

**The Metalworking Cluster
in the
Northeast Ohio Region**
A Briefing Paper

Completed by John Brennan, The Urban Center, Levin College
of Urban Affairs for the Northeast Ohio Regional Economic
Development Strategy Initiative

June, 1998

Not for duplication or citation without consent of the Greater Cleveland Growth Association

Purpose of Briefing Paper

The objective of this paper is to provide an overview of the metalworking cluster in the Northeast Ohio (NEO) region. The Northeast Ohio region includes the following eight counties: Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Summit, and Portage. The term “cluster” refers to a geographic concentration of interdependent companies within the same industry, with common suppliers, labor pools, and institutions that together constitute an important competitive advantage for the region in that industry. The paper is a starting point for discussion about the priorities of the metalworking cluster—what needs to happen for the cluster to prosper in the future. The paper may be used to launch a process in which business leaders, public officials, and community leaders will have the opportunity to take action on top cluster priorities.

This briefing paper is a product of the Northeast Ohio Clusters Project. The Greater Cleveland Growth Association, in cooperation with the Akron Regional Development Board, Cleveland Tomorrow, and other Northeast Ohio regional leaders are directing the Project. The Gund and Cleveland Foundations have provided funding. The Urban Center at Cleveland State University’s Levin College of Urban Affairs, Collaborative Economics of San Jose, California, and the Economic Development Research Division of the Greater Cleveland Growth Association have undertaken the research efforts for this project.

Primary sources of information for this briefing paper include ES-202 public use employment statistics, employment data from the U.S. Bureau of the Census, results of a regional input-output model devised by the late Ben Stevens and furnished by the Regional Science Research Corporation, interviews with local industry executives, case studies of individual local enterprises, historical articles relating to NEO’s industrial development, and relevant industry trade publications.

Overview

This briefing paper describes the NEO’s metalworking cluster, elaborates on its growth potential, and explores possibilities for collaborative action.

In the first section, the paper describes the cluster’s size in terms of employment and payroll, as well as the cluster’s occupations, relative productivity, and exports. It also describes the intra-cluster relationships, including insurance products, suppliers, distribution channels, final markets, and the community infrastructure that supports the cluster.

The next section describes the potential of the metalworking cluster, including external and internal influences, and the requirements for continued vitality of the metalworking cluster in NEO. The last section presents opportunities and ideas for possible collaboration among NEO's metalworking companies, universities, and others.

I. Cluster Description

The Metalworking cluster, which is actually two sub-clusters—one steel, one aluminum—in Northeast Ohio includes over 2,000 companies or plants producing the entire range of steel and non-ferrous (mostly aluminum) products, from basic steel rod, sheet, or plate to a wide range of industrial or consumer items including industrial machinery and supplies, automotive parts, and household appliances.

The cluster is composed of companies producing goods or services in 11 three-digit driver SIC categories, eight are directly related to the steel sector, three to the non-ferrous sector.¹

Steel Cluster

- SIC 331, Blast Furnace and Basic Steel Products
- SIC 343, Plumbing and Heating, except Electric
- SIC 345, Screw Machine Products, Bolts, etc..
- SIC 346, Metal Forgings and Stampings
- SIC 347, Metal Services, nec
- SIC 349, Miscellaneous Fabricated Metal Products
- SIC 354, Metalworking Machinery
- SIC 359, Industrial Machinery, nec

Aluminum Cluster

- SIC 339, Miscellaneous Primary Metal Products
- SIC 334, Secondary Nonferrous Metals
- SIC 336, Nonferrous Foundries (Castings)

¹ These categories include the core industries of the cluster, which are called "driver" industries. Some three digit SIC metalworking industries that have significant employment are not included in the analysis due to the methodological technique used to identify driver industries.

Characteristics

Size and Growth

As shown in Tables 1a and 1b, the NEO Metalworking cluster provided over 80,000 jobs in 1995, adding 260 jobs since 1989 for a very small increase of 0.5 percent. Compared to 6.2 percent total regional growth, the cluster as a whole can be characterized as stagnant in terms of job production. Exceptionally strong segments within the cluster include those SICs for Industrial Machinery, NEC; Plumbing and Heating, except Electric; Metal Services, NEC; Nonferrous Foundries; and Miscellaneous Fabricated Metal Products. Much of the strength within these SICs can be attributed to growing external demand for their products as well as the growth of outsourcing by larger companies inside and outside of the cluster.

