

THE SHEET METAL WORK INDUSTRY: TRENDS AND CHARACTERISTICS

A Report of the Center for Competitive Analysis

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This report, prepared by the Center for Competitive Analysis of the University of Missouri Outreach and Extension (UO/E), provides an overview of some important aspects of the Sheet Metal Work industry (“sheet metal industry”), Standard Industrial Classification (SIC) code 3444.¹ Its primary intended audiences are UO/E, which may consider educational programming designed to assist business owners and workers in the industry, and economic development policy makers, who can use the information contained herein to learn more about the industry and develop programs designed to attract or retain businesses in this industry. It is not an exhaustive survey of all aspects of the industry. The final section of the report identifies issues that will have to be studied in greater depth before educational or developmental programming can be designed. The sources of information for this report include government publications and a variety of trade journal articles.

1. General Industry Information

The sheet metal industry includes, according to U.S. Census information, “establishments primarily engaged in manufacturing sheet metal work for buildings (not including fabrication work done by construction contractors at the place of construction), and manufacturing stovepipes, light tanks, and other products of sheet metal.” In 1997, the latest year for which U.S. Economic Census data are available, this industry had 4,591 establishments² nationally. There were 130,608 employees in total (\$4.09 billion payroll), including 96,991 production workers (\$2.57 billion payroll). National total value of shipments was \$16.06 billion, of which \$8.86 billion represented value added.

Census data also indicate that Missouri’s share of value of shipments in 1997 was approximately \$259 million (\$142 million value added). There were 86 establishments in Missouri, 36 of which had 20 or more employees. The industry employed a total of 2,313 persons in Missouri (\$70.6 million payroll), of which 1,677 were production workers (\$43.3 million payroll).

Census data from 1992 regarding overall concentration for SIC code 3444 reveal that control of the industry was relatively diffuse. The four largest firms controlled just 9% of total industry value of shipments, the top 20 firms controlled 20% and the largest 50 firms had 29%. In comparison, the top 50 firms regardless of industry controlled 24% of the U.S. total value added for manufacturing, making this industry slightly more

¹This largely corresponds to the new North American Industry Classification System (NAICS) code 332322, which is defined to include “ducts, flumes, flooring, siding, dampers, etc.” Other products appearing in SIC code 3444 (metal bins and vats; cooling towers) were transferred to NAICS codes 332439 and 333414.

²The number of companies is slightly lower; some companies operate multiple establishments.

concentrated than the overall economy. Our research did not disclose the extent to which markets in this industry are regional or local. We suspect that, given the number of firms in Missouri and that typically the products are made in the shop and then transported to the installation site, most purchasers obtain these products in relatively localized markets. To the extent markets are indeed less than national in scope, national concentration numbers would tend to understate concentration in the meaningful regional/local markets, particularly in sparsely populated areas. Even with this factor accounted for, however, this industry is sufficiently competitive in most or all regional/local markets to prevent the exercise of market power by firms.

2. Product Market Competition and Efficient Production Methods

Most sheet metal work is associated with the building of structures. Firms in the industry make heating, ventilating, air-conditioning, and pollution control duct systems; roofs and siding; rain gutters, downspouts, and skylights; and a variety of other parts for buildings. The health of the industry is therefore correlated with new construction activity. On the other hand, a significant portion of the industry's work involves refurbishing the same items on existing buildings. Building owners in many cases undertake such work instead of building new structures, and as a result, sheet metal work is not as volatile as new construction. Sheet metal work is also extensively used in the manufacture of kitchen equipment.

As discussed above, the extent of competition in the industry, whether the work is new construction or refurbishing existing structures, will likely depend on the regional structure of the industry. Firms, particularly those concentrating on the construction industry, will therefore tend to experience greater amounts of competition in urban areas where there are many sheet metal firms in operation.

