United States International Trade Commission

Tools, Dies, and Industrial Molds:

Competitive Conditions in the United States and Selected Foreign Markets

Investigation No. 332-435
USITC Publication 3556
October 2002

U.S. International Trade Commission

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PREFACE

On January 10, 2002, the United States International Trade Commission (Commission) instituted investigation No. 332-435, Tools, Dies, and Industrial Molds: Competitive Conditions in the United States and Selected Foreign Markets. The investigation, conducted under section 332(g) of the Tariff Act of 1930, was in response to a request from the Committee on Ways and Means of the U.S. House of Representatives (Committee), received December 21, 2001 (see appendix A).

The purpose of this investigation is to provide a report analyzing competitive conditions facing the U.S. and foreign industries producing tools, dies, and industrial molds during the most recent 5-year period. As requested by the Committee, the report specifically provides:

1. A profile of the U.S. tool, die, and industrial mold industries;

2. Information on changes in marketing and manufacturing processes, and trends in U.S. production, consumption, and trade;

3. A global market overview and assessment of foreign markets and significant foreign industries, including those in China, Taiwan, Japan, Canada, Mexico, and member countries of the European Union;

4. A comparison of the strengths and weaknesses of U.S. and foreign producers regarding factors of competition such as production costs, labor costs, availability of skilled/experienced labor force, level of technology in the design and manufacturing process, availability of capital, transportation costs, pricing, product quality and after-sales-service, and government programs assisting these industries; and

5. Information on the principal challenges and potential implications for the industries over the near term.

Written submissions for this investigation were solicited by publishing a notice in the Federal Register on January 16, 2002 (66 F.R. 2237) (see appendix B). The Commission held a public hearing for the investigation on May 21, 2002. A list of hearing participants is shown in appendix C.

The Commission sent questionnaires to 1,008 potential producers. Questionnaire responses were received from 420 producers, however 95 of these firms reported no production of tools, dies, or industrial molds. Twenty-eight questionnaires were returned by the U.S. Postal Service as undeliverable, which may indicate these firms have gone out of business. The producers that responded represent about 9 percent of U.S. product shipments reported by the Bureau of Census. Questionnaires were also sent to 130 purchasing firms. Fifty-seven purchasers responded, representing an estimated 4 percent of consumption.

PREFACE–*Continued*

The information and analysis in this report are for the purpose of this report only. Nothing in this report should be construed as indicating how the Commission would find in an investigation conducted under other statutory authority.

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GLOSSARY

AMBA	American Mold Builders Association
BLS	U.S. Bureau of Labor Statistics
CAD	Computer aided design
CAM	Computer aided manufacturing
CAMM	Canadian Association of Mouldmakers
CAMTI	Coalition for the Advancement of Michigan Tooling Industries
Census	U.S. Census Bureau
CITT	Canadian International Trade Tribunal
CNC	Computer numerical control
CN$	Canadian dollar
COGS	Cost of goods sold
Commission	United States International Trade Commission
CTMA	Canadian Tooling and Machining Association
Die	Device for cutting out, forming, or stamping material
EDM	Electrical discharge machining
EU	European Union
FDI	Foreign direct investment
Fixture	Device for holding a workpiece or assembly during manufacturing operations
FR	*Federal Register*
FTA	Free-trade agreement
FY	Fiscal year
GTIS	Global Trade Information Services
HKMDC	Hong Kong Mould and Die Council
HTSUS	Harmonized Tariff Schedule of the United States
ISO	International Organization for Standardization
ISTMA	International Special Tooling and Machining Association
Jig	Device for holding a workpiece while guiding or controlling a cutting tool
Lead time	Time between receiving an order and completing it for delivery

GLOSSARY—*Continued*

METI	Ministry of Economy, Trade and Industry
Mold	Hollow form within which, or solid form around which, molten material is shaped
NAFTA	North American Free Trade Agreement
NAICS	North American Industry Classification System
NTMA	National Tooling and Machining Association
NTR	Normal trade relations
OEM	Original equipment manufacturer
PRW	Production and related worker
R&D	Research and development
RFQ	Request for quote
RMB	Renminbi
SG&A	Selling, general, and administrative
SIC	Standard Industrial Classification
TDM	Tool, die, and industrial mold
Tier I supplier	Firm that supplies components directly to an original equipment manufacturer
Tier II supplier	Firm that supplies components to a tier I supplier
TMA	Tooling and Manufacturing Association
Tool	In TDM industry usage, a die, punch tool for a die, industrial mold, jig, or fixture
Tooling	Tools, dies, and industrial molds
USCS	U.S. Commercial Service
US&FCS	U.S. & Foreign Commercial Service
USITC	United States International Trade Commission
VAT	Value-added tax
WTO	World Trade Organization

EXECUTIVE SUMMARY

Introduction

This study was requested by the Committee on Ways and Means of the U.S. House of Representatives (Committee) in a letter dated December 20, 2001.[1] The Committee requested that the U.S. International Trade Commission (Commission) institute a fact-finding investigation of the current competitive conditions facing producers in the U.S. tool, die, and industrial mold[2] (TDM), or tooling[3] industries. The Commission's report provides U.S. market trends and a profile of the U.S. TDM industry as well as an overview of global trends and an assessment of significant foreign markets and industries, including those in China, Taiwan, Japan, Canada, Mexico, and EU member countries (Germany and Portugal); examines the principal challenges and potential implications for these industries over the near term; and compares the strengths and weaknesses of U.S. and foreign producers, for the period 1997-2001.

The U.S. TDM industry is faced with several major dilemmas: (1) the recent downturn in the U.S. economy and its slow recovery; (2) a shrinking domestic market due to the migration of manufacturing customers to foreign locations; (3) excess capacity due to reduced domestic market demand and new technologies; (4) customer demands for lower prices and more services; (5) increasing foreign competition; and (6) rising costs, particularly labor-related costs.

Domestic Industry Overview

- The U.S. industry has about 7,000 firms, with more than 90 percent employing fewer than 50 persons. TDM operations are concentrated in areas that have historically supported extensive manufacturing activity: Michigan, Illinois, Ohio, California, Pennsylvania, Indiana, and Wisconsin. Many domestic producers have invested in up-to-date production equipment and sophisticated computer software resulting in decreasing lead times and increasing productivity and capacity.

- Adverse conditions in recent years have resulted in downsizing at many firms, according to recent industry information, and the exit of many firms from the industry (at least 200 firms in the past three years). Shipments and average hourly earnings rose during 1997-2000. During 2001-2002, however, publicly available data indicate sharp declines in employment and average weekly hours. Commission questionnaire data show steep declines in the same factors as well as a 20 percent drop in shipments.

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[1] The request from the Committee is reproduced in full in app. A. A copy of the Commission's *Federal Register* notice is included in app. B.

[2] See app. C for a complete list of covered items.

[3] End-use industries, such as the metal stamping, die-casting, and plastics molding industries typically refer to the dies, punch tools for dies, industrial molds, and jigs and fixtures as tooling—the tools used in their machines that give the final shape or form to the items being produced.

Financial performance of the U.S. industry

- Financial performance of TDM producers responding to the Commission's questionnaire deteriorated sharply between 2000 and 2001, after rising slightly between 1999 and 2000. Indicators include a fall in the industry's ratio of operating income to net sales to below 1 percent, decreased cash flow, and a near doubling in the number of companies reporting losses on an operating and net-income-before-tax basis.

- These companies reported relatively low research and development expenses compared to sales. An irregular decline in capital expenditures between 1999 and 2001, which exceeded charges for depreciation, led to increases in the value of plant and equipment. Company cash flow represented the dominant source of funds, followed by secured debt.

Market Characteristics and Trends

- Since demand for tooling is heavily dependent on new product introduction in the automotive industry (which absorbs nearly 50 percent of tooling), the tooling industry has weakened during the last 24 months as automotive manufacturers have delayed new product introduction in order to build up their balance sheets. At the same time, many of the industries supplied by U.S. toolmakers, such as appliances, have become very cost-competitive, forcing many tooling customers who produce in the United States to reduce product costs by sourcing their tooling from less-expensive foreign locations.

- The compression of product cycles in many key industries (such as automotive, appliances, electronics, and telecommunications) due to competitive pressures, has required toolmakers to adapt to these product cycles by shortening their lead times to supply tooling to OEMs. In many cases, these shortened lead times have favored foreign toolmakers, particularly in Asia, who frequently operate their plants 24 hours a day to supply customer orders.

- For many items that are easy to ship, such as small appliances and electronics or telecommunications items, it has become cost-effective for manufacturers to produce in low-cost foreign locations, such as Asia, for shipment to the U.S. market. This is especially the case for products like air conditioners, radios, vacuum cleaners, power hand tools, televisions, and telephones, which are increasingly produced abroad. This has adversely affected U.S. toolmakers who no longer supply the tooling for many of these items because the TDM sourcing has shifted to foreign locations along with the manufacturing.

International Trade

- Canada is the largest U.S. trade partner accounting for 41 percent of U.S. TDM import value and 34 percent of export value in 2001. Other important trade partners include Japan (accounting for 33 percent of import value) and the EU (almost 16 percent of import value). Although the value of U.S. TDM imports from many countries peaked in either 1999 or 2000, imports from China and Korea, among other countries, continued to rise to higher levels in 2001. During 1997-2001, U.S. TDM imports from China and Korea rose by 191 percent and 248 percent, respectively, albeit from relatively low bases.

- The major U.S. export market, other than Canada, is Mexico which accounts for 27 percent of total TDM export value in 2001. Canada and Mexico overshadow all other markets with the third largest export destination, Germany, accounting for only about 4 percent of total TDM export value.

- The value of imports as a share of U.S. consumption stayed fairly stable from 1997-2000. However, Commission questionnaire data suggest that import penetration rose in 2001. Aggregate export value remained relatively stable during 1997-2001, but major shifts occurred in the value of exports to Canada (down by about 35 percent) and Mexico (up by 27 percent).

Government Assistance Programs

- Several U.S. TDM producers responding to the Commission's questionnaire indicated overall positive perceptions from participating in government assistance programs. Many TDM firms have access to loan guarantees and diverse financing/working capital assistance through a variety of widely available Federal and State programs, which are intended to help with short-term needs or acquiring loans that may not be feasible under normal financing circumstances.

- Programs also provide assistance for improving a firm's competitive ability. Such assistance has been used for a variety of activities, including acquisition of International Standards Organization (ISO) or other quality assurance standard certifications, materials engineering research, computer design and manufacturing software implementation, apprenticeship programs and workforce training, productivity improvement and business planning, market analysis, energy audits, application of information technology and electronic commerce, and tax abatement.

- Other respondents to the Commission's producers' questionnaire noted that certain mechanisms to provide assistance were not always responsive to their needs, and some programs imposed more stringent guidelines than others. In some instances, modest fees and paperwork requirements were considered a burden, and ceiling limits within some

programs were considered insufficient for machinery or labor-related costs typically expended by TDM producers.

- Some government programs attempt to lessen these burdens by facilitating services to individual firms through extensive networks of various local assistance centers.[4] These include assistance offered through Trade Adjustment Assistance Centers (TAACs), the Manufacturing Extension Partnership (MEP) nationwide network, SBA's Small Business Development Centers (SBDCs), as well as State and regional offices of other Federal and State programs that work with local lenders.

Selected Foreign Industry Profiles

North America

Canada

- Most of Canada's TDM production is exported to the U.S. automotive sector. The United States is Canada's leading trading partner for TDMs, with total trade (imports plus exports) far exceeding trade with all other countries combined.

- Overseas-based motor vehicle producers are increasing their investment in North America and these transplant producers tend to import TDMs from their home countries. As the transplants' share of North American automobile production increases, Canadian TDM firms may be facing a declining demand for tooling in this market, unless they are successful in winning business from the non-traditional North American automotive producers.

- The Canadian dollar depreciated against the U.S. dollar during 1997-2001, giving Canadian TDM producers a potential competitive advantage on sales to the United States. Some U.S. industry sources contend that with the exchange rate, prices of Canadian-produced TDMs can be as much as 40 percent lower than comparable U.S. tooling, while Canadian industry sources consider the prices of Canadian-produced TDMs to be roughly equal to U.S-produced TDMs.

- According to Canadian industry sources, costs for the manufacture of molds are very similar to those in the United States in terms of raw materials and capital costs. These sources state that Canadian moldmakers purchase materials and equipment on a U.S.-dollar basis and have no advantage over U.S. moldmakers as far as material costs are concerned. Labor costs, however, are affected by fluctuations in the Canada/U.S. exchange rate. The current impact of the lower Canadian

[4] See "Contact Information" in ch. 3, tables 3-19 and 3-20.

dollar is estimated by Canadian sources to provide an advantage of less than 10 percent to Canadian moldmakers in terms of overall costs.

Mexico

- Mexico's indigenous TDM shops are few and of small-scale. Due to limited production capabilities and capacity, Mexico is highly dependent on imports to meet domestic consumption needs, despite the presence of U.S. and other foreign TDM makers following their customers into Mexico and the willingness of some major customers to develop Mexican TDM suppliers. Trade in TDMs is enhanced by preferential import duties and tax-treatment programs for TDM-using customers.

- Due to shortages of skilled TDM builders and limited machining technology, Mexican TDM firms generally build, maintain, and upgrade less-complex products. Sector performance and growth are also constrained by relatively high labor rates and electricity costs, and by the high cost and limited availability of domestic investment capital. Moreover, some customers in Mexico are moving their production abroad, particularly to China and Southeast Asia.

Asia

Japan

- Japanese TDM producers are experiencing many of the same difficulties as U.S. firms, including a shrinking domestic market, excess capacity, increased competition from lower cost Asian suppliers, and severe cost and time pressures. Moreover, the transfer of technology, via overseas training initiatives and the transferral of TDM designs, data, and production techniques to foreign producers, has contributed to the erosion of the industry and has helped overseas suppliers increase their capabilities and competitiveness vis-à-vis domestic firms. Further, the industry is dominated by small producers, who often lack the financial resources and marketing skills necessary to compete in the global market.

- A tenuous but lingering strength of the Japanese industry is the endurance of keiretsu-style relationships among TDM firms within the domestic subcontracting hierarchy and between domestic TDM producers and Japanese OEMs and transplants. Further, Japanese producers have applied niche market and specialization strategies effectively to secure work and increase their competitiveness.

China

- The large and growing industry is estimated to be the third largest die and mold manufacturer after Japan and Germany, by value, and second in terms of quantity, after Japan. About 70 percent of the TDM industry production is integrated, allowing such companies to provide both tooling and parts production. Unlike other major TDM producers, China has a substantial number of large, foreign-invested TDM producers.

Foreign investment has largely resulted from integrated foreign tooling suppliers following their customers to China.

- China has the advantages of a low-cost, well-educated labor force and a large, growing domestic and international customer base. Chinese wages for toolmakers are among the lowest in the world. Its disadvantages include a lack of sophistication and creativity in tooling design, high costs for imported inputs, and low quality domestic TDM inputs. Currently, China appears to have difficulty producing high precision and complex TDMs, but is capable of producing low-cost TDMs of low and medium precision and complexity.

Hong Kong

- The Hong Kong industry has contracted significantly from a peak of 2,000 firms in the mid-1990s to its present level of approximately 50 firms. Much of the industry moved manufacturing operations to low cost facilities in China. Therefore, the Hong Kong tooling industry is highly integrated with, and largely dependent upon, tooling and other manufacturing enterprises in China. Proximity to China combined with Western business infrastructure allow Hong Kong TDM producers to integrate Chinese production with a modern business infrastructure gateway to the global market.

- Hong Kong tooling producers are able to produce many types of medium and high precision TDMs and can produce TDMs within short lead times.

Taiwan

- The current production and design capabilities of TDM producers in Taiwan are primarily based on technologies transferred by Japanese companies that invested in Taiwan in the 1960s and 1970s and trained Taiwan toolmakers. Such training allowed the Taiwan TDM industry to advance rapidly from the production of simple products to the manufacture of medium precision and more complex TDMs. Taiwan producers are known for their short lead times and competitive prices. In the future, the industry intends to focus on the production of high precision TDMs and cultivate the region's expertise as a design and management center for tooling production.

- A number of Taiwan firms operate manufacturing facilities in China. The combination of manufacturing in China with design and business functions in Taiwan allows TDM firms to take advantage of low wage rates while controlling key processes. Taiwan firms are also reportedly strong in terms of computerization and international sales and marketing. At the same time, the relocation of numerous manufacturing industries from Taiwan to low cost production locations such as China has reportedly hurt those firms that continue to manufacture TDMs domestically.

EU

- As a region, the EU likely ranks as the largest producer and consumer of TDMs in the world with a relatively small number of tooling producers in each EU member country. Two TDM industries in the EU stand out, those of Germany and Portugal.

- The principal issues affecting the TDM industries in traditional producing nations include rising labor costs and a migration of EU customers to low cost foreign production locations and emerging markets. EU customers have shifted production to Spain, Eastern Europe, and Asia. High cost EU tooling producers are turning to foreign direct investment to take advantage of lower labor costs in Spain, Portugal, and Eastern European countries such as the Czech Republic, Poland, and Hungary.

Germany

- The German TDM industry ranks as the largest exporter and importer in the EU, and is a world leader in the production of high precision and high complexity TDMs. Germany is also one of the largest producers of tooling in the world.

- Since high labor costs and labor regulations hamper German TDM producers, German TDM producers have focused on high-precision and complex TDMs. In this regard, the German tooling industry benefits from a strong tradition of craftsmanship, as well as strong apprenticeship training programs and extensive TDM research and development efforts.

Portugal

- Despite Portugal's small size, it has emerged as one of the world's leading exporters of industrial molds. In 2001, despite limited production of dies, Portugal was the eighth largest producer of dies and molds in the world and it exports to more than 70 countries.

- The Portuguese TDM industry's success in exporting, and in adoption of the latest computer technologies, has occurred despite the fact that Portugal has a small industrial base on which the TDM industry can depend.

- Since joining the EU in 1986, Portugal has focused on serving customers in the common market. The share of total Portuguese exports of industrial molds going to the United States has declined from 65 percent in 1997 to less than 11 percent in 2001.

Competitive Position of U.S. and Foreign Producers

- U.S. TDM producers ranked competition from low-cost imports as their number one concern in their responses to the Commission's questionnaire. The second biggest concern was the shift of production by U.S. customers to foreign production locations. They also listed, in descending order, high U.S. labor costs, healthcare costs, and insurance costs.

- Price was by far the leading factor of competition cited by U.S. TDM producers in their responses to the Commission's U.S. producer questionnaire. U.S. purchasers responding to the Commission's questionnaire stated that foreign producers usually have a significant advantage in price. Delivery time and product quality were cited as the next most important competitive factors by U.S. producers. However, U.S. purchasers indicated that neither U.S. nor foreign TDM producers had any significant advantage with regard to competitive factors other than price.

- During the past 5 years, competitive market conditions have driven domestic manufacturers of consumer goods to rationalize all aspects of production, including the procurement of TDMs, with resultant downward pricing pressure on tooling producers. This pressure has been especially significant for molds used in sectors such as automotive, household appliances, power hand tools, housewares, and electronics.

- The difference in prices between U.S. produced and imported TDMs can be significant. Many U.S. TDM producers cite prices from China and Taiwan as being extremely low, ranging from 30 to 75 percent below prices quoted by U.S. TDM producers. In their responses to the Commission's questionnaire, U.S. purchasers reported that prices quoted by producers in China and Taiwan are significantly lower, but not as low as U.S. producers reported. Other countries with significantly lower prices include Korea, and certain other countries in Asia and Eastern Europe.

- Technological advances within the tooling industry have significantly improved productivity and competitiveness, while increasing capacity and ameliorating the need for highly skilled labor, traditionally a strength of the U.S. industry. Because advanced TDM production technology is universally available, increased productivity is occurring simultaneously in both formerly industrialized and newly industrializing regions.

- Since prices are largely a function of production costs, U.S. and foreign TDM producers constantly strive to minimize their production costs. Despite the significant capital equipment used in this industry, labor costs are the largest single component of production costs for U.S. TDM producers and a significant component of production costs for all global producers.

- With regard to labor costs, the U.S. TDM industry is at a significant disadvantage compared with China, Portugal, Hong Kong, Taiwan, and Korea. Chinese hourly compensation costs for toolmakers and tool designers are one-twelfth of those in the United States, and those in Taiwan are one-third.

- Factory overhead costs for many U.S. TDM producers are high compared with certain foreign competitors. This is in part the result of firms operating at less than full capacity because of weak business conditions and intense foreign competition. Many Chinese firms operate 24 hours a day, 7 days a week, thus more fully utilizing their machinery. With regard to material costs, U.S. and many foreign TDM producers often purchase certain materials, such as some specialized tool and mold steel and other components, from a limited number of suppliers worldwide and prices are believed to be approximately the same. However, steels that are more widely available may vary significantly in price in different national markets, and the scale of purchases may introduce pricing differentials for all materials among TDM producers.

- Although the majority of tool steel used by U.S. TDM producers was excluded from the imposition of additional tariffs announced in March 2002 by the U.S. Government, certain steel products used by toolmakers were subject to tariffs, including stainless steel bar and rod which are used in molds and dies. Although some TDM industry sources report that prices for steel subject to the tariffs did not rise in price because of existing inventories in the United States, some moldmakers have reported difficulties due to increased steel costs.

- The extent of government involvement in foreign TDM industries is for the most part limited. The Chinese Government has provided tax incentives to attract foreign TDM investment and also offers import tariff exemptions on machinery, including TDM production machinery. These incentives are part of a larger set of policies aimed at encouraging foreign manufacturing investment in China.

- With regard to tariffs, trade in TDMs is free of duty within NAFTA. Otherwise, many U.S. tariffs on TDMs are free, with tariffs on dies ranging from 2.9 percent ad valorem to 5.7 percent ad valorem and on molds from free to 3.8 percent ad valorem. Like the United States, EU tariffs are relatively low (ranging from free to 5 percent ad valorem), however, tariffs in China (ranging from free to 19 percent ad valorem) and Taiwan (ranging from free to 11.5 percent ad valorem) are relatively high.[5]

- The strong value of the U.S. dollar relative to foreign currencies has adversely affected the competitive position of U.S. TDM producers in the global tooling market. U.S. TDM producers responding to the Commission's questionnaire note that the strong value of the U.S. dollar has significantly limited their ability to obtain business in foreign markets.

[5] For a comparison of tariffs for countries addressed in this report, see app. D, table D-1.

Challenges and Potential Implications Facing the Industry Over the Near Term

- Major challenges facing the U.S. TDM industry include (1) the recent downturn in the U.S. economy and its slow recovery, which caused significant delays in manufacturing activity that would have otherwise created demand for tooling; (2) a contracting domestic market resulting from the U.S. TDM customers shifting production to foreign locations; (3) excess capacity in the TDM industry caused by reduced domestic market demand and new technologies; (4) customer demand for lower prices and more value-added service; (5) increasing foreign competition; and (6) rising costs, particularly labor-related costs. A number of these issues will continue into the foreseeable future.

- When asked what challenges U.S. TDM producers are likely to face over the next three years, many respondents to the Commission's questionnaire stated that "survival" was an overriding concern. U.S. toolmakers have frequently mentioned that the current TDM business environment has resulted in significantly reduced profit margins, resulting in increased cash flow problems. Therefore, it becomes more difficult to obtain funding for purchasing state-of-the-art equipment and/or training deemed necessary to remain competitive.

- In the short term, there likely will be a significant number of firms exiting the industry. U.S. industry representatives estimate current excess production capacity at 25-30 percent. One industry representative forecasts a 50-percent decline in the number of firms in the U.S. TDM industry, despite forecasts that North American automakers expect to launch numerous new products during 2003-2005.

- The character of the U.S. TDM industry is likely to change, as small, often family owned businesses exit the sector and the number of larger firms (measured by sales and number of employees) increases. In the automotive TDM market, increased consolidation is forecast, resulting in fewer, larger firms that are able to supply a full range of TDM services.

- Suggestions for improving the competitive ability of U.S. TDM producers have been offered by TDM industry groups, and by U.S. producers and purchasers in response to Commission questionnaires.

    - U.S. TDM industry groups suggested the formation of industry-wide consortia in areas such as marketing and technical cooperation, and building a model of a world class TDM firm to benchmark the best global business and technical practices.

    - U.S. TDM purchasers focused on operational improvements, such as investing in modern machinery, reducing lead times, and providing more value-added service.

- Some U.S. TDM producers suggested changes to existing U.S. laws and regulations, such as an investment tax credit to enhance their capability to purchase new machinery, and changes in the tax treatment for depreciating machinery to reflect the short life span and high cost of machinery and computer software used in TDM production.[6]

- With regard to healthcare, a major concern for many TDM producers, industry representatives suggested that laws be amended to allow trade associations to purchase group healthcare plans that would cover all interested member companies.

- Potential solutions to some of the U.S. TDM industry's challenges may lie in TDM business practices of other countries and in recommendations from groups that have studied the industry.

  - Where production and cost constraints allow, or in geographic areas in which TDM producers are concentrated, increased use of subcontracting certain precision machining operations to firms not focused on tooling production may be viable. However, some TDM producers note that in the current economic environment, there is unused capacity that would mitigate against the use of subcontractors unless firms were to reduce capacity. In Japan and Taiwan, subcontracting has been used not only to reduce lead times but also as a buffer in weak economic times against having excess capacity and employee layoffs.

  - In response to the abilities of larger foreign competitors, the formation of buyer groups for the purchase of materials, supplies such as cutting tools and fluids, and machinery also may be investigated. Such buyer groups might include firms in related industries, such as the precision machining industry.

  - Some foreign TDM producers are leveraging the amount of time firms have available to design by having design offices in several countries or continents. Emulating this expansion of operations to include other time zones may result in quicker lead times.

  - In the automotive market, some industry sources contend that in the past, U.S. TDM producers and original equipment parts suppliers have not aggressively pursued business with foreign transplant automotive producers in the United States. Foreign transplants are expected by one source to garner up to 40 percent of North American production by the end of the decade. Initiatives by U.S. toolmakers to gain access to this new business is considered essential to forestall the likelihood of this business otherwise being absorbed by foreign competitors.

- Foreign TDM industries and/or their governments also have recognized problems or opportunities facing their TDM industries, and in many instances are

[6] U.S. TDM industry sources state that some foreign TDM competitor countries' tax treatment of machinery and software allows faster depreciation (by up to 4 years) than in the United States.

implementing plans to move their industries forward.[7] The extent to which the U.S. TDM industry pursues industry-wide and firm level initiatives to improve its competitiveness, concurrent with numerous efforts by foreign TDM industries and governments to do so, will affect the outlook and future competitive ability of the U.S. TDM industry.

[7] A summary of these efforts appears in ch. 6, table 6-10.

CHAPTER 1. INTRODUCTION

Purpose and Scope of the Report

On December 21, 2001, the U.S. International Trade Commission (USITC or Commission) received a letter from the Committee on Ways and Means of the U.S. House of Representatives, requesting that the Commission conduct an investigation, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), of the current conditions affecting the domestic tool, die, and industrial mold (TDM or tooling) industries.[1] As a result, the Commission instituted investigation No. 332-435, *Tools, Dies, and Industrial Molds: Competitive Conditions in the United States and Selected Foreign Markets*, on January 10, 2002. The Committee asked the Commission to provide its report within 10 months of the receipt of the request, or by October 21, 2002.

As requested by the Committee, the Commission will provide information, to the extent possible, for the most recent 5-year period (1997-2001) regarding the following:

- A profile of the U.S. TDM industries.[2]
- Changes in marketing and manufacturing processes, and trends in U.S. production, consumption, and trade.
- A global market overview and assessment of foreign markets and significant foreign industries, including those in China, Taiwan, Japan, Canada, Mexico, and selected European Union (EU) member countries.
- A comparison of the strengths and weaknesses of U.S. and foreign producers regarding factors of competition such as production costs, labor costs, availability of a skilled/experienced labor force, level of technology in the design and manufacturing process, availability of capital, transportation costs, pricing, product quality and aftersales service, and government programs assisting these industries.
- The principal challenges and potential implications for the industries over the near term.

The Committee also requested that the Commission take into account currency fluctuations in considering the factors of competition.

Public notice of this investigation was posted in the Office of the Secretary, U.S. International Trade Commission, Washington, DC 20436 and published in the *Federal Register* (67 F.R. 2237).[3] A public hearing, in which all interested parties were permitted to present testimony regarding this investigation, was held on May 21, 2002, in Washington, DC.[4] A copy of the transcript of the hearing as well as written statements submitted in conjunction with this investigation may be found at the Commission's

[1] A copy of the request letter is included in app. A.

[2] This report provides information on the tool, die, and industrial mold industries by analyzing and referring to them as a single industry—the TDM industry—and by presenting information separately by subsectors as data availability warrants.

[3] This notice is included in app. B.

[4] A list of witnesses is included in app. C.

Internet site *http://www.usitc.gov* under the dockets section through the Electronic Document Imaging System (EDIS) program.

Product Coverage

The products of interest to the Committee are industrial molds (North American Industry Classification System (NAICS) 333511, Industrial Mold Manufacturing), and dies for stamping or forming (NAICS 333514, Special Die and Tool, Die Set, Jig, and Fixture Manufacturing)[5, 6] which account for the majority of production under tools, dies, jigs,[7] and fixtures.[8] The tools included in this investigation are tools in NAICS category 333514 for punching holes that are incorporated in the die.[9]

Industrial molds are used to produce a wide variety of plastic, metal, rubber, glass, and mineral products. These include plastic and metal parts (particularly die-cast metal parts) for motor vehicles, appliances, electronics and electrical products, housewares, consumer products, furniture, and medical products. Molds for plastics include injection, compression, blow, reinforced, transfer, forming, plunger, and rotational types, with the most widely used being injection molds.

Dies are used to produce a wide variety of metal stampings; extrusions; forgings; and drawn products, including wire. Stampings are used as parts for motor vehicles, aircraft, furniture, construction and farm equipment, appliances, electrical connectors, and so forth.

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[5] In 1997, the most recent year for which data are available in NAICS industry 333514, jigs and fixtures accounted for 42.7 percent of U.S. product shipments and dies accounted for 57.3 percent. The focus of the investigation is on dies, for which there is greater import competition. Based on the 1997 data, the share of imports to apparent consumption for dies was 12.7 percent and for jigs and fixtures was 1.4 percent.

[6] The NAICS was adopted in 1997. For data prior to 1997, the United States used the Standard Industrial Classification (SIC) system. NAICS industries 333511 and 333514 together equate to 100 percent of SIC industry 3544, Special Dies & Tools, Die Sets, Jigs & Fixtures, & Industrial Molds.

[7] "A jig is a device locating and holding a workpiece while guiding or controlling a cutting tool." Society of Manufacturing Engineers (SME), *Fundamentals of Manufacturing*, 1993, p. 179.

[8] "A fixture is simply a locating and holding device having nothing to do with tool guidance or control." Ibid.

[9] The TDM industry also commonly uses the terms "tools" and "tooling" to refer to tools, dies, and/or industrial molds. In keeping with TDM industry practice, the term tooling is also used in this report to refer to the entire range of products of interest to the Committee. The industry also uses the term "toolmakers" to refer to both moldmakers and/or diemakers.

Organization

The report is divided into six chapters. Chapter 1 sets forth the scope of analysis on TDMs by defining the industry and products, and the time period under study. It also describes the data-gathering efforts for this study, including a brief review of the literature. Chapter 2 identifies the product characteristics, methods of manufacture, and synergies affecting end-use industries and changes in marketing of TDM products. Chapter 3 discusses developments in the U.S. TDM industries over the past 5 years, including industry structure, technology, and performance. A discussion of the U.S. market follows, describing its structure and purchase-decision variables, and identifying patterns and trends in consumption and trade. The chapter concludes with analyses of government programs and policies that affect U.S. producers. Chapter 4 contains available country-specific information along the lines of the information presented for the U.S. industry in the previous chapter, examining patterns and trends for the major exporting countries of TDMs relative to the United States. This chapter includes assessments of the market conditions and industry characteristics in Canada, Mexico, Japan, China, Hong Kong, Taiwan, the EU, Germany, and Portugal. Chapter 5 is a categorical assessment of the advantages and disadvantages facing U.S. and foreign producers of TDMs. This chapter compares absolute and relative conditions of competition, and assesses the competitiveness of U.S. TDM producers in both domestic and foreign markets. Chapter 6 builds on the information and analysis presented in the previous chapter to identify the most significant and immediate challenges facing the U.S. TDM industry.

Study Approach, Research Base, and Organization

Methodology

This report analyzes the TDM industry in the United States, Canada, and Mexico, as well as in selected Asian and EU locations during 1997-2001. USITC staff used data gathered during the course of the investigation to perform a comparative analysis of competitive conditions. The principal data source for the U.S. market analysis is aggregated TDM producer and purchaser responses to Commission questionnaires,[10] although publicly available data from the U.S. Department of Commerce and the U.S. Department of Labor are included where appropriate.

There are more than 7,200 TDM producers (more than 4,700 tool and die producers and more than 2,500 industrial mold producers) in the United States, according to the most recent *1997 Economic Census*. Because this industry is characterized by many small

[10] Questionnaires requested data for 1999-2001 from U.S. producers and U.S. purchasers, as well as a projection of U.S. purchasers' TDM procurement activities for 2002. Although the request letter asked the Commission to provide information for the most recent 5-year period, to the extent possible, from field testing the questionnaires, USITC staff concluded that many producers and purchasers would not have records for 1997-98 readily available and that asking for such data would place an undue burden on respondents, especially the many small producers that comprise this industry. Copies of the questionnaire can be found on the Commission's Internet site *http://www.usitc.gov* under the dockets section by using the EDIS program.

firms,[11] concern about the burden on the industry by attempting to gather data from all participants led the Commission to send U.S. producer questionnaires to a stratified, randomly selected sample of 1,008 producers. Questionnaires were also available on the Commission's website to allow firms to voluntarily participate in the information gathering activities, if they so desired.

Questionnaire Responses

These questionnaires requested detailed information on shipments, exports, employment and wages, finances, investment, and market conditions for 1999-2001. Questionnaire responses were received from 420 producers, but 95 of these firms reported no production of TDMs. Twenty-eight questionnaires were returned by the U.S. Postal Service as undeliverable, which may be an indication that these firms have gone out of business. Although Commission staff extended the cutoff date for questionnaire receipt by over a month, a number of questionnaire responses were not included in the database for the reasons cited below.

A significant number of questionnaires were returned bearing incomplete data, data that were internally inconsistent, or data that included significant downstream stamping or molding operations. Although many of these questionnaires were completed through the efforts of Commission staff by telephone and e-mail follow-up, some were not able to be completed. Nevertheless, the Commission was able to build a core database of 278 producer firms,[12] representing about 9 percent of U.S. shipments and 12 percent of the employees reported by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics, respectively, for the overall TDM industry in 1999 and 2000. Despite the random sampling used to create the mailing list, the Commission does not assert that the data collected would be statistically representative of the industry as a whole, or with regard to individual industry segments.

Responses from U.S. producers include 38 companies that voluntarily submitted a questionnaire response. Further, the share of useable questionnaires returned by firms on the mailing list generated by stratified random sampling was only 24 percent. Finally, some firms were not able to provide data since they were either entering or exiting the industry. Comparing the responses to *1997 Economic Census* data, the Commission's database is more heavily weighted towards larger firms (table 1-1). The data do, however, support other information collected from hearing testimony, fieldwork, submissions to the Commission, and other reports reviewed during the course of the investigation. Thus, the Commission views the trends and conditions depicted by the firms in the database as illustrative of conditions in the industry as a whole.

U.S. purchasers' questionnaires were sent to 130 firms, requesting detailed information on purchases of TDMs, procurement practices, price levels, and market conditions. Fifty-seven purchasers responded, representing an estimated 4 percent of consumption. The majority of respondents to the purchasers questionnaires were in the automotive

[11] More than 90 percent of the establishments producing TDMs have 49 or fewer employees.

[12] For certain data points or groups, a few producers were backed out from the core database because of special circumstances in their data that distorted the trends exhibited by the sample.

Table 1–1
Employee firm size group shares, 1997 Economic Census, and Commission questionnaire responses

(Percent)

Firm size by employees	Share of total industry	
	1997 Census	Commission questionnaire[1]
1-19	76	35
20-49	17	32
50-99	5	18
100-249	2	12
250+	([2])	2
Total	100	100

[1] Average for 1999-2001.
[2] Less than 0.5 percent.

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from U.S. Bureau of the Census, *1997 Economic Census*, and Commission questionnaires.

industry, including a number of original equipment manufacturers (OEMs) and Tier 1 suppliers.[13] All purchaser questionnaires were able to be included in the core database of 57 purchasers.

Supplemental Research

Supplementing the data from questionnaire responses were testimony from the Commission's public hearing and written submissions to the Commission. Publicly available data were used to show overall industry trends in shipments, employment, and other broad measures for 1997-2000. Information was also obtained from field interviews, trade associations, conversations with industry representatives (producers, brokers, suppliers, and purchasers), and trade literature. Fieldwork included interviews and plant visits in the Chicago, IL, and the Grand Rapids and Detroit, MI, areas. For information on Asian and Canadian producers and markets, interviews and plant visits were conducted with government and trade association representatives, and producers in China, Japan, Taiwan, and Canada. A literature search resulted in the Commission obtaining added information from a number of surveys of the TDM industry. The major studies and surveys are described briefly below.

DesRosiers Automotive Consultants (DesRosiers), Inc.,[14] Richmond Hill, Ontario, Canada, prepared by request of the Commission a report entitled *Key Factors Influencing the Canadian Tool Making Industry*. Although focusing on issues affecting the Canadian industry, the report also addresses significant factors influencing competitive conditions in the United States, and provides a global perspective on the

[13] A Tier I supplier is a firm that supplies components directly to an original equipment manufacturer.

[14] DesRosiers Automotive Consultants (DesRosiers), Inc., is an independent, Canadian consulting and research firm dedicated to the automotive industry. Founded in 1985, the company provides automotive consulting, publications, forecasting, consumer research, and aftermarket analysis. DesRosiers' clients include vehicle assemblers, parts suppliers, financial institutions, governments, retailers, and raw material suppliers.

TDM industry. Trends noted by DesRosiers include, among others: (1) difficulties and/or lack of aggressive pursuit by North America-based TDM firms in penetrating the supply chains of foreign transplant automotive producers that are increasingly accounting for a greater share of North American vehicle production; (2) automotive OEM and Tier 1 producers pushing onerous supply performance requirements onto TDM producers which are expected to intensify over the next 3 to 5 years; (3) increasing consolidation into "fewer, larger, more sophisticated, full-service tool shops serving the Tier I and Tier II parts makers;"[15] and (4) restructuring of the TDM industry. Further, TDM producers in both the United States and Canada serving the North American-controlled automotive parts industry are anticipated to experience stronger business activity over the next 3 to 4 years as new automobile and light truck models are introduced to the market.

Other Studies

In Spring 2002, The Right Place Program, a regional economic development organization of the west Michigan tooling industry,[16] conducted an assessment of the tooling industry in Michigan and presented the analysis at the Commission's public hearing. The report concluded that the competitive challenges that face the die and moldmaking sectors, "when added up, {these} amount to a 'paradigm shift' for this highly traditional sector."[17] The report notes that the essential characteristics of world-class tooling firms are control of the customer relationship, picking the right customers, differentiating the firm with unique product or process knowledge, building intellectual capital, continuously experimenting with new technologies, building "lean" organizations, knowing the firm's costs, and pursuing global sourcing and production alliances.[18] The report also identified a number of strategies in which economic development organizations might support the tooling sector, including establishment of tooling councils; the development of a world-class tooling business model, marketing and technical consortia, user groups, and new financing tools; offering customized consulting and training products; and assisting in the formulation of public policy.[19]

In March 2002, the Economic Research Institute of the Japan Society for the Promotion of Machine Industry published a report looking at the current state and future prospects of the die and mold industry in Japan.[20] The report profiles the die and mold industry in Japan, notes the migration of Japanese TDM consumers to overseas production locations, assesses changes in the competitiveness of foreign TDM producers, and defines goals for the industry and problems that must be overcome in attaining those goals. The report observes that Japanese TDM producers must enhance their technological capabilities, shorten lead times and lower production costs, and cultivate foreign markets. Challenges facing the industry in meeting these goals include developing better human resources and management practices, including the use of consortiums; optimizing subcontracting

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[15] DesRosiers Automotive Consultants, *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), executive summary.

[16] The Right Place Program, written submission, May 29, 2002, incorporating IRN Inc., *A Competitive Assessment of the Die and Mold Building Sector* (Ann Arbor, MI: IRN Inc., May 2002).

[17] Ibid., p. 73.

[18] Ibid., pp. 73 and 76.

[19] Ibid., pp. 73 and 79.

[20] Economic Research Institute, Japan Society for the Promotion of the Machine Industry, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002.

practices, introducing and utilizing to a greater extent computer-aided-design (CAD) and computer-aided-manufacturing (CAM) and electronic ordering systems; concentration of expertise in certain niches; lowering firms' cost structure; and protecting intellectual property rights and preventing the flow of know how to foreign countries.

In October 2000, CIMdata, Inc., Ann Arbor, MI, published a major report on the industrial mold industry entitled *The Worldwide Moldmaking Environment and How to Compete*. The report noted that the "center of gravity" for growth in the moldmaking industry was shifting from the United States and Europe to the Asia-Pacific region.[21] The report noted that capital to purchase machinery and equipment was easily accessible in the Asia-Pacific region, reported the region's efforts on training the next generation of moldmakers, and reported the multiplier effect in the growth of molds produced in the region due to the shift of molded part production to the Asia-Pacific region. The report observed that price and delivery were the principal basis of competition and that improving delivery time would be the "primary means by which worldwide moldmakers intend to remain competitive."[22] Finally, the report covered business and technological trends among U.S., European, and Japanese moldmakers.

In 1997, the Hong Kong Mould and Die Council issued a report that cataloged Hong Kong and foreign countries' investment benefits available to mold and die producers.[23] The report, in Chinese, covered Hong Kong, North America, selected EU countries, Japan, Taiwan, South East Asia, and Australia, but did not cover China. Most of the programs listed appear to be programs open to any small- and medium-sized businesses in the particular country studied.

Surveys

During April and May 2002, the American Mold Builders Association (AMBA) conducted a survey of the state of the moldmaking industry[24] The survey noted that from 2000 to 2001, the average backlog fell from 10 to 6 weeks, and the employee's average work week fell by 8 hours from 51 average hours to 43 average hours. The average moldmaking shop employment fell from 34 persons in the past 3 to 5 years to 25 persons in 2002. Respondents to the survey reported that of the total number of jobs lost to foreign competition, most were lost to China (59 percent) followed by Canada (26 percent)—these jobs would include both molds built in foreign countries for use in foreign production locations and also for export to the U.S. market. Of the factors that may be adversely affecting the moldmaking industry today, moldmakers ranked as first, competition from low-cost offshore shops; second, overall economic conditions; third, high U.S. labor costs; fourth, competition from Canadian shops due to the U.S. dollar-Canadian dollar valuation issue; and almost tied for fifth were the high cost of capital equipment and over valuation of the U.S. dollar. Approximately 93 percent of respondents stated that they anticipate more moldmaking and molding production shifting

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[21] Alan Christman and Jeanné Naysmith, *The Worldwide Moldmaking Environment and How to Compete* (Ann Arbor: MI: CIMdata, Inc., 2000), p. 14.

[22] Ibid.

[23] Hong Kong Mould & Die Council, *Hong Kong and Foreign Countries Investment Benefits Explanation Handbook*, 1st ed., (Kowlon, Hong Kong: Hong Kong Mould & Die Council, Aug. 1997).

[24] Communication Technologies, Inc. and AMBA, *AMBA State of the Industry Survey Results–06/28/2002*, found at *http://www.moldmakingtechnology.com*, retrieved July 17, 2002.

to offshore locations. The number of moldmaking firms responding to the survey totaled 345.

D-M-E Company, a subsidiary of Milacron, Inc., Cincinnati, OH, in spring 2002 commissioned a Mold and Die Making Industry survey "for the purpose of quantifying the economic trends in recent years for presentation to the U.S. International Trade Commission."[25] Approximately 1,000 U.S. die- and moldmaking firms responded to the survey. Major points from the survey are that during 1997-2001, combined data for all respondents indicate that sales revenue fell by 28 percent, employment fell by 24 percent with over 46,000 jobs lost, the average number of hours worked per week fell by 19 percent (1997-2000), capital expenditures fell by 36 percent, and profits before taxes dropped from almost 16.6 percent of revenue to just 1.4 percent of revenue. The main factors identified as adversely affecting U.S. moldmakers were the shift of production to foreign locations, increased U.S. imports of molds and dies, and pricing pressures. The survey was supplemented by commentary provided by many of the approximately 1,000 respondents to the survey.

Previous Commission Investigations

In 1983, the Commission, at the request of the Chairman of the Subcommittee on Trade of the Committee on Ways and Means of the U.S. House of Representatives, conducted an investigation on the conditions of competition between industrial molds imported into the United States from Canada and those produced domestically. The Commission issued its report, covering the period 1979-83, in April 1984.[26] The current investigation, No. 332-435, examines the period 1997-2001. Key issues facing the U.S. industry that differ today from 1984 include the shift of many consumers of TDMs to low-wage countries and the emphasis by U.S. purchasers on price as the single-most important factor in their purchase decisions. In addition, since the 1984 report, the United States-Canada Free Trade Agreement and the North American Free Trade Agreement were implemented. As in 1984, U.S. producers today are also confronted with a U.S. dollar that has appreciated against the Canadian dollar, resulting in lower prices for Canadian products.

TDM products were also addressed in analyses related to United States participation in the World Trade Organization's (WTO's) Information Technology Agreement in *Advice Concerning the Proposed Modification of Duties on Certain Information Technology Products and Distilled Spirits*, investigation No. 332-380, April 1997; and *Advice Concerning the Proposed Expansion of the Information Technology Agreement: Phase I*,

[25] Jerry R. Lirette, president, D-M-E Co., written submission, May 9, 2002.

[26] USITC, *Competitive Conditions Relating to the Importation of Industrial Molds into the United States from Canada*, investigation No. 332-169, USITC publication 1522, Apr. 1984.

investigation No. 332-390, March 1998.[27] In the case of investigation No. 332-380, the result was a new tariff line was established in 1997 to the Harmonized Tariff Schedule of the United States for rubber or plastic injection- or compression-type molds for the manufacture of semiconductor devices with a duty rate of 2.6 percent ad valorem (which is currently free of duty) as compared with a duty rate of 3.4 percent ad valorem for similar molds for other uses at that time. Investigation No. 332-390 also resulted in new tariff line items for dies and industrial molds.

[27] USITC, *Advice Concerning the Proposed Modification of Duties on Certain Information Technology Products and Distilled Spirits*, investigation No. 332-380 (final), USITC publication 3031, Apr. 1997; and *Advice Concerning the Proposed Expansion of the Information Technology Agreement: Phase I*, investigation No. 332-390, USITC publication 3097, Mar. 1998.

CHAPTER 2. PRODUCT, MANUFACTURING PROCESSES, AND MARKETING

Product Characteristics

Description and Uses

Tools, dies, and industrial molds are used by industries such as the metal stamping, die-casting, and plastics molding industries to give the final shape or form to the items being produced. In industry usage, tools include dies, punch tools for dies, industrial molds, jigs, and fixtures. Molds and dies are similar to some extent in exterior appearance as both are usually produced as reverse-representations of the objects or shapes to be manufactured. However, in operation, molds generally come together and pull apart on a horizontal plane, whereas dies come together and pull apart on a vertical plane as the strike force of the press is aided by gravity. Industrial molds are used to produce a wide variety of plastic, metal, rubber, glass, and mineral products. These include plastic and metal parts for motor vehicles, aircraft, appliances, electronics and electrical products, housewares, consumer products, furniture, military items, and medical products.[1] Molds for plastics include a variety of types including injection, compression, blow, reinforced, transfer, forming, plunger, and rotational molds, with the most widely used being injection molds.

A mold consists of a base clamping plate and a top half called a clamping plate. This assembly (base clamping plate and clamping plate, as well as guide pins) is called a mold base.[2] Mold bases have been standardized by size and other attributes, and are commercially sold by mold base producers. Essentially, these bases hold the interior plate halves together in which cavities are cut out that form the inverse of the desired part. It is into these cavities that molten plastic or metal is either injected or poured.

Dies are used to produce a wide variety of metal stampings, extrusions, forgings, and drawn products, including wire. Stampings are various parts used in the production of motor vehicles, aircraft, furniture, construction and farm equipment, appliances, electrical connectors, and so forth. Stampings can vary in thickness, for example, ranging from 0.03 inches of hardened stainless steel up to 1 inch or more in steel plate.

A stamping die consists of a base, known as the punch plate, and the top half, called a punch holder. This assembly (punch plate, punch holder, and guide posts) is called a die set. Die sets have been standardized by size and other attributes, and are sold commercially by die set producers. The punch holder holds the punches for forming holes and other shapes in the sheet metal. The punch plate is guided precisely onto the

[1] Testimony of John D. Belzer, president, TCI Precision Metals, and chairman of the board, National Tooling and Manufacturing Association, transcript of the hearing, p. 45.

[2] Mold bases are included within the scope of this investigation.

die holder by guide posts. The die will generally have nitrogen cylinders that act as a cushion to push the punch plate off the part so the metal can advance.

Product Characteristics

TDMs (or tooling) comprise a wide group of heterogeneous products that vary greatly in terms of physical dimensions, sophistication, and functionality. The overall size of a TDM is generally proportionate to the item it is used to produce; for example, dies for automobile body stampings measure several feet in length and width, but single cavity molds for individual cell phone cases are relatively compact and may be transported by hand. Likewise, TDM producers serve a diverse range of customers and industries, with TDMs of varying properties classified by end-use market. The TDM product group also encompasses the complete range of tooling of a particular construction or form, from low-end, simple fabrications to highly intricate and technologically advanced TDMs.

Within a distinct product category or type of TDM, the major characteristics used to differentiate distinct TDMs are precision, complexity, and quality. Moreover, the degree to which these attributes are developed and advanced is a useful gauge of the particular capabilities of individual TDM manufacturers. In the TDM industry, the term "precision" is used to describe the accuracy of a die or mold, including the extent to which the die or mold meets specified measurement tolerances, such as within 0.001 inch. Therefore, some TDMs are more "precise" than others. The die or mold must produce accurate part features, so that when the tooling pulls apart to eject a formed part, there are no blemishes, deformations, or surface imperfections on the stamped or molded piece. The accuracy of the TDM is critical because errors may adversely impact the performance of the finished product. TDM producers can achieve repeatable dimensional tolerances of plus or minus 0.00005 inch.

General levels of precision are defined by the tolerances required according to end use of the part.[3] An example of low-level precision in a molded product would be a plastic bucket, where significant variances in dimensional tolerances are acceptable. Medium-precision TDMs would be those where fit and function are important, but not critical to end use. Examples of medium-precision molded products include computer housings, computer keyboard bezels, facsimile machine housings, and clock faces. High-precision products would be those where fit and function are critical to the end use. High-precision products may have pieces that are required to snap-fit or screw together, such as caps and closures for food containers. Another example of a high-precision product is a cell phone housing, as it is relatively small, the holes for the dialing buttons must be accurate, and the front housing, back housing, and battery door must all snap together perfectly for a tight fit. Still other examples of high- precision TDMs are those used to produce highly functional or dependable items, such as automotive under-the-hood components and medical devices. Notwithstanding the clear categorization of certain types of products, definitions of what constitutes low-, medium-, and high-precision items vary by product application and end-use market. Therefore, the final use and intended market (both segment and consumer) affect the levels of precision needed and the subsequent degree of accuracy built into the tooling.

[3] Clare Goldsberry, American Mold Builders Association (AMBA) marketing consultant and contributing editor, *Injection Molding Magazine*, e-mail to USITC staff, Aug. 14, 2002.

Complex TDMs are defined by the degree of internal detail, internal action, or technological integration within the die or mold. For example, a complex die would be one that performs multiple processes, such as progressive alterations of the metal or the embedment of components, in one or more successive hits. Complex dies might also incorporate sensors within the tooling to check that certain production conditions are being met. A mold that is complex might have numerous cavities to fabricate multiple pieces in a single casting or incorporate internal movement for ejection of the part or the formation of internal holes or undercuts. Complex TDMs include molds and dies used to form objects from innovative materials, (e.g., new types of plastic resins or composite materials), as well as tools used to produce items incorporating numerous types or colors of material, such as automobile tail light lenses. Molds incorporating hot runner systems, where no sprues[4] of plastic are created, would also be considered complex molds.

Quality as a characteristic reflects consistent application of a range of design ideas and manufacturing performance that result in a TDM that will fulfill the needs and desires of the customer. Within the concept of quality are design ideals that result in the desired TDM product life, performance, durability, and increased maintainability. Performance includes higher production efficiencies (more parts per cycle and more cycles per hour) and less TDM downtime. Product life and durability suggest a TDM that will continually produce parts to specification without excess wear, fatigue, or premature breakdown. Creativity is involved in the design of the TDM and is constrained by cost limits and customer specifications. Intrinsic to producing a quality TDM is craftsmanship. Also included is the selection and use of materials, parts, and components of appropriate quality.

Method of Manufacture

Both industrial molds and dies are manufactured using similar machinery and processes. However, it should be noted that mold makers typically produce molds for plastics and metals used in die-casting, but rarely make dies for stamping, extruding, or drawing. Likewise, die makers seldom produce molds. The production processes pertaining to the design and construction of dies and molds are described in the Figure 2-1.

As a result of efforts to reduce lead times, that is, the time from order to delivery to the customer, TDM producers concurrently, rather than sequentially, perform many of the design and manufacturing steps. In some instances, even before the final design by the customer is approved, TDM producers have already ordered many of the raw materials, such as steel, and have begun initial machining operations. Typically, a TDM producer receives electronic files that describe the part for which the customer wants the TDM producer to build a mold or die. The part and tool designs are created with computer-aided-design (CAD) software. Once the design of the mold or die is complete, the TDM maker will develop the computer instructions (computer-aided-manufacturing (CAM) software) that run the machine tools to fabricate components for the mold or die. A variety of machine tools typically are used to cut and polish the various parts of a mold

[4] Sprues are the solid trails of plastic running in the mold between the parts and the injection molding machine.

Figure 2-1
Dies and industrial molds: Common manufacturing steps

Request for price quote and finalize quote	• Customer math data received • Conceptual sketch • Estimate purchased components • Estimate labor hours	• Review customer pricing • Submit price quote • Negotiate quote with customer
Design with computer-aided design (CAD) software	• 3-D surface design • 3-D solid design • Simulation or mold flow analysis	• Preliminary design submitted for approval • Approval received
Computer-aided manufacturing (CAM) software programming	• Design released for cutter paths • Cutter paths programmed	
Material ordering	• Steel or metals ordered • Die pattern created	• Casting ordered • Die and mold components ordered
Machining	• Roughing • Stress relief • Semi-finish • Finish	• Gun drilling • EDM machining • Component machining • Surface treatments
Inspection of mold or die parts and components	• Inspections for quality assurance and accuracy occurs on incoming materials and in machining steps	• Measuring for adherence to design and tolerance requirements
Assembly	• Die or mold assembly	• Bench work and hand finishing
Tool tryout by builder	• Test mold or die on tryout presses • Perform capability analysis • Rework tool if necessary	• Inspection may occur on parts produced during tool tryout for conformance with desired design
Tool tryout by customer	• Die or mold tested on production presses • Capability analysis	• Die or mold rework if necessary

Source: IRN, Inc., The Right Place Program, *A Competitive Assessment of the Die and Mold Building Sector: A West Michigan Perspective*, May 2002; and Commission staff plant visits in the United States, Taiwan, Japan, and China, 2002.

or die, including high-speed machining centers and 5-axis machining centers,[5] electrical-discharge machines (EDMs),[6] and grinding machines. Most machine tools are computer controlled. After all the mold or die components are produced or purchased, they are assembled and fitted together. Quality inspection is usually performed during most stages of production. The TDM producer may then produce a tryout run of parts at its own facilities if it owns a stamping press or plastic injection molding machine.

The production of TDMs requires extensive capital inputs.[7] For example, a new machining center with the required level of precision costs approximately $200,000 to $400,000, and cutting tools and accessories may add another $50,000, whereas most firms in the U.S. TDM industry have annual sales of less than $20 million.

Technological Changes

In recent years, a number of technologies have emerged in both the TDM end-use and manufacturing environment that have affected TDM manufacturing and TDM consumption by end-users. New manufacturing technologies have resulted in accelerated processing and compressed production schedules. Such technologies were once considered leading-edge, state-of-the-art manufacturing methods, but have increasingly become more widely adopted. Many leading U.S. and foreign TDM producers are adopting advanced manufacturing technologies in order to remain competitive.

Computer numerical controlled (CNC) machining advances have enabled faster design and machining times that have allowed for shortened TDM production times, leading to an increased number of TDMs that could be produced by a firm, without an increase in factory size or number of machines. One of the most significant changes occurred during the late 1990s as improvements were made in CNC machine tool speed, accuracy, and versatility due to increasing sophistication of the computer systems that controlled them. For example, curved surfaces, consisting of an incremental series of flat surfaces, can be produced to specified finish levels using CNC machining centers. This reduces, and in some cases eliminates, the traditional requirement for expensive, and time-consuming, hand finishing. Automatic tool gauging and compensation for tool wear is another aspect of CNC machining that improved significantly as a function of increasingly sophisticated computer-based control systems. As a result of these advances in computer control technology, productivity was significantly enhanced. This raised the effective capacity of

[5] Five-axis machining centers allow for the cutting tool to address the workpiece from 5 axes; 3 mutually perpendicular axes along which the cutting tool moves, and 2 rotational axes that position the cutting tool on the workpiece. On today's state-of-the-art 5-axis machining centers, the computer control system is sophisticated enough to ensure that the cutting tool is always held at the optimal angle to the workpiece, which allows faster cutting speed, longer tool life, and lower operating costs.

[6] During electrical discharge machining (EDM), a spark jumps across a gap from a consumable electrode to the workpiece and erodes the workpiece material. A computer-controlled motor drive maintains the gap between the electrode and the workpiece, while a dielectric fluid flushes away the minute spherical chips eroded from the workpiece and the electrode.

[7] A study of the Japanese TDM industry suggests that machinery per capita is reported to be higher in the TDM sector than in other manufacturing industries. *See*, Economic Research Institute (ERI), Japan Society for the Promotion of the Machine Industry (JSPMI), *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 2.

those shops that adopted the technology, and by extension increased capacity for the industry as a whole.

Other technological improvements have spurred the development of more complex dies and molds that allow end-users to realize greater productivity and efficiencies. In still other cases, technologies have emerged among TDM consumers that either change the way TDMs are built or affect demand for TDMs. These technologies and their effects are described in Table 2-1.

The adoption of sophisticated computer software programs and computer-controlled machining of TDMs by foreign competitors has allowed new producers to accelerate development of their TDM industries and become a major force in the global market, particularly in Asia. These technologies have enabled new producers to increase the precision, complexity, and quality of their product in a short amount of time. As a result, emerging global competitors are on almost equal technological footing, with many having the added advantage of price competitiveness from lower labor costs.

Further, computerization has reduced the amount of time needed to develop a sufficiently skilled TDM workforce, resulting in reduced labor costs and altering what historically has been a significant competitive advantage for the U.S. industry. A number of U.S. TDM producers have stated that in the past, 5 years of apprenticeship and 5 years of work experience were required to produce a skilled toolmaker. This was particularly so for die makers, because of skills required to make adjustments to the die during tryout before production stamping. Today, however, a toolmaker often requires less skill. For example, within 2 years, a TDM trainee can acquire 70 percent of the knowledge of a traditionally trained toolmaker because of computerization of the production process.[8] Less training time is needed to enable the employee to be technically proficient to produce TDMs in the low and medium ends of the market in terms of precision, complexity, and quality. For the production of high-precision TDMs, 6 to 7 years of experience might be required.[9] Nonetheless, at the same time that technology has incorporated more of the knowledge base required to make TDMs, computer design software and manufacturing automation cannot fully replace design creativity, talent, and experience.[10] As a result, technology has allowed certain Asian producers to improve rapidly and to enter the low and medium ends of the TDM market, although they are not fully competitive with many other global TDM producers in all segments of the market.[11]

Distribution Practices

Producers generally sell TDMs to two major types of customers—firms that use TDMs for their own production of consumer products or firms engaged in metal stamping, molding, and die-casting that produce parts under contract for outside companies. In the

[8] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.
[9] Ibid.
[10] Ibid.
[11] AMBA, interviews by USITC staff, Medinah, IL, Apr. 22, 2002; ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 53; Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002; Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002, and Osaka, June 7, 2002; and Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

Table 2–1
Recent technologies affecting the production of tools, dies, and industrial molds (TDMs)

Technology	Description	Benefits
Advanced manufacturing technologies		
High-speed machining	High-speed (HS) machining involves cutting metal at speeds 5 to 10 times higher than conventional machining. However, the rotational speed of the cutting tool and the rate at which the tool is forced against the workpiece ultimately depend upon the type of material being worked. The rotational speed of spindles that hold the cutting tools on HS machining centers typically exceed 20,000 rpm, and some companies report it approaches 40,000 rpm.	The benefits of HS machining are increased rates of removal of material from the workpiece; reduced costs due to shorter production cycles; higher output in a given time and, therefore, increased productivity; lower investment costs as the result of reduced machine requirements; improved manufacturing flexibility as production times are improved and output raised; and accuracy in terms of dimension, shape, and surface due to the reduced cutting forces.
Hard milling	Hard milling involves the machining of metal workpieces that have been prepared for final cutting by being rough shaped, hardened in a furnace, and quenched in an oil bath. Prior to hard milling, cutting hardened material involved either grinding or EDM machining operations. Hard milling allows for machining of hardened workpieces at high speeds with very fine finishes.	The benefits of hard milling are productivity gains through the reduction or elimination of grinding or EDM machining operations.
Solid modeling	Solid modeling is the representation of objects in 3-dimensional (3-D) form, rather than 2-dimensional shapes or outlines. A 3-D model can be viewed from various perspectives, and 3-D modeling is currently used in the dominant CAD software programs. Solid modeling is also used in CAM software that generates programs directing the cutting path and cutting implements of a machine tool. Solid modeling creates a complete and unambiguous part definition.	Solid modeling allows for better access to information in the product design process, thereby resulting in shortened design cycles, streamlined manufacturing processes, and accelerated product introductions.
5-axis machining	Machining centers incorporating 5 angles of approach to workpiece; 3 mutually perpendicular axes along which the cutting tool moves and 2 rotational axes that position the workpiece. 5-axis machining centers are computer controlled.	Allows for increased number of operations in one workpiece setup, therefore reducing production time.
"Lights out"– unattended machining	"Lights out" or unattended machining is a procedure wherein a workpiece is placed on the workholder of a pre-programmed machine tool and machined without human supervision, usually during evening or weekend hours. When the operation is finished, the computer controls frequently send a pager signal to workers indicating that the job is finished. Depending upon the setup of this procedure, machines can run until staff return to the factory. This technique is particularly utilized in high labor cost countries.	Benefits include stable or increased production output coupled with the reduction of labor costs and reduced factory overhead costs through the continuous running of machines.

Table 2–1—*Continued*
Recent technologies affecting the production of tools, dies, and industrial molds (TDMs)

Technology	Description	Benefits
Advanced manufacturing technologies—*Continued*		
Automated quality control data management	This process allows for the collection of quality control data through sensors that feed data to computer systems in real-time, without taking time away from shop floor personnel. Types of quality control data include information generated and used in statistical process control and defect reporting. Automated data management allows TDM producers to follow quality issues in their production operations and pinpoint problem areas with machinery or operators.	The lack of automated quality controls could deter potential TDM purchasers, who might believe that non-implementing firms allow too much variation in their finished products. Automated quality control data can also be linked with design and manufacturing data, leading to improved operations.
Production management software	Software programs that track all phases of the production process.	Allows for the monitoring and adjustment of production schedules, resulting in increased productivity and firm efficiencies.
Concurrent engineering	A practice where TDM producers and customers integrate product design and manufacturing in order to improve efficiencies and reduce time to market.	For the TDM producer, integration into the TDM customer's concurrent engineering process may beget better customer relationships.
Innovative TDM manufacturing methods		
Rapid prototyping	Rapid prototyping is a technology used for building physical models and prototype parts from 3-D CAD data. Rather than a subtractive process, rapid prototyping systems use materials to build up the model or prototype part. Materials such as liquids, powders, or sheet materials of plastic, wood, ceramic, and metal are layered together to form the desired object, based upon the computer model.	Faster production of prototype models for the production of parts and tooling. Companies are using rapid prototyping for a number of purposes, including the examination of fit and assembly functions, the production of functional models, visual aids for engineering, patterns for prototype tooling, and direct tooling inserts; and the preparation of ergonomic studies, business proposals, and quotes.
Rapid tooling	Rapid tooling can mean any method or technology that allows for the rapid production of tooling. In a stricter sense, rapid tooling is tooling that is derived from rapid prototyping. There are two categories of rapid tooling: indirect and direct. Indirect rapid tooling uses rapid prototyping to produce master patterns, which in turn are used to produce a mold or die. Direct rapid tooling uses a rapid prototyping machine to build the tool core and tool cavity inserts. Rapid tooling manufacturing processes include direct laser sintering, ultrasonic welding, spray metal tooling, and additive forming, as well as other methods.	Faster production of molds and dies for low volume production runs.

Table 2–1—*Continued*
Recent technologies affecting the production of tools, dies, and industrial molds (TDMs)

Technology	Description	Benefits
Innovative TDM manufacturing method—*Continued*		
Functional Build	Functional Build is a concept of producing parts only sufficiently within tolerance so that when assembled the parts will result in a product that is within the desired tolerances for the assembly, as opposed to producing all parts within the assembly to tolerance levels desired in the design. Functional Build has been applied to the production of stamping dies by Japanese TDM producers and is now increasingly being adopted by the U.S. automotive industry. Functional Build may also be applied to the production of industrial molds.	Up to a 50-percent reduction in die stamping tryout costs. Such tryout costs account for up to 20 percent of die stamping costs. Functional Build will also result in shorter die tryout periods.
New technologies incorporated in TDMs		
Sensors in dies	Sensors are added to the die in order to detect certain conditions occurring during the stamping process. About 20 percent of the U.S. market for dies currently incorporates sensors.	Less damage to the stamping tool and less downtime for repair and maintenance. Increased productivity through monitoring of stamping results.
Hot runner systems for plastic injection molds	Hot runner systems allow the injection of plastic into a mold to form the part, but eliminate the production of sprues. About 30 percent of the U.S. market for injection molds is of hot runner systems.	Eliminates plastic sprues, which have to be cut off the molded parts and discarded or recycled into production.
Technologies affecting TDM demand		
Hydroforming metal forming	Hydroforming is a method for producing parts using water pressure. The most common type of hydroforming is tubular hydroforming, whereby a metal tube, typically steel, is placed in a die press and forced to shape in the die cavity via intense water pressure directed on the inside of the tube. Currently, tubular hydroforming is used to produce vehicle structural components, such as side rails, A-pillars, engine cradles, and roll bars.	The benefits of using tubular hydroforming include a reduced number of parts, reduced weight levels, improved structural strength and stiffness, reduced tooling costs as a result of fewer parts, reduced number of secondary operations, closer dimensional tolerances achieved, and reduced scrap. Of the 350-400 dies required to produce a truck, the use of hydroforming may eliminate the need for 50 dies.

Table 2–1—*Continued*
Recent technologies affecting the production of tools, dies, and industrial molds (TDMs)

Technology	Description	Benefits
Technologies affecting TDM demand—*Continued*		
Computer aided engineering and process simulation and verification software	Computer aided engineering (CAE) consists of a variety of methods used to simulate the mechanical functions of a component.	Advance simulation of metal stamping or molding processes can lead to a reduction in the number of hard models required, thereby reducing the need for prototype manufacturing and trial dies and molds.
Modular TDMs	The increased use of progressive dies in metal stamping and the increased use of dies and molds with changeable inserts for producing similar parts.	Results in more complex TDMs, but reduces the number of TDMs that need to be produced for a particular product(s).

Source: Compiled by the Commission, based on field work and discussions with TDM industry representatives.

latter case, the contract parts producer will either use a TDM provided by its customer or purchase an appropriate TDM on behalf of its customer as a condition of the parts production contract. This customer usually takes the ownership title of the TDM which remains at the parts producer. After the parts production contract is fulfilled, the TDM may be returned to the customer or inventoried and maintained by the parts producer should additional parts be required. Contract parts producers may also have in-house production of TDMs and market that capability to customers seeking parts production.

With the increasing ease of global communication, TDMs from a variety of foreign countries have become readily available in the marketplace. Traditionally, U.S. TDM producers have relied on word of mouth, their reputation for good work, direct sales calls, advertising in trade journals, dissemination of sales brochures, participation in trade shows, and established supplier-customer relationships as methods for obtaining sales. Many TDM producers now have Internet sites. Such sites also function as communication portals with customers for the transfer of purchasing, project management, and design information and data. Larger TDM producers may also have sales personnel to solicit prospective customers. Smaller TDM producers are generally more passive, waiting to be contacted by prospective purchasers, and often rely on a limited number of repeat customers. TDM producers may also use industrial products representatives or service agencies that provide request-for-quote (RFQ) solicitations.

Historically, TDM producers have tended to specialize in sales to one or a few industries, the production of certain types or sizes of TDM products, or marketing initiatives in select regional markets. Also, TDM producers tended to serve customers that were close in proximity, marketing themselves as being better able to assist customers in the TDM design and production phases and provide maintenance and repair services on short notice. With business downturns in some markets, a number of TDM producers are now seeking sales to other industries, as well as extending their sales territory to include more distant domestic and foreign customers. However, one recent study encourages U.S. TDM producers to be even more proactive in gaining access to new business that will

supply foreign vehicle transplant operations in the United States, which are expected to grow to about 35 to 40 percent of North American production by the end of the decade.[12]

Within the past few years, TDMs in higher-cost countries such as the United States have also been sold by brokers, and TDM producers that focus on TDM design have entered the industry. These firms will market to TDM customers through direct sales contacts, mailings, and through an Internet presence. The production of the TDM is largely completed in an offshore, low-cost TDM production location.

[12] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), p. 10.

CHAPTER 3. DOMESTIC INDUSTRY AND MARKET OVERVIEW

This chapter begins with an overview of the U.S. tool, die, and industrial mold (TDM or tooling) industry's structure; followed by the industry trends and corporate financial conditions that characterize the TDM market; the major consuming industries, product cycles, foreign competition, international trade,[1] and purchasing decision factors that influence demand for TDMs; government programs to assist the industry; and concludes with impacts of Federal and state tax provisions, regulations, and policies.

Unique industry characteristics and major strengths and weaknesses of the U.S. TDM industry

Unique industry characteristics:
- Large industry, albeit shrinking in recent years, with a significant number of small firms
- Most firms tend to specialize in either dies or molds, and some also produce stampings or moldings
- Foreign direct investment in the domestic industry, particularly to serve foreign-transplant customers, is more prevalent than U.S. TDM producers investing abroad

Strengths:
- High-quality products
- Innovative production technologies
- Capable of producing a wide variety of TDMs, including high-precision and highly complex TDMs
- Well-developed product design capabilities
- Large and diverse customer base

Weaknesses:
- High TDM prices compared to foreign competitors
- High labor costs
- High costs of employee benefits, employee training, and

Composition of the U.S. Tool, Die, and Industrial Mold Industry

Industry Structure

The U.S. TDM industry is characterized by a large number of small firms with virtually all of the independent[2] TDM firms classified as small businesses by the U.S. Department

[1] The Harmonized System, used by many countries to classify import data, treats TDM parts and subassemblies, as well as certain molds, in an inconsistent manner. Further, the U.S. application of the Harmonized System, in the Harmonized Tariff Schedule of the United States, does not provide for quantity data for many types of dies. These issues complicate the analysis of import quantity and value data.