Large in size and mature in its development, the cluster remains very important to the regional economy, as it has for the past seven decades. The cluster is slow growing in terms of jobs, where the aggregate contribution to the regional employment base has declined from 1989 to 1995, from 6 percent of total employment to 5.7 percent. However, as the location quotients (LQs) demonstrate, the cluster is highly concentrated in NEO in relation to the national employment figures for the same cluster SICs, with LQs of 3.8 for steel and 4.2 for aluminum. In fact, for both aggregate clusters, the concentration within the region of these industries relative to the nation has increased over the six-year period analyzed. So, even though both clusters may be declining in local job importance, a slight increase in importance in terms of industrial concentration has taken place, a reflection of competitive advantage.

Table 1a: Steel Employment

SIC	Description	Employment 1995	Location Quotient* 1995	%Change in LQ from 1989-1995	Employment % Change 1989-95	Employment Change 1989-95
CLUSTER TOTAL		77,903	3.8	2.96	.6	498
331	Blast Furnace and Basic Steel Products	11,533	4.0	0.79	-16.5	-2280
343	Plumbing and Heating, except Electric	3,443	5.0	25.62	15.3	458
345	Screw Machine Products, Bolts, etc..	6,573	5.5	4.25	1.6	106
346	Metal Forgings and Stampings	15,069	5.0	-6.88	-3.1	-476
347	Metal Services, NEC	4,014	2.6	14.49	18.5	627
349	Miscellaneous Fabricated Metal Products	7,282	2.4	13.28	17.0	1056
354	Metalworking Machinery	18,189	4.5	2.52	0.3	56
359	Industrial Machinery, NEC	11,800	2.9	7.64	8.8	951

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data), Edited by Cleveland State University's Urban Center.

* Location quotient is the relative concentration of industry employment in the region compared to the nation as a whole (nation=1.0).

Table 1b: Aluminum Employment

SIC	Description	Employment 1995	Location	%Change in	Employment	Employment
			Quotient*	LQ from	% Change	Change
			1995	1989-1995	1989-95	1989-95
CLUSTER TOTAL		6,546	4.2	1.70	-3.5	-238
339	Miscellaneous Primary Metal Products	1,408	4.1	18.34	14.8	181
334	Secondary Nonferrous Metals	600	3.2	-50.83	-59.1	-868
336	Nonferrous Foundries (Castings)	4,538	4.4	14.79	11.0	449

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data), Edited by Cleveland State University's Urban Center.

Payroll Per Employee

The Metalworking cluster provides, on average, high wage jobs to its workers (see Tables 2a and 2b). Compared to all manufacturing workers, metalworking workers receive higher than average wages. With all manufacturing workers earning an average \$30,900 per year, workers in the steel cluster and the aluminum cluster earn \$39,787 (29 percent greater) and \$31,985 (4 percent greater), respectively.

Payroll per employee decreased for the aluminum cluster by 2.9 percent from 1989, while payroll per employee increased in the steel cluster by 7.7 percent. Differences between the two clusters may be found in changes in productivity, where the steel sectors may have achieved better gains than aluminum. In any case, many industry officials and analysts contend that most losses in wages for aluminum-based enterprises in NEO have been recovered since 1995 due to tight labor market conditions.

In 1995, average payroll per employee for the NEO cluster was 13 percent (a ratio of 1.13) higher than that of national cluster for steel and just 1 percent (a ratio of 1.01) higher for the local aluminum cluster. This may represent an interaction of unionized labor bargaining as well as greater productivity for these industries (steel more so than aluminum). In addition to the increasing employment concentrations of these industries from 1989 to 1995, this condition reflects a distinct competitive advantage for these industries relative to the nation.

Table 2a: Steel Payroll

SIC	Description	Payroll Per	Payroll Per	Payroll Per
		Employee 1995	Employee % Change 1989-95	Employee Relative to the Nation 1995
CLUSTER TOTAL		\$39,787	7.7	1.13
331	Blast Furnace and Basic Steel	\$51,652	34.1	1.13

Products				
343	Plumbing and Heating, except Electric	\$37,959	8.0	1.22
345	Screw Machine Products, Bolts, etc..	\$35,056	8.0	1.07
346	Metal Forgings and Stampings	\$47,560	6.1	1.26
347	Metal Services, NEC	\$29,133	8.5	1.07
349	Miscellaneous Fabricated Metal Products	\$31,027	4.3	1.02
354	Metalworking Machinery	\$38,956	1.9	1.04
359	Industrial Machinery, NEC	\$31,743	-0.4	0.99

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data)
 Edited by Cleveland State University's Urban Center.