The industry's output is rather standardized, and firms are likely to compete rather heavily on the basis of price. Product differentiation is not as easy to achieve as it is in the production of consumer goods. (For an elaboration of this point, see the section below that discusses the selection of business strategies.) In turn, the ability to compete on price is tied to the cost of production, and so reducing cost is a key component of a successful approach to this line of business.

Competition in the sheet metal manufacturing industry is getting tougher. Eliminating the waste of materials, of employee effort, and of the time shop machinery is used has become an essential part of manufacturing. Lean production in sheet metal shops is focused on continuous improvement in shop efficiencies, mainly through the elimination of waste. Reducing waste lowers costs and increases the satisfaction of customers and employees.

Current quality control methods and computer-based operating systems are essential to integrate the wide array of equipment, materials, and processes used in the industry. Boosting productivity and lowering costs begins in the design stage. For example, sheet metal parts have traditionally been designed as flat pieces that are then bent into a three-dimensional shape. Stress studies, product visualization, and spotting interference between assembled parts remain difficult tasks. But when the design process takes place in three dimensions, many problems with the fabrication and performance of the finished

product can be spotted early and eliminated. Computer-assisted design (CAD) techniques are integral to such an approach.

For example, one type of machine used in the manufacture of tortilla chips is about 30% sheet metal. The traditional approach to making a part for such a machine is for mechanical engineers to make up drawings of various views of the part and then give them to a sheet metal specialist who would “unfold” the part and make a flat pattern drawing. This process could take up to a full day using pencil and paper and early CAD technologies. Now more advanced design software such as Solid Edge (a product of Unigraphics Solutions in St. Louis, MO) allows the same work to be performed in 2 hours while simultaneously integrating the design process more fully with manufacturing. Another software product that can perform similar tasks is COBRA MetalBender Desktop, a product of data M, which allows the conversion of two-dimensional contours to three-dimensional volume models.

These software products are examples of a broader class of computer design techniques known as finite element analysis (FEA). FEA programs can take much of the guesswork out of manufacturing processes involving stamping, casting, and molding operations. For example, the latest FEA applications let a firm’s production people better predict springback in formed sheet metal parts. Larger companies are more inclined to ask their suppliers to perform FEA on new designs than smaller companies because the smaller ones lack the analytical expertise to meet such demands. But smaller companies can turn to software developers for easy-to-use and affordable codes for the analytical work.

Generally speaking, new software that allows for designing in solids provides many benefits. These benefits include the ability to see the part in three dimensions rather than guessing what it might look like from a flat pattern; maintaining knowledge bases that contain design and manufacturing information (e.g., the tools available in a given firm’s shop); and the ability to calculate bend radius, flatten three-dimensional designs for production, and automatically dimension drawings. By using computer design, users can fold and unfold an entire part or individual bends at will and add features to parts in the folded or unfolded state. The ability to actually manufacture a designed part is ensured through automatic creation of bend allowances and reliefs. An important feature of the new software is its ability to work with sheet metal parts imported from other systems. The overall result is to save time as well as materials.

Another technology that can help reduce waste and improve the quality of the product is laser-beam cutting. It has become an integral part of sheet metal fabrication because it lends precision to heavy sheet and light-plate applications.

One expert in sheet metal design software offers important advice to firms: make sure that both the designers and the sales staff clearly understand the capabilities of the manufacturing shop. This requires designers and salespeople to be familiar with the design software as well as the manufacturing process. One way to ensure that designers and salespeople understand shop floor capabilities is to have them spend time—perhaps a week or two—observing and even participating in the manufacturing process. If a firm’s nonmanufacturing staff understands what can actually be executed, they will not design or promise to customers parts that cannot be fabricated at a reasonable cost. This advice

is another form of the general principle that an integrated operation tends to function more smoothly than one made up of a series of autonomous parts.