[2] Independent TDM firms' primary output is TDMs. TDMs are also produced in captive operations of larger organizations that use the bulk of their TDM production internally for the production of parts.

of Labor.[3] There were approximately 7,000 TDM firms in the industry, with over 90 percent employing fewer than 50 persons; table 3-1 shows the structure of the U.S. industry, classified by firm size in 1997, the most recent year for which such detailed data are available. On average, U.S. TDM firms in 1997 shipped less than $2 million per establishment, and the large segment of the industry represented by firms of fewer than 20 employees averaged less than $600,000 in annual shipments. Adverse conditions in recent years have resulted in downsizing at many U.S. TDM firms and the average firm size is likely smaller now than in 1997. Such conditions have also resulted in the exit of many firms from the industry, and industry sources indicate that in the past 2 years, as many as 200-400 firms have gone out of business.[4]

Although some firms manufacture both dies and molds, concentration on one or the other activity is far more common.[5] Most firms are stand-alone operations producing only TDMs, although some production operations evolved as captive shops run by firms primarily engaged in the production of stamped or molded parts.[6] Independent firms are also increasingly adding stamping or molding operations to diversify their operations, as independent TDM producers are finding it increasingly difficult to generate sufficient revenues by solely producing TDMs.[7]

Production of TDMs is widely distributed throughout the United States, but tends to be concentrated in areas that have historically supported extensive manufacturing activity. Accordingly, the majority of TDM operations are located in Michigan, Illinois, Ohio, California, Pennsylvania, Indiana, and Wisconsin.[8] TDM customers have historically preferred that their suppliers be located in close proximity in order to facilitate tryout, maintenance, and repair activities. However, because TDMs typically have a high value relative to their size and weight, transportation costs represent a small fraction of total costs, and a majority of firms responding to the Commission's questionnaire indicated that their primary geographic market area extends 150 miles or further from their location (table 3-2).

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[3] For NAICS industry codes 333511 and 333514, the threshold for classifying a TDM producer as a small business is at 500 persons or less. See Small Business Administration, "SIC Codes and Their Size Standards Matched to Their Corresponding NAICS Codes and Their Size Standards," found at *http://www.sba.gov/size/naicstb2-mfg.html*, retrieved Sept. 2, 2002.

[4] Jerry R. Lirette, president and chief executive officer, D-M-E Co., written submission, May 9, 2002; and U.S. industry participants, interviews by USITC staff, Jan. - Sept. 2002.

[5] Responses to Commission Producers' questionnaires; and interviews of TDM industry officials by USITC staff.

[6] Data from the U.S. Census Bureau (Census) indicate that firms with TDM production as their primary activity accounted for 92 percent of overall TDM product shipments during 1997-2001.

[7] The financial dynamic of such operations is different, in that TDM production has a relatively high labor cost component, anywhere from 25 to 50 percent with relatively long lead times, whereas in parts production, material costs are more significant.

[8] Census, *1997 Economic Census*, "Industrial Mold Manufacturing," EC97M-3335A, Oct. 1999; and "Special Die and Tool, Die Set, and Jig, and Fixture Manufacturing," EC97M-3335D, Oct. 1999.

Table 3–1
U.S. tool, die, and industrial mold industry: Number of establishments, employees, shipments, capital expenditures, shipments per employee, and shipments per establishment, by industry segment, by firm size, 1997

Employees	Establish-ments	Employees	Shipments	Capital expenditures	Shipments per employee	Shipments per establishment
	(*Number*)		(*1,000 dollars*)			
1-19	5,500	36,996	3,218,857	220,818	87	585
20-49	1,236	37,030	3,820,862	241,356	103	3,091
50-99	363	25,154	2,724,417	169,202	108	7,505
100-249	157	20,962	2,502,198	151,294	119	15,938
250-999	22	8,517	1,090,727	76,293	128	49,579
Total	7,278	128,659	13,357,061	858,963	545	76,698
			Share (*percent*)			
1-19	75.6	28.8	24.1	25.7	([1])	([1])
20-49	17.0	28.8	28.6	28.1	([1])	([1])
50-99	5.0	19.6	20.4	19.7	([1])	([1])
100-249	2.2	16.3	18.7	17.6	([1])	([1])
250-999	0.3	6.6	8.2	8.9	([1])	([1])
Total	100.0	100.0	100.0	100.0	([1])	([1])

[1] Not applicable.

Source: U.S. Census Bureau, *1997 Economic Census*, "Industrial Mold Manufacturing," EC97M-3335A, Oct. 1999; and "Special Die and Tool, Die Set, and Jig, and Fixture Manufacturing," EC97M-3335D, Oct. 1999. Includes North American Industrial Classification System (NAICS) industry codes 333511 and 333514.

Table 3–2
Primary geographic market range served by domestic tool, die, and industrial mold firms

Primary geographic market range	Percentage of firms primarily serving this market
0-49 miles from producer location	21
50-99 miles from producer location	12
100-149 miles from producer location	12
150 miles or further from producer location	55
All distances from producer location	100

Source: Compiled from data submitted in response to Commission Producers' questionnaires.

Geographic location also tends to determine the industries served by any individual TDM shop, although most firms serve more than one consuming industry.[9] Less than one-fifth of the firms responding to the Commission's questionnaire indicated that they only served customers in a single downstream industry. An important distinction among tooling producers serving a single industry is that over three-quarters specialize in sales to the automotive industry. To a large extent, TDM producers specialize in certain die or mold sizes. Generally, larger shops tend to produce larger molds and dies, because they

[9] Testimony of John D. Belzer, president, TCI Precision Metals; and chairman of the board, National Tooling & Manufacturing Association, transcript of the hearing, pp. 71-72.

have the financial resources to invest in larger equipment required to produce such tooling.[10]

Firm Structure

Even the largest firms in the tooling industry are relatively small when compared to firms in other manufacturing sectors. Examining leading TDM firms in the United States for which publicly available data could be found (table 3-3) reveals that the largest organization employs only 360 persons and had estimated 2001 sales of only about $80 million. The majority of firms in the U.S. industry are significantly smaller than the firms listed in table 3-3.

Tooling firms are predominantly privately held, in the form of a sole proprietorship, a partnership, or a Subchapter S corporation, and may often employ several generations of the owner's family.[11] In such firms, the principal owner makes most of the decisions regarding human resources, overall management, purchasing, investment, and marketing, and is thus involved in most of the day-to-day production activities.[12] These firms are often headed by individuals who developed engineering and technical skills at another firm before managing their own operation.[13] This form may be changing somewhat as increasingly, some TDM producers are forming domestic or international alliances or partnerships, or are being purchased. Midwest Tooling Group has become a holding company, owning a group of TDM producers. This group is divided into four independent operating companies, aiming to be a one-stop TDM product and service provider, with a sales goal exceeding $100 million.[14] Caco Pacific Corp., of Covina, CA, is employee owned and operated through an employee stock-ownership plan (ESOP) organization. Only the largest firms have a corporate structure that would allow them to carry out market intelligence activities; to operate other product lines, such as molding or stamping; or to expand into other product or geographical markets, including foreign markets. Larger size also facilitates the provision of a large array of customer services.

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[10] Testimony of David L. Rasmussen, president, Progressive Die & Automation; president, Quality Die & Mold; and member, Board of Directors, Coalition for the Advancement of Michigan Tooling Industries (CAMTA), transcript of the hearing, pp. 72-74.

[11] U.S. industry officials, interviews by USITC staff, Chicago, IL, area, Apr. 22-26, 2002. Also testimonies of Matthew B. Coffey, president, National Tooling & Machining Association, hearing transcript, p. 35; and David R. Sandy, vice president, Systems Group, M.S. Willett, Inc., hearing transcript, p. 183. A Subchapter S corporation provides limited corporate liability and certain income and deductible provisions for tax purposes.

[12] U.S. industry officials, interviews by USITC staff, Chicago, IL, area, Apr. 22-26, 2002.

[13] The Right Place Program, written submission, May 30, 2002, incorporating IRN, Inc., *A Competitive Assessment of the Die and Mold Building Sector; A West Michigan Perspective* (Ann Arbor, MI: IRN Inc., May 2002), p. 11. Also industry officials, interviews by USITC staff.

[14] Midwest Tooling Group, "About M.G." and "Midwest Tooling Group Implements Aggressive Acquisition Strategy," found at *http://www.midwesttoolinggroup.com*, retrieved Sept. 30, 2002.

Table 3–3
Leading U.S. tool, die, and mold firms, 2001

Firm	Location	Sales	Employees	Plants
		Million dollars	*(Number)*	
H.S. Die & Engineering Inc.	Grand Rapids, MI	[1]80.0	360	5
Atlas Tool, Inc.	Roseville, MI	[1]60.0	340	1
Hi-Tech Mold & Engineering Inc.	Rochester Hills, MI	[1]55.0	240	2
Synergis Technologies Group	Grand Rapids, MI	50.0	250	3
Delta Tooling Co.	Auburn Hills, MI	45.0	250	2
Triangle Tool Corp.	Milwaukee, WI	45.0	240	2
MGS Manufacturing Group Inc.	Germantown, WI	43.2	230	2
Autodie International, Inc.	Grand Rapids, MI	[1]42.3	[1]260	1
R&D Tool & Engineering Co.	Lee's Summit, MO	[1]30.0	[1]200	1
Sekely Industries, Inc.	Salem, OH	[1]30.0	175	1
Reddog Industries Inc.	Erie, PA	30.0	165	1
Tooling Tech Group	Dayton, OH	23.0	155	4
Caco Pacific Corp.	Covina, CA	22.5	164	1
W.G. Strohwig Tool & Die Inc.	Richfield, WI	22.0	145	1
Paragon Die & Engineering Inc.	Grand Rapids, MI	21.5	130	1
Midwest Tooling Group	Chagrin Falls, OH	20.0	160	3

[1] Estimated.

Source: *Dun & Bradstreet Million Dollar Directory, 2002*, *Plastics News*, May 6, 2002, company Internet sites and brochures, interviews with industry officials.

The full extent of foreign direct investment (FDI) abroad by U.S. TDM producers is unknown, but seems to be rare.[15] Based upon information received, a few leading U.S. TDM producers have established operations in foreign locations. For example, one of the largest moldmakers, Delta Tooling Co., has a foreign subsidiary in Mexico, and has working agreements with companies in Germany, Italy, and Switzerland in order to access the European market. PacMold's design and marketing operations are based in California, but it also owns a manufacturing plant in Taiwan. Several of the firms that produce TDM parts and components in the United States, such as mold bases and hot runner systems, have invested in foreign manufacturing operations. For example, D-M-E Co., a subsidiary of Milacron Corp., has production operations in Europe and joint-venture agreements in Asia. Superior Die Sets, Inc., recently established a production facility in Poland.

In contrast, FDI appears more common in the U.S. TDM industry. Based on anecdotal information, most foreign investment in the U.S. tooling industry appears to be by Japanese, German, and Canadian TDM producers, molders, or stampers. A number of Japanese automotive suppliers have invested in TDM production facilities in the Midwest to serve U.S.-based Japanese automotive customers, or have established facilities to access the U.S. automotive market. These include FDIs by Ogihara, Fuji Technica, and Ryobi Diecasting. Investments by German TDM producers include a joint

[15] Official U.S. Government statistics on inbound and outbound foreign direct investment are published at aggregated levels which do not allow analysis of this industry.

venture by Rampf Molds and a U.S. TDM producer to form Alabama Molds, Inc., LLC. In August 2002, the German mold-maker PGAM Advanced Technologies AG located a facility in Michigan to serve the U.S. automotive market.

Manufacturing Infrastructure

Because the TDM industry is highly capital intensive, investment in up-to-date production equipment and software is important for individual TDM firms to improve their productivity and meet customer demands for shorter lead times between receiving orders and completing TDMs for delivery. The industry appears to have been successful at reducing average lead times. Domestic producers responding to the Commission's questionnaire exhibited a wide variation in average lead times, ranging from 55 weeks to less than 1 week, an indication of the diverse nature of the products produced by this industry. On average, aggregated lead times for all 252 respondents to this question steadily decreased from 14 weeks to 11 weeks during 1999-2001.

For the 165 U.S. TDM producers who reported decreased lead times (65 percent of all respondents), the average lead time decreased from 16 weeks to 11 weeks. Almost 85 percent attributed their decreased lead times to increased efficiency and productivity resulting from improved technology and increased capacity utilization. Some producers reported that investment in new technology, extended work hours, and additional plant shifts were driven by customer demand for shorter lead times (see "Product Cycles" in this chapter). These producers noted that after price, lead time was the most important customer consideration when procuring tooling. U.S. TDM producers also reported that reduced lead times are a necessity to compete against foreign TDM producers. However, 15 percent of U.S. producers who reported decreased lead times cited a reduced backlog of new orders as the reason for lead time decreases.

By contrast, the average lead time increased from 15 weeks to 20 weeks for 14 U.S. TDM producers who reported increased lead times (1 percent of all respondents). Almost all producers attributed increased lead times to working on larger or more complex TDMs, although two producers reported that their lead times grew because of increased backlogs as a result of additional orders. Finally, 73 responding TDM producers (34 percent of all respondents) reported no change in their average annual lead times.

Efforts to reduce lead times have focused on three principal segments of toolmaking:

- Cutting design time through use of more sophisticated design software and higher levels of concurrent engineering;

- Reducing fabrication and machining time through higher speed and more accurate machines; and

- Eliminating as much tryout time as possible, through the use of front-end simulation to reduce the need for expensive and time-consuming reworking of the tooling.

A number of innovative technologies, representing the latest advances in equipment application and use, were reviewed in chapter 2. The Commission's questionnaire asked producers to report which of these technologies they had implemented. Results are mixed, but many of the technologies that have been adopted by a significant share of the 278 firms that provided usable responses, such as integrated CAD/CAM software, high-speed machining, unattended ("lights out") machining, and hard milling, offer considerable productivity improvements (table 3-4). However, other important technologies, such as 5-axis machining and rapid prototyping, have been adopted by only a small share of the firms responding. A separate question regarding the adoption of lights-out machining revealed that the number of firms using this production strategy increased 18 percent between 1999 and 2001.

Table 3-4
Production technologies implemented by domestic tool, die, and industrial mold producers

Production technology	Percentage of respondents using this technology
High-end computer aided design/computer aided manufacturing software	73
High-speed machining	62
Unattended or "lights out" machining	61
Solid modeling	53
Hard milling	45
Production management software	37
Process simulation and verification software	29
Rapid prototyping	26
Inclusion of sensors in products	23
5-axis machining	23
Automated quality-control data management	18
Robot material handling	12
Additive forming	2

Source: Compiled from data submitted in response to Commission Producers' questionnaires.

Market Characteristics and Trends

Industry Trends

Between 1997 and 2000, publicly available data for the TDM industry exhibit nominal changes in key measures (table 3-5). Shipments and average hourly earnings rose throughout the period, while employment and hours worked slowly declined. These offsetting trends reflect consistent improvements in productivity, likely related to the application of advanced production technology, as capital investment levels remained high throughout most of the period. However, available data for 2001 reveal a sharp decline in most measures. These declines reflect information collected during the study

Table 3-5
U.S. tool, die, and industrial mold industry: Shipments, production and related workers, total employees, average hourly earnings, total average weekly hours, and capital expenditures, 1997-2001

Item	Calendar year					1997 to 2000	2000 to 2001
	1997	1998	1999	2000	2001		
						—— *Percent* ——	
SIC Code 3544 tools, dies, and industrial molds							
Shipments (*million dollars*)[1]	14,498	14,597	14,857	15,298	([2])	5.5	([3])
Production and related workers (PRWs) (*1,000*)	127.8	127.6	122.5	118.2	107.8	-7.5	-8.8
Total employees (*1,000*)	167.1	167.1	160.8	157.3	145.5	-5.7	-7.5
Average hourly earnings (PRWs) (*dollars*)	15.64	16.06	16.83	17.43	18.04	11.4	3.5
Total average weekly hours (PRWs)	51.4	49.8	48.8	48.2	45.6	-6.2	-5.4
Capital expenditures (*million dollars*)	858	872	940	875	([2])	2.0	([3])
USITC Producers' questionnaire							
Shipments (*million dollars*)	([3])	([3])	1,784	1,878	1,503	([3])	-19.9
PRWs (*1,000*)	([3])	([3])	12.1	11.5	10.2	([3])	-11.4
Total employees (*1,000*)	([3])	([3])	15.5	14.8	13.3	([3])	-10.4
Average hourly earnings (PRWs) (*dollars*)	([3])	([3])	19.48	20.81	20.65	([3])	-0.8
Total average weekly hours (PRWs)	([3])	([3])	44.1	42.9	41.5	([3])	-3.3
Capital expenditures (*million dollars*)	([3])	([3])	116	138	104	([3])	-24.3

[1] These figures represent total product shipments, including shipments by captive operations for firms not classified as being primarily engaged in the production of tooling (e.g., stamping or automotive). U.S. Census Bureau industry shipment data, which include only shipments of tooling by firms classified as being primarily engaged in the production of tooling, total $1.0 billion to $1.2 billion per year less than these figures.
[2] Not available.
[3] Not applicable.

Source: U.S. Census Bureau, "Statistics for Industry Groups," *Annual Survey of Manufactures*, (various years); "Metalworking Machinery and Equipment," *Census of Manufactures*, (various years); *Survey of Plant Capacity*, (various years); official statistics of the U.S. Bureau of Labor Statistics; and Commission Producers' questionnaire responses.

indicating that industry conditions began deteriorating rapidly near the end of 2000. Discussions with industry sources indicate that further declines have occurred in 2002.

U.S. shipments of TDMs rose throughout the 1997-2000 period, increasing by 5.5 percent over the 4-year period. An increase of just under 3 percent between 1999 and 2000 in the U.S. Census Bureau (Census) data was less than the increase of just over 5 percent for questionnaire respondents. This upward trend changed, however, as commercial shipments of all TDMs reported by U.S. producers responding to the questionnaire declined almost 20 percent from 2000 to 2001.

Shipments for the major industry subsectors generally exhibited similar upward trends during 1997-2000, according to Census data. Special dies, tools, jigs, and fixtures accounted for most industry shipments ($8.5 billion or 60.2 percent) in 2000, but rose only 2.9 percent over the 4 years. By comparison, industry shipments of industrial molds, although lesser in both absolute and percentage terms ($5.6 billion or 39.8 percent) in 2000, rose more (4.1 percent) over that same period. However, sales data collected for the D-M-E study (which covered primarily moldmakers) recorded a 28-

percent drop in sales[16] between 1997 and 2001 indicating a significant decline for 2000-2001.[17]

One of the most important indicators of current activity among TDM producers, as well as an important predictor of future cash flow for tooling firms is work backlog, or the work in progress in the various stages of tooling design and build. As backlog decreases, profits for the tooling industry tend to decrease correspondingly as firms are encouraged to quote prices closer to their costs in order to land a contract rather than idle employees who are often hard to replace when demand for tooling picks up again.[18] Since 2000, tooling industry sources have noted a steady decline in company backlogs corresponding to the declines in capital spending by manufacturers and lower profitability.[19]

Capacity utilization data for the period are available only separately for the two major industry sub-sectors, but not for the aggregated industry. Trends in capacity utilization between these sub-sectors diverged somewhat during 1997-2000, declining from 72 percent to 67 for percent for special dies, tools, jigs, and fixtures, whereas the utilization rate for industrial mold building ended the period at the same level it began, 72 percent. The existence of such significant levels of unused capacity tends to generate downward pricing pressures. The trends noted earlier with respect to improved productivity contributing to a shortening of average lead times also leads to overcapacity in the U.S. industry,[20] making it increasingly difficult for firms to find enough work to keep equipment and workers fully utilized. Although a significant number of firms have exited the industry in recent years, the sharp decline in 2001 shipments reported in the Commission's questionnaires suggests that capacity utilization levels in that year were well below recent trends. If cyclical demand rebounds, the loss of capacity in the industry may lead to stronger performance for the remaining firms.

Despite the fairly stable capacity utilization trends, U.S. Bureau of Labor Statistics (BLS) data[21] indicate a steady decline in national employment of production and related workers (PRWs) in the tooling industry between 1997 and 2000, falling 7.5 percent over the 4 years. However, employment fell sharply between 2000 and 2001, declining by 8.8 percent in a single year. Employment levels for total employees also declined, although to a slightly lesser extent; more than 90 percent of the job losses affected PRWs. Employment levels of PRWs for respondents to the Commission's questionnaire followed a comparable trend, declining 4.5 percent between 1999 and 2000 and 11.4

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[16] Although sales and shipments are slightly different, they are acceptable proxies for each other, especially in an industry that carries virtually no inventory and fairly short delivery times.

[17] Lirette, written submission, May 9, 2002, p. 5. The D-M-E study did not collect data for the interim years. Eighty five percent of D-M-E's respondents were moldmaking firms.

[18] American Mold Builders Association (AMBA), "Business Forecast Survey Shows Continued Decline in Industry," Aug. 2001, p. 8.

[19] Ibid.

[20] Testimony of Jay Baron, director, Manufacturing Systems Group, Center for Automotive Research; and president, CAMTA, transcript of the hearing, pp. 50, 53-54.

[21] At the Commission's hearing, questions were raised regarding the validity of what was considered "grossly underestimated" BLS employment data. Testimony of U.S. Representative Donald A. Manzullo (R-16-IL), transcript of the hearing, p. 11. Discussions with BLS reveal that State and local employment statistics (which are what Rep. Manzullo questioned) contain larger sampling and nonsampling errors than national statistics, due to different statistical methodologies. Although Census also collects employment data, BLS national employment data for this industry are significantly larger than Census data, indicating more complete coverage.

percent from 2000 to 2001. Questionnaire data for total employment in the industry followed a similar trend and mirrored the BLS data with respect to the heaviest losses occurring among the skilled PRWs. Respondents to the D-M-E study reported a 24-percent fall in total employment between 1997 and 2001, although the report estimates much higher employment levels, and therefore larger employment losses, than the BLS data.[22]

The layoffs of recent years have affected the market for skilled toolmakers in many geographic areas. The response was mixed to an inquiry on the questionnaire that asked if firms had encountered difficulty in hiring qualified people, with 55 percent responding "no" and 45 percent responding "yes."[23] Firms that reported difficulties in hiring qualified personnel cited factors such as the lower skills of new entrants and a declining pool of workers interested in entering the field. Small shops also noted difficulties in competing with larger shops on wages and benefits. Conversely, those who reported no problems in attracting skilled workers often indicated the presence of a community college or vocational high school that developed strong candidates, or indicated that they have not been seeking to hire workers. However, many respondents in both groups ("yes" and "no") noted that beginning near the end of 2000 it became much easier to find qualified, experienced toolmakers because of recent shop closures and layoffs.

Declining industry activity also affected industry employees who retained their jobs. Although average hourly wages in the industry rose by 15.3 percent during 1997-2001, average weekly regular and overtime hours declined steadily beginning in 1997, with total hours falling by 6.2 percent over the first 4 years of the period (see table 3-5). This decline accelerated in 2001, falling by 5.4 percent from the previous year, yielding an 11.2-percent drop over the 5 years.[24] Improved productivity also seems to be a factor in declining labor utilization, as investment in improved capital equipment raises productivity.

Capital expenditures by TDM producers, based on Census data, rose each year during 1997-99, climbing by 9.6 percent over the period, but declined by 6.9 percent the following year. The greatest decline in capital expenditures during 2000 was by industrial moldmakers. Although capital expenditures by respondents to the Commission's questionnaire rose between 1999 and 2000, they fell by 24.3 percent from 2000 to 2001.[25] Since previous investment and increases in productivity have lead to

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[22] The D-M-E report extrapolated the data collected from approximately 1,000 firms (approximately 850 of which were moldmakers) to estimate total TDM industry employment by applying a multiplication factor of 5 to its data set, based on an estimate of 4,200 firms producing molds in the industry. Although the study suggests that the numbers could be doubled to account for the tool and diemaking segment of the industry, there is no indication of the average number of employees per firm for the companies responding to their survey. If respondents were primarily larger firms, this could explain the significant differences between BLS employment levels and those estimated by the D-M-E study. Lirette, written submission, May 9, 2002.

[23] This mixed response was evident even when the data were examined at the State level, and attempts to correlate the responses with geographic location were unsuccessful.

[24] Respondents to the D-M-E survey reported a 19.3-percent decline in average weekly hours between 1997 and 2001, falling from 50.3 hours to 40.6 hours.

[25] Likewise, respondents to the D-M-E survey reported an aggregate 36.4-percent drop in capital investment levels between 1997 and 2001. Ibid., p. 6.

growing excess supply capability,[26] this decline is not entirely unexpected. However, capital investment is seen as "absolutely critical"[27] in this industry, and if this downturn in investment is the beginning of a long term trend it may have significant ramifications for the industry.

Financial Conditions

Publicly available data sources do not contain financial information for the tooling industry, but limited data were collected in the Commission's questionnaire, including income statement information and some supplemental financial information on debt, costs, and investment. Some 286 producers provided useable financial data on their TDM operations, although not all producers reported for all periods.[28] The vast majority of reporting companies have a FY ending December 31, hence, reported data represent nearly 100 percent of total shipments reported in questionnaire responses for 2001.

Financial Performance

Income and loss data for U.S. producers' TDM operations are presented in table 3-6. Following the trends of other data collected, financial performance generally improved between 1999 and 2000, and worsened between 2000 and 2001. Although the value of sales peaked in 2000, it fell overall from 1999 to 2001, as did the components of cost of goods sold (COGS); selling, general, and administrative expense (SG&A); and operating income. However, COGS and SG&A did not fall as fast as sales in absolute or in percentage terms, and operating income declined significantly during 1999-2001, falling from $95.8 million in 1999 to $13.2 million in 2001 (a decrease of 86.3 percent), after rising between 1999 and 2000. Net income before taxes also fell rapidly from $72.9 million in 1999 to a loss of $8.7 million in 2001 (a decrease of 112.0 percent), despite increasing from 1999 to 2000. Cash flow (net income before taxes plus depreciation) also fell by $72.2 million (45.2 percent) between 1999 and 2001 due to the industry's lower net income before taxes. The number of firms reporting operating losses and net losses before taxes nearly doubled between 1999 and 2001.

To examine financial performance by firm size, the reporting companies were ranked according to their net sales value and then divided into five segments based on ranges of net sales values (table 3-7). With the exception of midsize firms in the $5 million to $10 million sales segment, profitability (as measured by income-to-sales ratios) appears to be loosely correlated with firm size. For each larger sales segment, profitability generally increases, although the mid-sized segment ($5 million to $10 million) generally outperforms the segment just above it ($10 million to $20 million). All segments experienced lower profitability between 2000 and 2001, with 2001 performance also

[26] Coffey, transcript of the hearing, p. 36.

[27] Ibid., p. 35.

[28] For example, one company reported that it went out of business in 2000 and did not report their results for 2001; conversely, four other companies stated they had changed their corporate structures in 1999 and reported full data only for 2000 and 2001.

Table 3-6
Results of tool, die, and industrial mold operations of reporting U.S. producers, fiscal years 1999-2001

Item	Fiscal year 1999	2000	2001
	Value (*1,000 dollars*)		
Commercial sales and exports	1,637,921	1,719,925	1,421,481
Internal consumption and transfers	62,512	111,242	59,030
Total net sales	1,700,433	1,831,167	1,480,511
Cost of goods sold:			
Raw materials	345,569	419,906	312,961
Direct labor	569,410	571,798	500,434
Other factory costs	415,909	446,241	392,933
Total cost of goods sold	1,330,888	1,437,945	1,206,328
Gross profit	369,545	393,222	274,183
Selling, general, and administrative expenses	273,709	282,959	261,007
Operating income or (loss)	95,836	110,263	13,176
Interest expense	29,909	36,140	30,242
Other income or (expense), net	6,933	10,044	8,333
Net income or (loss) before taxes	72,860	84,167	(8,733)
Depreciation/amortization	86,992	95,500	96,391
Cash flow	159,852	179,667	87,658
	Ratio to net sales (*percent*)		
Cost of goods sold:			
Raw materials	20.3	22.9	21.1
Direct labor	33.5	31.2	33.8
Other factory costs	24.5	24.4	26.5
Total cost of goods sold	78.3	78.5	81.5
Gross profit	21.7	21.5	18.5
Selling, general, and administrative expenses	16.1	15.5	17.6
Operating income or (loss)	5.6	6.0	0.9
Net income or (loss)	4.3	4.6	(0.6)
	Number of firms reporting		
Operating income losses	69	67	116
Net losses before taxes	73	75	126
Data	264	268	267

Source: Compiled from data submitted in response to Commission Producers' questionnaires.

well below 1999 performance. Small firms, with sales of less than $1 million per year, posted aggregate losses in all 3 years. Since Census data show that such firms account for just over 75 percent of the industry (table 3-1), this implies that a substantial portion of the industry is in financial difficulty.

Table 3-7
U.S. tool, die, and industrial mold industry: Salient data for U.S. producers, grouped by value of net sales, fiscal years 1999-2001

Sales ranges and numbers of firms[1]	Total net sales	Operating income or (loss)	Net income or (loss)	Ratio to net sales: Operating income or (loss)	Ratio to net sales: Net income or (loss)
	1,000 dollars			*Percent*	
			1999		
Over $20 million (15 firms)	660,617	41,106	30,971	6.2	4.7
$10 to $20 million (26 firms)	367,865	23,045	19,479	6.3	5.3
$5 to $10 million (49 firms)	336,821	21,870	17,705	6.5	5.3
$1 to $5 million (120 firms)	303,936	10,297	5,723	3.4	1.9
Less than $1 million (54 firms)	31,194	(482)	(1,018)	(1.5)	(3.3)
Total/average for 264 firms	1,700,433	95,836	72,860	5.6	4.3
			2000		
Over $20 million (16 firms)	753,026	61,164	50,380	8.1	6.7
$10 to $20 million (29 firms)	403,473	23,019	14,821	5.7	3.7
$5 to $10 million (42 firms)	303,897	20,382	16,439	6.7	5.4
$1 to $5 million (131 firms)	342,754	6,178	3,265	1.8	1.0
Less than $1 million (50 firms)	28,017	(479)	(738)	(1.7)	(2.6)
Total/average for 268 firms	1,831,167	110,263	84,167	6.0	4.6
			2001		
Over $20 million (13 firms)	510,830	16,948	7,324	3.3	1.4
$10 to $20 million (24 firms)	326,926	(3,251)	(9,835)	(1.0)	(3.0)
$5 to $10 million (45 firms)	308,262	8,088	1,313	2.6	0.4
$1 to $5 million (127 firms)	305,821	(6,106)	(4,818)	(2.0)	(1.6)
Less than $1 million (58 firms)	28,672	(2,503)	(2,717)	(8.7)	(9.5)
Total/average for 267 firms	1,480,511	13,176	(8,733)	0.9	(0.6)

[1] Due to fluctuations in total sales value, firms operating near the thresholds may shift groups from year to year.

Note.–Operating income and net income are comparable to table 3-6.

Source: Compiled from data submitted in response to Commission Producers' questionnaires.

Costs

U.S. TDM producers also provided information on their costs of sales and costs of production.[29] COGS slowly but steadily increased as a share of sales, by just over 3 percentage points, to 81.5 percent during the 3-year period. Increases in cost shares for raw materials, direct labor, and other factory costs all contributed to the rise. Responding firms were requested to report the share of certain categories of costs as a percentage of their total cost of production. Reported cost shares, averaged over FYs 1999-2001, are shown in the following tabulation (in percent):

[29] Census and BLS collect aggregated annual information on material costs and employment costs, respectively. Such information is available only through 2000 at the time of this report.

Cost category	Cost share
Direct labor costs	43
Factory overhead	26
Raw materials	19
Other outside costs	6
Purchased subassemblies	4
Assembly and finishing costs	3
Total	[1]101

[1] Does not sum to 100 due to rounding.

The relative shares exhibited only slight annual variation with no discernible trend over the 3-FY period. Respondents further specified rising costs of materials, labor, healthcare, and employee training as among the top factors hindering their ability to compete.

Labor costs

Labor costs represent not only the largest production cost category, but one that has elicited much concern in discussions with industry officials. The Commission's questionnaire requested information on various aspects of labor costs (table 3-8). Total labor costs fell 6.0 percent between FYs 1999 and 2001, primarily due to declining overall employment, but costs per employee grew by 8.4 percent. On a per-employee basis, all areas of cost have increased.

Although average hourly compensation increased (table 3-5), salaries and wages as a percent of total employee costs fell slightly between 1999 and 2001, from 82.7 percent to 81.2 percent. Because of declining employment, total salaries and wages fell by 7.7 percent, and was the prime contributor to the decline in total costs. Salaries and wages paid per employee increased by 5.9 percent, in line with the 5.6-percent increase in the average hourly wage rate for shop personnel. The average hourly wage rate reported by questionnaire respondents (rising over the period from $19.48 in FY1999 to $20.65 by FY2001, table 3-5) is relatively high compared to average manufacturing rates,[30] reflecting the high level of skill and training required for most toolmaking activities.[31] These hourly wage rates are also well above those reported by the BLS for the TDM industry, which increased steadily to a peak of $18.04 in 2001.

[30] Average hourly wage rates for manufacturing in general rose from $13.90 to $14.83 over the same 3-year period. BLS, "Average Hourly Earnings of Production Workers," Series EEU30000006, found at *http://data.bls.gov/egi-bin/srgate*, retrieved Aug. 20, 2002.

[31] Since tool and diemaking is more and more a highly technical, highly skilled position, a typical journeyman can easily earn $50,000 to $75,000, or even $80,000 a year. Belzer, transcript of the hearing, p. 120.

Table 3-8
U.S. tool, die, and industrial mold industry: Employee costs, cost shares, and costs per employee, fiscal years 1999-2001

Item	Fiscal year 1999	2000	2001	1999 to 2000	2000 to 2001	1999 to 2001
Employee costs:	(*1,000 dollars*)			(*Percent*)		
Salaries and wages	701,099	737,977	646,875	5.3	-12.3	-7.7
Health benefits	66,633	74,730	75,304	12.2	0.8	13.0
Other benefits	76,227	79,433	70,281	4.2	-11.5	-7.8
Training	3,893	4,973	4,416	27.7	-11.2	13.4
Total	847,852	897,115	796,876	5.8	-11.2	-6.0
Share of total employee costs:	(*Percent*)					
Salaries and wages	82.7	82.3	81.2	([1])	([1])	[2] 82.2
Health benefits	7.9	8.3	9.5	([1])	([1])	[2] 8.6
Other	9.0	8.9	8.8	([1])	([1])	[2] 8.9
Training	0.5	0.6	0.6	([1])	([1])	[2] 0.6
Total	100.5	100.1	100.1	([1])	([1])	[2] 100.2
Costs per employee:	(*Dollars*)					
Salaries and wages	45,926	50,104	48,637	9.1	-2.9	5.9
Health benefits	4,365	5,074	5,662	16.2	11.6	29.7
Other benefits	4,993	5,393	5,284	8.0	-2.0	5.8
Training	255	338	332	32.4	-1.7	30.2
Total	55,539	60,908	59,914	10.1	-1.6	8.4

[1] Not applicable.
[2] Period average.

Source: Compiled from data submitted in response to Commission Producers' questionnaires.

Materials costs

According to official Census statistics for 1997 and 2000, materials costs grew by 8.8 percent (table 3-9), slightly faster than the 5.6 percent rise in industry shipments,[32] and rose slightly from 28.4 percent to 29.3 percent of shipment value. Between 1999 and 2000, materials costs for the Commission's sample increased by 22 percent, far greater than both the growth in shipments (8 percent) and Census data, which showed an increase of 5.0 percent in the cost of materials. However, for 2001, questionnaire respondents reported materials costs fell 25 percent, while shipments fell by only 19 percent from the previous year's level. Among TDM manufacturing sectors, producers of special dies, tools, jigs, and fixtures experienced greater materials cost increases (6.4 percent) than did those producing industrial molds (2.8 percent) between 1999 and 2000. However, over the longer 1997-2000 period, special die, tool, jig, and fixture producers enjoyed lower materials-costs increases (7.9 percent) than did industrial mold producers (10.4 percent), according to Census data.

[32] Although Census product shipment data increased from $14.5 billion in 1997 to $15.3 billion in 2000, this material cost data are reported on an industry basis and must be compared with Census industry shipment data, which increased from $13.3 billion in 1997 to $14.1 billion in 2000 (increase calculated on unrounded numbers). The difference is shipments by firms whose primary output is not TDMs, and are therefore not included in the TDM industry classifications.

Table 3-9
U.S. tool, die, and industrial mold industry: Cost of materials, 1997-2000

(*1,000 dollars*)

Item	Calendar year			
	1997	1998	1999	2000
Tools, dies, and industrial molds (SIC Code 3544)	3,793,042	3,796,919	3,931,102	4,127,995
Industrial molds (NAICS industry 333511)	1,411,514	1,408,129	1,515,720	1,558,303
Special dies, tools, jigs, and fixtures (NAICS industry 333514)	2,381,528	2,388,790	2,415,382	2,569,692

Source: U.S. Census Bureau, "Statistics for Industry Groups," *Annual Survey of Manufactures*, (various years); and "Metalworking Machinery and Equipment," *Census of Manufactures*, (various years).

Materials, such as metals, and TDM parts and components, are generally available from a number of global suppliers. Because TDM producers are typically small companies and the steel they purchase is of high quality, they generally cannot purchase steel in quantities large enough to receive price discounts. With regard to steel costs, the President's remedy determination under section 203 of the Trade Act of 1974 as the result of an affirmative determination of injury under the recent safeguard investigation[33] has provoked mixed conclusions regarding its impact on U.S. tooling producers. Although the majority of tool steel used by U.S. TDM producers was not subject to the imposition of additional tariffs announced in March 2002 by the U.S. Government,[34] certain steel products used by toolmakers are subject to these tariffs, such as stainless steel bar and rod and some other alloy or carbon steels.[35] Although some reports indicate that mold and die steel prices subject to the safeguard tariffs did not rise in price because of existing inventories in the United States,[36] other moldmakers have reported difficulties due to increased steel costs.[37] Of greater concern for die producers were the effects of tariffs and increased prices on sheet steel used by their stamping customers. According to industry officials, higher sheet steel prices have adversely affected the price of domestic stamped parts, causing companies to seek out foreign stamped-parts sources, thereby reducing domestic demand for stamping dies. Discussions with officials of U.S. firms involved in the production of stamped parts confirm that the effect the program has had on sheet steel pricing and availability in the U.S. market has caused them to start investigating the relocation of stamping operations offshore.[38]

[33] Presidential Documents, Memorandum of March 5, 2002, *Action Under Section 203 of the Trade Act of 1974 Concerning Certain Steel Products*, 67 *FR* 10593, Mar. 7, 2002, 67 *FR* 12635, Mar. 19, 2002, and 67 *FR* 16485, Apr. 5, 2002.

[34] For example, a domestic TDM producer testified before the Commission that because tariffs were not levied on tool steel, there was very little effect on the firm's mold and die-casts building operations. Testimony of Michael Retzer, controller, W.G. Stronhwig Tool & Die, Inc., transcript of the hearing, p. 226.

[35] Joseph Pryweller, "Tool-Steel Suppliers Seek Tariff Exemptions," *Plastics News*, May 6, 2002, found at *http://www.plasticsnews.com*, retrieved May 6, 2002. Subsequent Administration actions in July and August excluded certain steel grades used for tooling production that had originally been included in the tariff program.

[36] Ibid.

[37] Frank Haflich, "Buyers Protest, Share '201' Horror Stories," *American Metal Market*, Sept. 9, 2002, p. 2.

[38] U.S. automotive parts industry officials, interview by USITC staff, Sep. 2002.

Healthcare costs

Many U.S. TDM producers contend that healthcare insurance premiums, other healthcare costs, and human resource regulations have greatly added to their overhead and direct labor costs. In addition to the information collected in Commission questionnaires, hearing testimony,[39] and written submissions, discussions at conferences, and during staff visits to production facilities yielded reports of concern over the costs of providing healthcare benefits. Total health-care costs for questionnaire respondents rose by 13 percent, which when coupled with declining employment yielded a 30-percent increase in healthcare costs per employee over the 3-year period from 1999 to 2001. Although salary per employee and other costs per employee both fell between 2000 to 2001, healthcare costs increased over the 3-year period, up by 16 percent for 2000 and up 12 percent for 2001.[40] These sharp increases drove the share of total costs accounted for by health benefits up from 8 percent in 1999 to 9.5 percent in 2001. Representatives of domestic TDM producers testified that measures undertaken to moderate the rising cost of health coverage included cost-sharing by employees,[41] dropping of some coverage,[42] seeking of less-expensive carriers,[43] and cutting back and switching over benefits for retirees.[44]

Employee training costs

Likewise, significant increases in costs for employee training observed in questionnaire data track information from other sources. Total training costs for employees increased by 13 percent between 1999 and 2001, although training costs still averaged less than 1 percent of total employment costs. However, increased training needs coupled with falling employment levels combined to increase training costs 30 percent per employee over the 3-year period from 1999 to 2001. This steep increase reflects the changing labor-skill needs and skill levels of new workers. An increasing ratio of designers to production staff[45] and the need for expertise in a variety of design, modeling, and manufacturing computer-software packages seem to have increased the need for ongoing

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[39] For example, a tool and die manufacturer characterized costs of health insurance as a serious problem for small businesses, with premiums continuing to increase at "an alarming rate." Testimony of Laurie Moncrieff, president and owner, Schmald Tool & Die, Inc., transcript of the hearing, p. 189.

[40] For comparison, a tool and die manufacturer noted that insurance costs (including Workers' Compensation, short-term disability, and property) have been increasing 15 to 20 percent a year. Ibid., pp. 188-189.

[41] For example, at the beginning of 2002, employees at Progressive Die & Automation and Quality Die & Mold were requested to help pay for their health insurance for the first time in 18 years. Rasmussen, transcript of the hearing, pp. 67-68.

[42] At that same time, employees were informed that Progressive Die & Automation and Quality Die and & Mold could no longer afford to provide dental coverage. Ibid.

[43] Moncrieff, transcript of the hearing, p. 189.

[44] For example, in shopping for a new medical insurance carrier, beginning in 1997, Schmald Tool & Die, Inc. found that carriers declined to provide cost quotes, if coverage was to include retirees. Retiree medical coverage is no longer carried by Schmald and retirees were placed into an optional (COBRA) plan. Ibid.

[45] IRN Inc., *A Competitive Assessment of the Die and Mold Building Sector*, May 2002, p. 68.

training.[46] Likewise, potential apprentices must not only have very strong mechanical and mathematical aptitudes, but now must have a high level of computer literacy as well.[47] Qualitative responses on the questionnaires, in testimony and in submissions also indicate that, partly as a result of the phase-out of vocational training courses by many high schools, new employees entering the toolmaking trades are increasingly less well-prepared in core skills than their predecessors.[48] This trend also contributes to increasing training requirements and expenditures for individual firms.

Sources of Funds

The significant requirements for capital investment in this industry, and trends by customers to stretch out payments and require TDM firms to finance tooling, make it imperative that firms have access to funds to cover such financing requirements. There are different types of financial capital available for different purposes with a range of maturities, risk, and cost. Many TDM firms also have access to loan guarantees and diverse financing assistance through various Federal and State programs (available to all industries) that are identified in the "Government Programs" section of this chapter. The choice of whether to finance investment with debt or with equity is important (historically, investment has been financed with roughly 40 percent debt and 60 percent equity[49]), because debt-financed corporate investment enjoys a tax advantage over equity-financed corporate investment,[50] and the tax advantage is heightened during periods of inflation. But the risk is that the company may become over-leveraged, which exacerbates the effect of a downturn in revenue.

In response to a questionnaire request regarding sources of funds for all uses (not just capital expenditures), many firms indicated that they relied on a mix of financing sources. The vast majority (98 percent) stated that cash flow[51] is a primary source; this was followed by secured debt (70 percent), unsecured debt (24 percent), and the issuance of equity (6 percent). These responses are in line with an industry composed of small, privately held firms that are leveraged (e.g., see interest expense in table 3-6).

With respect to secured and unsecured loans as a source of funding, there was the widespread perception, voiced by company executives at the Commission hearing, that the banking industry had figuratively turned its back on the TDM industry, although this

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[46] As drawings and specifications are increasingly transmitted electronically, toolmakers generally need proficiency in the customer's design software.

[47] Testimony of Bruce Braker, president, Tooling & Manufacturing Association (TMA), transcript of the hearing, p. 121.

[48] Potential workers would graduate from high school with some background in vocational education, but not sufficient enough to be hired as an apprentice on the shop floor. Rather, they would work their way through a 4-year apprenticeship program, as a "college education" in tool and diemaking. Belzer, hearing transcript, p. 119.

[49] U.S. Treasury, *Report to The Congress on Depreciation Recovery Periods and Methods*, July 2002.

[50] Interest paid on debt is tax deductible, and both the corporation and shareholder benefit. In contrast, the corporation is not allowed to deduct inputed interest on an equity-financed investment, so it is taxed once at the corporate level and again in the form of dividends or capital gains to the shareholder.

[51] Cash flow is calculated as the sum of after-tax net income plus depreciation.

impression may reflect broader trends in the banking industry.[52] During the course of this study, management personnel at several firms decried changed lending practices, as local, community-based banks have been taken over and incorporated into larger, often nationwide, organizations. This shift has reportedly reduced the importance of long-term personal relationships in securing loans as local branches have less flexibility in making lending decisions.[53]

Some of the difficulties appear to be cyclical problems, as financial institutions become less willing to finance capital investment when economic conditions weaken. It appears that this has been the case for the industry since the end of 2000. However, financing for operating capital is just as important, and TDM firms appear to be encountering long-term problems with this type of financing. As customers stretch out payment schedules, firms need to be able to borrow against accounts receivable. However, banks reportedly will not lend on accounts receivable beyond 30 days, and payments in this industry typically are made well beyond 30 days from delivery.[54]

These industry-specific perceptions seem to reflect observations made at a more aggregate level. Lending and credit have been affected by a number of factors in the past several years, including a general decline in the quality of borrowers' balance sheets and increased default rates; consolidation in the banking industry; and tie-in of banks' cash management services to secure short-term credit instruments. Many of the firms in the TDM industry are privately held or their creditworthiness has not been rated by one of the three major credit rating agencies, and the experience of other such non-investment-grade firms reportedly has been that banks have tightened the terms of extending credit to them, including shorter terms, higher rates, lower amounts, faster repayment, and restricting the uses of the company's cash flow to repay debt.[55] Many non-investment-grade borrowers rely on the syndicated loan market or bank lines of credit; following years of consolidation in the banking industry, commercial banks are fewer in number and tend to service existing clients. Also, with the increase in credit ratings on new loans, the riskier credits are squeezed out.[56] Short-term credit has become more expensive, in part due to the general decline in company credit ratings as well as pressure from banks to purchase high-margin cash-management services.[57] Considering these factors, it is understandable that the TDM industry relies on cash flow and "asset-based

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[52] Braker, hearing transcript, p. 32; Baron, hearing transcript, p. 59; Coffey, hearing transcript, p. 114; testimony of Michelle Cleveland, vice president, The Right Place Economic Development Program of Greater Grand Rapids; and vice president, CAMTI, hearing transcript, p. 125; Olav L. Bradley, chairman, Government Affairs, AMBA, hearing transcript, p. 126; and Rasmussen, hearing transcript, p. 128.

[53] Cleveland, hearing transcript, p. 125.

[54] Bradley; Belzer; and Rasmussen, hearing transcript, pp. 126-128.

[55] It should be noted that many, if not the vast majority, of the firms in this industry do not have the size or credit rating necessary to be an "investment-grade" borrower, that is to have access to the commercial paper or to the bond market, and, thus are dependent upon bank lending for short-term credit. A tightening of bank lending; starting in 2000, is expected to continue, even for large businesses. Andrew Osterland, "To Lend and Lend Not: Corporate Borrowers are Finding That an Investment-Grade Credit Rating Makes a Big Difference," *CFO Magazine*, Dec. 1, 2001, found at *wysiwyg://22/http:www.cfo.com*, retrieved June 25, 2002.

[56] Ibid.

[57] Marie Leone, "Credit Squeeze: Turning the Screws on Borrowers," *CFO Magazine*, May 1, 2002, found at *wysiwyg://18/http://www.cfo.com*, retrieved June 25, 2002.

lending" in which a loan is collateralized by a company's asset(s), including accounts receivable, inventory, or equipment.[58]

The TDM industry has not attracted venture capital because returns have not been commensurate with the risk of investment in what is perceived to be a mature and fragmented industry. Venture capital tends to flow to firms in industries expected to experience significant growth, as was the case in the late 1990's with Internet-oriented (e-commerce) companies, telecommunications, or other industry sectors.[59] Also, very few of the many firms that produce TDMs are public (i.e., have issued stock), or intend to go public, or possess a balance sheet and credit rating enabling them to tap into the commercial paper market.[60]

Investment, Research, and Development

The responding firms' data on capital expenditures, research and development (R&D) expenses, and the value of their property, plant, and equipment used in the production of TDMs are shown in table 3-10. Thirty-three producers reported incurring expenses for R&D, which are usually associated with improving existing products or equipment, or developing new products or equipment.

Nearly all responding U.S. producers reported capital expenditures during 1999-2001. The value of fixed assets increased between those years in response to capital expenditures made by the producers in their plant, property, and equipment to increase

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[58] Walter Einhorn, CPA, "Are You Having a Credit Crisis?" *Strategic Finance*, July 2002, found at *http://www.strategicfinancemag.com/2002/07h.htm*, retrieved Aug. 20, 2002. The author cites an estimate of the Commercial Finance Association that more than 24 percent of all outstanding loans are short-term loans from asset-based lenders. Leasing is one such form of asset-based loan.

[59] Rob Wright, "E&Y: It's a Jungle Out There–Venture Capital May Be Back, But Start-Ups Still Face an Uphill Battle," *VARbusiness*, June 10, 2002, found at *http://proquest.umi.com/pqdweb*, retrieved June 25, 2002. Companies may be ranked and analyzed according to their growth rates, cash flow, and market share. See Michael E. Porter, *Competitive Strategy: Techniques for Analyzing Industries and Competitors* (New York: Free Press, 1980), p. 362.

[60] Quite a few of the companies that responded to the Commission's questionnaire stated they were Subchapter S corporations. Subchapter S of the Internal Revenue Code defines the requirements of this limited liability form of business organization in which the income and certain deductibles flow through the entity to the partners to be included on the partners' individual tax returns. Up to 75 individuals, including estates and certain trusts may form such a business entity. A subchapter S corporation may invest in a partnership (e.g., two S-corporations, each composed of 75 individuals, could form a partnership), but the reverse is not allowed. Theoretically, this should not stymie a venture capitalist from investing in the TDM industry, and the structure of a subchapter S corporation is to encourage individual investors; the declining returns in a fragmented mature industry with low market power appear to pose a greater hurdle.

Table 3-10
Capital expenditures, research and development expenses, and asset values of U.S. producers of tools, dies, and industrial molds, fiscal years 1999-2001

(*1,000 dollars*)

Item	Fiscal year 1999	2000	2001
Capital expenditures	115,879	136,734	103,476
Research and development expenses	9,759	12,621	11,357
Fixed assets:			
Original cost	2,136,782	2,217,040	2,260,024
Current book value[1]	738,895	669,505	591,555

[1] Cost less accumulated depreciation.

Source: Compiled from data submitted in response to Commission Producers' questionnaires.

production capacity, to improve production efficiency, or to purchase new equipment. The reported capital expenditures in table 3-10 compare favorably with the depreciation expenses that these same firms reported during the same periods, an indication that in the aggregate, equipment is being replaced or modernized faster than the rate at which it is losing economic value. However, the value of capital expenditures fell to a 3-year low in 2001, after rising the previous year, reflecting deteriorating industry conditions. Moreover, the book value of fixed assets fell between those years, a general indication of firms exiting the industry or the writing off impaired assets.

Major Consuming Industries

The largest single end-user for tooling is the motor vehicle industry, accounting for more than one-half of all tooling consumed in the United States. The other major end-user of tooling is the home appliance industry. The end-use markets for dies differ somewhat from those of molds. Although specific end-use market data are not available, the following tabulation shows end-use industries of stampings in 1999, which likely approximate the end-use industries of dies (in percent):[61]

End-use industries for stampings, 1999	Market share
Motor vehicles	64
Home appliances	5
Other motors/agricultural equipment	5
Construction	4
Cooking ware	4
Office appliances	3
Furniture	3
All other	12
Total	100

The major consuming industry of molds is the motor vehicle industry, followed by electronics and appliance industries, as shown in the following tabulation (in percent):[62]

[61] Reinhard L. Geissbauer, Roland Berger & Partners International Management Consultants, "Growth in Press Sales May Soften," *Stamping Journal*, Jan./Feb. 2000, p. 38.

[62] Jeff Mengel, "North American Update: Money Making Molds," Plante & Moran, LLP, 2001.

End-use industries for molds, 2001	Market share
Motor vehicles	41
Electronics	16
Appliances	14
Packaging	10
Medical	6
Toys	4
All other	9
Total	100

Motor Vehicles

The motor vehicle industry uses TDMs to produce the large variety of stampings, molded plastic products, and die castings used by this industry. Automotive tooling producers typically supply Tier 1 and Tier 2 manufacturers[63] of stampings, molded plastic products, or die castings. The Tier 1 and Tier 2 suppliers, in turn, supply original equipment manufacturers (OEMs) with finished motor vehicle parts made from this tooling. Producers of stamping dies also may directly supply OEMs with tooling since all automakers also provide large percentages of their stamping needs[64] through their own internal production.[65] Very few automotive OEMs internally produce any portion of their molded plastic products or die castings and tend to purchase virtually all such products through Tier 1 suppliers.[66] Finally, a number of smaller tooling manufacturers with

[63] According to U.S. automotive industry officials, components that are not supplied through captive, in-house production by an OEM are supplied directly to the OEM by a Tier 1 supplier. A Tier 2 supplier, in turn, may supply certain components to the Tier 1 supplier. The toolmaker either supplies the OEM directly, or the Tier 1 or Tier 2 supplier directly. Many Tier 1 suppliers were at one time owned by the OEMs and were later spun off as separate businesses, largely because of their heavy capital requirements, while other Tier 1 suppliers began as toolmakers and later developed into component manufacturers. Telephone interviews by USITC staff, Feb.-Aug. 2002.

[64] All motor vehicle manufacturers in North America also have significant in-house captive capacity to produce the various stampings needed to supply their own product production. At present, General Motors manufactures 82 percent of its stampings in-house, DaimlerChrysler, 66 percent, and Ford 58 percent. Geissbauer, "Growth in Press Sales May Soften," p. 37. In addition, OEMs also maintain some in-house, captive tool and die capacity to meet part of their tooling needs. According to Riviera Tool Co., General Motors maintains the largest tool and die captive capacity, internally supplying an estimated 75 to 80 percent of its die needs, while Ford and DaimlerChrysler internally supply 50 percent and 25 percent, respectively, of their die needs. Riviera Tool Co., "Annual Report on Form 10-K405," p. 5.

[65] Major motor vehicle stampings include large Class A motor vehicle body structural stampings and assemblies, such as doors, hoods, floor panels, side panels, frames, deck lids, fenders, bumpers; lower vehicle structural stampings and assemblies, including engine cradles, side rails, roll bars, and cross members; and suspension components, which include control arms, suspension links, and support brackets.

[66] Major molded plastic motor vehicle components include the Class A surface items installed in the interior of the vehicle and most visible to the passenger, such as door trim panels, instrument panels, headliners, the seat assemblies (seat parts and trim), window parts and visors, as well as less visible components such as wheel housings. Major die cast components used in motor vehicles may include large components such as cylinder heads, oil pans; transmission bell housing and transfer cases; ladder frames; and roof rails on convertibles; as well as a large number of parts that are attached to the engine, including alternator and power steering pump brackets, and a large number of electrical components.

particular TDM expertise will often supply specialized tooling to other tooling manufacturers as part of larger tool sets.

The decision on whether to purchase a particular component or produce in-house is typically based on a number of considerations, including the anticipated volume of the proposed component and assumptions on whether such volume exceeds the ability of in-house resources to supply it, as well as strategic considerations related to the physical location of proposed automobile production and the ability of press capacity at the location to supply the component. In some instances, a limited-volume stamping will be purchased rather than internally produced in order to avoid committing valuable in-house stamping resources that can be better used to produce larger-volume components. The level of in-house stamping production may also be specified by terms of labor contracts a company may have with the United Automobile Workers (UAW). In-house component production is said to permit closer monitoring of quality control for certain parts and permits greater flexibility in using press equipment for a variety of vehicle models. In addition, an in-house stamping operation can offer additional profit opportunities for the OEM.

When outsourcing its tooling needs, an automotive OEM typically works from a bid list of 4-6 pre-qualified suppliers who have demonstrated they have the technical capability to produce tooling that meets OEM quality standards. This bid list has typically been refined over time from a larger universe of potential tooling suppliers. Qualifying for an automotive bid list is often a difficult process requiring a series of plant inspections to establish that the prospective bidder has the equipment and technical capability to fulfill an order. In addition, the toolmaker may be required to have certain press capacity to produce tryout or prototype parts to allow the OEM to monitor product quality. In recent years, OEMs, in cooperation with Tier 1 suppliers, have begun to impose certain ISO/QS-9000 series certification standards[67] to ensure the tooling quality, typically the QS-9000 TE (Tooling and Equipment) Supplement. Part of this certification process consists of routine audits of a toolmaker's technical and business processes and facilities to ensure

[67] The ISO 9000 series includes three quality assurance models against which organizations can be certified: ISO 9001, ISO 9002 and ISO 9003. The difference between these three standards is simply one of scope. An organization chooses among ISO 9001, ISO 9002 or ISO 9003 according to the business processes covered by the quality system. There is no difference of quality ranking between the three standards. ISO 9001 sets out the requirements for an organization whose business processes range from design and development to production, installation and servicing. ISO 9002 is the appropriate standard for an organization which does not carry out design and development since it does not include the design control requirements ISO 9001–otherwise, its requirements are identical. ISO 9003 is the appropriate standard for an organization whose business processes do not include design control, process control, purchasing or servicing, but basically uses just inspection and testing to ensure that final products and services meet specified requirements. The ISO has published a booklet titled *ISO 9001 for Small Business* and has information on the publication at *http://www.iso.ch/iso/en/commcentre/pressreleases/2002/Ref827.html*. The QS-9000 TE Supplement requirements were developed by the Big Three automobile firms as a means of combining their individual supplier quality requirements into a uniform supplier standard. QS-9000 incorporates ISO9000:1984.

that their product will be consistent in quality.[68] Tooling quality in the motor vehicle industry is further measured by supplying the customer with certain "tryout" and "prototype" components produced by the tooling to assure that they will match the customer's quality standards. In recent years, the motor-vehicle OEMs have attempted to reduce the list of qualified component and tooling suppliers in order to reduce the complexity of managing a large number of suppliers and to capture cost savings resulting from volume discounts offered by individual suppliers.[69]

Appliances

The major U.S. household appliance[70] OEMs generally produce large stampings[71] and molded[72] products through captive, in-house production due to the high costs of shipping bulk components across long distances.[73] In addition, shipping often exposes stampings with painted surfaces to scratches. When components are internally produced, the OEM generally purchases tooling from outside vendors. Appliance OEMs tend to purchase smaller stampings and moldings[74] through independently owned custom stampers and molders. The custom stamper or molder then contracts with a toolmaker to supply the tooling. Whether a company internally produces a component or purchases it from outside sources may also depend on whether the particular appliance plant has sufficient capacity to produce the necessary volume of components. For more complex components, appliance manufacturers tend to order tooling from a select group of toolmakers who have been pre-qualified as having the necessary equipment, capacity, and technical expertise to manufacture the tooling.[75] In recent years, appliance OEMs have also sought to reduce the number of their tooling suppliers in order to reduce costs associated with sourcing from a larger supplier list and to achieve cost savings due to volume discounts offered by individual suppliers.[76]

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[68] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), p. 4.

[69] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[70] Major household appliances consist of refrigerators, gas stoves and electric ranges, washing machines and dryers, microwave ovens, air conditioners, and vacuum cleaners.

[71] Major appliance stampings include large components such as body liners, inner and outer doors; the cabinet shell of a refrigerator; the top, cabinet, back, and base pan of an automatic washer; and the welded steel drum of an automatic dryer.

[72] Major molded plastic appliance components include washer tubs and agitators for washing machines, door bins, handles, and crisper bins for refrigerators; pump housings and spray parts; tubes and hoses; and various trim pieces, connectors, panels, and brackets. Vacuum cleaner components often include the vacuum cleaner housing, as well as a number of plastic attachments. Die cast components for use in appliances may include motor mounts, door latches, and various transmission components for washing machine agitators.

[73] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[74] Smaller stamped and molded components include the end cap of an automatic washer console, as well as various baskets, brackets, clips, and clamps to secure components in washers, dryers, and refrigerators.

[75] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[76] Ibid.

Electronics and Telecommunications

Since the electronics and telecommunications industry[77] includes a large number of diverse product lines, the manufacturing structure for different subsectors tends to differ according to the final product. Unlike the automobile and appliance industries, where OEMs will often manufacture a substantial amount of their own components, most OEMs in the electronics and telecommunications industry tend to contract out production of the final product components and tooling. This outsourcing trend has grown in recent years as it has become cost-effective for OEMs to purchase subassemblies or final products rather than to produce them in captive, in-house production facilities. In the cellular telephone and computer industries, in particular, contract manufacturers now assume many of the functions formerly performed by OEMs, including product design, sourcing of product inputs, production of components, assembly into a finished product, delivery of the finished product, and supply chain management[78] responsibilities.[79] In turn, the role of the custom molder and stamper has changed from one of supplying components directly to the OEM to supplying increasing amounts of their production to the contract manufacturer. In the television industry, the custom molder or stamper is typically under contract with the OEM to supply particular components for final assembly by the OEM and is often supplied the tooling by the OEM.[80]

Plastic Packaging and Medical Equipment

Molds for plastic packaging and medical equipment are manufactured by tooling firms that supply TDMs to plastics processors, which in turn manufacture the finished product under contract to the final user, typically a food processor, restaurant chain, or distributor for these products. No known tooling is manufactured through captive, in-house production by the final user.[81] The plastic-packaging tooling market is essentially divided between manufacturers of blow molds[82] and thermoformed molds.[83]

The medical supply industry uses injection and extrusion molds to manufacture such medical devices as syringes, catheters, intravenous lines, plastic parts for pumps and housings, as well as plastic handles and knobs on medical equipment. Toolmakers

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[77] Major electronic and telecommunications components typically include injection molded products such as plastic housings and internal plastic components for cellular phone handsets; plastic housings and internal components for AM/FM and two-way radios; plastic cabinets and internal plastic components for televisions; and plastic enclosures and internal components for computer printers, monitors, central processing units, and keyboards.

[78] Supply chain management refers to managing the way in which a company coordinates, in the most efficient manner possible, the inputs needed to make a product or service, the manufacturing of the product or service, and delivery to customers. Efficient supply chain management results in reduced inventory levels and costs.

[79] U.S. electronic/telecommunications industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[80] Ibid.

[81] U.S. tooling and plastic packaging and medical equipment industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[82] Blow molds are used to manufacture plastic containers used for soft drinks and other food products, windshield washer bottles, plastic fuel tanks, etc.

[83] Thermoformed molds are used to manufacture disposable containers, GladWare containers, clear clamshells (used for packaging in fast-food restaurants), microwavable containers, plastic trays, blister packages, plastic drinking cups, etc.

manufacturing molds for medical uses sell directly to custom molders who then manufacture the finished product under contract to the medical-equipment OEMs. Standards for tooling performance and longevity are solely imposed by these medical-equipment OEMs.[84]

Determinants of U.S. Demand for Tooling

The principal factor affecting demand for tooling appears to be the level of capital spending by business on manufacturing equipment for use in the production of new products or models for the major consuming industries, especially the automotive industry. The demand for U.S. produced tooling is affected by both cyclical and structural factors that drive both the overall demand by U.S. consumers, as well as the decisions regarding the source (domestic verses foreign) of tooling purchases.

Cyclical factors are related to the levels of consumer demand and capital spending by manufacturers in various end-use sectors. In general, sales of tooling are less dependent on the level of final sales within end-use sectors and more dependent on the introduction of new product designs into the market. Introduction of new product designs creates a demand for new stampings, molded plastic products, and die castings that are assembled into the new products and, therefore, for new tooling to produce the parts. Some slight variations in the production platform, such as changes in the drive train of an automobile, may involve no changes in tooling or slight modifications in existing tooling to allow the production of components with minor variations. However, the vast majority of new product entries into the market require completely new tooling. According to toolmakers, the original tooling produced for a particular product line tends to last, with regular maintenance, the lifetime of the production run.

Structural factors affecting tooling demand include a trend to shorter product cycles and lead times, the implementation of globalized manufacturing strategies by consuming industries, the increasing competitiveness of foreign toolmakers, and the capture of domestic consuming industry production share by offshore-based firms.

[84] U.S. tooling and plastic packaging and medical equipment appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

Cyclical Factors

During the 1990s, rapidly expanding capital spending by numerous U.S. manufacturing industries caused significant increased demand for tooling and increased levels of production and employment within the tooling industry. During 1997-2000, apparent U.S. TDM consumption rose slightly to almost $16.0 billion from $15.4 billion.[85] Although data for 2001 are not available, a drop in U.S. apparent consumption is believed to have occurred as both U.S. imports and exports declined and information received by the Commission indicates a significant drop in U.S. apparent consumption and product shipments in 2001. During 2001, capital spending began to soften in response to slower actual and anticipated consumer demand for final products. Corporate capital spending declined at an average annual rate of 15 percent in 2001 compared to 2000.[86] Similarly, the "Big Three"[87] U.S. domestic automobile makers announced significant reductions in capital spending budgets for both 2001 and 2002 from previous year's levels.[88]

For the U.S. manufacturing sector overall, low capacity utilization rates, depressed profits, and lowered profit expectations contributed to the drop in capital spending. Manufacturing capacity utilization fell to 73.1 percent in October 2001, well below the capacity utilization level of 82 percent during June 2000.[89] An 80-percent manufacturing capacity utilization level for the U.S. economy is considered a threshold level for profitability for a broad cross-section of firms in the tooling industry.[90] Net after-tax profits of U.S. manufacturing corporations fell by 67 percent during the first quarter of 2002 compared to the same period in 2000, while net profits fell by 80 percent during the final quarter of 2001 compared with the same period in 2000.[91] Durable goods manufacturers recorded operating losses for every quarter of 2001 compared to net profits recorded for every quarter of 2000.[92] Profit declines of this magnitude also negatively affected cash flows, causing manufacturers to conserve cash reserves by delaying capital spending for new product introduction.[93]

Among the factors contributing to low factory operating rates and depressed profits was slowing consumer demand, which expanded retail and manufacturing inventories to excessive levels in late 2000 and early 2001. In order to clear excessive inventory levels, general manufacturing activity was reduced. Auto producers responded to declining demand by reducing prices either directly through price discounts, or indirectly through attractive financing packages to encourage consumer purchases. During the third quarter of 2001 total U.S. corporate inventories declined by some $60 billion, the largest relative

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[85] Based on Census product shipments, import, and export data.

[86] National Tooling and Machining Association (NTMA), *Business/Customer Forecast Report*, winter 2001, p. 2.

[87] General Motors, Ford, and DaimlerChrysler.

[88] NTMA, *Market Intelligence: Cars & Trucks,*, May 1, 2002, pp. 4-5.

[89] Board of Governors, Federal Reserve System, "Industrial Production and Capacity Utilization," Federal Reserve Statistical Release, Dec. 5, 2000 and Jan. 16, 2002, found at *http://www.federalreserve.gov/releases/G17/ Revisions/ 20001205,* retrieved July 23, 2001.

[90] NTMA, *Business/Customer Forecast Report*, winter 2001, p. 2.

[91] Census, "Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations," found at *http://www.census.gov/csd/qfr/view/qfr_mg.html* retrieved July 15, 2002.

[92] *Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations*, U.S. Bureau of Census, retrieved July 15, 2002 at *http://www.census.gov/csd/qfr/view/qfr_mg.html*.

[93] NTMA, *Business/Customer Forecast Report*, winter 2001, p. 2.

decline since the early 1980s. U.S. domestic light-vehicle inventories declined to a 60-day sales-on-hand level in January 2002, with inventory on auto dealer lots falling to 1 million vehicles during the same month.[94]

During the past 18-24 months, conditions in the motor vehicle market have been particularly difficult as U.S. OEMs, experiencing deteriorating financial health, have decided to delay or cancel the launching of planned new product entries. During 2000 and 2001, new model introduction in the North American automotive sector declined by 10 percent from the previous 2-year period.[95] Previously announced major new or redesigned product models, such as the Dodge Dakota, the Cadillac Seville, the Chevrolet Venture, and the Buick Park Avenue, were delayed until as late as 2005.[96] Instead, these OEMs have decided to reallocate cash that would have been required to finance these product platforms to rebuild their balance sheets, thus fortifying the financial health of their businesses. At the same time, the slowdown in the introduction of new products appears to have been more pronounced among U.S. automotive OEMs than among foreign automotive transplants in the United States due to the stronger financial health of the transplants. Other sources suggest that during the next few years the motor vehicle industry in North America is likely to introduce a considerable number of new products into the U.S. market in the form of major platform changes.[97] Such platform changes will require new tooling, thus reversing the trend of the last 2 years.

A cyclical factor that may also have structural effects is the imposition of safeguard remedies, in the form of additional tariffs, affecting many imported steel products.[98] Although the direct effect on raw material costs for toolmakers is thought to be minor (see "Materials costs", earlier in chapter), manufacturers of stamping dies note that any increase in domestic steel costs relative to steel costs in foreign markets provides an added impetus for customers to move production overseas.[99] For example, Delphi, the world's largest automotive parts maker, has announced that it has already begun to place contracts for some new steel-intensive parts and products with overseas manufacturers as a result of costs increases related to rising steel prices.[100] Although the additional duties are staged and will expire after 3 years, it is unclear whether any stamping production that actually moves from the U.S. would return at the end of the program.

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[94] "North American Sales & Production At-A-Glance," *Autofutures*, Apr. 30, 2002, p. 2.

[95] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), p. 11.

[96] "North American Sales & Production At-A-Glance," *Autofutures*, Jan. 2002, p. 5.

[97] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), p. 11-16.

[98] Presidential Proclamation 7529, Mar. 5, 2002.

[99] David Sandy, transcript of the hearing, p. 226; Nancy E. Kelly, "Resolution seeks early 201 steel tariff review," *American Metal Market*, Oct. 10, 2002, found at *http://www.amm.com/index2.htm*, retrieved Oct. 17, 2002.

[100] James Mackintosh, "Delphi steps up steel tariffs fight," *Financial Times*, Oct. 17, 2002, found at *http://search.ft.com/search/article.html?id=021017000716&query=delphi&vsc_appId=totalSearch&state=Form*, retrieved Oct. 19, 2002.

Structural Factors

Product Cycles and Lead Times

Manufacturers, especially those of consumer goods, periodically revise the design of their products to enhance their appeal. The product cycle is the period of time between the corporate decision to introduce a new product line, the design of particular product components, the manufacture of the tooling required to produce the components, and the beginning of full-scale production. Competitive market pressures to bring new products to market more quickly has served to reduce the product cycle in the three largest TDM consuming industries: motor vehicles, appliances, and electronics and telecommunications. Being first to market allows manufacturers to gain a market advantage over competitors and is considered to be essential in building product loyalty among consumers, while also building market leadership in a product market. Conversations with market participants in the motor vehicle industry indicate that a decade ago, automotive product cycles lasted as long as 60 months. However, increasing competition has forced OEMs to shorten the motor vehicle development cycle to 30 to 36 months. As with automobiles, a similar desire to get new products to market faster is leading to a compression of product cycles by appliance OEMs, although product cycles for appliances are typically only 6-12 months.[101] Similarly, the product cycle for new electronics and telecommunications products has declined from 2-3 years only 5 years ago to as little as 6 months at present.[102]

The market dynamics for medical and packaging products are somewhat different. Most product design changes in medical devices are a result of efforts by the equipment supplier to improve the performance of the medical device, often in response to staff in the medical delivery business requesting a change in the design of an instrument, such as a syringe or catheter. Product change in the medical supply industry appears to run approximately 3 years. Typically, a packaging manufacturer will change the design of a product package to attract consumer attention or to fit the functional requirements of a change in product configuration. Product cycles for the plastic packaging and medical equipment industries have also become more compressed during the past decade for similar reasons, although not as dramatically, as in the motor vehicle and appliance industries.

