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Role of Colleges of Applied Arts and Technology (CAATs) in raising Ontario's labour productivity and contributing to its prosperity

(Prism & Donner)

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Role of Colleges of Applied Arts and Technology (CAATs) in raising Ontario's labour productivity and contributing to its prosperity

Prepared for the Association of Colleges of Applied Arts and Technology of Ontario

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Table of Contents

Introduction and Summary

This report documents the central role of the college-educated workforce in improving labour productivity across the economy and supporting an innovation culture in the workplace. It describes critical "enabling occupations" that play a key role in allowing companies to build a culture of innovation in the workplace which they need if they are to continually restructure for success. It develops a *"Prosperity Cycle"* model and demonstrates the importance of college graduates in building a culture of innovation in a dozen key Ontario industries.

Ontarians work hard and build for the future, hoping that rising prosperity will improve the quality of life for their families. A higher standard of living seems hard to achieve these days – especially for young people leaving school. Government, businesses, researchers and others believe that Ontario's prosperity depends on rising productivity that improves the competitiveness of industry. But how is this achieved and how do young people share in the benefits?

A recent report says: "Ontarians increase their incomes primarily by encouraging businesses to innovate to stay ahead of the competition – they must produce new products and services and adopt new processes and technologies that meet market demands."[1]

Many reports are focused on how Ontario and Canadian industries can produce more new products and services. They focus on a model of economic growth that promotes research, development and commercialization of new technologies, products and services. Success in this model is represented by new products or services that are invented and commercialized in Ontario and then sold in large volumes on a global scale. This is an obvious and high-profile path to success. However, in practice, this path is limited to a very small range of Ontario businesses which are in a position to withstand the substantial additional costs and risks inherent in being a 'global first mover.'

This report suggests that productivity improvements are realized on a much larger scale and in a complementary manner by the systematic implementation of state-of-the-art technologies and processes.[2] In other words, this report focuses on productivity growth based on the second part of the quote "adopt(ing) new processes and technologies that meet market demands".[3]

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[1] Ontario Ministry of Finance. *Toward 2025: Assessing Ontario's Long-Term Outlook.* October, 2005. p. 56.
[2] "In the short and medium-term, data seems to suggest that a substantial contribution to overall productivity growth also comes from productivity changes within industries, rather than as a result of significant shifts of employment across industries." OECD. *Understanding Economic Growth*. 2004. p. 54.
[3] See, for example, The Centre for the Study of Living Standards. September 23, 2005 (Revised Version). *The Diffusion and Adoption of Advanced Technologies in Canada: An Overview of the Issues* which states "The reality is that while R&D is not undertaken by the vast majority of Canadian firms, these firms do adopt new technologies. From this perspective, the innovation and productivity performance of the vast majority of firms in Canada depends on the diffusion of new technologies and their adoption by firms. Without diffusion, invention and innovation / commercialization would have little economic and social impact."

Instead of restricting themselves to the 2.5 per cent of the G-7's R&D conducted in Canada[4] as a source of new ideas to improve their ability to compete, Ontario businesses must be open to adopt good ideas wherever they can find them. Branch plants, such as auto assemblers, have access to R&D produced in their head offices as well as the R&D they conduct in Ontario, and many businesses depend on the R&D embedded in the new technology they purchase.

These new technologies and processes may already be commercialized in Canada or elsewhere in the world but must be disseminated to and adopted by Ontario businesses such as small and medium enterprises (SMEs), manufacturers and their suppliers as well as the rapidly expanding service sector if they are to enhance their productivity and competitiveness. [5]

Significantly, a Statistics Canada study on innovative firms and activities found that the major cost or risk to adopting new technology is shortages of workplace skills to implement the technology. [6]

This view of the critical importance of an innovative culture that supports ongoing restructuring for success puts new demands on the full workforce, not just on a small cadre of managers and researchers.[7] As stated in *Toward 2025: Assessing Ontario's Long-Term Outlook*, "Productivity can rise through technological advances, investments that lead to more abundant and complex equipment for workers, and investments in the training and education of workers."[8]

Colleges play a crucial role in this process through programs that train the workers who will design, install, maintain, repair, troubleshoot and manage the new processes.[9] Their 1,700,000 graduates are contributing to productivity improvements and an innovation culture in virtually every industry and every community in Ontario. Their skills seem, on the surface, different but they apply analytical skills and an understanding of how things

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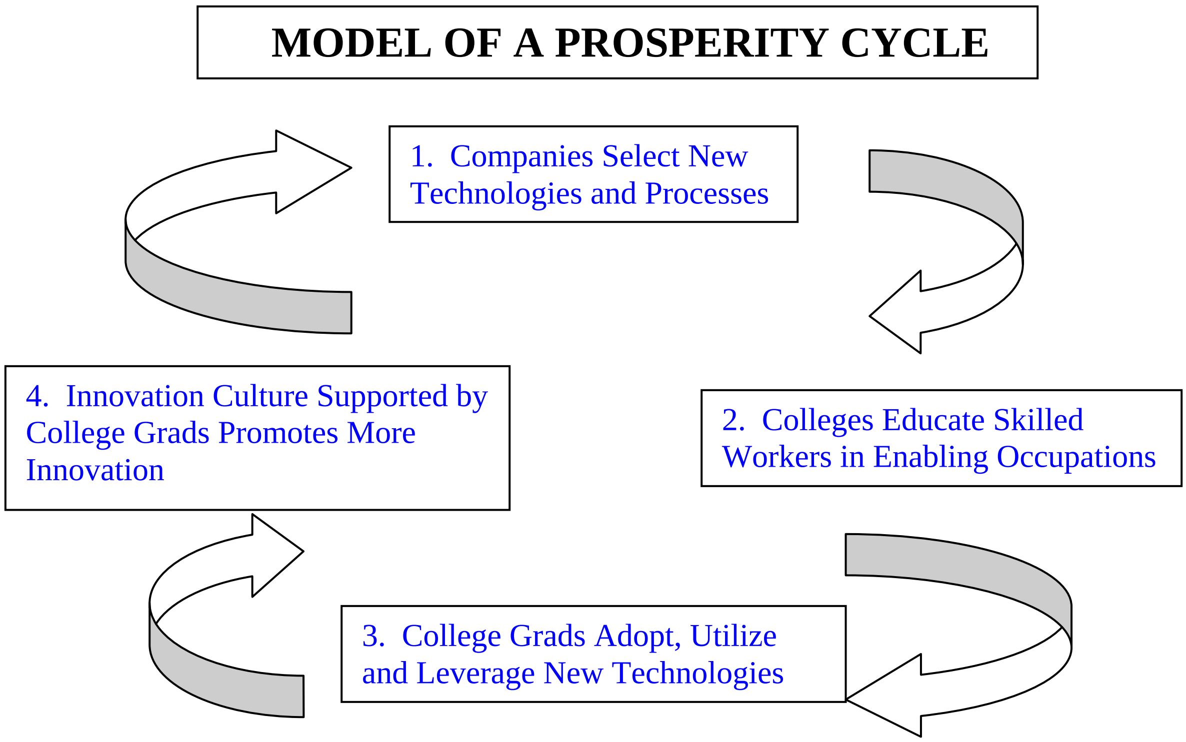
[4] Statistics Canada. Innovation Analysis Bulletin—Vol. 7, No. 3 (October 2005). P. 5.
[5] Indeed, for many businesses, success in implementing new technologies and processes developed elsewhere is a pre-requisite for engaging in applied research and development – some of which may not be eligible for Canadian R&D tax credits, and may not be fully incorporated in estimates of total industry R&D.
[6] See Impediments to Advanced Technology Adoption for Canadian Manufacturers, by John Baldwin and Zhengxi Lin, Micro Economic Analysis Division, Statistics Canada, August 2001, page 8.
[7] "The transition toward a global economy based on the acquisition and application of knowledge as the driving force for new processes, businesses and industries depends extensively on progressively higher levels of skills in the labour markets of industrialized nations. In this regard, the demand for workers possessing appropriate and high level skills has increased dramatically over the past several years and will continue to increase over the next decades….
An overarching theme which emerged was the critical importance of a lifelong learning approach to skills development. Such an approach would encourage the growth of a new "ethic" both inside post-secondary institutions and outside in the private training institutions and, fundamentally, in the workforce." *Skills Development in the Knowledge-Based Economy*. Conference Summary Report. June 22-23, 1999. Moncton, New Brunswick.
[8] Ontario Ministry of Finance. *Toward 2025: Assessing Ontario's Long-Term Outlook*. October, 2005. p. 56.
[9] See, for example, Robert D. Atkinson and Paul D. Gottlieb. 2001. *The Metropolitan New Economy Index: Benchmarking Economic Transformation in the Nation's Metropolitan Areas. p15.* The rise of new industries has meant the rise of new jobs, while new technology and new ways of organizing work have transformed many existing jobs. Both trends have changed the occupational mix in America. In particular, managerial, professional, and technical jobs have increased as a share of total employment. These workers include, among others, managers, engineers and scientists, health professionals, lawyers, educators, accountants, bankers, consultants, and engineering technicians.

get done in the workplace that are needed on the job to transform new technologies and processes into improved productivity.



What is the *Prosperity Cycle*?

1. The cycle begins when companies select new machinery, equipment, technology and necessary business processes.

2. In the short term, colleges provide skilled workers with analytical skills and hands-on savvy. Many of these graduates are in 'enabling occupations.'

3. In the medium term, businesses, with the help of college graduates in enabling occupations implement the new technologies and processes.

4. In the long term, business, with the support of college graduates, especially in enabling occupations, creates an innovation culture in the workplace to ensure it can improve competitiveness and raise productivity through more innovation.

This basic framework – the *Prosperity Cycle* – is applied in six key Ontario industries. In several cases, sub-industries are considered, bringing the total to a dozen. The first is the critical *manufacturing* sector, and three others, *mining*, *broadcasting and telecommunications* and *professional and scientific services* are sub-industries of those identified by the Ontario Ministry of Finance as significant exporters to other provinces, the United States and the rest of the world.[10] The other two are ***repair and maintenance***, an industry requiring new skills as equipment becomes more complex and changes more quickly, and ***health services*** in which technological change and cost-cutting are changing roles of workers.

These industries represent both goods and services sectors. They include both high- and low-productivity achievers and high and average college-intensive employers. They include export industries, direct producers for business and consumers and supporting industries (e.g. repair and maintenance).

The nature of the new technologies and related structural change is different in each industry – but the role of college-qualified enabling occupations is clear. There are three elements in the description of each industry;

- technologies and processes that build productivity,
- enabling occupations that implement these and
- college programs that educate the workers.

The dozen industry studies illustrate the role of colleges and their graduates in implementing new technology. This role is slowly being recognized in evolving government policies and industry plans. Evidence of recognition of the "*prosperity cycle*" is apparent in, for example, in the *2005 Ontario Budget Paper B*, which says:

> "Knowledge workers act as a magnet for leading-edge firms seeking to invest in new ideas. In addition, workers with up-to-date skills can make the most of emerging technologies and contribute to a more productive economy that can compete successfully for international capital."[11]

The *Prosperity Cycle* links productivity directly to college programs. This link is already clear to many companies – for example, in the case studies. Often, these companies see their access to Ontario's college graduates as an important competitive advantage.

The Prosperity Cycle is a key strategic tool for Ontario industry and colleges. The next steps to implement this strategy would be to:

- Validate and reinforce the overall idea of the *Prosperity Cycle* with the colleges and industries described in this paper.
- Describe the *Prosperity Cycle* in other industries – finding both active examples of success with enabling occupations and potential applications in new industries.
- Draw government into the discussion through a new dialogue about productivity.

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[10] "Ontario has a high employment share in four industries: manufacturing, information and communications technology, financial and professional services, and the entertainment and creative cluster. In other words, Ontario has specialized in these industries, and exports these goods and services to other provinces, the United States and the rest of the world…. In addition, rural and northern Ontario have competitive advantages in agriculture and resources."
Ontario Ministry of Finance. *Toward 2025: Assessing Ontario's Long-Term Outlook.* October, 2005. p.32.
[11] Ontario Minister of Finance. 2005 *Budget Paper B: Progress Towards a New Generation of Economic Growth.* p.95.

- Map out new programs – for industries covered in this report and new opportunities.
- Seek funding and industry partnerships drawn from the *Prosperity Cycle model* and based on measures of success. For example:

  - Identify technologies, equipment, materials, products and services.
  - Identify enabling occupations and target the number of workers needed.
  - Identify the elements for new program development including corporate partners, curriculum, instructors, equipment and facilities and costs.
  - Initiate training programs based on the *Prosperity Cycle* and track associated productivity gains.

In this view of Ontario's economic well-being, the public policy advantage of more college funding is gains in productivity across the economy leading to a more prosperous Ontario.

1. Achieving Prosperity Through Productivity Growth

Economic prosperity brings a sense of well-being and security related to rising incomes, savings and productive work in successful organizations. Individuals, families, businesses and governments all share in this experience and seek ways to improve prosperity. This section describes measures of prosperity and links them to the contribution of Ontario colleges.

> "A knowledge-based economy relies primarily on the use of ideas rather than physical abilities and on the application of technology rather than the transformation of raw materials or the exploitation of cheap labour. Knowledge is being developed and applied in new ways. Product cycles are shorter and the need for innovation greater. Trade is expanding world-wide, increasing competitive demands on producers."
>
> "The global knowledge economy is transforming the demands of the labour market throughout the world. It is also placing new demands on citizens who need more skills and knowledge to be able to function in their day-to-day lives."
>
> World Bank: "Lifelong Learning in the Global Knowledge Economy: Challenges for Developing Countries" pg. xvii (May 2003)

1.1 Measuring Prosperity

Prosperity is usually measured by income, wealth and the quality of life. For national and provincial economies, the best available measure is "Gross Domestic Product" per person – an estimate of each person's contribution to the real value of economic output. The rate of increase in GDP per person is widely used to benchmark performance and Ontario's success is a source of government and private focus.[12]

Exhibit 1 uses GDP per person to measure prosperity for Canada and competing jurisdictions. Ontario is a prosperous place compared to the rest of the world, but some jurisdictions are more successful and wealthier. The United States sets the world standard and Ontario's GDP per person is 10 per cent below the US level and much farther below the most prosperous American states. There is a wide variation on these measures across US States and it is natural to compare Ontario to the more successful states. In the comparisons made by the Institute for Competitiveness and Prosperity, Ontario per-capita GDP is just two thirds of Massachusetts.[13]

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[12] There are many studies and reviews that monitor productivity and prosperity in Canada, Ontario and specific industries. This study relies, in particular, on the Centre for the Study of Living Standards (CSLS) for core data and analysis.

[13] See "Investing in Prosperity, Task Force on Competitiveness, Prosperity and Economic Progress, Second Annual Report, Page 13.

This same measure, tracked over time, highlights the real problem. Ontario's growth in GDP per person has slowed down and growth is now below many other industrial jurisdictions. Ontario is losing ground and government policies are focused on catching up.