3. Labor, Skills, and Labor Market Conditions

The labor force employed by the sheet metal work industry in Missouri is not generally characterized by high skill levels, but many employees are in occupations requiring specific trade skills (e.g., sheet metal workers and welders). The following table contains the occupational titles and the 1997 average annual wages of workers employed in the three-digit SIC code 344: Fabricated Structural Metal Manufacturing. Note that this 3-digit category is broader than the 4-digit sheet metal industry; the percentages of employees in each occupation in SIC code 3444 will therefore likely vary from those shown here. For example, the occupation entitled “sheet metal workers” is ranked sixth in Table 1, with 3.7% of the total employees in the 3-digit SIC category 344, but would certainly account for a larger percentage of employees in SIC code 3444. The table contains information for the six most heavily employed occupations.

| TABLE 1. Sheet Metal Industry Occupations | | |
|--|---------|---------------------------|
| Job Title | Percent | 1997 Annual Average Wages |
| Assemblers, Fabricator (All other) | 5.9 | \$16,848 – \$37,669 |
| Structural Metal Fabricators | 5.8 | \$15,059 – \$23,379 |
| Welders and Cutters | 5.7 | \$18,574 – \$28,330 |
| First Line Supervisors, Production | 4.2 | \$24,461 – \$43,846 |
| Helper, Laborer, Mover, All Other | 3.8 | \$13,208 – \$24,419 |
| Sheet Metal Workers | 3.7 | \$25,480 – \$47,840 |

The annual wage data are for all workers in Missouri in that occupational category, not just those employed by firms in SIC code 344. The “Percent” column states the percentage of the industry workforce classified in a particular occupation. The source of the information is the Missouri Occupational Information System (MOIS). The table shows that sheet metal workers receive relatively high pay.

Because most of these jobs do not require extensive skills, training would typically be done on the job, and there are no technical school programs designed to prepare workers for such occupations. Welders and sheet metal workers possess higher skills, and welding programs are in place in most vocational-technical schools in Missouri. There are examples of sheet metal worker training in other states. On the outskirts of Detroit, Michigan, a former contractor who had problems finding trained people started a private vocational school to train workers in a half-dozen fields, including sheet metal and duct work. In 1998, Oregon, working in concert with that state’s aerospace industry, began a training program to teach sheet metal skills to unemployed and underemployed workers.

Also in 1998, some national sheet metal trade associations and their member companies started a program to recruit and train new workers for the industry. Although the present research has found no evidence of a sheet metal worker shortage in Missouri, if such a shortage exists these examples from other states could serve as models. Missouri sheet metal firms could consider a partnership with state government to help train workers.

Generally speaking, job prospects for workers with these skills is good. This favorable outlook is the result of continuing activity in the construction of new industrial, commercial, and residential buildings, and of the growing demand for energy efficiency improvements in older buildings undergoing renovation. Other important occupations in this industry, not shown in Table 1, include combination machine tool operators, cost estimators, and welding machine operators.

Table 1 is based on overall industry employment in Missouri, which means that the occupational proportions are heavily weighted toward the largest employers in the state. These data may not therefore be appropriate for the smaller firms in the industry. Each establishment, no matter how small, requires a minimum number—perhaps only one—of certain types of employees. As commerce moves more into the electronic realm, it will probably be necessary for even the smallest producers to have an employee who has relatively sophisticated computer skills that go beyond, for example, proficiency with a single word processing package. In order for a local area to attract and retain even small sheet metal firms, it is therefore important for the nearby secondary and vocational schools to provide the kind of computer skill training required by such small businesses.³ Even if the attitude, work ethic, and basic skills of the local workforce are sufficient in every other way, firms will be reluctant to locate in rural areas if workers with the requisite specific skills are unavailable.