The compression of product cycles has put pressure on component suppliers and toolmakers to reduce the lead time required to both design and produce components and associated tooling, since the amount of time devoted to tooling design and production accounts for a significant part of the production cycle. The ability of tooling suppliers to match their production of tooling to shortened lead times has become a critical sourcing factor, especially for firms supplying the automotive and appliance industries.[103] Tooling customers often insist that suppliers take active steps, including capital investment in the latest technologies, to improve plant efficiency on an annual basis, thus demonstrating

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[101] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[102] U.S. electronics and telecommunications contract manufacturing industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[103] Responses to USITC purchasers' questionnaire.

that they are in a position to continue to reduce lead times and product costs.[104] These customers also monitor the ongoing commitment to invest in human resources skills, computer technology, and sophisticated machining equipment that would enable a tooling supplier to continue to improve tooling design and production capabilities while adapting to increasingly shorter lead times.[105]

The lead time a toolmaker has had to complete an automotive tooling contract has declined from as much as 1 to 2 years just 5 years ago to 9 months or less at present.[106] Compressed appliance product cycles have diminished the period of time allotted for the completion of the tooling from a period of as long as 30 weeks only a few years ago, to as little as 16 weeks at present.[107] An informal survey of the plastics packaging and medical equipment industries indicates that the required lead time to complete the design and production of molds has declined to nearly 10 to12 weeks, from a lead time of 18 to 24 weeks a decade ago.[108]

The compression of lead times is magnified if the product is subject to change orders. During the product cycle, the design of a component may go through a number of changes before final delivery of the tooling and commencement of full-scale production for the end product. A tooling manufacturer must have the technical and engineering capability to alter or rework tooling to accommodate component change orders and do so quickly enough to meet tight delivery schedules. As product cycles have shortened, changes in tooling design become more common to accommodate the updated component design.

According to industry contacts, U.S. OEMs are more prone than their Japanese competitors to significantly alter the design of their components. U.S.-owned manufacturers tend to place a greater emphasis on the styling of their vehicles as a consumer selling point. Large variations in component design tend to require more complex tooling to produce these components, thus leading to more frequent tool change orders and higher tooling costs for vehicles made by U.S.-owned manufacturers. These sources indicate that change orders for tooling used in Japanese vehicles are relatively uncommon because they are more "manufacturing-friendly" as requirements for complex tooling are minimized due to the relative simplicity of product design.

In a typical product cycle, change orders may account for up to an additional 15 to 20 percent of the time allocated for the completion of a tooling contract and account for as

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[104] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[105] U.S. tooling and automotive and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[106] This effort to reduce product cycle and lead times has been aided by improvements in CAD/CAM systems that permit quicker tooling design and manufacturing and by increases in machine tool speed. U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[107] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[108] For the introduction of new medical products requiring FDA approval, the product cycle will typically be longer than normal.

much as 25 percent of a tooling manufacturer's revenues.[109] Often times, a tooling manufacturer in the United States will be asked to modify tooling originally manufactured by another manufacturer to meet a change order. This often occurs when tooling is purchased from off-shore sources since change orders often occur after the tooling is shipped from a remote location to the United States.[110]

Foreign Competition

Foreign competition affecting demand in the U.S. tooling market appears to manifest itself in essentially three forms: through direct imports of tooling for the manufacture of finished goods in the United States, through the movement of customers' manufacturing operations to foreign nations with the consequent importation of the finished good into the United States, and (to a lesser extent) through the establishment of foreign-based production operations in the United States.[111]

In the automotive industry, foreign tooling competition is principally in the form of direct imports of tooling for the manufacture of finished goods in the United States. This is true for both the traditional North American manufacturers as well as the foreign-based manufacturers that have set up production operations in the United States. In the appliance industry, manufacturers also directly import tooling for final goods manufactured in the United States. However, these manufacturers have also moved significant production of certain appliances destined for the U.S. market to foreign nations, often procuring the tooling locally for this production. In the electronics and telecommunications industries, the trend has increasingly been to relocate assembly of certain products to low-wage foreign nations and to source product components and tooling from sites located near these assembly points.

Overall, respondents to the U.S. producers' questionnaire reported that they have lost at least $200 million of business to foreign suppliers for the period of 1999 through 2001. The year with the biggest loss was 2001, when an estimated $114 million of business moved to foreign countries.[112] The next highest year was 1999 when $55 million of business was lost by U.S. tool and die manufacturers. Of the 210 instances reported over the past 3 years, in which customers have moved production overseas leading directly to lost tooling business, 51 instances each cost U.S. tool and die producers over $1 million apiece in annual lost revenue.[113]

The leading product category in which business was relocated to a foreign TDM supplier was automotive, encompassing a reported $104.8 million in lost revenue, or 52 percent of the total, from 1999 to 2001. The top-five companies from which business had been lost were all in the automotive product sector and represented $73 million of business.[114] The

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[109] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[110] Rasmussen, transcript of the hearing, pp. 145-146.

[111] Although it is clear that suppliers have followed foreign automakers' establishment of production facilities in the United States, it is unclear the extent to which this has occurred in the tooling sector.

[112] Responding companies reported total 2001 sales of $1.5 billion.

[113] Compiled from responses to the Commission's producers' questionnaire.

[114] General Motors, Oxford Automotive, Collins & Aikman, Daimler Chrysler, and Ford.

next-highest product category was household appliances, encompassing a reported $15.5 million in lost revenue, 28 percent of which was attributed to business moving to China.

Another key sector in which respondents reported that business was lost to foreign markets from 1999 to 2001 was electronics ($31 million). This includes product categories such as computers and peripherals ($11 million), electronics and electrical components ($13 million), and consumer electronics ($7 million). Forty-two percent of reported instances of lost business in the electronics sector was attributable to business moving to China, particularly the production of electronics and electrical components ($8 million).

Overall, the dominant region where producers indicated business moved to was East Asia, totaling a reported lost revenue of at least $125.7 million.[115] For companies that listed specific countries, Japan was the leading country, accounting for a reported $62 million in lost revenue, $59 million of which was in the automotive sector. China was reported as the second-leading destination of business moves, and producers indicated that $38 million of lost revenue was attributable to relocation of manufacturing to China.

The choice of where to source tooling for the manufacture of finished goods in the United States tends to be influenced by the following set of factors:[116]

1. Tooling that is simple in design and can be produced using simple manufacturing techniques with little consultation between the customer and supplier is often more likely to be procured from a distant supplier. A more complex tooling design, requiring more value-added in the form of engineering input and tighter control of the tooling manufacturing process, is more likely to be purchased closer to the point of assembly of the final product.

2. Tooling for a part that fits into a larger, complex module or subsystem is usually purchased closer to the assembly point of the final product, often because the tolerances in such subsystems are highly precise and involve consultation between the various manufacturers of system components and tooling to ensure that these separate components fit into the subsystem. Such attention to subsystem precision is often not possible if components and tooling are purchased from remote locations.

3. Large-sized tooling tends to be more costly to ship than small-sized tooling, and tends to be purchased closer to the final point of assembly.

Industry officials have identified a number of factors responsible for increasing foreign competition in the tooling industry, including improvements in CAD/CAM technology

[115] As some producers listed multiple countries or "global" as their answer for this question, actual business lost by respondents to East Asian suppliers may be greater.

[116] Jeff Mengel, Plante & Moran, LLP, Auburn Hills, MI, telephone interview by USITC staff, July 22, 2002.

and CNC machine tools, the strong U.S. dollar, and foreign producers' vehicle production and tooling capacity (Box 3-1). Because of the constant pressure to reduce costs under these market conditions, OEMs have looked to lower costs of their inputs by sourcing more of their components and tooling from foreign sources. In order to meet budget targets, OEMs often demand that Tier 1 suppliers and custom stampers and molders use less-expensive foreign tooling when submitting their bids.[117] The main factor driving foreign TDM purchasing is lower costs, principally due to lower prevailing wages in certain nations, although in certain instances other factors (such as quality, global sourcing programs, or faster build time) may lead customers to foreign TDM suppliers. Tooling operations in low-wage nations often possess the same machinery, equipment, and tooling design and manufacturing software systems used by toolmakers in the United States.[118] As such, foreign shops are able to produce less complex tooling (such as stamping dies or molds for certain motor vehicle or appliance parts and subassemblies), which require less input by a skilled machinist, for considerably less than it can be produced by a U.S. tooling manufacturer.

Increasingly, as the skill level of foreign machinists continues to rise, these operations may be capable of producing more complex tooling, such as stamping dies for certain motor vehicle doors and outer body panels, which have typically been domestically produced. Foreign toolmakers, such as those in Korea and Taiwan, have an additional competitive advantage because the firms are operating their facilities on a 24-hour basis, with employee shifts (both design and production staff) of 12 to14 hours not uncommon.[119] The ability to run plants "flat out" allows these foreign competitors to meet large volume production runs within shorter lead times.[120] According to U.S. OEMs, Asian toolmakers are more willing than U.S. toolmakers to use a sub-tiered production process in which larger toolmakers form partnerships with smaller specialty toolmakers. Certain components of a tooling contract may then be subcontracted to these specialty toolmakers, who develop specialty niches for certain dies and molds.[121] This practice reportedly helps ensure that production is completed within a required time period. A sub-tiered process is less advanced in the United States where traditionally the primary toolmaker produces the entire TDM in-house. However, evidence suggests that an increasing number of toolmakers in the United States are beginning to adopt more of a sub-tiered approach to toolmaking in response to shortened lead times in the industry.[122]

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[117] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[118] Ibid.

[119] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[120] Ibid.

[121] "Developing a Collaborative Business Model for Die and Mold Industry Competitiveness," undated document supplied by Jay Baron, Center for Automotive Research, Ann Arbor, MI, Mar. 14, 2002.

[122] U.S. tooling and OEM industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

Box 3-1
Factors affecting growing international competition in the U.S. tooling market

1. **Improvements in CAD/CAM technology**— With improvements in computer-generated design technology, it has become increasingly possible to capture the complexity of mold or die designs in a set of mathematical data that easily can be translated into multiple programming languages and sent throughout the world over the Internet. As a result, the process of programming tool selection, sequencing and cutting paths for machine tools has become simpler and more universally available.

2. **Improvements in CNC machine tools**— The increasing accuracy and precision of computer numerical controlled machine tools has enabled the production of tooling, using less experienced, or semi-skilled labor. Because these machines have higher tolerances, more rapid spindle speeds, and ease of cutting tool selection they permit the production of repeat tooling with little or no product variation. The combination of improved CAD/CAM software and high-quality machine tools makes it possible to purchase relatively complex tooling from remote parts of the world with a reduced risk of variability in output.

3. **Increased strength of the U.S. dollar**—The increased value of the U.S. dollar versus the currencies of major U.S. trading partners during the past 5 years, has provided foreign toolmakers that export to the United States a cost advantage over their U.S. competitors. In particular, the weakening of the yen/dollar relationship during the past 2 years has strengthened the competitive position of Japanese tooling manufacturers who sell to the United States. According to industry sources, Japanese manufacturers have established tooling operations in many Asian nations recently in order to produce the tooling needed to supply the U.S. motor vehicle market.

4. **Excess capacity in overseas industries**—Capacity additions due to new investments in countries with growing industries, combined with growth of excess capacity due to demand declines and productivity gains in countries with established industries, have led to increased interest on the part of many foreign TDM firms in the U.S. market. Strong growth in TDM consuming markets in certain foreign countries, such as China, provides a foundation for capital investment in the TDM industry. As foreign TDM consumers, especially in the automotive sector, establish production facilities in the United States, foreign toolmakers seek to replace lost business in their home market by maintaining supply relationships with traditional customers' U.S. facilities.

Source: U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug., 2002.

One disadvantage faced by foreign producers of motor vehicle tooling is difficulty of incorporating change orders into their operations. Due to the geographical separation of production in Asia and use of the tooling in the United States, it is often not possible for a foreign shop to alter the tooling to reflect a component design change prior to shipment to the United States. As a result, foreign tooling is often subject to the further time and cost of additional machining in the United States to accommodate design changes in a component.

Customers shifting production overseas

The movement of production facilities to off-shore locations appears to be heavily influenced by intense price competition in final product markets and OEMs' efforts to lower manufacturing costs by producing the final product in low-cost assembly locations and to purchase product inputs from low-cost sources worldwide. Generally, the decision to relocate production facilities abroad or to purchase components or tooling from foreign sources depends on the product's size, transportation cost, and price margin when sold in end-use markets. Because smaller, higher-volume final products tend to be less expensive to transport, they are more likely to be produced and assembled in locations that tend to minimize manufacturing costs and still allow for economical shipment to the U.S. market. In cases where production for the U.S. market is being performed from overseas locations, component and tooling needs are also more likely to be satisfied from lower-cost production sources close to the production facility.

The extent to which manufacturing that uses TDMs has shifted from the United States to foreign production locations is unknown. However, many Fortune 500 companies, including Hewlett Packard, Black and Decker, Eastman Kodak, 3M, Johnson and Johnson, Gillette, Baxter International, Abbott Labs, Bechton Dickinson, Procter and Gamble and Colgate-Palmolive, have shifted production to foreign locations.[123] Much of the new manufacturing capacity in the world is being located in China, with some production being shifted there from the United States and Mexico. An indication of the amount of production moving to China may be gleaned from a report to the U.S. Trade Deficit Review Commission. Between October 1, 2000 and April 20, 2001, more than 80 corporations announced plans to move production to China.[124] Further, this report estimated that, on average, between 70,000 to 100,000 jobs have been lost each year to China and Mexico, about 70 percent of which were in industrial sectors that consume TDMs. Companies shifting production to China were intending to serve the U.S. and global market, as well as the Chinese market.

The demand for U.S. tooling by the appliance industry has been adversely affected by the increasing globalization of the North American major household appliance industry as major U.S. producers long have been pursuing growth opportunities abroad, given the gradual leveling of appliance demand in the United States due to market saturation. In addition, intense price competition in appliances has led U.S. manufacturers to supply certain appliances to the U.S. market from lower-cost foreign production facilities. Much of the sourcing of components and tooling is, when possible, through sources close to the facility where the final product is assembled.[125] U.S. appliance OEMs are increasingly

[123] Testimony of Manfred Hoffman, president and CEO, Caco Pacific Corp., transcript of the hearing, p. 164.

[124] Kate Bronfenbrenner, School of Industrial and Labor Relations, Cornell University, et. al, *Impact of U.S.-China Trade Relations on Workers, Wages, and Employment: Pilot Study Report*, U.S. Trade Deficit Commission, June 30, 2001, found at *http://www.ustdrc.gov/research/china1.pdf*, retrieved May 8, 2002.

[125] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

supplying the U.S. market for certain small-size appliances[126] from foreign production facilities, notably in Mexico,[127] Taiwan, and China.

In countries where tooling capacity to supply appliance production facilities does not exist or is limited, such as Mexico, the tooling is still being supplied by U.S. toolmakers or other foreign toolmakers. However, tooling capacity in countries such as Mexico is growing and eventually much of the tooling for these foreign production facilities could be supplied from local sources, once a TDM manufacturing base has been established.[128] Manufacturers of electronics and telecommunications products also have sought to lower their manufacturing costs through a strategy of global manufacturing and sourcing of inputs. This is particularly true of smaller, higher-volume inputs that are relatively easy to ship to the point of assembly.[129] This has long been the practice in the television and AM/FM radio market, where U.S. manufacturers have tended to close down high-cost U.S. production facilities in order to move production to lower-cost facilities in Mexico (and eventually to China) to supply the U.S. market.[130] More recently, as the market for such items as cellular phones and personal computers has become increasingly competitive, OEMs and contract manufacturers have tended to close down facilities in the United States and relocate production to low-cost facilities in Mexico, South America, and Asia.[131]

The trend toward global production and procurement has been aided by the growth of the contract manufacturer. An increasing number of electronics and telecommunications OEMs, in an effort to lower their operating costs, have decided to out-source production of molded products and other components that were once manufactured through captive, in-house capacity. The contract manager has emerged to supply the global component needs of OEMs and to form global partnerships with other organizations in the supply

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[126] This trend is most evident in small-size appliances such as vacuum cleaners, microwave ovens, air conditioners, and small-scale refrigerators which are virtually all produced in foreign production facilities. These items tend to be marketed through large discount chain stores where intense price competition exists and manufacturers are under constant pressure to reduce production costs.

[127] The elimination of cross-border duties on appliances and parts under the North American Free Trade Agreement (NAFTA) and the liberalization of investment regulations were key elements in the decisions of General Electric (GE) and Whirlpool to enter into joint ventures with Mexico's two largest appliance manufacturers. GE has formed a joint venture with the Mexican appliance manufacturer MABE to manufacture gas ranges in Mexico while Whirlpool has formed a joint venture with appliance producer Vitromatic Corp. (Vitro) to manufacture refrigerators and washers and dryers in Mexico. In 2000, GE also built a state-of-the art production facility in Mexico to supply small-size refrigerators to the entire North American market.

[128] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[129] In general, larger, more complex product components and subsystems continue to be produced in the United States.

[130] U.S. electronics and telecommunications industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[131] As part of this pattern, countries such as China have established specific government regulations and local content laws which require that suppliers must have presence in China in order to supply OEMs producing in China. Laurie Sullivan, "Midtier Distributors Edge into China," *EBN* (*Electronic Business News*), June 28, 2002, found at *http://www.ebnews.com/story/OEG20020628524S0086*, retrieved Aug. 15, 2002.

chain, such as plastic molders and toolmakers[132] for the sourcing of these inputs at prices desired by the contract manufacturer. These trends have made it more difficult for U.S. injection molders and toolmakers to supply the material needs of OEMs from higher-cost production facilities located in the United States and have encouraged the foreign sourcing of materials and the relocation of molders and their production capacity to Asia.[133]

According to representatives of plastic packaging and medical equipment industries, competition from foreign tooling is far less intense in these industries than in the motor vehicle and appliance industries. Part of the reason for this is that both industries are small relative to motor vehicles and appliances, and have not attracted the same degree of attention from foreign toolmakers who have tended to target more visible industries with greater tooling demand. In addition, because some of the plastic forming processes used in these industries (including thermoforming) are relatively new, there has not yet developed a production base in foreign countries capable of producing this type of tooling.[134] Finally, manufacturers of plastic medical equipment, for reasons of product liability,[135] have tended to purchase tooling from established suppliers in the United States rather than from less-expensive foreign sources.

Transplant operations

Between 1999 and 2001, the market share of automobiles produced by foreign transplants in the U.S. market has grown from 15.6 percent to 17.5 percent, whereas the market share of the Big Three automakers has dropped from 69.6 percent to 64.5 percent during the same period.[136] The trend toward increasing market share of foreign transplants has caused particular difficulties for the U.S. tooling firms serving the automotive industry since many of these firms have largely concentrated their efforts on marketing their tooling to the Big Three automotive OEMs, often to the exclusion of foreign transplants.[137] As a result, many domestic firms have found it difficult to adjust their orientation away from the Big Three and to seek to develop supplier relationships with foreign transplants.[138]

At the same time, foreign automobile transplants in the United States have tended to continue tooling supplier relationships with toolmakers located in their home countries,

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[132] Recently, a growing number of contract manufacturers have begun to manufacture their own tooling in foreign facilities through captive, in-house production in an effort to lower their cost structure. Claire Serant, "Flextronics Builds Vertical Model," *EBN (Electronic Business News)*. May 24, 2001, retrieved Aug. 21, 2002 at *http://www.ebnews.com/story/OEG20020524S0053.*

[133] Steve Toloken, "UPG plans June opening of Asian facility," *PlasticsNews*, found at *http://www.plasticsnes.com*, retrieved Sept. 7, 2002.

[134] U.S. tooling and packaging industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[135] The market for plastic medical equipment is governed by strict quality requirements imposed by both the medical industry and the U.S. Government.

[136] IRN, Inc., *North American Automotive Outlook*, Mar. 13, 2002, p. 14.

[137] Riviera Tool Co. reports that in their fiscal year ended Aug. 31, 2001 approximately 98 percent of the company's revenue was accounted for by DaimlerChrysler, Ford, and General Motors. Riviera Tool Co., Annual Report on Form 10-K405," p. 9.

[138] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

some of which have established U.S. production operations to improve service.[139] U.S. toolmakers that have been successful in supplying the tooling needs of foreign transplant operations have indicated that it is often difficult for U.S. toolmakers to penetrate this market segment due to a reluctance by the foreign-based consumers to disrupt existing supplier relationships.[140]

Competition from imported tooling

U.S. automotive companies have developed strategies that seek to control their tooling costs while also working to improve the quality of tooling. Part of this tooling strategy involves the global sourcing of tooling from TDM firms (particularly Japanese and Canadian) that may offer price advantages and similar quality levels relative to domestic tooling.[141] An important factor in the global sourcing of tooling appears to be related to currency fluctuation. Automotive sources indicate that automotive OEMs closely monitor exchange rate behavior to determine when opportunities exist to lower tooling costs through the use of foreign tooling.[142] The global sourcing of tooling has been a particularly important strategy during the last 2 years, in response to the faltering corporate earnings of automakers. At the same time, pressures to reduce product cycles and tooling production lead times have also favored certain foreign toolmakers, who appear to have placed a great deal of strategic emphasis on satisfying these shortened lead times.

Many of the remaining appliance production facilities in the United States also have increasingly satisfied their tooling needs from off-shore sources.[143] The presence of foreign appliance tooling in the U.S. market is more likely in the production of components for low-value, high-volume appliances, which tend to be most price sensitive segment of the appliance market. Market sources indicate that import competition in tooling is a somewhat less serious consideration in the higher-value, lower-volume segment of the market, which tends to be less price sensitive and where quality factors such as the fit and finish of the components are more important competitive considerations. Industry sources indicate that U.S. toolmakers continue to have a competitive advantage in the upper-end segment of the market.[144]

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[139] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), p. 11.

[140] U.S. automotive tooling industry officials, interviews by USITC staff, June 2002.

[141] Automotive and tooling industry sources indicate that Japanese exports of motor vehicle tooling to the United States are also closely related to the level of Japan's vehicle production and the level of idle tooling capacity existing in Japan. U.S. TDM producers and automotive industry officials, telephone interviews by USITC staff, Feb.-Sept. 2002.

[142] U.S. automotive industry officials, telephone interviews by USITC staff, Feb.-Sept. 2002.

[143] Industry sources indicate that molds for the appliance industry are more subject to import competition than are stamping dies. Since appliance stamping dies are larger in nature, requiring more expensive equipment and larger tryout presses to manufacture and test, they are more likely to be produced by a more select group of manufacturers; such dies are bulky in nature and tend not to be transported across long distances. On the other hand, appliance molds tend to be smaller, less complex to manufacture, and are more likely to be purchased from foreign suppliers.

[144] U.S. tooling and appliance industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

International Trade

U.S. Imports

Quantity data for trade flows are not presented in this report, primarily because of inconsistencies in tariff schedule treatment. Data on quantity are not collected for a number of products being examined, including many types of dies, so as a result aggregated quantity data would be significantly understated.[145] Secondly, the tariff schedule is inconsistent in classifying TDMs and TDM parts and sub-assemblies. Parts of dies are included in the tariff classification grouping for complete dies, whereas certain molds and all parts of molds are classified with the machine in which the mold is used; for example, a part of an injection mold would be classified as a part of an injection molding machine. The way in which parts are treated likely explains the significant swings (in some cases two orders of magnitude) in quantity data observed for certain countries from year to year.[146] Given the lack of a consistent methodology for parts classification, and that parts of molds are not specifically provided for under the Harmonized System headings for molds, comparable quantity data do not exist and it is conceivable that many parts, such as injector springs, may be erroneously included in the classification headings for molds. These classification issues affect the import value data as well as the quantity data, and explain industry concerns regarding the validity of the import data. Research also has revealed that there are errors in the tabulation of the quantity data for imports, although the extent of these errors is unknown.[147]

Trends in the value of U.S. imports[148] of TDMs and the two sub-sectors comprising this industry, industrial molds (NAICS 333511), and tools, dies, jigs, and fixtures (NAICS 333514) are shown in tables 3-11 through 3-13, respectively. In 2001, almost 90 percent of U.S. imports of TDMs, were accounted for by three sources: Canada (41 percent), Japan (33 percent), and the EU (16 percent). Other significant suppliers in 2001 included Taiwan (3.1 percent), China (1.6 percent), Korea (1.4 percent), and Mexico (0.5 percent). Although the value of imports from many countries peaked in either 1999 or 2000, for other sources, such as China, Korea, Hong Kong, Brazil, and Switzerland, the totals continued to rise through 2001. During 1997-2001, the value of imports from China and Korea rose by 191 percent and 248 percent, respectively. In contrast, the value of imports from Japan during this period was at its highest level in 1997, and has continued to decline since. Shifts in foreign currency valuations may account for some

[145] Quantity data are collected only for diamond wire-drawing dies, jigs and fixtures, and molds.

[146] For example, the quantity data for imports of molds (NAICS 333511) from the United Kingdom rose from 304,000 in 1999 to over 15 million in 2000.

[147] For instance, the quantity originally reported for an entry of certain molds (HTSUS 8480.71.80.45) from Malaysia to the Customs district of Chicago in September 2001 was 66,000. This was a data entry error, as 66,000 represented the value in dollars of the imports. The number of units imported was two.

[148] The normal trade relations (NTR), or column 1 rates of duty on U.S. imports of dies range from 2.9 percent ad valorem to 5.7 percent ad valorem. The duty rates for jigs and fixtures range from zero to 4.6 percent ad valorem. The NTR rates of duty on molds range from zero to 3.8 percent ad valorem, with a rate of 3.1 percent ad valorem on plastic injection molds and on molds for metal (commonly used in die-casting).

Table 3-11
Tools, dies, and industrial molds: U.S. imports for consumption, 1997-2001, by country

(*1,000 dollars*)

Country	1997	1998	1999	2000	2001
Canada	781,288	786,979	819,107	828,053	696,936
Japan	799,573	597,580	555,217	571,538	549,481
Germany	98,940	108,417	150,921	112,016	88,615
Taiwan	31,393	45,047	53,881	50,730	52,263
Italy	37,630	51,805	42,633	41,437	31,425
Portugal	38,216	32,879	39,492	42,009	30,827
United Kingdom	28,195	31,195	25,038	32,755	28,030
China	9,486	12,703	18,805	26,810	27,581
France	34,765	39,439	43,002	40,263	27,362
Korea	6,895	8,423	14,772	16,316	23,981
Hong Kong	14,186	11,734	11,202	13,338	14,230
Ireland	10,626	11,058	13,430	10,067	13,208
Singapore	11,827	9,017	10,876	11,011	11,661
Brazil	3,472	6,403	3,712	7,049	10,147
Switzerland	7,622	9,882	9,126	8,276	10,110
Mexico	8,929	9,502	10,179	14,748	9,347
All other	63,945	89,583	86,746	84,877	81,728
Total	1,986,988	1,861,646	1,908,139	1,911,293	1,706,932
EU-15	290,945	336,557	371,528	326,321	263,935

Note: Total import values for Jan.-Aug. 2002 were 15.4 percent higher than Jan.-Aug. 2001.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-12
Industrial molds (NAICS 333511): U.S. imports for consumption, 1997-2001

(*1,000 dollars*)

Country	**1997**	**1998**	**1999**	**2000**	**2001**
Canada	670,622	637,580	704,903	694,793	574,380
Japan	321,537	236,256	216,708	248,593	223,900
Germany	48,543	63,604	94,364	72,296	68,596
Taiwan	27,628	38,397	49,100	43,710	46,620
Portugal	38,035	32,835	39,455	41,938	30,730
Italy	34,835	48,236	33,051	35,327	24,978
China	8,387	11,345	17,453	24,607	24,274
France	30,952	36,432	38,904	37,468	24,119
Korea	6,442	7,820	14,155	15,113	21,428
United Kingdom	15,876	16,875	18,370	21,466	18,457
Hong Kong	13,495	11,622	11,165	13,221	13,286
Singapore	11,667	8,142	9,260	9,072	9,995
Netherlands	6,634	8,764	9,575	9,449	8,207
Australia	3,961	4,746	7,296	10,154	7,601
Mexico	6,843	6,458	6,986	10,706	6,195
Switzerland	5,685	7,593	6,098	6,495	5,493
All other	40,080	54,626	52,938	53,571	52,365
Total	1,291,222	1,231,329	1,329,782	1,347,979	1,160,625
EU-15	199,670	239,787	267,941	245,125	203,448

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-13
Special tools, dies, jigs and fixtures (NAICS 333514): U.S. imports for consumption, 1997-2001

(*1,000 dollars*)

Country	1997	1998	1999	2000	2001
Japan	478,036	361,324	338,509	322,945	325,581
Canada	110,666	149,399	114,204	133,260	122,556
Germany	50,397	44,813	56,557	39,720	20,019
Ireland	8,768	10,123	12,115	8,809	10,609
United Kingdom	12,319	14,320	6,668	11,289	9,573
Brazil	33	269	292	1,095	6,900
Italy	2,795	3,569	9,582	6,110	6,447
Taiwan	3,765	6,650	4,781	7,020	5,643
Switzerland	1,937	2,289	3,028	1,781	4,617
China	1,099	1,358	1,352	2,203	3,307
Spain	1,557	12,877	4,743	2,657	3,299
France	3,813	3,007	4,098	2,795	3,243
Mexico	2,086	3,044	3,193	4,042	3,152
Korea	453	603	617	1,203	2,553
Sweden	5,490	2,600	1,997	2,920	2,386
Australia	11	540	265	499	2,311
All other	12,541	13,534	16,357	14,968	14,111
Total	695,766	630,317	578,357	563,314	546,307
EU-15	91,275	96,770	103,587	81,196	60,487

Source: Compiled from official statistics of the U.S. Department of Commerce.

of the changes in the value of imports, particularly with regard to those from Japan and Canada.

During 1999-2001, duty-free imports accounted for 46 to 48 percent of all U.S. tooling imports, up from almost 40 percent in 1997. In 2001, approximately 85 percent of duty-free U.S. TDM imports entered under North American Free Trade Agreement (NAFTA) tariff preferences, whereas the remainder entered under duty-free tariff provisions for certain types of molds, and under tariff preference provisions of the Generalized System of Preferences and the U.S.-Israel Free Trade Agreement.

Imports as a share of consumption has remained fairly stable from 1997 to 2000 (the latest year available), declining slightly in line with the overall fall in imports (table 3-14). Although industry-wide shipment data are not yet available for 2001, the sharp fall-off in shipments indicated by the Commission's questionnaire data, coupled with a smaller decline in imports, would seem to indicate that import penetration rose in 2001.

TDMs are highly heterogenous products, which lessens the analytical value of aggregate unit value data. Since TDMs are, for the most part, custom-built products with a wide variety of sizes and complexities, they have a fairly wide range of prices. Discussions with industry participants indicate that most tooling ranges in value from approximately $3,000 (occasionally less) to at least $1.5 million, and U.S. TDM producers frequently refer to TDMs valued in the tens of thousands of dollars. However, the belief that mis-classification and inclusion of parts skews value and quantity data is underscored by analysis of import unit value data. Many import unit values are less than $1,000, with some as low as $6. Although domestic producers allege that they face tooling imports

Table 3-14
Tools, dies, and industrial molds: U.S. shipments, exports of domestic merchandise, imports for consumption, U.S. apparent consumption, and imports as a share of consumption, 1997-2001

Item	1997	1998	1999	2000	2001
			(Million dollars)		
U.S. product shipments	14,498.2	14,597.2	14,856.8	15,297.9	(1)
Exports	1,091.1	1,141.7	1,071.2	1,221.0	1,084.0
Imports	1,987.0	1,861.6	1,908.1	1,911.3	1,706.9
U.S. apparent consumption	15,394.1	15,317.2	15,693.7	15,988.2	(1)
			(Percent)		
Imports as a share of U.S. apparent consumption	12.9	12.2	12.2	12.0	(1)

[1] Not available.

Source: Official statistics of the U.S. Department of Commerce.

that are priced 30 to 70 percent below domestic prices,[149] and that prices for imported molds for rubber and metal have declined by 70 and 75 percent, respectively, over the last 3 years,[150] these still seem to be unrealistically low unit values.

Regardless of the problems in the quantity data, information gathered on the declining prices for tooling in the U.S. market, coupled with the trends in import value, would seem to indicate that the aggregate quantity of tooling imports has increased since 1997, at least through 2000. This is even more likely for certain countries, such as China, for which U.S. import values have grown significantly, or for other countries whose currencies have weakened against the U.S. dollar over the period (e.g., Canada, Germany, Japan, and Portugal).

Producers were asked in the Commission's questionnaire about their imports of TDMs during the 1997-2001 period. Only 23 companies indicated that they had imported during the period, and most of those imported sporadically. However, the group that did import increased their imports almost five-fold during the 5 year period, from slightly over $2 million to over $10 million. Imports were purchased from a variety of sources, with China, Taiwan, Japan, Canada, and Portugal the most common suppliers.

The primary reason these producers gave for importing was cost pressures or meeting customer "target pricing." Other reasons included faster delivery times, international corporate ties (typically for captive shops), or to round out a product line (e.g., a manufacturer of drawing dies makes certain sizes and imports other sizes).

Producers were also queried about their plans to import TDMs in the future. Over 90 percent of the firms that had imported within the past 5 years indicated an intention to continue to import TDMs. Additionally, 23 firms that reported no import activity during the 5-year period indicated the intention to import in the future. Reasons given for considering importing were essentially the same as given above, although several firms reported that they intend to try to form an alliance with a foreign producer. The typical plan is to manufacture tooling in the foreign country and perform the tryout, service, and repair activities in the United States. Although acknowledging that such a plan will mean

[149] Coffey, transcript of the hearing, p. 39.
[150] John D. Belzer, president, TCI Precision Metals, written submission, May 21, 2002, p. 3.

fewer jobs for toolmakers, firms indicated that this strategy is crucial to maintaining their ability to compete for their customers' business.

U.S. Exports

During 1997-2001, the majority of U.S. TDM exports have been to Canada or Mexico (table 3-15 through 3-17). In 2001, these two markets accounted for 62 percent of all U.S. exports of tooling. U.S. exports to other markets are relatively small. However, those to Hong Kong and China rose substantially during 2000-2001. It is not known how much of these exports were used dies and molds that had been engaged in domestic parts production before being exported to China or were newly manufactured dies and molds. There is also no way to determine if the dies and molds re-exported back to China were for parts that would later be exported to the United States either for assembly or as part of a finished item. During interviews in the course of this investigation, several industry participants related instances where a long-time customer has had the first die or mold in a group made by a U.S. tool builder, with the intention of exporting it to China to be copied in order to produce the rest of the needed quantity.

The total export value of TDMs has remained relatively steady between 1997 and 2001, fluctuating slightly at just over $1 billion. The majority of export value is accounted for by industrial molds, with its share of total value rising from 60 percent in 1997 to 70 percent in 2001. The overall decline in export value of tools, dies, jigs and fixtures was driven by a 70-percent reduction in exports to Canada, the value of which fell by almost $200 million over the period. Increases to other markets, especially Mexico, Philippines, and Honduras offset the overall impact of lowered sales to Canada.

Pricing Dynamics

Pricing Pressures

During the past 5 years, and especially during the past 2 years, extremely competitive market conditions have forced OEMs to re-evaluate their operations, including their strategies for purchasing components and inputs, including TDMs. TDM-consuming manufacturers are, by necessity, seeking cost reductions wherever they can. This is especially true in such TDM-using markets as household appliances, power hand tools, housewares, and electronics, where the growth of large, nationwide retail chains has shifted additional pricing demands, and power, from producers to consumers throughout the manufacturing chain.

In order to minimize the cost of key inputs, such as tooling, OEMs seek out potential supply sources worldwide in order to increase price competition among suppliers and reduce the cost of manufacturing the final product.[151] Because the market for TDMs tends to be dominated by a relatively small number of OEM purchasers, and because

[151] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, July 2002), p. 7.

Table 3-15
Tools, dies, and industrial molds: U.S. exports of domestic merchandise, by destinations, 1997-2001

(*1,000 dollars*)

Country	1997	1998	1999	2000	2001
Canada	568,711	563,003	456,224	483,971	372,302
Mexico	234,902	263,476	307,498	358,438	297,575
Germany	26,888	32,252	29,017	48,127	41,961
United Kingdom	34,037	40,065	49,424	45,337	36,143
Hong Kong	8,975	21,058	23,304	17,521	26,392
China	15,491	14,475	10,280	15,271	22,655
Ireland	10,410	8,939	8,633	12,528	19,554
Japan	18,606	15,545	16,853	22,964	17,475
France	9,670	20,038	13,735	12,702	16,894
Singapore	15,193	11,113	13,051	20,561	16,812
Philippines	3,849	1,913	2,853	10,082	16,065
Thailand	10,521	5,455	5,845	5,007	15,828
Brazil	12,009	11,804	11,788	31,351	15,163
Taiwan	4,068	4,471	5,396	10,401	14,255
Korea	7,681	7,232	3,858	6,792	13,600
Italy	9,250	10,939	16,097	18,074	13,005
All other	100,843	109,881	97,322	101,893	128,319
Total	1,091,104	1,141,659	1,071,178	1,221,020	1,083,998

Note: Total export values for Jan.-Aug. 2002 were 0.5 percent less than Jan.-Aug. 2001.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-16
Industrial molds (NAICS 333511): U.S. exports of domestic merchandise, by destination, 1997-2001

(*1,000 dollars*)

Country	1997	1998	1999	2000	2001
Canada	284,299	404,487	387,132	369,747	284,281
Mexico	194,944	217,317	237,798	295,774	227,640
Hong Kong	7,093	15,929	20,278	13,682	20,870
Germany	10,123	11,483	10,853	27,787	20,623
United Kingdom	15,800	17,885	22,833	22,160	18,175
China	9,194	5,551	5,362	9,999	15,083
Ireland	6,725	5,210	5,804	9,778	14,155
Japan	10,825	6,725	7,665	12,487	12,297
Brazil	9,777	8,418	9,054	16,770	12,034
Thailand	4,248	1,420	1,161	939	11,837
France	6,533	9,145	9,007	6,668	10,727
Singapore	8,672	5,782	8,939	15,708	9,355
Taiwan	2,833	2,497	2,894	6,503	8,963
Malaysia	5,838	4,284	1,961	3,213	6,938
Belgium	6,140	5,663	3,836	5,763	6,893
Korea	5,887	5,144	2,640	4,777	6,232
All other	59,560	62,120	57,455	59,044	76,884
Total	648,492	789,060	794,671	880,799	762,986

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-17
Special tools, dies, jigs and fixtures (NAICS 333514): U.S. exports of domestic merchandise, by destination, 1997-2001

(*1,000 dollars*)

Country	1997	1998	1999	2000	2001
Canada	284,412	158,516	69,092	114,224	88,021
Mexico	39,958	46,159	69,700	62,664	69,935
Germany	16,765	20,769	18,164	20,340	21,338
United Kingdom	18,237	22,180	26,591	23,177	17,968
Philippines	724	1,019	917	8,659	15,219
Honduras	77	639	3,903	7,629	10,411
Italy	5,259	5,417	9,252	11,292	8,135
China	6,297	8,924	4,918	5,272	7,572
Singapore	6,521	5,331	4,112	4,853	7,457
Korea	1,794	2,088	1,218	2,015	7,368
France	3,137	10,893	4,728	6,034	6,167
Hong Kong	1,882	5,129	3,026	3,839	5,522
Ireland	3,685	3,729	2,829	2,750	5,399
Taiwan	1,235	1,974	2,502	3,898	5,292
Japan	7,781	8,820	9,188	10,477	5,178
Thailand	6,273	4,035	4,684	4,068	3,991
All other	38,571	46,970	41,682	49,029	36,032
Total	442,609	352,593	276,503	340,218	321,007

Source: Compiled from official statistics of the U.S. Department of Commerce.

OEM demand for tooling is critical to the economic health of the toolmaking industry, OEMs tend to take advantage of their market power when negotiating tooling purchases with suppliers. Typically, during the planning for a new product introduction, the OEM develops a detailed tooling budget, often in cooperation with suppliers, in which the company will arrive at a target (benchmark) cost for its tooling needs for major components.[152] These OEM tooling customers then often solicit bids from tooling suppliers that meet or exceed this target. Any productivity improvements gained during the course of completion of a tooling contract are expected to be incorporated into future tooling contracts. Major customers are always seeking to reduce their tooling costs on an annual basis in order to keep the cost of their final product competitive.[153]

In recent years, certain tooling customers have implemented on-line requests for bids through electronic Internet sites in an effort to further lower their tooling costs by receiving quotes from a larger universe of potential suppliers worldwide.[154] In addition,

[152] According to questionnaire responses more than 20 purchasers of TDMs and most automotive OEMs use some type of detailed cost-modeling process, including variables such as steel cost, CAD/CAM design and programming costs, finishing and assembly costs, labor rates, transportation costs, etc. when establishing a tooling budget for new product introductions. This tooling budget is then used as a basis to analyze vendor quotes.

[153] U.S. tooling and automobile industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[154] Thus far, the use of electronic Internet sites to source tooling does not appear widespread, due partly to resistance from tooling suppliers. According to questionnaire responses, 6 purchasers of tooling reported that they used the Internet to post Requests for Quotes (RFQs) for the purchase of tooling, while 5 other firms indicated in responses that they plan to use the Internet to post RFQs. Electronic websites listed included Covisint (used by two respondents) and B2E (one

(continued...)

these customers often call on large suppliers to rebate up to 5 percent of the mutual annual business back to the OEM.[155] These rebates or price concessions typically occur as a result both of productivity improvements instituted by suppliers, as well as give-backs by suppliers. However, many automotive tooling suppliers argue that annual demands for price concessions endanger the long-term financial health of these suppliers.[156]

Interviews with die and mold builders, hearing testimony, and information from publicly available sources, indicate that strong downward price pressures exist for U.S. tooling producers as a result of both supply-side[157] and demand-side factors. Downward price pressures on the demand side appear to have intensified since 2000, due in part to contraction in the market during the recession, the shift of manufacturing to Mexico and Asia, and a reduction in the number of automotive contracts released due to fewer automotive program launches. This has led to firms competing more aggressively for TDM production contracts. Since much of the market for telecommunications tooling has shifted to Asia, TDM producers that formerly specialized in that market have begun to look at other markets. These new entrants have driven down prices in those other TDM markets. For example, in the automotive stamping die market, some firms report that prices dropped as a result of intensive competitive bidding by domestic and foreign TDM producers, as well as fewer automotive contracts being released during the past 24 months.[158] Reverse auctions on Covisint, an online marketplace operated on behalf of several automobile OEMs, also reportedly contributed to the erosion of prices and contributed to smaller profit margins for tooling producers.[159]

Commission staff interviews with die and mold builders also indicate that their customers are seeking low prices by citing price levels from China. In some instances, such price levels have ranged from 50 to 75 percent of the prices initially quoted by the U.S. TDM builder.[160] One company reported a 65-percent price advantage for a mold from China.[161] Another U.S. moldmaker does not even bid on mold production jobs from a former U.S. customer, since the customer has decided to purchase molds at a lower price from Taiwan.[162] It is not uncommon to hear accounts from U.S. TDM producers that the final price being quoted from a Chinese TDM producer, by way of the U.S. purchaser, is lower than the cost of materials for the U.S. TDM producer. For example, when a U.S. mold producer quoted a price of $95,000 for a mold, a Chinese company bid $34,000, and the

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[154] (...continued)
respondent). Other respondents used the firm's home page and private trading networks to solicit bids.

[155] Two of the purchasers responding to the Commission's questionnaire indicated they required rebates from their suppliers of U.S.-made TDMs.

[156] "Are Better Supplier Relationships Helping Japanese Automakers Outpace Detroit's Big Three? New 2002 OEM Benchmark Study From Planning Perspectives, Inc., Suggests So," Planning Perspectives, Inc., Birmingham, MI, July 10, 2002.

[157] See earlier discussion on productivity gains and overcapacity.

[158] Riveria Tool Co., Form 10-K405 filed with the U.S. Securities and Exchange Commission, Nov. 19, 2001, found at *http://www.sec.gov*, retrieved May 5, 2002.

[159] Ibid.

[160] U.S. TDM producers, interviews by USITC staff, Mar. 4-6, 2002, and Apr. 22-26, 2002.

[161] Plastikos, Inc., written submission, Mar. 4, 2002.

[162] JS Die & Mold, written submission, Apr. 26, 2002.

U.S. mold producer reported that the price of his materials was $35,000.[163] Since early 2000, it is not uncommon to hear that U.S. TDM producers have produced TDMs at a loss in order to keep their workforces busy.[164] Prices offered by Canadian producers, according to U.S. TDM producers, are approximately 30 to 40 percent lower than U.S. prices.[165] These U.S. TDM producers believe most of the price difference between themselves and Canadian TDM producers is due to the foreign exchange rate between the U.S. and Canadian currencies. U.S. TDM producers indicate that they are able to compete with Japanese and EU producers based on price and other factors.

These anecdotal observations suggest that foreign competition is placing strong downward pricing pressure on U.S. tooling producers. However, because of the heterogenous nature of these products, there is no data source that tracks comparative prices for TDMs and therefore a definitive analysis of international pricing differentials is not possible. One survey[166] has attempted to develop an "apples-to-apples" comparison by soliciting tooling bids for the same group of five parts from tooling companies in 15 countries. Although responses were obtained from a very limited number of companies in each country (and none in China), the U.S. average price (two companies) exceeded every other country, with the exception of Germany, and in most cases by a significant margin.

Price Trends

Pricing trends as measured by the BLS Producer Price Index (PPI) present divergent trends for dies compared to molds between 1997 and 2001(table 3-18). Whereas the effect of the pricing pressures described above are clearly evident in the trends in PPI indexes for molds, the PPI data for dies exhibit fairly steady increases.[167] Most mold indexes ended the period lower than they started, and all peaked in 1999 or 2000 before declining to the end of the period.

Monthly data from these series for 2002 show that mold prices continue to soften, whereas most die data have plateaued. However, the data for forming and drawing dies have declined rapidly between January and August, and the August index (preliminary) is 141.2, below the 1997 average.

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[163] Gloria Irwin, "Cuyahoga Falls, Ohio, Mold Maker Says Unfair Foreign Competition Causes Woes," *Akron Beacon Journal*, Apr. 4, 2002, found at *http://www.newsedge-web.com*, retrieved Apr. 16, 2002.

[164] For example, one U.S. tooling manager testified before the Commission that he literally "had to buy a job" by quoting the customer $25,000 for a project that would otherwise cost $40,000 because his shop needed the work. Testimony of Mark A. Milbrandt, plant manager, Apollo Tool, Inc., transcript of the hearing, p. 198.

[165] U.S. TDM producers, interviews by USITC staff, Mar. 4-6 and Apr. 22-26, 2002.

[166] South Australian Centre for Manufacturing, *Global Survey of Price and Delivery*, July 1999.

[167] Metal compression molds for plastic (PCU3544#255) bucked the overall mold trend, rising from 103.4 to 113.6 over the period.

Table 3-18
U.S. producer price indexes for tools, dies, and industrial molds, 1997-2001

Item	Calendar year				
	1997	1998	1999	2000	2001
Special tools, dies, jigs, and fixtures (PCU3544#1)	153.9	155.2	156.7	158.9	162.2
Forming and drawing dies (PCU3544#1E)	141.3	141.9	141.7	141.8	144.6
Stamping dies (PCU3544#1F)	122.7	123.5	123.8	125.1	128.4
Other dies (PCU3455#1J)	105.5	107.1	108.2	108.3	108.3
Industrial molds (PCU3544#2)	134.7	134.9	135.5	135.5	130.9
Metal industrial molds for casting metals or carbides (PCU3544#21)	136.7	137.6	137.2	135.7	133.6
Metal industrial molds for molding plastics (PCU3544#25)	133.0	132.9	133.4	133.7	127.7
All other industrial molds (PCU3544#26)	115.1	116.8	118.0	117.4	115.7

Source: Compiled from official statistics of the U.S. Bureau of Labor Statistics, U.S. Department of Labor.

Payment Terms

Compounding the pricing problem for U.S. TDM producers are the extended payment terms demanded by U.S. customers (a concern also expressed by many foreign competitors[168]). Typically, in the automotive industry, and to a certain extent in the appliance industry,[169] the customer requests either delayed payment, until after the die or mold has been producing in the customer's operations, or in the form of staggered payment plans, ranging up to as much as 8 years, over the life of the die or mold.[170]

In the motor vehicle industry, the toolmaker typically will pay the cost of producing the tooling and will submit the cost to the OEM, Tier 1, or Tier 2 supplier for repayment. Contracts in the motor vehicle industry between the OEM and their suppliers tend to be based on some form of Production Part Approval Process (PPAP) in which terms of payment tend to be either full payment after OEM approval of the quality of a specified number of components produced or staged payments according to agreed-upon production targets, and after certain agreed-upon quality assurance guarantees have been satisfied.[171] Once full payment is made, the OEM becomes the owner of the tooling. Toolmakers seek generally to match their revenue from OEMs and Tier 1 customers as closely as possible to their production costs, minimizing the financing of their own working capital needs. However, this goal has become extremely difficult in recent years due to the pressure on profits experienced by U.S. OEMs. In recent years, the OEMs have used their dominant market position to delay payments to suppliers until well into

[168] See ch. 4.

[169] Testimony of David L. Rasmussen, president, Progressive Die & Automation, president of Quality Die & Mold; and member of the Board of Directors, Coalition for the Advancement of Michigan Tooling Industries, transcript of the hearing, p. 144.

[170] Testimony of Jay Baron, director, Manufacturing Systems Group, Center for Automotive Research, and president, Coalition for the Advancement of Michigan Tooling Industries, transcript of the hearing, p. 51.

[171] U.S. tooling and automotive industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

the production run of the vehicle, effectively pushing more of the financing of the tooling onto the toolmaker.[172]

Tooling contracts in the appliances, electronics, telecommunications, packaging, and medical industries generally follow some sort of a staged payment schedule, in which tooling payments tend to match the cash flow requirements of the toolmaker to build the tool.[173] For instance, a 30/30/30/10 payment schedule would involve[174]

- 30 percent down at the contract signing,
- 30 percent at final design approval,
- 30 percent at customer buy-off at the tooling company, and
- 10 percent at approval in customer's facility.

In recent years, some tooling manufacturers have indicated that some appliance manufacturers, led by the major appliance OEMs, may be moving closer to the model that prevails in the automobile industry in which payment for tooling is delayed until well into the production cycle of the appliance.[175] Payment policy by OEMs in the electronics and telecommunications industry has never approached the aggressive levels that prevail in the automotive industry.[176] However, it appears to be common for electronics and telecommunications OEMs to squeeze suppliers into granting price concessions, particularly during periods when falling demand for end-use products has put pressure on profitability, as has occurred in the industry since early 2000.

The practice of delaying payments instituted by the auto industry and now being adopted by other consuming industries means that TDM producer is essentially financing the mold or die for the customer.[177] Very large molds and dies may sell for up to $1.5 million, and it is not unusual for dies and molds to cost between $250,000 and $500,000. Because of the small size of the typical TDM producer, extending such credit terms may pose a significant financial burden. Further, U.S. automotive customers also frequently demand a price rebate as a condition for a tooling producer to remain as a qualified vendor. U.S. TDM producers have reported that these rebates are typically 5 percent of the price.[178] These practices are also being adopted by TDM customers in other markets.

Efforts are being made at the state level to give manufacturers of producer goods, including TDM firms, a legal tool to compel payment for their products. Most states have enacted lien laws addressing TDM makers' concerns about their inability to compel payment in a timely manner or, in some cases, to be paid at all, particularly from custom

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[172] Baron, transcript of the hearing, p. 51.

[173] U.S. tooling and consuming industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[174] IRN, Inc., *A Competitive Assessment of the Die and Mold Building Sector*, May 2002, p. 41.

[175] Rasmussen, transcript of the hearing, p. 144.

[176] U.S. electronics and telecommunications contract manufacturing industry officials, telephone interviews by USITC staff, Feb.-Aug. 2002.

[177] Although cash flow may even itself out over a period of years, accrual accounting methods lead to a recognition of the sales revenue and profit on the transaction, provided certain criteria are met. Hence, in the view of certain members of the industry, increasing a lag in receiving payment leads to the supplier also financing Federal and state taxes on his income even though the payment actually has not been received.

[178] U.S. industry officials, interviews by USITC staff, Chicago, IL, area, Apr. 22-26, 2002.

molders, reportedly the primary offenders.[179] However, with possession of the mold, die, or form a critical factor in enforcing a lien and compelling payment, the laws favored TDM users over TDM builders. A key provision of a new Michigan lien statute, enacted February 28, 2002, empowers TDM shops to attach a lien, even if not in physical possession, and gives the toolmaker the legal right to repossess the tooling if payment is overdue.[180] However, given the highly competitive character of the market for tooling, TDM firms must carefully consider taking such action against customers with whom they continue to seek business.

[179] Clare Goldsberry, "Moldmakers Fight Back Against Nonpayment," *News & Views*, American Mold Builders' Association (AMBA), summer 2002, found at *http://www.amba.org/NewletterDetail.php?mag_id=1&Issue_ID=3&Article_ID=6&mag_id=&*, retrieved Aug. 30, 2002.

[180] Under this law, if a customer does not remit payment within 90 days after receiving written notice of nonpayment and the amount owed, the moldmaker has the right to take possession of the mold, die, or form "without judicial process." For the full text of this legislation, see *http://www.michiganlegislature.org*, bill No. 4812, *Michigan Mold Lien Law*, Feb. 28, 2002.

Government Programs

Assistance Programs

Commission staff identified 10 Federal Government programs and 16 selected state government programs that offer assistance in many of the areas cited as important to maintaining competitiveness by TDM firms responding to Commission questionnaires. However, it should also be noted that these programs are available to most companies in any industry. The types and number of programs identified, based upon information presented on Federal assistance programs (table 3-19) and selected state assistance programs (table 3-20), are shown in the tabulation below:

Level	Type of program	Number
Federal		
	Loan programs	6
	Training assistance	1
	Consulting/competitive assistance	3
State		
	Loan programs	10
	Training assistance	4
	Consulting/competitive assistance	2

At the Federal level, six programs offer loan guarantee or financial assistance. These programs are geared towards facilitating loans to companies that have short-term needs or that may not acquire loans under normal financing circumstances. At the state level, ten programs currently exist for the selected states that offer loan assistance to firms. Both Federal and state governments provide assistance through various consulting services that offer firms advice on how to improve daily operations and adjust to the challenges of competition and the changing marketplace. In addition, there are five training assistance programs that can be used by TDM firms to facilitate training for apprentices and workers.

Highlights of the various types of assistance, eligibility guidelines, and contact information are presented for Federal programs in table 3-19 and for selected state programs in table 3-20.[181] For purposes of this investigation the five states (California, Illinois, Michigan, Ohio, and Pennsylvania) with the largest number of TDM firms[182] are highlighted to illustrate the type of assistance that may be available at the state level. A variety of assistance programs are known to exist in other states and may be identified by consulting the various assistance centers and/or state, regional, or local offices identified under the contact information provided for the various Federal programs in table 3-19. Many of these Federal programs work closely with and through state and local offices or designated state assistance centers to help facilitate services to companies, and would have familiarity with various state programs that could be of assistance.

[181] Information is presented to highlight key elements of each program and should not necessarily be considered as a comprehensive list of all government programs that may be of assistance to the TDM industry. Users are encouraged to refer to contact information for specific details and guidance on obtaining available assistance.

[182] Census, 2000 County Business Patterns.

Table 3–19
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Department of Commerce, Economic Development Administration (EDA) *www.osec.doc.gov/eda*	Types of assistance provided: The Trade Adjustment Assistance (TAA) program offers 50/50 cost sharing of projects aimed at improving a manufacturer's competitive position, including manufacturing and engineering (such as ISO quality-assurance program preparation and registration, product development, productivity improvement, and CAD/CAM); marketing (research, strategy, and market analysis); financial and general management (debt restructuring, cost management, and training); and information technology (hardware/software selection, programming, and systems).
Program: Trade Adjustment Assistance (TAA)–Primary goal is to assist domestic manufacturers and producers injured by increased imports prepare and implement strategies to guide their economic recovery. *www.taacenters.org*	Program eligibility and guidelines: • With the help of a TAA Center (TAAC), businesses submit a petition to the EDA to determine their eligibility. • TAAC staff will assess eligibility and prepare an application on behalf of import-impacted manufacturers • Manufacturers qualify if imports have contributed to declines in employment and sales or production • TAAC staff assist with ways requirements can be met using firm data such as sales, employment, and lists of customers which have reduced purchases • Once certified, a firm is eligible for technical assistance and cost-sharing financial assistance from the EDA

	Application process, time frame, and costs:
	Steps that need to be taken—
	• Certification Process (2-3 months)
	• Submission of paperwork detailing data from the company and determination of eligibility by the EDA Washington, DC, office
	• EDAhas 60 days to review the application
	• Costs to firm: None
	• Adjustment Plan (2-6 months)
	• Once certification is received from the EDA, a practical Adjustment Plan is drawn up with the assistance of TAAC staff
	  • TAAC staff assist the firm in determining strengths and weaknesses
	  • Costs to firm: A firm must pay 25 percent of the costs associated with the plan development
	• Implementation (2-3 years)
	  • Once the Adjustment Plan is approved by the EDA, a firm has 6 months to request implementation assistance from the TAAC
	  • Costs to firm: at least 50 percent of the costs of implementation. EDA will cover a maximum of 50 percent of the costs of technical consulting services, up to a maximum total of $75,000

	Contact information: • More information on the TAACs and results can be found on their website: *www.taacenters.org* • Contact information for the 12 Trade Adjustment Assistance Centers can be found at: *www.taacenters.org/contact.asp* • EDA regional office contact information can be found at: *www.osec.doc.gov/eda/html/1c_regloffices.htm*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Department of Commerce, National Institute of Standards and Technology (NIST) *www.nist.gov*	Types of assistance provided: The Manufacturing Extension Partnership (MEP) program uses the expertise of manufacturing and business specialists to provide assistance in: process improvement, quality and business management systems, materials engineering, plant layout, product development, energy audits, financial planning, CAD/CAM/CAE, and electronic commerce/EDI, and other related areas.
Program: Manufacturing Extension Partnership (MEP) is a nationwide network of non-profit centers whose primary goal is to assist small and medium-sized U.S. manufacturers improve their operations. *www.mep.nist.gov*	Program eligibility and guidelines: • MEP Centers work with small and medium-sized manufacturers—typically, those with fewer than 500 employees • Clients include manufacturers who want expert help to solve specific problems (such as product defects, work flow, and employee training); to reverse negative business situations (sales decreases, loss of market share, and cost increases); or to implement new technologies or processes • MEP can assist in areas such as reducing time to market, employing lean manufacturing, finding market niches, and increasing focus on quality
	Application process, time frame, and costs: • Individualized consulting is available for a nominal fee, although no formal application process is required • Consultation is arranged by calling the national hotline to schedule a field agent to perform an on-site assessment • A nominal fee varies from state-to-state, although programs are one-third NIST-funded and one-third state-funded
	Contact information: • Information on MEP success stories, such as a metal fabricator serving OEMs and Tier 2 suppliers in the automotive industry; an engineered parts supplier to the aerospace, medical, and industrial industries; and a components manufacturer for the aerospace industry are included at website *www.mep.nist.gov/index2.html* • There are 60 MEP centers with over 400 locations nationwide. To find the nearest center, call 800-637-4634 or visit *www.mep.nist.gov/index3.html*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Department of Agriculture (USDA), Rural Business-Cooperative Service (RBS) *www.rurdev.usda.gov/rbs*	Types of assistance provided: Loan guarantee program in which loans are made through private lenders and guaranteed by the USDA. The USDA provides guarantees of up to 90 percent of a loan made by a commercial lender—up to a maximum of $10 million for a single borrower. Under special circumstances, there is a maximum of $25 million for a single borrower.
Program: Business and Industry Guaranteed Loans–targeted specifically at non-agricultural sector firms to help create jobs and stimulate rural economies by providing financial backing for rural businesses. *www.rurdev.usda.gov/rbs/busp/bprogs.htm*	Program and eligibility requirements: • Loan proceeds may be used for working capital, machinery and equipment, buildings and real estate, and certain types of debt refinancing • This type of assistance is available only to businesses located in rural areas with a population of 50,000 or less. The USDA makes the final determination as to whether this requirement is met • Existing businesses must show that they have a 10-percent balance sheet equity to cover the loan, whereas new businesses must show a 20-percent balance sheet equity • The private lender may discount the collateral in accordance with sound lending practices, but the loan must be fully secured • Recognized lenders include federal or state chartered banks, credit unions, insurance companies, savings and loan associations, farm credit banks or other farm credit system institutions with direct lending authority, a mortgage company that is part of a bank holding company, and the National Rural Utilities Finance Corporation
	Application process, time frame, and costs: • There is a one-time guarantee fee, usually 2 percent of the loan multiplied by the percentage of the guarantee that is charged to the bank by USDA. The bank may pass this fee along to the borrower • Loan approval authority for each RBS office is for amounts of $5 million or less; the application is approved at the local RBS office and takes about 60 days • For amounts of over $5 million, the application must be sent to Washington, DC, for approval. The time frame is approximately 90 days
	Contact information: • Rural development field staff for state offices are listed at: *www.rurdev.usda.gov/recd_map.html* • USDA service centers also assist with rural development programs, and local offices may be reached via “Service Center Locator” at *www.sci.usda.gov/sci/*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Small Business Administration (SBA) *www.sba.gov/*	Types of assistance provided: Loan guarantees to small businesses that are unable to secure financing on reasonable terms through normal lending channels. Private-sector lenders provide loans which are, in turn, guaranteed by the SBA.

Program: 7(a) Loan Guaranty—one of the SBA's primary lending programs.
www.sba.gov/financing/fr7aloan.html
	Program eligibility and guidelines:
	• The firm must meet the SBA definition of a small business. In the case of the TDM industry, the firm must have 500 or fewer employees
	• Maximum loan amount is $2 million of which maximum SBA guaranty is $1 million. Loan amounts of $150,000 or less carry a maximum guaranty of 85 percent; loans greater than $150,000 carry a maximum guaranty of 75 percent
	• 7(a) loan proceeds can be used for the following—
	  • Expand or renovate facilities
	  • Purchase machinery and equipment
	  • Finance receivables
	  • Augment working capital
	  • Refinance existing debt with compelling reason
	  • Purchase of land or buildings

	Application process, time frame, and costs: • The average turnaround time for SBA processing and review is 1 week • The entire application time frame may differ depending on the private lender • Guaranty and servicing fees are charged to lenders by SBA for each loan approved, which can be passed on to the borrower • The guaranty fee is 1 percent of the guaranteed portion when the loan amount is $150,000 or less (lenders are permitted to retain 25 percent of fee for this size loan only); 2.5 percent up to $700,000; and 3.5 percent for loans greater than $700,000 • Loans are subject to a 0.5 percent annualized servicing fee
	Contact information: • Local lenders are familiar with SBA loan programs and can assist in the SBA loan application process • To locate a local SBA office, call 1-800-827-5722 or visit their website at *www.sba.gov/regions/states.html*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Small Business Administration(SBA)—*Continued*	Types of assistance provided: Long-term financing/working capital loan guarantees to small businesses who wish to compete more effectively, expand exports, or are adversely affected by competition from imports.

Program: International Trade Loan—targets businesses involved in international trade or are adversely impacted by import competition. *www.sba.gov/financing/frinternational.html*	Program eligibility and guidelines:
	• The firm must meet one of the following criteria—
	  • Loan proceeds will significantly expand existing export markets or develop new ones
	  • The applicant's business is adversely affected by import competition
	  • Equipment or facilities will be upgraded to improve competitive position
	• The firm must also meet the SBA definition of a small business. In the case of the TDM industry, the firm must have 500 or fewer employee
	• Loan guaranty percent is the same as for any standard 7(a) loan; however, SBA provides a 90-percent guaranty on the export working capital portion of such loan up to a maximum of $150,000
	• Use of loan proceeds—
	  • Working capital, facilities, and/or equipment
	  • Cannot be used for debt payment
	• SBA can guarantee up to $1.25 million, for a combination of fixed asset (facilities or equipment) financing up to $1 million, and a working capital portion up to $750,000

	Application process, time frame, and costs: • The average turnaround time for SBA processing and review is 1 week • The entire application time frame may differ depending on the private lender • Guaranty and servicing fees are the same as for any standard 7(a) loan
	Contact information: To locate a local SBA office, call 1-800-827-5722 or visit their website at *www.sba.gov/regions/states.html*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Small Business Administration (SBA)—*Continued*	Types of assistance provided: Loan guarantees by private lenders for short-term financing needs, to include advances against anticipated inventory and accounts receivable, direct labor and materials costs to perform contracts, and standard or small asset-based line of credit.

Program: CAPLines Loan—primary purpose is to meet the needs of short-term and cyclical working-capital needs. *www.sba.gov/financing/frcaplines.html*	Program eligibility and guidelines:
	• A firm in the TDM industry must have 500 or fewer employees
	• Use of loan proceeds—
	  • Working capital, facilities, and/or equipment; or purchase of inventory
	  • Cannot be used to pay existing debt unless refinancing is justified as benefitting the business
	• The total loan amount available under this program generally would be limited to $1.33 million based on a maximum SBA guaranty of $1 million and a lender requesting the maximum SBA guaranty of 75 percent

	Application process, time frame, and costs: • The average turnaround time for SBA processing and review is 1 week • The entire application time frame may differ depending on the private lender • The lines of credit have a maturity of up to 5 years but a shorter initial period may be established and tailored to individual business needs • Guaranty and servicing fees are the same as for any standard 7(a) loan
	Contact information: To locate a local SBA office, call 1-800-827-5722 or visit their website at *www.sba.gov/regions/states.html*
U.S. Small Business Administration (SBA)—Continued	Types of assistance provided: Counseling, training, research, and advocacy are just some areas in which SBDCs offer assistance.

Program: Small Business Development Centers (SBDCs) provide management and business consulting to small business owners. *www.sba.gov/sbdc*	Program eligibility and guidelines:
	• Benefits of SBDCs—
	  • Knowledgeable about local conditions regarding small businesses
	  • Good resource on information and referrals about local banks, and state and county financing programs
	  • Counseling assistance provided on applying for different types of loans available to small business
	• Eligibility Requirements—
	  • TDM firms must have 500 or fewer employees

	Contact Information: To locate the nearest SBDC, go to SBA's website at *www.sba.gov/sbdc/mission.html*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Small Business Administration (SBA)—*Continued*	Types of assistance provided: Short-term working capital loan guarantees to small businesses for exporting purposes. The typical maturity of the export working capital program (EWCP) loan is 12 months or less.

Program: Export Working Capital Program (EWCP) is designed to provide short-term working capital to small business exporters	Program eligibility and guidelines:
	• The SBA guarantees up to 90 percent of the loan amount or a maximum of $1 million (whichever is less), with the loan assisting exporting needs
	• Loan proceeds must be used to finance the working-capital needs associated with the exporting transactions of the exporter; examples include—
	  • Acquiring inventory
	  • Paying manufacturing costs of goods for export
	  • Supporting standby letters of credit used for bid and performance bonds
	  • Financing foreign accounts receivable
	• Loan proceeds cannot be used for refinancing, fixed assets, marketing, or setting up operations abroad
	• Applicants must submit cash flow projections to support the need for and the ability to repay the loan

	Application process, time frame, and costs: • The average turnaround time for SBA processing and review is 1 week • The entire application time frame may differ depending on the private lender • Lender fees and interest rates are determined by bank • The borrower must provide the SBA with a security interest equal to 100 percent of the EWCP guaranty amount
	Contact information: For further details, contact a local SBA office by calling 1-800-827-5722 or visit the EWCP website at *www.sba.gov/financing/frexport.html*
Export Import Bank of the United States (Ex-Im Bank) *www.exim.gov/*	Types of assistance provided: Working capital loan guarantees for export-related activities.

Program: Working Capital Guarantee	Program eligibility and guidelines:
	• Eligible use of proceeds—
	  • Purchase finished products for export
	  • Exporters should have a 1-year operating history
	  • Exporters need a positive net worth
	  • Payment for raw materials, labor, and overhead to produce goods for export
	  • Cover standby letters of credit serving as payment guarantees
	  • Cover retainages and warranties
	• Ex-Im's working capital guarantee covers 90 percent of the loan's principal and accrued interest
	• The borrower must provide collateral for the guaranteed loans

	Application process, time frame, and costs: • A processing fee of $100 with each application for a final loan commitment and an up-front facility fee of 1.5 percent of the total loan amount, based on a 1-year loan
	Contact information: For more information, contact one of the six Ex-Im regional offices. A detailed list of regional office contact information is available at *www.exim.gov/regional.html*

Table 3–19—*Continued*
Federal Government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
U.S. Department of Labor; Employment and Training Administration (ETA); Office of Apprenticeship Training, Employer and Labor Services (OATELS) *www.doleta.gov/atels_bat*	Types of assistance provided: Technical assistance to an apprenticeship sponsor in designing and implementing an apprenticeship program. This assistance can include identification of training needs and instruction sources, development of apprenticeship standards and a system to record individual progress, and coordination with other Federal programs.

Program: Bureau of Apprenticeship and Training (BAT) Registered Apprenticeship System—provides assistance to employer associations, labor and management in establishing registered apprenticeship programs.
www.doleta.gov/atels_bat/bat.asp
	Program eligibility and guidelines:
	C Apprenticeship program sponsors must be registered with BAT before they are eligible for consultation assistance from the ETA
	C Prospective employers/associations work with Apprenticeship and Training Representatives (ATRs) to develop apprenticeship program standards. This may include an on-the-job training outline, related classroom instruction curriculum, and apprenticeship program operating procedures
	• These program standards are registered with BAT if they meet Federal requirements, including—
	  • Full and fair opportunity to apply
	  • Schedule of work processes in which an apprentice is to receive training and experience
	  • Organized instruction to provide technical knowledge of trade
	  • Recording keeping of apprentice's progress
	C The program standards are tailored to the employers' individual needs in keeping with the industry standards. For example, BAT has a work process for occupations in the TDM trades that could be tailored to address employer needs for "national" entities that desire to establish a registered "national" apprenticeship program

	Application process, time frame, and costs: C The time frame necessary to register a program varies with each apprenticeship program sponsor C Once the apprenticeship program is registered, consultation and/or technical assistance is an ongoing process provided by the ATRs at no cost for the duration of the program C No direct financial assistance (e.g., loan or shared funding) is provided by BAT, although as the apprenticeship registration agency, BAT can provide information about Federal and state vocational education resources that may pay a portion of the related technical instruction, instructors, or related apprenticeship instruction
	Contact Information: • TDM business owners or trade groups seeking advice or interested in establishing a "local" program may contact state offices listed at *www.doleta.gov/atels_bat/sobat.asp*, or by calling 1-877-872-5627. • Entities seeking advice regarding a "national" program may contact ATRs within the OATELS in Washington, DC, listed at *www.doleta/atels_bat/national.asp* or by calling (202) 693-3813

Source: Compiled from program material and Internet sites of the U.S. Government agencies noted in the table.

