The Western Alabama-Eastern Mississippi Region: A Strategy for the Future

A Report on the Region
for the
U.S. Department of Labor WIRED Project

Part 2

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Implications of the Region's Leading Economic Options

Executive Summary

This report represents the final part of the analysis of the 37-county Western Alabama-Eastern Mississippi region (the Region) conducted by the RUPRI Center for Regional Competitiveness (University of Missouri) for the Montgomery Institute as part of the U.S. Department of Labor's WIRED grant to the region. Our analysis had four goals:

1. Identify the key economic trends in the Region;
2. Assess the Region's critical economic assets;
3. Identify the Region's most promising economic directions, and
4. Evaluate the implications for the Region of its leading economic options.

Last October, RUPRI submitted a report addressing goals 1through 3 of the analysis. This final phase of our report addresses goal 4—evaluating the Region's leading economic options.

The process of identifying the Region's key economic options—which are the focus of this final report—began in early 2007. During the course of the year, over 250 public, private, and civic leaders from throughout the 37-county region attended five local roundtables and then a broader region-wide roundtable. The discussions held during these events culminated in a Regional summit, hosted by Governors Barbour and Riley held on May 14, 2007.

At each point in the process, the Center for Regional Competitiveness provided assessments of the Region's economic strengths and sought input from participants to conduct a more detailed analysis, now culminated in this report. Where previously we took a wide-lens approach at evaluating the Region's options, this final report looks with greater detail at the sectors leaders from the region selected as critical to the Region's economic future.

Our analysis is based on two principle components. The first component addresses the likely impacts that the Region could expect from investments in the seven key industries given high priority by regional stakeholders. The second component provides a detailed cluster analysis of three of the top sectors favored by participants at the May 14th Governors' Summit.

While more detailed analysis is contained in the body of the report, here is a short summary of some of the key findings from the cluster analysis and impact assessment.

Motor Vehicles

The region clearly has a strong emerging cluster in motor vehicle and related manufacturing. Of the three major clusters analyzed in this report and the 15 or so analyzed in the October report, motor vehicles has the richest mix of potential linkages within the region. Geographically this is obvious as well—the region is situated within a crescent of one of the most significant networks of auto assembly and parts suppliers in the South. The Region has strong potential to tap into this network of suppliers and auto assemblers at the Region's periphery.

While the region has a significant representation of motor vehicle assembly activity, many industries with strong linkages to motor vehicles are under-represented, especially in metals, industrial equipment, plastics, rubber, glass and measuring equipment industries. Further, data indicates the region has suffered major declines in some motor vehicle sectors (namely parts, with over 3,000 net jobs lost between 1998 and 2005).

A comprehensive input/output model of the Region's economy suggests that increases in motor vehicle employment would have substantial impacts on employment in the broader regional economy—more so than any other industry evaluated. The model shows that for every new motor vehicle manufacturing job, an additional three jobs will be created elsewhere. Of the remaining sectors evaluated, the employment impact estimates are remarkably lower, with only about one additional job created. In terms of income impacts, motor vehicles have an impact much closer to other sectors, though still it ranks the highest. However, the extreme capital intensity of the sector limits the potential for production increases to impact the broader economy. Still, the employment multiplier results are quite compelling.

Metalworking

Metalworking production is a broad industry that includes metal production as well as goods fabricated from metals. The Region's top producers in metalworking between 1998 and 2005 were: power boiler and heat exchangers; plastic plumbing fixtures; and search, navigation and detection instruments. In terms of employment size, well-established industries linked to metalworking included electric power and specialty transformers; sawmills; plastics plumbing fixtures; power generation and supply; motor vehicles parts manufacturing; power boiler and heat exchangers; ferrous metal foundries; and ball and roller bearing manufacturing.

Trends in the nation and the region indicate that the region may have an emerging advantage in the linked industries of coating, heating, and engraving; ball and roller bearings; pipes and pipe fittings; and enameled iron and metal ware. Still, several metalworking-related industries declined in the region by at least 500 workers between 1998 and 2005. Those declines included motor vehicle parts (down 3,064 workers), tires (down 2,361 workers); motor and generator manufacturing (down 1,949 workers), sawmills (down 1,510 workers); conveyer and conveying equipment (down 660 workers).

Aerospace

Aerospace industries pay high wages. Thus, the Region naturally would like to boost this cluster. Unfortunately, the reported data as of 2005 finds no major employment in this sector. Among industries with linkages to aerospace, the largest in the region are ball and roller bearings; audio and video equipment; ferrous metal foundries; and search, detection and navigation instruments.

Regional employment growth between 1998 and 2005 was especially robust in search, detection and navigation instruments; fluid power cylinders and actuators; commercial and services industry machinery; and ball and roller bearings. While it is not possible to determine from the

data if those industries are actually supplying aircraft or space vehicle producers, their presence in the region will be necessary for any emerging aerospace firms in the region.

Multiplier Summaries

	Production Multiplier	Rank	Income Multiplier	Rank	Employment Multiplier	Rank
Steel and Fabricated Metals	1.45	5	1.94	3	1.91	4
Healthcare	1.73	3	1.49	6	1.49	6
Warehousing & Distribution	1.75	2	1.54	4	1.52	5
Wood Products	1.90	1	2.19	2	2.44	2
Motor Vehicles	1.41	7	2.20	1	5.13	1
Tourism	1.51	4	1.40	7	1.22	7
Aerospace	1.45	6	1.50	5	2.43	3

To assist the reader to interpret the results, a brief introduction to impact analysis, a glossary of terms, and the methodology we used is provided in the Appendix.

A Strategy for the Future

Introduction

Part one of the Center's report to the Region showed that the best economic research available today argues strongly for WAEM to adopt a regional strategy based on three core principles. First, if the WAEM region is to thrive in a globalizing environment it must embrace a strategy that utilizes the unique strengths of the Region. Second, investments must be targeted at industries where the region can build on synergies found in its key business clusters. Finally, creating a world-class environment for growing entrepreneurs must be a cornerstone of the strategy.

Recognizing these three core principles, the Western Alabama-Eastern Mississippi Region has before it a number of viable options on which to compete in the global marketplace. Previously we have reported on a broad range of compelling options for the Region. This final report focuses on the specific choices for the Region most favored by regional stakeholders. This final report represents the culmination of the Center's efforts to present the Region with a clear assessment of its options based on the best available research methods. As the Region moves forward in developing a comprehensive strategy, this information will be vital to achieving regional competitiveness.

The Road Up to Now

The process of arriving at this menu of investment options was carried out over the course of many months. It involved sustained efforts by the Montgomery Institute, eight community colleges in the Region, and other stakeholders. This process drew on public involvement from a wide cross-section of regional participants, the expertise of four of the nation's top regional economists, and important background work from analysts at the University of Alabama and Mississippi State University.

The Center's involvement began in early 2007 with an initial baseline analysis of Region's economy— one that would provide a reliable benchmarking of the Region's economy around which alternative economic futures could be discussed. The analysis suggested a number of compelling and unexploited economic assets in the Region but significant challenges for the Region moving forward.

Five regional roundtables were then held during the summer of 2007. The Center's initial benchmarking provided a starting point for discussions at these events. The sessions began with a presentation of the baseline economic report. Then, in small groups, participants were asked to react to the analysis and discuss their perception of the Region's economy. Most importantly, participants were asked to identify distinct economic assets in the region while offering their own ideas for promising new economic directions for the Region.

A region-wide event was then held that brought together local champions from across the entire 37-county region. This event helped to refine the list of possible economic options and continued the building of support for the implementation phase of the project. Through this

facilitated discussion, participants identified a number of key economic assets that could form the basis for a new regional strategy:

- *Forest* –the best pine forest east of the Mississippi.
- *Agriculture*—a strong history of commodity production.
- *Manufacturing*—a diverse legacy of industrial activity.
- *Quality of life*—excellent water, clean air, and connection to outdoors.
- *History & culture*—the cradle of Civil Rights and a rich history of the Region.
- *Location & logistics*—great highway/railway/waterway network in the heart of the South.
- *Faith community*—a vibrant faith community woven into the fabric of the Region.
- *Outdoor recreation*—abundant outdoor recreation opportunities.

In preparation for the Governor's Summit, the Center team analyzed in greater detail these specific sectors around which a region-wide consensus could be reached.

The Center facilitated the Governor's Summit event in Monroeville, Alabama in order to establish region-wide consensus on the most promising economic options. Participants were presented with the Center's analysis of the various economic options developed through the prior events. The Region's top economic choices were presented in two parts: first those options which held the most promise over the next five years, and then those options which held the most promise five to ten years in the future.