Another factor in considering prosperity is the distribution of income. Riddell and Sweetman point out that "earnings inequality did not increase as much in Canada as it did in countries such as the US, where the increasing education premium is a factor contributing to growing income inequality. In this context, it is important to emphasize that the supply response [i.e. more postsecondary graduates] not only increased the the number of more-educated workers but decreased the supply of less-educated workers, thus reducing what otherwise would have been downward pressure on their earnings and employment opportunities."[14]

Another of their findings also tends to support the concept of the Prosperity Cycle: ""There also seems to be a large wage premium among those with a close education-work relationship. Finally, the jobs of a large proportion of well-educated workers are being affected by technological change that is increasing the skill requirements of those jobs."[15]

1.2 Measuring Productivity

Prosperity measured in Exhibits 1 above applies to the entire population – both people working and those outside the workforce. Improving prosperity will depend both on employing as many Ontarians who want or need a job as possible as well as on the success of those who are working and the organizations that employ them.

One of Canada's, and particularly Ontario's, challenges during the 1990s was that too few were in the workforce: unemployment was very high, many more were too discouraged even to look for work. Moreover, many who were working had jobs whose requirements were well below their capabilities.

The situation has been improving during the past few years, in part through effective monetary and fiscal policies, along with greater attention to labour market policies.

These issues are well beyond the scope of this report, which is concerned primarily with improving the productivity of those who are working. It is concerned about an economy in which more are working up to their capabilities and in which they are trained to anticipate continued changes and increased responsibility in their jobs.

[14] W. Craig Riddell and Arthur Sweetman. "*Human Capital Formation in a Period of Rapid Change*." In W. Craig Riddell and France St-Hilaire. *Adapting Public Policy to a Labour Market in Transition*. 2000. p. 135.
[15] Ibid p. 136.

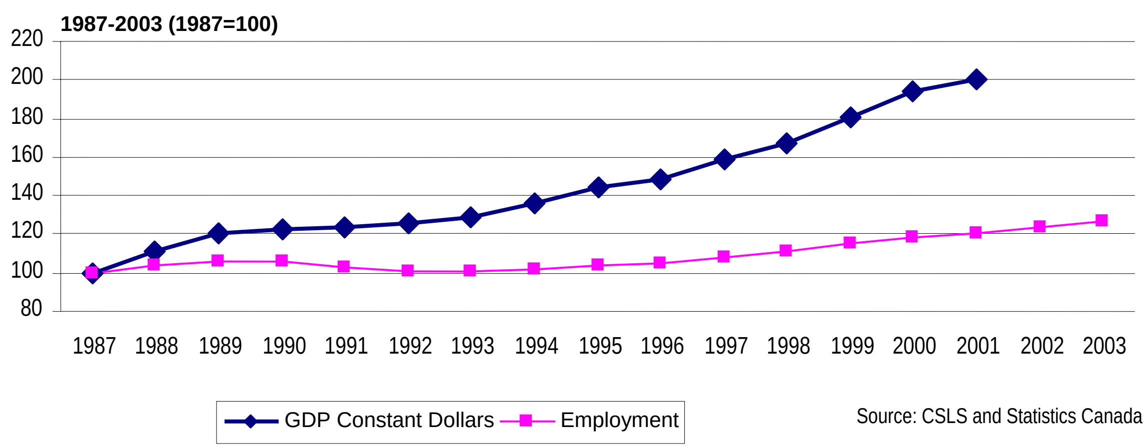
Productivity is a more targeted measure of output per employed worker. This measure tracks the overall efficiency of the economy as it combines workers with the materials and equipment to produce the province's total goods and services. Productivity is the operational measure of economic success.

Governments recognize productivity improvement as a crucial goal in industrial policy. Economists argue that rising productivity is the most important long-run source of prosperity. Productivity focuses attention on the ability of the economy and its industries to supply goods and services efficiently by measuring physical output per unit of input – usually per unit of labour. While the first impression is that higher productivity means working harder, research shows that productivity gains are much more complex.

Measures for Ontario shown in Exhibit 2 indicate the overall growth in output per worker (measured by real GDP) and employment. [16]

The widening gap between output and labour is a measure of improving labour productivity. Investment in capital is the driving force behind productivity and it reflects the addition of more efficient tools, equipment and machinery to assist the workers. The quality of the labour force is a key factor. Section 3 below shows how the college graduates and journeypersons in the workforce play a special role.

Exhibit 2: Index, GDP (Current Dollars) and Employment, All Industries, Ontario



Source: CSLS and Statistics Canada

[16] There are several measures of productivity, often depending on the specific nature of the analysis and the availability of data. International productivity comparisons, for example, can be complex because of the difficulty of finding comparable, meaningful data. One report states:

> "…There are several alternative measures of productivity, one … is real GDP per hour worked in the whole economy…real GDP per hour worked in the business sector …[and] multifactor productivity [which] divides real GDP by the quantity of capital used, not just the quantity of labour, and is generally thought to be a measure of general technological progress and efficiency."
> Ontario Ministry of Finance. *Toward 2025: Assessing Ontario's Long-Term Outlook*. October, 2005. p.56.

1.3 The Productivity Challenge

There are many examples of government policies and industry initiatives that seek to promote economic prosperity by increasing productivity through training and education. The federal government's 2001 Innovation Strategy focused extensively on productivity growth, innovation and human resources. Many Canadian governments and think-tanks have also analyzed issues of prosperity, productivity, innovation, research and development and commercialization. [17]

In many cases, these reviews focus on Canada's weak productivity growth compared to the U.S. Their concern is that the growing productivity gap will exacerbate the difference in living standards in years to come. Recently, for example, Andrew Sharpe stated:

> "The recent aggregate labour productivity performance of the United States has been unprecedented in its robustness. In contrast, labour productivity growth has been much weaker in Canada."[18]

The challenge for business and governments in Canada, then is that "Over the past two decades, the productivity levels of Canadian industries have been slipping relative to those of American industries."[19]

The challenge is shown to be much greater once it becomes clear that productivity measures and improvements are entirely different in each industry of the economy. Appendix 1 shows the growth in productivity in 20 Ontario industries from 1987 to 2003. Variations are huge, with industries such as mining and manufacturing up 35 per cent while construction actually reports a decline!

1.4 The *Prosperity Cycle*

The model of prosperity used here rests on five basic precepts:

- Rising labour productivity is essential to long-run prosperity
- Productivity growth varies widely by industry
- Improving productivity depends in large measure on investment in new technology and processes

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[17] This includes work by:
- The Conference Board of Canada
- The Centre for the Study of Living Standards
- The Ontario Task Force on Competitiveness, Productivity and Economic Progress
- Industry Canada
- Human Resources and Skills Development Canada and the Sector Council
- Canadian Policy Research Network

[18] Andrew Sharpe, Centre for the Study of Living Standards. "*Recent productivity developments in Canada and the United States: Productivity growth deceleration vs. acceleration*." *International Productivity Monitor*. No. 8. Spring 2004. p. 16.

[19] Conference Board of Canada, *Annual Innovation Report*, 2004.

- Adoption of new technology and processes depends on key "enabling" occupations and on the successful creation of an innovation culture in the workplace.
- Many of the most important "enabling" occupations are trained in colleges

The importance of the role of new technology in disseminating the results of the world's best R&D is highlighted by the fact that private sector spending on telecommunications, computer equipment and software in Ontario has grown from 4 to 29 per cent of their total investment budgets in the past two decades.[20] The implication of this huge increase is that many businesses have moved forever from an environment in which they built a plant and operated it with little change to an environment in which they must constantly change their core mandates, production processes and expectations of their workforce if they are to be competitive and thrive in a more open world economy. [21]

Even this rapid change may not be enough for success in a more demanding and competitive world economy. The Conference Board urges "Canadian businesses [to] become more innovative. Countries that demonstrate more innovation are wealthier and experience faster growth than less innovative countries…More innovative firms have improved productivity, higher profits and higher market share – and they grow more quickly." [22] Ontario's October1995 Throne Speech stated that "the Premier has established two goals for the new Ministry of Research and Innovation he is leading: to support the process of innovation and to create a culture of innovation".

And with a Statistics Canada study on innovative firms and activities finding that the major cost or risk to adopting new technology is shortages of workplace skills to implement the technology, the role of college credentials for enabling occupations is further highlighted.[23]

What is the P*rosperity Cycle*?

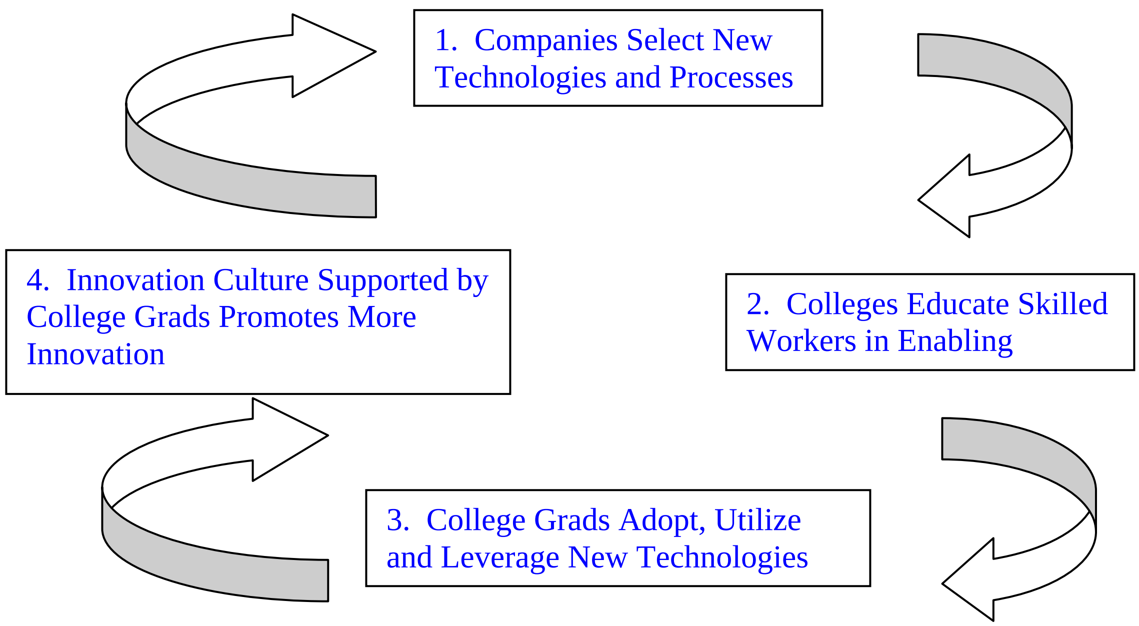
1. The cycle begins when companies select new machinery, equipment, technology and necessary business processes.

2. In the short term, colleges provide skilled workers with analytical skills, and hands-on savvy and an understanding of how things get done in the workplace. Many of these graduates are in 'enabling occupations.'

[20] Ontario Ministry of Finance. *Toward 2025: Assessing Ontario's Long-Term Outlook*. October, 2005. p. 31.
[21] In the manufacturing sector, investment in new machinery and equipment is the most important factor in increasing labour productivity. Statistics Canada, *Effect of Changing Technology Use on Plant Performance in the Manufacturing Sector*, July 2004 For companies in Ontario, new technologies are often imported and are adopted here because they are used in parent companies, required by important customers, or needed to meet pressures to cut costs or improve quality.
[22] Conference Board of Canada, Annual Innovation Report, 2004.
[23] See Impediments to Advanced Technology Adoption for Canadian Manufacturers, by John Baldwin and Zhengxi Lin, Micro Economic Analysis Division, Statistics Canada, August 2001, page 8.

- Colleges design and implement training programs for enabling occupations that fit the needs of employer groups and focus on the skills needed to implement and leverage new machinery, equipment, other technologies and business processes.

MODEL OF A PROSPERITY CYCLE



- Colleges recruit and enrol students based on employer needs and labour-market conditions.
- Skill shortages that threaten innovation and new technology can be managed by the expansion of college programs if funding permits.

3. In the medium term, businesses, with the help of college graduates in enabling occupations, adopt new technologies and processes.

    - College graduates, particularly those in 'enabling occupations", utilize and leverage new technologies in every part of the economy. As the graduates become established in the workforce, their incomes rise and experience expands. College graduates often are at the centre of new organizational structures and innovative teams of workers.

4. In the long term, business, with the support of college graduates, especially in enabling occupations, creates an innovation culture in the workplace to ensure it can improve competitiveness and raise productivity through more innovation.

    - By having skilled workers who can use and leverage the new technologies, companies can realize desired improvements in areas such as productivity, higher quality, and lower costs. For example, college grads' use of the new technologies and processes can encourage them to critique the new technologies which can then lead to further improvements and innovations.

- As productivity increases and new technology spreads through the economy, rewards for workers and owners are generated from innovation and investment in new technologies.

The *2005 Ontario Budget's* approach to productivity enhancement is broadly compatible with the ideas set out in the *Prosperity Cycle*. Its *Budget Paper B* begins:

> "Today, Ontario provides a quality of life that is among the highest in the world. There is, however, no room for complacency. In an era where ideas and technology spread rapidly over borders, where barriers to trade are falling and where global competition is fierce, the challenge of improving living standards is significant...
> Productivity gains are the key to improving living standards – the government's primary economic objective… government does have an important role to play in fostering a positive business climate and making strategic investments in postsecondary education, public infrastructure and services." **[24]**

[24] Ontario Minister of Finance. 2005 *Ontario Budget. Budget Paper B, "Achieving Our Potential; Progress Towards a New Generation of Economic Growth.* p. 93.

2. College Graduates Raise Productivity and Contribute to an Innovative Workplace Culture

"Knowledge workers act as a magnet for leading-edge firms seeking to invest in new ideas. In addition, workers with up-to-date skills can make the most of emerging technologies and contribute to a more productive economy that can compete successfully for international capital."

Ontario Budget 2005

Ontario's Colleges of Applied Arts and Technology (CAATs) are at the centre of future prosperity and their graduates are an essential force driving productivity. This report describes the role of the colleges and their graduates in building Ontario's prosperity.

Twenty-nine percent of Ontario's workforce (1.75 million workers) has a college qualification – the largest component of the six million strong labour force. Their skills are one of the most important contributions to Ontario's productivity growth.

Colleges teach practical skills that are essential in organizations investing in new technology or implementing new processes. Without skilled technicians and savvy operators, new technology is not contributing its full potential. Managers, engineers and scientists may have a vision of more productive potential, but it is the people installing, monitoring and problem solving the new processes who make things work.

An essential tier of these workers – often practicing new trades and occupations – are enabling the introduction of new technology and the associated productivity. These workers are often in short supply and are always in high demand.

Exhibit 3 shows that college-qualified workers are as likely as university graduates to be employed: both have employment rates well above workers without postsecondary credentials.