Table 3–20
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Illinois Illinois Development Finance Authority (IDFA) *www.idfa.com*	Types of assistance provided: Loan proceeds may be used for acquiring building and machinery as well as construction and renovation projects.
Program: Title IX Loans—IDFA is a state-authorized, self-financed authority. The Title IX Revolving Loan Fund provides low-cost supplemental financing for fixed asset financing to small and medium-sized manufacturing located in areas designated for Title IX assistance by the Economic Development Administration (EDA).	Program eligibility and guidelines: C Applicants must be manufacturing companies located in one of the following areas designated by the EDA: counties of Boone, Clinton, Cook, DuPage, Henry, Kane, Kankakee, Know, Lake, LaSalle, Macon, Madison, Massac, McHenry, Monroe, Montgomery, Peoria, Perry, Rock Island, St. Clair, Tazewell, Vermillion, Will, Winnebago, or Woodford; or the city of Monmouth C Financing provided under this program must create new jobs or must retain existing jobs C Loan amounts totaling the lesser of 30 percent of fixed-asset costs or $100,000 C The interest rate is fixed at 7.5 percent C Ten percent equity required
	Application process, time frame, costs: C $100 non-refundable application fee C $225 loan commitment fee to IDFA once the loan is approved C $225 loan servicing fee due at the loan closing C The typical time frame for staff review for loan approval is 30 to 45 days from time of application submission
	Contact information: • More information and an application form is available at *www.idfa.com/loanix.htm*, or by calling IDFA at (618) 453-5566. • IDFA offers a variety of loan and bond programs that may be of interest to firms in the TDM industry
Illinois Department of Commerce and Community Affairs (DCCA) *www.commerce.state.il.us*	Types of assistance provided: A special reserve fund is set up where the borrower and the state all contribute funds. The reserve fund allows lenders to provide loans beyond conventional risk levels and draw upon the fund if the firm is unable to meet payment requirements.
Program: The Capital Access Program (CAP) is designed to enhance credit availability to small business from private lenders. CAP is a resource where small businesses can obtain a loan that they may not be able to acquire by conventional financing.	Program eligibility and guidelines: C Under the CAP, the borrower places a non-refundable contribution to a reserve fund, typically between 3 and 7 percent of the loan amount C The DCCA provides a matching contribution to the reserve fund C Loans under CAP cannot be used for refinancing or for financing passive real estate ownership
	Contact information: For more detailed information, contact the Illinois DCCA at (312) 814-8534.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Illinois—*Continued* Illinois Department of Commerce and Community Affairs (DCCA) *www.commerce.state.il.us*	Types of assistance provided: Assistance to Illinois employers in the training, retraining, and upgrading of employee skills.
Program: The Industrial Training Program (ITP) provides grants that reimburse companies for up to 50 percent of the cost of training their employees. Businesses can benefit through increased productivity, reduced costs, improved quality, and competitiveness.	Program eligibility and guidelines: C There are typically two forms of assistance under the ITP— • Single Company Training Project—typically granted to large-sized firms • Multi-Company Training Project—geared towards small to medium-sized firms • Only full-time employees may participate in any ITP-funded training project • Training activities that are eligible under the Single Company component include but are not limited to— • Training necessary to implement total quality management or improvement systems in the workplace • Job-linked training that offers new or additional skills • Training related to new machinery or equipment. • Training programs in response to new or changing technologies or processes being introduced in the workplace • Training not eligible for funding assistance under the ITP program includes human resource practices, consulting services, personal development, and apprenticeship programs
	Application process, time frame, costs: • An application package should include the following (forms are provided by the DCCA)— • Cover sheet—a form contained in an application package from the DCAA • Transmittal letter—a description of the proposed training program • Business Certification • Schedule M-1 Training Outline—a description of each training component(s) and the job classification tasks • Schedule M-2, Training Outline Data/Trainees • Schedule M-3, Training Outline Data/Trainers • Schedule M-4, Project Budget Summary, and a Budget Narrative that explains each line of the proposed budget
	Contact Information: • For further information, contact the Office of Industrial Training (OIT) by calling (217) 785-6284 (Springfield, IL) or by e-mail at *ckulek@illinoisbiz.biz* • Contact the OIT Chicago office by calling (312) 814-5962 or by e-mail at *lclark@illinoisbiz.biz*

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Ohio Ohio Department of Development (ODOD) *www.odod.state.oh.us*	Types of assistance provided: Manufacturers can use loans for machinery and equipment purchases with low interest rates, with past rates at 4-5 percent.
Program: 166 Direct Loan Program Manufacturers in Ohio are eligible for loans of up to $1 million maximum and $350,000 minimum.	Program eligibility and guidelines: C A private lender must participate C About 30 percent of costs are funded by the state C Borrower must put up 10-percent cash equity C The private lender puts up the remainder of the fund C For every $15,000 received under this program, one job must be created or retained C Loan maturities are at 15 years for buildings and 5-7 years for equipment
	Contact information: For more information, contact the ODOD, Office of Financial Incentives at (614) 466-5420 or (800) 848-1300.
Ohio Department of Development (ODOD) *www.odod.state.oh.us*	Types of assistance provided: Loan assistance for working capital, purchase of construction of fixed assets such as buildings and equipment, and refinancing of other existing loans.
Program: The Ohio Capital Access Program encourages financial institutions to lend to small businesses that may not meet conventional loan requirements. A reserve account is set up as an incentive for private lenders to ensure recovery of losses that may be incurred for loans under this program.	Program eligibility and guidelines: C Reserve account details— C The firm, the lender, and the state all contribute to the reserve account C The firm contributes 1.5 to 3 percent of the principal amount of the loan, with the amount determined by the lender C The lender must match the firm's contribution C The state contributes 10 percent of loan amount C The firm must have annual sales of less than $10 million C The State of Ohio must be the firm's principal business location C Ineligible uses of loan proceeds include construction or purchase of residential housing and passive real estate investments
	Application process, time frame, and costs: C The lender may charge normal and customary fees, but no additional fees are charged by the state C The ODOD, Division of Minority Business Affairs has 15 days to enroll a loan and submit the 10-percent contribution into the program reserve account after the lender has closed on the loan C The total time frame will vary depending on the lending institution
	Contact information: The ODOD Office of Minority and Business Financial Incentives at (614) 644-7708 or (800) 848-1300.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Ohio—*Continued* Ohio State Treasurer's Office *www.ohiotreasurer.org* Program: The Small Business Linked Deposit Program offers small businesses the capability to secure funds with below-market interest rates for 2 years.	Types of assistance provided: The ability to secure funds through a qualified Ohio bank for different purposes, such as working capital, fixed assets, and debt refinancing. Program eligibility and guidelines: C The firm must employ less than 150 employees C The firm must operate facilities and maintain offices exclusively in Ohio C The firm must be a for-profit organization C Loan proceeds cannot be used for investment purposes or holding property C For every $25,000 requested, one full-time equivalent job must be created or saved C Current limits on funds are $250,000 per business Application process, time frame, and costs: C The Ohio State Treasurer's Office typically takes 2 weeks to process an application C No fees are associated with the application process C The private lending institution applies on the firm's behalf for the program Contact information: Contact Ohio State Treasurer's Office at (614) 466-6546 for further information or visit their website at *www.ohiotreasurer.org/programs.htm*

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Pennsylvania Pennsylvania Department of Community and Economic Development (DCED) *www.inventpa.com/*	Types of assistance provided: The Machinery Equipment Loan Fund (MELF) provides low-interest financing to firms up to $500,000 or 50 percent of the total eligible project costs.
Program: Machinery and Equipment Loan Fund (MELF) Manufacturing firms have the option of using the MELF to finance the purchase of new machinery and equipment or upgrade existing machinery and equipment.	Program eligibility and guidelines: C Interest rates range from 3 to 5 percent C Loan maturities are up to a 7-year term, depending upon the loan useful life of the machinery being financed C 10-percent equity is required C $25,000 cost per job retained or created C The project must be directly related to the manufacturing process
	Contact Information: For further details, contact the DCED customer service center at (800) 379-7448 or the Loans Division at (717) 787-6245.
Pennsylvania Department of Community and Economic Development (DCED) *www.inventpa.com/*	Types of assistance provided: Small Business First (SBF) provides low-interest loan financing for working capital, equipment purchases and upgrades, and machinery purchases.

Program: Small Business First (SBF) is a loan program similar to the federal government's programs offered by the SBA.	Program eligibility and guidelines:
	C Maximum loan amounts under this program are $200,000 or a maximum of $100,000 for working capital
	C The firm must be a small business with 100 or fewer employees
	C Interest rates are set at 5 percent
	C Loan maturities—
	  C Up to 10-year term for land and building
	  C Up to 7-year term for machinery and equipment
	  C Up to 3-year term for working capital
	C Condition—for every $25,000 borrowed, the firm must show that they created one full-time job within 3 years

	Application process, time frame, and costs: C Applications are available through area loan organizations C A list of area loan organizations are available through the SBF office C The typical time frame for each applicant varies
	Contact Information: For further information, contact the SBF office at (717) 783-5046.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Pennsylvania—*Continued* Pennsylvania Department of Community and Economic Development (DCED), Pennsylvania Economic Development Financing Authority (PEDFA) *www.inventpa.com/*	Types of assistance provided: Loan funds may be used for working capital, equipment purchases, and land purchases.
Program: The Pennsylvania Capital Access Program (PennCAP) provides loan guarantees made through private banks through a portfolio concept. PEDFA provides capital to guarantee loans made through participating lending institutions involved in the program.	Program eligibility and guidelines: C Under the PennCAP program, the borrower will place an amount into a reserve fund, with the bank matching that amount, and the state placing 2.5 times the total amount into the fund C With a reserve fund, a bank can make a larger loan than they would normally to a firm C The bank can tap into the reserve fund if the loan is not repaid C Loans can be guaranteed up to $500,000 C Loan proceeds must be used for business purposes in Pennsylvania
	Application process, time frame, and costs: C There is a one-time PennCAP reserve enrollment fee charged to borrowers at the close of the loan. This fee ranges from 0.5 percent up to 3 percent of the loan amount C Only two state forms (available from a participating bank) are required to enroll a PennCAP loan, which is completed by the bank on behalf of the borrower
	Contact information: For further information, contact the DCED Bonds Office at (717) 783-1109 or a local participating Pennsylvania bank.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Pennsylvania—*Continued* Pennsylvania Department of Community and Economic Development (DCED), Pennsylvania Economic Development Financing Authority (PEDFA) *www.inventpa.com/*	Types of assistance provided: PEDFA offers two forms of bond financing—Composite Bond Issues and Stand-Alone Bond Issues. Proceeds from bond sales are provided to businesses as loans

Program: Bond Financing Program (Tax-Exempt and Taxable)—PEDFA provides cost-effective financing to businesses by issuing bonds, selling the bonds to private investors, and lending the proceeds to eligible businesses	Program eligibility and guidelines:
	• PEDFA bonds are private activity bonds and *are not guaranteed by the government*
	• A bank letter of credit or other credit support is needed by the business to guarantee repayment of PEDFA bonds to bondholders in case of a borrower default
	• All PEDFA loans must be a minimum of $400,000
	• Types of bond financing—
	  • Composite Bond Issues—small-to-medium sized projects are combined into a single issuance; projects share the high up-front costs of bond issuance, typically range from $400,000 to $7 million, and must be guaranteed by a participating bank
	  • Stand-Alone Project medium-to-large-sized projects that typically range from $4 million and up; projects can be issued on an individual “stand-alone” basis, and guarantee of repayment must be shown to PEDFA
	• Borrowers may be eligible for tax-exempt or taxable issues
	• Tax-exempt and taxable bond proceeds differ in eligibility requirements and interest rates
	• Tax-exempt projects are subject to more stringent eligibility guidelines and receive more favorable interest rates
	• A complete list of eligibility requirements can be acquired by contacting the PEDFA office. PEDFA determines if the borrower meets the tax-exempt project requirements
	• Tax-exempt proceeds—TDM firms must use at least 75 percent of bond proceeds for manufacturing activities; a limit of 25 percent of proceeds may be used for other directly related purposes at the same site and facility.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program

State of Pennsylvania—*Continued*	Application process, time frame, and costs:
	• Borrowers must apply through a local Industrial Development Authority (IDA) or an Industrial Development Corporation (IDC)
	• Once the project is approved by the IDA/IDC, the IDA/IDC submits the Single Application document from the borrower to PEDFA. The PEDFA office evaluates each application within 20 days of receipt
	• Composite Bond pools close three times a year in April, August, and December
	• The time frame for the composite bond issue is typically 10 to12 weeks from the application deadline to when funds are available after bond closing
	• Costs to the borrower and financing arrangements include—
	  • Issuance costs—typically from 2.25 percent to 2.75 percent for composite bond issues
	  • PEDFA charges a one time fee of 0.2 percent
	  • Local sponsors (IDA/IDC) and banks charge fees, which is at their discretion but monitored by PEDFA
	  • Taxable bond—entire issuance cost can be financed with bond proceeds
	  • Tax-exempt bonds—portion of closing costs can be financed with bond proceeds
	  • A detailed list of fees associated with this program can be obtained from PEDFA
	
	Contact information:
	• DCED PEDFA Center for Private Financing at (717) 783-1109
	• Other states may have similar bond financing programs available.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Pennsylvania—*Continued* Pennsylvania Department of Community and Economic Development (DCED) *www.inventpa.com/*	Types of assistance provided: The Customized Job Training (CJT) program provides companies, except point-of-sale retail, with funds that may be used to cover training items such as instructional costs, supplies, and contracted services.
Program: The Customized Job Training (CJT) Program provides grant funds for specialized job training for new and existing employees.	Program eligibility and guidelines: • Grants of up to 75 percent of total project cost may be provided for new job creation and up to 70 percent for job retention • Training programs must be administered by local education agencies such as communities and vocational technical schools • The local education agency is the actual applicant for assistance under the CJT program • Students/trainees must be employees of the firm in order for the education agency to qualify for grant funds • Funds acquired under the CJT must be used for actual training
	Contact Information: For further information, contact the Center for Business Financing at (717) 787-7120.
Pennsylvania Department of Community and Economic Development (DCED) *www.inventpa.com/*	Types of assistance provided: Services offered include—market analysis and development; lean manufacturing; electronic business and information technology; and selection, implementation, and optimization of available technologies.
Program: The Industrial Resource Center Network (IRCs)—IRCs provide financial and technical assistance to small and medium-sized manufacturers with 500 or fewer employees. IRCs are a part of the NIST Manufacturing Extension Partnership (MEP) Program	Contact Information: A list of regional IRCs and contact information can be found at *www.inventpa.com*

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Michigan Michigan Economic Development Corporation (MEDC) *medc.michigan.org/*	Types of assistance provided: The State of Michigan contributes to a reserve fund to encourage lenders to loan to firms that may not receive financing under normal circumstances.

Program: The Capital Access Program (CAP) provides firms with a portfolio concept loan option that they may not receive under normal circumstances. This program is set to be phased out by September 30, 2002.	Program eligibility and guidelines:
	• A reserve fund is set up as a mechanism that the bank turns to in case there is a loss on the loan incurred in the future
	• The borrower contributes a minimum of 1.5 percent and a maximum of 3.5 percent of the total loan amount into the reserve fund
	• The bank matches the borrower's contribution.
	• MEDC contributes an amount that is the total of the borrower and the bank contribution
	• The reserve is owned and controlled by MED
	• Proceeds of the loan must be used for a business purpose within the State of Michigan—
	  • Financing acquisition of land or building intended for use in business operations of the company
	  • Construction or purchase of residential housing
	  • Passive real estate ownership

	Application process, time frame, and costs: • The bank makes the loan, then files a one-page Loan Filing Form with MEDC within 10 days after the loan is made • The bank determines the interest rates, fees, terms of maturity, collateral requirements (if any), and loan conditions • There is no minimum or maximum loan amount
	Contact Information: To contact the MEDC Lansing Office, call (517) 335-5883.

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of Michigan—*Continued* Michigan Economic Development Corporation (MEDC) *medc.michigan.org/*	Types of assistance provided: The State of Michigan provides grants to companies to support employee training programs as an incentive package. The employer must match 25 percent of the state grant.
Program: The Economic Development Job Training Program (EDJT) provides grants on a competitive basis to companies that need to train or retain workers to accommodate changes in the marketplace. The EDJT Program has provided $30 million annually to assist companies in their employee training efforts. The budge allocation for FY2003 is expected to be $13.5 million.	Program eligibility and guidelines: C All Michigan-based companies are eligible to compete for funds through the EDJT C Funds received through the EDJT are sent to educational and training facilities such as local community colleges, and trade academies C Companies work with their local educational facility to create a training program that is specialized to their need
	Contact Information: For further information contact the MEDC Lansing Office at (517) 373-9808 or the Livonia Office at (517) 335-5883
Michigan Economic Development Corporation (MEDC) *medc.michigan.org/*	Types of assistance provided: A full range of services and programs such as strategic planning, quality management, and inventory control are provided by the Michigan Manufacturing Technology Center (MMTC).

Program: The Michigan Manufacturing Technology Center (MMTC) was established in 1991 as a part of the NIST Manufacturing Extension Partnership (MEP) in Michigan. Small to medium-sized manufacturers with 499 or fewer employees are the main types of firms that MMTC seeks to assist.
www.mmtc.org
	Program eligibility and guidelines:
	C MMTC staff assist manufacturers through—
	  C Improvement of operating performance and efficiency levels
	  C Seminars, workshops, group training, and on-site consulting
	C Funding support for the MMTC is provided by the MEDC and MEP

	Contact Information: MMTC staff can be contacted at (888) 414-6682 or at: *www.mmtc.org/contact%20us/index.asp*

Table 3–20—*Continued*
State government assistance programs available to the tool, die, and industrial mold (TDM) industry

Agency/program	Background and details of program
State of California	Types of assistance provided: The Employment Training Panel (ETP) provides funds to businesses that need to train or retrain workers that face technological advancements or foreign and domestic competition.
Program: The Employment Training Panel (ETP) is a state agency that assists in providing training funds firms in attempt to promote the state economy. The ETP utilizes the Employment Training Fund (ETF) and has provided over $762 million in training funds since 1982. *www.etp.cahwnet.gov*	Program eligibility and guidelines: C TDM firms located in California that face out-of-state competition are eligible for the ETP program C Potential applicants must first attend an orientation held by the ETP. A list of orientation sessions is listed on the ETP website. Orientations are held at ETP field offices in Sacramento, San Mateo, North Hollywood, and San Diego C Each participant receives a Request for Eligibility Determination (RED) at the end of the orientation
	Application process, time frame, and costs: C The RED is an application used by the ETP to determine if applicants may qualify for ETP funds, and does not indicate that the firm will receive funds C If the RED is approved, an ETP analyst will work with the applicant through the following steps to apply for ETP funding— C The analyst will work with the applicant through the following steps: • 1st Step—Site Visit (1st Meeting with the Analyst) • An application is provided for funding • A checklist of items is provided and further contracting requirements are explained • The checklist may include but is not limited to— • Course curriculum • Groups or employees, occupations, wage rates, hours, etc • Agreements with subcontractors • 2nd Step—Contract • Once all required information is received, the ETP analyst will write the contract for the applicant • The contract is submitted to an ETP panel for review • 3rd Step—Panel Meeting • At a monthly Panel Meeting, contracts are reviewed • The ETP analyst and a member of the company present the contract proposal to the Panel and answer questions • If approved, training can begin after official notification by the ETP • The average time frame for entire process is typically 60-90 days
	Contact information: Visit ETP's website for contact information at: *www.etp.cahwnet.gov*

Source: Compiled from program material and Internet sites of the state government agencies noted in the table.

A significant number of U.S. companies responding to Commission questionnaires indicated that they had taken advantage of assistance from state and local agencies. The types of assistance included loans; industrial revenue bonds; various tax credits; funding for training and certification to meet ISO/QS-9000 series performance standards, and other activities; work share or wage programs; state and local tax abatements for machinery and facilities; state safety audits; and benefits from locating in enterprise zones. Several respondents that participated in government assistance programs reflected favorable perceptions. Specific examples included loans from SBA, that have helped firms move into new buildings; tax abatements that eased financial burdens; and grants that assisted with ISO certification and training expenses.[183] Meanwhile, other respondents noted that certain mechanisms to provide assistance were not always responsive to their needs. Some programs had more stringent guidelines than others. In some instances, modest fees and paperwork requirements were considered a burden. In other programs, adjustments to maximum limits were considered necessary to more closely reflect machinery or labor-related costs typically expended by TDM producers.

Research and Development Assistance

The Advanced Technology Program within the National Institute of Standards and Technology offers research and development (R&D) assistance to industries, along with the National Science Foundation, and the U.S. Department of Energy. Table 3-21 lists selected R&D funding that has been allocated to projects related to TDM products within the past 6 years.

Federal and State Laws, Regulations, and Policies

Federal, state, and local government policies affect U.S. TDM producers in a variety of ways, including their cost structure and the competitive environment in which they operate. Tax treatment affects a company's financial position over time and may stimulate capital investment. Labor laws and other regulations may also increase costs and paperwork burdens for small businesses. A study by the U.S. Small Business Administration Office of Advocacy in 2001 showed that small businesses bore the largest cost burden in meeting federal compliance regulations.[184] Certain government policies may be perceived as providing an advantage to foreign competitors.

Tax Treatment of Capital Expenditures

A concern expressed by U.S. TDM producers at the Commission's hearing is Federal tax treatment of capital expenditures. Such treatment has changed over time, with an

[183] Some government programs are administered through extensive networks of various local assistance centers (noted under "Contact Information" in chapter 3, tables 3-19 and 3-20) which greatly facilitate services to individual firms. These include assistance offered through Trade Adjustment Assistance Centers (TAACs), the Manufacturing Extension Partnership (MEP) nationwide network, SBAs Small Business Development Centers (SBDCs), as well as State and regional offices of other programs that work with local lenders.

[184] W. Mark Crain and Thomas D. Hopkins, *The Impact of Regulatory Costs on Small Firms*, The Office of Advocacy, U.S. Small Business Administration, Oct. 2001, found at *http://www.sba.gov/library/reportsroom.html* June 21, 2002.

Table 3-21
Federal Government research and development grants by agency since 1995

Government agency	Research organization	Duration	Location	Project title	Grant allocation
National Science Foundation	DMI Division Of Design, Manufacturing & Industrial Innovation	Sept. 15, 1997-Aug. 31, 2001	Maryland	Modeling and Control of Extruders and Injection Molding Machines	$204,324 (estimated)
National Science Foundation	DMI Division Of Design, Manufacturing & Industrial Innovation	May 1, 1998-Apr. 30, 2001	North Carolina	Tool Tuning for High Speed Machining	$188,934 (estimated)
National Science Foundation	DMI Division Of Design, Manufacturing & Industrial Innovation	Oct. 1, 1999-Mar. 31, 2002	Oregon	Non-Invasive Temperature Estimation and Control in Titanium Casting	$79,980 (estimated)
National Institute of Standards and Technology, Advanced Technology Program	Budd Company, Design Center	Sept. 15, 1995-Sept. 14, 1998	Michigan	Manufacturing Methodologies for Automated Thermoset Transfer/Injection Molding (TIM)	$2,000,000 (requested)
National Institute of Standards and Technology, Advanced Technology Program	Montronix, Inc.	Sept. 1, 1995-May 31, 1998	Michigan	Machine Tool Process Monitoring Diagnostic System	$1,232,074 (requested)
National Institute of Standards and Technology, Advanced Technology Program	Near Zero Stamping, Inc.	Sept. 15, 1995-June 30, 2000	Michigan	Agile Precision Sheet-Metal Stamping	$8,301,000 (requested)
National Institute of Standards and Technology, Advanced Technology Program	Extrude Hone Corporation	Dec. 19, 1997-Dec. 18, 2002	Pennsylvania	Development of the 3D Printing Process for Direct Fabrication of Automotive Tooling for Lost Foam Castings	$3,170,536 (requested)
National Institute of Standards and Technology, Advanced Technology Program	Stewart Automotive Research, LLC	Oct. 1, 1997 - Sept. 30, 2000	Texas	Low Cycle Time Liquid Molding Process for Automotive Structural Components	$1,998,782 (requested)
National Institute of Standards and Technology, Advanced Technology Program	Stewart Automotive Research, LLC	October 2000, projected time 3 years	Texas	Flexible Manufacturing Techniques for Large Plastics Molds	$2,000,000 (requested)
U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy	Idaho Operations Office	June 22, 1995-Sept. 30, 1997	Ohio	Deflection of Die Casting Dies: Prediction and Attenuation	$407,443

Table 3-21—*Continued*
Federal Government research and development grants by agency (1995-present)

Government agency	Research organization	Duration	Location	Project title	Grant allocation
U.S. Department. of Energy, Office of Energy Efficiency and Renewable Energy	Idaho Operations Office	June 21, 1995-Sept. 30, 1997	Ohio	Develope Design Tools for Die Casting Used to Promote Compatibility Between the Design and Die Casting Process from the Perspective Die Filling and Solidification	$346,264
U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy	Idaho Operations Office	Dec. 9, 1999-Dec 31, 2002	Idaho	Effect of Design Factors on Thermal Fatigue Cracking of Die Casting Dies	$176,885
U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy	Idaho National Engineering and Environmental Laboratory	Nov. 15, 2000-Nov. 15, 2003	Idaho	Integration of Rapid Solidification Process Tooling Die Casting	$78,793
U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy	Idaho National Engineering and Environmental Laboratory	Nov. 15, 2001-Nov. 15, 2005	Idaho	Development and Demonstration of Advanced Tooling Alloys/Molds	$6,675
U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy	Idaho National Engineering and Environmental Laboratory	(')	Idaho	Spray Form Tooling-USCARD	$94,839
U.S. Department of Energy, Office of Economic Impact and Diversity; U.S. Dept. of Energy, Office of Energy Efficiency and Renewable Energy	Oak Ridge National Laboratory	Feb. 1, 1998-Sept 30, 1999	Tennessee	Measurements of Internal Die Cavity Temperature	$59,622

Source: Compiled from Internet sites of the U.S. Government agencies noted in the table.

investment tax credit that stimulated capital equipment purchases. The cost of a company's investments in property, plant, and equipment can generally be recovered over time (cost recovery in the form of depreciation), and is sometimes partially offset by a tax credit on the company's tax return.[185] The Internal Revenue Code (IRC) distinguishes capital expenditures; amounts paid out for new property, plant, and equipment, or for permanent improvements to increase the value of a property; from the ordinary and necessary expenses paid or incurred in carrying on any trade or business. Capital expenditures are not expensed, but are spread out in the form of a periodic

[185] For a discussion of depreciation, see Department of the Treasury, *Report to The Congress on Depreciation Recovery Periods and Methods*, July 2000 (Treasury Depreciation Study), available at *http://www.treas.gov/taxpolicy/documents.html#misc*.

deduction (depreciation), over a period roughly consistent with the asset's useful economic life.[186]

The depreciation deduction is specified in Section 168 of the IRC, and the Modified Accelerated Cost Recovery System (MACRS) applies to most tangible property.[187] "Under MACRS, tax depreciation allowances are computed by determining a recovery period and an applicable recovery method for each asset. The recovery period establishes the length of time over which capital costs are to be recovered, whereas the recovery method establishes how capital costs are to be allocated over that time period."[188] Depreciation is based on the original historical cost of the asset, adjusted for capital expenditures for betterment or improvement made subsequent to acquisition, but not adjusted for inflation. Each investment is assigned a recovery period (a "class life" in years) which determines the number of years over which depreciation allowances are spread, a recovery method which determines how depreciation allowances are allocated over the recovery period, and an applicable convention that determines when the property is deemed to have been placed into service in the year. Thus, depreciation allowances are determined by reference to statutory provisions that provide a schedule for deducting the cost of the asset over its recovery period. The recovery period for equipment depends on the type of asset or the employing industry (e.g., the cost of a metal lathe would be recovered over 7 years if employed in agriculture, but over 5 years if used in offshore oil drilling).[189] Equipment generally is assigned to one of seven recovery periods that range in length from 3 years to 25 years, based on its class life, which is defined in the IRC. Non-residential buildings are classified separately from equipment and are depreciated over 39 years.

According to Treasury officials, there are two major criticisms of depreciation methods that focus on the definition of asset classes: they reflect obsolete technology (i.e., have failed to keep pace with technological developments), and the defined asset lives do not reflect their actual economic lives (i.e., are too long).[190] Another criticism of the depreciation system by Treasury officials is that the current cost recovery system may distort investment decisions by businesses because the current law favors investment in equipment over nonresidential structures, and favors intangibles (e.g. patents, trademarks, or software licenses) over depreciable property.[191]

Part of the cost of capital equipment also may be subject to a tax credit, which is a deduction made directly from the taxes payable to the government, and differs

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[186] Depreciation allowances are a non-cash expense that reduce operating income, and, thereby reduce a company's income tax; depreciation allowances also are an important determinant of the tax cost of investment and the tax incentive to invest. Despite this, small businesses can expense (immediately deduct), rather than capitalize and depreciate, some of their investment in equipment under Section 179 of the IRC. This deduction is $24,000 in 2002, rising to $25,000 in 2003 and later, but is reduced dollar-for-dollar for total investment in qualified property exceeding $200,000. Certain other investments also are allowed to be expensed in the year in which incurred. See Ibid., p. 20.

[187] See page 12 of the Treasury Depreciation Study for a discussion of categories of property that are excluded from § 168, the alternative depreciation system (ADS), and other methods of depreciation.

[188] Ibid., p. 12.

[189] Ibid., p. 13.

[190] Ibid., p. 11.

[191] Ibid., p. 11.

significantly from a deduction used to compute net income before taxes. One mentioned[192] at the Commission's hearing was the Investment Tax Credit (ITC), which was initiated in 1962 and amended several times before it was repealed in 1986.[193] Under this provision, a taxpayer could take a 10-percent tax credit for purchased qualifying equipment. The ITC was modified under the Economic Recovery Tax Act of 1981 to conform with the accelerated cost recovery system (ACRS); and was further modified under the Tax Equity and Fiscal Responsibility Act of 1982.[194] Under the modified ITC, an investor could take a 10-percent tax credit on equipment qualifying for 5-year accelerated cost recovery or take an 8-percent investment tax credit. In exchange for the higher tax credit, the taxpayer was to adjust the depreciable basis of the asset downward by one-half of the investment tax credit amount taken.[195] According to the Treasury Depreciation Study, the ITC favored investment in machinery and equipment over investment in nonresidential structures (office buildings).[196]

Other U.S. Federal and State Government Policies

A variety of other policies affect U.S. TDM producers, as reported by 196 U.S. TDM producers when asked on the Commission's questionnaire to identify government policies that have the greatest impact on the operation of their TDM business. A large number of producers indicated that the following government policies had the greatest effect on their ability to compete:

- Steel tariffs
- NAFTA
- Occupational Safety and Health Administration (OSHA) compliance
- Environmental Protection Agency (EPA) compliance
- Family and Medical Leave Act (FMLA) compliance
- Worker's Compensation
- Federal and state tax requirements
- U.S. dollar exchange rates[197]

Producers expressed concerns over extensive reporting requirements and the expenses associated with meeting compliance requirements set by each government agency. Specific references in questionnaires included the policies of OSHA, Equal Employment Opportunity Commission (EEOC), and U.S. Department of Labor. Many states also have

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[192] Braker, transcript of the hearing, p. 32; Baron, transcript of the hearing, p. 53; and Steve Zoumberakis, CEO and president, Quality Mold, Inc., transcript of the hearing, p. 204.

[193] Ibid., p. 20. Certain tax credits remain in the IRC, including qualified research and experimentation expenditures, reforestation, low income housing, rehabilitation of historic buildings, the purchase of electric vehicles, and for certain energy property.

[194] John P. Guercio and David G. Jaeger, "A Guide to the Investment Tax Credit," *Journal of Accountancy*, Mar. 1985, found at *http://proquest.umi.com/pqdweb*, retrieved June 21, 2002. According to the article, the 1982 modification stipulated that when the full Investment Tax Credit was taken, the taxpayer reduced the basis of the property for purposes of cost recovery under ACRS, but if the Investment Tax Credit instead were reduced by 2-percentage points, then the entire ACRS basis could be used.

[195] Gerald E. Smolen and Michael T. Bond, "ITC Made Simple," *Financial Planning*, Aug. 1985, found at *http://proquest.umi.com/pqdweb*, June 21, 2002.

[196] Ibid., p. 9.

[197] The U.S. dollar exchange rate will be discussed further at the end of ch. 5.

laws that parallel Federal laws which are enforced by state agencies. The high cost of healthcare, insurance, and wages were other factors that producers indicated as adversely affecting the financial performance of their operations as discussed earlier. Antiquated lien laws also have affected the ability of moldmakers to collect for non-payment by customers that take possession of a mold and then refuse to pay for the product. As noted earlier, Michigan has enacted a lien law allowing moldmakers to recover payment regardless of which party has possession of the mold.[198] With regard to trade, producers indicated that the U.S. tariffs on imported steel have driven the cost of materials higher and adversely affected their ability to compete.[199] Many producers also cited economic liberalization of Mexico under NAFTA and of China through its accession to the WTO as factors that have attracted U.S. customers to locate production in those countries and switch to foreign TDM suppliers.

The U.S. TDM industry is currently supporting legislation to assist in financing training of skilled workers. On March 6, 2001, H.R. 877 was introduced in the U.S. House of Representatives. The proposed bill would amend the IRC of 1986 to allow small business employers a credit against income tax for certain expenses for long-term training of employees in highly skilled small business trades. Referred to as the "Skilled Workforce Enhancement Act of 2001," the bill amend Subpart D of part IV of subchapter A of Chapter 1 of the IRC of 1986. Highly skilled trades include professions such as precision machinists, diemakers, moldmakers, tool and die designers, plumbers, pipefitters, patternmakers, and electricians. To qualify, small business employers must set up qualified 4-year apprenticeship training programs certified with the Secretary of Labor in accordance with state law.[200]

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[198] Clare Goldsberry, "Moldmakers Fight Back Against Nonpayment," retrieved from *http://www.immnet.com/articlelibrary/archive/getOneArticle.php3?getArtID=1882* on Aug. 30, 2002.

[199] See ch. 3, Materials Costs.

[200] Table 3-19 provides contact information for the Department of Labor Apprentice Training Program.

CHAPTER 4. SELECTED FOREIGN INDUSTRY PROFILES[1]

The tool, die, and industrial mold (TDM) or tooling industry is truly global in scope, as nearly all manufacturing industries rely on the services and products of TDM builders. Methods of production can vary greatly, from traditional manual procedures to highly automated production techniques; therefore, development of the industry in a particular locale does not depend on the availability of sophisticated technologies, the pool of educated workers, or the surrounding economic environment. At the same time, since the TDM sector is a cornerstone of manufacturing, countries with large, well-established industrial bases will undoubtedly have larger, more developed TDM industries. The migration of manufacturing enterprises around the globe is a key factor driving the development, growth, preeminence, or demise of TDM production in various regions. In addition to common macroeconomic influences, global TDM companies share similar commercial pressures; producers worldwide report that it is a constant challenge to reduce costs and shorten delivery times, all within the context of an increasingly competitive and dynamic global market.

Comprehensive data are unavailable on worldwide production of TDMs, but Japan is generally considered to be the largest global producer, followed by the United States. Other top producing countries are Germany and China. The United States, Germany, and Japan represent the apex of the global industry in terms of product quality and characteristics. The German TDM producers have a reputation as leaders in workmanship, design, and operation, with core competencies in high-technology and high-precision dies and molds, as well as expertise in creating durable tooling for high-volume applications. The Japanese industry, with its multiple manufacturing linkages and emphasis on research and development, reportedly also produces good quality tooling for a number of end uses.

Notwithstanding the capabilities of these leading producers, TDM industries in other regions, particularly other Asian countries, are sufficiently established and are quickly evolving. Such industries reportedly enjoy a "late-comers" advantage and are able to benefit from state-of-the-art production machinery and modern computer software packages that allow emerging producers to advance rapidly into the production of complex and complicated tooling. Lower wage rates are also a competitive characteristic of many developing producers. Although comparable production data are unavailable, China is estimated to be the third-largest producer of TDMs.[2] Further, production from China has increased substantially in recent years, whereas production in many other countries has been flat to declining. In terms of global trade, the top exporting country appears to be Japan, largely because of the substantial number of Japanese transplants operating worldwide that rely on Japanese sources for TDMs. The United States, with its

[1] Information in this chapter and the individual foreign industry profiles that follow are based upon trade and economic literature; USITC staff interviews with trade sources; written submissions to the USITC; responses to Commission questionnaires; and fieldwork conducted by USITC staff, including foreign travel and interviews with industry representatives and authorities in Canada, China, Hong Kong, Japan, and Taiwan.

[2] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

vast consumer market and large number of domestic and foreign automotive operations, is likely the top importing country.

The following TDM profiles cover nine selected foreign industries including Canada, Mexico, Japan, China, Hong Kong, Taiwan, the European Union, Germany, and Portugal. Information presented in these profiles offers insights regarding the structure of the selected foreign TDM industries, the competitive challenges faced by each, and the steps being taken by these respective TDM industries to enhance or counter their competitive strengths and weaknesses.

Canada

Industry Profile

Composition of the Industry

Unique industry characteristics and significant strengths and weaknesses of the Canadian TDM industry

Unique industry characteristics:
- Easy access to the U.S. market
- Shares similar culture and language with the United States

Strengths:
- Weak Canadian dollar relative to the U.S. dollar
- Larger firms relative to those in the United States promotes efficiencies of scale

Weaknesses:
- High labor rates
- Canadian customers have moved production to foreign locations, particularly China and Southeast Asia
- Growing shortage of skilled workers in the Canadian TDM industry

The Canadian TDM industry shares many of the same characteristics as the U.S. industry, including the availability of advanced technologies, a primary focus by manufacturers on the automotive sector, and a large number of establishments with fewer than 50 employees. Industry sources estimate that 80 percent of Canadian moldmakers are located in the Province of Ontario, with 50 percent of those located in Windsor, and another large concentration around Toronto. About 80 percent of the Canadian die sector is located in southern Ontario, primarily along the industrial corridor from Windsor to Toronto.[3]

The total number of Canadian TDM producers is unknown. In 2001, there were 280 mold producers, down from 368 producers in 1997, the peak during the period of review. Although the number of moldmaking establishments declined during 1997-2001, average employment per establishment increased from 29 employees in 1997 to 38 employees in 2001.[4] The number of die manufacturers is also unknown; however, the membership roster of the Canadian Tooling and Machining Association (CTMA) lists 53 producers of stamping dies.[5]

In general, Canadian TDM producers tend to be larger than their U.S. counterparts, on the basis of sales and number of employees. In the Windsor area, 43 percent of Canadian TDM firms had more than 100 employees, 17 percent had 50-99 employees, and 40 percent had under 50 employees.[6] A sampling of TDM firms throughout Canada showed similar size distribution: 22 percent of firms had 100 or more employees, 26 percent had

[3] Canadian Association of Mold Makers (CAMM) and Canadian Tooling and Machining Association (CTMA) officials, interviews by USITC staff, Windsor, ON, June 6, 2002.

[4] Official statistics from Statistics Canada, found at *http://cansim2.statcan.ca/cgi-win/CNSMCGI.EXE*, retrieved June 25, 2002; and Industry Canada, found at *http://strategis.ic.gc.ca/SSG/pl01352e.html*, retrieved Aug. 29, 2002.

[5] CTMA membership list, found at *http://www.ctma.com/list2.html*, retrieved August 29, 2002.

[6] CAMM and CTMA officials, interviews by USITC staff, Windsor, ON, June 6, 2002.

50-99 employees, and 52 percent of firms had fewer than 50 employees.[7] Some Canadian industry sources note that the larger sized firms have a competitive advantage since their employees can specialize in particular functions, thus becoming more efficient than employees in U.S. shops that function in multiple roles.[8]

The 8 largest Canadian moldmakers rank in the top 20 moldmakers in North America[9] and are shown in the following tabulation (in millions of dollars and number of employees and plants):

Rank	Company	2000 Sales	2001 Sales	Employees	Plants
1	Husky Injection Molding Systems Ltd.	[1]100.0	[1]100.0	([2])	1
3	Wentworth Technologies Co. Ltd.	51.0	67.0	562	9
5	StackTeck Systems Inc.	52.0	47.7	328	3
9	Reko International Group Inc.	40.0	40.0	300	6
9	Active Burgess Mould & Design	43.0	[1]40.0	325	3
9	Hallmark Technologies Inc.	([2])	[1]40.0	325	2
12	Windsor Mold Inc.	[1]30.0	[1]30.0	[1]230	3
15	Build-A-Mold Ltd.	[1]25.0	[1]25.0	200	1

[1] Estimated
[2] Not available.

All of these companies are located in Ontario, and two of the companies–Husky Injection Molding Systems Ltd. (Husky) and Reko International Group Inc–are publicly traded. Husky, the largest Canadian producer, designs and manufactures injection molding machines, molds for PET plastic containers, hot runners, and robots for the packaging, automotive, and technical industries. The company is the world's leading manufacturer of injection molding systems for PET preform molds with a 50-percent market share.[10]

Most Canadian TDM producers specialize in particular types of products, market sectors, or a select group of customers. These regions and their product focus are (1) southwest Ontario–automotive and building products; (2) Montreal–recreational vehicles, aerospace, and building products; (3) Toronto–automotive, aerospace, appliance, packaging, consumer products, and building products; (4) Winnipeg– aerospace; and (5) Edmonton and Calgary–petroleum. Overall, however, the Canadian TDM industry focuses on the automotive sector, which accounts for 78 percent of the tooling produced in Canada.[11]

[7] International Special Tooling and Machining Association (ISTMA), *2000 ISTMA Business Statistics Report*, (Fort Washington, MD: National Tooling & Machining Association, Feb. 2002), p. 48.

[8] Ed Bernard, president, Bernard Mould, in "Moldmaking: A Status Report of the Canadian Moldmaking Industry," *Canadian Industrial Machinery*, Jan. 2002, found at *http://www.cipmetalworking.com/CIM/cim_jan_02/moldmaking.htm*, retrieved Aug. 16, 2002.

[9] "Top 20 Mold Makers", *Plastics News*, May 6, 2002, p. 13.

[10] Husky Injection Molding Systems Ltd., "Investor Information Sheet - February 2002," found at *http://cache.husky.ca/doc/factsheet0202.doc*, retrieved Aug. 30, 2002,

[11] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry*, (Richmond Hill, ON: DesRosiers Automotive Consultants, Inc., July 2002), p. 2.

Workforce characteristics

Employment for the TDM industry as a whole is unavailable.[12] However, data for the mold-making sector show that employment declined irregularly from 10,729 in 1997 to approximately 10,500 in both 2000 and 2001. Mold-making employment reached its peak in 1998 at 11,028 workers. A major concern of the Canadian TDM industry is the shortage of available skilled workers due to fewer entrants into the industry coupled with rising retirements as the existing TDM workforce ages.[13] Canadian TDM industry sources contend that their workers are also leaving the industry to work in the United States because of the disparity of wages between the two countries and the erosion of disposable income that results from higher Canadian taxes.

With respect to working conditions, the average workweek for most employees exceeds 40 hours. Actual annual work hours for full-time TDM workers totaled 2,128 in 2000, which is 110.4 percent of the national norm for TDM employees of 1,928 work hours per year.[14] Average total hourly compensation (in U.S. dollars) for Canadian mold makers, toolmakers, and tool designers in 2000 was $15.72, $16.35, and $15.79, respectively.[15] Total hourly compensation is significantly lower than in the United States. Benefits and special compensation other than wages are equivalent to 25.5 percent of the payroll.[16]

Foreign direct investment

There seems to be little foreign direct investment (FDI) in the Canadian TDM industry. However, leading Canadian TDM producers are active in investing in production facilities in other countries. For example, Husky built manufacturing facilities and established a European sales headquarters in Luxembourg in 1985 and followed up in 1997 with an additional $185 million investment to expand its Luxembourg manufacturing facilities. The company also built a manufacturing facility in Milton, VT, in 1998. Hallmark Technologies acquired a manufacturing facility in South Lyon, MI, whereas Wentworth Technologies acquired various mold-making facilities in Germany, Poland, and New Jersey during 1999-2002. The third-largest Canadian producer, StackTeck Systems, Inc. (a holding company formed by a Castle Harlan Inc., a New York private-equity firm), consists of acquired firms Tradesco Mold Ltd. (Canada), Fairway Molds (United States), and Unique Mould Makers Ltd. (Canada).

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[12] The Canadian metalworking machinery manufacturing industry employed approximately 27,064 persons, based upon Statistics Canada 1999 data (the most recent year available). This sector includes the TDM industry as well as industries that manufacture other products such as automatic screw machines, die-casing machines, forging machines, hammers and presses, lathes, milling machines, rolling mill machinery, and power and metal-cutting saws. Employment in the metalworking machinery manufacturing industry fluctuated from a low point of 24,686 in 1997 to a peak of 28,468 in 1999. The moldmaking sector employment, as a ratio of employment in the entire metalworking machinery fluctuated between 40 and 44 percent during 1997-99.

[13] Skills Canada, "Skills Shortages & Labour Market Trends in the Machinery Industry," 2000, found at *http://www.skillscanada.com/new/index-e.html*, retrieved Aug. 19, 2002.

[14] The total number of normal working hours per year is calculated by subtracting holidays and other national celebrations from 365 and multiplying that figure by the number of normal work hours in a day. ISTMA, *2000 ITSMA Business Statistics Report*, Feb. 2002, p. 13.

[15] In 2000, Canadian moldmaker total hourly compensation ranges from $10.35 to $18.29, for toolmakers from $12.94 to $21.13, and for tool designers $10.35 to $21.35. Ibid., pp. 15 and 17.

[16] Ibid., p. 18.

Manufacturing Infrastructure

As in the United States, the primary market served by the TDM industry in Canada is the North American automotive market (78 percent of the market for tooling in Canada);[17] thus, the technological capabilities and manufacturing practices of both industries are similar. The Canadian TDM industry has the same access to technology (including manufacturing software) as the TDM industry in the United States; however, Canadian producers buy some steel and machine tools in U.S. dollars.

The Canadian steel industry satisfies most of the domestic demand for P20 tool steel, a grade commonly used in TDM production. Other grades of tool steel produced in Canada include H-13 and A2. Many mold producers require certain grades produced in Canada (e.g., 01, D2, and 15-5) in round bar form. Otherwise, companies must import steel of these grades in block form as well as tool steel grades that Canada does not produce (e.g., H-11, 420, and 420SM).[18] There is some concern by the industry about the possible imposition of tariffs as a result of the safeguard inquiry on certain steel products conducted by the Canadian International Trade Tribunal (CITT or Tribunal). The Tribunal recommended that three grades of tool steel (420, 420SM, and 15-5), that are most important to the industry,[19] be excluded from the safeguard remedies.[20] However, the Government of Canada has not yet announced its remedy.

Production and Sales

Canadian sales of TDMs fluctuated downward during the period of review, from a peak of $1.2 billion in 1997 to an estimated $950 million in 2001, for an overall decline of almost 32 percent (table 4-1).

Expressed in terms of Canadian dollars, the drop in sales was not as sharp (almost 14 percent) during 1997-2001. Most of the decline occurred during 2000-01 by an estimated 17 percent. Industry sources attribute the decline to the general economic recession during this period and the delay or cancellation of model changeovers by the automotive sector. Most of the cutbacks were with the "Big Three" North American automakers (General Motors (GM), Ford, and DaimlerChrysler)–customers on which traditional North American toolmakers are highly dependent.[21]

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[17] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry,* July 2002, p. 2.

[18] Canadian steel industry official, interview by USITC staff, Aug. 29, 2002.

[19] Canadian Government official, interview by USITC staff, Aug. 29, 2002.

[20] The Canadian International Trade Tribunal (CITT) recommended a tariff rate quota on steel plate (tool steel is commonly produced in this form) for a duration of 3 years. The remedy allows a quota volume of 334,000 metric tons in the first year, increasing to 352,000 metric tons in the third year. Imports of steel plate above the quota would be subject to a tariff of 25 percent in the first year, declining to 12 percent in the third year. The CTMA requested exclusions for all tool steels. CITT, *Safeguard Inquiry into the Importation of Certain Steel Goods*, Aug. 2002, pp. viii and 291.

[21] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing The Canadian Tool Making Industry*, July 2002, p. 9.

Table 4-1
Tools, dies, and industrial molds: Canadian shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	[1]1,231.3	934.5	627.3	924.1	67.9
1998	[1]1,077.7	950.0	769.4	897.1	85.8
1999	[1]1,089.9	929.4	619.2	779.7	79.4
2000	[1]1,194.0	918.3	696.9	972.6	71.7
2001	[2]950.3	826.8	515.8	[2]639.3	[2]80.7
	Value *(million Canadian dollars)*[3]				
1997	1,704.1	1,293.3	869.0	1,279.8	67.9
1998	1,595.5	1,406.4	1,138.6	1,327.6	85.8
1999	1,619.9	1,381.3	920.6	1,159.2	79.4
2000	1,771.5	1,362.4	1,032.9	1,442.0	71.6
2001	[2]1,471.3	1,280.0	798.9	[2]990.2	[2]80.7

[1] International Special Tooling and Machining Association, *ISTMA Business Statistics Report*, various years.
[2] Commission estimate base upon official statistics of Industry Canada.
[3] The value of exports and imports in Canadian dollars was obtained from Global Trade Information Services, Inc., World Trade Atlas Internet database. The value of shipments in Canadian dollars is based on from the exchange rate derived from in the ratio of export values in U.S. dollars to export values in Canadian dollars.

Source: Global Trade Information Services, Inc., World Trade Atlas Internet database, found at *http://www.gtis.com* unless otherwise noted.

Concerning product distribution, TDM production is overwhelmingly concentrated in molds, accounting for 80 percent of all TDM sales in 2000. Molds for plastic and rubber accounted for virtually all (98 percent) sales of molds. Tools for pressing, stamping, or punching metal accounted for 12 percent, and jigs and fixtures accounted for a small 1 percent of TDM sales.

Financial Conditions

On average, Canadian TDM firms appear profitable and able to reinvest earnings into upgrading and improving their existing facilities. A recent survey of Canadian TDM producers indicated that net operating profit before taxes averaged 7.8 percent of sales.[22] In addition, total investment in 2000 represented 8.6 percent of sales, and investment in new machines and mechanical installations averaged 5.2 percent of sales. Notwithstanding the relative financial strength of Canadian firms, these figures represent a slight deterioration in the financial performance from previous years. For example, compared with conditions in 1997, net operating profit dropped from 13.3 percent of sales, total investment declined from 12.9 percent of sales, and investment in new machines and mechanical installations declined from 8.6 percent of sales. Moreover, capital expenditures dropped from $171.1 million in 1997 to only $71.4 million in 2001, or by more than 58 percent over the past 5 years.[23]

[22] ISTMA, *2000 ISTMA Business Statistics Report*, Feb. 2002, pp. 7-10 and *1997 ISTMA Business Statistics Report*, Nov. 1998, pp. 6-9.
[23] Industry Canada, *The Canadian Tool, Die, and Mould Making Manufacturing Industry*, Apr. 2002.

Market Characteristics and Trends

Customer Base

The main domestic customer base for Canadian TDMs consists primarily of processing plants that mold automobile parts. The number of companies with such plants jumped from 64 in 1995 to more than 90 in 2000. Their output grew from CN$1.76 billion in 1995 to CN$2.97 billion in 2000, with the overwhelming majority of the increase due to improved sales to U.S. assembly plants.[24] Aside from domestic auto-related consumers, Canadian toolmakers also largely serve automotive parts suppliers and automobile producers located in the United States. As such, the U.S. automotive sector is the ultimate market for most Canadian tooling production, the Canadian TDM industry is therefore strongly affected by the purchasing practices of the U.S. automotive industry. Since the primary market for TDMs in the United States is also the automotive sector, TDM firms in both Canada and the United States compete in the same market for the same end users.

Three major developments, two in the automotive sector and one across all industries, present important challenges to the Canadian TDM industry. An increasing share of the automotive market is dominated by newer, foreign-owned automotive manufacturers that tend to source tooling from non-North American firms.[25] Tooling supplied from foreign sources represents about 20 percent of Canadian demand for TDMs in the automotive market, and this percentage has remained relatively stable over the past 5 years. Foreign-owned automotive production is anticipated to grow to about 35 to 40 percent of North American production by the end of the decade.[26] As a result, offshore tooling for the automotive sector could increase as production capacity rises and foreign-owned automotive equipment production facilities increase.

In addition to the challenge posed by increased foreign-owned automobile production, the automotive firms (primarily the Big Three) are also stretching out payments to suppliers, sometimes by more than 1 year after delivery of the tooling. These payment delays may cause hardships to TDM producers who must cover their expenses while awaiting payment. Industry sources note that firms in Canada tend to cover expenses from operating funds, which may delay capital expenditures but ensures that companies do not need bank financing. By comparison, U.S. TDM producers responding to the Commission's questionnaire indicate that for U.S. TDM producers, cash flow was the primary source of funds, followed closely by secured and unsecured debt.[27] In addition to the payment constraints imposed on automotive tooling suppliers, automobile producers are also pressuring TDM builders to reduce lead times and use new, sophisticated software packages that both reduce human error and curtail the need for prototypes and testing. Such initiatives add to the existing cost pressures on TDM firms.

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[24] Agostino von Hassell, The Repton Group, "International Molding Report: Understanding the new NAFTA," *Injection Molding Magazine*, Feb. 2002, found at *http://www.immnet.com/articlelibrary/aarchive/getOneArticle.php3?getArtID=1808*, retrieved Aug. 16, 2002.

[25] The share of automotive production accounted for by foreign-owned companies grew from practically zero in 1960 to about one-fourth of total North American production today.

[26] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing The Canadian Tool Making Industry*, July 2002, p. 10.

[27] See ch. 3.

Finally, several large customers of the Canadian TDM industry have moved production offshore. For example, all Canadian television and electronics manufacturing has relocated overseas; automobile manufacturers Hyundai and Volkswagen closed facilities in Quebec Province and Barrie and moved production to South Korea and Mexico. Customers are also increasingly sourcing TDMs offshore, particularly the toy, consumer products, electronics, office equipment, small tool, and small appliance industries.[28]

Purchase Decision Variables

There is limited information available on TDM price comparisons between Canada and the United States. In one survey, quotes were obtained from both Canada and the United States for an industrial mold. The Canadian price was about 1.8 percent lower than the U.S. price ($667,482 and $679,388 in U.S. dollars, respectively).[29] U.S. industry sources contend, however, that Canadian-produced TDMs can be as much as 40 percent lower than comparable U.S. tooling.[30] Some Canadian and U.S. TDM industry sources attribute the price differentials primarily to the U.S.-Canadian dollar exchange rate differences.[31] With respect to quality, both U.S. and Canadian industry sources indicate that the TDM quality is about equal in both countries.

Data available on cost comparisons are mixed for materials and equipment for Canadian and U.S. firms. According to Canadian industry sources, costs for the manufacture of molds are very similar to those in the United States in terms of raw materials and capital costs. These sources state that Canadian many mold makers purchase materials and equipment on a U.S.-dollar basis and have no advantage over U.S. mold makers. Labor costs, however, are the one factor affected by fluctuations in the Canadian-U.S. exchange rate. According to Canadian industry sources, the current impact of the lower Canadian dollar provides an advantage of less than 10 percent to Canadian mold makers in terms of overall costs.[32]

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[28] CAMM and CTMA officials, interviews by USITC staff, Windsor, ON, June 6, 2002.

[29] South Australian Centre for Manufacturing, *Global Survey of Price and Delivery*, July 1999. Three Canadian companies and two U.S. companies participated.

[30] American Mold Builders Association officials, interviews by USITC staff, Roselle, IL, Apr. 22, 2002.

[31] Testimony of Matthew Coffey, executive director, National Tooling & Machining Association, transcript of the hearing, p. 83, and CMTA officials, interview by USITC staff, Windsor, June 4, 2002.

[32] Canadian Plastics Industry Association, written submission, May 28, 2002.

Trade

Trade with the United States overshadows that with any other nation and exceeds trade will all other partners combined. The share of TDM imports from the United States was comparatively high, fluctuating between 79 and 88 percent during 1997-2001 (table 4-2).

Likewise, TDM exports to the United States as a share of total TDM exports fluctuated during 1997-2001 in the range of 87 to 94 percent, illustrating the clear dependence of Canadian producers on the U.S. market (table 4-3). Industry sources indicate that the majority of trade between Canada and the United States consists of trade between the Big Three automotive facilities in both countries. Canada maintains a trade surplus in TDMs, including a bilateral surplus in trade with the United States.

Regarding product distribution, imports of jigs and fixtures are overshadowed by imports of industrial molds, and tools and dies (table 4-2). Mold imports grew as a share of all TDM imports from 48.4 percent in 1997 to 62 percent in 2001. The share of TDM imports accounted for by tools and dies declined from 47.6 percent in 1997 to 34 percent in 2001. Exports of TDMs consist primarily of molds (table 4-3). The share of exports accounted for by mold exports fluctuated during 1997-2001 between 77 and 83 percent.

Government Policies and Programs

Canada provides a variety of government assistance including export development, research and development (R&D), and employee training. Although most government programs are aimed at a wide variety of industries, certain employee training programs are targeted directly at the machining sector.

One of the most important sources of government assistance to Canadian TDM exporters is Export Development Canada (EDC). EDC functions similar to the Export-Import Bank of the United States by providing Canadian exporters with financing, insurance, and foreign-market expertise. The EDC also provides various of export-financing plans to purchasers of Canadian products, including lines of credit, direct loans, and equity investments. Lines of credit are a streamlined form of financing in which EDC lends money to a foreign bank, institution, or buyer for subsequent lending of the necessary funds to foreign buyers of Canadian goods and services. Interest rates, repayment terms and other details are prearranged between EDC and the foreign borrower, which speeds transaction time. Transactions supported under lines of credit are usually valued between $50,000 and $5 million. The EDC currently has 52 lines of credit, providing one form of access to export financing for buyers in some 27 countries. Direct loans, usually large transactions with lengthy repayment terms, are made to buyers of Canadian capital goods. Equity investments are restricted to a maximum investment in any one company, project, or fund to the lesser of $6.4 million[33] or 2.25 percent of share capital.

[33] The maximum dollar investment is given by EDC as CN$10 million. The Bank of Canada exchange rate average for 2001 was used for conversion from Canadian to U.S. dollars.

Table 4-2
Tools, dies, and industrial molds: Canadian imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
United States	260,196	397,330	379,888	363,344	257,153
Japan	7,053	14,873	8,917	9,212	15,074
Canada	11,461	12,327	13,079	14,053	12,923
Italy	3,211	10,235	10,164	5,364	6,076
Germany	4,452	4,271	8,478	5,451	5,562
France	2,771	3,303	3,649	6,297	3,840
All other	14,991	23,940	25,462	18,221	19,401
Total	304,135	466,279	449,637	421,942	320,029
EU-15	20,985	34,552	38,541	28,382	24,002
NAFTA	272,523	411,492	395,632	377,696	271,063
China & Hong Kong	1,805	2,177	3,128	3,144	4,439
Tools and dies:					
United States	279,320	198,013	116,793	170,488	135,240
Japan	10,692	68,978	7,949	51,450	16,121
Canada	4,307	5,916	8,129	11,562	7,669
Germany	750	1,803	3,995	3,231	5,787
Italy	639	1,876	2,862	1,731	2,435
Taiwan	848	876	537	1,031	1,594
All other	2,325	3,603	6,417	7,709	6,291
Total	298,881	281,065	146,682	247,202	175,137
EU-15	3,366	6,367	11,991	9,303	11,725
NAFTA	283,641	204,019	125,160	183,204	143,540
China & Hong Kong	184	210	181	312	1,126
Jigs and fixtures:					
United States	17,282	15,363	16,586	15,570	12,574
Germany	1,034	880	1,076	1,085	1,319
Japan	1,013	2,072	1,158	1,420	1,290
Taiwan	534	627	880	1,568	750
France	26	26	24	92	739
Poland	1,194	763	566	767	728
All other	3,212	2,276	2,632	7,224	3,194
Total	24,295	22,007	22,922	27,726	20,594
EU-15	3,205	1,947	2,534	7,244	3,846
NAFTA	17,356	15,573	16,696	15,619	12,724
China & Hong Kong	491	493	521	544	504
Total:					
United States	556,797	610,706	513,266	549,402	404,967
Japan	18,758	85,923	18,024	62,083	32,485
Canada	15,779	18,354	21,236	25,661	20,713
Germany	6,236	6,954	13,549	9,767	12,668
Italy	4,204	12,440	13,440	12,140	9,211
France	3,552	3,951	5,318	8,103	5,923
All other	21,985	31,022	34,408	29,714	29,794
Grand total	627,311	769,350	619,241	696,870	515,761
EU-15	27,557	42,865	53,065	44,929	39,573
NAFTA	573,520	631,084	537,487	576,519	427,327
China & Hong Kong	2,480	2,879	3,830	4,000	6,069

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-3
Tools, dies, and industrial molds: Canadian exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
United States	674,195	640,655	697,230	693,080	573,687
Japan	13,604	5,922	10,339	2721	25,173
Mexico	6,009	8,501	13,840	6,741	9,431
Germany	5,212	6,141	6,256	4,166	8,339
Luxembourg	22,142	24,486	4,192	3,863	4,666
Brazil	6,984	4,618	3,342	1,068	4,318
All other	47,653	45,599	29,002	27,165	29,519
Total	775,799	735,922	764,201	738,804	655,133
EU-15	44,993	50,152	29,526	15,650	20,858
NAFTA	680,205	649,156	711,070	699,821	583,118
China and Hong Kong	8,357	7,781	2,729	4,591	4,252
Tools and dies:					
United States	142,261	184,261	139,760	164,933	140,059
Austria	18	14,755	11,083	2,040	18,884
United Kingdom	77	428	204	1,854	1,900
Mexico	19	165	102	23	1,703
Germany	190	212	394	336	548
Australia	175	2,222	0	27	170
All other	1,768	1,320	5,822	1,936	1,064
Total	144,508	203,363	157,365	171,149	164,328
EU-15	579	15,664	12,783	4,919	21,791
NAFTA	142,280	184,426	139,862	164,955	141,763
China & Hong Kong	0	318	119	44	0
Jigs and fixtures:					
United States	14,039	9,643	7,118	7,936	6,802
United Kingdom	24	61	41	65	200
Ireland	0	0	0	0	154
Australia	0	0	7	42	83
Poland	3	5	15	5	59
Japan	8	0	42	46	13
All other	112	1,000	600	232	30
Total	14,186	10,709	7,823	8,326	7,341
EU-15	39	201	156	138	372
NAFTA	14,039	9,651	7,162	7,937	6,802
China & Hong Kong	68	2	138	82	12
Totals:					
United States	830,495	834,558	844,108	865,948	720,548
Japan	13,993	6,147	10,570	2,830	25,210
Austria	361	15,583	12,771	2,131	18,970
Mexico	6,029	8,675	13,986	6,765	11,134
Germany	5,417	6,493	6,664	4,506	8,887
United Kingdom	6,859	4,552	6,158	4,466	4,992
All other	71,338	73,987	35,132	31,633	37,061
Grand total	934,492	949,995	929,389	918,279	826,802
EU-15	45,611	66,017	42,465	20,708	43,020
NAFTA	836,524	843,233	858,094	872,713	731,683
China & Hong Kong	8,425	8,100	2,986	4,717	4,264

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

EDC insurance programs directed at Canadian exporters include insurance against political risk and accounts receivable insurance. Accounts receivable insurance may cover accounts receivables up to 90 percent of the value of receivables owed by foreign buyers. Canadian industry sources state that EDC programs not are widely used in the Canadian TDM industry, as sales to the United States are considered as no different from sales in Canada.[34]

Other government organizations providing export assistance include the Business Development Bank of Canada, the Canadian Commercial Corporation (CCC), Industry Canada, and the Canada Ontario Business Centre. The Bank of Canada provides loans, venture capital, and consulting assistance. The CDC provides government-backed guarantees of contract performance for sales to foreign customers and also functions as the prime contractor for sales to foreign public-sector buyers, such as the U.S. Department of Defense. The CDC also provides a project line of credit (up to $2 million per exporter) to cover production costs for a particular export sale. Industry Canada provides a large on-line information resource data base called Strategis. The Canada Ontario Business Centre provides information on both Federal and Ontario assistance programs. Government programs providing funding for R&D are noted in table 4-4.

Table 4-4
Canada: Federal and Ontario assistance programs

Program	Activity
Technology Partnership Canada Program of Industry Canada	Supports enabling technologies in advanced manufacturing and processing
Canada Customs and Revenue Agency	Provides tax incentives to Canadian businesses (especially small and start-up firms) that conduct research and development that will lead to new, improved, or technologically advanced products or processes
Integrated Advanced Manufacturing Technologies Institute	Conducts research on advanced manufacturing issues
Industrial Research Assistance Program	Provides grants for research projects. Most technical universities and colleges have representatives on staff.
Canadian Technology Network	A joint initiative between Industry Canada and the National Research Council to provide information, data, intelligence, and services on technology and related business issues.
Intelligent Manufacturing Systems	An international research and development effort involving the Untied States, Japan, Canada, Europe, Australia, and Switzerland focused on developing advanced manufacturing technologies
Ontario Centres for Excellence	Brings universities, industry and the government together to help in the application of new science and technology.

Source: Canada-Ontario Business Centre.

[34] CAMM and CTMA officials, interviews by USITC staff, Windsor, ON, June 6, 2002; and official of EDC, interview by USITC staff, Aug. 15, 2002. The official stated that there were CN$30 billion in all automotive sector exports to the United States in 2001. TDM exports are considered part of the automotive sector exports, but only CN$1 billion in financing was provided by all EDC programs combined.

The government is also involved in increasing the skilled workforce for the TDM industry. Industry sources indicate that some of the most important training programs in the Windsor area include the Ontario Youth Apprenticeship, Moulding Youth for Industry (MYFI), and St. Clair College post- secondary trade-related certificate and diploma programs.[35] The Ontario Government entered into a 2-year Memorandum of Understanding (MOU) in January 2001 with Human Resources Development Canada (Ontario Region); the Ministry of Training Colleges and Universities of Ontario; the Automotive Parts Manufacturers Association; the Canadian Die Casters Association; The Canadian Plastics Industry Association; and CTMA to streamline the visa process for immigrant TDM makers. Under the MOU, employers are relieved of the usual requirement to provide proof of adequate efforts to recruit Canadians for these TDM positions. The MOU also calls for TDM firms to hire one Canadian apprentice per foreign worker in the first year of the MOU and two apprentices per foreign worker in the second year.

There are no Canadian tariffs on imports of TDMs from the United States, Mexico, Commonwealth Caribbean Countries, Chile, Israel, certain countries considered to be least developed, and certain countries receiving general preferences. Tariffs on imports of TDMs from countries receiving normal trade relations status range from free of duty to 6.5 percent ad valorem.

[35] The Ontario Youth Apprenticeship Program, offered at four high schools in the region, provides both on-the-job and academic training while students work toward high school diplomas. The MYFI, managed by CTMA at a high school, offers pre-apprenticeship training for unemployed high school graduates between the ages of 18 and 30. Upon successful completion of the program, students can sign apprenticeship agreements with TDM firms. St. Clair College offers several courses useful for those entering the TDM industry–a 1-year certificate program in mechanical shop techniques, and four 2-year diploma programs in tool-making, CAD/CAM software, and industrial mechanical skills. CAMM and CTMA officials, interviews by USITC staff, Windsor, ON, June 6, 2002, and Windsor-Essex County Government, *Implementation Committee Report: Precision Metal Cutting Journeymen Work Plan and Recommendations*, May 2001.

Mexico

Industry Profile

Composition of the Industry

Despite Mexico's rise to prominence as a North American manufacturing platform for a wide range of TDM-using sectors, its TDM industry is small and limited by comparison. Indigenous producers are relatively few in number[36] and are predominately small-scale operations (1-12 employees),[37] generally family-owned or with a single owner, and often service a primary customer or are captive operations.[38] Mexico's TDM industry is clustered in three major industrial and manufacturing centers. For example, there are more TDM shops in the central interior cities of Celaya, Guadalajara, Mexico City, Querétaro, Puebla, San Luís Potosí, and Toluca, and in the northeastern cities of Monterréy and Saltillo than anywhere else in the country. Likewise, TDM shops, which are predominantly U.S. owned,[39] also

Unique industry characteristics and significant strengths and weaknesses of the Mexican TDM industry

Unique industry characteristics:
- Relatively few indigenous firms
- Highly dependent on imports to meet domestic consumption needs
- Preferential import duties and tax-treatment programs

Strengths:
- Willingness of some major customers to develop select domestic TDM firms as suppliers
- Influx of some U.S. and other foreign TDM makers following their customers into Mexico

Weaknesses:
- High labor rates as compared with China
- High electricity costs as compared with the United States
- Domestic investment capital is limited and expensive
- Production capabilities are limited to less-complex TDMs
- Insufficient production capacity
- Limited number of skilled TDM builders to meet demand
- Some problems with lack of availability, delivery delays, and product-quality issues
- Customers in Mexico are moving some production abroad, particularly to China and Southeast Asia

[36] Official statistics were not readily available as to the number of firms, employment, and domestic shipments for Mexico's TDM industry, for in many instances, particularly for punch and die producers, these operations are considered machine shops. An estimate of machining operations by the National Manufacturers Association (Canacintra) ranged between 600 to 1,200 shops. Arturo Dessommes, *Tool, Die, and Mold Industry in Mexico*, U.S. Commercial Service (USCS)-Mexico City, Aug. 30, 2002. Another indication of the small size of both the industry and of individual producers is the lack of a TDM-specific industry association in Mexico. Likewise, ISTMA, which receives industry statistics provided voluntarily by member-country industry associations, did not include Mexico in its *2000 ISTMA Business Statistics Report*, Feb. 2002. ISTMA representative, interview by USITC staff, July 15, 2002.

[37] Employment per firm is estimated to range from the owner-operator in very small "job" machine shops to about a dozen in larger, more specialized shops with CNC machine centers. Dessommes, *Tool, Die, and Mold Industry in Mexico*, Aug. 30, 2002.

[38] U.S.-based industry official with operations in Mexico, interview by USITC staff, July 10, 2002.

[39] Dessommes, *Tool, Die, and Mold Industry in Mexico*, Aug. 30, 2002.

are concentrated along the U.S.-Mexico border area, particularly in the cities of Tijuana, Ciudad Juaréz, and Reynosa, among others.[40]

In the Mexican TDM industry, there are reportedly some good "B-class" shops, but reportedly no world-class mold makers whereas high-quality "class-A" tools are largely sourced from the United States.[41] For indigenous firms, shortages of skilled TDM builders[42] and limited technology[43] hamper their ability to produce high-quality TDMs.[44] Likewise, there is the perception that some Mexican shops can produce smaller or less-complex TDMs for small customers at lower prices,[45] but not in sufficient quantities to satisfy domestic consumption. Hence, many TDMs, particularly new, larger, or more complicated products required by manufacturers and assemblers operating in Mexico are almost always sourced from abroad, primarily from the United States.[46] Moreover, the vast majority of Mexican TDM vendors typically do not have ISO 9000 certification[47] and would likely be unable to meet the ever-increasing production standards of major TDM-using customers.

Because of growing demand for skilled TDM builders and an inadequately skilled workforce, manufacturers have had to invest in training on their own or form training partnerships with local schools.[48] A number of trade and technical schools are turning out several hundred TDM builders annually, but not to the extent necessary to meet current

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[40] Ibid.; and editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

[41] James Hollifield, Strategic Unit Manager for Plastic Molding, Black & Decker de Reynosa, in Clare Goldsberry, "On the Border: Manufacturing's Big Push," *Injection Molding Magazine*, Mar. 2002, found at *http://www.immnet.com/article/library/archive/*, retrieved June 21, 2002.

[42] Ronald Rogers, Anchor Tool & Plastic, Minneapolis, MN, in Clare Goldsberry, "Minnesota to Mexico: Moving South to Support Your U.S. Business," *Injection Molding Magazine*, Jan. 2000, found at *http://www.immnet.com/article/library/archive/*, retrieved June 21, 2002. However, another industry assessment characterized the supply of skilled TDM builders as not a significant concern, particularly given the small scale of most Mexican shops. Dessommes, USCS-Mexico City, *Tool, Die, and Mold Industry in Mexico*.

[43] Ronald Rogers, in Clare Goldsberry, "Minnesota to Mexico: Moving South to Support Your U.S. Business," Jan. 2000.

[44] U.S.-based industry official with operations in Mexico, interview by USITC staff, July 10, 2002; and editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

[45] For example, smaller facilities that build molds in general purpose machine shops do not bear as heavy a production cost burden compared to larger mold builders with higher overhead and quality-control costs. Dessommes, *Tool, Die, and Mold Industry in Mexico*, Aug. 30, 2002.

[46] U.S.-based industry officials with operations in Mexico, interviews by USITC staff, July 10 and 25, 2002; and editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

[47] U.S.-based industry official with operations in Mexico, interview by USITC staff, July 25, 2002.

[48] For example, Nemak, an auto parts producer in an industrial suburb of Monterréy trains machinists, welders, and tool and die makers by providing new hires with some 400 hours of training in their first 2 to 3 years with the firm, at a cost of $4,000 to $5,000 per employee. Workers are also paid 10 to 15 percent above market wages, which helps reduce turnover. The extra expenses appear to pay off as productivity grew by more than 9 percent in 1999, nearly double the estimated industry average. Productivity gains, along with improvements in product quality, also helped the firm gain new contracts. "Mexico, Help Wanted Badly," *Business Week Online*, Mar. 20, 2002.

demand.[49] Likewise, wages for skilled TDM builders are rising to the point that competitiveness is being eroded.[50] For example, the current average monthly salary for Mexican moldmakers along the border, where wages tend to be higher than in the interior region, is about $1,000 a month, which is relatively high compared with the salaries of other jobs in Mexico,[51] and significantly higher than such wages in China.