Table 2b: Aluminum Payroll

SIC	Description	Payroll Per Employee 1995	Payroll Per Employee % Change 1989-95	Payroll Per Employee Relative to the Nation 1995
CLUSTER TOTAL		\$31,935	-2.9	1.01
339	Miscellaneous Primary Metal Products	\$32,498	3.6	0.93
334	Secondary Nonferrous Metals	\$37,635	-1.2	1.02
336	Nonferrous Foundries (Castings)	\$31,007	-1.5	1.05

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data)
 Edited by Cleveland State University's Urban Center.

Productivity and Export Strength

As Tables 3a and 3b show, the SICs within the metalworking cluster are moderately productive industries relative to the rest of the region and maintain a significant export base. The steel cluster has a 1.29 productivity ratio relative to the rest of the region while the aluminum cluster's ratio is 1.23. Both clusters export a majority of their final products, with steel exporting 61.5 percent of its output and aluminum, 70.3 percent. Collectively, the metalworking cluster accounts for 14.4 percent of NEO's total exports.

Table 3a: Steel Productivity and Exports

SIC	Description	Productivity* Relative to the	Percent of Output	Percent of Total
-----	-------------	-------------------------------	-------------------	------------------

		Region 1992	Exported Outside of the Region 1992	Region's Exports 1992
CLUSTER TOTAL		1.29	61.5	13.0
331	Blast Furnace and Basic Steel Products	1.76	40.0	2.5
343	Plumbing and Heating, except Electric	1.27	91.2	0.5
345	Screw Machine Products, Bolts, etc..	1.12	71.2	0.9
346	Metal Forgings and Stampings	1.45	74.9	3.8
347	Metal Services, NEC	0.98	51.0	0.3
349	Miscellaneous Fabricated Metal Products	1.10	69.6	1.2
354	Metalworking Machinery	1.23	70.6	2.5
359	Industrial Machinery, NEC	1.05	62.8	1.2

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data)
Edited by Cleveland State University's Urban Center.

* Proxy for productivity based on gross metropolitan product per employee. Calculated as SIC GMP per employee divided by GMP per employee for all SICs.

Table 3b: Aluminum Productivity and Exports

SIC	Description	Productivity*		
		Relative to the Region 1992	Percent of Output Exported Outside of the Region 1992	Percent of Total Region's Exports 1992
CLUSTER TOTAL		1.23	70.3	1.4
339	Miscellaneous Primary Metal Products	1.25	61.3	0.3
334	Secondary Nonferrous Metals	1.36	68.0	0.4
336	Nonferrous Foundries (Castings)	1.20	77.2	0.7

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data)
Edited by Cleveland State University's Urban Center.

* Proxy for productivity based on gross metropolitan product per employee. Calculated as SIC GMP per employee divided by GMP per employee for all SICs.

Firm Size

As shown in Tables 4a and 4b, the larger number of firms in the metalworking cluster are small and medium-sized, with 92 percent of the steel firms and 86 percent of the aluminum firms having less than 100 employees. However, in the steel cluster firms, employment is relatively evenly distributed among the small, medium, and large firms while the distribution of employees among the aluminum firms is skewed toward the larger firms. This can be explained by the industrial diversity found within the steel cluster compared to the aluminum cluster.

Table 4a: Steel Firms—Size and Employment Distribution
(out of 1,943 total firms)

Firm Size	% of Cluster Firms	% of Cluster Employment	Average Firm Size
1-24	72.0	15.3	8
25-99	20.9	26.0	50
100-499	6.4	30.9	191
500+	0.7	27.7	1532

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data)
Edited by Cleveland State University's Urban Center.

Table 4b: Aluminum Firms—Size and Employment Distribution
(out of 119 total firms)

Firm Size	% of Cluster Firms	% of Cluster Employment	Average Firm Size
1-24	52.1	10.9	11
25-99	34.5	35.7	55
100+	13.4	53.4	211

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data)
Edited by Cleveland State University's Urban Center.

