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ECONOMIC IMPACT OF CIMS SUSTAINABILITY INSTITUTE

Prepared for:
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www.cgr.org

May, 2007

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SUMMARY

The Rochester Institute of Technology's Center for Integrated Manufacturing Systems (CIMS) has posted an exceptional record of practical achievement, particularly within the context of a major university. Their work addresses the practical challenges confronting the business community, something often not the focus of academic journals.

Much of what CIMS has achieved has occurred at a relatively small scale. Although they are active in a number of different fields, limitations of both staffing and their facility have prevented expansion to "production scale." The proposed Sustainability Institute (SI) will enable CIMS achievements to "scale up" total activity.

CIMS rate of growth has been very substantial throughout its life. The compound annual growth rate has been 28% since 2000.

The SI will be structured around three laboratories: Sustainable Design & Manufacturing, Fuel Cell Research, and Renewable Energy Research. The Sustainability Institute is intended to address the opportunity for CIMS to "scale up" its efforts in all of these areas. By adding substantial capacity at the senior research ranks, expanding the physical plant and improving support for technology transfer, the impact of CIMS on the regional economy will expand substantially.

CGR has explored the potential impact on the regional economy by assigning values (in terms of employment and payroll) to plausible outcomes of this expansion.

There are many caveats discussed in the report, but underscoring such caveats, CGR's combined estimates suggest that after a period of buildup, the Sustainability Institute could stimulate the creation of 6,000 jobs with earnings of roughly \$650 million.* Not all of these jobs would be located in the immediate Rochester area as the consulting activity of the Sustainability Institute and related ventures would not be restricted to the Rochester area.†

The Sustainability Institute would also retain Rochester's role as a leading center for key applied manufacturing research and its position as an appropriate location to contribute elements of emerging products and services, particularly alternative fuels and remanufacturing.

* We assume that the Sustainability Institute will maintain the robust rate of growth experienced by CIMS in previous years. More significantly, approximately two-thirds of the estimated \$36 million in project revenues by 2011 is driven by the growth of firms contracting with the SI and an affiliated spinoff. This presumes a significant level of entrepreneurial activity on the part of the SI staff. These growth figures are achievable – but only with effective execution by the new Institute. The 6,000 jobs estimate outlines potential growth – something less robust than a forecast.

† The jobs created by both the contractual work and the consulting work are not limited to the Rochester area since the SI would be free to conduct business with firms across the country, and perhaps the world. Thus, many of the estimated direct and spillover jobs created should be attributed to non-local areas.

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ACKNOWLEDGMENTS

CGR wishes to thank the many people at CIMS who helped provide data for this analysis. In particular, we would like to extend our gratitude to Nabil Nasr, Robert German, Newton Green, Mark Coleman, Cynthia Gary, Susan Moline, and Lisa Templar.

Staff Team

Rochelle Ruffer and Kent Gardner provided the analysis for this report.

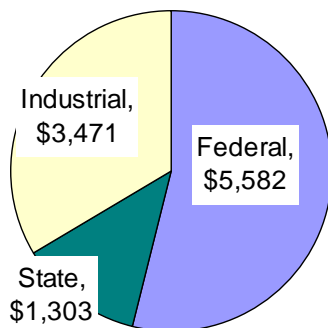
SUSTAINABILITY INSTITUTE EXPANDS WORK OF RIT CIMS

The Rochester Institute of Technology's Center for Integrated Manufacturing Systems (CIMS) has posted an exceptional record of practical achievement, particularly within the context of a major university. Their work addresses the practical challenges confronting the business community, something often not the focus of academic journals.

Much of what CIMS has achieved has occurred at a relatively small scale. Although they are active in a number of different fields, limitations of both staffing and their facility have prevented expansion to "production scale." The proposed Sustainability Institute (SI) will enable CIMS achievements to "scale up" total activity.