The TDM industry in Mexico also has been augmented by U.S. producers[52] that have set up operations in the border region (e.g., Anchor Tool & Plastic, Beach Mold & Tool, Catalina Tool & Mold, Precision Mold & Tool, Tech Group, and Tooling Science, among others), along with a few that have established themselves in the Guadalajara area.[53] Particularly in the border region, most TDMs are sourced from U.S. shops established along the border to serve TDM-using operations in Mexico. Likewise, a number of U.S. producers sell into Mexico through joint-venture partnerships with Mexican shops.[54] According to a molding industry consultant, U.S. molders and TDM-makers can take advantage of the preference of major manufacturers operating in Mexico for U.S. suppliers provided that the U.S. molders establish local operations and thus are able to minimize transportation costs and offer competitive pricing based on relatively low labor costs.[55] For example, because of the limited number of mold-building and good-quality mold maintenance shops in Guadalajara, original equipment manufacturers (OEMs) Lucent Technologies and Hewlett-Packard and five large injection molders sought Tooling Science Inc. (a U.S. moldmaker) to provide tooling support, repair, and maintenance.[56] However, such relocation has sometimes been characterized by those in

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[49] Editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

[50] Some business owners in the Monterréy area have even asked Nuevo León's state government to stop promoting the state to prospective investors, out of concerns that rising wages will erode their competitiveness. "Mexico, Help Wanted Badly," *Business Week Online*, Mar. 20, 2002.

[51] Editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

[52] Some U.S. molders and TDM producers have opted for satellite facilities on the U.S. side of the border to serve the Mexican market, citing advantages of common language, familiar business environment, greater technical expertise, ease of relocating strategic personnel, and not much need for semi-skilled labor. Michael Zacharias, President, Extreme Tooling & Engineering, Ironwood, MI, in Sherry L. Baranek, "Setting Up Shop in Mexico, Moldmakers and Suppliers Weigh In on the Pros and Cons of Establishing Satellite Operations South of the Border," *Moldmaking Technology*, Apr. 2002, pp. 40-42; and Seth Jantzen, Materials Manager, Tadim, LDM Technologies, MI, in Goldsberry, "On the Border: Manufacturing's Big Push."

[53] USITC staff interview with editorial staff member of *Injection Molding Magazine*, July 15, 2002.

[54] Ibid.

[55] Agostino Von Hassell, The Repton Group, "What You Should Know About International Expansion," *Injection Molding Magazine*, Aug. 2000, found at *http://www.immnet.com/article/library/archive/*, retrieved June 21, 2002.

[56] Michael Ditty, Sales Engineer, Tooling Science Inc., Maple Grove, MI, in Goldsberry, "Minnesota to Mexico: Moving South to Support Your U.S. Business," Jan. 2000.

the industry as "not by choice" but more "by command." For example, a small manufacturer in western Massachusetts was given the choice of either moving to Mexico or being dropped as a supplier for General Electric (GE).[57] In contrast to the influx of foreign investment capital into the TDM sector in Mexico, there is very little, if any, FDI by indigenous TDM producers in overseas operations primarily because of the relatively small size of the Mexican TDM industry and moderate scale of individual operations.

Manufacturing Infrastructure

Although of limited technology (despite improvements[58]), machinery is present in abundance at indigenous TDM operations in Mexico.[59] However, for Mexican TDM shops seeking investment capital to upgrade their operations, credit is expensive and limited, due to the significantly undercapitalized condition of the Mexican banking system and the substantial burden of non-performing loans. Current interest rates range from 25 to 35 percent, and small and medium-size businesses generally do not have access to commercial bank loans, letters of credit, or other financing.[60] Further, because of the higher cost of capital, TDM shops that seek operating locations in Mexico are confronted with higher property costs and building lease rates.[61]

To a certain extent, according to an industry source, some major foreign-based customers operating in Mexico are willing to develop selected Mexican TDM shops,[62] particularly as these customers seek to procure more of their TDMs from local sources in the long-run.[63] Some local credit lines to finance working capital are being made available to small and medium-size businesses through partnerships between banks and industry councils. For example, the Bital Financial Group and the National Financing Company signed an agreement with the state of Jalisco's Transformation Industry Council to provide loans to facilitate the acquisition and renovation of industrial machinery and equipment for Council-affiliated firms.[64]

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[57] Testimony of John D. Belzer, president, TCI Precision Metals, and Chairman of the Board, National Tooling & Manufacturing Association, transcript of the hearing, p. 124.

[58] Derald Quillin, Purchasing Manager, Whirlpool de Reynosa, in Goldsberry, "On the Border: Manufacturing's Big Push."

[59] Rogers, in Goldsberry, "Minnesota to Mexico: Moving South to Support Your U.S. Business," Jan. 2000.

[60] U.S. and Foreign Commercial Service (US&FCS) and U.S. Department of State (State Dept.), "Economic Trends and Outlook," *Mexico Country Commercial Guide FY 2002*, found at *http://www.usatrade.gov/Website/CCG.nsf/CCGurl/CCG-MEXICO2002-CH2:-0047622B*; and "Trade and Project Financing," *Mexico Country Commercial Guide FY 2002*, found at *http://www.usatrade.gov/Website/CCG.nsf/CCGurl/CCG-MEXICO2002-CH8:-00557658*, both retrieved June 25, 2002.

[61] James Hollifield, Strategic Unit Manager for Plastic Molding, Black & Decker, McAllen, TX, and Reynosa, TAMPS, and Ronald Mills, Chief Operating Officer, NAI Riocco, Mission, TX, and Reynosa, TAMPS, in Goldsberry, "On the Border: Manufacturing's Big Push."

[62] U.S.-based industry official with operations in Mexico, interview by USITC staff, July 10, 2002.

[63] Ibid., July 15, 2002.

[64] "Machinery Loans Approved," news bulletin, Maquila Portal, found at *http://www.maquilaportal.com*, retrieved June 24, 2002.

TDM shops have higher electricity costs in Mexico than in the United States as the combined shortage of generating capacity, the high cost of imported natural gas to fuel new generating plants, and transmission losses due to aging power lines have driven up the cost of electric power to Mexican industrial customers.[65] Moreover, TDM builders operating in Mexico cannot compete with the low costs of materials reportedly enjoyed by certain producers in China. A U.S. tooling producer that also operates in Mexico, quoting prices on a project for Ford, found that the cost of materials required to perform the work in Mexico exceeded the cost of purchasing the finished product from Chinese suppliers.[66]

Market Characteristics and Trends

Customers

Industry observers expect the Mexican TDM sector to grow only slightly;[67] if at all,[68] despite the manufacturing sector's rapid expansion through 2001, rising consumer demand for TDM-produced products, and increasing substitution of plastics for metal and glass in packaging materials, auto parts, consumer electronics, among other products.[69] Mexico's TDM-using consumers consist primarily of U.S. and Japanese manufacturers of automotive products, consumer electronics (televisions, DVD players, cellular telephones, etc.), household appliances, machinery, medical equipment, various other consumer products,[70] and almost any product requiring extensive assembly work.[71] Industrial sector output, which is heavily dependent on exports to the United States, declined by almost 4 percent in 2001. The Mexican economy contracted by 0.3 percent in 2001 in contrast to the almost 7-percent economic growth experienced in the previous

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[65] See Ralph Watkins, "Production-Sharing Update: Developments in 2001," *Industry Trade and Technology Review*, USITC publication 3534, July 2002, p. 30.

[66] Testimony of Michael Korneli, president, Bestech Tool Corp., transcript of the hearing, p. 217. Also, Mexico's Economy Secretary, Luís Ernesto Derbéz, reportedly acknowledged that Mexican manufacturers may be facing market-distorting practices that have prompted their complaints that Chinese products competing in Mexico and its key export markets allegedly are benefitting from unfair trade. Also at a news conference in Mexico City on July 10, 2002, the Economy Secretary reportedly raised concern about the transfer of assembly plants from Mexico to China and possible Chinese subsidies that may violate rules of the World Trade Organization (WTO). The Mexican Government is currently undertaking a preliminary investigation to determine whether China is offering direct or indirect subsidies to lure firms away from Mexico. Ioan Grillo, "Mexico to File Complaint Against China at WTO," *The News* (Mexico City), July 11, 2002; and Carlos Forcero, International Commercial Practices Group, Ministry of the Economy, Government of Mexico, interview by USITC staff, July 26, 2002.

[67] Editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

[68] U.S. industry official with operations in Mexico, interview by USITC staff, July 10, 2002.

[69] A previous forecast for growth of the Mexican market for plastic production machinery was at an annual average rate of 15 percent during 1999-2001. US&FCS and State Dept., "Plastic Production Machinery (PME)," *Mexico, Best Prospects/Industry Overview*, Dec. 20, 1999, found *http://www.usatrade.gov/website/ForOffices.nsf/*, retrieved Aug. 7, 2002.

[70] For a more detailed listing, by state and region, see US&FCS and State Dept., "Economic Trends and Outlook."

[71] Editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

year.[72] Moreover, some low-technology manufacturing of electronic circuit boards, cordless telephones, video games, and golf club parts, among other products, has moved abroad in recent years, particularly to China,[73] especially for those products accorded preferential duty treatment under international trade agreements.[74]

Purchase Decision Variables

Industry sources report that Mexican TDM producers are unable to meet ever-increasing production standards and volume requirements of major TDM-using customers. As such, these firms' business will likely consist of smaller contracts and will supply full-service operations on a more limited as-needed basis. Problems noted by industry observers in customers' dealings with indigenous TDM shops in Mexico include delays in delivery, lack of availability, and product quality problems.[75] Further, pre and post sales services are key factors for buying or selling molds (and other types of TDMs) in Mexico, given indigenous shops' limited building and repair expertise.[76] Given these issues, combined with the size and production limitations of the indigenous TDM industry, industry sources suggest that only about one-quarter of purchases by foreign-based firms operating in Mexico are from Mexican vendors.[77] As noted earlier, TDM-using consumers in Mexico prefer to source TDMs (and injection and other associated machinery) from abroad, particularly the more complex products.[78] Among products originating from sources other than the United States, Italian and Japanese TDMs reportedly enjoy reputations for good quality in Mexico.[79] China is beginning to penetrate the Mexican market for industrial molds, although Chinese and most other Asian TDMs reportedly are not known for quality among purchasers in Mexico; however, for products that do not require high quality standards, Chinese and other Asian TDMs are able to compete on the basis of price.[80]

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[72] US&FCS and State Dept., "Mexico's Economic Prospects for 2002," news, Mar. 26, 2002, found *http://www.usatrade.gov/website/ForOffices.nsf/*, retrieved June 25, 2002.

[73] See for example, "A Good Job Spoiled: Mexico's Golf Work is Now Fleeing to Asia," *The Wall Street Journal*, July 24, 2002, pp. A12-A13.

[74] See Ralph Watkins, "Mexico Versus China: Factors Affecting Export and Investment Competitiveness;" and "Production-Sharing Update: Developments in 2001," *Industry Trade and Technology Review*, USITC publication 3534, July 2002, pp. 11-26 and pp. 27-42, respectively.

[75] For example, in the production of plastic molded parts, some stray marks were noted by an industry observer although the problem may not be due strictly to defects in the mold, but possibly due to resin quality or the molding process. USITC staff interview with U.S.-based industry representative with operations in Mexico, July 25, 2002.

[76] Glenn Starkey, Progressive Components, Wauconda, IL, "Are there Mold Sales Opportunities Nearby? Are There Sales Opportunities for U.S. Moldmakers Right Here in Our Backyard?," *Moldmaking Technology*, (reprint) 2001.

[77] U.S.-based industry official with operations in Mexico, interview by USITC staff, July 25, 2002.

[78] Ibid.

[79] Dessommes, USCS-Mexico City, *Tool, Die, and Mold Industry in Mexico* Aug. 30, 2002; and former U.S. mold-making industry official, interview by USITC staff, July 22, 2002; respectively.

[80] Former U.S. moldmaking industry official, interview by USITC staff, July 22, 2002.

Trade

Trade in TDMs between Mexico and its partners reflects not only new purchases but also shipments for repair or upgrading. For example, many of the very large molders such as Carplastic (a Ford molding facility in Monterréy) source most of their new molds from the United States and send them back to the United States for major repairs.[81] Mexico's total trade (exports plus imports, table 4-5) in TDMs expanded 56.2 percent from $700 million in 1997 to nearly $1.1 billion in 1999 as both Mexico and the United States (Mexico's predominant trade partner) enjoyed uninterrupted economic growth during this period. Subsequently, total trade declined and recovered to just above $1.1 billion as imports from the European Union, Canada, and Japan fluctuated over 2000-2001 and as the U.S. economy slowed in 2001. Given that TDM-using consumers operating in Mexico are highly reliant on foreign sources to meet demand, Mexico's TDM trade balance (exports less imports) was in net deficit during 1997-2001. The deficit grew by almost 81 percent, from $475 million in 1997 to $858 million in 1999, before dropping by almost 11 percent, to $767 million, by 2001.

Table 4-5
Tools, dies, and industrial molds: Mexican shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	([1])	112.9	587.6	([1])	([1])
1998	([1])	101.7	665.5	([1])	([1])
1999	([1])	118.0	976.3	([1])	([1])
2000	([1])	128.6	907.7	([1])	([1])
2001	([1])	170.4	937.8	([1])	([1])

[1] Not available.

Note.—Mexican trade data are published in U.S. dollars; therefore, data in Mexican pesos are not presented.

Source: Global Trade Information Services, Inc., World Trade Atlas Internet database, found at *http://www.gtis.com*.

Mexico's TDM imports from all sources grew by almost 60 percent during 1997-2001, from $587.6 million in 1997 to a peak of $976.3 million in 1999, before falling to $937.8 million in 2001 (table 4-6). In that year, industrial molds accounted for almost 75 percent, tools and dies, for 24 percent, and jigs and fixtures, for 1 percent of all Mexican TDM imports. Given extensive U.S. ties for manufacturers operating in Mexico, the United States was the predominant supplier of TDMs to Mexico, accounting for 56 percent of all Mexican imports in 2001. Likewise, the United States was also Mexico's predominant source for each TDM category, providing almost 52 percent of all industrial molds, 69 percent of tools and dies, and almost 64 percent of jigs and fixtures in that year.

[81] Editorial staff member of *Injection Molding Magazine*, interview by USITC staff, July 15, 2002.

Table 4-6
Tools, dies, and industrial molds: Mexican imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
United States	254,475	296,615	372,275	476,668	363,549
Canada	33,879	50,748	62,587	51,899	62,915
Japan	35,157	25,995	67,125	26,823	44,592
Italy	27,918	27,437	32,752	29,933	37,764
Germany	42,721	49,903	50,921	30,967	30,909
Korea, South	4,861	10,380	6,283	7,933	28,214
All other	52,779	66,189	61,967	71,948	132,601
Total	451,790	527,267	653,910	696,171	700,544
EU-15	103,307	121,342	119,820	91,622	122,964
NAFTA	288,354	347,363	434,861	528,567	426,464
China and Hong Kong	3,575	3,711	2,585	3,575	9,369
Tools and dies:					
United States	48,824	46,455	150,741	122,205	158,016
Japan	15,425	10,077	43,598	13,877	19,694
Canada	16,787	7,725	71,732	34,506	19,236
Spain	7,259	34,419	12,372	11,105	12,562
Germany	31,850	19,049	15,883	9,095	6,421
Argentina	1,949	2,785	1,854	1,253	3,920
All other	6,111	8,519	17,411	9,530	7,713
Total	128,205	129,029	313,591	201,571	227,562
EU-15	43,365	58,628	42,375	24,550	21,920
NAFTA	65,610	54,181	222,473	156,711	177,252
China and Hong Kong	17	15	223	37	66
Jigs and fixtures:					
United States	5,222	4,776	4,966	6,229	6,179
Germany	849	777	1,083	1,087	1,340
Japan	187	1,799	624	609	356
Poland	193	298	283	383	321
Canada	28	80	119	73	293
China	211	317	402	356	269
All other	917	1,116	1,346	1,187	921
Total	7,607	9,163	8,823	9,924	9,679
EU-15	1,379	1,492	1,860	1,696	1,836
NAFTA	5,249	4,857	5,085	6,302	6,472
China and Hong Kong	215	319	402	356	300
Total:					
United States	308,520	347,847	527,982	605,102	527,745
Canada	50,694	58,554	134,437	86,479	82,443
Japan	50,769	37,870	111,347	41,308	64,643
Italy	30,722	30,586	43,848	33,060	39,627
Germany	75,420	69,728	67,887	41,149	38,670
Spain	18,476	50,252	27,886	26,896	31,680
All other	53,001	70,622	62,937	73,673	152,977
Total	587,602	665,459	976,324	907,667	937,785
EU-15	148,051	181,462	164,054	117,867	146,720
NAFTA	359,214	406,400	662,419	691,581	610,188
China and Hong Kong	3,806	4,045	3,210	3,967	9,735

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas Internet database, found at *http://www.gtis.com*.

Other important suppliers of TDMs to Mexican users in 2001 were the European Union (almost 16 percent), Canada (9 percent), and Japan (7 percent) (table 4-6). During 2000-01, Mexico purchased significantly more TDMs (predominantly of industrial molds) from East Asia and the Pacific Basin, with imports rising by almost 3 percent from Korea, to $30.0 million in 2001, by 86 percent from Taiwan, to $24.1 million, by 26 percent from Singapore, to $18.7 million, and by nearly 25 times from Australia, to $16.3 million.[82] Many companies operating in Mexico have recently begun buying Chinese-made TDMs, and imports from China and Hong Kong (almost exclusively of industrial molds) rose by 145 percent during 2000-01. However, China and Hong Kong still accounted for only 1 percent of Mexican TDM imports from all sources in 2001.

Mexico's TDM exports (table 4-7) to all destinations grew at a slightly lesser rate than imports, increasing by 51.0 percent during the period from $112.8 million in 1997 to a peak of $170.4 million in 2001. In that year, industrial molds accounted for 88.7 percent, tools and dies for 11 percent, and jigs and fixtures, for 0.4 percent of all Mexican TDM exports. Further, the United States was the predominant destination, accounting for 79 percent of all Mexican TDM exports in 2001. Likewise, the United States dominated each TDM category, receiving 80 percent of all industrial molds, 73 percent of tools and dies, and 70 percent of jigs and fixtures from Mexico in that year. By contrast, Canada received only 8 percent, and the European Union received only 5 percent of all Mexican TDM exports in that year.

Government Policies and Programs

Certain import duty, value-added and inventory tax, and standards-compliance certification exemptions are offered to manufacturers by the Mexican Government. However, few, if any, directly promote domestic TDMs but several facilitate competition from foreign TDMs. For example, although imports of most TDMs and parts thereof into Mexico are subject to a normal duty rate of 10 to 20 percent ad valorem, a great majority enter exempt from duty or at reduced duty rates under various free-trade agreements (FTAs) and export promotion programs. Mexico has negotiated FTAs with 32 countries,[83] most which exempt or are phasing out import duties on TDMs. Moreover, the recently enacted Mexico-European FTA will provide NAFTA-like benefits to EU producers similar to those currently enjoyed by U.S. TDM producers exporting to the Mexican market.[84]

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[82] Mexican trade statistics from Global Trade Information Services, Inc., World Trade Atlas Internet database, found at *http://www.gtis.com*.

[83] In addition to its NAFTA partners, currently Mexico has FTAs with the European Union, the European Free Trade Area (Iceland, Liechtenstein, Norway, and Switzerland), Israel, Bolivia, Chile, Colombia, Costa Rica, Guatemala, El Salvador, Honduras, and Venezuela. Mexico is also currently negotiating a FTA with Japan.

[84] Under the Mexico-European Union FTA, duties on TDMs from the European Union are currently around 5 to 7 percent, to be phased out completely by 2005.

Table 4-7
Tools, dies, and industrial molds: Mexican exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
United States	88,025	77,536	80,678	94,845	120,852
Canada	3,490	3,869	4,080	5,181	10,397
Brazil	836	4,310	1,533	2,300	3,332
Venezuela	1,026	787	1,086	800	2,660
Belgium	341	18	300	268	2,024
Germany	1,481	906	1,723	1,769	1,617
All other	8,023	6,300	8,676	10,531	10,254
Total	103,222	93,726	98,076	115,694	151,136
EU-15	3,532	2,184	5,136	5,820	7,810
NAFTA	91,515	81,405	84,758	100,026	131,249
China and Hong Kong	58	284	2	1,816	137
Tools and dies:					
United States	5,982	5,449	13,591	9,642	13,672
Canada	43	640	5,085	1,800	3,917
Argentina	3	2	1	0	257
Spain	11	94	1	9	231
United Kingdom	1	0	85	34	153
Dominican Republic	0	0	0	4	121
All other	377	1,248	541	486	322
Total	6,417	7,433	19,304	11,975	18,673
EU-15	278	1,140	245	316	493
NAFTA	6,026	6,089	18,676	11,442	17,589
China and Hong Kong	0	0	8	0	0
Jigs and fixtures:					
United States	342	328	479	921	420
Germany	2,801	210	92	0	136
Unidentified Country	0	0	0	0	26
Sweden	0	0	0	8	13
Netherlands	0	0	0	9	2
Canada	0	2	0	0	1
Spain	1	0	1	2	1
All other	71	14	34	10	0
Total	3,215	554	606	950	599
EU-15	2,803	213	109	22	153
NAFTA	342	330	479	922	421
China and Hong Kong	0	0	0	0	0
Totals:					
United States	94,349	83,312	94,748	105,409	134,944
Canada	3,534	4,511	9,165	6,981	14,315
Brazil	905	4,317	1,615	2,338	3,361
Venezuela	1,028	788	1,099	803	2,693
Belgium	341	18	301	298	2,024
Germany	4,525	2,160	1,835	1,932	1,794
All other	8,172	6,606	9,223	10,858	11,278
Total	112,854	101,712	117,986	128,619	170,409
EU-15	6,613	3,537	5,490	6,158	8,456
NAFTA	97,883	87,823	103,913	112,390	149,259
China and Hong Kong	58	284	10	1,816	137

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas Internet database, found at *http://www.gtis.com*.

Foreign-owned, export-oriented manufacturing facilities and their suppliers that use TDMs, operate in Mexico under either the Maquiladora Program, the Program for Importation to Manufacture Exported Products (PITEX), or both. These programs not

only offer import duty exemptions (except for imports from non-North American sources as of January 1, 2001,[85]) but also exempt machinery and components from value-added taxes (VATs), confirmation of compliance with *Normal Oficial* regulations (for labeling, safety standards, etc.),[86] and return requirements to the country of origin. Likewise capital equipment is exempted from the 25-percent inventory tax under these programs.[87]

Moreover, under the 1998 Promotional Sector (Prosec) Programs, normal duty rates are eliminated or reduced to 5 percent on a wide range of imported production machinery and components for 22 different export manufacturing sectors, although duty rates and exemptions (including TDMs) vary among sectors.[88] However, manufacturing inputs, such as TDMs, from Asian competitors may enter Mexico at the lower duty rates under Prosec, which, according to the U.S. and Foreign Commercial Service and the U.S. Department of State, diminishes the relative advantage that U.S. producers enjoy under NAFTA.[89]

No significant nontariff barriers were noted by an industry observer to TDM imports by Maquiladoras or PITEX operations.[90] A U.S. producer of dies characterized the border with Mexico as "fairly transparent."[91] However, Mexican regulations and enforcement are strict for import paperwork.[92] If import paperwork is not in order at the border, shipments into that country can be delayed by roughly an additional day, according to the U.S. producer of dies. Nonetheless, that same producer experienced easier paperwork for sending truckloads of dies and molds to cross into and out of Mexico than into and out of Canada. Moreover, the producer reported no problems in sending personnel into Mexico to work on dies.[93]

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[85] On Oct. 30 and Dec. 31, 2000, the Government of Mexico issued changes to the governing decrees to bring the Maquiladora and PITEX programs into compliance with Article 303 of NAFTA.

[86] In contrast, permanent imports require documentation of uses and qualification under *Normal Official* requirements; and are subject to a 10-percent VAT and 15-percent VAT, respectively, in the border and interior regions based on sales value and customs duties.

[87] U.S.-based industry official with operations in Mexico, interview by USITC staff, July 25, 2002. See also US&FCS and State Dept., "Marketing U.S. Products and Services," *Mexico Country Commercial Guide FY 2002*, found at *http://www.usatrade.gov/Website/CCG.nsf/CCGurl/CCG-MEXICO2002-CH-4:-0054F200*; and "Trade Regulations, Customs, and Standards," *Mexico Country Commercial Guide FY 2002*, found at *http://www.usatrade.gov/Website/CCG.nsf/CCGurl/CCG-MEXICO2002-CH-6:-0054F221*, both retrieved June 25, 2002.

[88] For example, industrial molds are exempt from import duties for the electronics products and the plastics and rubber sectors, but are not exempt for the chemicals sector. U.S.-based industry official with operations in Mexico, interview by USITC staff, July 25, 2002.

[89] US&FCS and State Dept., "Trade Regulations, Customs, and Standards," *Mexico Country Commercial Guide FY 2002*.

[90] USITC staff interview with U.S.-based industry representative with operations in Mexico, July 25, 2002.

[91] Testimony of David L. Rasmussen, president, Progressive Die & Automation, president, Quality Die & Mold, Board of Directors, Coalition for the Advancement of Michigan Tooling Industries, transcript of the hearing, pp. 140-141.

[92] US&FCS and State Dept., "Trade Regulations, Customs, and Standards," *Mexico Country Commercial Guide FY 2002*.

[93] Rasmussen, transcript of the hearing, pp. 140-141.

Japan

Industry Profile

Composition of the Industry

Unique industry characteristics and significant strengths and weaknesses of the Japanese TDM industry

Unique industry characteristics:
- Large number of small firms

Strengths:
- Tradition of craftsmanship in the production of dies and molds
- High quality
- Quick lead times (time required to produce a die or mold).
- Skilled in producing relatively high-precision and complex dies and molds

Weaknesses:
- Relatively high labor rates
- Japanese customers have moved production to foreign locations, particularly China and Southeast Asia
- Many Japanese die and mold producers tend to be small companies and lack financial and management resources
- Behind in the use of CAD/CAM software and the adoption of 3-dimensional computer modeling of dies and molds for

The TDM industry in Japan is large and well established. In 2000, there were 12,125 producers manufacturing TDMs in Japan, down from a peak of 13,115 producers in 1990.[94] Rather than a consistent decline over the past decade, the industry witnessed periodic increases in the number of establishments during 3 separate years, with the most recent expansion occurring in 2000. According to industry sources, an irregular flux of new entrants as well as exiting firms generated such spurts and has kept the overall number of producers fluctuating around 12,000 for the past few years.

A characteristic of the Japanese industry is the overwhelming preponderance of very small firms. The vast majority of Japanese TDM producers are privately run businesses, with more than 90 percent consisting of fewer than 20 employees.[95] Of that amount, more than 89 percent employ only 1 to 9 workers, with the remaining 11 percent supporting 10 to19 employees. Such businesses are often compact, modest facilities tucked into the residential areas of Japanese cities or suburbs. In many cases, the manufacturing operations are not detached; rather, they are abutted on either side by neighboring small businesses and private dwellings.

Larger producers with over 100 employees account for less than 1 percent of companies, and only 11 firms operate with 300 workers or more. The larger firms are more likely to operate one or multiple buildings on relatively broad expanses of land outside the city, or within the industrial zone of a particular location. Of the larger companies, only the few truly sizeable firms, e.g., those with more than 1,000 employees or those with multiple

[94] Official statistics of the Ministry of Economy Trade and Industry (METI), found at *http://www.jdma.net/toukei/index.html*, retrieved July 31, 2002.

[95] Data on firm size taken from official statistics of METI, found at *http://www.jdma.net/toukei/index.html*, retrieved July 31, 2002.

domestic and international establishments, are publicly traded.[96] Even those firms considered medium to large operations tend to be privately run enterprises with significant family linkages throughout the corporate management structure. With respect to the cycle of family management, most independent TDM producers, both large and small, are generally in the second generation of operation.[97]

Production of TDMs in Japan is concentrated in areas near and to the south of Tokyo, generally in locations central to Japan's overall manufacturing infrastructure. For example, over 14 percent of total TDM production originates from Aichi prefecture,[98] a key center for automobile and automotive parts production, with facilities for Toyota, Honda, and Mitsubishi. Aichi is also home to several appliance firms, as well as notable foreign enterprises, with independent TDM operations serving these OEMs as well as Tier 1 and Tier 2 suppliers in the region. With respect to product distribution, Aichi prefecture leads in the production of nearly all types of TDMs, including press dies, forging dies, die cast molds, and plastic injection molds. Osaka prefecture, the second-largest production center for forging dies, plastic injection molds, and rubber and glass molds, accounts for an additional 9 percent of total sector production. Key consuming industries in this region include consumer electronics, medical goods, and information technology. Other key production centers include Kanagawa and Shizuoka prefectures, each accounting for 7 percent of total TDM production. Notwithstanding the relative concentration of the industry in these key regions (37 percent of TDM production), Japanese TDM manufacturing is dispersed throughout the country, with the top 10 producing prefectures together accounting for only 66 percent of the industry's total output.

The TDM industry in Japan is characterized by a heavy reliance on outsourcing. Industry representatives describe the structure of the industry as a hierarchical system where larger companies operate at the top and maintain multifarious working relationships with small producers in the subcontracting role.[99] Likewise, even small producers themselves use subcontractors during periods of increased work or for particular tasks, such as grinding and polishing. According to one source, an OEM might subcontract tooling to one producer, who in turn divides the work among 10 to 20 smaller subcontractors.[100] The subcontracting infrastructure in TDM manufacturing provides an advantage of allowing access to a wide variety of industrial processes for finishing the product. Such subcontractors tend to be experienced craftsman and are reportedly extremely regimented and hardworking.[101]

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[96] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

[97] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002, and Saitama, June 5, 2002.

[98] Data on TDM production by prefecture compiled from official statistics of METI, found at *http://www.jdma.net/toukei/index.html*, retrieved July 31, 2002.

[99] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

[100] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[101] Ibid.

At present, the Japanese TDM sector is in a state of overcapacity, with industry sources gauging average capacity utilization at around 60 percent.[102] Consolidation has occurred among producers, but industry analysts stress that it is necessary for manufacturers to attain a certain size and level of competitiveness to remain viable, thus, additional mergers and acquisitions are anticipated.[103] Industry officials would prefer that the TDM sector follow the example set by Japan's electronics makers; overcapacity in that industry led to consolidation among smaller producers and enhanced international competitiveness. Industry sources anticipate that there are three possible consolidation scenarios in the ensuing years–consolidation among small producers, the acquisition of small firms by larger TDM producers, and/or the exit of small firms from the industry. Representatives of smaller firms indicate that there is discussion among peer companies but indicated no specific plans for consolidation at this time. Larger firms state that acquisitions are unattractive, since the current subcontracting hierarchy works well and outsourcing provides a buffer for firms during periods of decreased business.[104] With respect to firms exiting the industry, sources speculate that 30 percent of Japanese TDM firms have gone bankrupt in the past 5 years as a result of the supply-demand imbalance.[105] Further, it is estimated that during the next 3 years, 30 percent of small TDM shops, particularly those with 5 to 10 employees, will exit the market.[106]

Specialization by technology, process, or market is more common than diversification and has afforded Japanese TDM producers a means of survival in a highly competitive industry. Through specialization, which might include building molds for use with unique materials, manufacturing a particular type of die or mold, or focus on high-precision tooling used in a certain market segment, TDM producers are able to differentiate their businesses from the competition. In one area of Japan, for example, it is reported that there is a large concentration of TDM firms, each proficient in a particular and separate field. One Japanese producer with only 13 employees states that specialization provides sufficient business to survive and ensures that the company remains ahead of other Asian producers that as of yet cannot perform the same type of work.[107] Apart from the financial aspect, producers also consider it more important and commendable to achieve global leader status in a specific area than to allocate resources across a wide variety of production areas and activities.[108] Industry sources foresee more firms in the future, especially small producers, will chose to direct their engineering and production resources toward leveraging expertise in a particular niche in order to favorably position themselves against the myriad firms in the Japanese market and growing overseas competition.[109]

At the same time that specialization is the norm within the realm of Japanese TDM manufacturing, many shops find it necessary to diversify into separate but related businesses, such as prototyping and/or stamping or molding of the finished part or

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[102] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.
[103] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.
[104] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002, and Shizuoka, June 6, 2002.
[105] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.
[106] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002, and Gunma, June 6, 2002.
[107] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.
[108] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.
[109] Japanese industry officials, interviews by USITC staff, Tokyo, June 6-7, 2002.

component. In past years of buoyant demand and healthy macroeconomic conditions, Japanese TDM shops reportedly could make sufficient profits as exclusive die and mold suppliers.[110] Currently, however, profit margins in the TDM sector are slim, and Japanese firms strictly dedicated to TDM fabrication operate under severe financial constraints in an especially harsh business environment.[111] As such, die and mold shops, even successful firms, are increasingly engaged in fabrication of the end product in order to remain profitable.[112] For example, one large Japanese producer notes that die and mold fabrication takes substantial time and incurs payment delays, but the production and delivery of parts and components allows for consistent and quick capital inflows. This firm cites the difficulty of being 100 percent dedicated to TDM production and indicates that expansion into parts production could help ailing firms remain afloat.[113]

Foreign direct investment

There is little if any FDI in the Japanese TDM industry.[114] Since the fair majority of tooling shops are reportedly unprofitable, the acquisition of such firms, as well as the establishment of new TDM facilities funded with foreign capital, is largely unappealing to entrepreneurs interested in the Japanese market.[115] TDM producers with associated stamping or molding operations are more attractive, and currently one of Japan's largest producers of dies and stampings for the automotive industry is negotiating with foreign investors concerning direct investment in the form of partial to full equity participation. According to industry sources, buying a local tooling firm is one way for foreign companies to break into Japan's tight industrial groups and to access both the Japanese market and OEMs still producing in Japan.[116] Foreign companies may also set up a sales office or design center in Japan to market tooling to OEMs rather than purchase actual production capacity, particularly if the target customer does not maintain domestic production facilities.[117] For example, it is common for small and medium Korean firms to align and establish a joint office in Japan dedicated to securing production orders.[118]

Although numerical data on capital outflows are unavailable, qualitative information indicates that FDI abroad by Japanese firms is far more common. With Japanese OEMs increasingly operating worldwide, investment in overseas tooling establishments has become a veritable necessity for maintaining commercial ties with key TDM consumers. Japanese producers indicate that customers intending to move their manufacturing facilities offshore either explicitly ask TDM shops to follow them or intimate such desires during corporate meetings or informal business gatherings.[119] To date, the great majority of Japanese investment in overseas TDM operations has occurred in China, the United States, and Southeast Asia. Such investment is primarily to serve Japanese

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[110] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

[111] Economic Research Institute (ERI), Japan Society for the Promotion of the Machine Industry (JSPMI), *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 59.

[112] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

[113] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002.

[114] Japanese industry officials, interviews by USITC staff, Shizuoka, June 6, 2002.

[115] Ibid.

[116] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

[117] Ibid.

[118] Ibid.

[119] Ibid.; and Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

transplants in the automotive, appliance, and consumer electronics sectors. As the majority of Japanese TDM firms are small shops with limited finances and human resources, ordinarily only medium to large producers are able to establish a manufacturing presence abroad. Japanese tooling firms face various obstacles pertaining to investment overseas. TDM companies face the possibility that the customer they pursued will eventually procure tooling from local suppliers; thus, many TDM manufacturers try to find additional customers in the foreign locale. Further, some Japanese companies, particularly those of a smaller scale, find it difficult to compete in countries such as China, because of language differences; difficulties in training local workers; and differences in business methods, local customs, and government policies and practices.[120] Some firms overcome these hurdles by setting up joint ventures with Taiwan interests, wherein the Taiwan-based partner handles the business practices of the TDM operation, and the Japanese partner oversees the technological aspects and production quality.[121]

Workforce characteristics

The Japanese industry supported 113,206 workers in 2000, up 1 percent from 1999 levels, but below the industry's peak of 118,213 workers in 1991.[122] In 2001, the average age of workers in the TDM sector in Japan was 38.2 years, and the average length of service in the industry was 14 years.[123] Given the predominance of small firms in the industry, the average number of employees per establishment averaged only 9.3 in 2000. According to industry sources, employees in the TDM industry are mainly high-school graduates.[124]

In terms of working conditions, the average employee in the TDM industry works approximately 257 days per year.[125] Whereas the total number of hours worked per annum averages roughly 2,300 per person,[126] the typical workday for employees exceeds 8 hours in the TDM sector. According to industry sources, average conditions or a lull in business would keep workers on the normal schedule of anywhere from 7 hours on Saturday workdays to 9 hours on weekdays.[127] However, busy periods or times when the shop is under strong delivery pressures from the customer compel workers to labor over 12 to 13 hours a day, as well as on weekends.[128] Industry sources further note that daily work hours are often long because the system of multiple shifts is not widely adopted in small and medium-sized businesses engaged in TDM manufacturing.[129] As such, a core group of workers is responsible for additional hours when the production workload necessitates overtime. Likewise, because many TDM shops are headed by individuals of older generations, adherence to more arduous work schedules of the past is the norm in

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[120] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.
[121] Ibid.
[122] Official statistics of METI, found at *http://www.jdma.net/toukei/index.html*, retrieved July 31, 2002.
[123] Data provided by Japan Die and Mold Association, Western Division (JDMA/WD), to USITC staff, June 7, 2002.
[124] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.
[125] Ibid.
[126] Data provided by JDMA/WD to USITC staff, June 7, 2002.
[127] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.
[128] Ibid.
[129] Japanese industry officials, interviews by USITC staff, Saitama, June 6, 2002.

this industry.[130] At the same time, businesses report that the Japanese Government has been pushing work habits that are more in line with those of Western countries, and a number claim that they operate on a less-ambitious schedule, e.g., Monday through Friday with the occasional Saturday, or that they have increased the number of days off during the year for their employees.[131] Producers also report cutting back on the number of allowed overtime hours for financial reasons.[132]

With respect to wages, the average annual income for a worker in the TDM sector was $41,175 in 2001, including bonuses.[133] The average monthly salary was $2,896, with annual bonuses averaging an additional $6,418 per worker. Compensation in the TDM industry varies according to an individual's level of experience and particular responsibilities in the company. For example, an entry-level male with no previous experience earned an average of $27,837 per year in 2001, whereas a male worker with 31 or more years of experience received $56,020. Likewise, according to one TDM producer, a designer may earn double the monthly wages of a toolmaker in the same shop.[134] Hourly rates in the TDM sector average just over $15 per hour but can range from between roughly $8 to almost $22, depending on age and experience.

A key challenge facing Japanese producers is the maintenance of a skilled and sufficient workforce. Businesses are losing experienced personnel who are at or near the age of retirement, and the industry is experiencing difficulty attracting young people, who tend to shun professions falling into the "3-K category"–*kitsui* (hard), *kitanai* (dirty), and *kigen* (dangerous).[135] In certain cases, shops have hired foreigners of Japanese descent, who are more willing to accept the nature of the work and a lower wage structure. In the past, engineers in the TDM industry were able to net twice the earnings of engineers in other professions.[136] Currently, however, TDM manufacturing is not considered an elite business, and small firms in particular, which are not publicly traded and therefore unknown, have trouble attracting engineering talent.[137] Family-run shops also face problems with succession of the business. Descendants are often unwilling to take over the business, or in many cases shop owners work in the TDM sector to send their children to college for greater opportunities and do not intend to pass on the family operations. Such problems are less prevalent with the larger firms, especially those with overseas operations. Larger companies have an easier time attracting prospective entrants, who are often enticed by the opportunity to work abroad,[138] and likely have an easier time finding suitable candidates of ensuing generations to manage operations.

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[130] Ibid.

[131] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002, and Saitama, June 6, 2002.

[132] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[133] Data on income provided by JDMA/WD to USITC staff, June 7, 2002.

[134] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[135] Japanese industry officials, interviews by USITC staff, Osaka, June 7, 2002.

[136] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[137] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

[138] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002.

Manufacturing Infrastructure

Japanese TDM producers benefit from a strong domestic supply base for raw materials, components, and machinery. A number of Japanese companies produce high-quality metals, standardized bases and components, metal-cutting and metal-forming machine tools, and accessories for use in the die and mold industry. Japan's machine tool industry is reputed for producing reliable, high-precision machines in direct competition with global leaders from Germany and Switzerland. Reportedly, Japanese TDM producers are able to obtain leading-edge machines offered by Japanese machine tool manufacturers up to 2 years before such products are made available to other global markets.[139] Japanese TDM firms also have a proximity advantage, which allows for easy access to machinery maintenance and repair services, and facilitates cooperative development with machine tool manufacturers. Increasingly, TDM producers are working with machine tool companies to develop new technologies and machines with unique production properties. Joint development aids TDM firms in that their input helps ensure the final product will suit their manufacturing needs, whereas machine tool firms are able to create machinery that is more attractive to customers. Such collaborative efforts are reportedly encouraged by the government and are expected to grow.[140]

Despite unfavorable conditions facing the Japanese TDM industry, some Japanese manufacturers are adding machinery, with leading-edge electrical discharge machines, CNC machines, and rapid prototyping machinery evident in even the smaller tooling shops. In addition, although some U.S. sources consider the Japanese TDM sector as primarily a 3-axis market,[141] shops are increasingly introducing more 5-axis machines into their factories, along with high-end inspection machinery, and more modern machining centers.[142] According to Japanese industry sources, the trend toward reducing costs by replacing labor with machinery, combined with Japanese TDM producers' strong affinity for state-of-the-art machines, drives sustained investment in equipment by consuming firms. Moreover, in light of the strong competitive threat perceived from other Asian firms, which reportedly are acquiring sophisticated machinery at an accelerated pace, Japanese shops are pressured to invest in the latest machine tool technologies in order to stay one step ahead.

A key competitive disadvantage of the Japanese TDM industry is its slow adoption of computer technologies and software for design and manufacturing. Japanese firms are

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[139] U.S. industry sources indicate that the latest Japanese machine tools are often not introduced to the U.S. market for up to 2 years following their debut in Japan. They also contend that Japanese machine tool producers sometimes do not fully explain the full range of functions that a particular machine imported from Japan may perform. Such limitations may restrict the benefit U.S. producers realize from advances in machine tool technologies. Japanese TDM producers expressed unawareness of such delays or acknowledged a shorter time lag between the availability of machine tools in Japan versus the U.S. market. Neither industry indicated that such delays resulted from strategic maneuvers on the part of the TDM or machine tool industries in Japan. U.S. and Japanese industry officials, interviews by USITC staff, Chicago, IL area and various cities in Japan, Apr. 22, 2002, and June 3-7, 2002.

[140] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002.

[141] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 24, 2002.

[142] Japanese industry officials, interviews by USITC staff, Saitama, June 5, Gunma, and Shizuoka, June 6, 2002.

also behind in implementing electronic transfer of designs[143] and trail their U.S., European, and certain other Asian competitors in 3-dimensional (3-D) modeling. According to industry sources Japanese producers traditional reliance on 2-D modeling has made it difficult for firms to transition into 3-D design;[144] currently, only 40 percent of models in the mold sector are created in 3-D.[145] Although Japanese TDM firms indicate their desire to adopt computer technologies, several factors hinder their ability to advance in these areas:

(1) Japanese mold and die makers do not see the necessity in promoting CAD/CAM because of the high design and manufacturing capabilities of their design technicians and engineers;[146]
(2) the tradition of craftsmanship and emphasis on skilled labor has created a reluctance on the part of some firms to adopt the latest computer technologies;[147] and
(3) older workers, who dominate at many firms, discourage the adoption of computerization, because they perceive that computers are relatively expensive without producing anything tangible and contend that computerized design and manufacturing know-how can be easily compromised.[148]

Nonetheless, the Japanese industry hopes to boost computer hardware and software investment and capabilities in the near future.

Although some firms add equipment on a regular basis and most firms indicate the desire to upgrade their machinery and computer systems, the capacity for capital investment can be extremely tight for small producers. According to Japanese Government statistics, Japanese consumption of metal-cutting machine tools declined by 36 percent during 1997-2000, the latest year for which data are available.[149] With production equipment running upwards of $40,000 per machine and software packages costing several thousand dollars per seat,[150] small businesses lack the financial resources to invest in the latest tools and technologies, and have limited collateral upon which to borrow. Japanese producers state that banks have become unwilling to grant or extend loans to small-sized TDM manufacturers.[151] Industry officials further opine that Japanese TDM manufacturers are greatly disadvantaged vis-à-vis other Asian producers, who allegedly have access to

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[143] Alan Christman and Jeanné Naysmith, *The Worldwide Mold-making Environment and How to Compete*, (Ann Arbor: CIMdata, Inc., 2000), p. 45.
[144] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.
[145] Christman and Naysmith, *The Worldwide Mold-making Environment and How to Compete*, 2000, p. 46.
[146] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 5.
[147] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.
[148] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.
[149] Official statistics of METI, found at *http://www.jmtba.or.jp/English/e-toukei.htm,* retrieved July 31, 2002.
[150] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 2.
[151] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

pirated software and often receive deep discounts on machinery from machine tool makers looking to penetrate key markets.[152]

Technological Capabilities

Japanese TDM firms are competitive with respect to design capabilities and increasingly participate in the engineering and modeling phases of TDM production as customers shed design responsibilities and staff. In some cases, producers will make dies or molds using diagrams and instructions provided by the customer. However, in the majority of instances, TDM shops design tooling in-house based on customer specifications for the end product.[153] Moreover, there are instances where a TDM company will approach the customer with a concept for a final product and offer to produce the necessary tooling should the customer decide to manufacture the proposed item.[154] Such practices are likely to continue; however, certain factors may hinder the Japanese industry's ability to provide engineering support and further develop its design capabilities. Producers note that it is difficult for a firm to maintain 100 percent capacity for design, since lulls in work will result in high-salaried engineers having little to do.[155] Therefore, TDM firms may have to subcontract design work in times of increased business. In addition, some producers are resistant to increased involvement in the design phase, because they may not be fully compensated for their efforts, or are concerned that proprietary in-house technologies may be leaked via collaboration.[156] Finally, given Japanese TDM firms' lag in the adoption of CAD/CAM, they may not be able to interface with their customers who are increasingly adopting such systems in order to respond to their own competitive environment.

A number of Japanese TDM producers, both large and small, employ advanced process technologies, such as unmanned machining, rapid prototyping, and high-speed machining, and intend to increase such activities in an effort to reduce costs and maintain an edge over up-and-coming competitors. Target areas for development include high-speed machining, ultrafine precision machining, and the development of innovative forming methods.[157] The industry is also interested in developing production technologies for new types of dies and molds, tooling for use with new materials, products with greater complexity and precision, tooling constructed of alternate materials, and dies and molds for large-volume runs and high-speed fabrication.[158] Industry sources report that small companies often have unique technologies compared with those of larger firms;[159] thus, further development of design and process technologies likely will help some small firms differentiate themselves and remain competitive. Japanese TDM producers also note that in addition to machine technologies, Japan's experienced workforce supports a high degree of technical skill in polishing, welding, inspection,

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[152] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 22, 2002; Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002, and Saitama, June 6, 2002.

[153] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

[154] Ibid.

[155] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002.

[156] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 5.

[157] Ibid., pp. 6-7, 14-15.

[158] Ibid.

[159] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

adjustment, maintenance, and repair.[160] The combination of machine skills and human knowledge reportedly gives the Japanese TDM industry a slight, albeit tenuous, advantage over other Asian competitors.[161]

Production and Sales

Japanese production of TDMs decreased from just under $15.2 billion in 1997 to an estimated $13.2 billion in 2001, or by 13 percent (table 4-8). Expressed in Japanese yen, the value of production shows a slight increase during 1997-98, followed by consistent annual declines thereafter. Output for 2002 is expected to follow these trends; estimates place production for the current calendar year at roughly 1,530 billion yen[162] (about $12.8 billion), indicating a projected decrease of more than 4 percent from 2001. Although statistics are unavailable on worldwide production of TDMs, sources estimate that Japan accounts for essentially 25 to 30 percent of global production.[163]

Table 4-8
Tools, dies, and industrial molds: Japanese shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	15,157.7	2,928.1	313.2	12,542.7	2.5
1998	14,264.0	2,323.1	350.1	12,291.0	2.8
1999	14,561.3	2,598.7	327.4	12,290.0	2.7
2000	15,239.6	2,785.4	360.3	12,814.6	2.8
2001	[1]13,165.6	2,719.6	357.9	[1]10,803.9	[1] 3.3
	Value *(billion Japanese yen)*				
1997	1,833.9	335.7	37.9	1,536.1	2.5
1998	1,867.2	302.4	45.8	1,610.6	2.8
1999	1,658.6	295.0	37.3	1,400.9	2.7
2000	1,642.3	300.4	38.9	1,380.7	2.8
2001	[1]1,600.0	331.4	43.5	[1]1,312.0	[1]3.3

[1] Estimated by Commission staff based upon ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 11.

Source: Official statistics of METI; ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 11; and Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

[160] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002, and Osaka, June 7, 2002; Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[161] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

[162] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 11.

[163] Ibid., p. 47.

Japanese production of TDMs is largely concentrated in two product segments. In 2000, the latest year for which data are available, plastic molds accounted for close to 40 percent of the total value of production. Stamping dies, a product category in which Japanese manufacturers are reportedly considered more competitive, accounted for an additional 33 percent of total output. The secondary position of this product grouping likely stems from the fact that there are fewer end markets for stamping dies than for plastic molds. Production distribution remained relatively unchanged during 1997-2000, with these two product categories consistently accounting for nearly three-fourths of the total value of TDM production in a given year.

In-house production statistics indicate that OEMs with internal TDM production capabilities are increasingly relying on subcontractors to meet their tooling needs. In 1997, in-house production of TDMs accounted for roughly $727 million or about 5 percent of total sector output.[164] Although in-house production as a share of overall production increased to nearly 7 percent in 1999, the share has been on the decline ever since. In 2001, users produced an aggregate $757 million in tooling for their own operations, accounting for just under 6 percent of total shipments. A recent survey of Japanese TDM producers revealed that 12 out of 13 OEMs that manufacture TDMs reduced in-house production in recent years or indicated a relative dependence on subcontractors; only 1 producer reported increased in-house tooling production.[165] The trend toward greater outsourcing is likely to continue, as end users find subcontracting to be cost effective, time saving, and flexible, thus allowing firms to direct corporate resources to design, technological development, and other areas of competitive significance.[166] Industry sources indicate that in the next 3 to 5 years, decreased in-house production of TDMs will become a particularly visible trend in the automotive sector, as U.S. and Japanese automakers become increasingly disinterested in producing their own tooling.[167] At the same time, some OEMs prefer to keep tooling management under the jurisdiction of the parent company. Toyota, for example, reportedly manufactures approximately one-half of all stamping dies and plastic molds used in the production of its automobiles.[168]

Market Characteristics and Trends

Customer Base

Japan's prolonged recession combined with the hollowing out of Japanese industries has caused considerable shrinkage of the domestic market for tooling. In an effort to cut costs and better serve local markets, an increasing number of Japanese manufacturers have moved production abroad in the past decade. The shift to offshore manufacturing production has been particularly strong in the automobile and electronics industries,[169] which Japanese TDM suppliers cite as one of the major reasons behind the chronic decline in business. Although Japan's current rate of overseas production at approximately 14 percent is well below the U.S. rate, production relocation has

[164] Ibid., p. 7.
[165] Ibid.
[166] Ibid., p. 6.
[167] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002.
[168] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 6.
[169] Ibid., p. 19.

accelerated sharply in the past several years. In the absence of government intervention, industry sources predict that the offshore production ratio will reach nearly 19 percent by 2015.[170] Industry sources also emphasize a more recent phenomenon referred to as the "second hollowing out," wherein transplanted production bases curb their imports of parts and components from Japan and rely increasingly on local procurement for their manufacturing needs. Reportedly, this practice has also surfaced in the Japanese TDM sector in the past couple of years.[171] Results from a survey of the Japanese TDM industry reveal that, at present, approximately one-half of transplanted purchasers still buy 80 to 100 percent of their required tooling directly from Japan;[172] however, 60 percent of surveyed users report that they will increase local procurement of TDMs in the future.[173] This inclination, combined with the growing abilities of overseas producers, is cited as a key challenge facing the Japanese TDM industry today.

Despite the relocation of manufacturing abroad, some markets are expected to remain in Japan. Producers anticipate that domestic production in the automotive sector will continue, with Japanese TDM shops supplying body dies and various molds for plastic parts and components. Reportedly, it is less desirable to procure such items from overseas suppliers, because of the great size of the tooling, the high degree of accuracy required, and the desire to have suppliers nearby for just-in-time production. TDM producers also expect semiconductor and medical equipment work to remain in Japan, as those industries require advanced processing technologies and high-precision tooling. Surprisingly, Japanese TDM firms foresee continued business opportunities in certain niche segments within industries traditionally transferred overseas. For example, audiovisual, cellular telephone, and consumer appliance work has virtually disappeared from the domestic market, but Japanese producers report building molds for streamlined refrigerator handles, televisions over 30 inches, and even pens and mechanical pencils, as neighboring Asian competitors do not have the ability to produce such tooling to the customers' satisfaction. According to industry sources, product segments where functionality is crucial, quality is essential, designs are complex, and cosmetic attributes are important will continue to provide work for the Japanese industry.[174] Further, in most industries, firms anticipate that as long as advances are made in technology and new products are brought to market, there will be a share, albeit a smaller one, of domestic work for Japanese TDM shops.[175]

Since Japanese transplants abroad initially procure from established sources in Japan before turning to local suppliers, the relocation of Japanese manufacturing to offshore locations will benefit Japanese suppliers of TDMs in the near term. However, as the capabilities of local suppliers grow, Japanese firms will face formidable competition in securing orders thereafter. Currently, North America is the largest destination for

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[170] Japanese industry officials, interviews by USITC staff, Tokyo, June 7, 2002.

[171] As noted, Japanese transplanted companies often encourage tooling shops to set up operations in the foreign country of relocation. However, Japanese OEMs reportedly are increasingly interested in and plan to boost their procurement of tools from local non-Japanese sources. This may be due to cost advantages, increased need for tooling (that cannot be fulfilled solely by the Japanese supplier or suppliers), or other strategic reasons. ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 3.

[172] Ibid., p. 24.

[173] Ibid., p. 25.

[174] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[175] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

Japanese transplants, followed by Asia.[176] Investment in North America is largely in the automotive sector, whereas the majority of Japanese firms in Asia are in the electronics sector, particularly in China.[177] The North American market for TDMs is expected to grow in the near future, primarily because Japanese automakers have increased vehicle production and the Big Three are expected to introduce model changes to boost sales. In China, it is anticipated that basic modernization, combined with growth in China's auto industry and preparations for the 2008 Olympics in Beijing, will indirectly boost consumption of dies and molds. Japanese TDM producers also surmise that as the market for quality products expands in China and consumers seek technologically advanced goods, demand will increase for high-precision, top-quality TDMs from countries such as Japan.[178] At the same time, the majority of Japanese TDM shops are small and likely not to have sufficient resources or experience to successfully access foreign markets or capitalize on export opportunities. Japanese producers are also reportedly passive in securing orders and do not aggressively market themselves or seek new work opportunities.[179] To aid such endeavors, one Japanese producer suggests establishing a cooperative point of contact, for example the industry association in Japan, which could intervene on the part of producers and help firms secure orders overseas.[180] Such initiatives may be necessary for the Japanese TDM industry to take full advantage of overseas market opportunities.

Purchase Decision Variables

Price

Depending on the type and class of die or mold, Japanese prices are reportedly roughly 60 percent of what U.S. TDM producers charge and between 2 to 3 times above what Chinese producers generally quote.[181] By comparison, prices for dies and molds originating from Korea and Taiwan are approximately 25 to 30 percent below Japanese prices.[182] TDM firms report that the average price per unit has declined recently, with one manufacturer citing a 30 to 40 percent reduction in price over the past 5 years.[183] Another source reports that Japanese mold-producing firms have lowered prices by approximately 30 percent in the past few years.[184]

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[176] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 19.

[177] Ibid., p. 19.

[178] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

[179] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 16; and Japanese industry officials, interviews by USITC staff, Tokyo, June 4 and 7, 2002.

[180] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[181] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002, and Dongguan, June 13, 2002; and ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, pp. 51-52.

[182] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, pp. 51-52.

[183] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

[184] Christman and Naysmith, *The Worldwide Mold-making Environment and How to Compete*, 2000, pp. 9 and 17.

TDM manufacturers report that above all other considerations, customers are primarily interested in obtaining the lowest possible price for tooling, mainly because of the strong cost pressures bearing on users themselves. Excess capacity in the Japanese TDM industry has provided customers with strong leverage over tooling shops, and although some firms pass on orders where the price is too low to be profitable, others have been forced to drastically lower their price quotes in order to secure work for otherwise idle capacity. Japanese shops also find that in sales negotiations, they increasingly interface with purchasing agents, who focus exclusively on the bottom line but do not necessarily comprehend the engineering characteristics of the product and the premium charged for high quality and value-added services. As in the United States, customers also try to seek lower prices from Japanese TDM firms by citing the price levels of neighboring Asian competitors. Japanese producers indicate certain instances wherein a firm might be able to add a price premium or work with the customer within a particular budget rather than simply responding to price demands. Such cases include instances where the user cannot readily procure tooling of the desired quality from abroad, when prompt delivery is imperative and intensive design collaboration is required, or when the customer explicitly prefers a Japanese-made die or mold. TDM producers expect, however, that the rising skill of foreign competitors combined with the shrinking market for TDMs will result in increasingly higher cost pressures in the next 5 to 10 years.[185]

Lead times

Japanese firms are quite competitive with respect to lead times and meeting delivery targets, primarily because of the level of advanced machinery in the industry, the tendency for suppliers to subcontract or distribute portions of the work for simultaneous production,[186] and the regimented work ethic of small shops and individual toolmakers. According to published information on the industry, average lead times for Japanese TDM producers are roughly 23 percent shorter than those of their U.S. counterparts and on par, if not slightly behind, those of Asian TDM firms in general.[187] Although rates of production and delivery depend on several factors, including the complexity of the part and the size of the producing firm, industry sources allege cases where Japanese producers might need only 1 month for production, but Chinese or U.S. producers need 2 to 3 months.[188]

[185] Japanese industry officials, interviews by USITC staff, Saitama, June 6, 2002.

[186] Japanese industry officials, interviews by USITC staff, Saitama, June 6; Chinese industry officials, interviews by USITC staff, Shanghai, June 12; and Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.

[187] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 52.

[188] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002; and Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002; and Christman and Naysmith, *The Worldwide Mold-making Environment and How to Compete*, 2000, p. 34.

Quality

In terms of the general quality level of TDMs produced, Japan exceeds other Asian competitors but lags both the United States and top European manufacturers, who are reputed for making near-perfect, maintenance-free tooling.[189] On a scale of 1 to 100 points, industry sources rank Japanese producers at roughly 80 points with respect to overall quality, behind the U.S. at 90 points, but ahead of Taiwan at approximately 50 points.[190] Since TDMs are custom-made products requiring various manual production and finishing processes, the enduring emphasis on craftsmanship and history of experience in the Japanese industry are conducive to turning out high-quality tooling. Japanese shops are reportedly strong in product quality management and produce tooling that combines multiple attributes, including design, tool life, attention to details, accuracy, and raw-material selection.[191] Japanese producers are viewed as more proficient in the production of dies for various metal stampings but less skilled at mold production. Japanese molds are reputedly designed for short production cycles and are less durable than U.S.-made molds that are constructed for higher-volume production runs.[192] Durability of Japanese molds may also be compromised because production often begins early in the engineering phase before the design is set, resulting in a less-cohesive product that requires successive alteration and repair work.[193]

Customer relations

Japanese suppliers enjoy a slight competitive advantage over other global producers because of the lingering *keiretsu* system and historically strong OEM-supplier relationships that still exist among Japanese businesses. Industry sources report that although "good quality at low prices" has become the standard for supplier selection, long-term relationships and loyalty are still valued in the Japanese business environment.[194] According to TDM producers, some Japanese customers, both at home and abroad, prefer to obtain tooling from Japanese sources, whereas others are compelled to direct orders to Japanese suppliers in order to aid the Japanese economy in times of recession.[195] Such purchasers often ascertain that tooling made in Japan is of a higher quality, or they may find that purchase negotiations with Japanese suppliers are more familiar and therefore easier. One U.S. TDM manufacturer producing for a Japanese transplant reports that his customer repeatedly directs tooling orders to a Japanese supplier. Reportedly, the Japanese TDM company has longer delivery times and is not required to meet the same level of accuracy as the U.S. shop, but a portion of work is routinely directed there regardless.[196] Japanese producers contend that the *keiretsu*

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[189] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002; and Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.

[190] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002.

[191] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002; and Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002.

[192] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 22; and Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.

[193] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.

[194] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 22, 2002.

[195] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 22, 2002; and Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002, and Saitama, June 5, 2002.

[196] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 22, 2002.

structure has all but disappeared, but that some vertical relationships remain, particularly in the auto sector. Small producers, in particular, indicate no benefit from *keiretsu* relationships and stress that customer loyalty is nil.[197]

Customer-supplier Concerns

Payment terms

It is common practice in Japan for TDM producers to receive payment after delivery of the finished product, in many cases after the customer has tested and approved the die or mold. Of surveyed TDM producers, 89 percent indicate that they never receive compensation upon signing contracts with their customers.[198] Producers note that the lack of incoming funds during the initial design and subsequent production period places undue hardship on TDM manufacturers, especially financially constrained small shops, which must outlay up front the capital for materials and labor. According to Japanese Government officials, there is a law requiring payment 90 days after delivery.[199] However, the payment system in the Japanese TDM industry is based on promissory notes. Therefore, TDM producers regularly have to finance production of the tooling through tryout, wait up to 3 months following shipment to receive payment from the customer, and then incur additional delay while the promissory note is converted to cash. Producers also note that payment terms are particularly severe when there are several intermediaries between the final customer and the TDM shop but less harsh when the tooling firm deals directly with the end user.[200] Concerning overseas sales, some Japanese producers report better payment terms with their foreign customers, who will often pay a percentage upon endorsement of the contract, another portion upon delivery, and a final portion thereafter.[201] Others, however, report waiting up to 3 years to receive payment for dies shipped to U.S. OEMs in the automotive sector.[202] Unlike the case of U.S. producers, Japanese TDM producers indicate that they are not required to provide rebates to either domestic or foreign customers.[203]

Intellectual property

One of the greatest problems facing the Japanese TDM sector is the protection of intellectual property. This issue is not unique to the Japanese industry, but it appears to be a far more pervasive problem for Japanese producers. Industry sources report that not only is it customary for drawings and test and production process data to be supplied gratis with the product, but producers find that in the current state of overcapacity, they cannot refuse or the customer will pass them over for future orders that they need for

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[197] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[198] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (excerpt in English), Jan. 2002, p. 20.

[199] Japanese Government official, interviews by USITC staff, Tokyo, June 3, 2002.

[200] Japanese industry officials, interviews by USITC staff, Osaka, June 7, 2002.

[201] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002, and Shizuoka, June 6, 2002.

[202] Japanese industry officials, interviews by USITC staff, Shizuoka, June 6, 2002.

[203] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002, and Shizuoka, June 6, 2002.

survival.[204] It is common for customers to purchase the initial die or mold in Japan, then take the design for the product to lower-cost Asian countries, namely China, or even to competing Japanese firms for duplication at a lower cost. According to one producer, with the drawings and data related to processing in hand, a customer can obtain a copy of a die or mold made for about one-half of what the original TDM shop charged.[205] Advances in software technology and increased use of the Internet have facilitated customers' transfer of designs and data across borders.

The transfer of designs and production data to competing manufacturers has far-reaching implications for the competitiveness of the Japanese industry. There is an immediate decrease in work for Japanese producers once data and designs are transferred overseas for duplication. In addition, the practice facilitates technology transfer to other Asian suppliers who can study the Japanese data and drawings to improve their own production capabilities and competitiveness. Moreover, Japanese TDM firms fear that without recompense for their design and engineering efforts, the impetus to invest in product development and research for advanced production technologies will decline.[206] Small firms have little experience in protecting intellectual property. According to one producer, the Japanese TDM industry has operated for the last 5 decades without signing contracts with customers.[207] Moreover, firms are reportedly reluctant to apply for patents, since the patent process requires the submission of detailed documents, which then become accessible to competitors. Even if patents are granted, TDM producers have difficulty obtaining proof that their designs and technologies are duplicated, and they have limited resources to pursue legal action against patent violators. In addition to promoting awareness of the problem, the Japanese TDM industry association is currently working on developing a standard contract containing a confidentiality clause that small producers can use to protect their rights and assure compensation for the release of their designs and process technologies. The Japanese Government is also considering legislation on intellectual property rights that would likely help to protect the interests of TDM producers.[208]

Trade

Japan is a net exporter of TDMs, with about 20 percent of total production shipped overseas (tables 4-9 and 4-10). The value of Japanese exports reached $2.7 billion in 2001, down 7 percent from 1997 exports of approximately $2.9 billion (table 4-10). Measured in yen, the drop in exports was far less pronounced at just over 1 percent during 1997-2000. The largest export market for Japanese TDMs is the United States, followed by China, Thailand, and the United Kingdom. Although exports to the United States declined by over 26 percent to $619 million during the period, Japanese producers

[204] Japanese Government and industry officials, interviews by USITC staff, Tokyo, June 3 and 7, 2002.

[205] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[206] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002, and Osaka, June 7, 2002.

[207] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.

[208] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

Table 4-9
Tools, dies, and industrial molds: Japanese imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
South Korea	99,625	119,337	135,607	157,529	173,810
China	11,399	20,693	13,957	20,003	26,601
Taiwan	44,758	44,559	29,754	29,337	22,164
Australia	31,726	29,523	34,101	26,321	14,900
United States	18,879	16,916	17,848	17,887	12,751
Thailand	9,447	10,015	9,347	8,674	10,556
All other	49,797	45,010	43,410	46,194	35,277
Total	265,631	286,053	284,024	305,945	296,059
EU-15	18,807	19,932	17,736	16,121	12,295
NAFTA	29,826	22,565	23,888	21,203	17,713
China and Hong Kong	12,988	24,882	15,504	21,320	27,880
Tools and dies:					
South Korea	5,115	20,587	9,324	15,501	23,536
Vietnam	592	1,022	1,044	2,960	5,352
Thailand	5,032	6,527	5,974	5,525	4,540
Taiwan	3,952	4,722	2,674	4,201	4,169
United States	9,531	8,057	4,649	5,343	3,987
Germany	2,349	3,281	1,630	1,349	2,488
All other	10,371	10,161	10,244	10,031	8,212
Total	36,942	54,357	35,539	44,910	52,284
EU-15	5,653	5,933	4,013	4,004	4,988
NAFTA	9,763	8,103	4,986	5,402	4,000
China and Hong Kong	2,336	2,671	2,808	2,089	1,599
Jigs and fixtures:					
United States	3,384	2,831	2,110	2,341	2,478
Germany	3,682	2,501	2,144	2,174	2,104
South Korea	676	869	595	957	1,145
Taiwan	524	614	223	474	997
Italy	473	754	476	616	898
United Kingdom	288	436	548	746	381
All other	1,559	1,661	1,786	2,173	1,514
Total	10,586	9,666	7,882	9,481	9,517
EU-15	4,855	4,033	3,406	3,993	3,612
NAFTA	3,396	2,838	2,154	2,341	2,491
China and Hong Kong	163	411	273	363	501
Total:					
South Korea	105,416	140,792	145,526	173,987	198,492
China	13,646	23,537	16,897	22,378	28,535
Taiwan	49,234	49,896	32,651	34,012	27,330
United States	31,795	27,804	24,608	25,570	19,216
Thailand	14,578	16,762	15,660	14,796	15,222
Australia	31,726	29,536	34,125	26,354	14,912
All other	66,763	61,748	57,977	63,239	54,154
Grand total	313,158	350,075	327,444	360,336	357,861
EU-15	29,315	29,898	25,155	24,118	20,896
NAFTA	42,985	33,507	31,028	28,945	24,203
China and Hong Kong	15,486	27,964	18,585	23,772	29,979

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-10
Tools, dies, and industrial molds: Japanese exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
United States	409,426	352,301	329,415	356,157	309,482
Thailand	191,382	163,743	168,381	201,231	219,150
China	188,004	141,040	172,783	202,989	215,107
Hong Kong	113,022	114,055	125,133	154,359	144,396
Indonesia	72,705	45,742	72,395	93,284	102,545
Malaysia	116,857	96,153	117,025	151,854	100,418
All other	489,575	470,678	594,267	573,168	486,872
Total	1,580,971	1,383,712	1,579,399	1,733,042	1,577,970
EU-15	106,356	114,464	140,401	122,078	130,018
NAFTA	449,003	409,569	383,782	410,003	355,081
China and Hong Kong	301,026	255,095	297,916	357,349	359,503
Tools and dies:					
United States	410,729	294,894	292,006	292,648	290,385
United Kingdom	153,557	101,025	93,043	40,196	156,874
China	79,160	59,825	102,093	118,510	108,792
Thailand	103,230	70,345	71,842	81,561	90,172
Brazil	4,808	13,320	6,884	8,654	45,355
Canada	37,280	61,586	4,699	21,028	34,750
All other	505,944	289,624	400,740	424,633	364,449
Total	1,294,708	890,619	971,307	987,230	1,090,777
NAFTA	464,939	376,314	378,537	325,015	341,047
EU-15	224,636	151,069	160,561	131,889	254,866
China and Hong Kong	101,351	77,963	123,169	145,416	127,753
Jigs and fixtures:					
United States	18,100	15,046	12,272	21,889	18,835
China	2,359	3,115	3,500	4,140	5,388
Taiwan	4,804	5,558	5,255	5,900	4,027
Thailand	3,978	4,006	5,092	7,272	3,688
United Kingdom	2,277	3,630	2,465	2,371	2,872
Philippines	2,311	1,331	2,005	2,791	2,869
All other	18,640	16,127	17,445	20,737	13,222
Total	52,469	48,813	48,034	65,100	50,901
EU-15	5,622	7,423	6,196	6,846	6,191
NAFTA	18,642	18,517	14,020	22,302	19,850
China and Hong Kong	3,584	3,752	5,174	5,713	6,243
Totals:					
United States	838,256	662,241	633,693	670,694	618,702
China	269,524	203,980	278,376	325,640	329,287
Thailand	298,591	238,094	245,315	290,063	313,010
United Kingdom	220,263	178,300	159,587	96,721	228,793
Hong Kong	136,438	132,830	147,883	182,838	164,212
Malaysia	163,641	128,694	149,971	222,992	130,992
All other	1,001,435	779,006	983,914	996,423	934,652
Grand total	2,928,148	2,323,145	2,598,739	2,785,371	2,719,648
EU-15	336,613	272,956	307,157	260,813	391,074
NAFTA	932,585	804,399	776,339	757,319	715,977
China and Hong Kong	405,961	336,809	426,260	508,478	493,499

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

beset by lingering domestic recessionary conditions view the United States as a prospective growth market, inasmuch as consumption of dies and molds is high and Japanese automotive transplants in the United States have increased production and can provide future business opportunities.[209] Exports to China rose by more than 22 percent, to $329 million, during 1997-2000, reflecting the shipment of tooling to Japanese manufacturers that moved their production facilities to that country.

The total value of Japanese imports of TDMs grew by over 14 percent during the period, from $313 million in 1997 to $358 million in 2001 (table 4-9).[210] More than 55 percent of imports originated from Korea, with secondary suppliers China and Taiwan accounting for an additional 8 percent each of total sector imports. Imports from Korea rose by over 88 percent during 1997-2001. According to government representatives, there are several factors behind Korea's growing status as the dominant supplier of imported TDMs. Korea's close proximity to Japan facilitates cooperative design initiatives and allows for relatively quick and easy repair and maintenance on molds or dies by the producing firm.[211] Moreover, Korean prices are roughly 30 percent below Japanese prices, lead times are short, and the skill and quality level of Korean producers is reported as satisfactory and steadily improving.[212] Industry sources also attribute increased imports to the Asian financial crisis, which forced Korean TDM producers to focus on overseas markets.[213] Imports from China also increased substantially during the period by more than 109 percent, whereas imports from Taiwan declined by more than 44 percent. Results from a November 2001 survey of the Japanese industry reveal that over one-half of questionnaire respondents that are users of TDMs in Japan intend to increase overseas procurement of dies and molds, but no firms stated intentions of increasing domestic procurement.[214] As a result, the industry expects the trend of rising imports to continue.