Occupational Distribution

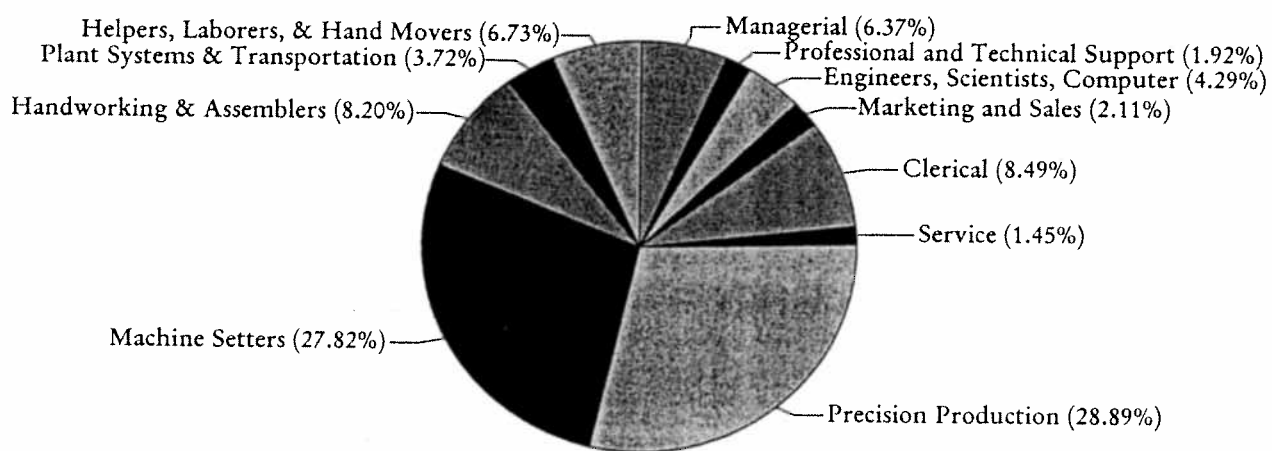
Figure 1 shows the 1996 occupational distribution of employees within the NEO Metalworking cluster. The graph combined the steel and aluminum clusters due to the similarity in their individual distributions.

The current occupational makeup of this cluster is a reflection of transformations taking place during the last two decades—the decline of low- and semi-skilled occupations. Precision production and machine setters collectively account for nearly 58 percent of all employee occupations. Managers and executives of companies interviewed view these types of occupations as reasonably high-skilled to very high-skilled in nature. Adding other managerial, professional, technical, engineering, scientific and service positions, the amount of at least relatively high-skilled occupations reaches nearly 75 percent. These same managers and executives note the decline of relatively unskilled occupations such as assemblers and laborers within this industry due to increased automation. There remains a concern within management circles as to the ability of NEO to furnish a more technically apt and versatile workforce.

