly created "on the fly" from data delivered by a database. In the case of education, that data is video, audio, course materials, and testing. Oracle would like to be the company to provide all of these features. In creating its set of offerings, Oracle has defined an "Oracle Learning Architecture" (OLA) based on learning objects, or "elements." In addition, Oracle offers a set of information technology training in the form of instructor-led and computer-based systems, including fully web-based, OLA programs.

Sun Microsystems/Java/Jini

PROFILE	
Number of employees	21,500
Nonprofit/for profit	for profit
Area of primary activity	network computer systems
Revenue	$8,589.3 million in 1997
Website	http://www.sun.com
Education Contacts e-mail	http://suned.sun.com/contacts.html

Earlier, this paper noted Sun CEO Scott McNealy's statement that "the network is the computer." If the network *is* the computer, then Sun would like Java and Jini to be its operating system. Java, the programming language launched by Sun in early 1995, and Jini, released from the bottle in July 1998, are designed to bring object methods and component infrastructure to the Internet, allowing software modules to be written, exchanged, and assembled anywhere on the Net.

Jini's creator, Bill Joy, says, "The trend is very clear. We are moving toward a world in which it will be possible to move software codes that act as our personal agents between many different computers in a global network."

Jini aims to bring computer devices—computers, printers, storage devices—into "intelligent" communities, where they are connected by interactions in which they share data and computing, storage, copying, imaging, or other capacity. (This "other" capacity can theoretically extend to diverse and noncomputational abilities such as refrigeration and toasting through appliances networked and controlled over the Internet.)

Jini and Java are somewhat at odds with the work of groups such as the Object Management Group, perhaps splitting the standards, efforts, and perceptions of developers and consumers. The visibility and market appeal of Sun, however, may bring the power of components to the Internet faster than the OMG has proven able to do.

Endnotes

1 http://www.simcalc.umassd.edu. See also the ESCOT profile in "The Sixth Component," p. 54.

2 http://wise.sri.com/escot/

3 http://www.eoe.org

4 I have debated over the use of this phrase. "Industrialization" has mainly harsh connotations for us in this late, or postindustrial, phase. Even those who generally support the changes in comfort, medical care, longevity, infant mortality, food production, and individual rights that have accompanied industrial development, are uncomfortable with the mechanization, factory labour, and profit-driven production methods integral to its first phase. I use the word because nothing else so tightly captures the interplay of demand, market, and production systems in a transformative mix.

David Noble has published a broad attack on online education, which he styles as the "commoditization" of education. While he uses a different term, it is clear that Noble means to attack many of the processes that I refer to as "industrialization." See Noble, "Digital Diploma Mills: The Automation of Higher Education," http://www.firstmonday.dk/issues3_1/noble/index.html, and *Educom Review*, May/June 1998, p. 22, for excerpts.

5 An interesting, if superficial, indication of these craft factors can be found by scanning books such as *The Chicago Manual of Style*, whose thirteenth edition lists thirty-six pages of rules of correct style for references, notes, and bibliographies in papers and books, another twenty-five on footnotes and endnotes, and seventeen pages on the proper use of illustrations, captions, and legends.

6 See Bell 1973.

7 See, for example, *Forbes*, "Baby Boomers," 3 November 1997; San Jose *Mercury News* lists fifty-two stories having "convergence" as a topic in 1998 alone; *Red Herring*, "Cisco capitalizes on voice, data convergence," 20 April 1998 (www.redherring.com/insider/1998/0420/cisco.html); and "When worlds collide," February 1997 (www.redherring.com/mag/issue39/worlds.html).

8 A 24 June 1998 press release by the Bureau of Labor Statistics of the US Department of Labor indicates that the average person in the US holds 8.6 different jobs from the ages of eighteen to thirty-two. These findings are from the National Longitudinal Survey of Youth, a survey of 9,964

young men and women who were fourteen to twenty-two years of age when first interviewed in 1979, and thirty-one to thirty-nine when last interviewed in 1996. The bureau also reports on median job-holding in a table that indicates that the number of jobs held may decline by age thirty-two, but at its longest, barely exceeds ten years. See Bureau of Labour Statistics News Release, Thursday, 30 January 1997.