CIMS rate of growth has been very substantial throughout its life. The compound annual growth rate (CAGR) has been 28% since 2000. The table below provides the total revenue of CIMS since 2000.

Fiscal Year	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Total Revenue (\$1000)	\$ 2,400	\$ 3,610	\$ 4,389	\$ 6,088	\$ 7,376	\$ 8,024	\$ 10,356



**2006 Revenue
by source
(\$1000)**

The work of CIMS has not been limited to public funds. In FY 2006, one third of total revenue has come from industrial sources. Although federal sources of support are substantial, much of this money comes in the form of work on behalf of the military that has a very clear "return on investment" to military procurement authorities.

CIMS relationship with military procurement

enables it to adapt technology developed with public funds and extend the benefits to private businesses. Once again, the expansion of CIMS envisioned in the Sustainability Institute will enable the CIMS staff to identify new applications of knowledge gleaned from public sector support and establish ongoing partnerships with private business.

ESTIMATING POTENTIAL ECONOMIC IMPACT

This paper is intended to explore the potential economic impacts of the Sustainability Institute. As the Institute's activity covers a broad range of endeavors and envisions a significant change in scale, CGR does not claim that these figures are a forecast. Rather, based on the history of CIMS achievements, this paper identifies plausible future achievements and translates these achievements into jobs and income.

The SI will be structured around three laboratories: Sustainable Design & Manufacturing, Fuel Cell Research, and Renewable Energy Research. As these three activities are closely related, the potential economic impact of each cannot be wholly separated, although CGR presents a separate discussion of each focus below.

Sustainable Design and Manufacturing

What is the responsibility of a manufacturer for products once they have reached the consumer? Historically, the manufacturer bore responsibility for the product only through the warranty period. Reliability only mattered to the extent that the aggregate cost of warranty repair remained below the cost of improved design and construction.

The Market for Reliability

The market has changed. Reliability, both during and beyond the warranty period, has become more of a priority for consumers. This change has been stimulated both by fierce competition among producers for the loyalty of consumers and better information.

The auto industry, long a bellwether for the manufacturing sector, provides a good example. Toyota has just overtaken General Motors as the world's largest car manufacturer. Toyota's success, by most accounts, has been influenced by its ability to convince consumers that its products are more reliable than those of the competition. The facts behind Toyota's rise to prominence are more complex, yet the public perception of quality has certainly contributed to their success. This attention to quality has stimulated a renewed focus on design that emphasizes reliability throughout the product life cycle.

CIMS has long played a role in helping companies identify critical weaknesses in manufactured products that prolong product life. In related work, CIMS has also been a pioneer in developing sensors that will improve the maintenance of manufactured products—particularly vehicles—thus reducing failure rates during the life of the product.

Remanufacturing & Disposal

Manufacturers are accustomed to bearing no responsibility for end-of-life disposal. Without an incentive to pay attention to factors influencing the share of product that can be recycled or remanufactured, sustainable design has received little attention. CIMS brings significant experience to this field and its contribution to the growing remanufacturing industry will be continued within the Sustainable Design and Manufacturing Laboratory.

EU End-of-Life Requirements

The European Union (EU) has already established requirements for end-of-life disposal of vehicles and electrical and electronic equipment.

EU Vehicle Disposal Directive

Member States shall encourage . . . the design and production of new vehicles which take into full account and facilitate the dismantling, reuse and recovery, in particular the recycling, of end-of life vehicles, their components and materials.

Member States shall take the necessary measures to ensure that producers meet all, or a significant part of, the costs of the implementation of this measure and/or take back end-of life vehicles.