Figure 1

Occupational Distribution, 1994

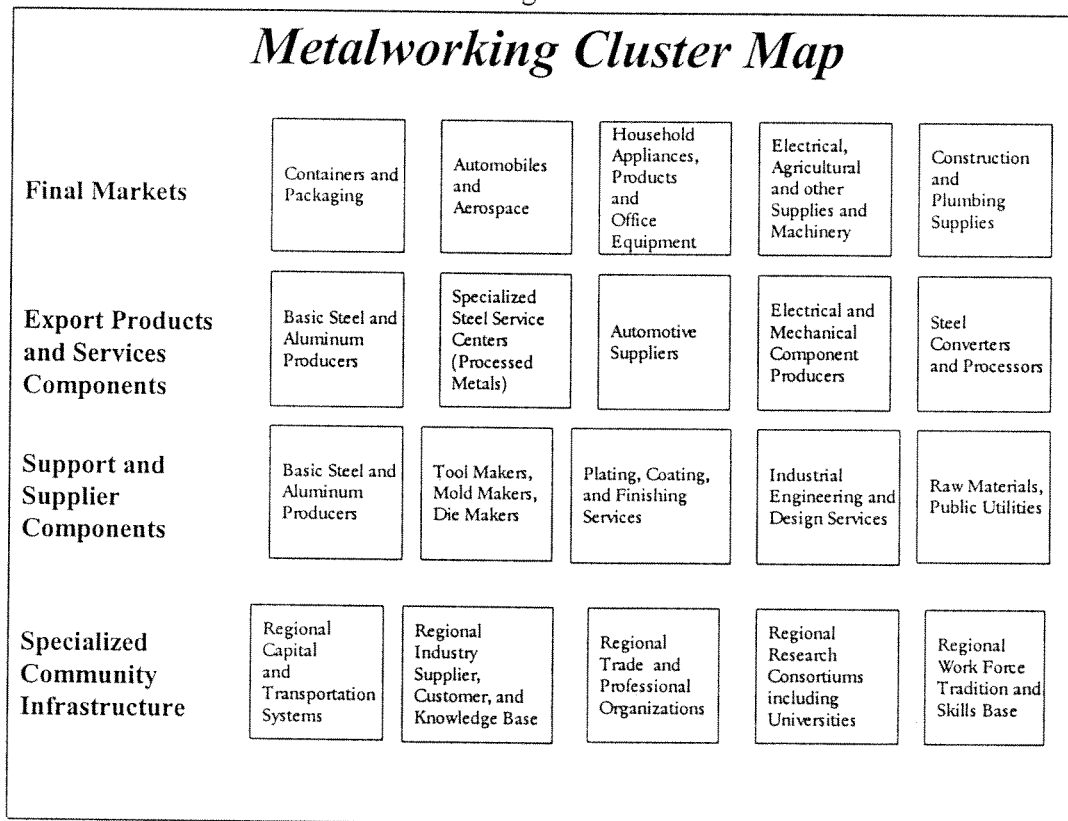
Aluminum and Steel Clusters Combined



Cluster Relationships

Figure 2 illustrates the structure of the Northeast Ohio (NEO) Metalworking cluster (both aluminum and steel). The four components of the cluster are final markets (customers,) export products (most of the core companies of the cluster,) suppliers, and community infrastructure. This map is, at best, a distilled representation of a very complex and intricate industrial cluster. It should be viewed as dynamic and changing, where one's perspective within the value chain could change the location of some of the components within the cluster map. Important instances of this situation will be discussed below.

Figure 2



Final Markets

The Final Markets segment of the cluster produces finished, stand-alone products. The products of the Metalworking cluster ultimately end up in industrial markets and consumer markets. Industrial goods include electrical and agricultural tools and machinery and construction and plumbing supplies used by durable and non-durable manufacturers and extractive industries. The dominant consumer goods are containers and packaging, automobiles, household appliances and products, and office equipment.

Industrial customers for this cluster are primarily located in the Great Lakes region, with additional strong concentrations scattered throughout the U.S., Canada, Asia, and Western Europe. Customers for consumer products are nationwide and worldwide.

Export Products

The Export Products and Services Components part of the cluster includes both core industries within the cluster and crucial service and processing components that add value to unfinished and semi-finished goods, thereby making the goods more market-ready. Basic steel and aluminum producers, specialized steel service centers, automotive suppliers, electrical and mechanical components producers, and steel processors are all included in this part of the cluster. Especially confusing—in both the trade literature and trade statistics—is how to classify the role of the specialized steel service centers. Traditionally classified as providing warehousing functions, steel service centers have undertaken within roughly the last 15 years many of the finishing services provided by steel processors and converters. These service centers and processors have filled a niche within the industry by aiding companies that utilize “just in time” manufacturing processes.

Support and Suppliers

This part of the cluster map can be as complex as the previous. Included as supporters and suppliers are basic steel and aluminum producers (which were also included in the previous segment), toolmakers, moldmakers, diemakers, platers, coaters, finishers, engineering services, raw material producers, and public utilities.

Basic metals producers—described as exporters above—are also crucial suppliers to local durable goods manufacturers. The service centers and processors mentioned above could also be included here, but are not due to the importance of the export of their finished goods to their local vitality.

Community Infrastructure

Industry officials have cited a number of local infrastructure items as being crucial to the development and vitality of metalworking in NEO. Regional capital access and transportation systems provide the basic industrial inputs necessary for manufacture and,

in most instances, are more than adequate in NEO. The regional supplier, customer, and knowledge base is mature, complex, and efficient in supporting basic research and manufacturing activities. Regional trade associations and research consortiums (such as the Cleveland based Steel Service Institute (SSI) and the Cleveland Advanced Manufacturing Program, Inc. are seen as less important for current development and basic manufacturing activities, but potentially important for future success. The trade associations are seen, however, as crucial in having a voice in regulatory and international trade disputes. Finally, the regional workforce tradition of manufacturing and its core skills base cannot be understated in importance.