9 For example, an article in the Seattle *Times* reports that there are presently 9,000 to 30,000 unfilled jobs in Washington State in the information technology sector. See Seattle *Times*, 13 August 1998. http://www.seattletimes.com/news/local/html98/info_081398.html

10 Lynn Margherio, "The Emerging Digital Economy" (Washington, DC: US Department of Commerce, 1998).

11 Lewis, *Friction-Free Economy*, discussing mainstreaming, p. 36. Note that the market is not defined as population but rather as potential consumers, a number that can be much smaller.

12 Statistics are notoriously difficult. Lower numbers reflect calculations of "active" users. See http://www.currents.net/newstoday/98/07/09/news3.html?st.ne.fd.mnaw. The following chart indicates the estimates and the estimators.

Figure 6: Source Comparison: Millions of Net Users 1997–1998 (year-end)

Source	Definition	1997	1998
Intertrek	US total pop.	63.0	n/a
Intelliquest	US adults, 16+	62.0	70.0
Relevant Knowledge	US adults, 12+	55.4	57.0
NUA Consultancy	North Am. adults, 18+	54.0	n/a
Nielsen Media Research	North Am. adults, 18+	52.0	58.0
Morgan Stanley	US adults, 18+	50.0	80.0
Find/SVP (CyberDialogue)	US adults, 18+	41.5	75.0
Media Metrix	US adults, 18+	38.0	n/a
Computer Intelligence	US total pop.	31.0	n/a
MRI	US adults, 18+	n/a	44.0
eStats	US adults, 18+	28.0	47.0

Source: eStats

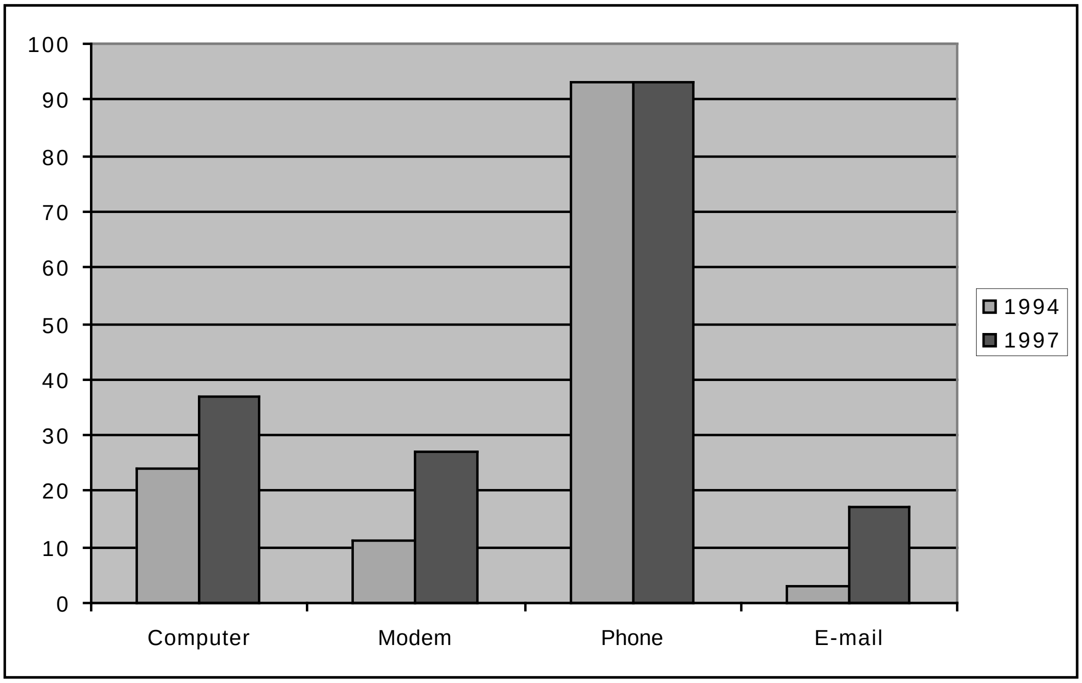
13 In 1996, 24 million personal computers were sold in the US. *Friction-Free Economy*, p. 48.

14 "Falling through the Net II" (Washington, DC: US Department of Commerce, 28 July 1998). The chart on the next page is taken from that report.