Exhibit 4 illustrates the growing importance of Ontario's colleges in training the province's workforce. The number of college-trained people in the workforce has been growing rapidly since 1990. Over the period 1990-2003, the number of college-trained persons in the workforce grew by 724,000, more than the net increase of 623,500 in university-trained workers. [25]

[25] In fact the number of college-educated persons may be understated as those with both university and college qualifications would be shown as university graduates only in the Statistics Canada data.

Exhibit 3

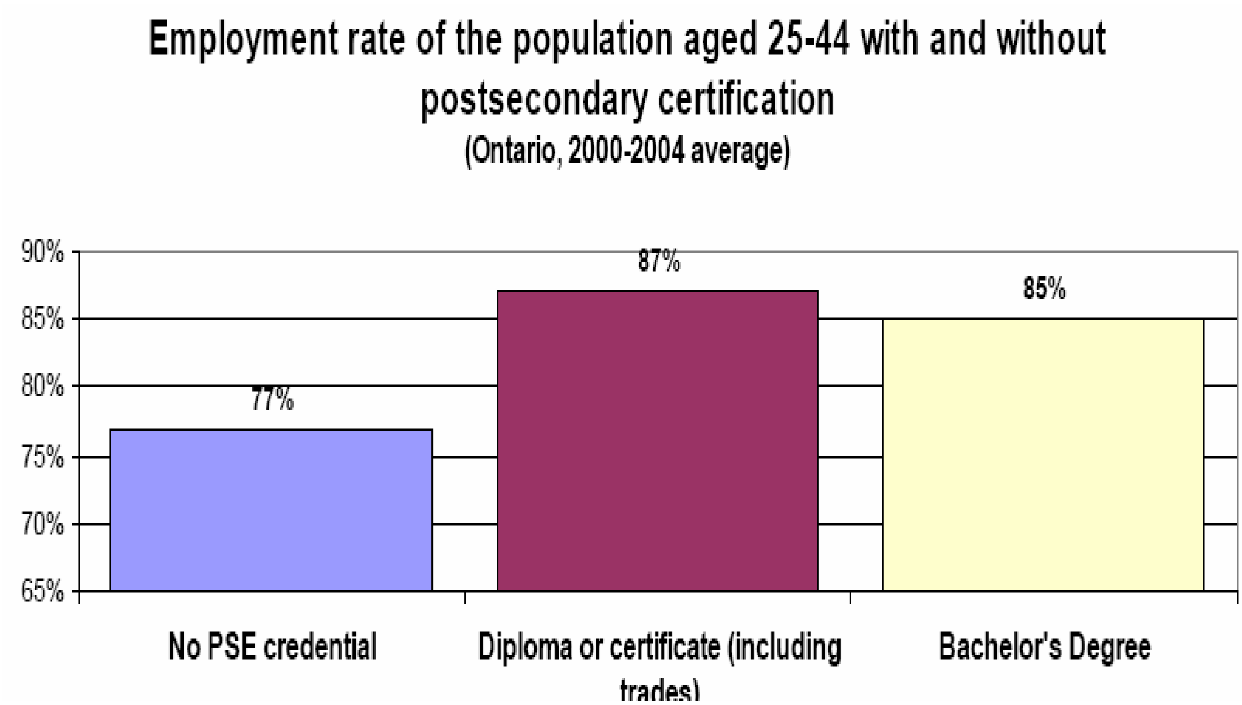
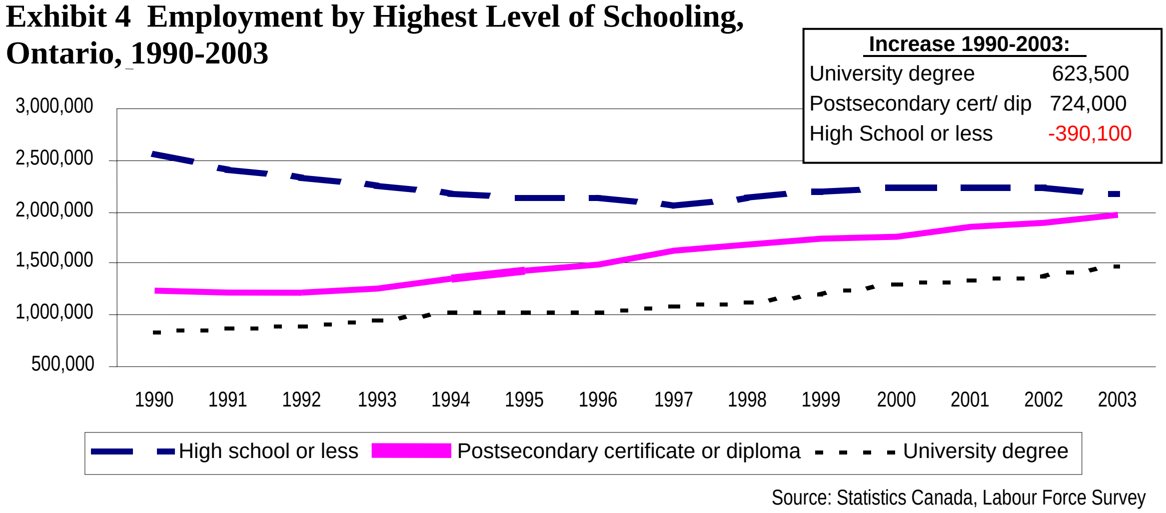
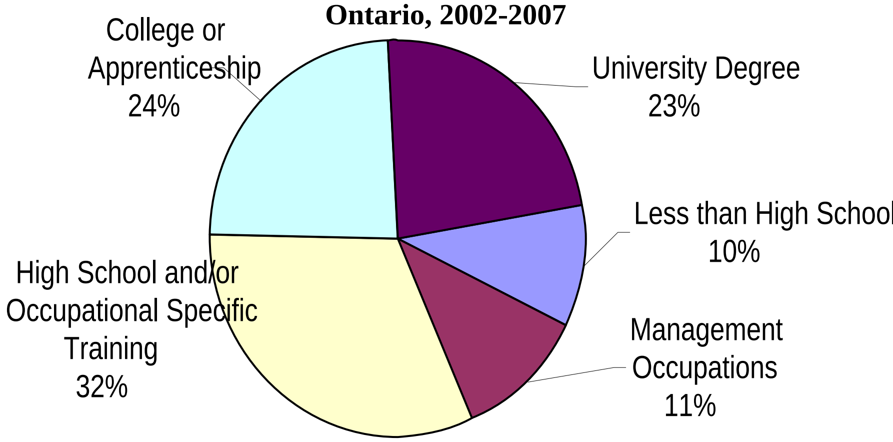


Exhibit 4 Employment by Highest Level of Schooling, Ontario, 1990-2003



In addition, projections by the Ministry of Training, Colleges and Universities for employment growth anticipate that more jobs will be created for college graduates than for university graduates.[26]

Exhibit 5: Contribution by Skill Levels to Projected Employment Growth, Ontario, 2002-2007



Source: Job Futures (MTCU and HRDC, Ontario Region)

Another example of the long-term contribution of jobs through the colleges is in a recent Toronto "Labour Force Readiness" study that projects more new jobs in the Greater Toronto Area for college graduates than for university graduates.[27]

Exhibit 6
Toronto Regional Projected Employment Change by Skills Requirement, 2000-2010

Skills Requirement (NOC Classification)	2000	2010	2000-2010 (Increase)
Management	265,800	303,600	37,800
University Education	441,700	516,900	75,200
College or Apprenticeship Training	670,400	771,800	101,400
Secondary School and/ or Job Related Training	936,600	1,075,900	139,300
On-the-job Training	300,900	347,500	46,600
TOTAL	**2,615,400**	**3,015,700**	**400,300**

Source: Toronto Labour Force Readiness Plan, page 46 (COPS Data, HRDC)

[26] See Ontario Job Futures (from Labour Market Information and Research, Ministry of Training, Colleges and Universities & Economic Analysis and Information Directorate, Human Resources Development Canada, Ontario Region) http://www1.on.hrdc-drhc.gc.ca/ojf/ojf.jsp?lang=e&section=Overview&noc=0000
[27] See City of Toronto, Economic Development, *Toronto Labour Force Readiness Plan*, 2003. http://www.city.toronto.on.ca/business_publications/labour_force_readiness_plan.htm

2.1 College-Qualified Workers Throughout the Economy

Exhibit 7 shows the proportions of the labour force in each industry in Ontario with college and university qualifications.

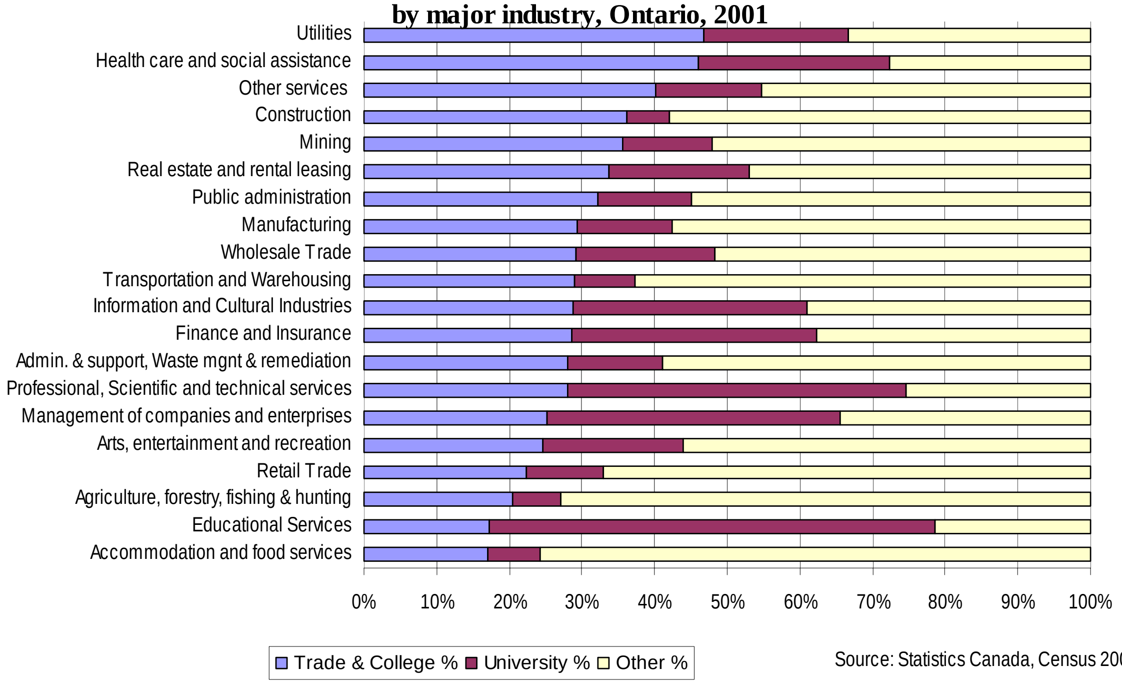
It is readily apparent that those with college qualifications are widely distributed across the economy with strong representation in virtually all industries (i.e. with at least one fifth the industry workforce).

- In 18 of 20 industries, the college-qualified workforce exceeds a fifth of the total. In six of these industries, the college-qualified share is over a third. And in two industries, Utilities and Health Care and Social Assistance, 46 per cent of the workforce is college trained.

- In comparison, the university-qualified workforce exceeds a fifth of the total in seven of the 20 industries. Three of these industries are in the public sector: education services (61 per cent with a university degree), public administration (32 per cent), and health care and social assistance (26 per cent). Close to half of all university graduates are employed in the broader public sector, which has about a quarter of the workforce.

- University-qualified workers exceed twenty per cent of the workforce in only two of 17 private-sector industries. These are Professional Scientific and Technical Services (47 per cent) and the Management of Companies and Enterprises (40 per cent).

Exhibit 7: Percent of workforce with college or university credentials by major industry, Ontario, 2001



Source: Statistics Canada, Census 2001

- The number of college graduates exceeds the number of university graduates in 17 of the 20 industries. Throughout most of the private sector, they are more numerous, often by a factor of two, and sometimes by a factor of three.

2.2 College-Qualified Workers in Enabling Occupations

To appreciate the role of colleges in Ontario's prosperity, it is important to identify workers in "enabling occupations" who are educated in colleges. These occupations are catalysts that activate the potential of new technology in organizations. There is a tight link between new technologies driving productivity and the skills of enabling occupations.

College graduates often enter occupations that have been linked by research to the implementation of new technologies in specific circumstances (e.g. team work environments, software intensive applications, practical hands-on experience) that foster productivity. For example,

- Research at the Canadian Technology Human Resources Board (CTHRB) shows that engineering and science technicians and technologists are replacing junior professional engineers and scientists in many applications of new technologies.
- The Statistics Canada "*Survey of Innovation and Advanced Technology*" describes five applications of new technologies that are directly linked to the skills of college graduates. The survey revealed that employers regard a shortage of skilled workers as a major barrier to implementing new technology. [28]

Research for this report used various sources to identify college training with occupations and then to further allocate the occupations to industries.[29] This tracking system has traced the progression of college graduates into Ontario's workforce and into jobs which enable technology innovation. There are many examples; some familiar and some surprising, e.g.

- Ontario's mining industry leads the world in productivity improvements. Investments in robotics, tele-mining and remote guided mining services have reduced costs and boosted competitiveness.
- Skilled mechanics and equipment operators in transportation and construction are the key to implementing new technology. The depth of their skills with new materials, processes and equipment determines the effectiveness of change.

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[28] Several research reports used the Survey of Innovation and Advanced Technology to study the impediments to technological change. See for example "Impediments to Advanced Technology Adoption for Canadian Manufacturers", by John Baldwin and Zhengxi Lin, Micro Economic Analysis Division, Statistics Canada, August 2001, page 8. and "Technology Use, Training and Plant-Specific Knowledge in Manufacturing Establishments" by John R. Baldwin* , Tara Gray** and Joanne Johnson, Micro-Economics Analysis Division, Statistics Canada. December 1995

[29] The most important sources in this analysis were the 2001 Census from Statistics Canada that identifies the post secondary training of 4 digit SOC occupations and the "Employment Profile" from the Ontario Ministry of Training, Colleges and Universities. The latter document tracks the employment experience of college graduates by program, occupation and industry.

- Computer-based medical systems for diagnostics and treatment; operated by skilled technicians, are complementing the roles of physicians, pharmacists and nurses and improving the efficiency of Ontario's health care system.
- Engineering technicians and technologists, paralegals, architectural associates and other technicians are implementing new computer software systems and performing tasks previously done by university-trained individuals.

Fewer people doing the equivalent work – often faster and to higher quality standards – is the main mechanism through which productivity is improved.

This report shows how similar examples are repeated in many Ontario industries. Colleges are at the centre of the process as they develop curriculum, create programs, attract industry partners, invest in new equipment and materials, attract students and send graduates with critically important skills into the economy to implement technological change and raise productivity.

These structural shifts and the related technologies are described in industry settings more fully below. They represent the final and crucial stage in implementing new technology.

Workers with up-to-date qualifications in enabling occupations are commonly in short supply because the new approaches require training in new software and machinery. Many types of industrial changes are evolving around these enabling occupations, including redefining trades and occupations and outsourcing. This structural change is often painful and controversial. In fact, the process may well displace trades, skills and jobs that are now identified with college training.