The audience's tabulated responses indicated the strategy elements that were most compelling to the participants and that deserved further analysis. The industries listed below achieved the most favorable response, and form the basis of the analysis in this final report

- Advanced manufacturing
    - Aerospace
    - Motor vehicles
    - Steel & fabricated metals
- Healthcare
- Tourism
- Warehousing & distribution
- Wood products

Participants expressed an especially strong interest in advanced manufacturing as a strategic area of focus for the Region. In particular, the following sub-sectors of advanced manufacturing were seen to be the most desirable sectors on which to compete: aerospace; motor vehicles; steel & fabricated metals.

These seven sectors provided the starting point for the RUPRI's final evaluation of the Region's most promising economic directions. Our analysis investigated the current status of these sectors in the Region's economy as well as the potential impacts that targeted investments in these sectors might have on the broader economy. The remainder of this report provides a detailed look at the seven sectors according to these two aims.

This final report is organized as follows: the first section discusses findings from an impact analysis of the seven major industry categories selected previously: steel & fabricated metals, healthcare, warehousing & distribution, wood products, motor vehicles, tourism, and aerospace. Impact analysis provides the means to compare the economic impacts from new investments in the target industries. The second section singles out the three principle sectors comprising the Region's advanced manufacturing sector: aerospace, motor vehicles and metalworking. The cluster linkages in these three key manufacturing industries are closely evaluated. Cluster analysis allows regional leaders to assess the competitive strength of their business constellations in critical industries.

Findings from the Economic Impact Analysis

Economic impact analysis is a widely used tool by practitioners in local economic development. The main purpose of impact analysis is to evaluate the impacts that flow out of an initial economic event such as an industrial expansion. The results give policy makers a greater sense of the total impacts generated as the initial direct impacts filter through the broader economy.

A single industry focus is the common scope of analysis, but for a region such as WAEM that is pursuing the creation of a comprehensive economic strategy, the tool can be utilized to evaluate a larger set of investment options. This comprehensive approach allows for a side-by-side comparison of the Region's investment options so that the Region can prioritize strategic investments.

The impact analysis presented here focuses on the region's top investment choices. These choices were arrived at through broad-based public input and careful economic analysis conducted by the Center's team. These results suggest a useful set of information by which the WAEM region can prioritize the public investments it will make in order to fully develop its global economic competitiveness.

To assist the reader to interpret the results, a brief introduction to impact analysis, a glossary of terms, and the methodology we used is provided in the Appendix.

Discussion of results

Table 1 of the Appendix lists the components of the focus industries. Tables 2 through 4 show the magnitude of the estimated impacts across the categories of direct, indirect and induced effects. As stated above, it was assumed that production expanded by $1 million for each sector of focus. This amount does not reflect actual project sizes, but is used as a convenient benchmark to compare the relative size of direct and indirect effects[1]. The data in Tables 2 through 4 are difficult to compare across industries because of scale differences and several other factors. Consequently, the multipliers given in Table 5 provide the most effective way to compare across industries.

Performance of the Region's focus industries

- **Tourism** generates the largest total labor employment impact (30 new jobs) by far, but most of the impact is a direct employment effect (24.5 new jobs). This is not unexpected given the structure of the tourism industry. It is a highly labor-intensive industry, and thus generates a large number of direct jobs relative to indirect jobs. The sector is marked by the provision of services (hotels, entertainment, tour guides, access fees) and goods (food, equipment) which draw on outside sectors to a much lesser extent than other, more capital-intensive industries.

[1] The model is linear and thus analogous figures for production increase other than the $1m used here may easily be determined. Given a specified amount of initial investment, take this number as a fraction of $1m and multiply by the $ amounts presented in Tables 2 through 4.

- **Healthcare** generates the largest total labor income effects and the second largest employment impact. Like tourism, healthcare is relatively labor intensive and this accounts for the large employment impact. Unlike tourism, healthcare is marked by high wages and this is reflected in the nearly $500,000 direct labor income effect.

- The **Wood Products** sector generates the largest total production ripple effect at nearly $1.9m with almost $610,000 coming from indirect spillovers. This suggests the wood products sector is highly linked with other sectors in terms of production effects. Notice, however, that the sector has only the fourth largest labor income effect ($445,538) and employment impact (12.7 jobs).

- The results for **Motor Vehicles** are interesting. The sector's rank in terms of dollar impact (lowest in all cases) seems discouraging for an industry that is so prominent in the region and with assembly plants nearby. However, consider the scales involved in auto production. The total value of goods flowing through the sector is substantially larger than in other manufacturing sectors and this scale difference is apparent when focusing on a one-time increase of $1m in production. Consequently, the production multiplier will remain small, but given the higher wage nature of auto assembly, the sector ranks highest in terms of labor income and employment multipliers.

Practical Use of the multipliers

The multipliers given in Table 5 can be applied to estimate the total impact (direct and indirect effects) from the sectors WAEM is contemplating. Typically, economic developers often know the direct impacts of a development project at the outset, but often do not know the total impact because the indirect effects are so difficult to estimate. For example a firm aims to increase production by $500 thousand or create 200 workers with salaries of $20 thousand each. If our example firm is in the tourism industry then we would expect the creation of 200 new jobs to result in an actual increase of 244 jobs --200 from the direct impact and 44 from the indirect and induced effects. In addition, the 200 tourism jobs will generate $4 million in annual direct labor income and $1.6m in indirect income for a total of $5.6 million.

Thus, when a region has multiple investment opportunities, be they strategic investments or recruitment incentives, an investment approach that compares the alternative total impacts and then prioritizes investments accordingly is prudent.

Development projects have a specified cost to the region that could be in the form of recruitment incentive dollars or regionally funded investments in training programs, for example. Ideally, it will be known what the costs to the region are and what the estimated direct impacts will be. Consider the following examples:

- A new plant will employee 200 in metals fabrication. The firm is asking for tax abatements valued at $1m. The jobs will be moderately skilled wage positions paying the equivalent of $30k a year.

- Another firm wants to relocate to your region but needs a highly skilled workforce. A regionally funded training program costing $2m to operate will upgrade the region's skills base, enabling 100 workers to earn $55k a year working for the firm.

In each case, we know what the cost is and what the direct impact will be, but it is not immediately clear which project will generate the biggest return on the required investment. The multipliers in table 4 allow one to estimate the total impact to the region. This information, when evaluated in light of the cost to the region, then provides each project's "rate of return."

Cluster Linkages in Advanced Manufacturing:
Aerospace, Motor Vehicles and Metalworking

This section provides an in-depth analysis of the Region's cluster presence in advanced manufacturing. The analysis uses data through 2005, the most recent year for which Bureau of Labor Statistics data is available in this detail. Obviously, there have been developments in all of the region's sectors since then. While the analysis does not include these developments, it nonetheless provides an important foundation for understanding the strength of the region's key business clusters.

Tables 6 through 8 identify key detailed industries (as defined by the NAICS codes) linked to final or intermediate end market industries in three clusters within the broad area of advanced manufacturing: **aerospace** (including aircraft, guided missiles, and space vehicles); **motor vehicles** (including automobiles, light and heavy duty trucks, motor homes, and trailers and campers); and **metalworking** (including, among other industries, cutlery and hand tools, hardware, metal valves, ball and roller bearings, small arms, ammunition and ordnance, pipes and pipe fittings, and industrial patterns).

The information helps to identify the relative presence in the region of industries within key identified clusters. Each table is sorted in descending order by 2005 employment location quotient and all industries with location quotients greater than 1.20 are shaded. Note that sector linkages are identified by reference to U.S. input-output relationships and do not reflect *actual* trading patterns between industries within the region. For example, in Table 1, a "1" in the column labeled "Aircraft engines and parts" for NAICS industry 332991 (ball and roller bearings) indicates that the production of ball and roller bearings is closely tied to the production of aircraft engines *in the U.S.*

Using the U.S. input-output trade data provides useful information about the aerospace value chain nationwide, against which the regional industry mix can then be benchmarked. Continuing with the example, Table 1 indicates that the region has no employment in 18 of 53 industries within or closely tied to aerospace markets.

Major Findings

Of the three clusters, the motor vehicles industry has the richest mix of potential linkages within the region (in relative terms), while aerospace has the weakest mix. Table 4 summarizes the number of linked industries in various components of each cluster. Also included is the ratio of linked industries with an above-average concentration in the region to the total number of linked industries. For instance, investigation of U.S. input-output linkages identifies 17 NAICS industries with close linkages to aircraft manufacturing. Three of those industries—or 17.6 percent of the total—are over-represented in the region relative to the U.S.