15 Cable television now reaches approximately 70 percent of the US, or 65 million homes. *Forbes*, "Worldgate TV," 26 September 97, or http://www.forbes.com/tool/ html/97/sep/0926/feat4.htm;

and "Elsewhere in Internet TV Land," July 1997, or http://www.forbes.com/tool/html/97/july/release0718/tvland.htm. Numbers for television and radio are found in *Business Week,* 22 June 1998, p. 122. All of these numbers are only indicators of general trends. In the case of the radio and television numbers, which are absolute figures rather than percentages, it should be remembered that the population of the US was much smaller in the time of radio, making it much harder to reach 60 million listeners than it is today to reach the same number of people.

Figure 7: Percentage of US Households with Computers, Modems, Phones, and E-mail 1994 and 1997.



16 "The Emerging Digital Economy," p. 48.

17 This paper makes extensive use of American material, as US Internet and labour statistics represent larger global populations and for that reason are more useful than Canadian equivalents.

18 *EduPage,* 9 July 1998.

19 http://www.forbes.com/forbes/97/0616/5912084a.htm

20 Note the discussion on bandwidth increasing internationally on p. 28.

21 http://www.idg.net/server-java/ClientInterface?method=getUrlFrame&docId=20665&referer=&server_name=www.idg.net

22 I am excluding distance education by television. While it has had widespread use, that use is also limited geographically. Only rarely does the range of televised education extend beyond the natural geographical boundaries of the institution. In that way, it tends to augment classroom offerings within the same market area. Two-way televised classrooms are, even more, an augmen-

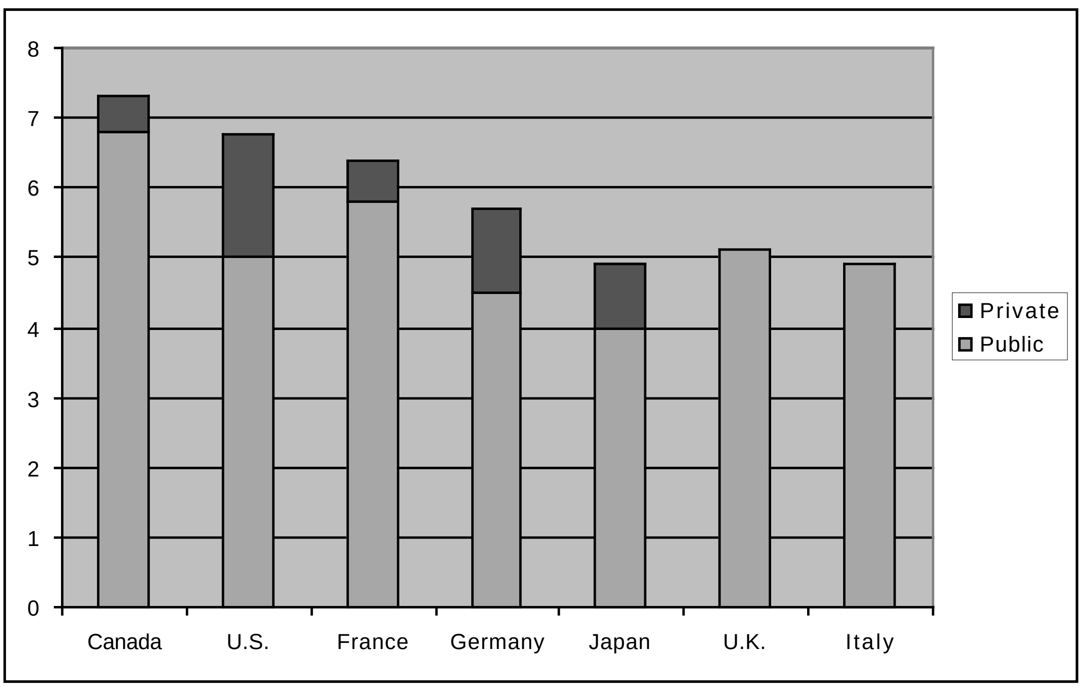
tation of classroom presentation to the same student market, given that they require students to assemble in the distant classroom organized by the institution for that purpose. Notwithstanding these limitations, televised distance education has been widespread. A report of the United States National Center for Education Statistics (October 1997) determined that one-third of all US higher education institutions offered distance education and one-quarter of these offered full-degree courses by this method.