It is not uncommon for university undergraduates in sciences and other areas to return to colleges to acquire these skills to boost their chances for employment. In some cases, skilled trades are attracted to college programs for upgrading their skills.

Not all college graduates are in enabling occupations, but the numbers are growing, as they are part of a major structural change that is driven by technology. Often, their work will displace other workers including both less skilled workers and professionals.

These structural changes are not easily accommodated. It is an ongoing challenge for the colleges, working with employers, to design curriculum and acquire equipment and software. Risks extend to employees in traditional occupations, from graduate engineers to sheet metal workers, who find their jobs at risk.

Examples of enabling occupations

Engineering and Science Technicians and Technologists are a good example of enabling occupations. A report from the Canadian Technology Human Resources Board (CTHRB) in 2000 clarified this role through a survey of the workforce. The key findings include:

- Technology-driven change in industry has reallocated work from professional engineers and trades to engineering technicians and technologists, specifically:

  As production equipment becomes more computer and control-system intensive, set up, troubleshooting and maintenance functions are shifting from skilled trades to engineering technicians and technologists

  Engineering software has enabled calculation, design and process control tasks, previously undertaken by junior, Professional Engineers to be shifted to engineering technicians and technologists

  90 per cent of the technicians and technologists are trained in colleges

  Technicians and technologists are highly mobile across industries, specializations and regions

  30 per cent of the sample attended, but did not complete, university training

  90 per cent of the sample work on teams, usually headed by engineers

  Over 70 per cent of respondents identified increased use of engineering software with rising productivity

  Engineering technicians and technologists are distributed across the entire economy and are concentrated in manufacturing, consulting engineering, government, primary industry (mining, forestry, oil and gas), and construction.

These technicians and technologists are distributed across many industries. Their skills now displace the work of junior professional engineers. This feature of leveraging the work of professional groups is a key attribute of all enabling occupations. All of these occupational groups grew more rapidly than the total workforce and this is a general measure of the growing technological intensity of the economy.

3. The "*Prosperity Cycle*" Applied to Industries

This section of the report describes the role of the colleges and their graduates in raising productivity in six Ontario industries. The industries are chosen to represent a wide variety of circumstances; including goods and services, different patterns of productivity growth, and different relationships with colleges. In each case, the analysis reveals the role of enabling occupations and the link to college programs.

3.1 *Goods Sector*

Measures of productivity are more accurate in the goods producing sectors and the strongest evidence of gains related to investment in machinery and equipment are apparent in these industries. It is also most common to find the best examples of enabling occupations in these industries.

There is a corresponding, large role for college graduates in the occupations and industries identified here. This section of the report covers several important examples of the contribution of college programs to improving productivity in Ontario industries.

3.1.1 Manufacturing and Selected Sub-industries

The Workforce of the Future

"Workforce capabilities will be an even more important determinant of competitive success in a manufacturing world where knowledge and capital are the prime business assets and business growth is driven by the continuous acquisition, deployment protection, and funding of new knowledge.
...the growing complexity of tasks and the pace of change with respect to technologies, organizations, and business objectives will mean that the core competencies of Canada's manufacturing workforce in 2020 will be substantially different from those of today."

> Canadian Manufacturers and Exporters. "20/20: Building our Vision for the Future." 2004

"…many firms have placed strong reliance on increasing the flexibility of their workforce in order to build a wider array of skills into a given worker complement and benefit from the productivity and cost advantages that can result. Cross-training, multiskilling, job rotation, and some movement to teams have characterized these strategies."

> Canadian Steel Trade and Employment Congress. Human Resources Study of the Broader Canadian Steel Industry. Final Report. 2005. p. xii.

The manufacturing sector is central to Ontario's growth prospects. At 1.1 million, its employment level exceeds that for the manufacturing sector in any other province or in any U.S. state except for California. Ontario's auto sector, key to communities like Windsor, Oshawa and Cambridge, is the second largest in North America, exceeded only by Michigan. Many other communities benefit from the manufacturing sector's high productivity and high wages. Typical examples include pulp and paper plants in Northern Ontario, chemicals in Sarnia, and steel in Hamilton.

Access to well-educated college graduates is central to the growth prospects of Ontario manufacturing. The 2005 Ontario Budget points out:

> "Ontario's top 10 manufacturing export industries enjoy a major labour skills advantage, particularly in college credentials, as about 48 per cent of their workforce have completed postsecondary education (33 per cent college and 14 per cent university). In the United States, only 32 per cent of the workforce in these industries have completed a similar level of education (nine per cent college and 23 per cent university)."[30]

This is a classic application of the *Prosperity Cycle* with strong investments in technology combining with college training and enabling occupations. Measurement problems limit analysis in many industries, and manufacturing is the best source of reliable data. Manufacturing industries have outperformed the economy in productivity growth but results vary widely among over twenty sub-groups.

The high-profile success stories, profiled in more detail in the Appendix on manufacturing, are *computer and electronics products*, *motor vehicles assembly and parts*, *primary metal and metal fabrication* and *plastics*.

Each case is a solid application of the *Prosperity Cycle*, with heavy investment in new equipment, technology and processes and reliance on enabling occupations, such as: Supervisors in Manufacturing; Mechanical, Engineering Technicians and Technologists; Manufacturing Engineering Technicians and Technologists; Tool and Die Makers; Machinists; and Industrial Instrument Mechanics.

A shift away from hierarchical organizations to teams is also apparent in these industries. This change is associated with increasing responsibility for technicians and technologists who are able to use new engineering software systems to take on work previously done by graduate engineers.

Highlights of the analysis for each manufacturing industry are as follows:

Computer and electronics products[31]*:* The most prominent example of productivity growth is in the computer and electronics products industry. In addition, the application of

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[30] 2005 Ontario Budget. Budget Paper B, "Achieving Our Potential; Progress Towards a New Generation of Economic Growth. p. 102.

[31] This sector produces semiconductors, telephone and other communications, audio and video, navigation, medical and control equipment.

computer technology is improving productivity across the economy.[32] The implementation of these capabilities across the economy is a driving force in overall industrial development.

College graduates make up 30 per cent of the workforce, and are driving the growth of the computer and electronics sector just as they do in the rest of manufacturing.

Plastics: Ontario is a leading producer of plastics moulds, plastics moulding machinery and advanced plastics components for use in the automotive, packaging and medical industries.[33]

The industry was initially low-knowledge intensive and required low skilled labour to operate processing machinery. But technological change has accelerated and the industry has grown rapidly. Advances in the plastics industry are closely linked to new technologies in moulding machinery and tool and die technology where larger and more sophisticated moulds are key to many advances. There is also major ongoing investment in advanced, computer-controlled processing equipment. Integrated systems are now required that include CAD/CAM in product design and management, robotics for material management and advanced statistical controls for quality.

At the centre of this change is the training of process engineers, designers and technicians.[34] The plastics industry has grown rapidly more knowledge intensive and is actively creating new training standards that is adding apprenticeship and advanced training for technicians and technologists.

> In Ontario, the plastics training program at Humber College is the recognized leader in the essential upgrading of the plastics workforce. Key programs at Humber include; Plastics Engineering Technician, Electrical Engineering Technology and Technician, control systems, Facilities Systems Maintenance Mechanic, Mechanical Engineering, CAD/CAM, Mechanical Technician, Industrial Maintenance.

Motor vehicle assembly and parts: Arguably, the most important manufacturing industry in Ontario is transportation equipment. This industry produces parts and assembles vehicles. With 184,000 workers in 2001, it was the largest single manufacturing industry. As well, its production is tightly linked to industries such as plastics and rubber, as well as primary and fabricated metal.

Technologies available for parts manufacture and assembly are widely distributed around the world. Ontario has a strong reputation for quality and one of the world's most skilled workforces. However, other jurisdictions have targeted motor vehicle assembly and parts,

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[32] See for example, Jorgenson, Dale and Frank Lee, "Industry Level Productivity and International Competitiveness Between the U.S. and Canada" Industry Canada Research Monograph.

[33] Several recent studies highlight the need for training in plastics related occupations and businesses. See for example, the report of MPP Douglas Galt to the Ontario Government "Keeping Ontario's Plastics Industry a Global Dynamic Leader" Ministry of Enterprise, Opportunity and Innovation, 2002

[34] See research at the Canadian Plastics Sector Council "People in Plastics, 1996" and "People in Plastics, Update 2001", http://www.cpsc-ccsp.ca/PDFS/updated%20plastics%20report%202001.pdf

so key to continuing success in this sector is sustaining productivity gains in comparison to other jurisdictions.

One measure of college graduates and trades importance to the success of this industry is the repeated reference to skills shortages by employers. Indeed, the continuing shortages of technical skills in auto assembly and parts manufacturing is described as chronic by the Automotive Parts Manufacturing Association and other industry groups.[35] The shortage is specifically related to workers with in-depth training and skills with new technologies. Sixty per cent of the mechanical engineering technicians and technologists working in the industry are trained in colleges.

Primary metals and metal fabricating: One final example from manufacturing focuses on. Steel manufacturing and processing is the largest single subindustry in primary metals and metal fabricating and is an important supplier to the auto parts sectors described above. These industries are college intensive with 36 per cent of employees from the college system. They are both among the highest productivity performers and this is clearly driven by investment in machinery, equipment, materials and material handling.

There are strong similarities to the technology changes in the plastics sector. CAD/CAM/CAE software is changing the design and management process and increasing the role of technicians and technologists outside of machinery operation. Processing technology in the steel and related industries was shifted by electric arc furnaces and new thin slab caster/flat rolling mills in the late 1980s and 1990s. Smaller, lower-cost operations now challenge large integrated businesses. Robotics in material handling and "vendor managed inventory" systems are changing the logistics and statistical control processes.

Skill shortages are a major concern in this sector and this is driven by the high average age of the workforce and threatened retirements. Declining employment in recent years has been related to both weak economic growth and rising productivity.[36] The limited need for recruiting has left an older workforce in place and the emerging need to replace them as they retire.

> Ontario's colleges have worked with the Canadian Steel Trades and Employment Congress (CSTEC) to develop programs that target the needs of these industries and employers. Apprenticeship is a central training model for the industries and the major trades are: stationary engineers, power station engineers and machinists.

[35] See "The Auto Shift 2002 survey and APMA Compensation and Human Resource Practices Survey".

Case Study 1 – Mechanical Engineering Technologists
St. Clair College

The role of the colleges is illustrated with a case study from the Mechanical Engineering Technologists Program and the Ford Centre for Excellence in Manufacturing at St. Clair College in Windsor.

- St. Clair College is located in Windsor, Ontario, at the heart of the auto and parts economy. It has a three-year Mechanical Engineering Technology program which provides almost 200 students with the theoretical and practical knowledge to design automotive parts: product design, analysis, as well as in manufacturing processes. Many of its graduates are hired by the local auto and parts industry.

Ford and Daimler/Chrysler actively support the program and recognize the contribution that the graduates make to the success of their business.

- A new facility, the Ford Center for Excellence in Manufacturing which has six computer-equipped labs with all required software for CAD (Catia students – a powerful and automotive-orientated CAD design software package, UG, AutoCad) and CAM applications. The facility also has new PLC, Hydraulic, and Metallurgy labs, and has added ANSYS and MatLab software to improve the training tools available to the students.
- The curriculum was developed in cooperation with Daimler/Chrysler Canada and the University of Windsor. The program has had a co-operative educational agreement with DaimlerChrysler Canada for four years.
- The program also offers student entry into the Mechanical Engineering program at the University of Windsor.
- The college participates in an annual job fair with the University of Windsor and places about five to 10 students into co-op jobs each year.

The program affects the workplace through the adoption of the latest technologies or new technologies. Program officials comment, “we have added new technology on an ongoing basis based on our opinion of the industry needs and the availability of new technology tools. Our students will introduce these technologies to the industry as they graduate and gain employment.”

3.1.2 Mining

This primary industry is chosen for its remarkable record of productivity improvement. Among the best performers in the economy, its accomplishments are rarely noted. There has been massive investment in machinery and equipment and new technologies such as global positioning systems, compact underground borers, plasma blasting, telemining, robotics, remote guided mining services and AutoCAD. These technologies have altered mining operations so that there are now many fewer operators underground.[37]

The focus on improved productivity in mining and forestry had dramatic impacts on labour markets. Weak commodity markets during much of the past decade have depressed output and employment. The total number of jobs in the sectors has declined from 1987 to 2003. This change masks the restructuring that is described above. One notable consequence of the industry's success has been a shortage of skilled workers to facilitate the change.[38] These shortages are concentrated in the enabling occupations described above and the college system is working to meet the training needs of the restructuring. Improving commodity prices and strong world markets have revived demand for metal and wood products in 2005 and investment by the industry and colleges is now contributing to significant new prosperity.

Mining is substantially more college-intensive than the average industry in Ontario with 38 per cent of its workforce graduates from diploma/certificate programs or apprenticeships. Graduates fill enabling occupations such as: Specialized equipment operators; Underground production and development miners; Supervisors; Heavy equipment operators; Transportation equipment operators; Mechanics; Geological and mineral engineering technicians and technologists; Electrical engineering technicians and technologists; and Mechanical engineering technicians and technologists.

> "From the surface, using a Mining Teleoperation Chair developed by Inco, Daniel operates three robotic drills that are located in a Frood Stobie mine slope. The slope is 2,000 feet underground and 10 kilometres away from where he sits. He relies on a combination of phone, computer, joystick, and foot pedals in the Teleoperation Chair to properly run the machinery."
>
> *Source: Cambrian College, 'Meet a Grad', Daniel Plante - Mining Engineering Technology (Class of 1991) http://www.cambrianc.on.ca/ meet a grad/alumni daniel plante.htm*

[37] Similarly, advances in the forest industry have come through the design and introduction of new equipment that relies on innovations such as GPS, remote sensors and computer diagnostics.
[38] See "Mining industry faces labour crunch" The Toronto Star, page c 16, March 8, 2005

Case Study 2
Industrial Electricians and Electrical Engineering Technology in Mining
Cambrian College

"INCO has been directly involved with Cambrian College on a joint collaboration to enhance trades training since 1995. For many years now, industry has the seen the need to develop a tradesperson to a much higher standard than the regular apprenticeship program. …The trade of Industrial Electrician supports this concept. The development of the Electrical Engineering Technology program at Cambrian allows industry to hire highly qualified and motivated individuals. They graduate from Cambrian with an exceptional knowledge base that has been enhanced by practical work experience. …INCO is pleased to be part of the Electrical Advisory committee that aids in the development of this program."

Tom Tario, Group Leader, Maintenance Training, Support & Technical Services, INCO Ltd., March 27, 2003.

"Domtar Limited has been a long-standing industry partner of Cambrian College and we have worked with the college on many occasions to meet our specific training and development needs. This TDA designation will allow the college to continue to meet our specific training needs and those of other industry partners in our area."