An important reason why the educational system rather than the firms themselves will be the critical source for training in electronic commerce computer skills lies in the nature of the training. Economists distinguish between general training, which can be put to use by a worker in any of a number of firms or industries, and specific training, which is applicable only in individual or small groups of firms. Firms are more willing to provide specific training because the workers receiving it cannot easily (if at all) apply the knowledge gained to a job at another firm. The employer therefore need not be concerned with the possibility of investing what can be considerable sums in training only to see the employee leave for a more lucrative position with another firm. The sorts of metal work and electronic commerce computer skills at issue here are more general skills that are largely transferable from one employer to another. These principles apply to a greater extent in small businesses, for which training costs would be a larger proportion of total costs and which cannot offer their employees as many opportunities for intrafirm advancement.

Another labor issue associated with this industry is worker safety. Industrial power presses, which are used to press flat sheets of metal into a particular shape, account for thousands of injuries a year and nearly 10% of all amputations among factory workers. The Occupational Safety and Health Administration (OSHA) estimates there are 300,000

³This principle applies to a wide variety of industries in addition to sheet metal work.

power presses in operation in the U.S. and has stepped up safety inspections because of accidents resulting in smashed hands and severed limbs. Most of these accidents are caused by removal of safety guards or not following safety practices.

A more general labor-related problem facing smaller businesses is the ability to maintain a competitive package of benefits, especially medical insurance. In today's tight labor market (especially with respect to workers with high skill levels), the ability to provide a strong benefits package may be the most critical factor in recruiting and retaining employees. In rural areas, the presence of one major employer with attractive benefits packages can leave smaller businesses in the area the choice between losing employees and incurring high benefits expenses.

Because labor market conditions vary considerably across Missouri, no blanket statements about labor availability in the state can be made, except to state generally that outstate labor markets are not as tight as those in urban areas. A good source of information on local (county) labor markets and a variety of other labor-related information for Missouri is the "Missouri Works" Web site at

<http://www.works.state.mo.us/index.htm>⁴.

4. Physical Infrastructure Requirements

Our research did not uncover specific information about infrastructure requirements peculiar to this industry. In the absence of evidence to the contrary, we believe it is fair to assume that the requirements of this industry are not significantly different from most manufacturing industries. Necessary utility services are an adequate supply of electricity, probably including three-phase service, telecommunications facilities sufficient to permit data as well as voice services, and good supplies of water and sewer services. In addition, since this industry's primary input is the "raw" steel or other metals to be processed, a good road system is needed so that large trucks carrying the input materials can reach the plant. Similarly, good roads are needed in order to get the output from the plant to customers' construction sites.

5. Support Industries

An obviously important cost faced by sheet metal firms is that of the "raw" metals—primarily steel—used to make finished structural items such as ducts and roof sections. Steel sheet prices reached an all-time low of \$277 per ton for the benchmark flat-rolled grade in 1999, but increased by nearly 23% to \$340 per ton in early 2000. Cold rolled steel prices are predicted to average \$448 per ton in 2000, up from \$385 per ton in 1999. Last year's low prices were the result of a number of factors, including the addition of new highly efficient steelmaking capacity and the economic slowdown in Asia. The latter factor had a dual impact, causing excess capacity in that region of the world and

⁴Note that Web addresses and the contents of Web pages change from time to time. The Web addresses provided in this report were correct at the time of writing.

increasing the value of the dollar relative to Asian currencies, which in turn caused low prices for imported steel. Recent price increases reflect the cumulative effect of the booming North American economy and the imposition of high punitive tariffs on imports from many countries. These increases may be viewed as simply a reasonable recovery from unusually low 1999 prices. Although buyers have to this point been resistant to price increases, some analysts expect prices to gain strength, and for price increases to stick. Other analysts suggest that the strength in sheet metal prices is mainly the result of strong demand from automobile manufacturers, and any reduction in automotive use of sheet metal could quickly push prices back down.

6. Regulatory Requirements

Although there appear to be no industry-specific regulatory issues affecting sheet metal companies, such firms must be aware of broader labor, occupational, and environmental regulations. Large companies typically have employees or entire departments devoted to following new regulatory developments and devising compliance procedures. In many small businesses, however, such responsibilities cannot be assigned to special experts. A good place to begin gaining a familiarity with federal (primarily employment) regulations is the U.S. Department of Labor's *Small Business Handbook: Laws, Regulations, and Technical Assistance Services* (November, 1997), available on the Internet at

<http://www.dol.gov/dol/asp/public/programs/handbook/ofccp.htm>.