23 *Forbes* (19 June 1997) reports that Duke University's online MBA program attracts more students than the less costly resident version.

24 It is interesting to compare the number of corporate degree-grantors (1,600) with the number of degree-granting colleges in the US. The US National Center for Education Statistics "Digest of Education Statistics 1997" reports 2,244 four-year colleges with 1,855 offering bachelor's degrees.

25 "The Condition of Education 1997" (Washington, DC: National Center for Education Statistics, 1997), p. 176.

26 Figure 8: Public and private expenditures on educational institutions in G-7 countries as a percentage of GDP, by level of education and source of funds: 1994 .



Source: "Education at a Glance: OECD Indicators, 1997," Organization for Economic Co-operation and Development, Center for Educational Research and Innovation.

1. Includes all institutions (public and private), except for Germany and Italy, which include only public institutions, and the United Kingdom, which includes public and government-dependent private institutions.
2. Private expenditures are defined as private payments from households and other private entities to educational institutions, subtracting any portion derived from public subsidies.

3. Public expenditures are defined as direct public expenditures on educational institutions plus public subsidies to households and other private entities for educational institutions (e.g., tuition and fees), excluding other public aid to students and households (e.g., subsidies for student living costs).
4. Data for private sources expenditures for the United Kingdom are not available.

Note: Private sources of funds for some countries are less than 1 percent; therefore, percentages may not be discernible in the graphs.

27 "Oracle Learning Architecture: Bringing Education Online and into the Next Century" (Redwood Shores, CA: Oracle Corporation, 1996), p. 3.

28 These are numbers gathered informally by the author at numerous conferences during the past year.

29 http://www.microsoft.com/education/hed/online/distlfaq.htm

30 Cisco Corporation offers schools and universities $2 million and training for two teachers in return for teaching network classes on Cisco products.

31 "The Emerging Digital Economy," p. 2. It is interesting to compare more current numbers. In July 1998, J.D. Power & Associates reported that two hundred thousand cars had been sold online in the prior month, or double the monthly number reported in the Department of Commerce survey of 1997. Their report projects that 20 percent of all auto sales will be online by 2000. See http://www.thestandard.net/metrics_display/0,1283,1191,00.html

32 http://advisor.gartner.com/n_inbox/archive/ar_digital_008.html

33 "Today's Internet … cannot meet the business and consumer needs of the future. 'That's why we named the project Oxygen. For carriers, it's a matter of survival.'" Project head Tagare, quoted in *EETimes*, 1 December 1997, issue 983. http://www.techweb.com/se/directlink.cgi?EET 19971201S0075

34 http://www.techweb.com: 320/se/directlink.cgi?EET19980518S00277

35 See note 22.

36 "The Doctor Is Online: Health Care Goes Digital," *The Industry Standard*, 24 July 1998, http://www.thestandard.net/articles/issue_display/ 0,1261,1206,00.html; and see also "Former Microsoft Exec To Launch Drugstore.com," *The Industry Standard*, 27 July 1998, http://www.thestandard.net/articles/issue_display/0,1261,1218,00.html

37 "Homeschool Battles," *US News Online*, 2 December 1996; http://www.usnews.com/usnews/issue/school.htm

38 "Higher Earning: The Fight to Control The Academy's Intellectual Capital," 28 June 1998. http://www.thestandard.net/articles/issue_display/0,1261,874,00. html

39 Hagel and Armstrong's *Net Gain* is an example of a recent book extolling the benefits of community-building for online businesses.

40 Just go to http://www.eoe.org and click on "Library" for a collection of thousands like these, freely available for anyone to send their students to.

41 This summary draws heavily on a paper by Denis Newman of IMS, and published on the EOE Foundation website. See http://www.eoe.org

42 Information is quoted from the OMG website.

43 Information on MERLOT was gathered from the website; this summary is a distillation of the description provided by the project organizers.

44 This profile is summarized from the ADL paper posted to the EOE website, by Don Johnson of the ADL.

References

Bell, Daniel. 1973. *The Coming of Post-Industrial Society.* Basic Books.