Steve Broadhurst, Reliability Superintendent, Domtar Ltd., May 8, 2003.

Inco, Falconbridge, Ontario Power Generation and Domtar are among firms noting that new technologies were combining the traditional skills of industrial electricians (an apprenticeship trade) and electrical engineering technicians and technologists. Workers in their mines and mills were installing, setting up and monitoring more advanced equipment that required specialized learning offered to engineering technicians, as well as the skills taught in the first three years of the industrial apprenticeship program. At the same time, the employers recognized the advantages of the on-the-job component of apprenticeship training.

Cambrian's new Sky Tech program produces graduates who are leaders in enabling the introduction of new mining technologies. Under the earlier system, specialized training was not available to apprentices and Electrical Engineering Technologists were required to pass exams or repeat training as they entered the apprenticeship program.

Introducing new technology required a new kind of skilled worker, with advanced training on new equipment and systems and some of the benefits of apprenticeship. The Skills Technology Institute (Sky Tech) program at Cambrian College was designed with advanced equipment provided by corporate supporters and a new format co-op program that offered the equivalent of the first three years of the industrial electrician apprenticeship.

3.2 Services sector

> "Services are the fastest growing component of the global economy. Even in developing countries, service exports grew more rapidly than manufacturers in the 1990s. More efficient backbone services in finance, telecommunications, domestic transportation, retail and wholesale distribution, and professional business services improve the performance of the whole economy because they have broad linkage effects."
>
> Source: World Bank (Global Economic Prospects: Realizing the Development Promise of the Doha Agenda, 2004) pg. xxi

The model developed here describing "enabling occupations" can be applied to many situations in service industries. Indeed, the trend to contracting out and out sourcing many services has transferred the work of college graduates into professional service businesses. This section of the report identifies the many cases of productivity gains with their origins in the service sector.

3.2.1 Health Services

Improved productivity and investment in health care equipment and facilities is a high-profile public concern.[39] Health care is among the most college credential-intensive industries in the province with almost half of its workers as graduates.

The Ontario government's strategy for improving health care focuses on new investments and a structural change which shifts care out of hospitals to lower cost ambulatory and residential care. This vision is intended to raise productivity, improve quality and manage costs. As investment in new machinery, equipment and technology proceeds in the health care industry, productivity should rise

Colleges must be a key component of this new vision for rising productivity in health care if the intent is to use professional care more efficiently by substituting the work of nursing assistants, pharmacy assistants, medical technicians and technologists and other supporting staff. These are the enabling occupations for health care and they are all trained at the colleges.

Skill shortages are a major concern in the health care sector. This reflects under-funding in the past, as well as the rapid pace of change. Reports of shortages are particularly common among enabling occupations (See Appendix 6) and this underlines the key role of colleges in raising productivity in this sector.

In this case, the application of the Prosperity Cycle is just beginning to the extent the government realizes the potential in combining investment in technology with enabling workers trained at the colleges.

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[39] However, one finding in Appendix Exhibit 10 is that health services has a relatively low level of investment in new equipment as compared to other industries. This lower level may reflect the limited capacity of government to fund purchases of machinery and equipment and initiate potential productivity gains. Essentially, the health care sector remains labour intensive while other sectors invest in technology that enables productivity gains.

The Ambulatory Care industry: The planned structural shift to ambulatory care is associated with investment in diagnostics and other types of equipment that reduce treatment times or substitute the work of technicians, technologists, nursing assistants and other workers for medical doctors. Workers introducing these reforms are trained at colleges and are the "enabling occupations" in this transformation of health care.

Medical laboratories: New technologies and instrumentation have been established in medical laboratories at an extremely fast pace in the past 20 years.[40] Practical nurses use some of these technologies to promote innovation and productivity in the health care industry. Course descriptions in many colleges identify these technologies as part of their curriculum.

Medical Radiation Technologists also use new technologies to promote innovation and productivity in the health care industry. Mohawk and Fanshawe College both offer Medical Imaging Technology (Radiology) programs.

Case Study 3: Medical Radiation Technologists

Technology leaders such as GE Healthcare and Phillips Medical Systems partnered with Mohawk College and McMaster University in the creation of a Medical Radiation Sciences Program, accredited with the Canadian Association of Medical Radiation Technologists.

The program is qualifying a new pool of graduates to work in one of three specialist professions within the area of clinical medical technologies. The three specializations are Radiography, Ultrasonography and Radiation Therapy.

This broad skill set will allow graduates to be more involved in interdisciplinary activities and applied clinical research in the workplace. The new program will also increase the potential for innovation while ensuring the optimal use of diagnostic imaging resources.

The planned annual intake for the program that began in the fall of 2004 was 120 students. The first cohort of students will graduate in 2008. The program is 10 semesters in length, and includes 50 weeks of hospital/clinic work experience. It is expected that 55 percent of the graduates will be in Radiography, 35 percent will be in Ultrasonography and 10 percent in Radiation Therapy.

An indication of how important this field is for the new world of work is that in its first year of admissions, the program received more than 1700 requests for information and more than 700 applications for admission. Graduates from this program will work both in the health sector and in other sectors of the economy.

[40] See Canadian Society for Medical Laboratory Science, "Medical Laboratory Technologists National Human Resources Review," April 26, 2001.

3.2.2 Broadcasting and Telecommunications

This industry is a high-profile and high-tech example of success. Technological change described in the report for Broadcast and Telecommunications are really part of the broader technological change in all the Information and Cultural industries.

Productivity gains are among the highest in the economy and the workforce has average representation from college graduates and apprentices. The dominant theme is the rapid pace of technological change and convergence of products and processes. Large investments are required to succeed and employers have utilized college graduates to implement the new technology.

There are different groups of enabling occupations and related technologies in each sector.

Telecommunications has relied on occupations such as: Electricians (including industrial and power system electricians); Electrical power line and cable workers; Telecommunications line and cable workers; Telecommunications installation and repair workers; Cable television service and maintenance technicians; and Power systems and power station operators.

The broadcast and other cultural sectors (e.g. publishing) combine new information technology with a wide range of new computer graphic and related advances. These are most effectively implemented by occupations such as: Film and video camera operators; Graphic arts designers, illustrators and technicians; Broadcast technicians; Audio and video recording technicians; Other technical, co-ordinating and support occupations in motion pictures, broadcasting and the performing arts; and Theatre, fashion, exhibit and other creative designers.

While there are distinct processes and results, these industries are another example of the *Prosperity Cycle*.

Case Study 4 – The Animation Program
Sheridan Institute of Technology and Advanced Learning

Working in partnership with industry leaders like Alias, Adobe, Avid, IBM, Panavision and PS, Sheridan College, operating the third largest animation school in the world, is offering leading training in computer animation.

- Its graduates have gone on to successful careers in studios and animation houses in California and around the world.
- Sheridan has introduced a Bachelor of Applied Arts (Animation Program targeting growth of 60 students. It's internationally acclaimed Animation Program dates back over 30 years

Over the medium term, the demand for new graduates should be strong. While the entertainment sector of the industry remains highly dynamic, the applied degree program will give animators the creative skills that will enable them to lead their profession as it diversifies into emerging areas.

- "With the proliferation of new channels around the world, the demand for quality animation continues to grow, and we have seen the number of hours of animation swell from four hours per week on conventional television to more than 150 hours per week on specially networks. The Internet also offers unlimited possibilities for this medium, and has whetted the appetite for original, branded content. - Creativity dominates technology." (Source: M. Lemire, *Playback*, Oct. 15, 2001, p. 18.)

- The Roncarelli Report predicts decreasing technology costs and greater accessibility will contribute to both wider use and the development of more uses for animation. North America should continue to account for close to half computer-animation production volume, specializing in the most advanced, complex and expensive styles of animation.

3.2.3 Professional and Scientific Services

College graduates in enabling occupations play "behind-the-scenes" roles in supporting rapid change in the final two industries considered in this report.

The surprise here is the growing role for college graduates in support of professionals. These two industries illustrate the impact of contracting out, outsourcing, off-shoring and other structural changes that are fragmenting industrial processes and moving the work of enabling occupations into new industries.

The professional and scientific services industry is best described by its principle sub-groups: Legal Services; Accounting Services; Architectural, Engineering and Related Services; Computer Systems Design and Related Services; Management, Scientific and Technical Consulting Services; Scientific Research and Development Services; and Advertising Services.

Many of these services offer a core group of expertise needed in the implementation of new technologies. Workers are at the centre of the web of customer–supplier networks that distribute new technologies and build productivity improvements in many industries.

The traditional professionals associated with these activities are supported by Technical occupations related to natural and applied sciences, and clerical occupations, as detailed in the Appendix.

In each case, these groups are the enabling occupations that are being empowered by changing technology, including advanced machinery and software. These occupations are being trained with a combination of science and technology that prepares them for the crucial roles in technology implementation, including installation, design, set up, diagnosis, repair, logistics, quality control and operations. Skills taught in the college programs often allow graduates to take on some of the responsibilities of engineers, architects, accountants, lawyers and research scientists.

3.2.4 Repair and Maintenance

The repair and maintenance industry is relatively low profile, but it is adapting to technological change and reporting important productivity gains.

Repair and maintenance is an important success story in productivity gains. Forty-six per cent of the workforce is trained in the colleges and many are working in key enabling occupations such as: machinists, welders, mechanics, and various technicians and technologists. (See Appendix 9).

Employers for all these occupations face major changes in technology, consumer preferences and manufacturing strategies that are altering the skills needed to work in the industry. These changes include:

- Manufacturing technologies that permit rapid product design and introduction and more customized product features to meet more segmented markets
- Repair and service delivery through customer contact centre systems with electronic diagnostics
- Quality control in manufacturing that is reducing demand for repair and maintenance services but adding to the demand for technical expertise in the manufacturing (and sometimes installation) process, and
- Environmental pressures forcing reuse and recycle options

Traditional divisions that identified markets and occupations are also being blurred by product convergence driven by new technologies. For example:

- Computer suppliers offer video, audio, game/entertainment and basic voice communications.
- Electronic and related technologies (e.g. microwave) capabilities are added to and replace mechanical features on appliances.
- Traditional commercial products enter household applications (e.g. fax and photocopiers).
- Industrial technologies such as robotics enter household applications.
- New medical and related health products enter household applications.
- Computer software systems and electronics dominate new areas of traditional motor vehicle maintenance and repair.

These changes result in fewer jobs for traditional repair and maintenance technicians and more complex and advanced qualifications with extensive core skills and specializations for those working in the field. Repair and maintenance services are linked to new diagnostic and other specialized equipment that represents a major investment by service suppliers.

3.3 Industry Examples – Conclusions

This review of the role of college graduates in a dozen industries illustrates how enabling occupations contribute to productivity gains. It is clear from these examples that the gains are not solely due to the addition of enabling occupations. In each case, the process of technological change requires investment in new technology, tools, equipment, machinery, software and materials. But the investment is not enough. There is a new cadre of enabling occupations which are largely filled by college graduates.

There were several traditional examples of the process – in mining, forestry and manufacturing (especially plastics, metal fabrication and automotive assembly). There were also other variations on the theme, such as health care and repair and maintenance services. In the latter case, where investments have been made in the needed technology, productivity gains can be measured. In health care, the needed investment is well documented and some government funding seems to be planned. A model for leveraging the investment with the health equivalent of enabling occupations is in place.

In all these cases, employers turn to colleges to recruit or retrain workers for enabling occupations. Colleges have taken on the challenge by designing the programs, acquiring partnerships and technology, attracting students and preparing them for the next generation of enabling occupations. Productivity will rise where college success is matched by investments by industry and government.

Strong consumer and industry demands for new products and services create a sense of urgency for all of these changes. In labour markets, this is compounded by the distinctly high-age profile for many occupations noted above. Industry is concerned about skill shortages for many of the enabling occupations discussed in this report.

4. Conclusions and Next Steps

The ideas presented in this report are a first step in forming a new vision for colleges and industry competitiveness in Ontario. The message – reinforced with examples from industry – is:

- Ontario's prosperity is tied to gains in industry productivity.
- Productivity is, in turn, related to investment in new technologies and structural change.
- These investments and business transformations in turn require workers educated in enabling occupations.
- Ontario college programs are critical in supplying workers for these enabling occupations.

The *Prosperity Cycle* links productivity directly to college programs. This link is already clear to many companies – for example, in the case studies. Often, these companies see their access to Ontario's college graduates as an important competitive advantage. The next steps to implement this strategy would be:

- Validate and reinforce the overall idea of the *Prosperity Cycle* with the colleges and industries described in this paper.
- Describe the *Prosperity Cycle* in other industries – finding both active examples of success with enabling occupations and potential applications in new industries.
- Draw government into the discussion through a new dialogue about productivity.
- Map out new programs – for industries covered in this report and new opportunities.
- Seek funding and industry partnerships drawn from the *Prosperity Cycle model* and based on measures of success. For example:

    - Identify technologies, equipment, materials, products and services.
    - Identify enabling occupations and target the number of workers needed.
    - Identify the elements for new program development including corporate partners, curriculum, instructors, equipment and facilities and costs.
    - Initiate training programs based on the *Prosperity Cycle* and track associated productivity gains.

In this view of Ontario's economic well-being, the public policy advantage of more college funding is gains in productivity across the economy leading to a more prosperous Ontario.

Statistical Appendices

APPENDIX 1 – Productivity Growth by Individual Industry

College programs often train graduates for work in specific industries, therefore the role of colleges in Ontario's prosperity is properly described at this specific industry level.

Wide variations in productivity gains across industries have persisted for many decades. Appendix Exhibit 1 shows the growth in productivity in 20 Ontario industries from 1987 to 2003 using index numbers. The higher the value of the index in 2003, the greater the productivity growth over the period. Variations are huge, with industries such as mining and manufacturing up 35 per cent while construction actually reports a decline!