Also of assistance to small businesses is the Department of Labor's Office of Small Business Programs. One of that agency's initiatives is the Regulatory Compliance Assistance program, available on the Internet at

<http://www.dol.gov/dol/osbp/public/sbrefa/main.htm>

or by toll-free telephone at 1-888-972-7332 (1-888-9SBREFA), which is designed to help small businesses cope with regulatory requirements.

The U.S. Environmental Protection Agency (EPA) is a good source of information on how that agency's regulations affect small business and ways in which small businesses can satisfy EPA regulations at the lowest possible cost. See

<http://www.epa.gov/smallbusiness/>

for more information.

Generally speaking, a key factor in successfully and efficiently complying with state and federal regulations governing the environment and employee compensation and safety issues is familiarity with such regulations on the part of business owners and managers. While gaining such familiarity can be quite time consuming for small business owners who must serve their firms in many capacities, it is imperative that sufficient time be devoted to keeping up to date with regulatory enforcement practices. The information cited here can help begin that process.

As mentioned above, OSHA has expressed some concern about the number of injuries associated with pressing and stamping operations. Sheet metal firms should be on the lookout for increased enforcement or perhaps even proposals for stronger regulations governing stamping operations. Sheet metal shop owners should be sure that safety policies and procedures are implemented throughout the plant and are understood and followed by all workers.

7. General Strategic Issues

The profitability of a business depends upon both the overall degree of competition in an industry and the position of the business relative to its rivals. A business has little control over the general degree of competition in its industry, but can take strategic actions to position itself favorably relative to its rivals and thereby influence its profitability. Businesses that earn profits above the industry average typically do so because they find a sustainable competitive advantage. This advantage allows such firms to position themselves relative to their rivals in ways that emphasize their relative strengths; and this in turn allows them to better cope with the various forces of competition.

It is common to distinguish between two broad strategies to achieve competitive advantage. The first is cost leadership and the second is product differentiation. Each of these strategies represents a different route to sustainable competitive advantage and above average profitability. Moreover, no matter which of these approaches is adopted, a firm also needs to determine whether it will compete for all buyers in a particular market or focus on just a target segment of market. Successful firms will choose a strategy and target segment based upon their own individual strengths and weaknesses.

Cost leadership is a strategy of attempting to become the low cost supplier in the industry. Sources of cost leadership are varied but would include such things as pursuit of scale economies, use of proprietary technology, preferential access to raw materials and other inputs, and specific knowledge of customer needs. Firms pursuing this strategy must seek out all sources of cost advantage while at the same time produce a product that is perceived as comparable to that of rival firms.

In a **differentiation strategy** a business attempts to make itself and its products unique along dimensions that are considered valuable by buyers. The business needs to find attributes that buyers perceive as important and position itself to meet those needs. The attributes along which differentiation may be achieved are extremely broad including the product or service itself, the delivery system used, the marketing approach adopted, and so forth. To be successful in a differentiation strategy, a business must choose attributes to emphasize which will allow it to be perceived as distinct from its rivals. Differentiation is often a more promising strategy for products sold to consumers, rather than to firms processing them for later sale.

No matter whether cost leadership or product differentiation is pursued, a firm must also decide how broadly over the market it should compete. Most markets contain segments, which are distinct customer groups that possess a common set of characteristics or special needs. In consumer goods industries, for example, buyers may be segmented by income levels, frequency of purchase, knowledge of the product, and so forth. Industrial goods buyers may be segmented by size of buyer, willingness to trade

price for quality, location, type of industry (e.g., sheet metal for ventilation ductwork), or special product needs. A firm needs to determine whether it will attempt to serve all of the market segments or focus upon target segments.