Government Policies and Programs

The Japanese Government does make available a variety of support programs directed at small businesses. However, such initiatives are not specific to the TDM industry, but are open to all small and medium-sized enterprises, defined in the manufacturing sector as businesses with no more than 300 employees and 300 million yen in capital. A guidebook on government programs for such businesses is published by the Small and Medium Enterprise Agency of the Ministry of Economy, Trade, and Industry, but TDM producers indicate that even with a clear understanding of the available support, they are rarely able to take advantage of such programs because of the cumbersome application processes. Industry sources also attribute the lack of use of these programs by TDM producers to pride, as many shops may be embarrassed or ashamed to ask the Government for assistance. Government officials further acknowledge that, in general,

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[209] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002, and Gunma, June 6, 2002.

[210] All foreign-made TDMs are imported into Japan free of duty.

[211] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

[212] Japanese Government and industry officials, interviews by USITC staff, Tokyo, June 3-4, 2002; and ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, pp. 51-54.

[213] Japanese industry officials, interviews by USITC staff, Saitama, June 5, 2002.

[214] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002; and ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry* (in Japanese), Mar. 2002, p. 26.

support is directed to more prominent industries such as biotechnology or information technology, since projects and activities in these fields tend to attract more attention and are often considered important areas for development.[215]

Few Japanese TDM firms report receiving benefits from Government policies and programs. One large producer with roughly 1,000 employees indicates that it will receive funds for R&D for two specific projects during the next 3 years.[216] Another small producer with only 30 employees dismissed its workers for 3 months with full compensation under an employment adjustment program whereby the Government pays approximately 60 to70 percent of the workers' salaries and the company pays the remainder. The firm reports that this program allowed it to ride out a downturn in business, but notes that ironically most Japanese TDM producers cannot use the program because they are unable to pay the 30-40 percent share of the workers' earnings. TDM manufacturers are encouraged that the Japanese Government has recently shown a greater interest in the industry and has encouraged firms to approach the Government for assistance. This could lead to greater use of the available Government support programs and preservation of some of the industry's cottage facilities.

[215] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.
[216] Japanese industry officials, interviews by USITC staff, Gunma, June 6, 2002.

China

Industry Profile

Composition of the Industry

The Chinese TDM industry is both large and growing. In 2000, one source estimated China to be the third-largest die and mold manufacturer after Japan and Germany, by value, and second-largest in terms of quantity after Japan.[217] In 2000, there were approximately 18,000 TDM producers in China. Since industry data are not readily available, growth in the number of firms is unknown; however, FDI in the Chinese TDM sector has reportedly led to a substantial increase the size of the industry.[218]

Unique industry characteristics and significant strengths and weaknesses of the Chinese TDM industry

Unique industry characteristics:
- About 70 percent of the TDM industry is captive, allowing for such companies to provide both TDM and parts production
- Substantial number of large, foreign-invested TDM producers are located in China

Strengths:
- Large and growing domestic and international customer base, including the motor vehicle industry
- Low cost labor, especially engineers and designers
- Well educated labor force
- Relatively quick lead times (time required to produce a die or mold)

Weaknesses:
- Lack of sophistication and creativity in TDM design
- Lack of experience in producing high-precision and complex TDMs
- High costs for imported inputs, low-quality domestic TDM inputs

Firms encompass a wide range of sizes, based upon the number of employees. At the top is probably Foxconn Precision Components Co., Ltd., a subsidiary of Hon Hai Precision Industry Co., Ltd. of Taiwan, with approximately 6,000 employees who are principally designers and toolmakers.[219] Another large toolmaker is Altrust Precision Tooling Company, Ltd., with approximately 1,200 to 1,500 employees.[220] Typically, large TDM firms have 600 to 700 or more employees, mid-sized firms have 150 to 300 or more employees, and smaller producers have at least approximately 50 employees.[221]

Many foreign-invested TDM factories are located in foreign trade zone developments or industrial zones, usually within compounds that may be surrounded by worker housing or other industrial facilities. Many of these establishments have adjoining molding or

[217] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry*, (in Japanese), Mar. 2002.

[218] Chinese industry officials, interviews by USITC staff, Beijing, June 11, 2002.

[219] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[220] Joseph Pryweller, "Precision Allies with Chinese Firm," *Plastics News*, July 16, 2001, found at *http://www.plasticsnews.com*, retrieved Aug. 2, 2002; and Altrust USA Inc., "Our Facilities," found at *http://www.altrust.com/al_facil.htm*, retrieved Aug. 2, 2002.

[221] Chinese industry officials, interviews by USITC staff, Beijing, June 11, 2002, and Dongguan, June 13, 2002.

stamping facilities. By comparison, small indigenous producers typically operate in a factory that from the outside appears like a store front with apartments above. These factories typically use manually operated machines.

Ownership patterns are varied, but specific data are not available by industry shares. Since 70 percent of Chinese TDM production is captive, it is likely that these producers have a corporate structure, as opposed to the family business structure found among many TDM producers in the United States.[222] Foreign-invested and state owned TDM producers are likely to have a corporate structure. In contrast, newer, indigenous privately owned TDM firms were usually started by workers who have accumulated sufficient capital and experience to go into business for themselves, as owner-run operations.

Reportedly, most indigenous Chinese TDM establishments do not have cost accounting systems for their TDM operations, which is particularly the case with in-house or captive TDM production. Firms with captive TDM operations therefore may not know if their TDM operations are profitable.[223] A related concern to industry officials is that many indigenous Chinese TDM producers lack financial management skills, particularly with regard to debt management.[224]

The TDM industry is concentrated in three principal areas of China. In Zhejiang Province, south of Shanghai, TDM producers are concentrated in the cities of Ningbo, Yuyao, Cixi City, Huangyan, Tiantai, Wenzhou, and Ninghai; about 60 percent of China's industrial molds are produced in this province, with a sizeable portion being of captive or in-house production.[225] Production in the Shanghai metropolitan area is focused on the manufacture of small, high-precision molds, as well as tooling for the automobile industry. In Guangdong Province of southern China, TDMs are primarily for the production of toys and plastic appliances, but also electronics products.[226]

In Guangdong Province and around Shanghai a number of large contract manufacturers specialize in serving the multinational electronics companies with designing, molding or stamping, or even assembly of electronics products. These contract manufacturers have extensive facilities to build the necessary TDMs for their contract parts and components production operations. If necessary, the firms will subcontract TDM production to outside suppliers. Contract manufacturers generally have hundreds to thousands of employees and hundreds of tooling designers and toolmakers on their payrolls. These contract manufacturers also tend to be foreign-invested companies, usually from Taiwan, Singapore, or the United States.

With regard to industry consolidation, one source reported that overcapacity is emerging in China and that company names frequently change.[227] Others sources indicated that overcapacity is more regionalized and/or occurring in market areas defined by end uses and the degree of precision and complexity. Adding to industry excess capacity are

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[222] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.
[223] Japanese industry officials, interviews by USITC staff, Osaka, June 7, 2002.
[224] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002.
[225] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002.
[226] Ibid.
[227] Ibid.

workers that start their own TDM production shops, such as in Zhejiang Province.[228] Dongguan (Guangdong Province) appears to have excess capacity with resultant strong price competition, where a number of firms produce medium-level precision TDMs for the electronics and household appliance industry. Based on anecdotal information, industry officials indicate that some consolidation may be occurring with some mergers and older companies exiting the industry.[229] Likewise, there has been some consolidation in the electronics contract manufacturing sector. For example, in July 2002, Flextronics acquired NatSteel (both from Singapore) with the expectation of gaining considerable tooling, molding, and electronics manufacturing capabilities in southern China.[230]

Given the size and diversity of the Chinese TDM industry, specialization appears to be more market oriented rather than being directed towards specific production processes or technologies. For the many captive TDM operations, tooling production is limited to the types of parts and components that the firm is producing for its own needs. Many foreign-invested TDM producers serving multinational customers in industries such as electronics, telecommunications, and consumer appliances are now focusing on the Chinese automotive market in China and will likely be able to displace foreign suppliers for automotive tooling for many products.[231] A number of TDM industry observers note that it is more profitable to produce parts, rather than solely TDMs; therefore, some Chinese TDM producers are shifting into parts production.[232] Small TDM producers serve the market for simple household items or perform some subcontracting roles.

In China, both domestic and foreign-invested TDM producers use subcontractors,[233] but to a much lesser extent than in Taiwan and Japan.[234] State-owned TDM producers reportedly rely on subcontractors for grinding, polishing, and finishing. One Chinese TDM producer reported using subcontractors for environmentally hazardous processes, noting that these were located in rural areas.[235]

Foreign direct investment

There is significant FDI in the Chinese TDM industry, particularly in Guangdong Province and the Shanghai metropolitan area. In Guangdong Province, FDI in TDM production is mainly from Hong Kong and Taiwan and concentrated in and around Shenzhen, Dongguan, and Zhuhai. In the Shanghai area, FDI is from Japan, Singapore, and Taiwan. Although there is substantial mold production in Zhejiang Province, most of it is owned by domestic private investors.[236] Some of the TDM FDI in Shenzhen and

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[228] Ibid.

[229] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002.

[230] Flextronics International, Ltd., "Flextronics Announces Completion of Take-over Offer for NatSteel Broadway, Ltd.," press release, July 23, 2002, found at *http://www.flextronics.com*, retrieved Aug. 3, 2002.

[231] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002, and Shenzhen, June 14, 2002.

[232] Chinese industry officials, interviews by USITC staff, Shanghai June 11, 2002, and Shenzhen, 14, 2002.

[233] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002.

[234] Japanese industry officials, interviews by USITC staff, Toyko, June 4, 2002.

[235] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002.

[236] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002.

Zhuhai is in the Special Economic Zone (SEZ), and in the Shanghai area is in the foreign trade zone (FTZ). There is no known FDI by Chinese TDM producers in other countries. FDI in the Chinese TDM industry has largely resulted from foreign suppliers following their customers to China. Large multinational and regional customers have located production in China in order to lower their production costs and export to global markets, as well as to position themselves for eventual access to the Chinese market. Frequently, these producers have requested their suppliers to relocate as well. Many of these foreign suppliers are metal stampers or plastics molders that have some in-house TDM production capabilities.

Workforce characteristics

Employment in China's TDM industry is estimated at about 150,000 persons.[237] The toolmaking profession attracts workers not only because of its relatively high wages but also because of the recognized role TDMs play in China's development.[238] The industry is characterized by the lack of experienced designers and tool makers, as much of the TDM workforce is young (early 20s). The TDM workforce also includes a significant number of women, as compared with other TDM industries around the world.

In China, toolmakers are the highest paid profession in manufacturing.[239] However, Chinese toolmakers' wages reportedly are among the lowest in the world. Although official data are not available, labor cost data were gathered from interviews primarily with foreign-invested Chinese TDM producers and trade association officials. The following tabulation shows ranges for average annual wages paid to workers in the TDM industry (in U.S. dollars):[240]

Worker type	Range of average annual wages, 2002	
	Low	High
Unskilled entry-level worker . . .	$585	$732
Molding machine operators	732	1,463
Skilled TDM builder	1,463	5,853
TDM designer	2,927	5,853
TDM production supervisor	4,390	5,122
TDM manager	7,317	10,243

In addition to employee wages, employers must also pay for unemployment insurance, pensions, allowances (housing stipends, transportation stipends, worker heating and training expenses), health care insurance, disability/work-related insurance, and bonuses.[241] The amount that these costs add to the total labor costs varies by company and location, and as industry sources report, ranges anywhere between 4 to 100

[237] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry*, Mar. 2002.

[238] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002, and Dongguan, June 13, 2002.

[239] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[240] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002; Shanghai, June 11, 2002; Dongguan, June 13, 2002; and Shenzhen, June 14 2002.

[241] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002, and Shanghai, June 12, 2002.

percent.[242] In southern China, TDM producers or parts producers with TDM operations also provide hostel-type housing and cafeterias for their workers.

Labor costs vary by locale and type of employer. Overall, the Beijing and Shanghai metropolitan areas reportedly have higher labor costs than Zhejiang or Guangdong Provinces. Reportedly, in Zhejiang, workers are paid according to their output and may earn more than their counterparts in other parts of the country.[243] According to industry sources, wages for TDM workers appear to be slightly higher in southern China, where there is a high concentration of tooling firms.[244] Among large, foreign multinationals in FTZs, wages for TDM personnel may be 30 percent higher than offered by other companies. Some TDM producers report providing relatively high wages in order to retain skilled staff, as workers in some areas of the country will travel to industrial areas for jobs and then quit after 3 years to return home.[245]

The Chinese TDM industry hires much of its workforce from high schools or technical schools. Designers and engineers are graduates from State-run universities. University students in the TDM field of study will often participate in internships at TDM producers prior to graduation. A number of universities offer degrees in TDM design and mechanical engineering, the most prominent being Shanghai Jiao Tong University. Once in the work force, workers may obtain further education at training centers sponsored by trade associations[246] or universities. TDM producers affiliated with investors from Singapore may send Chinese workers to train and/or work in Singapore through a program that receives sponsorship and funding from the Government of Singapore.[247] One large TDM producer has established its own company training centers in China to instruct toolmakers in a wide variety of factory skills, with training lasting half a year.[248]

Manufacturing Infrastructure

Although the Chinese TDM industry depends on foreign technology and materials, it has access to much of the same production machinery, design and manufacturing software, and materials as do U.S., Canadian, Japanese, and European TDM industries. Chinese TDM producers import high-precision machinery from Western Europe (principally Germany or Switzerland), Japan, the United States, and Taiwan. CAD/CAM/CAE software is principally imported from the United States, Europe, and Israel—such software is typically used by world-class companies that use TDMs. High-grade tool and mold steels are imported from Sweden, Austria, Germany, Japan, and the United States. Also, imported are TDM parts and components, such as high-quality mold bases or die sets, and ejector pins and springs.

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[242] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002; Dongguan, June 13, 2002; and Shenzhen, June 14, 2002.

[243] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002.

[244] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002; Shanghai, June 12, 2002; Dongguan, June 13, 2002; and Shenzhen, June 14, 2002.

[245] Japanese Government officials, interviews by USITC staff, Tokyo, June 3 and Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[246] The China Die & Mould Industry Association represents the Chinese die and mold industry nationally, has 1500 group members and 50 sub-associations in all the provinces, municipalities, autonomous regions, and major industrial cities.

[247] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002.

[248] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

China has indigenous production of metal-cutting machine tools, cutting tools and accessories, rapid-prototyping machines, and steel and TDM components. There are 14 Chinese producers of mold and tool steels.[249] Recently, Shanghai No. 5 Steelworks, a subsidiary of Shanghai Baosteel Group, announced its intent to add tool and mold steel capacity. The new capacity is expected to reduce China's reliance on imports of high-grade mold steel for the automotive, major household appliance, and machine-building industries.[250] Some Japanese machine tool companies have started producing or assembling machine tools at their Chinese subsidiaries. Likewise, several globally oriented foreign TDM components suppliers have announced intentions to produce in China to supply that market.[251]

Foreign-invested TDM producers extensively rely on imported machinery and materials. Since many of their customers are multinational companies, they are reluctant to use Chinese materials because of quality concerns. Imported machinery is preferred for its high-level precision, high speed, and reliability. Foreign-invested TDM producers note that their machinery and materials costs may be higher than those of producers in North America, Japan, and Europe because of high Chinese import duties and taxes, as well as high shipping costs to Asia from Europe and the United States. Also, it is more difficult and costly to have imported machinery serviced or repaired in China. To a certain extent, however, some foreign-invested TDM producers, because of their large size, may receive discounts on machinery and software because of high-volume purchases.[252]

Despite concerns about quality, indigenous TDM producers tend to rely on Chinese machinery and materials in large part because of their low prices.[253] The extent to which pirated design and manufacturing software are used in the industry is unknown. Reportedly, such copies can be purchased for as low as $1.00.[254] Small Chinese producers that typically produce TDMs for common, everyday articles reportedly do not use software for design or manufacturing.[255]

The use of advanced technologies and automation is limited, even to some degree among foreign-invested TDM producers. Large indigenous and foreign-based firms have a tendency to balance the use of modern machinery with the availability of labor.[256] Some firms have advanced machines capable of unattended overnight operation, but will not utilize this capability because there is available low-cost labor. The use of advanced

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[249] Appliance Magazine.Com, "China's Shanghai No. 5 Steelworks Opens New Mould Steel Line," found at *http://www.appliancemagazine.com/news.cfm?newsid=1258*, retrieved Feb. 6, 2002.

[250] Ibid.

[251] Joseph Pryweller,"Incoe moves into Hong Kong, China," Plastics News, July 2, 2001, found at *http://www.plasticsnews.com*, retrieved Aug. 2, 2002.

[252] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002, and Shenzhen, 14, 2002.

[253] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002, and Dongguan, 13, 2002.

[254] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002, and Shenzhen, June 14, 2002. One U.S. design software producer installed anti-piracy features on its software only in 2001. U.S. design software official, interview by USITC staff, Rosemont, IL, Apr. 24, 2002. Many design software companies have training centers in China and some have sales agreements with the Chinese Government for thousands of software site licenses.

[255] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[256] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002.

technology is also dictated by the precision level and complexity of the TDM. A number of firms perform high-speed machining.[257] But there is little use of 5-axis machining, since this type of machining is predominately used in making large-sized high-precision TDMs with complex curvatures, such as for automobile lights. One source estimates that about one-half the TDM producers in Guangdong Province use rapid prototyping either in TDM production or provide it as a service to customers.[258] Rapid prototyping is also taught at some universities in China. However, there has been little, if any, adoption of rapid-tooling production and technology.[259]

Technological Capabilities

China has widely varying technological capabilities to produce TDM products, but appears most capable of manufacturing TDMs at the low end and the middle of the product spectrum. Currently, China produces industrial molds for toys, household appliances, consumer appliances, electronics, and some automotive products. According to one foreign-invested TDM producer, there is no indigenous competition, and State-owned TDM producers have weak manufacturing skills and mostly produce TDMs for toys and kitchen utensils.[260] However, foreign-invested TDM producers in China have the capability to produce increasingly high-precision and more complex TDMs.[261] This includes a wide range of consumer electronics from cellular telephones to televisions and appliances.[262] China is less capable in producing TDMs for medical products[263] and molds for manufacturing parts requiring multiple colors and plastic resin types.[264] U.S. industry sources report increasing competition from China in more complex product types, including certain highly engineered products.[265] For example, one U.S. firm reported Chinese competition for molds that produces a complex mirror shelf for the exterior of an automobile.[266]

Much of the indigenous Chinese TDM industry is characterized as being backward and relatively weak with regard to quality levels and competitiveness.[267] Industry officials state that, from their perspective, their common concern is to improve the level of technology, operations, and management. In general, access to capital is not an issue for

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[257] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002, and Shenzhen, June 14, 2002.

[258] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[259] Ibid. Also, the mold division of Haier, the giant Chinese appliance manufacturer, uses rapid tooling production.

[260] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[261] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002, and Shenzhen, June 14, 2002.

[262] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

[263] Dan Jepson, president, Jepson Precision Tool, Inc., written submission to the USITC, May 21, 2002, p. 5, and Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.

[264] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[265] Testimony of Mark A. Hanaway, marketing director, Tech Tool & Mold, Inc., transcript of the hearing, p. 194.

[266] Testimony of David L. Rasmussen, president, Progressive Die & Automation, transcript of the hearing, p. 145.

[267] Chinese Government officials, interviews by USITC staff, Beijing, June 10, 2002.

the Chinese TDM industry,[268] although some Chinese firms lack the capital to purchase new machinery.

Certain segments of the Chinese TDM industry, particularly foreign-invested producers, have grown very rapidly through technology transfer and the acquisition of advanced, globally available machinery and software. Japanese TDM producers attribute much of technology transfer to Japanese TDM customers shifting production to China and consequently transferring existing tooling to Chinese parts producers that have in-house tooling production.[269] Many Japanese TDM customers also will have the initial TDM produced in Japan and have subsequent TDMs produced in China using design and production data from the initial TDM. The exposure of Chinese TDM producers to advanced TDMs and also training by foreign workers has allowed the Chinese TDM industry to leapfrog stages of development, so that the Chinese TDM industry has the toolmakers, machinists, and designers, as well as the production machinery and software to produce increasingly advanced TDMs.

Production and Sales

In 2001, China's production of TDMs was approximately $3.6 billion and consumption was around $4.6 billion (table 4-11).[270] Production and consumption have grown at rates consistent with growth in China's economy. Overall, China has rapidly expanded its production of industrial molds, but is further behind in the manufacture of dies which are more difficult and time-consuming to produce than molds.[271] Also, as noted earlier, the Chinese TDM industry lacks production capacity for both for high-precision and large-sized TDMs.

Market Characteristics and Trends

Customer Base

The current domestic customer base in China for TDMs is growing as foreign manufacturers continue to locate and expand in China, and as indigenous companies expand production. The rise in Chinese disposable income, and hence consumerdemand, will, in turn, generate additional demand by producers requiring TDMs. A number of large Japanese appliance and automobile manufacturers have moved production to China.[272] Currently, there are 10 foreign automobile producers in China, and

[268] Chinese industry officials, interviews by USITC staff, China, Beijing, June 10, 2002.
[269] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002, and Japanese industry officials, interviews by USITC staff, Tokyo, June 7, 2002.
[270] Chinese industry officials, interviews by USITC staff, Beijing 10, 2002.
[271] Japanese industry officials, interviews by USITC staff, Tokyo, June 4, 2002.
[272] ERI, JSPMI, *Assignments and Future Prospects for the Die and Mold Industry*, (in Japanese), Mar. 2002.

Table 4-11
Tools, dies, and industrial molds: Chinese shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	([1])	85.0	670.9	([1])	([1])
1998	([1])	99.2	802.7	([1])	([1])
1999	([1])	139.3	996.8	([1])	([1])
2000	([1])	173.9	1,034.8	([1])	([1])
2001	3,619.0	192.3	1,175.5	4,602.0	25.5
	Value *(billion Chinese renminbi)*				
1997	([1])	707.5	5,580.7	([1])	([1])
1998	([1])	823.5	6,662.8	([1])	([1])
1999	([1])	1,153.5	8,251.8	([1])	([1])
2000	([1])	1,439.5	8,566.3	([1])	([1])
2001	30,000.0	1,592.1	9,729.8	38,137.7	25.5

[1] Not available.

Source: China State Economic and Trade Commission, and Global Trade Information Services, Inc., World Trade Atlas internet database, found at http://www.gtis.com

some of these companies have announced further expansion plans.[273] The extent of increasing industrial growth in China is underscored by General Electric Co.'s recent announcement that it is moving its plastics division regional headquarters to China from Japan. Further, the company announced plans for $100 million in investment during the next 2 to 3 years in China and the establishment of a $30 million global research and development center in Shanghai.[274] Indigenous companies (such as Haier Group), reportedly by some to be the largest home appliance producer in the world, will also be a growing source of demand for TDMs. Other developments that will spur indirect consumption of TDMs are the growth of development in the interior of China and preparations for the 2008 Olympic Games. Customers in overseas markets are multinational companies, particularly for the foreign-invested TDM producers in China, and companies in developing countries, such as Vietnam and the in Middle East.

Purchase Decision Variables

Prices

According to Chinese TDM industry sources, Chinese prices are frequently 50 percent of what U.S. TDM producers charge, and in some instances are 75 percent or lower,

[273] David Murphy and David Lague, "As China's Car Market Takes Off, The Party Grows a Bit Crowded," *The Wall Street Journal*, July 3, 2002, p. A9; Karby Leggett, "GM Says Sales In China Soared in the First Half," *The Wall Street Journal*, July 19, 2002, p. A8; Todd Zaun, Scott Miller, and Joseph B. White, "Honda Aims to Export Cars from China," *The Wall Street Journal*, July 11, 2002, p. A12.

[274] Karby Leggett, "GE Move Illustrates Its Aggressive Strategy in China," *The Wall Street Journal*, June 26, 2002, p. A14.

depending on the type and class of die or mold.[275] Compared with other Asian TDMs, for similar TDMs, ex factory, Chinese TDM prices are 50 to 75 percent of those from Japan, 50 percent of those from Singapore, and 33 to 50 percent of those from Taiwan. Of all countries, Korean TDMs are the most price competitive with those from China, with the Chinese TDMs about 25-33 percent lower in price.[276]

Some Hong Kong invested Chinese TDM producers state that when Chinese and U.S. prices for the U.S. market, ex factory, are compared for exact TDMs, the maximum price differential is 40 percent, and more typically 30 to 35 percent.[277] When TDMs are made to U.S. specifications, the price differential is 25 to 30 percent.[278] For such TDMs, when other costs related to purchasing tooling are added to the initial ex factory Chinese price, such as transportation and associated customer travel related to design, production, and tryout, that amount may almost equal the initial quoted U.S. price ex factory.[279] Chinese and other foreign industry sources attribute the significant differences in prices to China's low-cost TDM labor and lower overhead costs resulting from around-the-clock operation. Material costs may be slightly higher or comparable to U.S. materials, if the tooling requires imported high quality tool and mold steels, but if Asian, including Chinese steels are used, materials may cost significantly less.

Within China, prices vary by region and product type. In the Shanghai metropolitan area, prices are high, reportedly because many of the TDMs produced there are sold to multinational customers and TDM inputs must meet international standards. Prices in neighboring Zhejing Province are lower because much of that TDM production is sold to indigenous customers. Prices in Guangdong Province are low as well because of intense competition and overcapacity for certain products.

Lead times

Chinese TDM industry sources indicate that their lead times are generally shorter than those of U.S. TDM producers.[280] One of these sources stated that for a given TDM, the lead time in China is 6 weeks compared with 3 months in the United States. However, other sources indicated that lead times in China might be higher than those in Japan, for example, 8 weeks versus 5 weeks.[281] Differences in lead times between producers in China and the United States reportedly result from a significant number of Chinese TDM producers operating around-the-clock. Further, because of the low cost of labor, Chinese TDM producers can divide a job into many specific tasks and use more workers concurrently on that job.[282]

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[275] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 22-26, 2002, and Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002, and Dongguan, June 13, 2002.

[276] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002.

[277] Chinese industry official, interviews by USITC staff, Shenzhen, June 14, 2002.

[278] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.

[279] Ibid.

[280] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002, and Shenzhen, June 14, 2002.

[281] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002.

[282] Ibid.

Quality

The quality level of Chinese TDMs varies considerably but is improving. Simple Chinese-made TDMs with low levels of precision and complexity and made from Chinese steel and components tend to be of low quality. These TDMs have frequently required repairs in the foreign markets where they were used to make parts. Some U.S. TDM producers repairing TDMs from China noted inconsistent and low grades of steel that would often result in the TDM cracking or creating parts with defects, and also, the designs were not well developed.[283] However, when Chinese TDMs are produced to international standards for foreign multinationals, the quality level is comparable with that produced in Western countries including Japan.[284] The steel and components used in these TDMs are typically imported and of high quality, and the production processes are managed to Western quality levels. These producers also have imported their production machinery and have extensively trained their Chinese workforce.[285] Many of these TDMs are of medium levels of precision and complexity. Overall, Chinese TDMs quality is seen as improving. Many customers in the United States have shown a greater acceptance of Chinese TDMs.[286] Some U.S. purchasers have noticed certain Chinese TDMs are increasingly more sophisticated in their design and performance, comparable with or even exceeding U.S. TDMs.[287]

Trade

China is a net importer of TDMs, importing about 25 percent of apparent consumption in 2001, or about 6 times the value of its exports. The value of Chinese imports totaled almost $1.2 billion in 2001, up by 75 percent from 1997 imports of $671 million (table 4-12). Measured in renminbi (RMB), the percentage is almost the same, 74.3 percent, because the RMB has been stable against the U.S. dollar (table 4-11). The largest source of imports was Japan, followed by Taiwan and Korea. Imports from the United States rose to $53.7 million in 2001, or by 113 percent, from $25.2 million in 1997. Industrial molds accounted for the 89 percent of China's imports of TDMs in 2001. The large increase in TDM imports likely reflects the shipment of tooling to Japanese, Taiwan, Hong Kong, U.S., and European manufacturers that have established production facilities in China.[288] Indigenous manufacturers, however, find that foreign tooling tends to be too expensive, and therefore they purchase domestic TDMs. Also, China tends to import sophisticated TDMs that cannot be produced in-country, such as molds for producing medical goods.[289]

Chinese TDM exports grew by 126 percent to $192.3 million in 2001 from $85.0 million in 1997 (table 4-13). The largest market was Hong Kong, where they may be used in

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[283] U.S. industry sources, interviews by USITC staff, Chicago, IL area, May 23, 2002.

[284] Chinese industry officials, interviews by USITC staff, Shanghai, June 12, 2002, and Shenzhen, June 14, 2002.

[285] Chinese industry officials, interviews by USITC staff, Dongguan, June 13, 2002.

[286] Daniel R. Jepson, president, Jepson Precision Tool, Inc., written submission to the USITC, May 21, 2002, p. 8.

[287] U.S. industry sources, interviews by USITC staff, Chicago, IL area, May 25, 2002.

[288] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002.

[289] Chinese industry officials, interviews by USITC staff, Beijing, June 10, 2002; Shanghai, June 12, 2002; Dongguan, June 13, 2002; and Shenzhen, June 14, 2002.

Table 4-12
Tools, dies, and industrial molds: Chinese imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Japan	217,134	203,637	242,219	313,954	341,206
Taiwan	165,655	166,671	226,895	274,332	245,348
Korea, South	54,871	39,873	61,274	91,531	108,680
Italy	15,109	27,053	51,020	16,986	71,250
Hong Kong	48,690	34,622	49,441	62,159	61,898
Germany	19,960	32,580	97,287	42,430	50,122
All other	83,176	108,068	138,871	127,580	166,658
Total	604,595	612,504	867,007	928,972	1,045,162
EU-15	58,891	88,236	203,262	101,360	173,170
NAFTA	23,478	42,838	33,550	35,381	54,096
China & Hong Kong	53,241	38,062	53,163	67,897	76,524
Tools and dies:					
Japan	3,504	4,190	21,092	18,950	21,214
Taiwan	3,742	8,724	19,430	9,566	14,084
United States	1,349	816	1,878	2,614	5,986
Korea, South	1,161	2,228	1,126	2,333	4,295
France	144	4,507	3,199	662	4,268
Germany	320	1,795	1,822	2,657	3,764
All other	1,460	4,625	4,679	6,486	6,671
Total	11,680	26,885	53,226	43,268	60,282
EU-15	1,060	9,966	8,399	6,736	11,007
NAFTA	1,349	915	1,937	2,624	6,016
China & Hong Kong	591	642	680	1,684	1,272
Jigs and fixtures:					
Japan	21,119	25,912	25,707	27,045	28,723
Germany	8,100	3,165	24,832	4,161	9,807
Taiwan	5,595	3,422	9,463	6,551	8,696
Korea, South	3,462	4,081	2,777	4,385	4,248
United States	4,263	3,403	5,450	4,729	4,221
Italy	2,658	1,036	920	6,026	3,087
All other	9,460	122,262	7,439	9,644	11,299
Total	54,657	163,281	76,588	62,541	70,081
EU-15	17,511	13,129	31,199	15,166	18,822
NAFTA	4,280	3,441	5,637	4,907	4,580
China & Hong Kong	943	700	500	969	1,053
Total:					
Japan	241,757	233,739	289,018	359,949	391,143
Taiwan	174,991	178,817	255,789	290,448	268,127
Korea, South	59,493	46,182	65,177	98,249	117,223
Italy	17,817	31,230	53,906	24,039	75,918
Germany	28,381	37,540	123,941	49,248	63,693
Hong Kong	50,113	35,814	50,536	64,552	63,584
All other	98,380	239,348	158,454	148,296	195,837
Grand total	670,932	802,670	996,821	1,034,781	1,175,525
EU-15	77,462	111,331	242,859	123,263	203,000
NAFTA	29,108	47,195	41,124	42,912	64,692
China & Hong Kong	54,776	39,405	54,344	70,550	78,849

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-13
Tools, dies, and industrial molds: Chinese exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Hong Kong	38,898	43,813	65,954	65,820	78,168
Japan	7,934	7,577	8,183	12,460	19,536
United States	1,862	3,729	5,047	10,951	11,801
Taiwan	4,692	13,417	20,026	24,438	8,396
Singapore	3,381	6,297	6,083	6,611	8,028
Vietnam	565	989	1,084	1,719	5,910
All other	15,464	13,543	20,969	33,905	44,428
Total	72,796	89,365	127,346	155,904	176,267
EU-15	1,200	1,727	3,121	4,183	5,025
NAFTA	2,116	3,951	6,379	11,485	13,473
China & Hong Kong	38,898	43,813	65,954	65,820	78,168
Tools and dies:					
Hong Kong	680	1,004	765	2,326	2,931
Japan	1,899	826	960	2,476	1,665
United States	1,589	769	702	1,108	879
Italy	0	22	60	80	488
France	21	0	0	131	361
Taiwan	809	312	354	1,531	329
All other	1,849	1,640	1,643	4,346	2,142
Total	6,847	4,573	4,484	11,998	8,795
EU-15	189	230	163	522	979
NAFTA	1,602	776	736	1,134	899
China & Hong Kong	680	1,004	765	2,326	2,931
Jigs and fixtures:					
United Kingdom	49	54	228	351	1,208
Belgium	4	6	4	3	970
United States	589	684	830	680	894
Myanmar	24	107	145	444	520
Pakistan	300	74	308	297	382
Iran	69	265	244	410	343
All other	4,370	4,104	5,752	3,795	2,968
Total	5,405	5,294	7,511	5,980	7,285
EU-15	664	739	1,003	1,110	2,858
NAFTA	890	1,034	1,199	827	998
China & Hong Kong	1,431	1,512	3,070	909	170
Totals:					
Hong Kong	41,008	46,330	69,789	69,056	81,269
Japan	10,048	8,722	9,223	15,323	21,526
United States	4,039	5,183	6,579	12,739	13,574
Taiwan	5,598	13,977	20,601	26,108	8,740
Singapore	3,855	6,359	6,121	6,788	8,321
Vietnam	856	1,184	1,265	1,856	6,149
All other	19,644	17,476	25,763	42,013	52,768
Grand total	85,048	99,231	139,341	173,883	192,347
EU-15	2,053	2,696	4,287	5,815	8,862
NAFTA	4,608	5,761	8,314	13,446	15,371
China & Hong Kong	41,008	46,330	69,789	69,056	81,269

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Hong Kong production facilities or undergo further processing for subsequent export. The second-largest destination was Japan, followed by the United States. As with imports, exports were primarily industrial molds, which accounted for almost 92 percent of all Chinese TDM exports in 2001. During 1997-2001, exports to Japan rose by 114 percent and to the United States, by 236 percent. The large increases in exports to these destinations were largely due to the low price of TDMs produced in China.

Government Policies and Programs

Chinese Government policies and programs benefitting the TDM industry are, for the most part, a subset of those promulgated to attract FDI to China and promote domestic economic stability. At the same time, the Government of China has been reducing the number of State-owned companies and selling many to private investors. China undertook economic reforms beginning in 1978, but foreign investment began to surge in the early 1990s when the government reaffirmed its commitment to allow foreign participation in the Chinese economy. Therefore, policies that encouraged TDM customers to invest in China were also beneficial in attracting TDM producers. Such policies use tax incentives and import-tariff exemptions and/or rebates.[290] Chinese TDM producers indirectly benefit from China's stable foreign exchange rate regime.

General Programs

China established a number of special economic areas in which foreign investment was granted preferential treatment in utilizing foreign capital, in introducing foreign technology, and in conducting economic cooperation overseas. These areas offered special regimes for tariffs, taxes, and regulations in order to attract FDI. As a result, many foreign TDM customers and TDM producers have located in these areas. In 1980, five Special Economic Zones (SEZs) were established: Shenzhen, Zhuhai and Shantou in Guangdong Province, Xiamen in Fujian Province, and the entire province of Hainan. In 1984, 14 coastal cities of Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang and Beihai were opened to FDI, and within these 14 cities, Economic and Technology Development zones were established. High Technology Development Zones were established beginning in the early 1990s, as were the first two Free Trade Areas in the Pudong area of Shanghai and Shenzhen. Other areas have also been opened up to foreign investment. The major tax incentive programs benefitting both domestic and foreign invested producers are shown in table 4-14.

The current VAT in China is 17 percent. Duty savings on principal types of metalworking machine tools used to produce TDMs may be significant under the above programs since Chinese import tariffs range from 9.7 percent ad valorem to 15 percent ad valorem, with most around 10 percent ad valorem.

[290] Wanda Tseng and Harm Zebregs, *Foreign Direct Investment in China: Some Lessons for Other Countries*, IMF Policy Discussion Paper, International Monetary Fund, PDP/02/3 Feb. 2002.

Table 4-14
China: Major tax and tariff programs, 1997-present

Target area/group	Geographic locations	Benefits
Special Economic Zones (SEZs) / foreign invested enterprises (FIEs)	Shenzhen, Zhuhai, Shantou, Xiamen, as well as the entire Hainan Province.	Preferential income tax rate of 15 percent.[1]
Economic and Technical Development Zones / FIEs	29 locations, including Tainjin, Ningbo, Shanghai, Wenzhou, and Huangzhou.	Preferential income tax rate of 15 percent.[1]
SEZ of the Pudong Area of Shanghai / FIEs	SEZ of the Pudong Area of Shanghai.	Preferential income tax rate of 15 percent .[1]
Foreign-invested enterprises	In nonpreferential areas.	For foreign-invested productive enterprises operating for more than 10 years, income tax for first 2 years is exempted and in years 3 to 5 reduced by 50 percent; base year is the first year of profitability. Under this program, provincial governments may reduce or exempt the local part of the income tax if the FIE is in an industry in which the Government of China is encouraging foreign investment.
Tax and tariff refund for export products for certain producers	Throughout China.	Import tariff exemption for raw materials and other inputs imported, processed, and then exported. If tariffs were collected, partial refund of collected tariffs.
Imported technology and equipment for investments in industries encouraged by the Government of China	Throughout China.	Import tariff and value added tax (VAT) exemption for imported technologies and equipment for (1) foreign investors investing in encouraged industrial areas defined in the "The Industrial Catalogues for Direct Foreign Investment" and for (2) domestic investors investing in encouraged industrial areas defined in "The Catalogues of Current Priorities of Industrial Sectors, Products, and Technologies Encouraged by the State."

[1] The normal income tax is 33 percent.

Source: World Trade Organization, *Report of the Working Party on the Accession of China*, WT/MIN(01)/3, Nov. 10, 2001.

One Chinese TDM source indicated that starting about 3 years ago, China would allow only the importation of new machinery.[291] The intent of this policy ensures that Chinese production facilities will have up-to-date machinery and will be producing at a high technological level.

Policies Specific to TDMs

Chinese Government policies specific to the TDM industry include Government guidance to encourage FDI in the TDM industry and the development of a specific area for the production of molds—Yuyao, or Mold City. These policies, a subset of a larger group of Chinese industrial policies, were launched during China's 9th Five-Year Plan period (1996-2000) and are being continued in the 10th Five-Year Plan (2000-2004). As part of these policies, China designated a large number of industries in which FDI was to be "encouraged" and published the list in the "Catalog Guiding Foreign Investment," effective January 1, 1998.[292] TDM "industries" included in the catalog were—

- Designing and processing, and manufacture of molds for nonmetallic products.
- Manufacture of precision dies, precision cavity molds, and standard components for molds.
- Design and manufacture of dies (including stamp dies, injection molds and extrusion molds, etc.) and jigs (welding jigs, inspection jigs, etc.) for motor vehicles and motorcycles.
- Manufacture of special electronic equipment, instruments, and molds/dies for use in electronics.

The above listed TDMs were also included in a new "Catalogue for Guiding Foreign Investment in Industry," approved by the State Council on March 4, 2002, effective April 1, 2002, and superseding the 1998 list. TDM-supporting industries were also included in the 1998 and 2002 catalogs. These include the manufacture of advanced machine tools and their controls, advanced software for product design, manufacturing, testing, and engineering.

In 1997, during the 9th Five-Year Plan, China Light Industry (Yuyao) Mold City was jointly established by the Chinese Ministry of Light Industry and the Yuyao Municipal People's Government.[293] The purpose of Mold City was to build a large industrial area for mold design, manufacturing, training and other activities related to industrial molds. The project was budgeted with RMB 1 billion ($115 million), with RMB 405 million

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[291] Chinese industry sources, interview by USITC staff, Beijing, June 11, 2002.

[292] China has encouraged, permitted, restricted, or prohibited foreign investment in certain industries. Foreign investment in the encouraged category may be entitled to preferential treatment in accordance with relevant laws and administrative regulations. The catalog was first published in 1995, and only approved by the State Council in December 1997 and then issued by the State Planning and Development Commission, the State Economic and Trade Commission, and the Ministry of Foreign Trade and Economic Cooperation.

[293] China Light Industry Mould City, "China Light Industry Mould City," found at *http://cpe.21cp.net/CLIMC/planning.htm*, retrieved Apr. 4, 2002. See also Chow Bee Lin, "The Chinese Government Has Committed About RMB 1 Bil ($115 Mil) to Establish China Light Industry Yuyao Mold City," *Modern Plastics*, June 1998, p. 76 in Jerry Lirette, President, D-M-E Co., written submission before the U.S. International Trade Commission, May 9, 2002.

($48.9 million) invested by 2000, without including additional infrastructure construction expenditures. More than 115 companies for mold production had moved into Mold City and 45 mold materials distributors. During the 10th Five-Year Plan period, city authorities plan to develop more land and invite a further 200 companies to locate there. The Yuyao Municipal People's Government provides a number of incentives for firms to locate in Mold City. These include exemption of income tax for 2 years from the first profitmaking year and payment of 50 percent of the normal tax rate for years 3 to 5. The city government also provides investors with preferential treatment on their payment of the city's facility building fee and land rental fee.

China became the 143d member of the WTO on December 11, 2001, 30 days after it notified the the WTO that it had completed domestic ratification of its accession package. Under its WTO commitments, China's tariffs on most TDMs will remain at the levels at which China entered the WTO, and not be further reduced. Tariffs on dies are 8 percent ad valorem, and on molds range, from 8.0 to 8.4 percent ad valorem, with molds for rubber and plastics falling from 6 to 6.7 percent ad valorem in 2001 to between free to 5 percent ad valorem in 2002 and 2003.

Other Programs

The types and extent of assistance to the Chinese TDM industry other than that related to FDI described previously is unknown. Several foreign-invested TDM producers indicated to Commission staff that they received no financial assistance from the Chinese Government to build factories[294] or to fund worker training.[295] Further, Chinese tax law reportedly provides long depreciation schedules, with 10-years on machinery and 5 years on software and information technology investments.[296] Also, the Chinese TDM industry benefits from a stable Chinese currency relative to the U.S. dollar, as the Chinese Government has maintained a soft peg to the U.S. currency.[297]

The Chinese TDM industry benefits from China's extensive state-run education system. Some technical schools are reportedly well equipped with advanced machinery and teach students to build relatively complex TDMs.[298] Several universities have programs that focus on TDM research and development and that offer training in TDM design and production. Perhaps most known is the National Die and Mold CAD Engineering Research Center at Shanghai Jiao Tong University.

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[294] Chinese industry sources, interview by USITC staff, Shanghai, June 12, 2002, and Dongguan, June 13, 2002.

[295] Ibid.

[296] Chinese industry officials, interviews by USITC staff, Shanghai, June 11, 2002.

[297] U.S.-China Security Review Commission, *Report to the Congress of the U.S.-China Security Review Commission: The National Security Implications of the Economic Relationship between the United States and China*, ch. 2, July 2002, found at *http://www.uscc.gov*, retrieved July 18, 2002. For a discussion of trends in foreign exchange rates, see ch. 5.

[298] Testimony of Mark A. Milbrandt, plant manger, Apollo Tool Inc., transcript of the hearing, p. 201.

The extent to which government regulations affect the operations of Chinese TDM producers is difficult to ascertain. Foreign-invested TDM producers likely maintain relatively high standards with regard to their operations. Regulation, though, appears to be expanding. With regard to workplace health and safety, two major national laws become effective in 2002. One law, taking effect in May 2002, focuses on occupational diseases. The other, effective in November 2002, focuses on prevention of workplace accidents and will require safety devices to be installed in newly constructed production facilities.

Hong Kong[299]

Industry Profile

Composition of the Industry

Unique industry characteristics and significant strengths and weaknesses of the Hong Kong TDM industry

Unique industry characteristic:
- Very few firms remain in Hong Kong due to migration of the industry to China

Strengths:
- Tradition of craftsmanship in the production of dies and molds
- Quick lead times (time required to produce a die or mold)
- Proximity to China combined with Western business infrastructure allow Hong Kong TDM producers to effectively integrate Chinese production with a modern business environment and logistical gateway to the global market
- Highly integrated with part of the Chinese TDM industry

Weaknesses:
- High labor rates
- Shortage of skilled TDM workers, particularly entry level workers
- Hong Kong customers have moved production to foreign locations, particularly China

The Hong Kong TDM industry has contracted significantly, from a peak of 2,000 firms in the mid-1990s to the industry's present level of approximately 50 firms.[300] Although a number of companies went out of business, a far greater number of Hong Kong TDM producers simply moved operations to low-cost facilities in China. As such, the Hong Kong TDM industry is highly integrated with, and largely dependent upon, TDM and other manufacturing enterprises in southern China. A number of TDM producers that manufacture in China maintain headquarters and/or design operations in Hong Kong. This arrangement reportedly facilitates the management of financing and purchasing, design, marketing, shipping, accounting, and billing activities. Producers that maintain both headquarters as well as production facilities in Hong Kong are few in number and are largely scattered around the region.

The heavy migration of Hong Kong TDM producers to China came about after the opening of China to FDI in 1979. It was not until 1987-88, however, that Hong Kong businesses realized that by moving to China, they could escape rising inflation in Hong Kong and substantially lower production costs, particularly for labor. Moreover, there was an increasing lack of qualified individuals applying to work in Hong Kong's TDM industry,[301] whereas in China, TDM producers found a large pool of well-educated workers. In addition, Hong Kong TDM customers moved production to China, TDM producers followed. Most Hong Kong TDM producers relocated production to the neighboring Guangdong Province, primarily to the cities of Dongguan and Shenzhen, the

[299] On July 1, 1997, China resumed sovereignty over Hong Kong from the United Kingdom, becoming a Special Administrative Region of the People's Republic of China with a high degree of autonomy in all matters except foreign affairs and defense.

[300] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[301] Ibid.

latter of which has an SEZ providing special tax and import tariff incentives to attract FDI. Many managers, supervisors, and other skilled Hong Kong TDM producers commute to work in southern China, either for the day or the entire work week. Wages paid to skilled Hong Kong TDM workers and management staff are generally higher than those paid to Chinese staff at Hong Kong-operated facilities in southern China. With respect to production facilities in Hong Kong, toolmakers receive approximately $14,000 to $15,000 a year, and designers and supervisors earn roughly $20,000 to $30,000 per year.[302] Hong Kong TDM producers have gained substantial industry experience over the past 20 to 30 years, and the industry, through investments in China, is building upon that country's labor force.

Manufacturing Infrastructure

At the same time, while many Hong Kong TDM producers have focused on developing production operations in China, others have invested in automation for their Hong Kong production facilities. Industry and the Hong Kong Government have invested in rapid prototyping as one way to enhance the competitiveness of Hong Kong's TDM producers. The Hong Kong Government has invested public funds for a rapid-prototyping research center and a number of private companies have purchased rapid-prototyping machines.[303] There is a substantial customer base in Hong Kong of multinational companies producing toys and other entertainment products that use rapid-prototyping services in Hong Kong. One industry source believes that in rapid-prototyping, Hong Kong is on a level comparable with the United States, Germany, and Japan.

With regard to other production equipment and materials supply, Hong Kong producers have access to similar advanced metal-cutting machine tools, cutting tools, quality inspection machines and design and manufacturing software, as do U.S., Western European, and Japanese TDM producers. Hong Kong TDM producers use tool and mold steels and components from Western Europe, Japan, and the United States. Because these inputs must be imported, shipping and other charges reportedly result in higher prices for these items than in their country of origin.[304] Hong Kong's TDM producers state they are able to produce many types of medium- and high- precision TDMs. Certain types of products, however, are not widely produced in Hong Kong. These include molds for two or more colored plastics, as well as medical molds, which are mainly imported from other countries.

Market Characteristics and Trends

Customer Base

The customer base for Hong Kong TDM producers consists largely of U.S. and European multinational companies and their Hong Kong and Chinese metal and plastics parts suppliers. These customers are concentrated in the consumer electronics, medium- and small-sized consumer appliances, consumer goods, sporting goods, and toy industries.

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[302] Ibid.

[303] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[304] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002, and Hong Kong industry officials, interviews by USITC staff, June15, 2002.

Hong Kong's production of dies is primarily for local consumption.[305] Hong Kong TDM producers have few, if any customers that produce transportation equipment, because motor vehicle production in Hong Kong and southern China has been negligible. However, Hong Kong TDM producers are beginning to look at the automotive market in China, as some products for that industry can be produced at more remote locations and as China's automobile industry is showing strong growth.

Purchase Decision Variables

According to Hong Kong TDM industry sources, in general Hong Kong TDMs prices, ex factory, are lower by up to 40 percent for similar TDMs than those made in the United States for the U.S. market.[306] Hong Kong molds, built with standard parts, high-quality steel, and to the standards of the U.S. Society of the Plastics, are 30 to 40 percent lower in price than similar U.S. molds. Prices of Hong Kong dies are reportedly 25 to 30 percent lower than U.S. die prices. However, if other costs such as shipping, customer visits to the production site, and so forth, are included with the initial ex factory price for a sale in the United States, the price differential almost disappears.[307] Comparatively, Hong Kong TDM producers with production in China rate their products as being slightly more expensive than Korean-made TDMs, but of higher quality than Korean products because of better construction, finishing, standardization of mold production, and communication with the customer.[308]

Reportedly, U.S. customers purchase from Hong Kong TDM producers because of shorter lead times.[309] Hong Kong TDM producers report that customers rank lead time as the most important factor in their purchase decision, followed by quality and then price.[310] One Hong Kong TDM producer reported a lead time of 4 to 6 weeks for a two-cavity mold for a cellular telephone compared with 8 weeks in the United States.[311] Hong Kong TDM producers' short lead times are due to 24 hour, 7 days per week operation and their assertions of better management skills and styles, as well as the attitude of Hong Kong workers to make efforts to complete jobs on time.[312]

Trade

Hong Kong maintains a trade deficit in TDMs, as calculated from trade data shown in table 4-15. The trade deficit narrowed in 2001 as exports rose and imports fell during 2000-01. Imports totaled $374 million in 2001, down from a peak of $436.2 million in

[305] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 14, 2002.
[306] Ibid.
[307] Ibid.
[308] Ibid.
[309] Ibid.
[310] Ibid.
[311] Ibid.
[312] Ibid.

Table 4-15
Tools, dies, and industrial molds: Hong Kong shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	([1])	285.3	338.9	([1])	([1])
1998	([1])	280.3	367.7	([1])	([1])
1999	([1])	289.4	379.8	([1])	([1])
2000	([1])	321.0	436.2	([1])	([1])
2001	([1])	325.3	374.5	([1])	([1])
	Value *(million Hong Kong dollars)*				
1997	([1])	2,209.0	2,624.3	([1])	(1.0)
1998	([1])	2,171.2	2,848.6	([1])	([1])
1999	([1])	2,245.6	2,947.6	([1])	([1])
2000	([1])	2,501.7	3,399.0	([1])	([1])
2001	([1])	2,537.4	2,920.6	([1])	([1])

[1] Not available.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

2000, but up from $338.9 million in 1997 (table 4-16). The increase in imports in 2000 was the result of increased imports of Hong Kong-origin TDMs and also increased imports from China. Imports of Hong Kong-origin TDMs are those that have been shipped overseas for further processing or use and subsequently returned to Hong Kong for manufacture, repair, or use. Imports of TDMs are dominated by industrial molds, representing 78 to 81 percent of all TDM imports during 1997-2001. Japan was the leading supplier of TDMs to Hong Kong, accounting for over 34 percent of imports in 2001, followed by China, accounting for slightly more than 28 percent. Taiwan supplied about 8 percent of imports; reportedly, 98 percent of such imports are transshipments to mainland China.[313] Hong Kong tariffs on TDMs are free.

Hong Kong exports totaled $325.3 million in 2001, up 14 percent from exports of $285.3 million in 1997 (table 4-17). Exports of molds accounted for 85 percent of all TDM exports in 2001, down from 88 percent in 1997. China was the principal destination, accounting for 64 percent of all Hong Kong TDM exports. The second-largest market was the United States, representing 10 percent of exports.

[313] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

Table 4-16
Tools, dies, and industrial molds: Hong Kong imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Japan	92,275	95,111	86,189	99,123	100,111
China	44,817	51,303	61,597	79,345	89,222
Taiwan	57,614	63,069	55,956	54,312	25,947
United States	7,604	17,968	24,953	22,499	20,796
Korea, South	19,687	21,576	19,658	21,654	15,364
Malaysia	5,013	2,341	8,705	20,083	9,665
All other	41,331	41,694	38,167	46,771	41,813
Total	268,341	293,062	295,225	343,787	302,918
EU-15	10,679	12,991	15,042	11,933	15,848
NAFTA	13,119	23,809	28,051	26,567	28,197
China & Hong Kong	55,469	62,444	68,961	93,374	96,781
Tools and dies:					
Japan	15,737	14,399	11,366	16,349	14,127
Taiwan	4,483	3,215	3,684	2,727	3,629
China	3,089	2,643	2,686	3,222	3,389
Germany	3,058	5,567	1,856	1,352	1,998
United States	1,214	2,904	1,101	1,187	1,282
Korea, South	1,245	460	1,753	1,069	1,026
All other	3,528	2,495	5,064	2,702	2,347
Total	32,354	31,683	27,510	28,608	27,798
EU-15	4,200	6,598	3,158	2,544	2,889
NAFTA	1,228	2,919	1,120	1,220	1,291
China & Hong Kong	3,572	2,976	2,842	3,388	3,572
Jigs and fixtures:					
Japan	26,636	15,901	22,468	34,555	14,903
China	3,068	7,570	7,748	14,055	14,091
Singapore	143	147	471	1,032	4,696
United States	3,021	12,324	17,065	7,214	3,605
France	1,262	39	515	394	1,331
Taiwan	1,243	2,273	1,700	2,159	1,036
All other	2,854	4,727	7,145	4,393	4,078
Total	38,227	42,981	57,112	63,802	43,740
EU-15	2,878	3,531	5,749	2,183	2,658
NAFTA	3,027	12,324	17,066	7,218	3,620
China & Hong Kong	3,115	7,590	8,113	14,208	14,160
Total:					
Japan	134,647	125,411	120,022	150,027	129,141
China	50,975	61,516	72,032	96,622	106,702
Taiwan	63,340	68,557	61,340	59,198	30,612
United States	11,839	33,196	43,120	30,899	25,683
Korea, South	21,395	22,360	21,789	23,177	16,614
Malaysia	5,929	2,840	9,302	20,908	9,820
All other	50,797	53,847	52,242	55,366	55,885
Grand total	338,922	367,727	379,847	436,197	374,457
EU-15	17,757	23,119	23,949	16,660	21,395
NAFTA	17,374	39,051	46,238	35,005	33,108
China & Hong Kong	62,156	73,010	79,917	110,969	114,513

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-17
Tools, dies, and industrial molds: Hong Kong exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
China	151,647	140,139	152,912	159,126	172,083
United States	19,639	17,790	22,637	32,610	30,978
Japan	6,700	10,401	7,531	7,152	8,855
Malaysia	6,005	8,072	7,453	7,411	8,363
Thailand	6,157	5,775	5,474	7,879	6,642
Germany	2,430	2,765	3,053	2,345	4,971
All other	59,056	46,261	41,082	52,814	45,144
Total	251,634	231,203	240,142	269,337	277,036
EU-15	12,397	7,708	9,201	14,772	15,738
NAFTA	25,602	23,554	28,103	37,004	39,315
China & Hong Kong	151,647	140,139	152,912	159,126	172,083
Tools and dies:					
China	9,720	12,463	10,708	15,339	17,820
Malaysia	1,284	1,958	1,952	3,029	1,960
Taiwan	2,557	2,985	2,679	1,746	924
Thailand	950	887	175	467	923
Singapore	2,153	872	134	216	733
United States	2,082	423	530	419	569
All other	4,241	3,644	2,528	3,293	2,302
Total	22,987	23,232	18,706	24,509	25,231
EU-15	1,265	1,318	635	551	522
NAFTA	2,185	435	546	498	746
China & Hong Kong	9,720	12,463	10,708	15,339	17,820
Jigs and fixtures:					
China	8,729	23,365	28,429	23,562	18,256
Thailand	134	390	229	16	1,422
Japan	1,117	1,126	1,227	1,233	1,080
United States	75	332	108	492	949
Taiwan	76	10	47	1,295	701
Singapore	88	40	74	45	284
All other	444	577	437	556	366
Total	10,663	25,840	30,551	27,199	23,058
EU-15	72	31	205	290	167
NAFTA	75	345	111	522	965
China & Hong Kong	8,729	23,365	28,429	23,562	18,256
Totals:					
China	170,097	175,967	192,049	198,026	208,159
United States	21,796	18,545	23,275	33,520	32,496
Malaysia	7,307	10,036	9,468	10,465	10,329
Japan	8,283	12,234	8,896	8,599	10,114
Thailand	7,241	7,053	5,877	8,362	8,988
Singapore	9,209	5,234	5,626	9,882	5,616
All other	61,352	51,206	44,208	52,190	49,623
Grand total	285,285	280,275	289,399	321,044	325,325
EU-15	13,734	9,058	10,041	15,613	16,427
NAFTA	27,863	24,334	28,759	38,024	41,026
China & Hong Kong	170,097	175,967	192,049	198,026	208,159

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Government Policies and Programs

The Hong Kong Government provides assistance to its TDM producers principally through support of a rapid-prototyping center and financing for R&D projects on dies and molds conducted at Hong Kong universities. Hong Kong also provides its small and medium-sized businesses with programs to assist with loan guarantees for facilities and equipment, export marketing, training, and business development. In 1994, with funding from the Innovation and Technology Commission, the Productivity Council and the City University of Hong Kong established a Rapid Prototyping Technology Center.[314] This center also sells rapid-prototyping services, and thus competes with private companies offering such services.[315] Hong Kong Polytechnic has established a Rapid Product Development Resource Center equipped with rapid-prototyping machinery to train students in rapid-prototyping production.[316] The City University of Hong Kong, Hong Kong Polytechnic, and Hong Kong University also conduct specific research projects on TDMs.[317] Some projects for the TDM industry are funded by the Innovation and Technology Commission of the Hong Kong Government. Hong Kong Polytechnic opened a Center for Advanced Manufacturing Research with almost $6.5 million in equipment in 1996 that, among other projects, researches ultraprecision machining for the mold industry. The center was funded by the Industry and Technology Development Council of the Hong Kong Government.

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[314] Innovation and Technology Commission, "Foundation Industries," found at *http://www.info.gov.hk/itc/eng/technology/foundation.shtml*, retrieved Aug. 27, 2002.

[315] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[316] Rapid Product Development Resource Centre, "Overview," found at *http://rpdrc.ic.polyu.edu.hk/content/rp_survival_for_hk_mfg_ind.htm*, retrieved Aug. 27, 2002.

[317] For example, see the list of 2001research projects conducted at City University of Hong Kong Department of Manufacturing Engineering and Engineering Management at *http://www.cityu.edu.hk/mpu/rp2001/*, including a number of TDM topics.

Taiwan

Industry Profile

Composition of the Industry

There are an estimated 3,400 TDM producers in Taiwan, 60 percent of which are small, family-owned businesses.[318] This figure includes establishments that are dedicated to other businesses and produce TDMs only on occasion; therefore, the number of exclusive TDM firms in Taiwan is estimated at only 1,000.[319] As the bulk of Taiwan's TDM firms have fewer than 30 workers, companies are generally not listed on the stock exchange. Reportedly, only those companies involved in additional commercial pursuits such as molding or stamping operations are publicly traded.[320] Further, there are reportedly no State-owned companies in the TDM sector. With respect to geographic distribution, approximately one-half of all TDM producers are located in the industry-intensive north, with firms surrounding Taipei involved primarily in TDM production for the electronics industry. The remainder is distributed evenly between central Taiwan, where producers primarily serve the hand tool and machinery industries, and southern Taiwan, which boasts a large concentration of automotive-related operations.[321]

Unique industry characteristics and significant strengths and weaknesses of the Taiwan TDM industry

Unique industry characteristics:
- Large number of small firms
- TDM producers are heavily invested in China
- Industry emphasis on increasing use of computers in design and production

Strengths:
- Quick lead times (time required to produce a die or mold)
- Skilled in producing medium-precision and relatively complex dies and molds
- Combination of production facilities in China and design and marketing operations in Taiwan allows TDM firms to take advantage of low wage rates while controlling key processes
- Aggressive marketing skills and experience

Weaknesses:
- High labor rates relative to China
- Taiwan customers have moved production to foreign locations, particularly China
- Many Taiwan die and mold producers tend to be small companies with limited financial resources

Total employment in Taiwan's TDM industry is 44,000, with average monthly salaries ranging from $868 for entry-level workers with over 1 year of experience to as high as $2,027 for experienced personnel with approximately 20 years of service.[322] The industry reports a recent increase in the number of high-school graduates in its workforce;

[318] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.
[319] Ibid.
[320] Ibid.
[321] Taiwan authorities, interviews by USITC staff, Taiwan, May 30, 2002.
[322] Taiwan authorities and industry officials, interviews by USITC staff, Taipei, May 29-30, 2002.

however, the majority of production workers join the trade after finishing the 9th grade.[323] Those workers who complete their education are often from local technical high schools, trade colleges, or technical training centers.[324] Converse to the rise in the number of educated workers, the industry has witnessed a decline in workforce age. Reportedly, older workers are increasingly being replaced with younger staff, pushing the average age of workers in the industry down to 35 in recent years.[325] Concerning working hours, Taiwan TDM shops generally operate on a 44-hour work week, with designers and technicians averaging an extra 6 hours and 15 hours of overtime, respectively.[326]

Worker training for distinct manufacturing skills is generally the responsibility of the individual company, but Taiwan's TDM industry association is taking an active role in sponsoring technical seminars, business-exchange workshops, and certification assistance to help its members better respond to the global market. Further, the industry is working to compress worker training times from approximately 1 year for machinists and 2 to 3 years for toolmakers and engineers to roughly 6 months overall by targeting the fundamental skills used most in TDM production versus a more comprehensive education.[327] Currently, the industry is experiencing difficulty attracting sufficient workers, particularly engineers and individuals competent in technical research and international market development. Through such training initiatives, as well as recruitment activities at local schools, the industry anticipates promoting interest in the TDM sector and hastening the initiation of new talent to producing firms.[328] The industry faces an additional challenge in retaining trained workers, since mandatory military service disrupts the apprenticeship of entry-level workers and often leads to the loss of young trainees, who lose their skills while on active military duty or simply lose interest in the business and pursue other fields.[329]

Taiwan's TDM industry mirrors that of Japan in that the abundance of small-sized producers lends itself to subcontracting and specialization by process or function. Reportedly, many Taiwan TDM shops focus on certain production processes for TDMs, including design, electrical-discharge machining, wire electrical-discharge machining, tryout services, etc. Subcontracting is used by both large and small producers. Small firms report outsourcing up to 100 percent of high-end services such as design and wire electrical-discharge machining work, whereas one of Taiwan's largest TDM firms indicates a reliance on subcontractors in times of high demand, or when the subcontractor can perform certain tasks at a lower cost than in-house staff.[330]

The TDM industry in Taiwan is characterized by increasing globalization. Not only are Taiwan-based companies pursuing global business opportunities in response to a shrinking domestic market, but TDM firms are successively establishing overseas production bases in key markets to take advantage of lower manufacturing costs and

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[323] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

[324] Eiji Saito, "Taiwan–Current Situation in the Die and Mold Industry," (in Japanese), *Machine and Tool* (*Kikai To Kougu*), Apr. 2001, special edition, p. 21.

[325] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

[326] Saito, "Taiwan–Current Situation in the Die and Mold Industry," p. 21.

[327] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

[328] Ibid.

[329] Japanese industry officials, interviews by USITC staff, Tokyo, June 7, 2002.

[330] Saito, "Taiwan–Current Situation in the Die and Mold Industry," p. 22; and Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

position themselves near important customers. Given the advantage Taiwan producers have with Chinese language and customs, TDM shops largely invest in China, with a notable concentration of Taiwan firms in the southern Province of Guangdong.[331] Taiwan producers have also followed domestic buyers and multinational OEMs that have shifted production to other Asian countries and have set up TDM manufacturing subsidiaries in Malaysia, Thailand, and Vietnam.[332] There is FDI in the U.S. industry by Taiwan TDM firms, but it is minimal. Commonly, a TDM firm investing abroad will establish a factory for fabrication of dies and molds in the overseas location but keep design and management operations headquartered in Taiwan. The industry encourages this arrangement to ensure that profits are directed back home and as a means of maintaining core competencies within Taiwan companies in order to redefine the industry's role as a TDM design base, with only limited domestic manufacturing in high-end tooling. A key challenge for the industry is the inability of small producers to adopt such structural changes. Industry sources indicate that those small firms that are unable to invest overseas will have to increase their size and capacity through consolidation, or exit the industry.[333]

According to industry sources, the Taiwan TDM industry is unattractive to foreign investors, because of the advanced age of production facilities and limited domestic market.[334] There are reportedly few, if any, foreign-owned shops that exclusively manufacture TDMs, and only minimal foreign investment in TDM shops with related stamping, molding, or assembly operations. Japan is the largest source of FDI capital, and essentially all Japanese investment in Taiwan's TDM industry is directed at the export market. For example, one of Japan's largest die producers established operations in Taiwan for the purpose of supplying tooling to China's automotive industry.

Manufacturing Infrastructure

Taiwan's TDM producers have access to lower priced raw materials from Asia and domestically produced machine tools, but must pay significantly higher prices for top-quality imported steel and machinery from the United States, Japan, Germany, Sweden, and Switzerland. With the growing emphasis on design capabilities and focus on multinational buyers, Taiwan TDM manufacturers must also purchase high-priced software systems that allow producers to interface with their customers and accept and transfer designs and data in the proper format. Despite the reliance on foreign sources for state-of-the-art production and design equipment, Taiwan TDM shops reportedly have better access to production equipment than in the past. Previously, a lack of after-sales service limited producers' choice of machinery. Once global machine tool manufacturers established local offices in Taiwan, TDM firms were able to increase purchases of foreign-made machine tools and therefore increase the level of precision in their products.[335] Despite the higher price associated with imported materials and machinery, some large producers report that they are able to secure lower prices because of their

[331] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002; Japanese industry officials, interviews by USITC staff, Tokyo, June 7, 2002; and Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.
[332] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.
[333] Taiwan industry officials, interviews by USITC staff, Taipei, May 29-30, 2002.
[334] Taiwan authorities, interviews by USITC staff, Taipei, May 30, 2002.
[335] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

volume purchases.[336] With respect to capital investment, TDM producers try to keep up with the latest technology and will frequently adjust their manufacturing infrastructure based on requirements from their customers. For the most part, however, Taiwan TDM firms have focused their efforts on building up their production facilities in China. Frequently, they have transferred older equipment from Taiwan to their Chinese production facilities for initial production of lower end TDMs.

Technological Capabilities

The current process and design competencies of the TDM industry in Taiwan are based upon technologies transferred by Japanese companies that invested in Taiwan in earlier years and trained Taiwan suppliers in their standards and methods for tooling production.[337] Reportedly, the Taiwan industry has rapidly advanced from the production of simple products to complex tooling,[338] and one source puts the technological capabilities of Taiwan's TDM producers behind those of Japan by only 6 months.[339] At the same time, there may be wide disparities in capabilities among Taiwan's TDM producers and other established global producers according to the end-user industries served. For example, production in Taiwan is concentrated in the mold sector, and the industry's capabilities in die design and fabrication are not as developed as core competencies with respect to medium- and high-precision mold production. Further, industry sources report that Taiwan TDM shops can build complex molds that rival if not exceed those of their Japanese counterparts;[340] but at the same time, Taiwan tooling imported into the United States must often undergo engineering changes or repair work either before it can be used or midway through the production cycle.[341] Capabilities also vary widely between the more underdeveloped small shops and large firms that have ample funds for R&D, computerization, and sophisticated equipment. Given the relative nascence of the industry, the principle of workmanship is reportedly less developed in Taiwan's TDM industry,[342] but producers may have a higher degree of computer literacy than more traditional competitors.[343]

In the future, the TDM industry in Taiwan intends to expand its production capabilities for high-precision and complex tooling and cultivate an expertise in product R&D and design.[344] Producers are also interested in pursuing value-added services and advanced production methods such as rapid prototyping and electrical-discharge machining, particularly if such skills are demanded by current and prospective buyers.[345] Moreover, Taiwan producers still work closely with Japanese OEMs, as well as other large

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[336] Ibid.

[337] Ben Shen, "Local Industry Remolds for High-Tech Markets," China Economic News Service, found at *http://www.cens.com/linerpt/20020430064.html* retrieved July 29, 2002; and Japanese industry officials, interviews by USITC staff, Saitama, Gunma, June 6, 2002, and Osaka, June 7, 2002.

[338] Testimony of Carl E. Jones, President, Penn United Technology, Inc., transcript of the hearing, p. 169.

[339] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[340] Ibid.

[341] Testimony of Steven R. Prahl, Trico Mold & Engineering, Inc., transcript of the hearing, p. 242; and U.S. industry officials, interviews by USITC staff, Chicago, IL area, Apr. 23, 2002.

[342] Hong Kong industry officials, interviews by USITC staff, Hong Kong, June 15, 2002.

[343] Japanese industry officials, interviews by USITC staff, Osaka, June 7, 2002.

[344] Taiwan industry officials, interviews by USITC staff, Taipei, May 29-30, 2002.

[345] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

multinational corporations, and are able to augment their current capabilities through the acquisition of sophisticated technologies from their customers.[346] If the Taiwan industry continues to nurture advanced technological skills while supporting low-cost production centers in China, Taiwan's TDM producers will likely remain formidable competitors to U.S. producers in many medium- and high-end applications.

Production and Sales

During 1997-2001, TDM production in Taiwan substantially dropped, from over $2 billion to $1.2 billion, or by more than 42 percent (table 4-18). Measured in New Taiwan Dollars, the decline was less dramatic but still considerable at just over 32 percent. Domestic shipments of TDMs fairly consistently declined during the period; however, the most sizeable reduction occurred between 2000 and 2001, over 24 percent when measured in U.S. dollars, or over 18 percent in terms of New Taiwan Dollars. The pronounced decline in production is largely the result of Taiwan TDM producers shifting production to China, as well as the general decline of manufacturing industries in Taiwan. The latter also explains the 55-percent drop in domestic consumption of TDMs during 1997-2001. With respect to product distribution, production data by product category are unavailable, but Taiwan TDM producers reportedly compete primarily in the industrial mold sector. However, industry sources expect that in the future, die production will increase relative to mold production.[347]

Table 4-18
Tools, dies, and industrial molds: Taiwan shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	2,022.0	498.4	179.7	1,703.3	10.5
1998	1,805.5	474.2	160.4	1,491.7	10.8
1999	1,647.8	535.7	158.4	1,270.5	12.5
2000	1,541.3	660.1	241.7	1,122.8	21.5
2001	1,165.5	556.3	161.1	770.3	20.9
	Value *(billion New Taiwan dollars)*				
1997	58.0	14.3	5.1	48.8	10.4
1998	60.4	15.8	5.3	49.9	10.6
1999	53.2	17.2	5.1	41.1	12.4
2000	48.1	20.6	7.5	35.0	21.4
2001	39.4	18.8	5.4	26.0	20.8

Source: Data provided by the Industrial Development Bureau, Ministry of Economic Affairs, Taiwan, May 30, 2002; and Global Trade Information Services, Inc., World Trade Atlas Internet database, found at *http://www.gtis.com*.