Appendix Exhibit 1: Labour productivity for major industries, Ontario, 2003, Index (1987=100)

Industry	Capital share as per cent of total inputs, Canada, 1997	Labour productivity for major industries, Ontario, 2003	Per cent of labour force with college qualifications, Ontario, 2001	Per cent of labour force with university qualifications, Ontario, 2001
All Industries	53.78%	122.5	29%	21%
11- Agriculture, forestry, fishing & hunting		174.5	20%	7%
21 Mining	77.70%	174.9	36%	12%
22 – Utilities	80.71%	91.1	47%	20%
23 – Construction	55.54%	89.9	36%	6%
31-33 Manufacturing	48.98%	147.9	29%	13%
41 Wholesale Trade	44.90%	167.9	29%	19%
44-45 Retail Trade	30.23%	125.1	22%	11%
48-49 Transportation & Warehousing	49.54%	na	29%	8%
51 Information & Cultural Industries	57.27%	na	29%	32%
52 Finance & Insurance	80.63%	na	29%	34%
53 Real estate & rental leasing		na	34%	19%
54 Professional, Scientific & tech services	32.22%	114.9	28%	47%
55 Mgt of companies & enterprises		na	25%	40%
56 Admin & support, Waste mgt	31.26%	92.0	28%	13%
& remediation services				
61 Educational Services	24.63%	79.8	17%	61%
62 Health care and social assistance	33.13%	89.6	46%	26%
71 Arts, entertainment & recreation	42.54%	79.1	25%	19%
72 Accommodation & food services	41.35%	85.8	17%	7%
81 Other services (except public admin)	43.66%	121.9	40%	14%
91 Public administration	46.07%	117.3	32%	13%

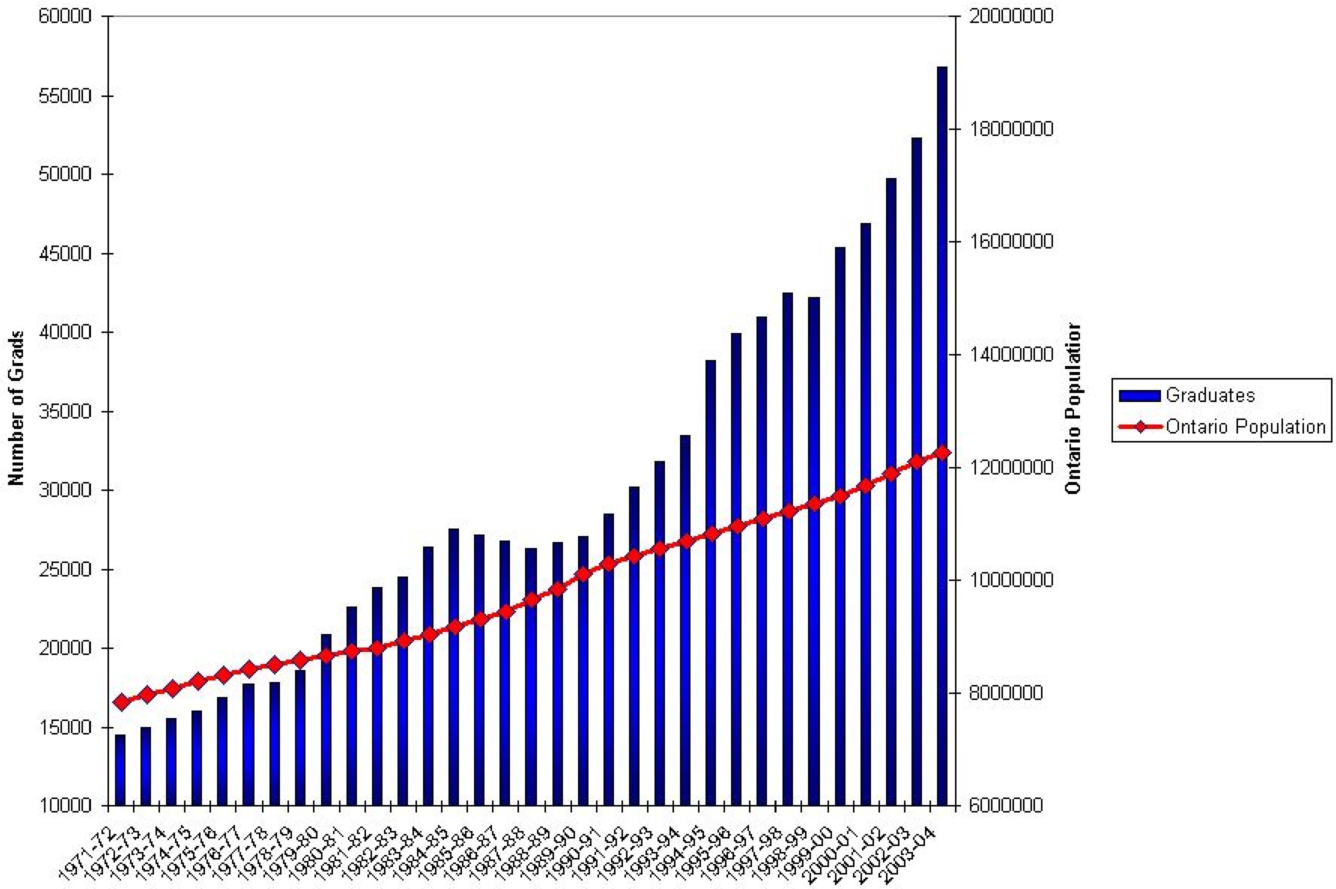
Note: Labour Productivity (Real GDP per Worker) Index (1987=100)
Source: The Centre for the Study of Living Standards and Prism Economics and Analysis; industry breakout based on Statistics Canada's North American Industrial Classification System

There is no generally accepted explanation of productivity growth and the differences that occur over time and across industries and jurisdictions. It is clear, however, that the starting point is investment in new machinery, equipment and technologies that enhance the production process.

Industry reports in Section 3 use the proportional contribution of capital as a measure of accumulated investment. In industries where the contribution of capital is high, the workforce is equipped with advanced technology, materials, equipment and information technology. In most cases, industries in Appendix Exhibit 1 reporting the largest capital contribution are also likely to be leaders in productivity. It is in training workers to utilize and leverage these technologies that colleges play a key role in Ontario's productivity.

APPENDIX 2 – College Certification: Role in the Economy

Appendix Exhibit 2
Growth in the Annual Number of College Graduates Over the Past 30 Years



Source: Graduate data -1975 onwards is MTCU; prior to 1975 are ACAATO estimates.
Population numbers – Statistics Canada Table 051-0001 - Estimates of population, by age group and sex, Canada, provinces and territories, annual

Appendix Exhibit 3 shows the distribution of the Ontario workforce, measured in the 2001 Census, by level of education. Twenty-nine percent of Ontario's workforce (1.75 million workers) has a college qualification – the largest component of the 6 million strong labour force.

As shown in Appendix Exhibit 4 and 5, the mix of diploma and certificate programs can be described in four broad categories: Technology; Business; Health; and Applied Arts. An equivalent classification for apprenticeship identifies: construction; manufacturing; services and other trade groups.

Appendix Exhibit 3: Highest Level of Schooling[41], Census 2001	**Total Labour Force**	**%**
Less than high school graduation certificate	1,178,835	20%
High school graduation certificate only	898,500	15%
Some postsecondary education	746,665	12%
Trades certificate or diploma	620,955	10%
College certificate or diploma	1,132,135	19%
Total College System Completions	*1,753,090[42]*	*29%*
University certificate or diploma below bachelor's degree	131,265	2%
University degree	1,284,410	21%
Total University System Completions	*1,415,675*	*24%*
Total labour force by highest level of schooling	**5,992,765**	**100%**

Source: Statistics Canada, Census 2001

[41] Education Attainment refers to the highest level of schooling a person in the labour force has attained. The proportion of the labour force with a college diploma may be understated as a number of individuals may have attained a college diploma and a university degree, but would be reported only as university graduates in the census survey.

[42] The number of persons holding a trade certificate or diploma trained in the "college system" versus union or other non-college training institutions is slightly less than 620,955. Readers should also be cautioned that a number of individuals obtained their trade certificate or diploma without formal in-school training by challenging the provincial qualification examination.

Appendix Exhibit 4: Selected CAAT Major Program Divisions and Program Clusters (Diploma and Certificate Programs)

Field of Study	Number of Graduates 2002/03	As % of Total Graduates
Health		
Animal care	271	0.5%
Health –Miscellaneous*	571	1.1%
Health Technology	1,451	2.8%
Nursing Related	6,559	12.6%
Health –Total	**8,852**	**16.9%**
Technology		
Architectural	398	0.8%
Automotive	524	1.0%
Aviation – Flight	62	0.1%
Aviation- Maintenance	243	0.5%
Chemical/Biological	538	1.0%
Civil	811	1.6%
Drafting	53	0.1%
Electronics	3,003	5.7%
Furniture/Wood Products	175	0.3%
Geology/Mining	85	0.2%
Industrial	54	0.1%
Instrumentation	118	0.2%
Machining	430	0.8%
Marine	47	0.1%
Mechanical	1,778	3.4%
Power	107	0.2%
Resources	824	1.6%
Technology Maintenance	203	0.4%
Welding	82	0.2%
Technology- Total	**9,535**	**18.2%**
Applied Arts		
Advertising and Design	1,803	3.4%
Art	774	1.5%
Child/Youth Worker	618	1.2%
Community Planning	21	0.0%
Crafts	86	0.2%
Developmental Services Worker	480	0.9%
Education	2,550	4.9%
Fashion	449	0.9%
Graphic Arts/Printing	66	0.1%
Horticulture	211	0.4%

Law & Security	2,793	5.3%
Library	64	0.1%
Media	2,689	5.1%
Native Community Worker	72	0.1%
Performing Arts	324	0.6%
Preparatory/Upgrading	2,686	5.1%
Public Relations	389	0.7%
Recreation/Fitness	821	1.6%
Social Services	2,051	3.9%
Applied Arts – Total	**18,947**	**36.3%**
Business Division		
Accounting/Finance	2,073	4.0%
Aviation Management	26	0.0%
Business Computer	2,909	5.6%
Business Legal	761	1.5%
Business Management	2,178	4.2%
Culinary Arts	675	1.3%
Government/Real Estate	23	0.0%
Hospitality Management	836	1.6%
Human Resources/Industrial Relations	859	1.6%
Marketing/Retail Sales	1,946	3.7%
Materials Management	155	0.3%
Office Administration	999	1.9%
Office Admin- Health	373	0.7%
Office Admin – Legal	159	0.3%
Small Business	98	0.2%
Travel/Tourism	857	1.6%
Business –Total	**14,927**	**28.6%**
Total Graduates	**52,261**	**100.0%**

**Includes communicative disorders assistant, complementary care, emergency telecommunications, funeral service education, health promotion, paramedic.*

Source: MTCU Employment Profile 2004

Appendix Exhibit 5: CAAT Apprenticeship Trades by Major Group

Automotive Including: ▪ Alignment and brakes technician ▪ Auto body repairer ▪ Automotive electronic accessory technician ▪ Automotive glass technician ▪ Automotive painter ▪ Automotive service technician ▪ Fuel and electrical systems technician	Motive Power Including: ▪ Farm equipment technician ▪ Heavy duty equipment technician ▪ Motive power machinist ▪ Motive power parts person ▪ Motorcycle mechanic ▪ Powered lift truck technician ▪ Recreational vehicle mechanic ▪ Small engine technician ▪ Truck and coach technician	Tourism and Hospitality Including: ▪ Assistant Cook ▪ Baker ▪ Cook ▪ Patisserie ▪ Retail Meat Cutter
Construction/ Maintenance Including: ▪ Brick and stone mason ▪ Cabinetmaker ▪ Carpenter ▪ Cement finisher ▪ Cement mason ▪ Construction craft worker ▪ Construction millwright ▪ Crane Operator ▪ Drywall, Finisher and plasterer ▪ Electrician, Construction and maintenance ▪ Elevating devices mechanic ▪ Floor covering installer ▪ Heat and frost insulator ▪ Heavy equipment operator ▪ Ironworker ▪ Painter and decorator ▪ Plumber ▪ Refrigeration & air conditioning mechanic ▪ Roofer ▪ Sheet metal worker ▪ Terrazzo, tile and marble setter	Manufacturing/ Industrial Including: ▪ Composites structures technician ▪ Draftsperson ▪ Electrician, Industrial ▪ Fitter (Structural steel/plate worker, steel fabricator) ▪ General machinist ▪ Hydraulics / pneumatics mechanic ▪ Industrial instrument mechanic ▪ Industrial mechanic millwright ▪ Machine-tool builder and integrator ▪ Micro-electronics manufacturer ▪ Mould maker ▪ Packaging machine mechanic ▪ Pattern maker ▪ Precision metal fabricator ▪ Process operator: refinery, chemical and liquid process ▪ Roll grinder / turner ▪ Sheet metal worker ▪ Tool and die maker ▪ Welder	Services Including: ▪ Hairstylist ▪ Aboriginal early childhood worker ▪ Appliance service technician ▪ Blacksmith ▪ Child and youth worker ▪ Early childhood educator ▪ Educational assistant ▪ Electrical motor & apparatus rewinding and repair ▪ Electrician, Domestic and rural ▪ Electronic service technician ▪ Horse groom ▪ Information technology support analyst ▪ Locksmith ▪ Network cabling specialist ▪ Optics technician (lens and prism maker) ▪ Tool and cutter grinder ▪ Transmission technician

APPENDIX 3: Enabling Occupations with College Credentials

Examples of college "enabling occupations"

Goods and Business / Consumer Services

- Engineering Technicians and Technologists
- Architectural Technicians
- Advertising and Design Technicians
- Paralegals
- Business Technicians
- Mechanics and related trades

Construction

- Equipment Operators
- Site Managers and Supervisors

Health Care

- Medical technicians
- Dental Technicians
- Pharmacist Technicians
- Occupational and other Therapists
- Practical Nurses

The "Canadian Technology Standards (CTS)" system that catalogues the competencies across 13 disciplines that correspond, in many cases, with the faculty structure of the colleges.

- Bioscience
- Chemical
- Building
- Civil
- Electrical
- Electronics
- Forestry
- Geomatics
- Industrial
- Instrumentation
- Mechanical
- Mineral
- Petroleum

Within each discipline, the CTS system identifies a range of occupations and competency areas. So, for example, under technicians in the *civil* discipline, the CTS identifies six occupations

- Civil Construction Technicians
- Civil Environmental Technicians
- Civil Municipal Technicians
- Civil Structural Technicians
- Civil Transportation Technicians
- Civil Water Resources Technicians

APPENDIX 4: Manufacturing and Selected Sub-Industries

Manufacturing is the most common focus for the analysis of productivity. Measures of the components of production (e.g. machinery, land, labour, technology) are more and the classic productivity advancements are often best illustrated with manufacturing processes.

Within manufacturing, though, there are many industries and wide variations in the productivity performance and educational qualifications of the workforce. The NAICS industrial classification identifies 21 separate manufacturing industries. Appendix Exhibit 6 lists average productivity growth for 16 years for industries for which data is available.[43]

Success with productivity gains is related to the ability of the firms in the industry to invest in needed technology. Appendix Exhibit 6 also tracks the overall success of selected key manufacturing industries where major investments were made. While each manufacturing sector is building productivity with investment in new technologies, there are big variations in the pace of success.