Competing Regions

Competitors to this cluster are located in the region and worldwide. Local industrial machinery, specialty forging and foundry operations find their major competition to be local and regional (the Great Lakes region) while the basic steel producers find their competition to be again, in the Great Lakes region in Europe and Asia. Local industry officials feel that the more value-added intensive operations such as industrial machinery and consumer durables—will maintain a strong competitive balance regionally, nationally, and even globally while the primary producers, such as basic steel, will more and more exist to serve the local market.

Cluster Evolution

The evolution of this cluster should be viewed in the context of the intertwined historical development of the steel industry and the machine tool industry in NEO.

The steel industry had its origins in the 1860s with the opening of the Sault St. Marie Locks, which enabled mass shipments of iron ore from the upper Great Lakes to the lower Great Lakes. By the mid-1860s, Cleveland's first major iron works, the Cleveland Rolling Mill Company, was producing pig iron in large quantities. By the early 1880s mills in Cleveland, including Cleveland Rolling Mill and the Otis Iron and Steel Corporation, were producing high quality steel using open hearth processes. This type of production would dominate the industry for the next three-quarters of a century.

At the same time steel production was growing significantly in Cleveland, the machine tool industry was expanding rapidly as well, due in large part to the expansion of steel. In 1876, Jacob D. Cox organized the Cleveland Twist Drill Company. Between 1880 and 1900, entrepreneurs and transplants from the New England region formed such companies as National Acme, Foote-Burt, and Warner and Swasey. These companies would catalyze the NEO machine tool industry over the next several decades by producing high quality drill machines, spindle bar machines, broaching machines, screw

machines, turret lathes, and telescopes, among many other items, for steel manufacturers, automotive suppliers, and other metalworking establishments.

Beginning in the early 1900s and continuing on through the early 1940s, steelmaking in Cleveland was largely characterized by continuing growth and consolidation of existing companies into larger enterprises. In 1900, Cleveland Rolling Mill was acquired by American Steel and Wire of New Jersey, which one year later merged with the growing U.S. Steel conglomerate owned by J.P. Morgan. U.S. Steel continually upgraded its Cuyahoga Works facilities and other local holdings, reaching peak capacity in the mid-1930s. In 1913, Corrigan and McKinney Steel was formed to produce high quality steel from state-of-the-art blast furnace facilities. In 1935, Corrigan and McKinney was acquired by Republic Steel Corporation, which moved its headquarter facilities from Youngstown to Cleveland by 1938. The final merger was that of Jones and Laughlin Steel of Pittsburgh with the Otis Iron and Steel company in 1942. Three companies—U.S. Steel, Republic Steel, and Jones and Laughlin—would dominate NEO's steel producing sector for the next five decades.

By the 1930s, the machine tool industry in NEO was one of the top producing industries of its kind in the world. However, competition from other major machine tool centers like Chicago, Detroit, and the Dayton-Cincinnati area prevented NEO from gaining dominant footholds in the industry. However, until the end of World War II, the NEO machine tool industry was thriving. At this time, Cleveland was third behind Detroit and Chicago in industrial machinery and machine tool production.

The post-World War II era for both the steel sector and the machine tool sector can be characterized as one of both growth and decline. By the mid-1950s, both sectors were booming in NEO due to the large economic expansion following World War II. The aluminum industry, which became a major metal producer in the NEO region in the decade before World War II, also benefited from this expansion and rapid changes in demand for its products due to the substitution of aluminum for steel in many manufacturing sectors. Continual expansion by the big three NEO steelmakers, smaller aluminum producers, and expansion and acquisitions by major machine tool entities solidified the strength of NEO's metalworking industry through the 1960s.