[346] Shen, "Local Industry Remolds for High-Tech Markets."
[347] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

Market Characteristics and Trends

Customer Base

The market for Taiwan-produced TDMs has undergone a notable transformation with the mass exodus of domestic downstream buyers and relocation of multinational OEMs to low-cost production centers such as China. Taiwan's domestic customer base has grown considerably smaller in the past several years, and there has been a progressive shift in the nature of domestic demand. Taiwan's TDM industry initially served the electronics, automotive, and home appliance sectors, but a significant amount of such work is now directed to foreign-invested or indigenous Chinese TDM firms, particularly as molding or stamping related to the end product is increasingly done in China. Currently, Taiwan producers are focused on and established in the production of TDMs for laptop computers, notebook personal computers, modems, cellular telephones, and other products. A goal of the industry is to move into production of dies and molds for integrated circuits, liquid crystal displays, high-definition displays, DVD devices, and other high-technology industries that are expected to develop in Taiwan in the near term.[348] China will likely remain the largest foreign market for Taiwan-produced TDMs, given the increase in OEM manufacturing there, as well as the underdeveloped capabilities of many Chinese firms. However, Taiwan TDM producers have been known to make aggressive marketing advances to U.S. customers, and many indicate a desire to do business with Western firms no matter where these potential customers produce.[349] Taiwan's experience with computers, proficiency in the English language relative to other Asian competitors, and use of brokers for small firms may aid many firms in doing business with U.S. customers.

Purchase Decision Variables

Taiwan industry sources report that ex factory prices for TDMs produced in Taiwan are about 30 percent higher than Chinese prices and roughly 60 percent lower than U.S. prices for the equivalent product.[350] Concerning quality, the transition of domestic producers from medium-precision TDM production into the manufacture of high-precision, complex dies and molds indicates that quality has improved; however, there are still high-end TDMs for which the quality level offered by Taiwan manufacturers is insufficient.[351] The Taiwan TDM industry ranks itself below Germany, the United States, and Japan in terms of accuracy and product life.[352] Further, TDMs produced in Taiwan are reportedly inferior to TDMs produced in China by Japanese-owned companies, but better than tooling manufactured in China by Taiwan- or Hong Kong-invested TDM shops.[353]

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[348] Saito, "Taiwan–Current Situation in the Die and Mold Industry," p. 23.

[349] U.S. industry officials, correspondence with USITC staff, May-August 2002; and Taiwan industry officials, interviews by USITC staff, Taipei, May 30, 2002.

[350] Prahl, transcript of the hearing, p. 207; and Taiwan and Chinese industry officials, interviews by USITC staff, Taipei and Dongguan, May 29 and June 13, 2002.

[351] Taiwan authorities, interviews by USITC staff, Taipei, May 30, 2002.

[352] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

[353] Japanese Government officials, interviews by USITC staff, Tokyo, June 3, 2002.

A competitive strength of Taiwan TDM manufacturers is their ability to compress lead times and design, produce, and ship tooling at a much faster pace than other global TDM manufacturers. Discrepancies exist between individual companies, and some producers reportedly are not making advances in minimizing their production times.[354] However, one producer with 55 employees reports lead times of approximately 20 days for smaller TDMs and 105 days for larger tooling.[355] Smaller companies ranging in size from 15 to 30 employees indicate that they take an average of 40 to 75 days to receive an order, produce the die or mold, and process it through the first tryout, whereas one very large firm headquartered in Taiwan with production facilities in China reports designing and producing a tool in just over 1 week.[356] The life cycles are becoming shorter for products in high-technology sectors, the very industries in which Taiwan producers desire to compete. Therefore, Taiwan's TDM firms consider the reduction of lead times as a crucial determinant of future competitiveness. Industry sources explain that through coordinated teamwork, which entails a company divvying out individual production processes or even actual parts of the die or mold to its employees, simultaneous work can be performed and the comprehensive time needed to fill a particular order can be reduced.[357] Another reported approach is to quickly produce a die or mold within the requested time frame and then duplicate the tooling shortly thereafter. When the first mold or die fails, the producer replaces it with the copy. This is reportedly a somewhat costly method for producers, but by agreeing to the initial deadline, the TDM firm is able to win the contract.[358]

Trade

Taiwan's TDM imports and exports are presented in tables 4-19 and 4-20, respectively. As with production, exports of TDMs from Taiwan declined during 2000-2001, reflecting the trend of Taiwan producers to maintain company headquarters in Taiwan but relocate a portion, if not all, of manufacturing capacity to China. Overall, however, exports grew during 1997-2001, from $498 million in 1997 to $556 million in 2001, or by nearly 12 percent (table 4-20). The Taiwan industry's specialization in mold production is evident in the trade data, with exports of industrial molds, primarily molds for plastics and rubber,[359] accounting for over 87 percent of sector exports in 2001. Although trade data denote Hong Kong as the primary destination for Taiwan-produced TDMs, 98 percent of exports to Hong Kong are transhipments to end users in China.[360] China garners another 8-percent share of direct exports, making it by far the largest market for Taiwan TDMs. The United States is the second-largest market, accounting for over $50 million or approximately 9 percent of Taiwan's exports in this sector. Shipments to the United States are comparatively small, but increased by over 50 percent during 1997-2001.

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[354] Saito, "Taiwan–Current Situation in the Die and Mold Industry," p. 23.
[355] Ibid.
[356] Ibid; and Taiwan industry officials, interviews by USITC staff, Taipei, May 30, 2002.
[357] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.
[358] Ibid.
[359] Saito, "Taiwan–Current Situation in the Die and Mold Industry," p. 21.
[360] Taiwan industry officials, interviews by USITC staff, Taipei, May 29, 2002.

Table 4-19
Tools, dies, and industrial molds: Taiwan imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Japan	75,784	74,054	87,282	126,489	69,299
Italy	3,520	1,693	2,109	382	14,756
United States	8,109	9,663	8,297	8,719	8,742
Korea, South	2,459	3,025	3,505	19,002	8,251
Canada	4,555	1,094	1,535	3,160	4,660
Hong Kong	6,367	6,023	3,500	3,782	4,225
All other	26,438	17,867	12,042	20,466	12,015
Total	127,232	113,419	118,270	182,000	121,948
EU-15	17,973	11,597	9,357	10,531	20,727
NAFTA	12,669	10,811	9,837	11,882	13,402
China and Hong Kong	6,429	6,671	3,595	4,187	4,942
Tools and dies:					
Japan	28,999	24,466	19,718	32,936	14,945
Korea, South	207	394	471	2,742	4,327
Malaysia	827	765	465	438	1,993
China	490	246	333	695	1,057
United States	2,002	1,541	1,561	2,159	849
Hong Kong	773	227	692	985	687
All other	3,481	3,565	2,312	1,812	1,743
Total	36,779	31,204	25,552	41,767	25,601
EU-15	2,144	1,369	1,404	1,358	1,034
NAFTA	2,015	1,564	1,583	2,172	866
China and Hong Kong	1,263	473	1,025	1,681	1,744
Jigs and fixtures:					
Japan	10,047	10,883	9,775	11,882	7,340
China	1,373	1,620	1,743	1,883	2,212
Netherlands	9	6	241	558	1,056
Germany	1,089	684	594	854	1,014
Italy	898	933	659	783	622
United States	1,405	545	588	921	441
All other	842	1,084	962	1,039	843
Total	15,663	15,755	14,562	17,920	13,528
EU-15	2,309	2,177	1,766	2,436	3,082
NAFTA	1,407	547	639	921	441
China and Hong Kong	1,472	1,660	1,810	1,884	2,228
Total:					
Japan	114,830	109,403	116,776	171,307	91,584
Italy	5,027	3,000	3,171	1,394	15,749
Korea, South	2,718	3,441	4,030	21,788	12,686
United States	11,517	11,748	10,446	11,799	10,032
Hong Kong	7,239	6,290	4,259	4,768	4,928
Canada	4,569	1,119	1,608	3,172	4,674
All other	33,774	25,377	18,095	27,459	21,423
Total	179,674	160,378	158,385	241,687	161,076
EU-15	22,426	15,144	12,527	14,325	24,843
NAFTA	16,091	12,921	12,059	14,975	14,709
China and Hong Kong	9,163	8,804	6,430	7,751	8,915

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-20
Tools, dies, and industrial molds: Taiwan exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Hong Kong	175,743	179,934	178,669	234,360	175,802
United States	29,728	37,001	38,138	49,858	45,510
China	3,611	5,004	17,511	43,077	39,698
Malaysia	39,302	25,682	28,305	39,015	31,511
Thailand	26,202	23,583	28,768	33,002	27,918
Japan	36,669	34,330	40,306	31,165	27,465
All other	144,517	127,050	131,090	158,869	137,230
Total	455,772	432,584	462,787	589,346	485,134
EU-15	17,275	16,299	24,737	32,399	28,940
NAFTA	34,246	41,710	41,658	61,332	56,645
China and Hong Kong	179,355	184,939	196,180	277,437	215,499
Tools and dies:					
Hong Kong	16,542	19,535	48,244	28,022	26,902
Malaysia	4,323	5,424	4,143	5,783	4,580
China	525	270	2,076	5,821	4,519
Thailand	1,721	1,676	2,221	3,022	4,303
United States	3,151	2,323	3,105	3,186	3,414
Japan	4,489	2,847	835	2,977	3,215
All other	9,096	5,393	7,551	15,563	17,359
Total	39,847	37,468	68,175	64,374	64,292
EU-15	3,775	2,615	2,190	4,226	6,410
NAFTA	3,258	2,519	3,369	3,848	4,328
China and Hong Kong	17,067	19,805	50,321	33,843	31,421
Jigs and fixtures:					
Hong Kong	792	935	2,072	2,438	2,856
United States	617	880	997	1,363	1,377
Malaysia	110	546	19	150	642
Germany	144	212	117	362	395
Japan	127	142	175	265	231
Singapore	280	106	57	133	158
All other	678	1,285	1,315	1,675	1,186
Total	2,748	4,106	4,752	6,386	6,845
EU-15	545	907	634	896	894
NAFTA	686	1,041	1,230	1,547	1,476
China and Hong Kong	793	938	2,141	2,748	2,880
Totals:					
Hong Kong	193,076	200,405	228,986	264,821	205,560
United States	33,495	40,204	42,240	54,407	50,301
China	4,138	5,277	19,656	49,207	44,241
Malaysia	43,735	31,652	32,467	44,948	36,732
Thailand	28,006	25,290	31,084	36,245	32,345
Japan	41,285	37,318	41,316	34,406	30,911
All other	154,633	134,012	139,965	176,072	156,181
Total	498,368	474,158	535,714	660,106	556,271
EU-15	21,596	19,821	27,560	37,521	36,243
NAFTA	38,191	45,270	46,258	66,726	62,449
China and Hong Kong	197,214	205,681	248,641	314,028	249,801

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York and New Jersey.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Imports as a share of domestic consumption doubled during 1997-2001, but the value of imports declined by more than 10 percent, from $180 million in 1997 to $161 million in 2001, reflecting reduced overall demand and a greater reliance on foreign sources of TDMs. Japan is the largest supplier of TDMs to Taiwan, accounting for 76 percent of sector imports in 2001. Secondary suppliers include Italy, with a 10-percent share of imports, Korea, with an 8-percent share, and the United States, which accounted for just over 6 percent of the total value of imports in 2001. Imports consist primarily of sophisticated dies and molds that Taiwan firms have not yet acquired the ability to produce, e.g., tooling for use in advanced technology industries such as semiconductor and disk manufacturing.[361] End-users also import products that cannot be replicated in Taiwan because of patent rights or technology-transfer concerns.[362] The unit price of imported TDMs is reportedly 1.5 times the price of exported products, further evidence that foreign sources serve a narrow, high-end market for precision products.[363]

Government Policies and Programs

Certain tax, investment, and R&D benefits are available to manufacturing industries by Taiwan authorities; however, only a few are applicable or accessible to TDM firms.[364] Producers of TDMs may be eligible for tax breaks and preferential loan treatment for upgrading or adding production machinery, or they may acquire research grants for product development. Exporting companies might also receive a break on sales and import taxes. Taiwan authorities report that use of such programs by TDM firms is low. With respect to R&D support, for example, approximately $30 million is allotted to all industries per year, but only $148,000 or 0.5 percent goes to firms that produce TDMs.[365] Sources also report that in any given year, there are no more than four TDM companies that apply for R&D grants.[366]

Duties on imported TDMs range from none to 11 percent ad valorem. Tariff rates are 5 to 10 percent ad valorem on dies and 4 percent on most molds, with certain plastic injection and compression molds having a tariff rate of "free."[367]

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[361] Taiwan authorities, interviews by USITC staff, Taipei, May 30, 2002.

[362] Ibid.

[363] Saito, "Taiwan–Current Situation in the Die and Mold Industry," p. 22.

[364] Information in this section was obtained primarily from Hong Kong Mould & Die Council, *Hong Kong and Foreign Countries Investment Benefits Explanation Handbook*, Edition 1, Aug. 1997; and Taiwan authorities, interviews by USITC staff, Taipei, May 30, 2002.

[365] Taiwan authorities, interviews by USITC staff, Taipei, May 30, 2002.

[366] Ibid.

[367] Taiwan became the 144th member of the WTO on January 1, 2002, 30 days after notifying the Director-General that it had completed domestic ratification of its accession package. For protocols of accession, see WTO, Working Party On the Accession of the Separate Customs Territory of Taiwan, Penghu, Kinmen, and Matsu, WT/MIN(01)/4/Add.1, Nov. 11, 2001.

European Union

Industry Profile

As a region, the European Union (EU) likely ranks as the largest producer and consumer of TDMs on the basis of the region's large trade volumes and various, though incomplete, estimates of TDM production. Since trade data are readily available, but data on EU TDM industry size, employment, and production are not, much of the following discussion and data are trade related. EU TDM producers have been affected by many of the same issues challenging TDM producers in the United States and Japan. Also, EU TDM producers benefit from a variety of EU programs for funding of training and R&D projects. Two TDM industries in the EU stand out, those of Germany and Portugal. The German TDM industry ranks as the largest exporter and importer in the EU, is a leader in the production of high-precision and high-complexity TDMs, and relies on extensive R&D, but has high labor costs. In contrast, the Portuguese TDM industry has been successful in exporting and is known for adopting the latest computer technologies despite the fact that Portugal has a small industrial base on which its TDM industry can depend.

Unique industry characteristics and significant strengths and weaknesses of the EU TDM industry

Unique industry characteristic:
- Relatively small number of TDM producers in each EU member country

Strengths:
- Tradition of craftsmanship in the production of dies and molds
- Some EU TDM producers have short lead times (time required to produce a die or mold), but others do not.
- Skilled in producing high-precision and complex dies and molds
- EU programs to support TDM R&D
- EU TDM producers may benefit from lower production costs at facilities in neighboring Eastern European countries

Weaknesses:
- High labor costs, particularly in northern Europe
- EU customers have moved production to foreign locations, particularly China and Southeast Asia

Market Characteristics and Trends

Customer Base

The principal issues affecting the EU TDM industry include rising labor costs within the EU and a migration of EU customers to low-cost foreign production locations and emerging markets. EU customers have shifted production to locations both within the EU, such as Spain, and externally, including Eastern European and Asian nations, particularly China.[368] For example, EU molders are investing in the Czech Republic, Poland, Hungary, Slovenia, and Croatia as demand in these countries rises for

[368] United Kingdom design software industry representative, interview by USITC staff, Feb. 19, 2002.

automobiles, consumer and business electronics, and disposable medical products.[369] Siemens, a large German electronics and electrical equipment producer, and Nokia, the Finnish cellular telephone producer, for example, have established extensive production facilities in China. EU TDM producers, faced with a contracting domestic market and increasing global competition, are also affected by rising labor costs and restrictive labor rules in the EU. Thus, they are seeking improvements in delivery times and cost reductions through productivity gains from investments in machinery, design, and manufacturing software. High cost EU TDM producers are taking advantage of lower labor costs in Spain, Portugal, and Eastern European countries such as the Czech Republic, Poland, and Hungary.

Trade

The EU has a large but slightly declining trade surplus in TDM products. In 2001, the EU TDM trade surplus totaled $1.6 billion, declining somewhat steadily from $1.8 billion in 1997 (table 4-21).[370] During 1997-2001, a number of EU members, mostly smaller countries, had chronic trade deficits in TDMs. However, the United Kingdom (UK) had the largest trade deficit, totaling $107 million in 2001, up from $91 million in 1997. Also, France moved from a trade surplus of $72 million in 1997 to a trade deficit of $43 million in 2001. Over the past 5 years, Germany's trade surplus eroded, rising during 1997-99, but then declining by more than $100 million in 2000-01. The TDM trade surpluses of Austria and Portugal grew steadily during 1997-2001.

EU TDM exports fluctuated between $4.4 billion and $4.8 billion over the past 5 years. The EU's largest TDM exporter is Germany at almost $1.5 billion, followed by Italy at almost $1.1 billion in 2001 (table 4-20). During 1997-2001, exports of TDMs from Austria and Portugal rose, and exports of TDMs from the UK declined.

EU TDM imports ranged between $2.7 billion and almost $3.1 billion during 1997-2001 (table 4-21). The largest importer of TDMs was Germany, followed by France and Italy in 2001. Spanish imports of TDMs rose substantially during 1998-2000 as compared with 1997. German imports of TDMs dramatically rose between 1997 and 1998 and remained at a higher level, whereas French imports increased steadily throughout the period.

The EU's major external trading partners, by TDM product groupings, are shown in tables 4-22 and 4-23. In 2001, the largest supplier of non-EU TDM imports was Switzerland, accounting for almost 23 percent of all non-EU TDM imports, followed by Japan at 18 percent and the United States at 15 percent (table 4-22). Other leading suppliers were the Czech Republic, Hungary, and Poland, imports from which have all consistently risen. With regard to TDM exports, the United States was the largest external EU market, accounting for almost 16 percent of the total, followed by Switzerland (table 4-23). Other major markets were the Czech Republic and China, to

[369] Agostino von Hassell, The Repton Group, "International Molding Report: Eastern Europe: An Undiscovered market," *Injection Molding Magazine*, Dec. 2000, found at *http://www.imment.com/articlelibrary/archive/getOneArticle.php3?getArtID=1447*, retrieved June 6, 2002.

[370] This discussion includes EU internal and external trade.

Table 4-21
Tools, dies, and industrial molds: European Union (EU) imports, exports, and trade balance, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
EU exports:					
Germany	1,483,188	1,611,948	1,626,058	1,457,716	1,465,487
Italy	1,050,604	1,072,966	1,031,259	914,442	1,083,378
France	404,210	441,295	435,618	399,291	394,798
Austria	247,712	249,949	287,160	320,358	336,300
United Kingdom	267,768	245,977	283,204	242,517	213,233
Belgium-Luxembourg[1]	284,781	317,539	282,329	328,151	281,675
Spain	278,576	289,633	319,808	289,964	284,958
Portugal	255,528	264,691	268,928	260,740	298,679
Netherlands	111,399	119,097	103,202	93,298	67,887
Sweden	53,273	65,290	58,783	50,130	42,758
Denmark	64,079	60,801	49,272	51,266	49,074
Ireland	31,635	32,630	21,799	18,966	20,642
Finland	15,970	18,090	25,587	18,741	16,272
Greece	6,351	5,091	5,607	2,143	2,726
Total	4,555,074	4,794,997	4,798,614	4,447,723	4,557,867
EU imports:					
Germany	769,102	891,429	868,981	818,602	833,632
Italy	315,910	377,254	372,149	333,439	361,917
France	328,240	359,507	406,585	425,948	437,818
Austria	175,786	183,926	206,484	234,105	218,107
United Kingdom	359,175	408,570	348,389	379,583	320,142
Belgium-Luxembourg[1]	169,386	188,849	229,187	208,684	208,864
Spain	121,919	203,085	180,530	203,286	148,305
Portugal	41,983	43,820	47,575	43,370	52,641
Netherlands	155,413	139,975	108,603	99,055	90,711
Sweden	158,196	128,002	107,252	91,246	95,255
Denmark	52,931	68,348	64,378	59,069	58,844
Ireland	33,299	37,499	44,768	45,572	43,727
Finland	34,327	37,819	36,499	46,085	41,036
Greece	23,678	22,657	21,264	20,478	17,438
Total	2,739,345	3,090,740	3,042,644	3,008,522	2,928,437
Trade balance:					
Germany	714,086	720,519	757,077	639,114	631,855
Italy	734,694	695,712	659,110	581,003	721,461
France	75,970	81,788	29,033	-26,657	-43,020
Austria	71,926	66,023	80,676	86,253	118,193
United Kingdom	-91,407	-162,593	-65,185	-137,066	-106,909
Belgium-Luxembourg[1]	115,395	128,690	53,142	119,467	72,811
Spain	156,657	86,548	139,278	86,678	136,653
Portugal	213,545	220,871	221,353	217,370	246,038
Netherlands	-44,014	-20,878	-5,401	-5,757	-22,824
Sweden	-104,923	-62,712	-48,469	-41,116	-52,497
Denmark	11,148	-7,547	-15,106	-7,803	-9,770
Ireland	-1,664	-4,869	-22,969	-26,606	-23,085
Finland	-18,357	-19,729	-10,912	-27,344	-24,764
Greece	-17,327	-17,566	-15,657	-18,335	-14,712
Grand total	1,815,729	1,704,257	1,755,970	1,439,201	1,629,430

[1] Belgium and Luxembourg reported data as a single entity during 1997-98, but separately thereafter.

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-22
Tools, dies, and industrial molds: European Union (EU) imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
EU external trade:					
Switzerland	206,205	232,046	215,730	193,068	225,145
United States	90,451	114,247	120,275	132,659	114,925
Czech Republic	51,255	74,811	85,751	90,269	94,725
Japan	70,006	79,588	90,097	110,279	77,052
Hungary	35,137	44,430	52,693	53,535	59,860
Poland	25,309	29,851	34,313	35,104	42,138
All other	188,095	193,379	231,920	245,170	253,125
Subtotal	666,458	768,352	830,779	860,084	866,970
EU internal trade	1,118,611	1,256,412	1,152,393	1,075,220	1,001,114
Total	1,785,069	2,024,764	1,983,172	1,935,304	1,868,084
NAFTA	122,553	147,668	150,638	166,285	153,725
China & Hong Kong	18,332	15,385	19,094	23,586	28,395
Tools and dies:					
EU external trade:					
Japan	110,290	115,579	101,648	116,637	162,952
United States	73,905	126,447	109,891	94,279	70,190
Switzerland	65,971	68,436	63,682	64,733	64,280
Czech Republic	13,698	14,731	23,475	29,768	41,139
Slovenia	8,881	6,297	6,354	11,571	11,688
Poland	6,046	7,422	11,038	6,522	10,348
All other	46,207	46,308	48,456	74,391	62,725
Subtotal	324,998	385,220	364,544	397,901	423,322
EU internal trade	469,039	482,154	506,709	488,543	442,539
Total	794,037	867,374	871,253	886,444	865,861
NAFTA	76,682	128,980	111,287	104,242	75,931
China & Hong Kong	2,630	3,226	1,145	2,023	2,067
Jigs and fixtures:					
EU external trade:					
United States	18,834	19,358	19,580	22,041	19,586
Switzerland	16,414	18,599	19,215	17,668	18,902
Japan	10,512	12,804	9,634	15,038	11,830
Czech Republic	5,346	6,932	6,153	7,063	7,219
Poland	2,718	2,636	2,508	2,898	3,042
Taiwan	2,262	2,726	2,603	2,443	2,480
All other	12,387	21,095	17,355	15,808	16,600
Subtotal	68,473	84,150	77,048	82,959	79,659
EU internal trade	91,767	114,452	111,170	103,815	114,832
Total	160,240	198,602	188,218	186,774	194,491
NAFTA	19,146	20,926	19,980	22,395	20,091
China & Hong Kong	1,423	1,855	1,230	2,212	2,451
Total:					
EU external trade:					
Switzerland	288,590	319,080	298,627	275,469	308,327
Japan	190,808	207,971	201,379	241,954	251,834
United States	183,190	260,053	249,746	248,979	204,701
Czech Republic	70,299	96,474	115,379	127,101	143,084
Hungary	42,018	50,188	62,133	61,564	71,576
Poland	34,072	39,909	47,858	44,524	55,528
All other	250,952	264,047	297,249	341,353	334,901
Subtotal	1,059,929	1,237,722	1,272,371	1,340,944	1,369,951
EU internal trade	1,679,416	1,853,018	1,770,273	1,667,578	1,558,486
Grand total	2,739,345	3,090,740	3,042,644	3,008,522	2,928,437
NAFTA	218,381	297,574	281,906	292,922	249,747
China & Hong Kong	22,385	20,466	21,468	27,822	32,913

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-23
Tools, dies, and industrial molds: European Union (EU) exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
EU external trade:					
United States	231,464	260,632	293,917	249,122	233,466
Switzerland	169,469	185,479	179,379	169,735	189,116
Czech Republic	78,954	120,254	118,042	124,876	147,279
Mexico	64,403	79,168	98,300	63,533	96,973
China	39,626	37,118	50,630	34,566	96,716
Poland	63,032	72,113	73,252	77,893	84,745
All other	757,578	799,385	722,876	641,975	701,828
Subtotal	1,404,526	1,554,149	1,536,396	1,361,700	1,550,123
EU internal trade	1,675,259	1,807,468	1,740,242	1,622,922	1,598,421
Total	3,079,785	3,361,617	3,276,638	2,984,622	3,148,544
NAFTA	323,748	372,194	431,586	346,114	357,046
China & Hong Kong	64,789	55,159	68,340	47,183	111,614
Tools and dies:					
EU external trade:					
United States	77,638	84,414	100,407	58,786	52,059
Switzerland	58,333	65,876	60,595	59,817	51,638
Czech Republic	14,631	18,346	44,198	38,247	38,233
Poland	28,537	18,433	30,865	20,768	21,672
China	5,702	16,822	95,401	12,049	21,111
Hungary	12,972	15,756	18,227	15,692	19,842
All other	238,341	225,950	185,436	163,892	165,346
Subtotal	436,154	445,597	535,129	369,251	369,901
EU internal trade	792,397	720,207	729,698	852,156	757,970
Total	1,228,551	1,165,804	1,264,827	1,221,407	1,127,871
NAFTA	110,462	126,549	130,303	79,610	72,604
China & Hong Kong	12,678	23,294	100,926	18,760	26,752
Jigs and fixtures:					
EU external trade:					
United States	36,738	47,786	34,377	35,705	33,381
Switzerland	13,706	16,824	16,051	13,985	14,340
Czech Republic	5,919	5,945	8,148	6,913	11,491
Japan	8,500	7,349	5,970	5,919	10,366
Norway	5,062	2,613	1,816	1,407	5,360
Slovakia	632	2,187	4,600	4,501	5,070
All other	51,773	50,200	50,946	48,311	56,600
Subtotal	122,330	132,904	121,908	116,741	136,608
EU internal trade	124,412	134,671	135,239	124,960	144,842
Total	246,742	267,575	257,147	241,701	281,450
NAFTA	43,003	55,651	40,766	41,511	42,244
China & Hong Kong	1,909	3,666	3,755	3,201	4,197
Totals:					
EU external trade:					
United States	345,840	392,833	428,700	343,613	318,906
Switzerland	241,508	268,179	256,025	243,537	255,094
Czech Republic	99,503	144,545	170,389	170,036	197,004
China	46,844	57,118	149,086	49,325	121,219
Mexico	99,354	123,527	127,182	83,948	118,519
Poland	93,031	92,419	107,058	101,647	110,318
All other	1,036,931	1,054,028	954,993	855,586	935,572
Subtotal	1,963,011	2,132,649	2,193,433	1,847,692	2,056,632
EU internal trade	2,592,063	2,662,348	2,605,181	2,600,031	2,501,235
Grand total	4,555,074	4,794,997	4,798,614	4,447,723	4,557,867
NAFTA	477,213	554,394	602,655	467,235	471,894
China & Hong Kong	79,376	82,119	173,021	69,144	142,563

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

which EU exports have risen steadily over the past 5 years. In 2001, almost 47 percent of all EU TDM imports were from non-EU members, whereas the remaining 53 was with EU members; for exports, the shares are 45 percent and 55 percent, respectively. In terms of product representation, imports of industrial molds accounted for almost 64 percent of all EU TDM imports, tools and dies, for almost 30 percent, and jigs and fixtures, for almost 7 percent. Exports of industrial molds accounted for 69 percent of all EU TDM exports, tools and dies, for almost 25 percent, and jigs and fixtures, for 6 percent.

Government Policies and Programs

TDM producers benefit from comprehensive EU Government programs as well as State assistance. However, the extent to which these programs, many aimed at small- and medium-sized firms, are used by EU TDM producers is unknown. The TDM industry appears to benefit most directly from EU-funded R&D in the EU Fifth Framework initiative (1998-2002)[371] under the Competitive and Sustainable Growth program, known as GROWTH.[372] Many TDM-related projects under this program are cooperative research contracts among a variety of partners, including research institutes and companies.

TDM producers may also benefit from training programs funded by the EU European Social Fund (ESF). During 1994-1999, two specific projects for training moldmakers, one in Spain and the other in Portugal, were funded by ESF. The ESF also provides funding for small- and medium-sized enterprises employing engineering staff. However, such funding, frequently in the form of a grant, may be limited to certain regions.[373]

The EU Commission Directorate-General for Enterprise has been assisting the TDM industry through benchmarking studies and efforts to restructure the industry. The Directorate's efforts are part of a larger set of initiatives in the area of subcontracting, including plastic moldings and stamped metal parts, both of which use tooling.[374] In the late 1997-98, the Directorate, in conjunction with the European Association of Consumer Electronics Manufacturers benchmarked EU TDM producers against those from Japan and Taiwan. Key findings were that Taiwan lead times were significantly shorter than those in the EU, that Japanese TDM producers had high investment levels in advanced technologies and also short lead times, and that supplier and customer relationships were stronger in those locations. During 1999-2001, the Directorate initiated an effort to enhance cross-border cooperation and grouping among moldmakers in France, Portugal, and Spain. This effort included an assessment of competitiveness factors and active

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[371] Compiled from types and number of projects listed in the EU's Cordis database of EU-funded research and technology development projects, found at *http://www.cordis.lu*.

[372] GROWTH predecessors were BRITE/EURAM 3 under the EU Fourth Framework initiative as part of the Industrial and Material Technologies Program (1994-98) and CRAFT under the EU Third Framework initiative for research and development.

[373] For example, see Tooling Trust, "Training Initiatives," found at *http://www.toolingtrust.co.uk/training.htm*, retrieved Aug. 30, 2002.

[374] EU Commission Directorate-General Enterprise, "Community Initiatives in the Field of Subcontracting," found at *http://www.europa.eu.int/comm/enterprise/entrepreneurship/supply/clusters.htm*, retrieved Sept. 13, 2002.

promotion of strategic partnerships and joint ventures between companies in the various countries.[375] Final results of this effort have not yet been published.

Although not limited to the EU, the EUREKA network has also facilitated R&D projects related to TDMs among European TDM producers. EUREKA is a pan-European network for market-oriented, industrial R&D, including European countries outside of the EU.[376] EUREKA has 33 European full member countries, the EU, and Israel, as well as several associate members that are Eastern European countries. EUREKA acts as a network, linking firms and organizations proposing R&D with government agencies in member countries that can provide financing. Funding types include loans, risk-sharing loans, grants, and subsidies, with funding levels ranging up to 100 percent of the project, depending upon the member country. An example of a recent EUREKA program is one announced in April 2002 by the UK Gauge & Tool Maker's Association entitled "emould@work." The 2-year EU funded project will aim to develop "innovative new software for online moldmaking management."[377] The project consortium includes software vendors, other TDM associations, and moldmakers in three EU countries–the UK, Spain, and Portugal.

EU TDM producers also benefit from aid provided at the national or local level. According to one industry source, certain EU countries benefit from relatively high levels of EU funding, whereas TDM producers in countries such as Germany, France, and Italy benefit from local government financial support that is not subject to EU scrutiny.[378] The UK reportedly provides very little support at the national level and local government support is nil. The extent of State aid provided by EU members is not known. However, a broad survey of EU State aid to manufacturing indicates that most is focused on R&D, support to small- and medium-sized enterprises, and regional aid to economically depressed or remote regions.[379] Most State aid to the manufacturing sector is in the form of grants, soft loans (loans with easy repayment terms, such as very-low interest rates or long repayment periods), and tax exemptions.

The EU has common external tariffs on imports but member states have varying VATs that are imposed on imports. EU tariff rates on TDMs range from free to 5 percent ad valorem, with tariff rates on dies at 2.7 percent ad valorem and the majority of tariffs on molds at 1.7 percent ad valorem. Within the EU, VATs range from 10 to 25 percent, with VATs for major TDM producing countries as follows: Germany and Spain at 6 percent, Portugal at 17 percent, and Italy and Austria at 20 percent.

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[375] EU Commission Directorate-General Enterprise, "Community New On-Going Projects in the Field of Subcontracting," found at *http://www.europa.eu.int/comm/enterprise/entrepreneurship/supply/ascamm.htm*, retrieved Sept. 13, 2002.

[376] See the EUREKA network Internet site at *http://www.eureka.be*.

[377] Gauge & Tool Maker's Association (GTMA), "Eureka Project for Mouldmaking Lifts Offs," press release, undated but listed as April 2002, found at *http://www.gtma.co.uk/media_press-releases-eureka-apr02.htm*, retrieved Aug. 30, 2002.

[378] Mike Page, "Editor's Message," The Manufacturing Talk Newsletter, Feb. 18, 2001, found at *http://www.manufacturingtalk.com/news/doc/doc503.html*, retrieved Aug. 30, 2002.

[379] Commission of the European Communities, *Ninth Survey on State Aid in the European Union*, COM (2001) 403 final, July 18, 2001, found at *http://europa.eu.int/comm/competition/state_aid/others/*, retrieved Aug. 30, 2002, pp. 32, and 48-50. The survey covers 995-99.

Germany

Industry Profile

Composition of the Industry

Germany is a major producer of dies and molds. The German TDM industry produces a wide variety of TDMs in terms of size, complexity, and precision. German TDM producers are noted to be involved in some of the downstream production processes, that is the design and production engineering of the part made by the TDM, whereas U.S. TDM producers focus on manufacturing of the TDM.[380]

Unique industry characteristics and significant strengths and weaknesses of the German TDM industry

Unique industry characteristics:
- German TDM builders tend to provide not only the TDM, but also the design and production-process engineering for to the part made with the TDM

Strengths:
- Tradition of craftsmanship in the production of dies and molds
- Skilled in producing high-precision and complex dies and molds
- Strong apprenticeship training program

Weaknesses:
- High-cost labor
- German customers have moved production to lower cost foreign locations, including Eastern Europe and China
- Larger German producers of dies and molds have followed customers for foreign locations

According to German industry sources, there are approximately 5,000 German TDM producers, including captive die and mold building operations.[381] Approximately 80 percent of the German TDM firms employ 20 or fewer persons, 19 percent employ 20 to 100 persons, and only 1 percent employ more than 100 persons.[382]

The industry is concentrated in certain regions serving particular industries. In the Nuremberg region of Bavaria, TDM producers serve the toy and electrical industry. In the Baden Wuerttemberg region, firms serve the metalworking and automotive industry. In the Nordrhein Westfalen region, firms serve the lock, metal-casting, plastics, and metalworking industry, and in the Berlin region, the electrical industry. There are approximately 50 independent TDM producers in the former East Germany, and about 200 captive TDM producers.[383]

Foreign direct investment

In the mid-1990s, some German TDM producers shifted certain production of TDMs to Eastern European countries, especially the Czech Republic, or sought subcontract parts

[380] Joseph Pryweller, "German Mold Builder Opens Mich. Facility," *PlasticsNews*, Aug. 26, 2002, found at *http://www.plasticsnews.com*, retrieved Aug. 27, 2002.

[381] German Machinery and Plant Manufacturers Association (VDMA--Verband Deutscher Maschinen-und Anlagenbau e. V), email to USITC staff, Oct. 7, 2002.

[382] Ibid.

[383] Ibid.

production, in order to take advantage of low-cost labor and access to growing markets for TDMs. However, these German firms had extensive problems with quality of their Eastern European products, which were not satisfactorily resolved, in part because of a lack of available skilled labor.[384] As a result, these German TDM producers reduced their activities in Eastern Europe.[385] Other German TDM producers, seeking new markets or following their customers, have invested in facilities in the United States. For example, Alabama Precision Mold, LLC, was established in February 2000 as a joint venture between two German moldmaking companies and a U.S. shop producing jigs and fixtures.[386] The German companies followed their customer, Mercedes-Benz of DaimlerChrysler Corp., to Alabama, where Mercedes-Benz was establishing an automobile production plant. Another example is PGAM Advanced Technologies AG's investment in Dearborn, MI. In February 2002, the firm opened a steel stamping, plastics-molding, and TDM production plant to serve automakers and Tier 1 automobile suppliers. The investment totaled $28 million, reportedly resulting in PGAM becoming one of the largest tooling producers in the Detroit metropolitan area.[387]

Some foreign TDM companies have invested in Germany. These include Mold-Masters Ltd., a Canadian producer of hot-runner systems for plastics molds, which in June 2002 expanded its German facility to include a R&D center.[388] D-M-E Co., a U.S. producer of mold bases and components, also has production facilities in Germany.[389] Other foreign companies, however, are not expanding in Germany, but rather in Poland or other surrounding low labor-cost countries to avoid high production costs in Germany, and yet be in position to access the German market.

Workforce characteristics

Employment among die and mold builders was estimated in 2001 at 34,000 persons, down from a peak of 34,907 in 1999, but up from 28,568 persons in 1997.[390] The German TDM industry, as well as the entire metalworking industry in Germany, has had difficulties finding skilled labor, including a shortage of engineers and mechanical engineering students. Further, large companies offer better wages and benefits than most firms in the German TDM industry, thus increasing the shortage and increasing the wage costs for small- and medium-sized TDM firms.[391] The high labor costs are a particular problem for German TDM producers, since their operations are relatively labor intensive.

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[384] Ibid.

[385] Ibid.

[386] *Modern Mold & Tooling*, "German Mold Makers See Future Deep in the Heart of Dixie," May 2000, found at *http://www.smithmachine.com/modern2.html*, retrieved Aug. 28, 2002.

[387] Joseph Pryweller, "German Mold Builder Opens Mich. Facility," *PlasticsNews*, Aug. 26, 2002, found at *http://www.plasticsnews.com*, retrieved Aug. 27, 2002.

[388] Mold Master, Ltd., "Mold-Masters Announces Official Opening of European Expansion," press release, July 2, 2002, found at *http://www.moldmasters.com*, retrieved Aug. 26, 2002.

[389] D-M-E Co., in April 2001, acquired Reform Flachstahl (Reform), a German manufacturer of mold bases with annual sales of approximately $16 million and in May 2001, EOC Normalien (EOC), another German manufacturer of mold bases with annual sales of approximately $35 million. Both acquistions were consolidated with existing German and other European mold component manufacturing operations. See Milacron Inc., *Form 10-K*, Mar. 20, 2002, filed with the U.S. Securities and Exchange Commission, found at *http://www.sec.gov*, retrieved Oct. 3, 2002.

[390] German Machinery and Plant Manufacturers Association (VDMA--Verband Deutscher Maschinen-und Anlagenbau e. V), email to USITC staff, Oct. 7, 2002.

[391] Ibid.

In May 2002, as a result of a wage settlement between employers and the IG-Metall, the national metalworking union, labor costs have risen by 3.8 percent in the metalworking industry.[392]

The German TDM workforce has largely been trained and developed through the country's strong vocational education system and apprenticeship training programs. A 2000 survey of a number of German TDM produces reported total hourly compensation for a skilled toolmaker averaged $12.13, but ranged as high as $19.28, and for a skilled tool designer averaged $16.91, and ranged as high as $25.26.[393] Total hourly compensation for German toolmakers and designers is among the highest in Europe but comparable with rates paid in Switzerland and Sweden. With regard to operations, German firms have a shorter workweek because of labor laws and also have more holidays. As a result, a TDM worker in Germany may work 15 hours less per week than in the United States.[394] According to one German TDM producer, round-the-clock operations in three manned shifts that might be common in China or occasionally might be found in the United States are not possible in Germany because of limits imposed by labor regulations.[395]

Manufacturing Infrastructure

The German TDM industry's manufacturing infrastructure is enhanced by German TDM producers' having access to state-of-the-art machinery from leading German and Swiss metal-cutting machine tool, other machinery, and software suppliers. German and Swiss metal-cutting machine tool suppliers are leaders in introducing precision cutting and automated machinery functions to increase productivity. German TDM producers also benefit from having leading plastics machinery manufacturers in close proximity. German TDM producers have easy access to tool and mold steels, which are produced by German, Swedish, and Austrian specialty steelmakers with a reputation for supplying quality products worldwide.

Production and Sales

German production of dies and industrial molds, excluding punching tools, jigs, and fixtures, fell to $3.2 billion in 2001 from a peak of $3.6 billion in 1998, still up from almost $3.0 billion in 1997, for an overall increase of 9 percent during the 5 years (table 4-24). Apparent consumption rose by 15 percent, to $2.7 billion from almost $2.4 billion in 1997. However, when measured in euros, the growth in German production and apparent consumption was significantly greater than when measured in U.S. dollars.

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[392] Ibid.

[393] ISTMA, *2000 ISTMA Business Statistics Report*, Feb. 2002, pp. 15 and 17.

[394] *Modern Mold & Tooling*, "German Mold Makers See Future Deep in the Heart of Dixie," May 2000, found at *http://www.smithmachine.com/modern2.html*, retrieved Aug. 28, 2002. According to ISTMA's *2000 ISTMA Business Statistics Report*, the actual hours worked per week by German TDM full-time employees averaged 1,687 hours per year, which equals 32.4 hours per week. U.S. moldmakers were known to work 55-60 hours per week in 2000, according to industry sources.

[395] Ibid.

Table 4-24
Dies and industrial molds:[1] German production, exports, imports, and apparent consumption, 1997-2001

Year	Production	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Value *(million dollars)*				*Percent*
1997	2,978.8	1,324.7	720.5	2,374.6	30.3
1998	3,606.4	1,441.0	829.6	2,995.0	27.7
1999	3,543.5	1,455.5	802.3	2,890.3	27.8
2000	3,209.7	1,300.3	757.9	2,667.3	28.4
2001	3,248.8	1,284.9	767.0	2,730.9	28.1
	Value *(million euros)*				
1997	2,639.8	1,175.0	638.5	2,103.4	30.4
1998	3,213.7	1,280.0	739.3	2,673.0	27.7
1999	3,325.7	1,368.0	753.0	2,710.8	27.8
2000	3,488.6	1,410.1	823.7	2,902.2	28.4
2001	3,634.2	1,435.7	857.9	3,056.4	28.1

[1] Excludes punch tools, jigs, and fixtures.

Source: German Machinery and Plant Manufacturers Association (VDMA--Verband Deutscher Maschinen-und Anlagenbau e. V) Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*

Using this measure, German production of dies and industrial molds rose steadily by almost 38 percent, to 3.6 billion euros in 2001 from 2.6 billion euros in 1997. Apparent consumption of dies and industrial molds rose by more than 45 percent, to almost 3.1 billion euros in 2001, from 2.1 billion euros in 1997.

German TDM producers depend on exports to an extent, as apparent consumption of dies and molds was only 80 to 84 percent of German production. Exports as a share of production fell to 40 percent in 2001 compared with 45 percent in 1997. Imports of dies and industrial molds as a share of apparent consumption fell to 28 percent in 2001 from 30 percent in 1997.

Market Characteristics and Trends

Customer Base

The customer base for TDMs in Germany is diverse, including automotive, electronics, machinery, consumer goods, aerospace, and medical goods producers. Many of these TDM end-users are globalized with world-class products in design and quality. Many German metal stampers and plastics molders supplying large German automobile and truck, electronics, and consumer goods producers have begun to follow their customers to foreign production locations. Data on apparent consumption cannot be calculated, as production data are not readily available. German TDM consumption was likely to have followed growth in the German manufacturing sector, which rose by 6.8 percent during 1997-2000, the most recent year for which data are available.[396]

[396] International Monetary Fund, *International Financial Statistics*, Sept. 2002.

Trade

Germany is a net exporter of TDMs, with a significant export surplus. During 1997-2001, imports rose by slightly more than 8 percent, to $834 million from $769 million (table 4-25). Measured in euros, however, German TDM imports rose by almost 37 percent. The leading supplier of TDMs to Germany was Switzerland, accounting for almost 20 percent of total German TDM imports (table 4-25). The Czech Republic was the second-leading source, displacing Italy during the 5-year period. TDM imports from the Czech Republic accounted for almost 12 percent of all German TDM imports in 2001, and those from Italy, for 10 percent. The United States, ranking fourth, supplied slightly less than 8 percent of imports in 2001, whereas China and Hong Kong supplied about 1 percent of total German TDM imports. Overall, EU suppliers accounted for almost 38 percent of total German TDM imports in 2001. Industrial molds accounted for 61 percent of total German TDM imports, tools and dies for almost 31 percent, and jigs and fixtures, for slightly less than 8 percent.

German TDM exports declined by slightly more than 1 percent, to almost $1.47 billion, during 1997-2001 (table 4-26). The leading export market external to the EU was Switzerland, accounting for almost 10 percent of total German TDM exports in 2001, followed by the Czech Republic at slightly less than 9 percent, and the United States at almost 8 percent. Internal EU destinations accounted for 47 percent of total German TDM exports in 2001. During 1997-2001, exports to the Czech Republic rose steadily by 92 percent as German TDMs were supplied to manufacturing establishments located in the Czech Republic. Exports to the United States rose significantly in 1998 and 1999, primarily reflecting changes in the euro and U.S. dollar exchange rate.[397] Exports to France fell steadily over the 5-year period. In 2001, exports of industrial molds accounted for 58 percent of total German TDM exports, tools and dies, for 30 percent, and jigs and fixtures, for 12 percent.

Government Policies and Programs

The German Government provides general support for all domestic manufacturing and along with the German States, offers programs for small- and medium-sized companies that are likely to have TDM producers as participants. More specifically the German TDM industry is assisted through strong R&D activities.[398]

R&D on TDMs are conducted at several German universities, such as the University at Aachen, and at several institutes of the Fraunhofer Society for the Advancement of Applied Research. R&D funding for universities is provided in part by the Federal Ministry of Education and Research, and by state governments. Other sources of funding include revenues generated by the Fraunhofer Society through its activities, and

[397] A portion of U.S. imports from Germany are molds for construction and landscaping materials, on the basis of analysis of the U.S. Customs Net Import File.

[398] U.S. industry sources perceive that Germany conducts more TDM R&D than the United States, with German stamping and steel companies performing some of R&D. Testimony of Dr. Jay Baron, director, Manufacturing Systems Group, Center for Automotive Research, and president, Coalition for the Advancement of Michigan Tooling Industries, transcript of the hearing, p. 57.

Table 4-25
Tools, dies, and industrial molds: German imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Switzerland	95,283	114,197	98,037	90,299	103,686
Italy	62,131	80,526	78,876	70,913	66,439
Czech Republic	30,498	42,631	53,338	54,902	62,229
Austria	46,475	50,387	60,022	45,234	32,057
United States	14,913	30,810	21,683	35,510	31,266
Hungary	19,955	25,115	25,670	26,809	30,682
All other	213,149	229,442	235,103	206,542	184,523
Total	482,404	573,108	572,729	530,209	510,882
EU-15	244,894	269,688	299,550	249,313	202,338
NAFTA	20,708	39,455	30,459	44,754	44,788
China & Hong Kong	2,500	3,853	6,042	6,046	6,883
Tools and dies:					
Switzerland	51,282	49,704	48,457	50,242	51,028
Czech Republic	9,944	11,837	19,449	23,374	28,910
Japan	6,848	9,121	13,608	10,358	25,399
United States	26,984	39,382	29,282	29,841	25,360
Austria	10,777	14,947	17,839	15,592	18,635
Italy	19,163	29,277	24,582	21,985	16,977
All other	113,114	102,211	76,364	76,256	89,771
Total	238,112	256,479	229,581	227,648	256,080
EU-15	105,951	115,710	93,220	86,016	89,949
NAFTA	27,335	39,708	29,551	30,207	25,704
China & Hong Kong	689	937	412	569	901
Jigs and fixtures:					
Switzerland	9,251	11,586	11,667	10,682	11,739
United States	7,613	8,936	10,097	11,098	9,417
Italy	3,797	4,825	4,735	4,310	6,075
Czech Republic	2,856	3,488	4,123	4,678	5,358
Japan	2,598	3,499	4,930	3,525	3,795
Spain	1,866	2,033	2,248	2,489	3,359
All other	20,605	27,475	28,871	23,963	26,928
Total	48,586	61,842	66,671	60,745	66,671
EU-15	17,555	20,709	22,449	19,193	24,372
NAFTA	7,706	9,244	10,204	11,162	9,510
China & Hong Kong	655	808	426	817	926
Total:					
Switzerland	155,816	175,488	158,161	151,223	166,453
Czech Republic	43,298	57,956	76,910	82,954	96,497
Italy	85,090	114,627	108,193	97,208	89,492
United States	49,511	79,128	61,062	76,449	66,042
Austria	58,343	66,550	80,810	62,881	53,674
France	82,932	66,443	56,597	40,646	42,039
All other	294,112	331,237	327,248	307,241	319,435
Grand total	769,102	891,429	868,981	818,602	833,632
EU-15	368,400	406,107	415,219	354,521	316,659
NAFTA	55,750	88,408	70,213	86,123	80,001
China & Hong Kong	3,844	5,598	6,881	7,432	8,710

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Table 4-26
Tools, dies, and industrial molds: German exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Czech Republic	51,868	72,803	66,687	82,880	95,322
Switzerland	83,889	89,227	86,479	80,065	93,480
United States	62,964	74,718	90,666	63,594	66,196
Austria	42,977	63,953	67,045	62,211	53,699
France	84,557	85,099	83,951	54,811	47,274
United Kingdom	59,725	60,939	56,443	53,839	43,307
All other	463,622	526,920	516,980	472,738	446,556
Total	849,602	973,659	968,251	870,138	845,834
EU-15	376,271	424,243	456,765	413,001	332,421
NAFTA	92,385	114,795	144,016	97,397	100,555
China & Hong Kong	26,824	22,010	22,921	19,419	21,858
Tools and dies:					
Netherlands	54,578	24,909	38,181	28,787	52,482
France	60,046	36,613	26,648	36,189	41,293
Spain	15,500	46,159	14,316	39,029	38,973
United Kingdom	13,873	17,380	11,451	33,235	38,370
Switzerland	39,491	47,412	44,109	45,022	36,845
Italy	25,719	21,028	23,132	36,625	27,532
All other	265,887	273,837	329,370	211,276	203,581
Total	475,094	467,338	487,207	430,163	439,076
EU-15	240,180	194,285	178,404	229,518	260,102
NAFTA	81,926	69,180	85,818	41,686	29,697
China & Hong Kong	7,513	17,429	60,061	11,296	8,642
Jigs and fixtures:					
United States	22,555	28,673	22,673	23,373	23,026
France	14,876	17,252	18,935	18,178	19,483
Spain	7,011	7,360	9,677	10,130	17,448
Austria	11,264	11,433	10,814	10,519	14,139
Italy	11,565	13,621	15,276	13,001	13,807
Switzerland	10,613	13,578	13,540	11,453	12,132
All other	80,609	79,034	79,685	70,761	80,542
Total	158,493	170,951	170,600	157,415	180,577
EU-15	73,993	79,763	88,674	80,539	95,499
NAFTA	27,859	34,818	27,326	26,894	29,675
China & Hong Kong	1,108	2,819	2,937	2,319	2,842
Totals:					
Switzerland	133,993	150,216	144,128	136,540	142,457
Czech Republic	67,717	92,835	109,525	119,166	130,407
United States	139,917	150,607	182,863	118,465	111,436
France	159,479	138,963	129,534	109,178	108,050
United Kingdom	85,185	90,099	80,384	97,193	93,459
Spain	73,081	109,414	89,805	110,249	93,189
All other	823,816	879,814	889,819	766,925	786,489
Grand total	1,483,188	1,611,948	1,626,058	1,457,716	1,465,487
EU-15	690,444	698,291	723,843	723,058	688,021
NAFTA	202,170	218,793	257,160	165,977	159,928
China & Hong Kong	35,444	42,258	85,918	33,034	33,342

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

depending upon the project, contributions from participating companies and other institutions. Three Fraunhofer Institutes focus on TDM research: the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz, the Fraunhofer Institute for Chemical Technologies ICT in Berghausen, and the Fraunhofer Institute for Manufacturing and Advanced Materials Near-Net-Shape Production Technologies Department in Bremen. A leading university R&D site is the Laboratory for Machine Tools and Production Engineering Rhineland-Westphalia Technical Institute in Aachen, with a staff of approximately 600 persons. The Fraunhofer Institute of Production Technology in Aachen has formed a joint venture with the Laboratory for Machine Tools in Aachen and the Fraunhofer Center for Manufacturing Innovation CMI of Boston, MA, to form the Aachener Werkseug und Formenbau, a consulting company to assist firms in positioning themselves in the market and with advanced technology in the die and mold manufacturing industry.

The Federal Ministry of Economics and Technology supports small- and medium-sized businesses with assistance for advisory services, training and vocational education, trade fairs, and R&D. It is likely that German TDM producers also participate in a certain number of these programs. The German States also provide assistance to small business in the form of grants, soft loans, and R&D assistance.[399] TDM producers located in the former East Germany reportedly are receiving substantial assistance from both the Federal and State governments. Assistance is in the form of reimbursements for capital expenditures (25 to 30 percent of the investment cost), subsidized interest rates on loans, loan guarantees, accelerated depreciation rates on new machinery investments, and reimbursement of R&D expenditures.[400] In Western Germany, machinery can be completed depreciated in 3 years.[401]

[399] Commission of the European Communities, *Ninth Survey on State Aid in the European Union*, COM (2001) 403 final, July 18, 2001, found at *http://europa.eu.int/comm/competition/state_aid/others/*, retrieved Aug. 30, 2002, pp. 32, and 48-50. The survey covers 1995-99.

[400] Rampf Mold Industries, Inc., written submission, May 2, 2002, p. 3.

[401] Testimony of Manfred Hoffman, president and CEO, Caco Pacific Corp, transcript of the hearing, p. 165.

Portugal

Industry Profile

Composition of the Industry

Despite Portugal's small size, it has emerged as a world leader in the production of industrial molds. Portugal is the eighth-largest producer of dies and molds in the world and it exports to more than 70 countries.[402] Portugal is also one of the world's principal producers of precision molds for the plastics industry. The Portuguese industry consists of approximately 250 companies that employ nearly 7,500 workers.[403] These companies are primarily small- and medium-sized, employ an average of 30 workers, and are located principally in the glassware region of Marinha Grande (60 percent) and the town of Oliveria de Azeméis (35 percent) in the northern part of the country. In 1998, 32 percent of Portugal's mold production went to the automotive sector, 23 percent to the electrical industry, 14 percent to household appliances, 13 percent for packaging, 6 percent for electronics-telecommunications, and 3 percent for toys (table 4-27).[404]

Unique industry characteristics and significant strengths and weaknesses of the Portuguese TDM industry

Unique industry characteristic:
- Small industry dedicated almost exclusively to exporting

Strengths:
- Specialist training colleges
- Quick lead times (time required to produce a die or mold), technological capability, price, and low labor costs
- Quality, technology, service, skilled in producing high precision and complex dies and molds

Weaknesses:
- Small domestic market with lowest productivity indicators (sales per worker) among International Special Tooling and Machining Association members
- Lacks modern automotive and aerospace industries to stimulate technological advancement
- Many die and mold producers tend to be small companies with limited financial and management resources

Manufacturing Infrastructure

Portuguese moldmakers are highly specialized, concentrating in different production areas such as mold cavities, mold bases, polishing, large molds, and precision molds. Since Portugal joined the EU in 1986, the share of companies capable of manufacturing highly complex molds grew from less than 30 percent to more than 80 percent by 1997.[405]

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[402] Assoçicão Nacional da Indústria de Moldes (Cefamol).

[403] Robert Neilley, "Profile of a Mold Maker: Focus on big molds leads to growth," *Injection Molding Magazine*, Sept. 2001, found at *http://www.immnet.com/articlelibrary/archive/getOneArticle.php3?getArtId=1677*, retrieved Aug. 7, 2002.

[404] Cefamol.

[405] Catarina Selada (ITEC), Alexandre Videria (ITEC), José Rui Felizardo (ITEC), Francisco Veloso (MIT), *The Technology and Innovation Audit in the Portuguese Moulds Sector; Analysis of the Main Results*, Massachusetts Institute of Technology, found at *http://www.web.mit.edu/~fveloso/www/research.html*, retrieved Aug. 7, 2002.

Table 4-27
Leading Portuguese mold and die manufacturers

Company	Mold types[1]	Employees	Industries served[2]	Percent exported
Moldit Sa	PI,O	100	A,E,D,P	95
Simolds	PI,O	173	A,E,M,P,TC	77
Alfamolde	PI,O	135	A,C,P,T	100
Somoltec	D,PI	80	A,E,H	95
AFA	PI	110	A,C,M,P,E	90
Anibal H. Abrantes	PI,O	145	A,E,H	90
Azemoldes	PI,D	105	A,D,P,TC,T	80
Mold Plastico	D,PI	170	A,E,H,M,P,T	90
MDA	PI,A,O	198	A,E,H,C,P,TC	90
SIM	PI	122	A	60
IMA	PI,O	110	A,C,H,P	90
Edilasio	PI,D,B	70	A,E,TC,	95
CEMO	D,PI	125	A,E,H,P,TC,T	100
Ubel	PI	165	A,E,H	33
Molde Matos	PI	100	A,E,M,PH,TC	90
Soarmoldes	PI,D	170	A,E,H,M,P	75
Intermolde	PI	96	G	20
Madumolde	PI	80	G	80
Cemo	D,PI	125	A,E,H,P,TC,T	100
Tecnimpolás	PI	81	G,A,H	95
Intermolde	PI	96	G	20
Costa & Rocha	D,PI	80	A,E,M,W	100
Planimolde	D,PI	75	A,E	95
Somema	PI,O	75	A,C,E,H,P	100
Setsa	D,B	65	A,C,E,H,M,P,T	95
Geco	PI	305	A,E,H,P	93
Edilasio	D,B,PI,O	70	A,E,TC	95
Azemoldes	D,PI	105	A,H,P,TC,T	80
LN Moldes	PI	54	A,C,E,H,PH,TC	95
Sindemoldes	PI	31	A,H	77

[1] **Mold types**: aluminum and zinc (A), mold bases (B), die cast tools (D), Other (O), plastic injection (PI).

[2] **Industries served**: automotive (A), computer (C) , domestic appliances (D), electrical appliances (E), glass (G), household (H), medical equipment (M), packaging and preservation (P), pharmaceutical (PH), toys (T), telecommunications (TC), metal working (W).

Source: Cefamol (National Association of the Industry of Molds).

Molds for less-complex products such as toys and electrical appliances have been supplanted by more complex molds for the automotive, electrical equipment, pharmaceutical, telecommunications, medical equipment, and computer industries. Recently, several larger moldmakers in the Marinha Grande region have shifted from being solely tooling producers to become integrated suppliers of design and manufacturing services, principally for the European market.[406] Since joining the EU, Portugal's mold industry has steadily evolved from a labor-intensive industry to a capital-intensive one. It possesses world-class equipment produced in Germany, Switzerland, and Spain. The majority of the companies have access to the latest generation of software, CNC and EDM machines, finite-element-analyst (FEA) technology, machining centers, 3-D measuring machines, and DNC and CAD/CAM/CAE systems. Many of Portugal's mold manufacturers have instituted Simultaneous or Concurrent Engineering

[406] Joseph Ogando, "Portuguese Molder Sell Software Skills, Too." *Design News*, Jan. 21, 2002, found at *http://www.findarticles.com/cf_)/m1068/2_57/82334057/print.jhtml*, retrieved Aug. 12, 2002.

and Total Quality, and many qualified for ISO 9001 and 9002 certification. According to a membership survey conducted by the International Special Tooling and Machining Association, Portuguese mold manufacturers invest approximately 14 percent of their total sales revenue in new equipment and technologies as compared with 4.6 percent for U.S. TDM producers.[407]

As shown in the following tabulation, Portuguese mold manufactures have a distinct wage advantage but lag behind U.S. producers in terms of value-added per employee:[408]

Item	Portugal	United States
Sales per employee (*U.S. dollars*)	48,664	124,610
Value added per employee (*U.S. dollars*)	25,392	79,626
Labor costs as a share of sales (*percent*)	34	50
Liquidity (ratio)[1]	1.05	1.18
Net operating profit as a share of sales (*percent*)	4.1	2.9
Average hourly compensation for skilled moldmaker (euros and *U.S. dollars*)	€7.48 ($6.92)	€24.05 ($22.24)

[1] Short-term accounts receivable and available funds (quick assets) divided by short-term liabilities.

The Portuguese mold industry is represented by the National Association of the Industry of Molds (Cefamol). The association consists of 130 members and accounts for approximately 90 percent of total shipments by the Portuguese mold industry.[409] Cefamol represents the industry before the Government, and its responsibilities include technological research, professional training, and exchanges of scientific and technical information with domestic and international groups. In 1991, Cefamol helped found the Technological Center for the Molds and Special Tools Industry (Centimfe) as an advanced R&D center for Portugal's mold industry. Centimfe was provided with the latest computer-integrated manufacturing technology to support companies desiring to improve their quality control and productivity.

Another private sector entity that supports Portugal's mold industry is Centro de Formação Profissional da Indústria Metalúrgica e Metalomecânica (Cenfim), a professional training center for the metallurgy sector. Cenfim offers courses ranging from executive management education for middle managers and technicians to training in areas such as CAD/CAM and CNC programming.[410]

[407] CTMA, written submission to the USITC, May 29, 2002, with attachment ISTMA, *2000 ISTMA Business Statistics*, Feb. 2002.

[408] ISTMA, *2000 ISTMA Business Statistics*, Feb. 2002.Canadian Tooling & Machining Association.

[409] Ibid.

[410] Cefamol, "The Portuguese Moulds Industry," Europlast 2002, found at *http://www.cefamol.pt/website/index.php?id=15&lang=en*, retrieved Aug. 7, 2002.

Graduates of Cenfim emerge well trained in the fundamentals of mold drawings, drilling, lathing, and machining, and of wire and erosion EDM processing.[411]

Market Characteristics and Trends

Portugal reportedly has a very small domestic market for TDMs. Apparent consumption of industrial molds[412] ranged from approximately $53 million to $84 million during 1997-2001 (table 4-28). Imports as a share of apparent consumption ranged from 54 to 59 percent. Traditionally, this industry has relied on exports for 90 percent of total sales[413] and imports have been relatively small (table 4-28). Imports of TDMs (i.e., tools, dies, industrial molds, jigs, and fixtures), rose by 25 percent, from $42 million in 1997 to $52.6 million in 2001(table 4-29). In that year, imports accounted for 15 percent of Portugal's total trade in these items. Industrial molds accounted for 81 percent of all TDM imports during 2001 with principal suppliers including Spain, Germany, France, the UK, and Japan. The portion of Portugal's imports of these items from the EU decreased from 68 percent of the total in 1997 to 63 percent in 2001.

Table 4-28
Industrial molds: Portuguese shipments, exports, imports, and apparent consumption, 1997-2001

Year	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption[1]
	Value *(million dollars)*				*Percent*
1997	269.3	250.2	34.3	53.4	64.2
1998	302.1	259.7	36.7	79.1	46.4
1999	278.6	264.9	38.8	52.5	73.9
2000	278.5	252.4	33.9	60.0	56.6
2001	317.9	290.5	42.8	70.2	61.0
	Value *(million Euros)*				
1997	243.9	221.4	30.4	52.9	57.5
1998	258.9	231.2	32.7	60.3	54.2
1999	277.3	248.5	36.2	65.0	55.7
2000	299.3	274.1	36.7	61.8	59.3
2001	360.7	324.8	47.9	83.8	57.2

[1] Ratios for euros and U.S. dollars differ because of slightly differing euro/U.S. dollar exchange rates used in converting shipments data and trade data.

Source: Cefamol, Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*

[411] Robert Neilley, "Profile of a mold maker: Focus on big molds leads to growth," *Injection Molding Magazine*, Sept. 2001, found at *http://www.immnet.com/articlelibrary/archive/getOneArticle.php3?getArtId=1677*, retrieved Aug. 7, 2002.

[412] Data are not available for Portuguese production of TDMs other than industrial molds.

[413] Moldmakers, Portugal Offer, 2002, found at *http://www.portugaloffer.com/moldmake.html*, retrieved June 6, 2002.

Table 4-29
Tools, dies, and industrial molds: Portuguese imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
Spain	6,955	3,245	4,193	4,702	7,479
Germany	6,047	6,026	5,712	6,762	6,703
France	4,345	7,184	4,664	4,551	4,678
United Kingdom	2,058	1,822	2,166	573	3,935
Japan	1,234	2,150	2,502	2,431	3,151
Switzerland	2,437	906	1,489	773	3,025
All other	11,188	15,385	18,046	14,132	13,835
Total	34,264	36,718	38,772	33,924	42,806
EU-15	23,374	23,798	26,886	23,368	27,222
NAFTA	1,687	2,720	3,220	1,915	1,717
China & Hong Kong	98	8	269	18	12
Tools and dies:					
Spain	1,933	2,063	1,990	2,255	3,346
Italy	1,641	1,557	1,887	1,650	1,668
Germany	818	876	856	1,110	1,137
Czech Republic	102	2	0	177	726
France	652	383	599	292	499
United Kingdom	388	305	657	549	181
All other	582	297	490	1,277	360
Total	6,116	5,483	6,479	7,310	7,917
EU-15	5,449	5,203	6,130	6,108	6,970
NAFTA	219	166	194	208	148
China & Hong Kong	6	0	3	0	1
Jigs and fixtures:					
Germany	923	680	637	884	691
Italy	131	428	933	700	636
Spain	186	220	330	273	436
United Kingdom	94	49	49	55	38
United States	13	11	14	13	24
Turkey	41	18	28	11	19
All other	215	213	333	199	73
Total	1,603	1,619	2,324	2,135	1,917
EU-15	1,487	1,506	2,133	2,068	1,818
NAFTA	13	11	14	13	24
China & Hong Kong	0	17	22	12	14
Total:					
Spain	9,073	5,528	6,513	7,230	11,261
Germany	7,787	7,583	7,205	8,756	8,530
France	5,097	7,693	5,424	4,905	5,191
Italy	3,990	4,789	7,759	5,815	4,628
United Kingdom	2,540	2,176	2,872	1,176	4,153
Japan	1,267	2,170	2,521	2,448	3,170
All other	12,229	13,881	15,281	13,040	15,707
Total	41,983	43,820	47,575	43,370	52,640
EU-15	30,310	30,507	35,149	31,545	36,010
NAFTA	1,920	2,897	3,428	2,136	1,889
China & Hong Kong	103	25	294	30	27

Note. —Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

Portuguese exports of TDMs increased by 17 percent from $255.5 million in 1997 to $298.6 million in 2001 (table 4-30). Principal export markets include the United States, Germany, France, Spain, the UK, and the Netherlands. Exports of industrial molds to the United States increased from $38.4 million in 1997 to $43.1 million in 2000 before declining to $32.9 million in 2001. Since joining the EU, the European market has become Portugal's principal market. Exports to the EU have grown by 40 percent from $145.3 million in 1997 to $203.7 million in 2001. A longer term view indicates a shift from the U.S. market, as exports to the United States declined from 65 percent of all exports in 1985 to 11 percent in 2001.[414]

Government Policies and Programs

Government assistance to the Portuguese TDM industry is focused primarily on export promotion and training. Cefamol works in conjunction with the Portuguese Foreign Trade and Tourism Department (ICEP) to plan and promote Portuguese mold exports through trade missions and fairs and international conferences. The Portuguese mold industry also benefits from a European EUREKA program known as "Round-the-Clock." EUREKA was initiated to provide a "market oriented framework for European collaboration in the area of advanced technologies among firms, research institutes, and universities with the aim of strengthening productivity and competitiveness of Europe's industries."[415] Round-the-Clock was a 24-hour collaborative product-development program involving participants from Portugal, Germany, Mexico, and China. The program began in 1998 and ended in May 2001, and Portugal's participants included Centimfe and mold producer, Ibermoldes.

Portugal has common import tariffs with other EU members.[416] Portugal has a value-added tax of 17 percent ad valorem calculated on imports based upon their value with costs, insurance, and freight charges included.

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[414] The Portuguese Moulds Industry, Europlast 2002, Cefamol, found at *http://www.cefamol.pt/website/index.php?id=15&lang=en*, retrieved Aug. 7, 2002.

[415] Every EUREKA project consists of at least two partner countries and aims to develop advanced civilian products, processes, and services for the international market. EUREKA was established in 1985 by the EU and 17 other countries. In 2002, membership consists of 33 countries and the EU. EUREKA, found at *http://www.eureka.be.*, retrieved Aug. 7, 2002.

[416] See the EU TDM industry section in this chapter.

Table 4-30
Tools, dies, and industrial molds: Portuguese exports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial molds:					
France	34,747	29,997	48,508	48,258	63,163
Germany	36,106	39,723	38,673	33,508	47,435
United States	38,409	35,692	40,450	43,046	32,864
Spain	10,004	12,549	24,576	26,576	30,579
United Kingdom	24,197	28,302	18,300	24,907	23,189
Netherlands	13,664	10,448	9,623	10,494	10,490
All other	93,092	102,983	84,748	65,657	82,778
Total	250,219	259,694	264,878	252,446	290,498
EU-15	145,312	143,876	166,843	167,819	203,664
NAFTA	44,599	43,248	47,343	49,103	44,272
China & Hong Kong	1,684	713	653	412	252
Tools and dies:					
France	2,220	2,134	2,904	3,191	3,089
Spain	979	852	478	3,702	2,467
Germany	202	839	120	579	1,271
Brazil	6	204	9	3	20
Israel	0	99	0	2	2
United Kingdom	0	91	1	1	46
All other	1,785	327	356	724	553
Total	5,192	4,546	3,868	8,202	7,448
EU-15	3,479	4,109	3,708	7,707	7,342
NAFTA	9	3	1	0	3
China & Hong Kong	0	0	0	0	0
Jigs and fixtures:					
France	0	0	0	0	434
Saudi Arabia	0	0	0	0	107
Switzerland	60	66	60	58	65
Brazil	1	0	21	0	27
Italy	0	0	0	0	27
Angola	0	113	21	8	13
All others	56	271	80	26	18
Total	117	450	182	92	691
EU-15	0	154	2	8	461
NAFTA	0	14	9	1	2
China & Hong Kong	0	0	0	0	0
Totals:					
France	36,968	32,131	51,412	51,449	66,686
Germany	36,308	40,566	38,792	34,087	48,706
Spain	10,983	13,550	25,054	30,286	33,047
United States	38,409	35,710	40,460	43,047	32,868
United Kingdom	24,197	28,393	18,301	24,908	23,234
Netherlands	13,664	10,464	9,623	10,506	10,490
All other	94,999	103,877	85,286	66,457	83,606
Total	255,528	264,691	268,928	260,740	298,637
EU-15	148,791	148,139	170,553	175,534	211,467
NAFTA	44,608	43,265	47,353	49,104	44,276
China & Hong Kong	1,684	713	653	412	252

Note.—Currency conversions are based on monthly averages calculated by GTIS, Inc. from rates published by the Federal Reserve Bank of New York.

Source: Global Trade Information Services, Inc., World Trade Atlas internet database, found at *http://www.gtis.com*.

CHAPTER 5. COMPARISON OF COMPETITIVE POSITIONS OF U.S. AND FOREIGN PRODUCERS

The position of the U.S. TDM industry relative to its major foreign competition is affected by numerous factors. Such factors include advances in the technology used to produce TDMs, as discussed in chapter 2. Cyclic and structural changes also affect the domestic industry's competitive position. Chapters 3 and 4 detailed the effects of these changes on TDM producers and consumers in the United States and foreign markets. Against this backdrop, the following discussion provides assessments by U.S. TDM producers and purchasers in response to the Commission's questionnaires, provides information regarding price comparisons, and assesses the position of the U.S. TDM industry with respect to costs and other competitive factors, as specified in the request letter from the Committee on Ways and Means.