Appendix Exhibit 6: Productivity Growth by Manufacturing Industry		
Labour Productivity Index, 2003 (1987=100)		
	Ontario	**Canada**
Fabricated Metal Manufacturing	Na	Na
Primary Metal manufacturing	Na	Na
Transportation Equipment Manufacturing	Na	150.1
Machinery Manufacturing	115.1	108.9
Plastics and Rubber Products	Na	174.6
Computer and Electronic Products	Na	265.9
Manufacturing Total	**147.9**	**139.7**
All Industries	**122.5**	**120.5**
Capital Share as % of Total Inputs, 1997		
Fabricated Metal Manufacturing	Na	35.9%
Primary Metal manufacturing	Na	48.3%
Transportation Equipment Manufacturing	Na	52.2%
Machinery Manufacturing	Na	43.6%
Plastics and Rubber Products	Na	41.8%
Computer and Electronic Products	Na	48.9%
Manufacturing Total	**Na**	**49.0%**
All Industries	**Na**	**53.8%**

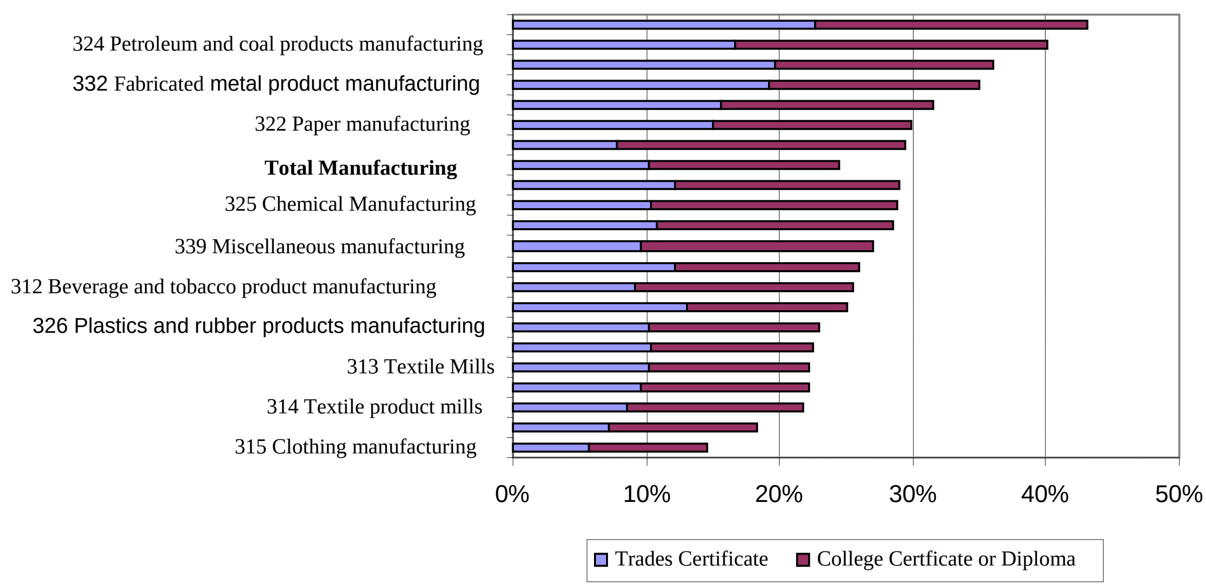
Source: Source: Centre for the Study of Living Standards.

[43] While the sub-industry estimates of labour productivity growth in this and succeeding Appendices are the best available estimates of labour productivity, their reliability is often weakened by limited samples and discontinued time series. In many cases, national data is more reliable and there are few variations in the rankings and circumstances between Ontario and national results. In some cases, national data is used to fill in where Ontario values are not available.

While the overall manufacturing sector has close to the economy-average college intensity of 30 per cent, there are some sectors with much lower and higher representations. The overall conclusion from the distribution shown in Appendix Exhibit 6 is that manufacturing industries have very different "knowledge intensity," with the high knowledge-intensive industries having a greater proportion of both college and university graduates. More rapid advances in productivity are associated with both higher knowledge intensity and a higher investment in new machinery and equipment. This combination creates the need for enabling occupations.

A key finding is that every manufacturing industry's workforce has a larger representation from colleges than from universities.

Appendix Exhibit 7: Trades and CAATs certified workforce in manufacturing
(per cent of total workforce)



New technology is imbedded by industries across the full spectrum of manufacturing in materials, equipment, software and hardware or processes. Statistics identified five types of advanced technologies in manufacturing:

- Design and Engineering
- Fabrication and Assembly
- Automated Material Handling
- Inspection and Communications
- Manufacturing Information Systems

Each of these categories can be linked to the college programs and trades listed above. Further, the research confirmed that firms adopting these technologies are expecting benefits from productivity gains, improved quality, lower costs and other factors. Productivity gains were the most important target. The survey also found that, after the cost of the technology, the major cost or risk to adopting new technology is shortages of workplace skills to implement the technology. These are the precise skills that the colleges are teaching.

Both the trades and college graduates are active in all these areas, with certain occupations offering critical support as "enabling" occupations. These include:

- Supervisors in Manufacturing
- Mechanical, Engineering Technicians and Technologists
- Manufacturing Engineering Technicians and Technologists
- Tool and Die Makers
- Machinists
- Industrial Instrument Mechanics

These workers are implementing a series of key technologies including:

- Steel Mini Mills
- Vendor Managed Inventories
- New substitute materials and alloys
- Computer Assisted Design, Manufacturing and Engineering
- Computer Numerically Controlled (CNC) Manufacturing
- Plastics and Composites
- Hydroforming Metal
- Just-In-Time Management

Auto assembly and parts:

Productivity depends on the overall skills and training of the key occupations in the sector:

- Assemblers
- Machinists and metal forming and shaping occupations
- Machine operators
- Mechanics
- Engineering Technicians and Technologists

These workers are trained in the mechanical, electronics and machining programs in Ontario's colleges.

Primary metals and metal fabricating:

The major occupations working in both primary and fabricated metals are:

- Machine operators
- Machinists, metal forming, shaping and erecting
- Mechanics
- Heavy equipment and crane operators
- Technical occupations in natural and applied science

Workers in these occupations are trained in the mechanical, electronics, welding, machining, industrial programs in the colleges. Apprenticeship is a central training model for the industries and the major trades are: stationary engineers, power station engineers and machinists.

APPENDIX 5: Mining

Mining employs 21,000 workers and represents 0.4% of total employment in Ontario. It has one of the best productivity records in the Ontario and Canadian economies. Appendix Exhibit 8 tracks labour productivity and the role of capital investment.

- The labour productivity index measures the cumulative increase since 1987. The measure for all industries in Ontario in 2003 was 122.5 and 120.0 for Canada. Mining far exceeded these averages.

- These major productivity gains in mining are directly related to capital investment. The contribution of capital to the productivity process is measured by capital contribution as a percentage of output. As the table shows, mining has had high rates of investment.

Appendix Exhibit 8: Productivity Growth in Mining

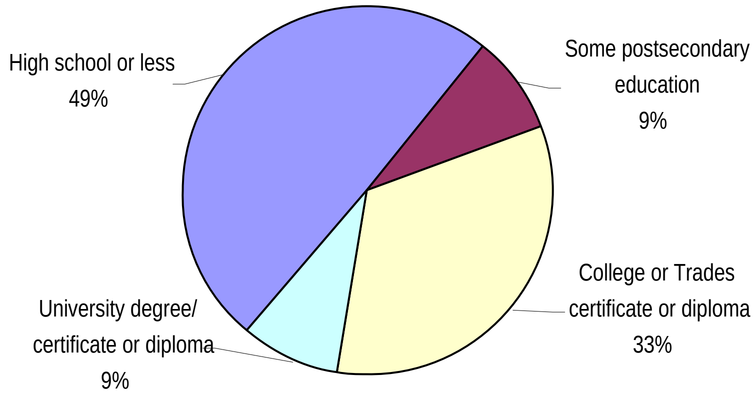
Labour Productivity Index, 2003 (1987=100)		
	Ontario	**Canada**
Mining and Oil and Gas Extraction	174.9	189.6
All industries	122.5	120.5
Capital Share as % of Total Inputs, 1997		
	Ontario	**Canada**
Mining and Oil and Gas Extraction	Na	77.7%
All Industries	Na	53.8%

Source: Centre for the Study of Living Standards.

As shown in Appendix Exhibit 9, the mining industry employs a slightly higher proportion of college qualified workers than the Ontario all-industry average. [44]

[44] The data from the Census moderately understates this role because active apprentices in mining are not recorded as postsecondary graduates prior to receiving their certification.

Appendix Exhibit 9: Mining, Highest Level of Schooling, Ontario, 2001



Source: Statistics Canada, Census 2001

The key occupations in the mining sector include:

- Specialized equipment operators
  - Underground production and development miners
  - Supervisors
- Heavy equipment operators
- Transportation equipment operators
- Mechanics
- Forestry Technicians
- Geological and mineral engineering technicians and technologists
- Electrical engineering technicians and technologists
- Mechanical engineering technicians and technologists

These occupations have many journeypersons and apprentices who learned their skills in colleges, such as:

- Crane operators
- Heavy equipment mechanics
- Millwrights and Industrial Mechanics
- Industrial Electricians

All of these are enabling occupations that have played a crucial role in the introduction of new technologies, including:

- Global positioning systems
- Compact underground borers
- Plasma blasting
- Telemining, robotics and remote guided mining services
- AutoCAD

Many colleges offer technician and technologist programs as well as the apprenticeship training that support this transformation of the mining industry. These programs include:

- Mining Technician/Technologist
- Geology/mining technician/technologists
- Electrical engineering technician/technologists

APPENDIX 6: Health Services

Health care is among the largest in Ontario (with 530,000 jobs). Rising health care costs are a key issue: the industry has a mediocre productivity record.

For the health care sectors, the evidence (Appendix Exhibit 10) shows only minor gains in productivity. This performance can be linked to limited investment in needed new equipment and technology.

Appendix Exhibit 10: Productivity Growth in Health Services

Labour Productivity Index, 2003 (1987=100)		
	Ontario	**Canada**
Ambulatory Care Services	82.1	82.3
Hospital	106.6	104.6
Nursing and Residential Care	na	Na
Social Care	na	Na
Total Heathcare and Social Assistance	89.6	90.3
All Industries	122.5	120.5
Capital Share as % of Total Inputs, 1997		
	Ontario	**Canada**
Ambulatory Care Services	na	Na
Hospital	na	12.8%
Nursing and Residential Care	na	18.7%
Social Care	na	37.7%
Total Heathcare and Social Assistance	na	33.1%
All Industries	na	53.8%

Source: Centre for the Study of Living Standards.

One important finding in Appendix Exhibit 10 is the relatively low level of investment in new equipment. This lower level may reflect the limited capacity of government to fund purchases of machinery and equipment and initiate potential productivity gains.

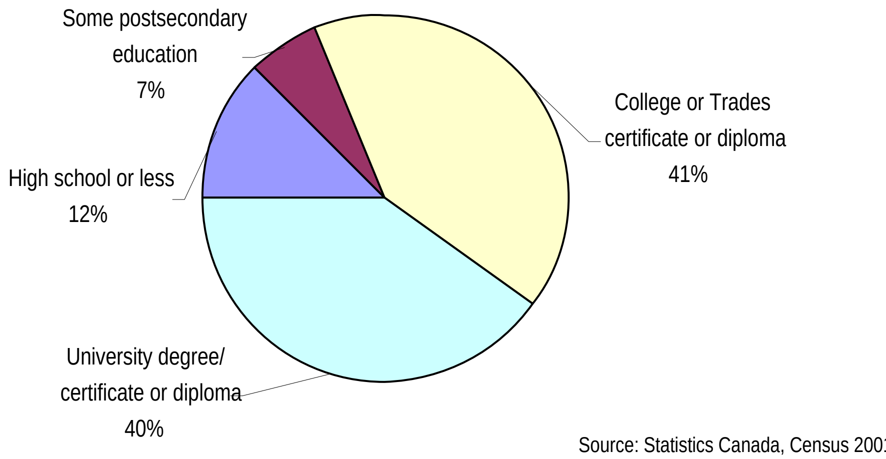
Essentially, the health care sector remains labour intensive while other sectors invest in technology that enables productivity gains. As this investment proceeds in response to the current government initiative to improve health care performance, the importance of the enabling occupations trained at colleges should grow.

Those with college credentials in the health sector have an important role to play in rebuilding productivity. The enabling role of many occupations is again linked to changing technology and related structural adjustments.

There are four sub-categories in the health care industry: *Hospitals*; *Ambulatory Care*; *Residential Care and Nursing*; and *Social Assistance*.

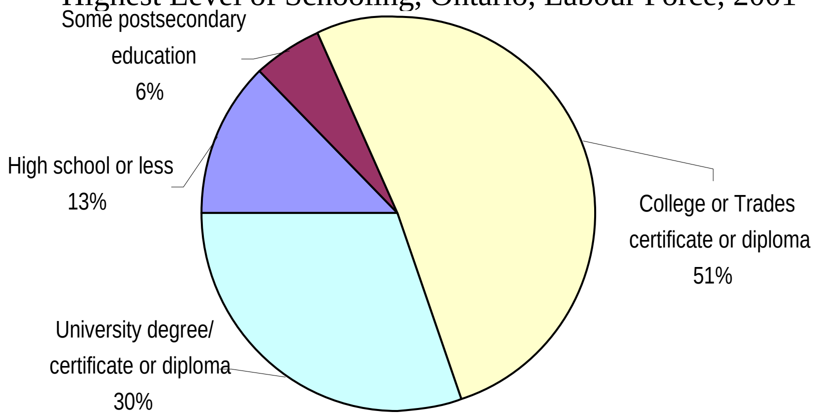
As Appendix Exhibits 11 to 14 show, each of these sectors is a major employer on its own and each is a college-intensive employer.

Appendix Exhibit 11: Ambulatory Health Care Services, Highest Level of Schooling, Ontario, Labour Force, 2001



Source: Statistics Canada, Census 2001

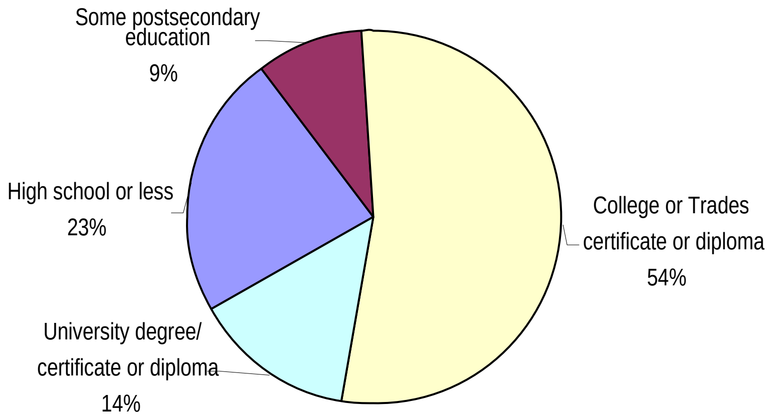
Appendix Exhibit 12: Hospitals, Highest Level of Schooling, Ontario, Labour Force, 2001



Source: Statistics Canada, Census 2001

Appendix Exhibit 13: Nursing and Residential Care Facilities,

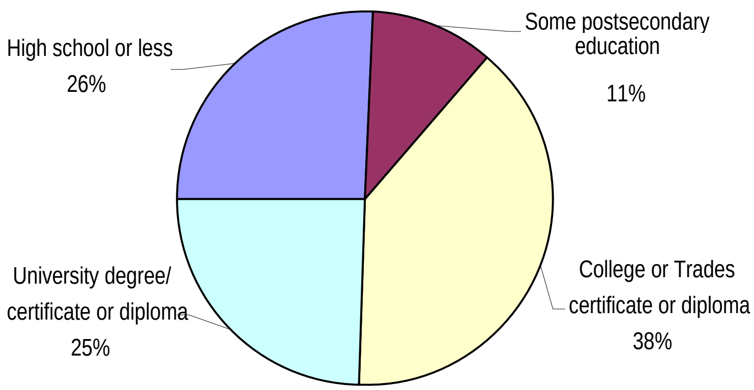
Highest Level of Schooling, Ontario, Labour Force, 2001



Source: Statistics Canada, Census 2001

Appendix Exhibit 14: Social Assistance,

Highest Level of Schooling, Ontario, Labour Force, 2001



Source: Statistics Canada, Census 2001

The Ambulatory Care industry is a good example of the role of colleges in improving productivity. Government policy and structural reform of health care can be described as a process of shifting care out of hospitals and into the other sectors. The Ambulatory Care sector is a natural focus as it avoids residential costs for patients.