Aerospace

There is no private sector (and, strictly speaking, "covered") aircraft, aircraft parts, aircraft engine, guided missile, or space and missile propulsion unit production employment reported for the region in 2005, according to U.S. Bureau of Labor Statistics data.

Among industries with linkages to aerospace, the largest in the region in terms of employment are ball and roller bearings, audio and video equipment, ferrous metal foundries, and search, detection and navigation instruments. Regional employment growth between 1998 and 2005 was especially robust in search, detection and navigation instruments, fluid power cylinders and actuators, commercial and service industry machinery, and ball and roller bearings. Again, it is not possible to determine from the information provided here if those industries are actually supplying aircraft or space vehicle producers.

Motor Vehicles

The region has a significant representation of end-market motor vehicle-related activity (automobile and light truck manufacturing, motorcycles and bicycles, motor vehicle bodies, motor vehicle parts, and tires). However, many industries with strong linkages to motor vehicles are under-represented, especially in the metals, industrial equipment, plastics, rubber, glass and measuring equipment industries. Moreover, the region has suffered major declines in some motor vehicles sectors (namely parts, with over 3,000 net jobs lost between 1998 and 2005).

Eighteen industries linked to motor vehicles have an above-average concentration of employment in the region as gauged by a 2005 employment location quotient (an LQ greater than or equal to 1.20). Of those 18, nine are in wood products or textiles and apparel. Wood products are used heavily in the manufacture of motor homes and truck trailers. Fabrics are used primarily in end-market vehicle assembly (automobiles, light and heavy duty trucks, motor homes, and campers).

Metalworking

Metalworking production is a very broad industry that includes metal production (e.g., iron and steel), as well as goods fabricated from metals. Table 3 summarizes industries connected to metal fabricated goods production. Potential linkages in the region are especially strong for coating, heating and engraving; ball and roller bearings; pipes and pipe fittings; and enameled iron and metal ware. Note that the ball and roller bearings and enameled ware industries are also linked to aerospace.

Dominating the cluster of linked industries in metalworking in terms of employment size are electric power and specialty transformers; sawmills; plastics plumbing fixtures; power generation and supply; motor vehicle parts manufacturing; power boiler and heat exchangers; ferrous metal foundries; and ball and roller bearing manufacturing.

Top growers in metalworking between 1998 and 2005 are power boiler and heat exchangers; plastics plumbing fixtures; and search, navigation and detection instruments.

Several metalworking-related industries declined in the region by at least 500 workers between 1998 and 2005, including motor vehicle parts (down 3,064 workers), tires (down 2,361 workers); motor and generator manufacturing (down 1,949 workers), sawmills (down 1,510 workers); conveyer and conveying equipment (down 660 workers).

Appendix

Economic Linkages

A regional economy like the one characterizing the AL-MS WIRED region has unique features that help explain why events like the change in size of major companies would generate impacts that are larger than one might expect. First, sectors in the region are linked to other sectors– some directly, others indirectly. For example, a sector producing automobile parts that are shipped to the final vehicle assembly line would represent a ***direct linkage*** between two sectors. For the sake of discussion, assume the automobile component supplier purchases some fabricated metals products from another supplier; this too represents a direct linkage. However, the fabricated metals producer has an ***indirect linkage*** to the automobile assembly producer. Although not directly dependent on automobile production, the fabricated metal producer is clearly influenced by the production levels of the assembler. Hence, while many sectors of the economy are linked directly, many if not more are linked indirectly. In short, no one is independent in the economic system.

Ripple or Multiplier Effects

Consider the case just reviewed, but now assume automobile production increases. With the assembly line ramping up, the assembler needs more components. This generates a direct effect—a column in the tables in this report will indicate the size and composition (across sectors) of these direct effects. But we know that the impacts will not stop at the first step of separation. The component supplier will purchase more fabricated metal products, the fabricated metal producer will buy more steel, the steel producer will buy more iron ore or scrap, and so forth. What we have described here are the multiple levels of the ripple effect – a direct change in one sector leads to expansion in other sectors of the economy. These sector-to-sector effects are referred to as ***indirect effects***.

During this whole process, firms need to purchase not only components and materials from other sectors, but they also have to pay wages and salaries to their employees. In turn, these employees will generate their own ripple effect. For example, an assembly line worker will use the extra income earned from overtime (assumed to occur to meet the additional demand) to take his/her family to dinner. Part of this expenditure becomes income to the waiter; he spends the money at the dry cleaners and part of that expenditure is used by the owners of the dry cleaning business to buy lumber to renovate their house. Part of this expenditure will be used by employees in the lumber yard to enjoy an evening at the cinema – and so the process continues until the impact diminishes to zero. This part of the ripple effect is referred to as ***induced income impacts***.

Thus, when all is said and done, there are direct effects and two types of indirect effects – one generated by industry-industry purchases and sales and one generated by expenditures by employees from wages and salaries. The summation of these impacts is revealed in the tables as ***total impacts***. If the total impacts are divided by the direct impacts, we obtain the ***ripple or multiplier effect***. For example, if the employment multiplier is 1.5, then for every direct job, an additional 0.5 jobs are generated through a combination of the indirect and induced impacts. When the labor income multiplier is 1.5, that means every $10,000 generated in labor income for a given project will lead to an additional $500 is generated in indirect and induced impacts.

Methodology

This model uses 2004 data, and all impacts are in 2004 dollars. The model employs a Social Accounting Matrix (SAM) which represents the flow of all economic transactions that take place in an economy. The methodology employed here tends to produce results that are somewhat conservative estimates of impact multipliers. A thorough impact analysis must account for the benefits as well as the costs associated with the economic event under question. Jobs created in one sector can pull workers, (and their income), out of other sectors, causing the total economy-wide impact to be less than if the new jobs were filled entirely by outsiders.

The SAM model mentioned above is used to simulate impacts in three areas of the region's economy: production, employment, and labor income. We achieve this by introducing into the model a one-time, but permanent, increase in one of the three areas: production, employment, or labor income. In this case, we model a one-time increase in **production** of $1 million. The model is closed so we can introduce a "shock" in either employment or labor income and the final impact multiplier results would be the same regardless of the choice.

Notice in the first column in Table 2 the $1 million shock to production appears as a $1m direct effect. The model then estimates the remaining indirect and induced effects for production. Taking this $1 million increase in production, the model then estimates the direct effects that should arise in employment and labor income due to the production increase. The model then estimates the resulting indirect effects.

The dollar amount of the impacts will vary greatly depending on differences in scale, labor intensity and linkages to the broader economy of the industries modeled. The multipliers based on the ratio of total impacts, (direct, indirect and induced), to direct impacts allow for a sensible comparison across the various industries. The 1$ million amount does not represent actual project costs, but the resulting multiplier indicates what the total impact will be for any given amount of initial increase in production, labor income or job creation.

Table 1. Focus Industries

Description	NAICS Sector (unless otherwise noted)
Steel and Fabricated Metals	100% 332 Fabricated metal products
Healthcare	50% 622 Hospitals 50% 623 Nursing and residential care
Warehousing and Distribution	100% 493 Warehousing and storage
Wood Products	100% 321 Wood products
Motor Vehicles	100% 33611 Automobile and light truck manufacturing (Heavy duty truck manufacturing – NAICS 33612 – didn't exist there in 2004 according the IMPLAN data.)
Tourism	50% IMPLAN sector 479 Hotels and motels 20% IMPLAN sector 481 Food services and drinking places 15% IMPLAN sector 478 Other amusement 15% IMPLAN sector 411 miscellaneous store retailers
Aerospace Aerospace cont.	50% 336411 Aircraft manufacturing 50% 336413 Other aircraft parts and equipment (Sectors 336412 Aircraft engine and engine parts manufacturing, 336414 Guided missile and space vehicle manufacturing, 336415 Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing and 336419 Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing didn't exist there in 2004 according the IMPLAN data.)