Braudel, Fernand. 1981–84. *Civilization and Capitalism, 15th–18th Century*. Harper & Row.

Cheny, Margaret. 1981. *Tesla: Man Out of Time.* Dell Publishing Co., Inc.

Davis, Stanley M. 1987. *Future Perfect.* Addison-Weseley Publishing Company, Inc.

Graham, Ian. 1995. *Migrating to Object Technology.* Addison-Weseley Publishing Company, Inc.

Hagel, John, and Arthur G. Armstrong. 1997. *Net Gain: Expanding Markets through Virtual Communities.* Harvard Business School Press.

Lewis, T.G. 1997. *The Friction-Free Economy: Marketing Strategies for a Wired World.* HarperBusiness.

Orfali, Robert, Dan Harkey, and Jeri Edwards. 1996. *The Essential Distributed Objects Survival Guide.* John Wiley & Sons, Inc.

——. 1997. *Instant Corba.* John Wiley & Sons, Inc.

Pacey, Arnold. 1975. *The Maze of Ingenuity: Ideas and Idealism in the Development of Technology.* Holmes & Meier.

Peppers, Don, and Martha Rogers. 1993. *The One-to-One Future: Building Relationships One Customer at a Time.* Doubleday Publishing Group, Inc.

Tyack, David, and Larry Cuban. 1995. *Tinkering Toward Utopia: A Century of Public School Reform.* Harvard University Press.

List of Publications

Occasional Papers Series

85.01 *Worker Co-operatives in Mondragon, the U.K., and France: Some Reflections.* Christopher Axworthy (48pp.)

85.02 *Employment Co-operatives: An Investment in Innovation: Proceedings of the Saskatoon Worker Co-operative Conference.* Skip McCarthy, ed. (288pp.)

85.03 *Prairie Populists and the Idea of Co-operation, 1910–1945.* David Laycock (48pp.)

86.01 *Co-operatives and Their Employees: Towards a Harmonious Relationship*. Christopher Axworthy (82pp.)

86.02 *Co-operatives and Social Democracy: Elements of the Norwegian Case.* Finn Aage Ekelund (42pp.)

86.03 *Encouraging Democracy in Consumer and Producer Co-operatives.* Stuart Bailey (124pp.)

86.04 *A New Model for Producer Co-operatives in Israel.* Abraham Daniel (54pp.)

87.01 *Election of Directors in Saskatchewan Co-operatives: Processes and Results*. Lars Apland (72pp.)

87.02 *The Property of the Common: Justifying Co-operative Activity*. Finn Aage Ekelund (74pp.)

87A.03 *Co-operative/Government Relations in Canada: Lobbying, Public Policy Development and the Changing Co-operative System*. David Laycock (246pp.)

87A.04 *The Management of Co-operatives: A Bibliography.* Lou Hammond Ketilson, Bonnie Korthuis, and Colin Boyd (144pp.)

87.05 *Labour Relations in Co-operatives.* Kurt Wetzel and Daniel G. Gallagher (30pp.)

87A.06 *Worker Co-operatives: An International Bibliography/ Coopératives de Travailleurs: Une Bibliographie Internationale.* Rolland LeBrasseur, Alain Bridault, David Gallingham, Gérard Lafrenière, and Terence Zinger (76pp.)

88.01 *Worker Co-operatives and Worker Ownership: Issues Affecting the Development of Worker Co-operatives in Canada.* Christopher Axworthy and David Perry (100pp.)

88.02 *A History of Saskatchewan Co-operative Law—1900 to 1960.* Donald Mullord, Christopher Axworthy, and David Liston (66pp.)

88.03 *Co-operative Organizations in Western Canada.* Murray Fulton (40pp.)

88.04 *Farm Interest Groups and Canadian Agricultural Policy*. Barry Wilson, David Laycock, and Murray Fulton (42pp.)

89.01 *Patronage Allocation, Growth, and Member Well-Being in Co-operatives*. Jeff Corman and Murray Fulton (48pp.)

89.02 *The Future of Worker Co-operatives in Hostile Environments: Some Reflections from Down Under.* Allan Halladay and Colin Peile (94pp.)