By 1970, a number of factors—market, management, macroeconomic, and technological—coincided to precipitate the decline of the metalworking sectors in NEO. Inflation, currency fluctuations, recessions, lack of new capital investment, changing input needs, and falling demand within the durable goods manufacturing sector collectively leveled NEO's—and other regions—metalworking sector to its lowest levels of production since before World War II. In 1979, U.S. Steel began its pullout from NEO by shutting down the historic Central Furnaces Plant (formerly Cleveland Rolling Mill) and completed it with the closing of the Cuyahoga Works facilities in 1984. The company maintained that the deciding factor for the pullout was the difficult labor environment that had developed since the 1970s, specifically, the inability of the local

unions to grant wage concessions to the company. Also in 1984, Jones and Laughlin merged with Republic Steel to form LTV Steel, which filed for bankruptcy in 1986.

The machine tool industry in NEO essentially followed the lead of the steel industry into decline for similar reasons. In addition, the lack of demand for metalworking products caused a decline in the machine tool industry skills base in NEO, causing the serious downsizing and/or exodus of traditional machine tool firms such as Acme-Cleveland (a result of a 1968 National Acme-Cleveland Twist Drill merger) in 1983 and Warner and Swasey in 1991, among many other establishments.

Since 1990, a resurgence in the metalworking sector in NEO has taken place. Although employing two-thirds to three-fourths less than the peak employment figures of the 1960s and early 1970s, the sector has significantly re-tooled to the point that it is recognized as a major producer in a diverse range of metalworking products. Indeed, upon inspection of the positive changes in their location quotients since 1989 (see Tables 1a and 1b), and with the exception of three SICs (331, 334, and 336), industries in this cluster have increased their national shares of their respective industries. Also, the cluster as a whole has increased its concentration. Both of these developments signal an increase in NEO's competitive advantage within this cluster from 1989 to 1995.

II. Cluster Potential and Opportunities for Collaborative Action

Forces from outside and inside the region will determine the productive growth of the metalworking cluster in NEO. The external forces include continued demand for products, increased global competition and opportunities, technological change, regulatory change, and national trade policy. Internal forces include labor force development, local competition, and local infrastructure vitality.

External Drivers

- **Continued demand for products made within this cluster will help maintain its companies.** Not surprisingly, companies interviewed within this cluster link future success with continued demand for their products. The robust economy has led to production levels that have not been achieved since the 1970s. These companies are confident that continued market success will support further product development and success.
- **Global competition can provide opportunities for some companies.** Some companies in the metalworking cluster, primarily higher-end machinery fabricators, see global markets as opportunities for commercial success. Competition from

foreign firms is forcing NEO metalworking companies to become very familiar with both practices and products of these companies, and the core markets in which they compete.

- **Technological change has transformed NEO metalworking.** Technological change, especially the application of CAD/CAM technology, has enabled NEO metalworking operations to dramatically increase worker productivity and product quality. Companies within this cluster are confident that continual improvement through the application of new technology will yield similar gains.
- **Changes in national regulatory policy and trade policy will affect the growth of NEO metalworking companies.** Some industry officials emphasized the negative impact of environmental and safety regulations set down by the federal government on their productivity. They do not feel that the regulatory environment will become less stringent in the near future. Also, many officials fear that the federal government is not closely monitoring the activities of foreign competitors in U.S. markets in regard to the “dumping” of products at below market prices to gain market share.

Internal Drivers

- **Labor force development is crucial to NEO metalworking companies.** Despite the presence of a high-skilled work force, interviews and case studies indicate that many NEO metalworking officials are concerned about the possible erosion of this skills base. They cite the lack of necessary numbers of younger machinists and high-tech workers and note the decline of vocational education programs within secondary education in NEO. Many have taken on a training capacity that was once not necessary, but feel that education policy could assist in this area.
- **Local competition and re-emergence of the metalworking sector in NEO is seen as a very positive development.** Many officials are exuberant about the resurgence of metalworking in NEO during the past decade. They highlight the competitive nature of the industry in NEO and cite this as a positive factor in their collective development. They also note the importance of the presence of competition in supplying a potential pool of talent for their own companies.
- **The traditional infrastructure remains quite good.** Infrastructure in terms of capital access, transportation networks, and customer-supplier networks remains an integral component of NEO’s competitive advantage in metalworking. The supplier networks are becoming more and more important due to the increased practice of lean production methods and the outsourcing of work for companies of all sizes. Also, when companies were questioned regarding expansion or relocation elsewhere, the lack of infrastructure was cited as the main inhibitor of such expansion. CEOs of larger companies, however, did mention that the lack of connected air travel to

foreign destinations was a hindrance to their ability to exploit those markets. Lack of direct international flights is also cited as a negative in attracting foreign investment to NEO.