Table 2. Production Impacts

$1,000,000 change in:	Direct Effect	Indirect Effect	Induced Effect	Total	Rank
Steel and Fabricated Metals	$1,000,000	$198,291	$257,879	$1,456,170	5
Healthcare	$1,000,000	$261,286	$475,646	$1,736,933	3
Warehousing & Distribution	$1,000,000	$224,097	$531,539	$1,755,636	2
Wood Products	$1,000,000	$609,704	$287,697	$1,897,401	1
Motor Vehicles	$1,000,000	$292,382	$117,531	$1,409,914	7
Tourism	$1,000,000	$217,872	$296,469	$1,514,341	4
Aerospace	$1,000,000	$223,404	$228,311	$1,451,715	6

Table 3. Labor Income Impacts

$1,000,000 change in:	Direct Effect	Indirect Effect	Induced Effect	Total	Rank
Steel and Fabricated Metals	$160,341	$80,533	$70,456	$311,330	6
Healthcare	$492,864	$77,042	$166,699	$736,604	1
Warehousing & Distribution	$416,766	$81,284	$145,681	$643,730	2
Wood Products	$203,772	$140,938	$100,828	$445,538	4
Motor Vehicles	$91,145	$76,243	$33,044	$200,432	7
Tourism	$361,312	$60,917	$83,353	$505,583	3
Aerospace	$260,119	$65,041	$64,190	$389,349	4

Table 4. Employment Impacts

$1,000,000 change in:	Direct Effect	Indirect Effect	Induced Effect	Total	Rank
Steel and Fabricated Metals	5.5	1.8	3.2	10.5	5
Healthcare	18.5	3.2	6.0	27.6	2
Warehousing & Distribution	16.7	2.1	6.7	25.4	3
Wood Products	5.2	3.9	3.6	12.7	4
Motor Vehicles	0.8	2.1	1.3	4.1	7
Tourism	24.5	2.2	3.3	30.0	1
Aerospace	3.0	1.7	2.5	7.3	6

Table 5. Multiplier Summaries (based on total effects / direct effects)

	Production Multiplier	Rank	Income Multiplier	Rank	Employment Multiplier	Rank
Steel and Fabricated Metals	1.45	5	1.94	3	1.91	4
Healthcare	1.73	3	1.49	6	1.49	6
Warehousing & Distribution	1.75	2	1.54	4	1.52	5
Wood Products	1.90	1	2.19	2	2.44	2
Motor Vehicles	1.41	7	2.20	1	5.13	1
Tourism	1.51	4	1.40	7	1.22	7
Aerospace	1.45	6	1.50	5	2.43	3

Additional Detail

Cluster Linkages in Advanced Manufacturing: Aerospace, Motor Vehicles and Metalworking

Attached Tables 1-3 identify key detailed NAICS industries linked to final or intermediate end market industries in three clusters within the broad area of advanced manufacturing: **aerospace** (including aircraft, guided missiles, and space vehicles); **motor vehicles** (including automobiles, light and heavy duty trucks, motor homes, and trailers and campers); and **metalworking** (including, among other industries, cutlery and hand tools, hardware, metal valves, ball and roller bearings, small arms, ammunition and ordnance, pipes and pipe fittings, and industrial patterns).

The information helps to identify the relative presence in the region of industries within key identified clusters. Each table is sorted in descending order by 2005 employment location quotient and all industries with location quotients greater than 1.20 are shaded. Note that sector linkages are identified by reference to U.S. input-output relationships and do not reflect *actual* trading patterns between industries within the region. For example, in Table 1, a "1" in the column labeled "Aircraft engines and parts" for NAICS industry 332991 (ball and roller bearings) indicates that the production of ball and roller bearings is closely tied to the production of aircraft engines *in the U.S.*

Using the U.S. input-output trade data provides useful information about the aerospace value chain nationwide, against which the regional industry mix can then be benchmarked. Continuing with the example, Table 1 indicates that the region has no employment in 18 of 53 industries within or closely tied to aerospace markets.

Major Findings:

- Of the three clusters, the motor vehicles industry has the richest mix of potential linkages within the region (in relative terms), while aerospace has the weakest mix. Table 4 summarizes the number of linked industries in various components of each cluster. Also included is the ratio of linked industries with an above-average concentration in the region to the total number of linked industries. For instance, investigation of U.S. input-output linkages identifies 17 NAICS industries with close linkages to aircraft manufacturing. Three of those industries—or 17.6 percent of the total—are over-represented in the region relative to the U.S.

- There is no private sector (and, strictly speaking, "covered") aircraft, aircraft parts, aircraft engine, guided missile, or space and missile propulsion unit production employment reported for the region in 2005, according to U.S. Bureau of Labor Statistics data.

- Among industries with linkages to aerospace, the largest in the region in terms of employment are ball and roller bearings, audio and video equipment, ferrous metal foundries, and search, detection and navigation instruments. Regional employment growth between 1998 and 2005 was especially robust in search, detection and navigation instruments, fluid power cylinders and actuators, commercial and service industry

machinery, and ball and roller bearings. Again, it is not possible to determine from the information provided here if those industries are actually supplying aircraft or space vehicle producers.

- The region has a significant representation of end-market motor vehicle-related activity (automobile and light truck manufacturing, motorcycles and bicycles, motor vehicle bodies, motor vehicle parts, and tires). However, many industries with strong linkages to motor vehicles are under-represented, especially in the metals, industrial equipment, plastics, rubber, glass and measuring equipment industries. Moreover, the region has suffered major declines in some motor vehicles sectors (namely parts, with over 3,000 net jobs lost between 1998 and 2005).

- Eighteen industries linked to motor vehicles have an above-average concentration of employment in the region as gauged by a 2005 employment location quotient (an LQ greater than or equal to 1.20). Of those 18, nine are in wood products or textiles and apparel. Wood products are used heavily in the manufacture of motor homes and truck trailers. Fabrics are used primarily in end-market vehicle assembly (automobiles, light and heavy duty trucks, motor homes, and campers).

- Metalworking production is a very broad industry that includes metal production (e.g., iron and steel), as well as goods fabricated from metals. Table 3 summarizes industries connected to metal fabricated goods production. Potential linkages in the region are especially strong for coating, heating and engraving; ball and roller bearings; pipes and pipe fittings; and enameled iron and metal ware. Note that the ball and roller bearings and enameled ware industries are also linked to aerospace.

- Dominating the cluster of linked industries in metalworking in terms of employment size are electric power and specialty transformers; sawmills; plastics plumbing fixtures; power generation and supply; motor vehicle parts manufacturing; power boiler and heat exchangers; ferrous metal foundries; and ball and roller bearing manufacturing.

- Top growers in metalworking between 1998 and 2005 are power boiler and heat exchangers; plastics plumbing fixtures; and search, navigation and detection instruments.

- Several metalworking-related industries declined in the region by at least 500 workers between 1998 and 2005, including motor vehicle parts (down 3,064 workers), tires (down 2,361 workers); motor and generator manufacturing (down 1,949 workers), sawmills (down 1,510 workers); conveyer and conveying equipment (down 660 workers).

