

2002

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## Recommended Citation

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## New Business Creation and Technology Transfer in the Rochester Cluster

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The Rochester, NY regional photonics industry is in a period a technological and organizational change. Over the past seventy years the regional has enjoyed a reputation as one of the premium optics and imaging (photonics systems) centers of the world. In the past, the driving force behind this preeminence was a small number of larger diversified companies with strong technological competencies and internally oriented operations. Supporting these firms were dozens of small optics, components, and imaging suppliers who grew and declined with their primary customers. Today's competitive photonics industry is far different technologically and organizationally then what existed 20 to 40 years ago.

The following research is the summary of two studies conducted by the Center of International Business at the Rochester Institute of Technology designed to understand the structure and driving forces of the current Rochester Photonics cluster. The studies sought to understand a number of essential questions related to the growth and development of the locally based photonics clusters. These included: What is the current structure of the Rochester Photonics cluster? What are the roles of the large firms which once dominated the local optics and imaging environment? What institutions support the creation of the new high technology firms based within the region? The overarching purpose of these studies were to gain better insight into the region in order to allow corporate executives, public policy makers, and academic leaders to better assess and provide for the needs of the region.

This research was in part based upon interviews from 22 of the most significant companies involved in photonics in the greater Rochester region. The senior management teams of these companies were invited to participate in the study; all agreed. Twenty two extended interviews were conducted with the CEOs of these companies. Interviews were constructed around conversations but a list of topics, derived from the preceding literature review, drove the conversation. The topics list was designed to explore how these executives perceived the role of local suppliers, end users, academic institutions, etc. and how internationalization was changing or modifying these relationships. Each interview was tape recorded and subsequently transcribed. Altogether the study generated some 400 pages of text. The content of the transcripts were analyzed and the analysis of the data was approached in a manner consistent with the recommendations of Glaser and Strauss (1967) and Miles and Huberman (1984). They required us to read and re-read the interview transcripts many times until a mutually exclusive set of categories emerged that we believe represent these data. The process was enhanced by the use of NVivo, a software package designed for this purpose (Richards 1999).

### **Industry History**

Rochester's reputation in photonics first developed with the establishment of three companies specializing in imaging and/or optics: Eastman Dry Plate Company in 1881, Bausch and Lomb (B&L) optics and eye care company in 1853, and Haloid Company (later renamed Xerox) in 1906. These companies formed a photographic and electronic imaging infrastructure that fostered the establishment of a large and dedicated local supplier and subcontractor base. As defined above, the big three (as they were sometimes referred) served as the drivers of a hub and spoke type industrial cluster (Sternberg, 1991).

Beginning in the late 1920s a number of local academic institutions began to create specialized training and knowledge generation to support the growing cluster. In 1929 the University of Rochester (UofR) was granted funds to establish the world-renowned Institute of Optics (Sternberg, 1991). In 1930 the Rochester Institute of Technology (RIT) established a formal curriculum in photographic science (Sternberg, 1991). Later it became the first (and only) university to offer a Ph.D. program in Imaging. In 1963, driven by chronic shortages of locally based skilled labor, Monroe Community College (MCC) became the first college in the nation to offer a two-year degree program in optics.

The role played by traditional companies has changed dramatically in the past 20 years. The presence of Kodak, Xerox, and Bausch and Lomb in the Rochester region, and in optics and imaging in particular, declined. Bausch and Lomb existed most of its optical business, closing some and selling others. Today the company is exclusively a consumer products company with only limited optical expertise. Xerox no

longer makes optical products. Kodak, the only member of the big three with a local imaging/photonics presence, is no longer a dominant actor. In the late 1990s a new large company entered the Rochester market. Corning Inc., based on its success in the telecommunications/fiber optics industry, entered the Rochester cluster by purchasing two small high technology optics/photonics companies and announcing the creation of an optics production facility. As of December 10, 2001, however, due to the telecommunications crash the company cancelled plans to open a manufacturing facility.

### **Organizational Structure**

Traditionally, regional cluster forms are associated with one of three non-mutually exclusive cluster organizational models: (1) Hub and spoke structures are based on large integrated firms and their dedicated supplier networks; (2) Value chain structures are based on the creation of one or more value chains within a particular region (This encompasses firms up and down the value chain who do not dominate firm relationships in a manner similar to hubs); and (3) Technology Spin off structures are based on spin off firms who emerge from universities, large companies, and governmental research centers.

### **Current Cluster Structures**

The interviews revealed a fairly small and fragmented industry. The revenues of 21 of the 22 companies ranged from \$.5 and \$35 million. The largest company, a unit of a Fortune 50 corporation, would not reveal its revenues, but industry experts estimate these revenues to significantly exceed the upper end of the range. The companies interviewed competed in a diverse variety of specialized components, services, and subassembly. Many of these firms competed in the segments of the optical glass or plastics markets. Firms in this field range competed in a wide variety of segments ranging from glass blanks to unique optical shapes. A number of value added companies provided needed services or equipment for optical systems, which include, gratings, coatings, and measurement devices (metrology). Another group of companies primarily compete in photonics system design. While a number of these firms possessed manufacturing operations, their primary expertise resides in photonics design.

Very few of the firms interviewed possessed a substantial local customer base. Only two reported local sales of approximately 50%. Of these, both firms were very small and had not been in businesses for a prolonged period of time. One of these companies, established in 2000 noted that they started with local contracts and anticipated a dramatic decline in the percentage of local revenues as their national sales increased. Twenty of the 22 firms reported local sales under 10%. Ten firms reported sales at 5% or less. Kodak and Corning were not dominant customers for any of the firms interviewed except for one company recently purchased by Corning who provided components for Corning products.

The most significant similarity among the interviewed companies was common optics/photonics related technology and the manner in which their companies were created. Uniformly, the founders of their companies were trained by the local photonics related academic establishment and/or one of the big three. For those firms specializing in precision optics, MCC's associate degree program played a major role in their business. Three of the CEO's created businesses in precision optics manufacturing soon after graduation from MCC. The University of Rochester's Institute of Optics and Laser Lab played the most significant role in the business creation process. For slightly under half of the businesses interviewed UofR played a significant role in creating the expertise or technology associated with the business. These businesses tended to be much more high tech oriented opposed to the MCC related firms which specialized in grinding and polishing precise optics and possessed only limited engineering capabilities. Kodak, B&L, and Xerox also played roles. Four companies in the sample were created from trained photonics (or other) engineers from Kodak. B&L also created three companies in the sample, but these companies were the result of the company closing or selling off its existing photonics related businesses. Only one firm was created from training and technology established from Xerox.

Hence, the interviews suggest a cluster structure that resembles a Technology/Spin off structural classification listed above. Universities, specifically UofR and MCC, and several large corporations, notably Kodak, created the specialized knowledge that drives these firms. No large firm(s) dominate the local cluster as they did in the past. Additionally, the region lacks any complete valued added chain associated with a mainline market.

### **Concluding Thoughts**

The Rochester photonics cluster is a region in flux. It can no longer rely upon the three or four large technology firms to nourish the region with markets, technology, or spin off firms. The current industry is based upon the expertise and market niches primarily developed from academic establishments and smaller high technology companies. This new reality provides significant insight to corporate executives, public policy makers, and academic leaders. To grow, develop, and mature, the region requires a new ethos of entrepreneurship. Programs and attributes must be developed that encourage and enable academics, graduates, and corporate employees to start new businesses based upon advanced technologies and neglected market niches. The region would also significantly benefit from both regional firms moving into subsystem production and/or outside subsystem manufacturers relocating to the area.