- no later than 1 January 2006, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 85 % by an average weight per vehicle and year
- no later than 1 January 2015, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 95 % by an average weight per vehicle

Directive 2000/53/EC of the European Parliament

EU Waste Electronic & Electrical Equipment (WEE) Directive

- distributors shall be responsible for ensuring that [WEE] can be returned to the distributor at least free of charge . . . for the final holder
- producers [shall] set up systems to provide for the treatment of WEE using best available treatment, recovery and recycling techniques
- by 31 December 2006, producers [shall] meet the following targets: . . . the rate of recovery shall be increased to a minimum of 75 % by an average weight per appliance (75% applies to personal computers--the range is 65% to 80% depending on the appliance)

Directive 2002/96/EC of the European Parliament

US firms are not exempt from these requirements. US firms exported \$186 billion in goods & services to the EU in 2005, a significant share of which was either vehicles or electrical and electronic equipment. Thus, there is great opportunity for CIMS to continue to aid US firms in meeting this European directive. In addition, there is strong sentiment supporting the passage of similar laws in the United States, thus expanding the market for CIMS expertise to the domestic market as well.

CIMS SI Support for Local Remanufacturing Startups

The key to an expanded economic impact within the Rochester area will be CIMS SI support for local start-ups focusing on remanufacturing. Unlike most academic ventures, CIMS brings extensive experience with private sector relationships and is well positioned to support local ventures.

CIMS also possesses licensable patents that are already contributing to private sector job creation. With additional support for technology transfer, CIMS will be patenting more innovations and improving the pace of licensing. The impact of tech transfer can be significant, although it takes time and sustained effort. A more robust tech transfer effort will be required if the region is to benefit directly from SI innovations.

Industrial Consulting Spin-off

The bulk of CIMS contracts with private firms will carry over to the industrial consulting lab in the Sustainability Institute. One possible outcome of the Institute will be a “spin off” of this industrial consulting practice. CGR explores the potential revenue implications of this change in structure later in the paper.

Fuel Cell Research Lab

The nation’s dependence on an increasingly costly and politically fraught fossil fuel industry has significantly increased interest in the development of fuel cells. The economic opportunity for Rochester is both short term and long term.

Fuel Cell Research

There is an immediate opportunity for Rochester to participate in fuel cell research. Funds are available from the federal and state governments and from industry. Rochester is fortunate in having two industrial fuel cell research facilities in the area, one owned by General Motors and one owned by Delphi. Fuel cell R&D grew 11% from 2004 to 2006 with a comparable increase in fuel cell related employment.

RIT CIMS is well positioned to expand the role it plays in fuel cell research. While it has been involved in the past, the role it plays will be significantly expanded under the Sustainability Institute.

Fuel Cell Manufacturing Commercial sales, which accounts for roughly half of spending on R&D, grew 7% from 2004 to 2006 (2006 Worldwide Fuel Cell Industry Survey). This growth pattern suggests that the market for fuel cells is still in its infancy. If, as many believe, fuel cells become viable outside its current, relatively narrow, market niche, there will be a significant opportunity for Rochester in the manufacture of fuel cell components and in fuel cell remanufacturing.

At their current state of development, remanufacturing is particularly important for fuel cells. The service life of a fuel cell is short without significant investment in maintenance. While the CIMS SI will likely be part of the solution to this particular technical problem, CIMS expertise in remanufacturing can and should be exploited to ensure that commercial fuel cell remanufacturing is viable in Rochester.

Renewable Energy Research Lab

The NYC Investment Fund reports that \$1.6B in venture capital flowed to “cleantech” in 2005, then expanded rapidly to \$2.3B by Q3 2006. Of this total, 60% of the funds support alternative energy. Federal support for alternative fuels research and development through the Energy Policy Act of 2005 and subsequent federal legislation is also substantial.

Production credits in some laws have spurred commercial expansion, another source of research funding. Many states, including New York State (NYS), have added their own support for alternative fuels. In NYS, New York State Energy Research & Development Authority (NYSERDA) funds research through a “systems benefit charge” assessed on all utility ratepayers. In addition, New York’s renewable portfolio standard credits (funded by the systems benefit charge) has increased New York State’s commercial viability.