Table 1

Detailed industry mix, linkages and regional employment trends: Aerospace

2002 NAICS	2002 NAICS Industry	Linkages: Aircraft mfg	Aircraft engines & parts	Other aircraft parts	Guided missiles & space vehicles	Propulsion units & parts	Establishments: 2005	Establishments: Change '98-'05	Employment: 2005	Employment: Change '98-'05	LQ: 1998	LQ: 2005	Pct Growth '98-'05: Region	Pct Growth '98-'05: US	BLS Technology Sector
334613	Magnetic and optical recording media mfg			1			1	0	414	-150	14.27	23.05	-26.6	-49.8	0
332991	Ball and roller bearing mfg		1	1			2	1	918	280	5.06	10.19	43.9	-21.0	0
3343	Audio and video equipment mfg				1		1	-4	874	133	4.63	10.14	17.9	-40.5	2
333995	Fluid power cylinder and actuator mfg	1	1		1		3	-1	363	235	2.11	8.13	183.6	-18.8	3
33151	Ferrous metal foundaries		1				7	0	808	-81	2.32	3.26	-9.1	-28.5	0
333319	Other commercial and service industry machinery mfg				1	1	4	3	414	130	1.49	2.91	45.8	-17.6	0
334511	Search, detection, and navigation instruments	1			1	1	1	0	574	559	0.03	1.40	3726.7	-8.0	1
333997-9	Scales, balances, and miscellaneous general purpose machinery	1					2	-5	156	-251	2.44	1.30	-61.7	-20.3	3
332998	Enameled iron and metal sanitary ware mfg		1				1	1	44	44	0.00	1.22	---	-8.7	0
33271	Machine shops				1	1	70	6	790	158	0.83	1.17	25.0	-2.2	0
333996	Fluid power pump and motor mfg	1			1		2	0	53	-2	0.68	0.99	-3.6	-26.8	3
3325	Hardware mfg			1			2	-5	76	-474	3.78	0.80	-86.2	-28.2	0
33422	Broadcast and wireless communications equipment	1			1		5	3	159	93	0.20	0.77	140.9	-32.2	1
32629	Other rubber product mfg		1				6	1	141	-134	0.99	0.74	-48.7	-24.5	0
493	Warehousing and storage					1	37	6	969	-117	0.77	0.63	-10.8	21.4	0
55	Management of companies and enterprises					1	109	61	2,049	1,234	0.16	0.44	151.4	0.7	3
332313	Plate work mfg				1		9	5	48	-221	1.71	0.38	-82.2	-11.6	0
5414	Specialized design services	1					13	2	97	45	0.15	0.28	86.5	6.8	0
325991	Custom compounding of purchased resins			1		1	2	0	15	-8	0.29	0.26	-34.8	-19.1	3
6112-3	Colleges, universities, and junior colleges	1					4	0	452	-60	0.20	0.16	-11.7	21.0	0
33593	Wiring device mfg	1					1	-1	15	-3	0.08	0.11	-16.7	-34.0	0
332813	Electroplating, anodizing, and coloring metal				1		3	0	21	-235	0.88	0.11	-91.8	-25.7	0
332996	Fabricated pipe and pipe fitting mfg			1			1	1	6	6	0.00	0.08	---	-6.5	0
333514	Special tool, die, jig, and fixture mfg					1	2	-3	13	-23	0.12	0.06	-63.9	-26.6	0
5417	Scientific research and development services		1	1	1	1	12	3	93	29	0.05	0.06	45.3	20.2	1
481	Air transportation					1	4	-7	81	-54	0.08	0.06	-40.0	-10.6	0
32551	Paint and coating mfg					1	1	0	3	-4	0.05	0.03	-57.1	-15.1	3
332812	Metal coating and nonprecious engraving				1	1	2	0	3	1	0.01	0.02	50.0	-7.8	0
332999	Miscellaneous fabricated metal product mfg		1	1			2	0	3	-34	0.17	0.02	-91.9	-17.2	0
334413	Semiconductors and related device mfg				1		1	0	9	4	0.01	0.02	80.0	-21.9	1
331521 331524	Aluminum foundries		1			1	2	-1	2	-116	0.62	0.02	-98.3	-24.6	0
334518-9	Watch, clock, and other measuring and controlling device mfg	1	1				1	1	1	1	0.00	0.01	---	-19.3	1
339991	Gasket, packing, and sealing device mfg				1	1	1	1	1	1	0.00	0.01	---	-17.6	0
336411	Aircraft mfg	1	1	1	1	1	2	1	5	-9	0.02	0.01	-64.3	-25.2	1
336413	Other aircraft parts and equipment	1		1	1	1	2	1	2	-33	0.11	0.01	-94.3	-23.6	1
31214	Distilleries			1			0	0	0	0	0.00	0.00	---	-7.3	0

Table 1

Detailed industry mix, linkages and regional employment trends: Aerospace

2002 NAICS	2002 NAICS Industry	Linkages: Aircraft mfg	Linkages: Aircraft engines & parts	Linkages: Other aircraft parts	Linkages: Guided missiles & space vehicles	Linkages: Propulsion units & parts	Establishments: 2005	Establishments: Change '98-'05	Employment: 2005	Employment: Change '98-'05	LQ: 1998	LQ: 2005	Pct Growth '98-'05: Region	Pct Growth '98-'05: US	BLS Technology Sector
31411	Carpet and rug mills	1					0	0	0	0	0.00	0.00	---	-8.7	0
32552	Adhesive mfg	1					0	0	0	0	0.00	0.00	---	-9.8	3
32791	Abrasive product mfg				1		0	0	0	0	0.00	0.00	---	-32.3	0
331522 331525-8	Nonferrous foundries, except aluminum		1				0	0	0	0	0.00	0.00	---	-18.0	0
332111	Iron and steel forging		1	1			0	0	0	0	0.00	0.00	---	-18.9	0
332112	Nonferrous forging		1	1	1	1	0	0	0	0	0.00	0.00	---	-23.6	0
332115-7	All other forging and stamping			1	1		0	0	0	0	0.00	0.00	---	-22.4	0
332212	Hand and edge tool mfg			1			0	0	0	-13	0.08	0.00	-100.0	-32.9	0
33291	Metal valve mfg		1	1	1	1	1	1	0	-11	0.03	0.00	-100.0	-20.9	0
333612-3	Speed changers and mechanical power transmission equipment	1					0	-1	0	-9	0.08	0.00	-100.0	-23.9	3
334512	Automatic environmental control mfg	1	1				0	0	0	0	0.00	0.00	---	-28.0	1
334516	Analytical laboratory instrument mfg	1					0	0	0	0	0.00	0.00	---	-9.9	1
335991	Carbon and graphite product mfg			1	1		0	0	0	-144	4.84	0.00	-100.0	-26.1	0
336412	Aircraft engine and engine parts mfg	1	1			1	0	0	0	0	0.00	0.00	---	-20.0	1
336414	Guided missile and space vehicle mfg				1	1	0	-1	0	-7	0.04	0.00	-100.0	-6.6	1
336415-9	Propulsion units and parts for space vehicles and guided missiles				1	1	0	0	0	0	0.00	0.00	---	-18.6	1
337125 337129	Other household and institutional furniture		1	1			0	0	0	0	0.00	0.00	---	-19.0	0

Notes: Employment data are from Minnesota IMPLAN Group, Inc., and the U.S. Bureau of Labor Statistics. A "1" in the linkages column indicates that the industry in the row is strongly linked as a direct or indirect supplier or buyer to the industry in the column. Codes in the "BLS Technology Sector" column are the following: 1--Very technology intensive; 2--Moderately technology-intensive; 3--Somewhat technology intensive. Industries with employment location quotients (for 2005) greater than 1.20 are shaded.