When a firm focuses it aims to better serve a single or small number of buyer segments in an industry. For some segments this will require a firm to be a low-cost producer. In other segments a firm may compete by offering a differentiated product. Firms that become very narrowly focused (specializing perhaps in as few as one segment with a single product) are often said to be following a “niche strategy.”

By their very nature, small businesses typically must focus on only one or a few segments of an industry. Whether a strategy of low cost or product differentiation is appropriate depends upon the nature of the buyers in the segments being pursued and the positions of rival firms competing for those same buyers. Consider for example the following sets of questions in reference to a particular buyer segment:

1. Are other firms competing in this segment currently utilizing large-scale, low-cost production technologies? The existence of such firms may make it difficult to attract or maintain customers.
2. Are the products or services produced for this segment virtually standardized? Purchase of standardized goods and services are generally made on the basis of price alone.
3. Can the attributes of the product or service and its quality be ascertained by the buyer prior to purchase? Such products can be judged as to acceptability by buyers, and for a given quality a supplier must also offer the lowest price.
4. Are the buyers extremely price sensitive and unwilling to pay much of a premium for enhanced quality or image? In some cases nothing matters other than price. As a result, only firms able to offer the lowest prices are able to survive.
5. Is little post-sale service required for this product or service? Competition in segments in which post-sale service has little or no significance often will turn on price alone.

If each of these questions is answered affirmatively, then for this particular segment cost leadership is a dominant strategy. Segments displaying these characteristics offer little scope for creating value to buyers through differentiation efforts. Successful firms will be those who manage to achieve minimum cost in serving this type of target segment.

Product differentiation becomes a more viable strategy in segments where the conditions given in questions (2.) through (5.) above do not prevail. Under these circumstances firms have the opportunity to offer differentiated products or services with attributes that are especially desired by buyers. Firms successful in product differentiation benefit through the ability to obtain price premiums for their products.

The basic lesson here for sheet metal firms is to take a hard look at their approach to the market to ensure that they have chosen the appropriate set of strategies, given their strengths and their local markets. Many businesses, particularly smaller ones, falter because they are locked into a “business as usual” approach and fail to realize that old markets may be declining or that new opportunities have arisen. Regular evaluations of a firm’s business strategy are therefore important.

8. Challenges

Challenges to the firms in an industry or to the industry as a whole can take the form of either opportunities or threats, and sometimes a threat is also an opportunity (or vice versa). Some threats can lead to opportunities as the firms in an industry, who are forced to face issues that they have not previously considered, discover new perspectives on their core business. The challenges we see here are similar to those confronting many other industries we have studied in the past year, and in that sense are not unique to this industry, but simply take a slightly different form. Our research revealed three important challenges for the sheet metal industry: maintaining efficient production techniques, addressing worker safety issues, and making the transition to a business model that relies on electronic commerce to a much greater extent. This section considers each of these in turn.

Efficient Production Techniques

Because competition in the sheet metal industry, including competition within its many narrow segments, is largely driven by price, it is imperative that firms control costs and seek more efficient approaches to the design and manufacture of their products. Adopting manufacturing methods that help reduce waste, including laser cutting, is an important component of this task, but the manufacturing process cannot be viewed in isolation. Integrating the design, manufacturing, and marketing/sales functions can help a sheet metal firm serve its markets effectively and at low cost while promoting the sense of a common goal among its different employee groups. The availability of better and cheaper design software is an important factor in this integration process. An understanding of all facets of the firm’s operations by each functional group of employees can also help achieve the goal of reducing costs. These approaches clearly represent an opportunity to increase profits for firms that can successfully adopt them, while simultaneously representing a threat to firms who either cannot or will not do so.