Expand Technology Transfer

CIMS research has generated ten patents (final & provisional) to date. Spin-out potential for patented innovations is strong, but CIMS needs the staffing to facilitate this expansion. The near term potential for increased employment and income in the Rochester

area is limited, yet the long term potential could be quite substantial.

One example of the potential is the device developed by CIMS to assess the remaining service life of printer wiper blades. Licensed to Optical Technologies Corporation (OTC), the device has been used to test nearly 2 million wiper blades, thus diverting 600 tons of metal & urethane from landfills. Additionally, a device to test an organic photoconduction drum, another printer component, is undergoing beta testing. It will also be licensed to OTC.

Economic Impact of Sustainability Institute: Overview

In order to estimate how continued growth would stimulate employment and payroll, CGR reviewed individual elements of CIMS current activities. CGR also estimated the economic impact of selected new endeavors, to the extent that some numerical estimate could be reasonably developed.

Continued CIMS Expansion

- ❖ If the 2000-2006 growth rate continues for CIMS through 2011, annual revenue will have increased to \$36 million, thus stimulating
 - ◆ 700-800 jobs
 - ◆ \$35-40 million in annual earnings

CIMS Spun-out Consultancy & Impacts on Aided Firms

Given the expanding market worldwide, a well-managed consultancy could generate \$10 million in annual revenue. This, in turn, would provide

- ◆ 110-120 jobs
- ◆ \$6-8 million in annual earnings

CIMS Impact on Contracting Firms: Historical View

The assistance provided to contractor firms helps these firms increase their profitability and expand their markets. As a part of their funding requirements, CIMS has surveyed firms involved in their research on issues dealing with job creation and retention. CIMS surveys of participating firms from 1998-2006 suggests that, on average, for each \$1 million invested in research, participating firms report that 110 jobs were created or retained. CGR believes that the spillover job creation within NYS can be expected to

equal direct job creation (when direct jobs are in manufacturing). Based on surveys provided by CIMS, CGR estimates the following

- ◆ 1,478 jobs were created or retained by participating companies
- ◆ the total job impact (direct & spillover) of 2,900 jobs

CIMS Impact on Contracting Firms: Forecast

Using the assumptions from above, CGR proposes the following scenario. Assume that two-thirds of the estimated \$36 million in revenue during 2011 supports direct contracts with firms.* Then, we would expect CIMS SI to engage in \$24 million in contractual work. These contract opportunities with manufacturers may stimulate

- ◆ 2,600 direct jobs created or retained
- ◆ total job creation/retention could reach 5,200 (direct and spillover)
- ◆ These workers would earn \$600-630 million in annual earnings

Remanufacturing Industry

Given what we know about the current size of the remanufacturing industry and assuming that Rochester captures 10% of the market, CGR estimates the total industry size could employ 60 people and pay them \$3.2 million in annual wages and salaries.

The OEM Product-Services Institute (OPI) estimates the size of the remanufacturing sector to post \$40 billion in annual turnover. If Rochester were to capture 10% of a 10% CAGR, local sales would reach \$6.5 million by 2011. Given those assumptions, we would expect the following

- ◆ Employment modest at about 60 jobs (direct & spillover)
- ◆ Earnings of \$3.2 million (direct & spillover)

* CIMS estimates that roughly two-thirds of their current revenue involves direct contact with firms.

CONCLUSION

RIT's Center for Integrated Manufacturing Systems (CIMS) has a documented record of assisting companies from around the world with the challenges posed by the need to reduce manufacturing costs, reduce disposal costs of products reaching the end of their service lives, and remanufacture aging products. CIMS has been active in a number of additional areas of research, particularly alternative energy.

The Sustainability Institute is intended to address the opportunity for CIMS to “scale up” its efforts in all of these areas. By adding substantial capacity at the senior research ranks, expanding the physical plant and improving support for technology transfer, the impact of CIMS on the regional economy will expand substantially.

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