Table 2

Detailed industry mix, linkages and regional employment trends: Motor vehicles

2002 NAICS	2002 NAICS Industry	Linkages							Establishments		Employment						BLS Tech Sector
		Autos & light trucks	Heavy duty trucks	Vehicle bodies	Truck trailers	Motor homes	Trailers & campers	Motor vehicle parts	2005	Change '98-'05	2005	Change '98-'05	LQ 1998	LQ 2005	Pct Growth '98-'05 Region	Pct Growth '98-'05 US	
321211-2	Veneer and plywood manufacturing					1			17	-3	2,282	-192	16.25	19.90	-7.8	-16.7	0
3159	Accessories and other apparel manufacturing	1							7	-6	910	397	4.17	16.26	77.4	-49.8	0
321113	Sawmills				1				95	0	3,867	-1,510	14.79	13.51	-28.1	-12.9	0
3343	Audio and video equipment manufacturing	1	1						1	-4	874	133	4.63	10.14	17.9	-40.5	2
321912	Cut stock, resawing lumber, and planing				1				14	-8	486	-860	20.04	9.15	-63.9	-12.5	0
333995	Fluid power cylinder and actuator manufacturing	1		1	1			1	3	-1	363	235	2.11	8.13	183.6	-18.8	3
33611	Automobile and light truck manufacturing	1	1	1		1	1		1	1	3,611	2,285	1.99	6.47	172.3	-7.1	0
31323	Nonwoven fabric mills	1						1	3	2	204	138	1.19	4.96	209.1	-17.8	0
336991	Motorcycle, bicycle, and parts manufacturing		1						1	1	227	227	0.00	4.58	---	-8.4	0
32621	Tire manufacturing	1	1		1		1		4	2	816	-2,361	12.34	4.54	-74.3	-22.7	0
31412	Curtain and linen mills					1	1		7	-1	457	-129	2.67	3.67	-22.0	-37.3	0
33151	Ferrous metal foundaries							1	7	0	808	-81	2.32	3.26	-9.1	-28.5	0
336211	Motor vehicle body manufacturing	1	1	1	1	1			2	-1	528	147	1.58	3.04	38.6	-20.3	0
321918	Other millwork, including flooring				1				12	3	449	68	2.20	2.82	17.8	1.6	0
326191 326199	Plastics plumbing fixtures and all other plastics products		1						10	-3	1,619	470	0.93	1.70	40.9	-14.7	0
33711	Wood kitchen cabinet and countertop manufacturing					1			69	10	757	259	1.26	1.69	52.0	25.9	0
321911	Wood windows and door manufacturing					1			4	-4	282	82	0.99	1.36	41.0	13.9	0
3363	Motor vehicle parts manufacturing	1	1	1	1	1	1	1	34	-2	2,300	-3,064	2.24	1.28	-57.1	-17.2	0
32614-5	Foam product manufacturing							1	2	0	212	-19	1.25	1.27	-8.2	0.1	0
81111-2 811191 811198	Automotive repair and maintenance, except car washes	1							529	20	2,157	98	0.97	1.10	4.8	1.6	0
332322	Sheet metal work manufacturing			1				1	7	-6	296	64	0.75	1.08	27.6	-2.4	0
327211-2 327215	Glass and glass products, except glass containers	1							4	-2	255	-98	1.00	1.07	-27.8	-25.4	0
333996	Fluid power pump and motor manufacturing							1	2	0	53	-2	0.68	0.99	-3.6	-26.8	3
333414	Heating equipment, except warm air furnaces					1			3	-1	46	-91	2.05	0.84	-66.4	-9.3	0
3325	Hardware manufacturing	1	1	1					2	-5	76	-474	3.78	0.80	-86.2	-28.2	0
336212	Truck trailer manufacturing	1		1	1				2	-4	71	7	0.59	0.74	10.9	-3.0	0
32629	Other rubber product manufacturing				1			1	6	1	141	-134	0.99	0.74	-48.7	-24.5	0
332321	Metal window and door manufacturing					1			3	-2	164	70	0.37	0.73	74.5	-0.9	0
32612	Plastics pipe, fittings, and profile shapes				1				3	1	91	48	0.22	0.57	111.6	-10.8	0
333415	AC, refrigeration, and forced air heating		1		1				1	0	127	-18	0.38	0.46	-12.4	-20.2	0
5619	Other support services			1					29	-7	314	50	0.32	0.41	18.9	5.1	0
332313	Plate work manufacturing							1	9	5	48	-221	1.71	0.38	-82.2	-11.6	0
314991 314999	Other miscellaneous textile product mills	1	1	1					12	5	36	-531	3.69	0.37	-93.7	-29.2	0
5414	Specialized design services	1							13	2	97	45	0.15	0.28	86.5	6.8	0
33511	Electric lamp bulb and part manufacturing	1						1	1	1	7	7	0.00	0.20	---	-36.3	0
6112-3	Colleges, universities, and junior colleges	1							4	0	452	-60	0.20	0.16	-11.7	21.0	0
33593	Wiring device manufacturing					1	1		1	-1	15	-3	0.08	0.11	-16.7	-34.0	0
33272	Turned product and screw, nut, and bolt manufacturing							1	3	1	21	-10	0.09	0.09	-32.3	-23.1	0
333911	Pump and pumping equipment manufacturing		1						1	0	2	-3	0.05	0.03	-60.0	-19.1	3

Table 2

Detailed industry mix, linkages and regional employment trends: Motor vehicles

2002 NAICS	2002 NAICS Industry	Linkages							Establishments		Employment				Pct Growth '98-'05		BLS Tech Sector
		Autos & light trucks	Heavy duty trucks	Vehicle bodies	Truck trailers	Motor homes	Trailers & campers	Motor vehicle parts	2005	Change '98-'05	2005	Change '98-'05	LQ 1998	LQ 2005	Region	US	
32551	Paint and coating manufacturing	1	1	1	1				1	0	3	-4	0.05	0.03	-57.1	-15.1	3
331315	Aluminum sheet, plate, and foil manufacturing			1	1				1	1	1	1	0.00	0.02	---	-27.7	0
332812	Metal coating and nonprecious engraving			1					2	0	3	1	0.01	0.02	50.0	-7.8	0
333611	Turbine and turbine generator set units manufacturing	1							1	1	1	1	0.00	0.02	---	-18.6	3
332999	Miscellaneous fabricated metal product manufacturing						1		2	0	3	-34	0.17	0.02	-91.9	-17.2	0
331521 331524	Aluminum foundries							1	2	-1	2	-116	0.62	0.02	-98.3	-24.6	0
332115-7	All other forging and stamping						1		0	0	0	0	0.00	0.00	---	-22.4	0
336999	All other transportation equipment manufacturing						1		0	0	0	0	0.00	0.00	---	31.9	0
331316	Aluminum extruded product manufacturing			1	1				0	-1	0	-4	0.04	0.00	-100.0	-9.8	0
334512	Automatic environmental control manufacturing							1	0	0	0	0	0.00	0.00	---	-28.0	1
31411	Carpet and rug mills	1	1			1	1		0	0	0	0	0.00	0.00	---	-8.7	0
31332	Fabric coating mills							1	0	0	0	-5	0.13	0.00	-100.0	-25.3	0
322225	Flexible packaging foil manufacturing			1					0	0	0	-5	0.78	0.00	-100.0	-16.5	0
33612	Heavy duty truck manufacturing		1			1	1		0	0	0	-93	0.66	0.00	-100.0	-21.8	0
335221	Household cooking appliance manufacturing					1	1		0	0	0	0	0.00	0.00	---	-2.0	0
335224	Household laundry equipment manufacturing					1	1		0	0	0	0	0.00	0.00	---	-14.7	0
335222	Household refrigerator and home freezer manufacturing					1	1		0	0	0	0	0.00	0.00	---	-16.0	0
332111	Iron and steel forging							1	0	0	0	0	0.00	0.00	---	-18.9	0
336213	Motor home manufacturing				1	1	1		0	0	0	0	0.00	0.00	---	13.6	0
332112	Nonferrous forging							1	0	0	0	0	0.00	0.00	---	-23.6	0
331522 331525-8	Nonferrous foundries, except aluminum							1	0	0	0	0	0.00	0.00	---	-18.0	0
331491	Nonferrous metal, except copper and aluminum, shaping			1					0	0	0	-39	0.68	0.00	-100.0	-27.1	0
331319	Other aluminum rolling and drawing				1				0	-1	0	-134	3.48	0.00	-100.0	-49.5	0
335929	Other communication and energy wire manufacturing			1					0	-1	0	-196	4.79	0.00	-100.0	-15.4	0
333618	Other engine equipment manufacturing	1	1						1	1	0	0	0.00	0.00	---	-15.6	3
335228	Other major household appliance manufacturing					1	1		0	0	0	0	0.00	0.00	---	-6.7	0
327113	Porcelain electrical supply manufacturing							1	0	0	0	0	0.00	0.00	---	-32.7	0
32622	Rubber and plastics hose and belting manufacturing			1				1	0	0	0	0	0.00	0.00	---	-6.3	0
333612-3	Speed changers and mechanical power transmission equipment		1						0	-1	0	-9	0.08	0.00	-100.0	-23.9	3
335911	Storage battery manufacturing	1	1			1			0	0	0	0	0.00	0.00	---	-34.5	0
334514	Totalizing fluid meters and counting devices	1	1						0	0	0	0	0.00	0.00	---	-24.5	1
336214	Travel trailer and camper manufacturing				1		1		0	0	0	0	0.00	0.00	---	30.3	0
333992	Welding and soldering equipment manufacturing			1					0	0	0	0	0.00	0.00	---	-31.0	3

Notes: Employment data are from Minnesota IMPLAN Group, Inc., and the U.S. Bureau of Labor Statistics. A "1" in the linkages column indicates that the industry in the row is strongly linked as a direct or indirect supplier or buyer to the industry in the column. Codes in the "BLS Technology Sector" column are the following: 1--Very technology intensive; 2--Moderately technology-intensive; 3--Somewhat technology intensive. Industries with employment location quotients (for 2005) greater than 1.20 are shaded.