Worker Safety

No business owner deliberately creates unsafe conditions simply to keep costs down, in part because in many jurisdictions workers’ compensation insurance rates are based on past safety performance. On the other hand, there may be initial resistance to new or increased government safety regulation because of the higher costs that often result. As discussed in other sections of this report, some of the machinery used in sheet metal shops can be quite dangerous, particularly if used in an improper manner. The major challenge here lies in maintaining high safety standards at a reasonable cost and in keeping abreast of OSHA and other regulations. Sheet metal shop owners should be sure

that safety policies and procedures are implemented throughout the plant and are understood and followed by all workers.

E-commerce

The sheet metal industry shares the challenge associated with electronic commerce (“e-commerce”) with most other industries. Although much of the publicity concerning e-commerce concerns transactions between retailers and consumers, business-to-business e-commerce is much more voluminous—roughly 10 times larger.⁵ It will be virtually impossible for any firm in almost any industry to survive, let alone grow, if it does not adopt an e-commerce model. For sheet metal firms this means that the Internet will be an important, and perhaps the sole, channel for procuring its material inputs and communicating with its customers. Internet-based project Web sites can communicate project information in a fast, cost effective, and efficient manner. Some Web sites act as the homepage for a specific project, where project participants can put drawing files, specifications, and cut sheets and perform certain project specific tasks, such as requests for information or shop drawing logs. The transition to e-commerce in the sheet metal industry is well underway.

A number of electronic marketplaces have been launched in a variety of industries over the past 12 to 18 months. SupplierOne.com, which inaugurated its Web site in early April of this year, is likely to become an important e-marketplace for sheet metal firms. It will facilitate electronic transactions for structural and sheet metal fabrications as well as for a number of other products, including castings, stampings, and forgings. Furthermore, it will provide a marketplace for all sorts of materials, including metals, rubber, and plastics. The potential benefits of this Internet company (and many others) include reducing costs, substantially cutting the purchasing cycle and substantially improving productivity.

The rapid growth of e-commerce is both an opportunity and a threat. It offers the potential for sheet metal firms to bid on a variety of projects that they may never have learned about otherwise and will allow better and more timely communications with suppliers. It can help control costs by allowing firms to receive electronic versions of designs from purchasers, which sheet metal firms can then use to facilitate manufacturing activities. This effectively eliminates one or more steps common to the older “pencil and paper” approach to design. In this fashion e-commerce opens more opportunities for increasing profits by expanding sales and cutting costs, particularly for those firms who successfully integrate their e-commerce and other computer operations rather than treating e-commerce as simply a separate marketing tool. But it clearly represents a threat as well. Firms that fail to make a sufficiently rapid transition to e-commerce will find it difficult to survive, because there can be no doubt that many of their competitors will do so soon. A major challenge in the transition to e-commerce will be finding personnel sufficiently knowledgeable about the technologies and techniques involved in a successful e-commerce plan. This is especially true because the present expansion of e-commerce is so rapid that such personnel are in short supply.

⁵It should be noted that this ratio is not unique to e-commerce. Even before the Internet was created, the total value of transactions between businesses was roughly 10 times greater than retail sales.

9. Topics for Further Research

Our research on the sheet metal industry has given us an overview of the industry on a national level. Except for a few statistics, however, we have not learned much detail about the Missouri firms in the industry. In order for economic developers to be able to attract and retain such businesses and for University programs aimed at helping the industry to be developed, more information on Missouri sheet metal firms should be compiled. A potential source of this information is a survey of or set of discussions with Missouri sheet metal firms.

Two other unresolved issues appear in this report. One is the scope of the market for a given firm. Is this market relatively localized because of transportation and other costs, or is it regional, state-wide, or even broader? Or is the market broad in some market segments or sets of circumstances but local in others? The other issue has to do with the availability of sheet metal workers. Do Missouri sheet metal firms have an adequate supply of workers with the desired amount of training? If not, what is causing the shortage, and what steps can be taken by the firms, the educational establishment, and government agencies to help firms recruit and retain the workforce needed to sustain the industry in the future?