90.01 *Community-Based Models of Health Care: A Bibliography.* Lou Hammond Ketilson and Michael Quennell (62pp.)

91.01 *The Co-operative Sector in Saskatchewan: A Statistical Overview*. Louise Simbandumwe, Murray Fulton, and Lou Hammond Ketilson (54pp.)

91.02 *Farmers, Capital, and the State in Germany, c 1860–1914.* Brett Fairbairn (36pp.)

92.01 *Co-operatives in Principle and Practice.* Anne McGillivray and Daniel Ish (144pp.)

92.02 *Matador: The Co-operative Farming Tradition.* George Melnyk (26pp.)

92.03 *Co-operative Development: Towards a Social Movement Perspective.* Patrick Develtere (114pp.)

93.01 *The Co-operative Movement: An International View*. S.K. Saxena (20pp.)

94.01 *Credit Unions and Caisses Populaires: Background, Market Characteristics, and Future Development.* J.T. Zinger (26pp.)

94.02 *The Meaning of Rochdale: The Rochdale Pioneers and the Co-operative Principles.* Brett Fairbairn (62pp.)

96.01 *Comparative Financial Performance Analysis of Canadian Co-operatives, Investor-Owned Firms, and Industry Norms.* Andrea Harris and Murray Fulton (152pp.)

98.01 *Co-operative Organization in Rural Canada and the Agricultural Co-operative Movement in China: A Comparison.* Zhu Shufang and Leonard P. Apedaile (56pp)

99.01 *The Components of Online Education: Higher Education on the Internet.* Byron Henderson (78pp.)

Books and Other Publications

1991 *Co-operatives and Community Development: Economics in Social Perspective.* Brett Fairbairn, June Bold, Murray Fulton, Lou Hammond Ketilson, and Daniel Ish (160pp.)

1992 *Saskatchewan Co-operatives: A Record of Community Development.* Centre for the Study of Co-operatives (32pp.)

1994 *Research for Action: Women in Co-operatives.* Leona Theis and Lou Hammond Ketilson (98pp.)

1995 *Making Membership Meaningful: Participatory Democracy in Co-operatives.* The International Joint Project on Co-operative Democracy (356pp.)

1995 *New Generation Co-operatives: Rebuilding Rural Economies.* Brenda Stefanson, Murray Fulton, and Andrea Harris (24pp.)

1995 *Realizing Community: Multidisciplinary Perspectives.* L.M. Findlay and Isobel M. Findlay, eds. Co-published with the Humanities Research Unit (208pp.)

1996 *Legal Responsibilities of Directors and Officers in Canadian Co-operatives.* Daniel Ish and Kathleen Ring (148pp.)

1997 *A Discussion Paper on Canadian Wheat Board Governance.* Murray Fulton (16pp.)

1997 *Balancing Act: Crown Corporations in a Successful Economy.* Brett Fairbairn (16pp.)

1997 *A Conversation about Community Development.* Centre for the Study of Co-operatives (16pp.)

1997 *Credit Unions and Community Economic Development.* Brett Fairbairn, Lou Hammond Ketilson, and Peter Krebs (32pp.)

1997 *New Generation Co-operatives: Responding to Changes in Agriculture.* Brenda Stefanson and Murray Fulton (16pp.)

1998 *Working Together: The Role of External Agents in the Development of Agriculture-Based Industries.* Andrea Harris, Murray Fulton, Brenda Stefanson, and Don Lysyshyn (184pp.)

1998 *The Social and Economic Importance of the Co-operative Sector in Saskatchewan.* Lou Hammond Ketilson, Michael Gertler, Murray Fulton, Roy Dobson, and Leslie Polsom (244 pp.)

1998 *Proceedings* of the Women in Co-operatives Forum, 7–8 November 1997, Moose Jaw, SK (112pp.)

1999 *Networking for Success: Strategic Alliances in the New Agriculture.* Mona Holmlund and Murray Fulton (48pp.)

These and other publications are available from:
Centre for the Study of Co-operatives
101 Diefenbaker Place
University of Saskatchewan
Saskatoon, SK S7N 5B8
Phone: (306) 966–8509 / Fax: (306) 966–8517
E-mail: coop.studies@usask.ca
Website: http://coop-studies.usask.ca