Table 3

Detailed industry mix, linkages and regional employment trends: Metal working

2002 NAICS	2002 NAICS Industry	Linkages: Forging & stamping	Cutlery & handtools	Architectural & structural metals	Boilers, tanks & shipping containers	Hardware	Spring & wire products	Machine shops & turned products	Coating, heating & engraving	Metal valves	Ball & roller bearings	Small arms	Ammunition & ordnance	Pipes & pipe fittings	Industrial patterns	Enamled iron and metal ware	Establishments 2005	Establishments Change '98-'05	Employment 2005	Employment Change '98-'05	LQ 1998	LQ 2005	Pct Growth '98-'05 Region	Pct Growth '98-'05 US	BLS Tech Sector
335311	Electric power and specialty transformer manufacturing							1									2	-1	2,914	88	25.76	41.95	3.1	-30.0	3
33241	Power boiler and heat exchanger manufacturing			1	1												2	-2	1,548	1,200	4.81	28.84	344.8	-18.0	0
321113	Sawmills												1		1		95	0	3,867	-1,510	14.79	13.51	-28.1	-12.9	0
321999	Miscellaneous wood product manufacturing		1						1								10	-5	900	-393	11.99	12.89	-30.4	-28.4	0
32592	Explosives manufacturing												1				3	1	168	81	3.79	10.44	93.1	-22.5	3
332991	Ball and roller bearing manufacturing										1						2	1	918	280	5.06	10.19	43.9	-21.0	0
333995	Fluid power cylinder and actuator manufacturing		1					1									3	-1	363	235	2.11	8.13	183.6	-18.8	3
332311	Prefabricated metal buildings and components			1													14	10	660	5	6.86	7.80	0.8	-2.0	0
333922	Conveyor and conveying equipment manufacturing								1								4	0	543	-660	9.61	7.02	-54.9	-31.7	3
332997	Industrial pattern manufacturing		1	1											1		1	0	81	69	0.51	5.18	575.0	-26.9	0
31323	Nonwoven fabric mills							1									3	2	204	138	1.19	4.96	209.1	-17.8	0
32621	Tire manufacturing		1														4	2	816	-2,361	12.34	4.54	-74.3	-22.7	0
325211	Plastics material and resin manufacturing								1				1			1	4	-3	701	216	2.27	4.44	44.5	-18.2	2
33151	Ferrous metal foundaries		1		1	1		1		1	1	1		1	1	1	7	0	808	-81	2.32	3.26	-9.1	-28.5	0
335312	Motor and generator manufacturing					1											3	-4	421	-1,949	10.50	3.18	-82.2	-35.2	3
327112	Vitreous china and earthenware articles manufacturing										1						4	3	98	94	0.06	2.89	2350.0	-45.6	0
332312	Fabricated structural metal manufacturing	1		1	1									1			17	-3	666	-170	3.12	2.81	-20.3	-2.4	0
33121	Iron, steel pipe and tube from purchased steel	1	1	1	1		1		1		1			1		1	3	1	193	75	1.38	2.74	63.6	-8.9	0
332323	Ornamental and architectural metal work manufacturing			1													7	-1	267	185	0.72	2.55	225.6	1.4	0
33242	Metal tank, heavy gauge, manufacturing				1												3	-2	155	-275	5.06	2.29	-64.0	-12.1	0
33243	Metal can, box, and other container manufacturing				1												5	2	250	158	0.54	2.10	171.7	-23.2	0
8113	Commercial machinery repair and maintenance								1								113	18	810	36	1.72	1.83	4.7	8.8	0
331111	Iron and steel mills	1	1	1	1		1		1		1			1		1	1	-2	432	-199	1.58	1.78	-31.5	-32.7	0
326191 326199	Plastics plumbing fixtures and all other plastics products		1			1				1		1				1	10	-3	1,619	470	0.93	1.70	40.9	-14.7	0
2211	Power generation and supply								1								82	41	1,791	340	1.14	1.70	23.4	-8.9	2
334511	Search, detection, and navigation instruments												1				1	0	574	559	0.03	1.40	3726.7	-8.0	1
333997-9	Scales, balances, and miscellaneous general purpose machinery							1	1								2	-5	156	-251	2.44	1.30	-61.7	-20.3	3
3363	Motor vehicle parts manufacturing	1															34	-2	2,300	-3,064	2.24	1.28	-57.1	-17.2	0
332998	Enameled iron and metal sanitary ware manufacturing									1						1	1	1	44	44	0.00	1.22	---	-8.7	0
33271	Machine shops	1	1					1	1		1	1			1	1	70	6	790	158	0.83	1.17	25.0	-2.2	0
32221	Paperboard container manufacturing	1	1	1	1	1				1		1				1	11	-2	552	-1,046	2.45	1.15	-65.5	-18.2	0
44-5	Retail trade		1														4,333	-260	46,229	-237	1.09	1.15	-0.5	4.3	0
332322	Sheet metal work manufacturing	1	1		1		1	1						1			7	-6	296	64	0.75	1.08	27.6	-2.4	0
327211-2 327215	Glass and glass products, except glass containers	1	1	1					1								4	-2	255	-98	1.00	1.07	-27.8	-25.4	0
483	Water transportation		1														1	-1	162	18	0.93	1.04	12.5	11.3	0
3325	Hardware manufacturing			1		1		1									2	-5	76	-474	3.78	0.80	-86.2	-28.2	0
33422	Broadcast and wireless communications equipment												1				5	3	159	93	0.20	0.77	140.9	-32.2	1
32629	Other rubber product manufacturing					1											6	1	141	-134	0.99	0.74	-48.7	-24.5	0
332321	Metal window and door manufacturing			1													3	-2	164	70	0.37	0.73	74.5	-0.9	0
5412	Accounting and bookkeeping services														1		298	46	1,580	223	0.57	0.70	16.4	6.5	0
2212	Natural gas distribution	1							1								16	-7	184	-187	1.00	0.65	-50.4	-16.0	0
562	Waste management and remediation services								1								57	-18	575	-148	0.80	0.64	-20.5	8.7	0
5411	Legal services										1						502	73	1,860	272	0.53	0.60	17.1	13.4	0

Table 3

Detailed industry mix, linkages and regional employment trends: Metal working

		Linkages															Establishments		Employment						
		Forging & stamping	Cutlery & handtools	Architectural & structural metals	Boilers, tanks & shipping containers	Hardware	Spring & wire products	Machine shops & turned products	Coating, heating & engraving	Metal valves	Ball & roller bearings	Small arms	Ammunition & ordnance	Pipes & pipe fittings	Industrial patterns	Enamled iron and metal ware					LQ		Pct Growth '98-'05		BLS Tech Sector
2002 NAICS	2002 NAICS Industry																2005	Change '98-'05	2005	Change '98-'05	1998	2005	Region	US	
42	Wholesale trade		1		1												907	-390	8,843	-3,811	0.78	0.58	-30.1	4.1	0
3326	Spring and wire product manufacturing		1			1	1	1									5	0	86	62	0.10	0.55	258.3	-26.0	0
54191 54193 54199	All other miscellaneous professional and technical services			1					1								12	7	214	198	0.04	0.48	1237.5	12.5	0
55	Management of companies and enterprises										1		1		1		109	61	2,049	1,234	0.16	0.44	151.4	0.7	3
333511	Industrial mold manufacturing							1									1	-2	49	26	0.14	0.44	113.0	-25.8	0
332313	Plate work manufacturing	1		1	1			1		1				1			9	5	48	-221	1.71	0.38	-82.2	-11.6	0
314991 314999	Other miscellaneous textile product mills							1									12	5	36	-531	3.69	0.37	-93.7	-29.2	0
5418	Advertising and related services		1														53	10	382	213	0.12	0.33	126.0	-4.8	0
325998	Other miscellaneous chemical product manufacturing	1	1	1	1				1				1				2	2	30	22	0.06	0.32	275.0	-17.0	3
325991	Custom compounding of purchased resins	1		1			1		1								2	0	15	-8	0.29	0.26	-34.8	-19.1	3
541511	Custom computer programming services							1				1	1				37	13	274	153	0.10	0.20	126.4	22.0	1
32512	Industrial gas manufacturing								1								3	2	7	-1	0.10	0.12	-12.5	-18.4	2
332813	Electroplating, anodizing, and coloring metal				1				1								3	0	21	-235	0.88	0.11	-91.8	-25.7	0
33272	Turned product and screw, nut, and bolt manufacturing	1	1	1		1	1	1		1		1					3	1	21	-10	0.09	0.09	-32.3	-23.1	0
332996	Fabricated pipe and pipe fitting manufacturing			1	1					1				1			1	1	6	6	0.00	0.08	---	-6.5	0
333514	Special tool, die, jig, and fixture manufacturing	1						1			1						2	-3	13	-23	0.12	0.06	-63.9	-26.6	0
5417	Scientific research and development services														1		12	3	93	29	0.05	0.06	45.3	20.2	1
32613	Laminated plastics plate, sheet, and shapes		1							1				1			1	1	3	3	0.00	0.06	---	-28.5	0
333512	Metal cutting machine tool manufacturing			1													1	1	3	3	0.00	0.04	---	-41.4	0
32551	Paint and coating manufacturing	1		1	1				1								1	0	3	-4	0.05	0.03	-57.1	-15.1	3
331315	Aluminum sheet, plate, and foil manufacturing	1	1	1	1			1							1		1	1	1	1	0.00	0.02	---	-27.7	0
332812	Metal coating and nonprecious engraving								1								2	0	3	1	0.01	0.02	50.0	-7.8	0
323116	Manifold business forms printing				1												1	-1	2	-265	1.53	0.02	-99.3	-37.6	0
332999	Miscellaneous fabricated metal product manufacturing	1	1	1			1					1	1		1		2	0	3	-34	0.17	0.02	-91.9	-17.2	0
331422	Copper wire, except mechanical, drawing	1			1			1		1			1	1			1	1	1	-15	0.17	0.02	-93.8	-31.9	0
331521 331524	Aluminum foundries		1	1	1	1		1		1		1			1	1	2	-1	2	-116	0.62	0.02	-98.3	-24.6	0
339991	Gasket, packing, and sealing device manufacturing			1				1		1							1	1	1	1	0.00	0.01	---	-17.6	0
324199	All other petroleum and coal products manufacturing	1	1	1					1								0	0	0	-7	0.33	0.00	-100.0	-27.3	3
32552	Adhesive manufacturing			1	1												0	0	0	0	0.00	0.00	---	-9.8	3
32591	Printing ink manufacturing			1	1												0	0	0	0	0.00	0.00	---	-17.1	3
32611	Plastics packaging materials, film and sheet		1	1		1	1										0	-2	0	-10	0.04	0.00	-100.0	-5.1	0
32622	Rubber and plastics hose and belting manufacturing									1							0	0	0	0	0.00	0.00	---	-6.3	0
327125	Nonclay refractory manufacturing								1								0	0	0	0	0.00	0.00	---	-27.6	0
32791	Abrasive product manufacturing		1	1		1		1			1	1	1				0	0	0	0	0.00	0.00	---	-32.3	0
327999	Miscellaneous nonmetallic mineral products										1						0	-1	0	-43	1.26	0.00	-100.0	4.9	0
331221	Rolled steel shape manufacturing	1	1	1	1		1		1		1			1		1	0	0	0	0	0.00	0.00	---	-28.3	0
331222	Steel wire drawing		1			1	1	1									0	0	0	0	0.00	0.00	---	-14.8	0
331312	Primary aluminum production	1															0	0	0	0	0.00	0.00	---	-40.5	0
331314	Secondary smelting and alloying of aluminum	1															0	0	0	0	0.00	0.00	---	-22.8	0
331316	Aluminum extruded product manufacturing	1	1	1	1												0	-1	0	-4	0.04	0.00	-100.0	-9.8	0
331319	Other aluminum rolling and drawing	1		1	1			1									0	-1	0	-134	3.48	0.00	-100.0	-49.5	0
331421	Copper rolling, drawing, and extruding	1			1			1					1	1			0	0	0	0	0.00	0.00	---	-33.1	0
331491	Nonferrous metal, except copper and aluminum, shaping	1		1			1		1								0	0	0	-39	0.68	0.00	-100.0	-27.1	0