The planned structural shift to ambulatory care is itself associated with investment in diagnostics and other types of equipment that reduce treatment times or substitute the work of technicians, technologists, nursing assistants and other workers for medical doctors. The core strategy to raise productivity in health care then revolves around more efficient use of medical doctors (they are expensive to train and in short supply), shifting patients out of residential care and increased use of advanced diagnostic and treatment equipment.

Workers introducing these reforms are trained at colleges and are the "enabling occupations" in this transformation of health care.

These key occupations in the Ambulatory Care sector are:

- Nurses
  - Registered
  - Practical
- Medical Technicians and Technologists
- Radiation Technicians
- Laboratory Technicians
- Dental Hygienists
- Paramedics
- Pharmacists
  - Pharmacist Assistants
- Physiotherapists
- Physiotherapist Assistants

Workers in these occupations are trained in the implementation of new technology and are able to substitute for some of the work of professionals in the field. This technology-supported process of moving care out of hospitals and substituting for professionals is the core of current policy plans to reduce health care costs and improve service.

There are many examples of technologies that are taught in the colleges and add to the efficiency of ambulatory care;

- Nurses
  - Advancements in biotechnology, genetics, advanced diagnostic testing, bioscreening etc.[45]
  - Miniaturization and portability of equipment
  - Information management used in patient records
  - Roles will change as nurses take on duties with more advanced procedures

- Medical Radiation Science – computerization, new instruments and tests[46]
  - Remote and mobile equipment
  - Electronic imaging
  - Magnetic resonance imaging
  - Digital data storage and management
  - Teleradiology (remote imaging)

- Medical Laboratory Science – computerization, new instruments and tests[47]

  Automated testing systems
  Robotics
  Imaging analysis
  Point-of-care testing instruments (e.g. glucose meter)

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[45] See Human Resources Services Development Canada, Sector Partnerships, Industry Profile for Hospitals and Other Institutions. http://www24.hrdc-drhc.gc.ca/def/profind/index.asp?VarParam=73&Param_Lang=0&Switch=index.asp

[46] See Health Canada, "An Environmental Scan of the Human Resource Issues Affecting Medical Laboratory Technologists and Medical Radiation Technologists", 2001

[47] Ibid.

Health Care is the largest focus of Ontario's colleges with programs offered in three "clusters:"

- Nursing related
- Health Technology
- Social Services

Conestoga and Georgian College both offer Practical Nursing programs. Course descriptions from both colleges identify these technologies as part of their curriculum.

Medical Radiation Technologists/Technicians use some of these technologies to promote innovation and productivity in the health care industry. Mohawk and Fanshawe College both offer Medical Imaging Technology (Radiology) programs. Course descriptions from both colleges identify as part of their curriculum:

- Diagnostic Imaging
- Specialized Imaging Modalities
- Quality Control Testing and Quality Assurance
- Radiographic Procedures
- Procedures for use of general radiology equipment
- Digital Imaging Recording

APPENDIX 7: Broadcast and Telecommunications Services

Appendix Exhibit 15: Productivity Growth in Information and Cultural Industries		
Labour Productivity Index, 2003 (1987=100)		
	Ontario	**Canada**
Information and Cultural Industries	na	187.2
Broadcasting and Telecommunications	na	241.1
All Industries	122.5	120.5
Capital Share as % of Total Inputs, 1997		
	Ontario	**Canada**
Information and Cultural Industries	na	57.3%
Broadcasting and Telecommunications	na	60.6%
All Industries	na	53.8%

Source: Centre for the Study of Living Standards.

APPENDIX 8: Professional and Scientific Services

Professional and Scientific Services industries provide services to the rest of the economy and, as the name implies, most such industries play a central role in the implementation of new technologies.

There are seven major sub-groups:

- Legal Services
- Accounting Services
- Architectural, Engineering and Related Services
- Computer Systems Design and Related Services
- Management, Scientific and Technical Consulting Services
- Scientific Research and Development Services
- Advertising Services

These services represent a core of expertise needed in the implementation of new technologies. Workers in these areas are at the centre of the web of customer – supplier networks that distribute new technologies and build productivity improvements in all the industries mentioned above.

Appendix Exhibit 16 shows that recent gains in productivity reported for the Professional, Scientific and Technical industry are quite small, in part because investment is low. In this case, data is only available for the entire industry.

Appendix Exhibit 16: Productivity Growth in Professional and Scientific Services

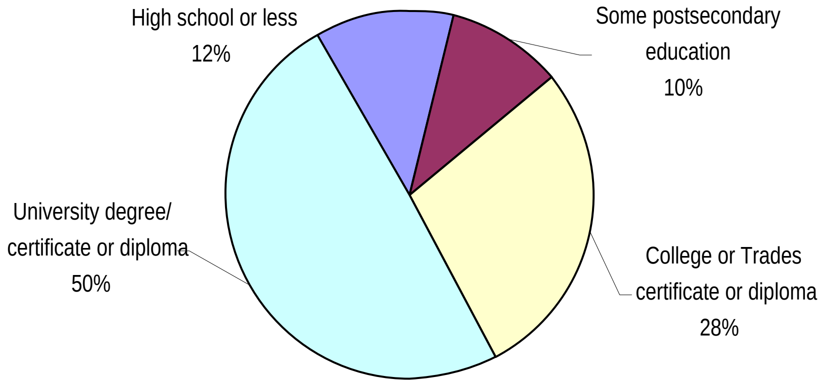
Labour Productivity Index, 2003 (1987=100)		
	Ontario	**Canada**
Professional, Science and Technical Services	114.9	111.3
All Industries	122.5	120.5
Capital Share as % of Total Inputs, 1997		
	Ontario	**Canada**
Professional, Science and Technical Services	na	32.2%
All Industries	na	53.8%

Source: Centre for the Study of Living Standards.

This is a large industry, with 429,000 in the workforce. The college contingent represents 28 per cent of the group, and is rising. Appendix Exhibit 17 reports the proportion of the workforce with a college certificate or diploma or trades certification has grown across the successive census surveys.

Appendix Exhibit 17: Professional Scientific and Technical Services,

Highest Level of Schooling, Ontario, Labour Force, 2001



Source: Statistics Canada, Census 2001

The principal college-related occupations working in this industry include:

- Technical occupations related to natural and applied sciences, including:
  - Engineering Technicians & Technologists
  - Architectural Technicians & Technologists
  - Drafting Technicians & Technologists
  - Chemical, Civil, Mechanical Engineering Technicians & Technologists
  - Interior Design Technicians & Technologists
  - Chemical technologists & technicians
  - Biological technologists & technicians
  - Technical occupations in art, culture, recreation & sport
  - Graphic designers & illustrators
  - Computer & network operators & web technicians
  - User support technicians
  - Systems testing technician

- Clerical occupations such as accounting and related clerks, legal secretaries and bookkeepers, and

- Paralegal and related occupations.

These occupations are all trained in college diploma and certificate programs. In each case, they are the enabling occupations that are empowered by changing technology, including advanced machinery and software. As described in the CTHRB research noted in section 2, these occupations are being trained with a combination of science and technology that prepares them for the crucial roles in technology implementation, including: installation, design, set up, diagnosis, repair, logistics, quality control and operations. Skills taught in the college programs often are sufficient to take on some of the roles of junior engineers, architects, accountants, lawyers and research scientists.

The payoff for this change is rising productivity.

APPENDIX 9: Repair and Maintenance

Expertise required for implementing new technologies is widely dispersed across the economy. Contracting out, off-shoring and other types of specialization have moved many functions (e.g. design, communication, logistics, installation, maintenance, repair and other services) out of manufacturing, health care, mining and forestry and service industries. These structural changes have the effect of shifting enabling occupations to many different industries.

The Repair and Maintenance industry is an important example of this shift. This college-intensive group has grown in response to a variety of technological advances and contributes directly to productivity growth across the economy. Productivity gains are among the highest in the economy.

Productivity gains in repair and maintenance work can be seen as the result of a complex series of structural, commercial, technological and other factors. Appendix Exhibit 18 reports the labour productivity index for the major industry groups.

Appendix Exhibit 18: Productivity Growth in Repair and Maintenance

Labour Productivity Index, 2003 (1987=100)		
	Ontario	**Canada**
Repair and Maintenance	169.2	159.2
All Industries	122.5	120.5
Capital Share as % of Total Inputs, 1997		
	Ontario	**Canada**
Repair and Maintenance	na	24.9%
All Industries	na	53.8%

Source: Centre for the Study of Living Standards.

The repair and service industry is building productivity with investment in new technologies. There are wide variations in the pace of success. Major gains in the areas of appliances and electronic products reflect structural changes noted above. Gains in automotive repair are more limited. In both cases, there have been major investments in specialized equipment, including diagnostic tools and computer-related support.

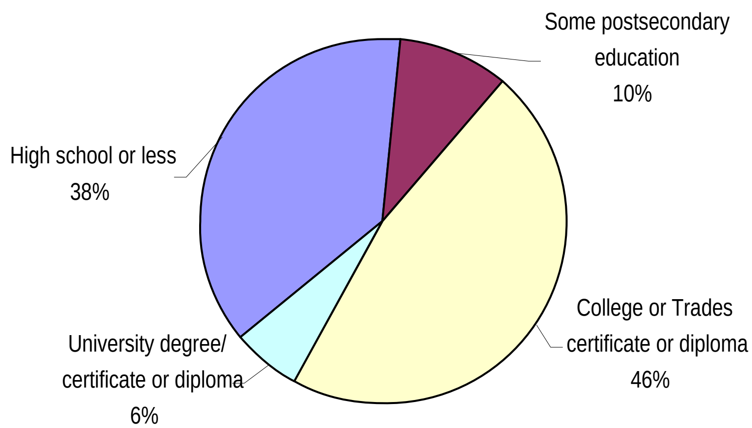
These productivity gains are driven by advances in technology, including:

- Instrumentation
- Electrical circuits
- Digital logic circuits
- Microprocessor systems
- Computer networks
- Fibre optics
- Microwave technology
- Biomedical instrumentation
- Medical and laboratory Instrumentation
- Medical imaging equipment

In 2001, there were 92,320 persons in the Repair and Maintenance labour force in Ontario. Some 88,835 (or 96 per cent) were employed. In 2001, 30 per cent of the labour force held a trade certificate or diploma and 16 per cent held a college diploma or certificate. Up to 46 per cent of the labour force was trained in the college system versus only six per cent in universities.

Appendix Exhibit 19: Repair and Maintenance,

Highest Level of Schooling, Ontario, Labour Force, 2001



Source: Statistics Canada, Census 2001

The Repair and Services industry is the largest sub-sector of the "Other Services" industry. The latter is the third most college-intensive industry in the economy. Appendix Exhibit 20 describes the broader and narrower industry definitions.

Appendix Exhibit 20 – Other Services Industries

Industry	**Labour Force in Ontario, 2001**					
	CAAT Grads		**Skilled Trades**		**All Employees**	
	#	%	#	%	#	%
Other Services (except public administration)	47,760	17%	62,130	23%	273,125	100%
Personal and Laundry Services	13,230	17%	25,770	34%	76,080	100%
Religious, Grant Making, Civic and Similar Organizations	16,075	21%	6,710	9%	77,575	100%
Private Households	3,780	14%	1,615	6%	27,150	100%
Repair and Maintenance	14,675	16%	28,040	30%	92,320	100%
Automotive	7,940	14%	19,995	35%	57520	100%
Electronic and Precision Equipment	2,585	32%	1,180	15%	8,110	100%
Commercial and Industrial Machinery and Equipment	2,135	16%	4,210	31%	13,610	100%
Personal and Household Goods	2,015	15%	2,655	20%	13,080	100%

Source: Statistics Canada, Census 2001

Three key groups in the Repair and Maintenance industry have the characteristics of enabling occupations and these include:[48]

- Mechanics, including:
    - Industrial mechanics and millwrights
    - Heavy Duty Equipment
    - Refrigeration and Air Conditioning
    - Railway
    - Aircraft
    - Textile equipment
    - Elevators
    - Auto service
    - Motor Vehicle Body repair
    - Electrical appliance service
    - Electrical
    - Motorcycle

- Technical Occupations related to science and engineering, for example:
    - Landscape and horticultural
    - Mechanical engineering technician and technologists
    - Electrical and Electronics technician and technologists
    - Electrical service technician (household and business equipment)
    - User support technicians

- Machinists, metal forming, shaping and erecting occupations, for example, sheet metal workers and welders.

The enabling occupations noted above are often divided further into further specialties. For example, auto service technician has been divided into several more specialized apprenticeships, such as auto electronics accessory technician and automotive glass technician. There are equivalent specializations in the area of electronic service technicians, such as alarm service technician and photocopy machine technician.

Employers for all these occupations face major changes in technology, consumer preferences, manufacturing strategies that are altering the skills needed to work in the industry. These changes include:

- Manufacturing technologies that permit rapid product design and introduction and more customized product features to meet more segmented markets,
- Repair and service delivery through customer contact centre systems with electronic diagnostics,
- Quality control in manufacturing that is reducing demand for repair and maintenance services but adding to the demand for technical expertise in the manufacturing (and sometimes installation) process, and
- Environmental pressures forcing reuse and recycle options.

[48] Two digit 2001 National Occupational Classification (NOC-S)

Traditional divisions that identified markets and occupations are being blurred by product convergence, driven by new technologies. For example:

- Computer suppliers offer video, audio, game/entertainment and basic voice communications.
- Electronic and related technologies (e.g., microwave) capabilities are added to and replace mechanical features on appliances.
- Traditional commercial products enter household applications (e.g., fax and photocopiers).
- Industrial technologies such as robotics enter household applications.
- New medical and related health products enter household applications.

These changes result in fewer jobs for traditional repair and maintenance technicians and more complex and advanced qualifications with extensive core skills and specializations for those working in the field. It is also clear that businesses at every stage of the supply chain must invest in new equipment, computer hardware and software and training to keep pace. All this change results in productivity gains that are distributed across the economy.