Requirements for Cluster Vitality

Most industry officials state that cluster vitality relies mostly on strong market demand—locally, nationally, and globally—for their products. These officials feel that the NEO metalworking sector has made tremendous strides in the last 15 years in adapting its production capacity to changing market needs and technological conditions. They are confident that these adaptations will continue.

Based on interviews and case studies, a number of specific requirements for vitality of the cluster are evident. In addition to maintaining the positive aspects of the internal and external forces affecting cluster growth above, two main points stand out.

- First, the need for a more technically skilled workforce at all levels of operations—from information systems people to machinists on the shop floor—is critical to future success. Companies have experienced serious difficulties in attracting and retaining persons who can adequately fill these positions. This dilemma has not reached crisis proportions, but managers fear that it may in the near future. An overall displeasure with the gutting of secondary education vocational programs is apparent.
- Second, the regulatory nature of environmental and workplace and trade environment at the national and international levels must be dealt with positively to insure competitiveness for NEO's metalworking industry, as well as for competing metalworking industries in other regions in the United States. Although many officials believe that the climates on the regulatory fronts are improving, more work is still needed.

Opportunities for Collaborative Action

New opportunities for collaborative action among companies, governments, and nonprofit organizations for the Metalworking cluster appear to be minimal. Larger companies within this sector, including primary metal producers and large secondary fabricators, maintain that their own research and development base is sufficient and that their product lines differ from those of the local metalworking industry mix to an extent that any form of collaboration would not be beneficial. Most companies feel that traditional customer-supplier relationships and professional networks are adequate in maintaining local cluster vitality.

The machine tool and industrial machinery sector has a somewhat different perspective on this issue. While most of the companies within this area have no interest in

collaborative action, the reasons are different. First, market demand limits their time to participate in any such activities at this time. Second, threat of competitors using ideas or attempting to recruit their high-skilled workers is seen as a major hindrance to collaboration. Finally, companies familiar with collaborative processes in NEO note that the Cleveland Advanced Manufacturing Program, Inc. a product of a 1983 Cleveland Tomorrow Initiative—provides possible networks, contacts, and research services for those companies interested in assistance through collaborative processes. Further development of this resource seems to be one of the few avenues for collaboration.

Most companies interviewed feel that collaboration with government on education and workforce development issues is crucial, but past attempts to set up useful mechanisms for such a process have had mixed results. A need for development along this front remains.

Sources of Information

- Gottlieb, P. (1998). REI's Profile of the Northeast Ohio. Available:
http://weatherhead.cwru.edu/dept/rei/neoprof/neo_prof.html (Accessed 1/29/98).
- Johnson, R. (1996). Machine Tool Industry. In D. D. Van Tassel & J. J. Grabowski (Eds.), *The Encyclopedia of Cleveland History* (pp. 668-670). Bloomington, IN: Indiana University Press.
- Miller, C. P. (1996). Iron and Steel Industry. In D. D. Van Tassel & J. J. Grabowski (Eds.), *The Encyclopedia of Cleveland History* (pp. 578-581). Bloomington, IN: Indiana University Press.
- Miscellaneous Metalworking Articles. (1994-1998). *Crain's Now--The Online Home of Crain's Cleveland Business* [Online]. Available:
<http://www.crainsicleveland.com/>.
- Nolan, K. (1995, May). Olympic in 1995: Absorbing Last Year's Phenomenal Growth. *Metal Center News*, pp. 36-44.
- Ritt, A. (1995, March). Working Smarter in the Melt Shop. *Iron Age New Steel*, pp. 20-23.
- Robertson, S. (1995, February). Synchronizing Processes in the Mill. *Iron Age New Steel*, pp. 36-38.
- Schriefer, J., & Berry, B. (1997, July). AISI in Cleveland: The Renaissance of Steel. *Iron Age New Steel*, pp. 84-87.
- Stapleton, D. H. (1996). Industry. In D. D. Van Tassel & J. J. Grabowski (Eds.), *The Encyclopedia of Cleveland History* (pp. 566-568). Bloomington, IN: Indiana University Press.
- Steel CEOs See Changes in Supply. (1996, June, 6). *Purchasing*, pp. 18-20.