Table 3

Detailed industry mix, linkages and regional employment trends: Metal working

2002 NAICS	2002 NAICS Industry	Linkages: Forging & stamping	Cutlery & handtools	Architectural & structural metals	Boilers, tanks & shipping containers	Hardware	Spring & wire products	Machine shops & turned products	Coating, heating & engraving	Metal valves	Ball & roller bearings	Small arms	Ammunition & ordnance	Pipes & pipe fittings	Industrial patterns	Enamled iron and metal ware	Establishments: 2005	Establishments: Change '98-'05	Employment: 2005	Employment: Change '98-'05	LQ: 1998	LQ: 2005	Pct Growth '98-'05: Region	Pct Growth '98-'05: US	BLS Tech Sector
331492	Secondary processing of other nonferrous	1							1								0	0	0	0	0.00	0.00	---	-11.4	0
331522 331525-8	Nonferrous foundries, except aluminum		1	1		1		1		1					1	1	0	0	0	0	0.00	0.00	---	-18.0	0
332111	Iron and steel forging	1	1		1	1	1	1		1	1	1	1	1		1	0	0	0	0	0.00	0.00	---	-18.9	0
332112	Nonferrous forging	1				1	1	1		1	1						0	0	0	0	0.00	0.00	---	-23.6	0
332115-7	All other forging and stamping	1	1	1	1	1				1		1	1			1	0	0	0	0	0.00	0.00	---	-22.4	0
332211	Cutlery and flatware, except precious, manufacturing		1														0	0	0	0	0.00	0.00	---	-25.4	0
332212	Hand and edge tool manufacturing					1											0	0	0	-13	0.08	0.00	-100.0	-32.9	0
332213	Saw blade and handsaw manufacturing		1		1			1									0	0	0	0	0.00	0.00	---	-19.0	0
332214	Kitchen utensil, pot, and pan manufacturing		1														0	0	0	0	0.00	0.00	---	-53.9	0
332811	Metal heat treating								1								0	0	0	0	0.00	0.00	---	-8.2	0
33291	Metal valve manufacturing				1					1				1			1	1	0	-11	0.03	0.00	-100.0	-20.9	0
332994	Small arms manufacturing											1					0	0	0	0	0.00	0.00	---	-0.7	0
332995	Other ordnance and accessories manufacturing												1				0	0	0	0	0.00	0.00	---	13.2	0
332992-3	Ammunition manufacturing												1				0	0	0	0	0.00	0.00	---	-10.3	0
333412	Industrial and commercial fan and blower manufacturing			1	1												0	-1	0	-8	0.18	0.00	-100.0	-29.3	0
333513	Metal forming machine tool manufacturing			1													0	0	0	0	0.00	0.00	---	-28.7	0
333515	Cutting tool and machine tool accessory manufacturing	1	1				1	1	1		1	1		1			0	0	0	0	0.00	0.00	---	-34.6	0
333516-8	Rolling mill and other metalworking machinery			1	1			1									0	-1	0	-5	0.09	0.00	-100.0	-33.2	0
333992	Welding and soldering equipment manufacturing			1	1												0	0	0	0	0.00	0.00	---	-31.0	3
333994	Industrial process furnace and oven manufacturing								1								0	0	0	0	0.00	0.00	---	-36.0	3
334513	Industrial process variable instruments								1								2	1	0	-2	0.01	0.00	-100.0	-16.3	1
335911	Storage battery manufacturing		1														0	0	0	0	0.00	0.00	---	-34.5	0
335929	Other communication and energy wire manufacturing	1	1	1						1							0	-1	0	-196	4.79	0.00	-100.0	-15.4	0

Notes: Employment data are from Minnesota IMPLAN Group, Inc., and the U.S. Bureau of Labor Statistics. A "1" in the linkages column indicates that the industry in the row is strongly linked as a direct or indirect supplier or buyer to the industry in the column. Codes in the "BLS Technology Sector" column are the following: 1--Very technology intensive; 2--Moderately technology-intensive; 3--Somewhat technology intensive. Industries with employment location quotients (for 2005) greater than 1.20 are shaded.

Table 4

Linkages to core industries: Aerospace, motor vehicles, and metalworking

Core market industry	Linked industries w/ regional LQ>1.2	Total linked industries	Ratio
Aerospace			
Aircraft mfg	3	17	17.6%
Aircraft engines & parts	4	17	23.5%
Other aircraft parts	2	17	11.8%
Guided missiles & space vehicles	4	22	18.2%
Propulsion units & parts	2	20	10.0%
Motor Vehicles			
Autos & light trucks	8	22	36.4%
Heavy duty trucks	7	18	38.9%
Vehicle bodies	4	18	22.2%
Truck trailers	7	17	41.2%
Motor homes	7	18	38.9%
Trailers & campers	4	16	25.0%
Motor vehicle parts	4	19	21.1%
Metalworking			
Forging & stamping	4	32	12.5%
Cutlery & handtools	8	38	21.1%
Architectural & structural metals	7	39	17.9%
Boilers, tanks & shipping containers	7	32	21.9%
Hardware	3	17	17.6%
Spring & wire products	2	14	14.3%
Machine shops & turned products	5	29	17.2%
Coating, heating & engraving	8	28	28.6%
Metal valves	3	18	16.7%
Ball & roller bearings	5	15	33.3%
Small arms	2	13	15.4%
Ammunition & ordnance	4	16	25.0%
Pipes & pipe fittings	4	14	28.6%
Industrial patterns	3	11	27.3%
Enamled iron and metal ware	6	13	46.2%