Conditions of Competition Facing Domestic Producers

The information gathered during the course of this investigation indicates that, as a whole, the U.S. TDM industry has been struggling in recent years. Virtually all performance indicators, including shipments, employment, and profitability, are trending downward. Increased competition from traditional foreign industries and the emergence of new, formidable foreign competitors are adding to existing structural challenges, leading to declining performance and the closures of many firms.

Competition from imports and shrinking domestic demand, coupled with increasing costs, are the most significant issues facing U.S. producers of TDMs. When respondents to the Commission's questionnaire ranked the importance of competitive issues, 54 percent ranked competition from imports as the first or second-most important issue, and 39 percent ranked a shift in domestic manufacturing production to offshore locations as the first or second most important issue affecting their firm's ability to compete (table 5-1).[1] A May 2002 survey of mold and die producers conducted by D-M-E Co., a supplier to the molding and die casting industries, generated a similar response.[2] Respondents to the D-M-E survey overwhelmingly cited "customers moving work to other countries" and "imports of molds and dies into the U.S." as the two "main factors impacting (their) business."[3] A 2002 survey by the American Mold Builders Association (AMBA) also cited "competition from low-cost offshore shops" as the "biggest factor hurting the (domestic) mold making industry today."[4]

[1] A total of 256 U.S. producers provided responses to this question.

[2] Testimony of Jerry Lirette, president, D-M-E Co., transcript of the hearing, p.152. See also written submission of D-M-E Co., May 9, 2002.

[3] Ibid.

[4] AMBA, *State of the Industry Survey*, Spring 2002, *http://www.amba.org*.

Table 5-1
Domestic producers' assessment of issues of competition in the U.S. TDM market

Issue of competition	Ranked 1	Ranked 2	Ranked 3	Ranked 4	Ranked 5
Competition from imports	88	55	18	9	18
Shift of production offshore	52	52	11	17	3
Labor costs	39	40	43	38	28
Healthcare costs	26	53	80	48	24
Lack of skilled labor	16	7	19	15	19
Access to investment capital	10	1	5	5	8
Employment taxes	7	13	10	29	28
Access to operating capital	6	8	7	4	5
Insurance costs	5	12	35	40	47
Cost of capital	4	5	5	11	17
Training costs for personnel	2	6	6	11	13
Tax schedules and amounts	1	1	4	10	17
Safety and health regulations	0	3	7	9	9
Environmental regulations	0	0	2	8	9

Source: Compiled from data submitted in response to Commission Producer questionnaires.

Labor costs and healthcare costs were the next most significant issues cited, with 30 percent of U.S. producers ranking one of those issues as the first or second most important with respect to their firm's ability to compete.[5] Although none of the responding U.S. producers cited safety and health or environmental regulations as the most important competitive issues, it is clear that some costs are imposed by such requirements. Concern was expressed by several witnesses at the Commission's public hearing about the cost of government regulations.[6] However, it is unclear how much of a competitive disadvantage such regulations present for U.S. tooling producers. Although the difficulties of comparing the relative costs imposed by government safety and environmental regulations in different countries is well known, competitors in Canada, the EU, and Japan are likely to face similar requirements in the areas of worker safety and environmental protection.

The increasing demands by customers for lower prices (see chapter 3) have made price the overwhelming factor of competition in the tooling market according to domestic producers. Seventy percent of the respondents to the Commission's producer questionnaire ranked price as the most important competitive factor, while 25 percent of respondents ranked price as the second or third most important competitive factor, when competing against other domestic tooling firms (table 5-2).[7] Delivery time was the second most significant factor of competition, as 66 percent of respondents ranked delivery time as the first or second most important factor of competition, and 25 percent ranked it third most important. Some sources have indicated that supplier relationships

[5] A comparison of U.S. and foreign labor costs is presented later in this chapter (see "Labor Costs").

[6] Lirette,, p.156; David Sandy, vice president, M.S. Willett Co., transcript of the hearing, p. 185; Laurie Moncrief, president, Schmald Tool and Die, transcript of the hearing, p. 191; Mark Hanaway, marketing director, Tech Tool & Mold, Inc., transcript of the hearing, p. 193; and Steven Prahl, president, Trio Mold & Engineering, Inc., transcript of the hearing, p. 212.

[7] A total of 265 U.S. TDM producers responded to this question.

Table 5-2
Domestic producers' assessment of factors of competition when competing against U.S. TDM producers

Factor	Ranked 1	Ranked 2	Ranked 3	Ranked 4	Ranked 5
Price	185	36	31	6	2
Delivery time	30	146	67	11	3
Product quality	29	50	88	40	12
Supplier relationships	13	14	36	75	52
Value-added services	3	7	7	38	45
Financing terms	3	4	19	20	21
Ability of tool, die, or mold firm to produce customer's parts	0	2	4	15	22
Compatibility with customer's existing manufacturing systems	0	1	2	8	11
Compatibility with customer's existing design systems	0	1	1	10	16
After-sales service	0	0	3	22	49
Warranty terms	0	0	0	6	7

Source: Compiled from data submitted in response to Commission Producer questionnaires.

had been important in retaining business, however, in the current competitive environment, only 10 percent of the respondents cited supplier relationships as either the first or second most important competitive factor.

Results were similar when U.S. TDM producers were asked about competing against foreign producers. More than 80 percent of respondents ranked price as the most important factor when competing against foreign tooling manufacturers (table 5-3). After price, product quality and delivery time were cited by producers as the next most significant factors of competition when competing against foreign producers. However, when comparing survey results presented in tables 5-2 and 5-3, the greater emphasis on price competition with respect to foreign competitors reveals that respondents consider that delivery time, product quality, and supplier relationship are more significant when competing against other U.S. producers than when competing against foreign producers.

The questionnaire results generally appear consistent with hearing testimony, written submissions, industry and economic reports, and results of interviews and fieldwork gathered during the investigation. TDM producers report that customers are increasingly demanding lower prices and often compare domestic quotes against quotes from international competitors. Even if a particular job eventually goes to a U.S. producer, industry officials assert that foreign quotes are often used to reduce the final price.[8] The questionnaire results and other information indicate that delivery time is a close second, and in some instances, determines which TDM producer receives a contract. Quality ranks third, and a number of sources have indicated that approximate levels of quality are assumed by a purchaser and that the ability to produce TDMs of equal quality is fairly widespread among TDM producers.

[8] Testimony of John Belzer, president, TCI Precision Metals, and chairman of the board, National Tooling Manufacturing Association, transcript of the hearing p. 43; testimony of Jay Baron, director, Manufacturing Systems Group, Center for Automotive Research, and president, Coalition for the Advancement of Michigan Tooling Industries, transcript of the hearing pp. 55-56.

Table 5-3
Domestic producers' assessment of factors of competition when competing against foreign TDM producers

Factor	Ranked 1	Ranked 2	Ranked 3	Ranked 4	Ranked 5
Price	215	7	2	0	2
Product quality	5	39	65	26	23
Delivery time	3	126	36	22	7
Supplier relationship	1	13	27	44	37
Financing terms	1	12	26	19	9
Value-added services	1	5	6	26	32
Ability of tool, die, or mold firm to produce customer's parts	0	3	12	11	15
After-sales service	0	2	19	19	29
Compatibility with customer's existing manufacturing systems	0	1	2	8	8
Compatibility with customer's existing design systems	0	1	2	2	11
Warranty terms	0	0	3	8	5

Source: Compiled from data submitted in response to Commission Producer questionnaires.

Domestic purchasers were asked to assess whether various factors of competition led to advantages for either U.S. or foreign tooling producers (table 5-4). More than 80 percent of purchaser respondents cited price as either a major or minor advantage of foreign TDM producers. It is noteworthy, though, that purchasers did not attribute significant advantages to foreign tooling producers for other factors of competition. Supporting these results is the statement by one major automobile producer in its questionnaire response that "considering by definition through its qualifying process that all... vendors, both domestic and foreign are technically capable, the principal advantage is lower price." With regard to delivery time, domestic purchasers responding to the Commission's survey indicated no discernible advantages for either U.S. or foreign tooling producers. Purchasers' responses indicate that U.S. TDM producers do have a larger advantage with respect to supplier relationships than their foreign competitors. With regard to quality, U.S. and foreign TDM producers rank almost equally for quality in medium- and high-complexity TDMs.

The above overall results regarding marginal differences in quality between U.S. and foreign TDM producers also appear when U.S. purchasers were asked to assess differences in TDM performance characteristics (table 5-5). Purchasers overwhelmingly ranked U.S. and foreign tooling performance as comparable across a range of performance measures.

The preceding assessments by U.S. TDM producers and purchasers indicate that U.S. TDM producers are competitive in most measures, the primary exception being price. Price is listed as the leading factor in purchase decisions by U.S. purchasers and as the major competitive factor with both U.S. and foreign TDM producers by U.S. toolmakers.

As noted in the tables above, U.S. TDM producers perceive price as the leading factor in the competition. The following discussion of pricing in the U.S. TDM market illustrates the range of price differentials, as seen by U.S. producers and U.S. purchasers. This is followed by a discussion of production and other costs that effect the competitiveness of TDM producers, including labor costs, labor availability, materials costs, availability of capital, technology level of design and manufacturing processes, and currency fluctuations.

Table 5-4
Domestic purchasers' assessment of factors of competition between U.S. and foreign TDM producers

Factor	U.S. producers have: Major advantage	U.S. producers have: Minor advantage	Neither has advantage	Foreign producers have: Minor advantage	Foreign producers have: Major advantage	Do not know
Purchase price (delivered)	0	5	19	67	46	0
Delivery time	12	39	42	20	28	0
Quality (low complexity TDM)	0	5	94	21	15	4
Quality (medium complexity TDM)	1	16	90	24	3	5
Quality (high complexity TDM)	20	25	48	22	14	7
Financing terms	1	7	81	7	14	29
Warranties	7	9	106	2	9	6
Supplier relationships	21	37	54	9	18	1
Compatibility with customer's existing design systems	4	29	74	14	11	2
Compatibility with customer's existing manufacturing systems	3	15	80	14	15	10
Rapid prototyping services	18	16	47	8	19	26
Value-added design/engineering services	9	19	68	9	12	7

Source: Compiled from data submitted in response to Commission Purchaser questionnaires.

Table 5-5
Domestic purchasers' assessment of performance characteristics of TDMs from U.S. and foreign producers

Characteristic	U.S. producers have: Major advantage	U.S. producers have: Minor advantage	Neither has advantage	Foreign producers have: Minor advantage	Foreign producers have: Major advantage	Do not know
Design	7	20	88	29	8	2
Durability	6	22	113	6	4	3
Production rate (parts per cycle and cycles per hour)	3	7	112	18	4	4
Less downtime	3	9	118	16	2	6
Less maintenance	4	14	113	15	2	5

Source: Compiled from data submitted in response to the Commission Purchaser questionnaires.

Pricing

Despite recent downward pricing pressure, U.S. TDM producers report that they are competitive with Japanese and EU producers.[9] Indeed, domestic purchasers' price comparisons show that TDM prices from those two foreign competitors may be both higher or lower than domestic prices (table 5-6). U.S. tooling producers attribute most of the price difference between themselves and Canadian producers to changes in the currency exchange rate (see "Currency Fluctuations"). Domestic purchasers report that the prices of Chinese TDMs are consistently lower than domestic prices, and Chinese

[9] U.S. industry officials, interviews by USITC staff, Chicago, IL area, Mar. 4-6, and Apr. 22-26, 2002.

Table 5-6
Domestic purchasers' comparisons of foreign versus domestic TDM prices, 1999-2001

Foreign country	Number of reported price comparisons	Instances of: Higher prices than U.S. producer	Same pricing as U.S. producer	Lower pricing than U.S. producer	Range of price difference, in percent[1]	Range of price difference required to purchase foreign rather than domestic, in percent[2]
Austria	1	0	0	1	-15 to -20	—
Belgium	1	0	1	0	—	-10
Canada	17	1	7	9	-25 to +5	0 to -25
China	11	0	0	11	-60 to -5	0 to -25
Czech Republic	2	0	0	2	-40 to -22	-10
France	5	1	2	2	-15 to +6	-10
Germany	12	2	4	6	-20 to +15	-10 to +5
Hungary	1	0	0	1	-18	-10
Ireland	2	0	1	1	-5	-5
Italy	8	0	3	5	-15 to -2	-10
Japan	16	2	6	8	-50 to +15	-15 to -5
Korea	10	0	0	10	-70 to -10	-15 to 0
Malaysia	2	0	0	2	-75 to -40	—
Mexico	3	0	1	2	-20 to -15	-20 to -5
Netherlands	1	0	0	1	-20	-15
Poland	3	0	0	3	-55 to -15	0
Portugal	9	0	0	9	-30 to -10	-20 to -15
Singapore	3	0	2	1	-15	-15
Slovakia	2	0	0	2	-20 to -18	-10 to 0
Spain	4	0	0	4	-20 to -2	-15 to -5
Sweden	1	0	0	1	-5	—
Taiwan	13	0	0	13	-50 to -5	-35 to 0
Thailand	3	0	0	3	-80 to -30	-15
Turkey	1	0	0	1	-50	—
United Kingdom	4	1	2	1	-5 to +10	-5

[1] Difference in percent reported by U.S. purchasers of the foreign prices compared with U.S. TDM producers' prices for TDMs in general.

[2] Estimate by U.S. purchasers of the required price difference for the U.S. purchaser to purchase a foreign-made TDM for use in U.S. manufacturing operations instead of a U.S.-made TDM.

Source: Compiled from data submitted in response to Commission Purchaser questionnaires.

products are by far the most commonly cited by the domestic industry as posing significant pricing problems. Other countries that are very price competitive, not only in the U.S. market, but also in other major global TDM markets are Korea, Taiwan, and Thailand.[10] With regard to Chinese and some other foreign tooling, the final cost of such foreign tooling may be greater than the price of U.S. tooling, after factoring in customer visits to the production site, transportation, rework, and various other costs.

[10] See price comparisons in country profiles (ch. 4).

Many U.S. purchasers reportedly evaluate only initial prices, and do not factor in other costs related to the tooling's purchase, or subsequent use. This may be partly explained by companies maintaining separate budgets for purchasing and manufacturing, and individual departments attempting to maximize their own performance while inadvertently increasing costs elsewhere in the organization.[11] However, some U.S. companies use a more comprehensive process to evaluate the total costs associated with purchasing a given TDM, rather than merely initial price. Many U.S. TDM producers have recounted instances of being requested to repair tooling from China and other foreign countries because of poor quality. For certain applications, it may be less expensive for a purchaser to buy several low priced TDMs knowing that the quality, particularly the TDMs' durability, is suspect, in effect making the tooling a disposable item.

Certain structural differences between the U.S. and Chinese industries may also contribute to the Chinese industry's initial pricing advantage, especially with respect to the movement by customers of stamping or molding programs to China. As noted in chapter 4, the Chinese industry has developed large firms that integrate tooling production with parts production, especially for plastics molding. These firms seemingly recover the cost of the tooling through the sale of parts to the customer. They offer "free" tooling as part of the entire molding program. To a lesser extent, the large size of these firms also enables them to achieve certain economies of scale when producing tooling for export.[12] Given the importance of price in the marketplace, manufacturers face ever increasing cost reduction pressures to remain viable.

Production Costs

Production of TDMs, like other goods, is a function of labor, capital, and materials. Although production equipment has grown increasingly sophisticated and expensive, TDM production still requires significant labor inputs, and differentials in labor costs appear to be an important component of the price comparison assessment. For U.S. producers, direct labor is the single largest component of overall TDM production costs, averaging more than 40 percent of total TDM production costs during 1999-2001.[13] Factory costs are next, at 32 percent, followed by raw materials, which represent 27 percent of U.S. TDM production costs.[14] Comparable information and data on the principal components of total production costs of foreign TDM producers are not readily

[11] For example, about one-half of the 125 mold producers responding to a recent survey by the AMBA reported that purchasing and engineering/manufacturing departments typically do not work well together to facilitate the mold buying process, with most respondents citing different agendas and a general lack of communication between the two departments. Purchasing has budgetary responsibility for the mold buying program, whereas engineering/manufacturing must also factor quality, performance, and maintenance considerations into the mold buying process. Clare Goldsberry, "Moldmakers and Purchasing Agents, the Language Barrier," Injection Molding Magazine, Feb. 2002, found at *http://www.immnet.com/articlelibrary/archive/getOneArticle.php3?getArtID=1807*, retrieved Oct. 18, 2002.

[12] There is some question, despite significant cost advantages, as to whether Chinese prices are covering full costs. Industry sources in Japan maintain that Chinese producers lack adequate cost accounting skills to guide them in making quotes.

[13] See ch. 3 for data on U.S. producers' TDM operations.

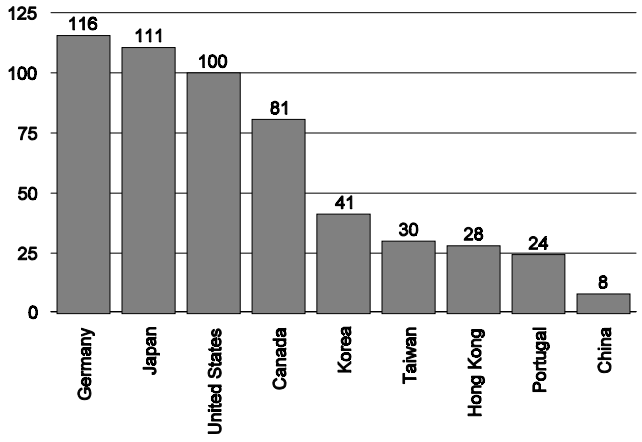
[14] Ibid.

available. Any estimate that might be made as to the major cost components of foreign TDM producers would also have to include capital costs for foreign producers, which cannot be accurately estimated.

Labor Costs

Comparable hourly compensation costs for global tooling industries are not available. Although it is clear that TDM workers earn higher wages than general manufacturing workers in most, if not all countries, available data on hourly compensation costs for manufacturing production workers are a valid proxy of relative labor costs for TDM production in the countries of interest. Total hourly compensation costs for manufacturing production workers show that such costs in Germany, Japan, and Canada are each within 20 percent of U.S. costs (figure 5-1).[15] The notable EU exception is Portugal, where manufacturing labor costs are less than 25 percent of U.S. costs. For countries where TDM-specific labor cost data are available, relative tooling labor costs are congruent with relative manufacturing production labor costs. For example, the International Special Tooling and Machining Association (ISTMA) reports that for mold makers, total hourly wages in Portugal are, on average, 31 percent of U.S. wages, and that for mold makers and tool makers, total hourly wages in Canada are, on average, 82 percent of U.S. wages.[16]

Figure 5-1
Indexes of hourly compensation costs for production workers in manufacturing, 2001



Source: Compiled from U.S. Bureau of Labor Statistics for all countries except China. Index for China estimated by the Commission based on interviews with Chinese Government officials and industry managers, June 10-15, 2002.

[15] The U.S. Bureau of Labor Statistics indexes are based on total hourly compensation costs for all manufacturing industries in each country, and are not necessarily representative of all industry sectors. The indexes in fig. 5-1 are believed to be appropriate proxies for relative comparisons of TDM production labor costs.

[16] ISTMA, *2000 ISTMA Business Statistics Report*, Feb. 2002.

As advances in machining technology narrows the distinction between tool makers and machinists, the role of the designer becomes more critical, and the disparity in wage levels between the United States and low wage foreign competitors more pronounced. For example, the effective hourly average wage for tool designers in the United States was $21.45, or an annual wage of $44,616 based on a 40 hour week in 2000.[17] Overtime, which is common in the TDM industry during busy times, might add as much as $16,000 to $20,000 to the annual wage. In addition, overhead employment costs add between 20 and 30 percent to the annual wage in the United States. The Commission estimated the average annual wage for tool designers in China to be between $3,000 and $6,000 in U.S. dollars, based on interviews with Chinese TDM industry managers. It is difficult to estimate the actual number of hours worked by Chinese tool designers, whereas estimates of overhead employment costs range from 4 to 100 percent. The disparity in wages is quite large, and the effectiveness of the designer in China for many TDM designs is almost the same.[18]

In response to high wages for toolmakers, some TDM manufacturers in other high wage countries, such as Japan, are turning to sub-contracting less critical parts of their TDM work to precision machining shops that have lower cost structures. Although no hard data exist to track this trend, it appears that this practice is less common in the U.S. industry. This may in part be due to differences in design approaches that make it more difficult to parcel out work for U.S. tooling.

A major labor-related cost item for U.S. TDM producers is healthcare costs paid by the employer. Healthcare costs are incurred to some extent by producers in all the countries examined, either through direct payments to insurance carriers or indirectly through taxes that support national systems. Because of the differences in the way such costs are incurred, the direct cost effects at the firm or industry level are obscured. However, U.S. healthcare costs have increased significantly in recent years. In a competitive environment where cost reduction is so important, the increases in healthcare costs faced by the U.S. tooling industry exacerbate the difficulty of improving, or even maintaining price competitiveness in this increasingly global industry.

Availability of Skilled/Experienced Labor Force

Although short term fluctuations in demand or other market conditions can and do influence the ability of individual firms to attract and maintain a skilled labor force, long term trends are more important to the competitiveness of the U.S. industry.[19] All the countries examined benefit from large pools of skilled workers, but the demographics of their labor forces differ. In the countries with long established TDM industries (e.g., the United States, Japan, and Canada), the labor force tends to consist of older employees when compared with emerging countries, such as China. In the more developed economies, it is becoming more difficult to identify, hire, and retain new, young entrants

[17] Ibid.

[18] Chinese industry officials, interviews by USITC staff, Shenzhen, June 14, 2002.

[19] Recent layoffs and firm closures have swelled the ranks of unemployed, experienced tool makers in the United States.

to the industry.[20] By comparison, if TDM production in the industrialized countries continues to contract, it is likely that the surplus of skilled, experienced workers will increase relative to demand, which may impose downward pressure on wages and therefore costs. The availability of skilled workers combined with pressure on TDM producer margins has resulted in apprentice training programs being eliminated at a number of U.S. TDM firms, thereby limiting the hiring of young workers into the industry. Training and recruitment programs have been noted in chapter 4 for Japan, Canada, and Hong Kong.

In developing countries, manufacturing careers offer improved standards of living to many citizens. In addition, educational systems in these countries often focus on providing training and education in manufacturing fields as part of the policy to attract foreign investment in industrial production and to further national development. As manufacturing activity grows, tooling activity, a relatively high wage sector, increases and draws the most experienced candidates. Since workers tend to earn lower wages in the early years of their career, this demographic difference exacerbates labor cost differentials between developing and established industries.

Materials Costs

With few exceptions, TDM specifications require U.S. and foreign TDM producers to purchase equivalent materials. Much of the tool and mold steels, stainless steels, mold bases and internal components used for tooling production are specialized items manufactured by a relatively limited number of global suppliers, that sell at world wide, transparent prices.[21] However, other raw materials are less specialized and are manufactured by a far wider group of suppliers. Given the variety of materials involved in TDM production, the concentration of suppliers and subsequent lack of publicly available pricing data, it is difficult to conclude which nations have advantages in materials costs. Regardless, regional differences do exist for material costs, reflecting local market conditions, trade barriers/protection,[22] and transportation costs.

The corporate structure of typical tooling manufacturers in different countries may contribute to differences in raw material costs. Larger firms, which purchase greater quantities of materials, may be able to negotiate more favorable pricing than smaller firms. National industries characterized by a large number of very small firms (such as in the United States, Germany, and Japan) may, in the aggregate, find themselves at a

[20] The reasons for this are myriad, but industry sources note a general desire for careers outside manufacturing, a shift in the emphasis of the educational system away from vocational training, or the industry offering fewer opportunities as increased productivity and global competition dampen job creation.

[21] TDM materials are primarily produced in industrialized regions, and exported to less industrialized regions. According to TDM-material industry sources, final prices for TDM materials are typically higher in less industrialized regions due to higher transportation costs and less efficient systems of distribution.

[22] U.S. tooling firms have expressed some concern over the imposition of duties on certain steel products as a result of the President's steel safeguard action. See ch 3.

disadvantage with respect to countries that have, on average, larger firms (such as in Canada and China).[23]

With the exception of China, the countries examined for this report all have well established market economies, indicating that material cost differentials are likely to be minimal. However, the situation is less clear with respect to China, where the extent of alleged market manipulation and possible government intervention is unknown. Although references to significantly lower material costs in China were made at the hearing, no solid evidence of this was uncovered during the investigation.[24]

Transportation Costs

TDMs are high value products relative to their size and weight. The cost of transportation is typically small compared to the cost of production. Within North America, TDMs are usually transported by truck. The proximity of U.S. TDM producers to domestic customers, as well as to customers in Canada and Mexico, provides some slight transportation cost advantage over producers outside of North America. However, U.S. TDM producers do not have a transportation advantage compared to Canadian or Mexican producers. Chinese TDM producers may have a transportation advantage in the U.S. market, over producers in Singapore, Indonesia, and Malaysia, because of the well-established freight system between China and the United States. However, if lead times are critical, air freight can add significantly to the cost of a TDM, whereas ocean freight may add several days or even weeks to the delivery schedule. Overall, any advantage in transportation costs contributes little to the competitive position of U.S. TDM producers.

Other Costs

Most of the other costs incurred by tooling firms relate to property, plant, and equipment. While there are national differences with respect to these items, they are not quantifiable on an aggregate, or average, national basis for the TDM industries. With respect to land costs or rents, the U.S. industry likely falls in the middle, with such costs for TDM producers being higher in Japan and Hong Kong and lower in some developing countries. More significant though, are the costs of financing capital equipment since newer machinery and software are constantly required to remain competitive.

Given the rapidly evolving nature of TDM production machinery (including control technology), it is advantageous to maximize the equipment utilization and thereby amortize the investment more quickly as well as minimize unit fixed costs. The U.S. industry, which tends to run only one or two shifts, seems to be at a competitive disadvantage in this area, especially with respect to China. TDM producers in China are much more likely to run 24 hours a day, 7 days a week, yielding significantly higher utilization rates. Since the Chinese economy is growing rapidly, with a significant amount of foreign investment in the export sector, Chinese TDM producers may be in a more favorable business cycle than U.S. TDM firms, and therefore, can more fully utilize

[23] See industry structure in "Composition of the U.S. TDM Industry" (ch. 3) and in country profiles (ch. 4).

[24] For references to material cost differentials in China, see transcript of the hearing, pp. 38, 198, and 209.

their factory overhead. Producers in high wage countries, such as Japan, the United States, Germany, and Canada, have been implementing unmanned machining to more fully utilize their machinery, and to reduce lead times. From an overall industry perspective, the highly disaggregated structure of the U.S. industry tends to contribute to underutilization of factory overhead, particularly when demand for TDMs is weak because of the recessionary economy, fewer new products, and customer migration to foreign production locations. In the future, consolidation and rationalization in the U.S. TDM industry may alleviate this competitive disadvantage.

The costs of investment and operating capital vary not only between countries, but also between sectors and firms within countries. Thus, capital cost comparisons between countries are not necessarily indicative of capital costs for individual TDM-producing firms within those countries.[25] In most cases, investment and operating capital must be financed from retained earnings, debt, or equity. However, differences in accounting practices, and limited transparency introduce a high level of uncertainty to capital cost comparisons between U.S. and some foreign TDM producers. In some cases, limited transparency may also lead to perceptions of steered investment by foreign governments.[26] Further, the cost of capital equipment is affected by tax treatment, especially with respect to depreciation, which some U.S. producers perceive as a competitive disadvantage.[27] Faster depreciation allows faster capital recovery, thus providing an incentive and capability to reinvest in new equipment, which is vital to maintaining a competitive position in the TDM industries.[28]

Availability of Capital

The U.S. tooling industry relies heavily on borrowed money to finance capital investment and, to a lesser extent, for operating capital. Testimony at the Commission's hearing cited a lack of availability of funds as indicative of the conditions facing U.S. TDM producers,[29] but this may be a symptom rather than a cause of the conditions facing many

[25] Capital cost estimates are typically based on the cost of borrowed funds, discounted for risk, opportunity cost, and inflation. The most accurate capital cost estimates are firm-specific.

[26] Anecdotal allegations of government subsidies or other industrial policies supporting the tooling industries in certain foreign countries were introduced at the hearing by Matthew B. Coffey, president, National Tooling & Machining Association, transcript of hearing, pp. 39 and 129; John D. Belzer, president, TCI Precision Metals, and chairman of the board, National Tooling & Machining Association, transcript of hearing, pp. 42 and 47; Olav L. Bradley, chairman, Government Affairs, American Mold Builders Association, transcript of hearing, p. 96; and Joseph Pedulla, owner, Sandor Manufacturing, Inc., transcript of the hearing, p. 181.

[27] For example, equipment that the U.S. industry must depreciate over 7 years can be depreciated in 3 years under the tax code of Germany. Testimony of Manfred Hoffman, chief executive officer, Caco Pacific Corp., transcript of the hearing, p. 166.

[28] However, because depreciation is a non-cash operating cost, shorter depreciation schedules mean lower net profits. Differences in business cultures, particularly with regard to profit expectations, may partially explain the variance in depreciation schedules between countries.

[29] Testimony of the Honorable Donald A. Manzullo, U.S. Congressman, 16th District, State of Illinois, transcript of the hearing, p. 11; testimony of Bruce Braker, president, Tooling & Manufacturing Association, transcript of hearing, p. 32; testimony of David L. Rasmussen, president, Progressive Die & Automation, president, Quality Die & Mold, board of directors, Coalition for the Advancement of Michigan Tooling Industries, transcript of hearing, pp. 67 and 125; testimony of Matthew B. Coffey, president, National Tooling & Machining Association,

(continued...)

U.S. TDM producers, that also are in the trough of a business cycle. This position is substantiated by the availability of capital for new construction for one U.S. TDM producer[30] and a U.S. TDM industry spokesman's prediction that availability of capital for the U.S. TDM industry would increase "when the (U.S.) economy comes back."[31] As noted previously, the cost of capital varies between and within countries, and also between firms. It is reasonable to assume that availability of capital is similarly firm-specific, both for U.S. and foreign TDM producers. However, chapters 3 and 4 corroborate the general availability of capital for TDM producers in countries of interest.

Level of Technology in the Design and Manufacturing Process

Technology transfer has made for a more level playing field in terms of U.S. and foreign TDM producers' abilities to meet customer specifications. As stated by one U.S. tooling industry official, "Technology is available worldwide. The machine tool technologies are very widely circulated around the world. The computer systems that drive those pieces of equipment are widely circulated. So there is no particular technological advantage."[32] Although portions of the U.S., and other long-established foreign industries have invested in state-of-the art equipment, the industries that have developed more recently seem to have benefitted from building their capital stock in a later period, taking advantage of the recent productivity enhancing developments of machining technology.[33]

Tooling design is a complex area, and for any given part there are a number of different tooling solutions. The U.S. TDM industry's strong design capabilities generally seem to confer an advantage. These capabilities are the result of many years of experience in the production of highly complex and precise TDMs demanded by world class customers. The U.S. industry appears to have an edge with respect to aesthetics, and a trend of customers cutting back on their own design functions and relying more heavily on the TDM producers may increase the importance of these skills. However, some foreign competitors view the U.S. industry's tendency to "over-design" as adding as much as 20 percent to final tooling costs. China, in contrast to its strong cost advantages, appears to be at a disadvantage with respect to design, especially the more creative aspects of

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[29] (...continued)
transcript of hearing, p. 113; testimony of Michelle Cleveland, vice president, The Right Place Economic Development Program of Greater Grand Rapids, vice president, Coalition for the Advancement of Michigan Tooling Industries, transcript of the hearing, p. 125; and testimony of Olav L. Bradley, chairman, Government Affairs, American Mold Builders Association, transcript of hearing, p. 126.

[30] Testimony of Carl E. Jones, president, Penn United Technology, Inc., transcript of the hearing, p. 304.

[31] Testimony of David L. Rasmussen, president, Progressive Die & Automation, president, Quality Die & Mold, board of directors, Coalition for the Advancement of Michigan Tooling Industries, transcript of hearing, p. 128.

[32] Testimony of Matthew B. Coffey, president, National Tooling & Machining Association, transcript of the hearing, p.103.

[33] USITC staff observed technological "leap-frogging" during site visits with TDM producers in newly industrializing regions, particularly in China. That is, the latest entrants into the market use the most advanced technologies and TDM production practices.

tooling design. However, the increasing ubiquity of CAD/CAM technology makes it very easy for designs to be generated elsewhere and sent to China for actual production.

Government Programs and Policies

Certain foreign TDM industries appear to benefit directly, or indirectly from government programs and policies. Although many countries have programs to assist individual firms, these programs are open to firms in many different industries, not just TDM industries. The extent to which firms in each country's TDM industry take advantage of such programs is unknown. Many countries have government mandates at the national and local level that affect not only TDM producers, but also other businesses. These laws, regulations, and policies may apply to obligations, such as healthcare, retirement, environmental and safety issues, as well as to tax treatment, although comments from various firms in the country profiles (chapter 4) would suggest that these policies may be applied unevenly. China is one country in which policy appears to encourage investment in the TDM industry. The Chinese Government has provided a number of incentives to encourage investment by Chinese firms in modern production equipment and to promote FDI in the TDM industry.

U.S. and foreign tariffs also play a role in the pricing of TDMs within home markets, with low-tariff countries often further disadvantaged by low-cost foreign competitors that maintain relatively high tariffs. Tariffs within NAFTA are free. Many U.S. tariffs are free. Tariffs in the EU are relatively low. However, Chinese and Taiwan tariffs are relatively high, almost double or triple those of the United States. Most Chinese and Taiwan tariffs on TDMs were bound[34] when China and Taiwan joined the WTO in late 2001 and early 2002, respectively. Table E-1 in appendix E compares tariff rates on TDMs of selected countries in 2002.

Currency Fluctuations

The strong U.S. dollar is a major factor in limiting the price competitiveness of U.S. TDM producers, according to industry sources. U.S. producers' questionnaire responses indicate that the high value of the U.S. dollar is a major impediment to U.S. exports. Most TDM producers in the United States are small companies with no ability to hedge against exchange rate risk. Most TDM producers do not export. Instead, their customers are frequently the exporters. For an explanation of exchange rates, see Box 5-1, "Background Information on Exchange Rates."

The depreciation of such currencies as the yen, peso, Canadian dollar, and euro against the U.S. dollar has effectively lowered the prices of imported TDMs from Japan, Mexico, Canada, and Germany, respectively. Statements made before the Commission indicate that U.S. manufacturers of TDMs are unable to compete with producers in the rest of the world due to the high dollar exchange rate. The fact that the dollar remains

[34] Under WTO negotiations, members will agree to bind, or cap tariffs at negotiated levels.

Box 5-1
Background Information on Exchange Rates

An exchange rate is the number of units of a country's currency exchangeable for 1 unit of another country's currency. A country's currency appreciates when its value increases relative to a foreign currency; i.e., 1 unit of its currency purchases more units of the foreign currency. Likewise, a country's currency depreciates when its value decreases relative to a foreign currency; i.e., 1 unit of its currency purchases fewer units of the foreign currency. For example, if 1 U.S. dollar is worth (can purchase) 100 Japanese yen at the beginning of a period, but can purchase 150 yen at the end of the period, the dollar has risen in value (has appreciated) because it can purchase more yen. Alternatively, in dollar terms, the yen is said to have depreciated from $0.0100 to $0.0067.

Under a system of flexible or floating exchange rates, market or nominal exchange rates (reported in the financial pages of major newspapers) of freely convertible currencies are determined by the supply of and demand for those currencies in the foreign exchange market. The supply of and demand for foreign currencies depends upon the demand for international transactions of goods, services, and assets. Foreign demand for U.S. dollars is based on foreigners' purchases of U.S. goods and services, investments in the United States, and holdings of dollar balances. Likewise, the supply of U.S. dollars outside the United States is based on U.S. citizens' purchases of foreign goods and services, investments abroad, and holdings of balances in foreign currencies.

Exchange rate shifts can significantly affect trade flows because they alter the relative prices of goods and services. For example, if demand for U.S. products rises, then U.S. exports will increase. This would cause the dollar to appreciate. This U.S. dollar appreciation (foreign currency depreciation) would raise the relative price of U.S. goods in foreign markets, thus discouraging U.S. exports, and likewise lower the relative price of foreign goods in the U.S. market, thus encouraging U.S. imports. The converse is true when the dollar depreciates. If the value of the U.S. dollar falls (depreciates), the price competitiveness of U.S. goods in foreign markets is enhanced and the price competitiveness of foreign goods in the U.S. market is diminished.

Exchange rates are dependent on basic macroeconomic factors, domestic monetary and fiscal policies, independence of the country's central bank, exchange controls and openness of its capital market, and the country's exchange rate arrangements (the mechanisms by which the exchange rate is established), which range from market-determined exchange rates (freely floating exchange rates or "clean" float) to fixed-rate systems. The U.S. dollar is a freely floating currency.

Most of the leading U.S. trade partners also maintain floating exchange rates, and their central banks intervene selectively or not at all. Several others, such as China, maintain an organized floating exchange rate, or a managed float. The central banks of several countries have announced their intentions to intervene should they consider market conditions disorderly or if their currency's foreign-exchange value fluctuates beyond a stated range of parity against other currencies or a basket of currencies. Other countries, such as Ecuador and Lithuania, have chosen to maintain the value of their currency through such arrangements as dollarization and currency boards.

Source: Heather Sykes, "Background on Exchange Rate Shifts", *Shifts in Merchandise Trade, 2001*, Inv. No. 332-345, USITC publication 3525, July 2002, pp. F1-F13.

stronger than currencies in other parts of the world is a detriment to exporting and slows U.S. production.[35] Although some testified about the lack of U.S. response to Asian countries devaluing their currencies in 1997,[36] others note that the strength of the dollar vis-a-vis Canada has been a long-term problem.[37]

Large-scale currency depreciations in real terms[38] versus the U.S. dollar have taken place during 1997-2001 in many key TDM trading partner countries. The strength of the U.S. dollar indicates that it remains the preferred international currency for both international trade and financial transactions. Other reasons for the high value of the U.S. dollar are the strength and relative stability of the U.S. economy compared to much of the rest of the world. Between 1997 and 2001, many major currencies depreciated in real terms. These depreciations are shown in the following tabulation (in percent):

Currency	Depreciation
Japanese yen	7
New Taiwan dollar	25
Hong Kong dollar	7
Singapore dollar	20
Korean won	13
Canadian dollar	9
German deutschemark/euro[39]	22

Figure 5-2 shows the extent of real depreciation in the Japanese yen, the Taiwan new dollar, the Canadian dollar, and the German deutschemark/euro, respectively, during 1997-2002, as well as the real appreciation of the Mexican peso during 1997-2000. The Mexican peso appreciated by almost 17 percent through the end of 2000.[40] The appreciation of the peso compared with the U.S. dollar is due to the strong Mexican

[35] Testimony of Matthew B. Coffey, president, National Tooling & Machining Association, transcript of the hearing, p. 88.

[36] Testimony of Jerry Lirette, President, D-M-E Company, transcript of the hearing, p.155.

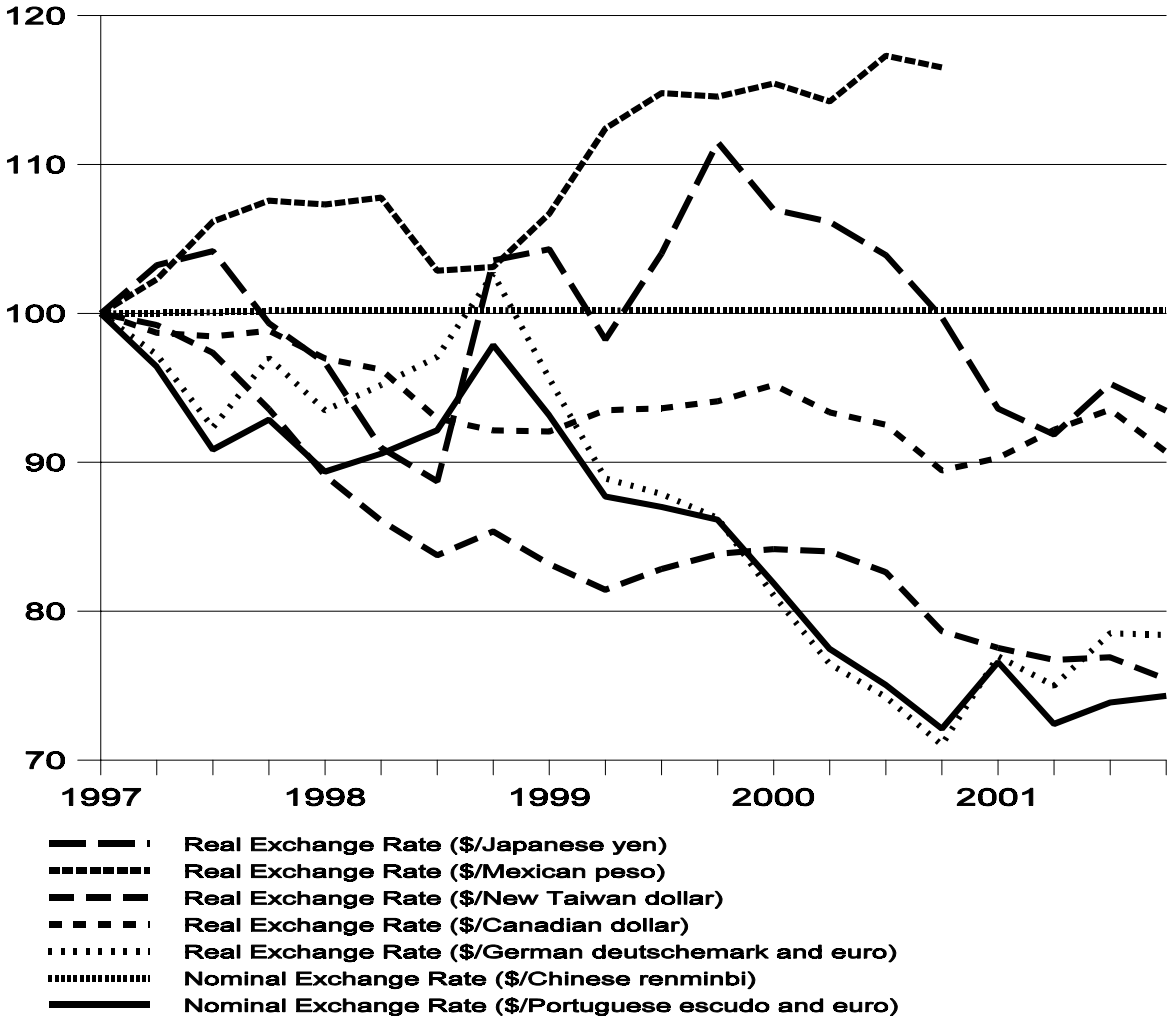
[37] Testimony of Bruce Braker, president, Tooling & Manufacturing Association, transcript of the hearing, p.31. Testimony of Daniel W. Jepson, president, Jepson Precision Tool, Inc., transcript of the hearing, p. 289.

[38] Real exchange rates are nominal rates that have been adjusted for inflation. Real exchange rate movements are relevant to individual sectors or subsectors, such as tools, dies, and industrial molds, insofar as the producer or wholesale price indices used in the calculation resemble price movements confronting producers and traders in the given sector or subsector. The producer price index for the TDM industry was used in calculating the real exchange rate indices referenced in this report.

[39] To obtain consistent currency indexes for Germany and Portugal that were not disrupted by the adoption of the euro in 1999, the deustchmark and escudo for the years 1997-1998 were converted into euros at the European Central Bank's set conversion rates, which are found at *http://www.ecb.int*. Depreciation of the Portuguese escudo is not shown on this tabulation, as real exchange rate information for Portugal could not be calculated because the producer price index for that country is not available.

[40] Real exchange rate information for Mexico is unavailable for 2001, as the price index for that country is not available for that year.

Figure 5-2
Exchange rate indexes for major currencies compared with the U.S. dollar, 1997-2001



Source: Compiled from International Monetary Fund, *International Financial Statistics*, various years, and from the official statistics of the Bank of China.

economy in recent years and its "safe haven" status in Latin America.[41] Figure 5-2 also shows the steady nominal exchange rate for the Chinese renminbi.[42] The renminbi's nominal exchange rate to the dollar remained more or less constant, as the People's Bank

[41] Mexico has a more stable economy and higher credit ratings than the other large Latin American economies. Argentina has been in an economic and financial crisis since November 2000 and Brazil suffers from low commodity prices and a national energy shortage. Tom Vogel, "Mexico's Economy Can Take Punches, Keep Standing," Nov. 20, 2001, *http://quote.bloomberg.com/fgcgi.cgi?ptitle=Thomas%20T.%20Vogel%20Jr.&touch=1&s1=vogel&tp=ad_topright_bbco&T=markets_fgcgi_content99.ht&s2=ad_right1_bbco&bt=ad_bottom_bbco&s=AO.njtxSWTWV4aWNv*

[42] The current exchange rate is described as a "managed float" by Chinese government officials; it has behaved more like a pegged rate for the past few years. U.S. Department of State, *1999 Country Report on Economic Policy and Trade Practices - China*, Mar. 2000, *http://www.state.gov/www/issues/economic/trade_reports/1999/china.html*

of China announces a daily reference rate against the U.S. dollar, the Hong Kong dollar, and the Japanese yen based on the weighted-average price of foreign-exchange transactions of the previous day.[43] The lack of a published producer price index for China and Portugal (the Portuguese escudo/euro depreciated by more than 25 percent) prevented the calculation of indexes comparable with the other currencies.

Table 5-7 shows monthly nominal exchange rates for the currencies of competing TDM countries for the first 6 months of 2002. The Mexican peso has continued to appreciate, the Hong Kong dollar and Chinese renminbi have remained steady due to the basket peg mentioned above, and all other currencies have continued to depreciate, in nominal terms, against the dollar.

Table 5-7
Monthly nominal exchange rates for selected currencies in 2002, compared with U.S. dollar

Month	Mexico (peso)	Germany (euro)	Portugal (euro)	Canada (dollar)	China (yuan renminbi)	Hong Kong (dollar)	Taiwan (new dollar)	Japan (yen)
January	9.16	1.13	1.13	1.60	8.28	7.80	35.02	132.67
February	9.11	1.15	1.15	1.59	8.28	7.80	35.07	133.52
March	9.08	1.14	1.14	1.59	8.28	7.80	35.02	131.19
April	9.13	1.13	1.13	1.58	8.28	7.80	34.91	131.07
May	9.49	1.09	1.09	1.55	8.28	7.80	34.46	126.48
June	9.74	1.05	1.05	1.53	8.28	7.80	33.99	123.60

Source: Compiled from International Monetary Fund, *International Financial Statistics*, various months, and from the official statistics of the Bank of China.

[43] This reference rate establishes the current day's maximum trading limits in the interbank foreign-exchange market. The Hong Kong dollar has held steady the past few years as well, as Hong Kong became a part of China in 1997.

CHAPTER 6. CHALLENGES AND POTENTIAL IMPLICATIONS FACING THE INDUSTRY

Challenges

The current global competitive conditions in TDM markets pose new challenges with potentially significant implications for the U.S. TDM industry that could change the character and structure of the industry. U.S. TDM producers currently are faced with several major problems: (1) the recent downturn in the U.S. economy and its slow recovery, which has caused a major delay in manufacturing activity recovery that would have otherwise created demand for tooling; (2) a shrinking domestic market due to the migration of manufacturing customers to foreign locations; (3) excess capacity due to reduced domestic market demand and to enhanced productivity from new technologies; (4) customer pressure for lower prices; (5) increasing foreign competition; and (6) rising costs, particularly labor-related costs. Many of these problems will likely continue into the foreseeable future, particularly rising costs, foreign competition, and customer demands on price and service.

The key problems noted above, as well as other challenges affecting the industry, were repeatedly mentioned in the various industry reports cited in chapter 1, hearing testimony and written submissions, and in interviews and fieldwork conducted by Commission staff. They also were noted by U.S. producers responding to the Commission's questionnaire when asked about the challenges U.S. TDM producers are likely to face over the next 3 years. For many companies that responded, "survival" was the overriding concern. These U.S. firms stated that excess domestic and global TDM capacity, low prices, increased domestic and foreign competition, depressed demand due to the recessionary-like economy, and the shrinking U.S. customer base have adversely affected the U.S. TDM industry. Within such a competitive environment, firms also cited negative implications stemming from rising healthcare costs, higher labor costs, and high tax burdens. Further, respondents cited the challenges of retaining a skilled workforce, obtaining funding to purchase new computer software and machinery, and training requirements in order to remain competitive. The low prices demanded by customers, lack of work, and constantly rising production costs have resulted, as U.S. producers note, in pressure on margins and cashflow problems. Only one company responded that it would be a challenge to service companies that have moved production and tooling to foreign production locations. Although no U.S. producers cited the strong U.S. dollar among the major challenges of concern over the next 3 years, U.S. producers have mentioned the adverse effects of a strong U.S. dollar with regard to conferring an advantage on imports and in limiting U.S. exports.

Implications

There are both short- and long-term implications arising out of the economic realities faced by the U.S. TDM industry. In the short term, despite a slowly improving economy, some TDM producers are likely to close due to weakened demand and financial conditions. One forecast predicts that there will be a 50-percent decline in the number of firms in the U.S. TDM industry.[1] With current excess capacity at approximately 25 to 30 percent and a significant share of U.S. production capacity characterized as inefficient, unprofitable, or based on older machinery, it is likely that underperforming companies will exit from the industry first.[2] Likewise, many smaller firms that cannot develop capacities in key competency areas[3] or are entrenched in less-sophisticated mold- and die-building niches likely will close their operations in the near term. Remaining viable firms likely will gain increased sales and orders with a recovering economy and the business left behind from firms that have failed. Overall, the U.S. TDM sector is likely to be a much smaller industry that focuses on producing higher value-added products, principally for the domestic market.

As the U.S. TDM sector is highly dependent upon the U.S. automotive market, trends in U.S. automobile production will also significantly affect U.S. TDM producers. In the short term, U.S. firms likely will benefit from projected growth in the automotive tooling market during 2003-05.[4] Such growth primarily will result from projected new model launches by the "Big Three" automobile producers. New model launches are expected to peak in 2004, with a smaller number of new automobiles launched in 2005. Likewise, foreign transplant automobile producers are expected to launch new models, with most occurring in 2004; one source forecasts that transplants will account for 35 to 40 percent of North American automotive production by the end of the decade.[5] Opportunities to supply tooling for these initiatives may be limited however, since foreign transplants currently source a portion of their tooling from suppliers in their home countries, and because U.S. firms tend to contract with either traditional North American or foreign transplant automotive producers but have not attempted to serve both customer bases.[6] In

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[1] Testimony of Daniel W. Jepson, president, Jepson Precision Tool, Inc., transcript of the hearing, p. 222. Also, in comparison, during the recession of the early 1980s, U.S. TDM industry shipments declined by slightly more than 15 percent during 1981-83, before rebounding by almost 25 percent in 1984. Unlike the current situation, during 1981-83, the TDM industry did not face a decline of industrial mold prices, a migration of U.S. customers to foreign production locations, or foreign competition from low labor-cost TDM producers.

[2] Testimony of Michael Retzer, controller, W.G. Strohwig Tool & Die, Inc., transcript of the hearing, pp. 230.

[3] Key competencies "required for success" are sophisticated design capability, ability to develop strategic customer relationships, unique and extensive product and process knowledge, strong program management, lean manufacturing systems, state-of-the-art manufacturing technology, and the ability to manage global purchasing and marketing alliances. Michelle Cleveland, Coalition for the Advancement of Michigan Tooling Industries, written submission, May 17, 2002, p. 2.

[4] DesRosiers Automotive Consultants (DesRosiers), Inc., *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, Inc., July 2002), p. 15.

[5] Ibid., p. 10.

[6] U.S. and foreign industry representatives, interviews by USITC staff, Chicago, IL area, and the United States and Japan, Apr. 22-26 and June 6, 2002; and DesRosiers Automotive

(continued...)

response to high costs relative to competitors, Ford Motor Co. recently announced that it would procure from China almost $1 billion of auto parts by mid-2003 and over $10 billion by mid-decade in an effort to reduce its $90 billion annual purchasing costs.[7] Such developments may reduce demand for U.S. tooling.[8]

Over the short term, domestic and foreign competition is likely to increase in all TDM market segments. In North America, this competition likely will be driven by the desire of U.S. and Canadian TDM producers to use excess capacity. Foreign competitors from Canada or Europe may consider establishing U.S. production in order to be close to the customer and provide more value-added services.[9] Competition from China, Taiwan, Korea, and other Asian producers likely will be driven by their desire to manufacture TDMs of greater precision and complexity. Within 5 years, a number of industry observers indicate that China will be supplying all of its own internal demands[10] and will have built up substantial experience to enable it to be a formidable competitor in the U.S. TDM market.[11] As noted earlier in this report, U.S. TDM producers are already seeing increasingly sophisticated Chinese TDMs entering the U.S. market, including TDMs for automotive parts.[12] Producers in one portion of the industry, TDMs made from cemented carbides, believe that China may eventually dominate that particular TDM market niche.[13]

With regard to markets other than the automotive shrinking demand is likely to continue as U.S. production is transferred to foreign locations. Both the automotive and the appliance tooling markets are likely to have increasingly foreign competition as customers in those industries continue to seek low priced TDMs for their parts production. Other markets may be more resilient to foreign competition, such as the medical and packaging industries. U.S. TDM producers may also face less competition

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[6] (...continued)
Consultants, Inc., Inc. *Key Factors Influencing the Canadian Tool Making Industry* (Richmond Hill, Ontario: DesRosiers, Inc., July 2002), executive summary.

[7] Mark Truby, "Ford to Buy More Parts in China," *The Detroit News*, Sept. 19, 2002, found at *http://www.detnews.com/2002/autosinsider/0209/19/c01-591459.htm*, retrieved Sept. 26, 2002.

[8] Auto parts being procured from China would be molded plastic components and small-size metal stampings, rather than larger or more-complicated items such as body panels or exterior components. U.S. tool and die industry representative, interview by USITC staff, Oct. 18, 2002.

[9] See ch. 4, Germany.

[10] Testimony of Bruce Braker, president, Tooling & Machining Association, transcript of the hearing, p. 91.

[11] U.S. industry representatives, interviews by USITC staff, Chicago, IL area, Apr. 23, 2002.

[12] See ch. 4, China.

[13] Baker & Hostetler, LLP, on behalf of the Cemented Carbide Producers' Association (CCPA), written submission, Sept. 20, 2002. Cemented carbides are used to produce tooling with hardness, strength, and wear-resistance greater than most tool steels; for example, because of wear-resistance, dies made from cemented carbide TDMs have replaced those of conventional tool steel in the manufacture of bullets. China, which is the largest producer of tungsten, has increasingly exported ammonium paratungstate, an intermediate input in the production of cemented carbides, as well as downstream products, such as powders, cemented carbides, TDMs, and cutting tools for machine tools. The CCPA believes that the U.S. cemented carbide TDM industry segment will be vulnerable to pricing decisions by Chinese producers of cemented carbide if the U.S. cemented carbide industry disappears because of the growing Chinese share of the market for cemented carbide and downstream products.

in market segments where customers have a need for large-sized, complex, and high-precision TDMs.

In the long term, more dramatic changes in the structure of the industry and the character of U.S. firms likely will occur. U.S. TDM producers that survive over the next few years likely will not resemble the "Mom and Pop" tooling shops that comprise the vast majority of the industry today. Industry sources suggest that those firms that do survive will likely be small, stand-alone firms that are either (1) small firms with "well-defined differentiation" serving niche markets or (2) firms with low margins and "uneven workflow" at low levels of the manufacturing supply chain.[14] According to one source, the successful and profitable tooling firms are likely to be tied to just one customer or a handful of customers, and such firms will supply a substantial portion of their customers' tooling needs. Surviving and successful firms, according to this source, likely will have sales of $15 to $30 million, which is generally higher than the current sales average for individual firms, and will have a management staff with strong business skills.[15]

The longer-term outlook for the automotive tooling market indicates that restructuring among TDM firms will result in "increased consolidation into fewer, larger, more sophisticated, full-service tooling shops servicing the Tier I and Tier II parts makers."[16] Industry sources suggest that those firms that cannot meet the automotive industry's performance standards for TDM suppliers likely will serve full-service tooling shops as needed and be limited to small contracts. Automotive TDM suppliers will also likely focus on particular automotive segments. Advanced technologies such as hydroforming, primarily used to produce structural components for trucks, may result in a fewer number of dies being produced for the automotive market, while material substitution may result in new opportunities.[17]

Suggestions for Improving Competitiveness

A broad range of suggestions has been offered for improving the competitiveness of the U.S. TDM industry. These suggestions primarily have been offered by trade associations, TDM producers, and U.S. purchasers. In addition, foreign industry officials have noted various steps being taken by their own TDM firms to become more competitive, given the many comparable challenges faced by TDM firms worldwide. The suggestions cover actions to be taken at the firm level as well as industrywide initiatives. U.S. TDM industry representatives also propose amending existing U.S. laws and policies that may affect the competitiveness of the U.S. industry.

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[14] The Right Place Program, written submission, May 30, 2002, incorporating IRN, Inc., *A Competitive Assessment of the Die and Mold Building Sector, A West Michigan Perspective*, May 2002, p. 78.

[15] Ibid.

[16] DesRosiers Automotive Consultants, Inc., *Key Factors Influencing the Canadian Tool Making Industry*, July 2002, executive summary.

[17] Ibid., pp. 11-16.

Firm-Level Initiatives

Ideas for increasing competitiveness via reforms at the firm level were primarily expressed by U.S. purchasers, but they echo some of the same thoughts stated by U.S. TDM producers. Purchasers responding to the Commission's questionnaire listed a number of steps that U.S. producers might undertake to improve their competitive position relative to foreign suppliers. They stated that U.S. TDM producers should decrease lead times, reduce costs and thus reduce TDM prices, and offer additional customer service. Respondents encouraged TDM producers to reduce labor and overhead costs, and become more efficient, thus offering higher value-to-price ratios. U.S. purchasers suggested that U.S. TDM producers continue to make investments in technology, including acquiring state-of-the-art machinery and software (3-D modeling and rapid prototyping). Also mentioned were the need for TDM producers to increase their flexibility with respect to engineering changes requested by the customer; use of continuous improvement programs; increased specialization in niche markets; improved project management; and improved worker training and education; and the establishment of foreign production capability, or partnerships or joint ventures with foreign producers.

Industry-Level Initiatives

Sustainable competitive advantage includes action at the industry level in addition to the improvement of individual TDM firms.[18] To that end, industry sources propose that all firms should emulate the characteristics of world-class tooling companies, and that the industry should establish support organizations and mechanisms to facilitate this goal. World-class tooling firms are characterized as having the following:

- Strategic focus
- Deep, long-term customer relationships
- Unique product or process knowledge
- Broad range of services
- Fully integrated, leading design technology
- Ability to act as a broker
- Strong program management
- Strategic financial management, including high knowledge of actual costs
- Commitment to continuous improvement and lean manufacturing practices
- Strategic vendor relationships
- Global sourcing and production alliances[19]

Industry sources have identified certain measures that individual firms might take to attain these characteristics, as well as additional initiatives to improve the

[18] The Right Place Program, written submission, May 30, 2002, incorporating IRN, Inc., *A Competitive Assessment of the Die and Mold Building Sector, A West Michigan Perspective*, May 2002, p. 73.

[19] Ibid.

competitiveness of the industry (table 6-1). Each has its advantages and disadvantages, with cost cutting and partnership being the more static strategies geared toward immediate results with little investment and potential downside risk in the longer term. The strategies of improving efficiency and diversification both require significant capital investment, and niche market specialization requires significant funding of research and development projects. For many U.S. TDM producers, a challenge is obtaining the capital at reasonable interest rates in order to invest in the state-of-the art machinery that U.S. purchasers say is needed and that foreign competitors are continuing to purchase.[20] Several government programs at the Federal and state level (chapter 3, tables 3-19 and 3-20) are geared toward facilitating assistance in these areas of need.

Table 6–1
Selected survival strategies for U.S. tool, die, and industrial mold producers: Required actions, advantages, and disadvantages

Strategy	Actions	Advantages	Disadvantages
Cost cutting	• Layoffs • Reduce overhead • Wage cuts • Reduce benefits to employees	• No capital investment • Immediate benefit	• Hard on employees • May lose key personnel
Improve efficiency	• Lean manufacturing processes • Advanced manufacturing techniques • Robotics and automation	• Substantial long-term benefits	• Significant capital investment • Training and disruptions hurt profits in the short term
Diversification	• Value-added services and products • Vertical integration • Machining other than tooling production	• Reduces reliance on one industry • Can make firm more valuable to its customers	• Likely to be in direct competition with customers • Significant capital investment • Need people with expertise in new market to be successful
Specialization	• Focus on niche markets • Proprietary products or processes	• Minimal capital investment • Focus on what firm is good at	• Vulnerable if niche market changes • Research required to develop own products is expensive
Partnership	• “Partner” with foreign competitor • Move operations outside the United States • Sell business to molder or contract manufacturer	• No capital investment • Immediate benefit	• Does not help keep existing workforce busy • May lose business to “partner” in long term

Source: American Mold Builders Association

Some practices used by foreign TDM industries may be avenues that the U.S. TDM industry might pursue in improving its competitiveness. In Japan and Taiwan, subcontracting is used extensively to reduce lead times and to buffer firms in weak economic times against having excess capacity and employee layoffs.[21] In both Japan and Taiwan, subcontractors were in close geographic proximity to TDM producers. For

[20] Responses to the Commission’s producers’ and purchasers’ questionnaires.
[21] See ch. 4, Japan and Taiwan.

some firms, the use of subcontractors allows the firm to focus its capital expenditures on particular types of machinery or processes. In contrast, U.S. TDM producers have used subcontractors in the past when capacity utilization was high, but in the current economic environment firms have been using their excess in-house capacity. Another foreign practice is that of performing TDM design activities across many time zones, allowing for design to be performed around-the-clock. Some U.S. TDM producers already work with design companies in order to accomplish this.

One practice beginning to be used in the United States is the formation of buyers groups for the purchase of raw materials in order to reduce the cost advantage that, according to anecdotal information, their foreign competitors may have. Conceivably, supplies such as cutting tools and fluids, and machinery might also be included in such group purchases. Expansion of buyers groups to include related industries, such as the precision machining industry, may result in greater purchasing leverage.

Public Policy Initiatives

In the area of public policy, a number of parties have made recommendations related to taxation, financial assistance, education, costs, and trade. With regard to taxation, industry representatives have suggested introducing investment tax credits, accelerating depreciation for machinery and software, and providing tax credits for energy-efficient equipment and plant modifications.[22] Government assistance to help reduce natural gas and other utility costs has also been mentioned.[23] Other suggestions include enabling trade association health plans to include TDM producers so that insurance may be purchased in large pools at a lower cost in order to compete with large companies.[24] Some parties have called for trade relief under U.S. trade laws.[25] Certain legislation that will benefit the TDM sector, such as the *Skilled Workforce Enhancement Act of 2001* (H.R. 877), or legislation to support small businesses, has been proposed and is currently before the U.S. Congress.

Selected Foreign Industry Initiatives

As noted in chapter 4, other TDM industries (Japan, Taiwan, Hong Kong, and certain European Union countries) have also been adversely affected by increasing low-cost TDM foreign competition and the migration of domestic customers to low-cost production locations. Foreign governments and/or trade associations (as well as TDM firms themselves) recognize the problems facing the TDM industries, and are becoming more proactive in seeking to improve the competitive positions of their industries. Other countries (China and Korea) are continuing the development of their TDM industries, and newer suppliers (Czech Republic and Poland) are developing into global competitors. Still others (Germany and Portugal) are striving to maintain their high level of competitiveness. Specific measures being undertaken by governments, trade

[22] For example, letter to Senator Richard Santorum (R-PA), from Government Affairs, Manufacturing Association of Northwest Pennsylvania, Oct. 17, 2001, found at *http://www.manp.org/santorumltr.htm*, retrieved Sept. 26, 2002.

[23] Quality Mold Inc., written submission, May 21, 2002, p. 7.

[24] Laurie Schmald Moncrieff, president, Schmald Tool & Die, written submission, May 21, 2002, p. 6.

[25] Ibid.

associations, and/or individual companies are highlighted in table 6-2, and are more fully discussed in chapter 4.

The potential severity of the previously detailed short- and long-term implications will depend upon the success of efforts by the U.S. TDM industry to improve its own competitiveness over the next few years. The domestic industry must be aware that its international competitors are seeking improvements in competitiveness as well and that performance levels necessary to stay competitive in the U.S. and global markets will continue to rise. For many U.S. TDM producers, the necessity to invest in capital equipment to reduce the labor component of production will be crucial to offset rising labor costs.

Table 6–2
Efforts by governments and/or tool, die, and industrial mold industries regarding their competitive position

Producer	Status of TDM industry	Known industry action plan for the future
United States	Challenged	• No consensus on a plan for guiding the industry due to fragmented representation by several trade associations and small firm size which limits financial resources for such an effort
Canada	Challenged	• Priority has been on obtaining government support for training • Otherwise, no future industry action plan is publicly available
Japan	Challenged	• Increased government awareness of issues affecting the TDM industry and interaction with TDM industry associations. Defined tasks for industry renewal include: • Greater cooperation with academia • Formation of consortium among firms • Optimization of subcontracting • Concentration by technological fields • Greater introduction of computer technologies • Better foreign market intelligence • Reductions in TDM firms' high cost structure, and • Protection of intellectual property rights relating to the transfer of TDM design and production process technology by customers
Taiwan	Challenged	• Trade association emphasis on TDM design capabilities and worker training • Focus on TDMs for the high-end of the market • Continue to leverage production capabilities in China with headquarters and design operations remaining in Taiwan
China: Mainland	Growth	• Trade association emphasis with government support, focused on improving management practices and worker training, as well as upgrading TDM industry technology • Many firms in the industry, particularly foreign-invested TDM producers, intend to produce high-precision and increasingly complex TDMs with higher levels of quality
Hong Kong	Growth	• Continued integration of the industry with Chinese production operations • Industry and Government focus on rapid-prototyping, rapid-tooling, and (R&D)
European Union (EU)	Split between maintaining competitive edge and challenged	• Continued support of R&D efforts • Enhancement of cross-border cooperation and grouping among moldmakers in France, Portugal, and Spain; this initiative is within a large set of projects in the area of subcontracting by the EU Directorate on Enterprise • Previous efforts included the benchmarking of the EU industry against Japanese and Taiwan TDM producers
Portugal	Maintaining competitive edge	• Increased emphasis on computer technologies to leverage its current low labor costs and TDM industry experience
Germany	Maintaining competitive edge	• Increased collaboration among industry, university, and private research institutes
United Kingdom (UK)	Challenged	• The UK Gauge & Tool Makers' Association (GTMA) continues to promote the use of World Class Profiles for benchmarking and their role in raising standards throughout the UK TDM industry. According to GTMA, the UK is the only country in the world to have developed specific benchmarking profiles within the toolmaking industry. Benchmarking profiles have been established based on world class precision machining and metrology firms (precision machining and metrology are used in toolmaking).

Source: Compiled by the Commission from various sources, including fieldwork by Commission staff in Asia and Canada; and Japan Society for the Promotion of the Machinery Industry, *Assignments and Future Prospects for the Die and Mold Industry*, executive summary, Mar. 2002.

APPENDIX A

Request Letter from the House Committee on Ways and Means

Congress of the United States

House of Representatives

COMMITTEE ON WAYS AND MEANS
1102 LONGWORTH HOUSE OFFICE BUILDING
(202) 225-3625
Washington, DC 20515-6348
http://waysandmeans.house.gov

December 20, 2001

Rec'd: 12/21/01
ER
SE

The Honorable Stephen Koplan
Chairman
U.S. International Trade Commission
500 E Street, SW
Washington, D.C. 20436

Dear Chairman Koplan:

The impact of globalization on important U.S. industries is of ongoing concern and interest to the Unites States Congress. It has recently come to the attention of the Committee on Ways and Means that U.S. producers in the tool, die, and industrial mold industries are concerned about competitive conditions affecting their industries.

Accordingly, on behalf of the Committee on Ways and Means of the United States House of Representatives, and under authority of section 332(g) of the Tariff Act of 1930, 19 U.S.C. §1332(g), I am requesting that the Commission institute a fact-finding investigation of the current competitive conditions facing producers in the U.S. tool, die, and industrial mold industries as classified in North American Industry Classification System (NAICS) industries 333514 and 333511, with respect to the U.S. and global markets. The Commission review of these industries should provide information for the most recent five-year period, to the extent possible, regarding the following:

1. A profile of the U.S. tool, die, and industrial mold industries.
2. Changes in marketing and manufacturing processes, and trends in U.S. production, consumption, and trade.
3. Global market overview and assessment of foreign markets and significant foreign industries, including those in China, Taiwan, Japan, Canada, Mexico, and EU member countries.
4. A comparison of the strengths and weaknesses of U.S. and foreign producers regarding factors of competition such as production costs, labor costs, availability of skilled/experienced labor force, level of technology in the design and manufacturing process, availability of capital,

transportation costs, pricing, product quality and after-sales-service, and government programs assisting these industries.

5. Principal challenges and potential implications for the industries over the near term.

The Commission should provide its completed report no later than ten months from receipt of this request. Thank you for your attention to this important matter.

Best regards,

Bill Thomas
Chairman

WMT/dk

APPENDIX B
Federal Register Notice

Metallurgical Co., Butler, PA, Shieldalloy Metallurgical Corp., Cambridge, OH, Gulf Chemical & Metallurgical Corp., Freeport, TX, U.S. Vanadium Corp., Danbury, CT, and CS Metals of Louisiana LLC, Convent, LA.

Notice of the institution of the Commission's investigations and of a public conference to be held in connection therewith was given by posting copies of the notice in the Office of the Secretary, U.S. International Trade Commission, Washington, DC, and by publishing the notice in the **Federal Register** of November 30, 2001 (66 FR 59815). The conference was held in Washington, DC, on December 17, 2001, and all persons who requested the opportunity were permitted to appear in person or by counsel.

The Commission transmitted its determinations in these investigations to the Secretary of Commerce on January 10, 2002. The views of the Commission are contained in USITC Publication 3484 (January 2002), entitled Ferrovanadium from China and South Africa: Investigations Nos. 731–TA–989 and 987 (Preliminary).

Issued: January 10, 2002.

By order of the Commission.

Marilyn R. Abbott,

Acting Secretary.

[FR Doc. 02–1124 Filed 1–15–02; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation 332–435]

Tools, Dies, and Industrial Molds: Competitive Conditions in the United States and Selected Foreign Markets

AGENCY: United States International Trade Commission.

ACTION: Institution of investigation and scheduling of public hearing.

EFFECTIVE DATE: January 10, 2002.

SUMMARY: Following receipt of a request on December 21, 2001, from the Committee on Ways and Means of the U.S. House of Representatives, the Commission instituted investigation No. 332–435, Tools, Dies, and Industrial Molds: Competitive Conditions in the United States and Selected Foreign Markets, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)).

FOR FURTHER INFORMATION CONTACT: Information specific to this investigation may be obtained from Dennis Fravel, Project Leader (202–205–3404; *fravel@usitc.gov*) or Harry Lenchitz, Deputy Project Leader (202–205–2737; *lenchitz@usitc.gov*), Office of Industries, U.S. International Trade Commission, Washington, DC, 20436. For information on the legal aspects of this investigation, contact William Gearhart of the Office of the General Counsel (202–205–3091; *wgearhart@usitc.gov*). Hearing impaired individuals are advised that information on this matter can be obtained by contacting the TDD terminal on (202) 205–1810.

Background

As requested by the Committee, the Commission will provide information, to the extent possible, for the most recent five-year period regarding the following:

1. A profile of the U.S. tool, die, and industrial mold industries.
2. Changes in marketing and manufacturing processes, and trends in U.S. production, consumption, and trade.
3. A global market overview and assessment of foreign markets and significant foreign industries, including those in China, Taiwan, Japan, Canada, Mexico, and European Union member countries.
4. A comparison of the strengths and weaknesses of U.S. and foreign producers regarding factors of competition such as production costs, labor costs, availability of skilled/experienced labor force, level of technology in the design and manufacturing process, availability of capital, transportation costs, pricing, product quality and after-sales service, and government programs assisting these industries.
5. The principal challenges and potential implications for the industries over the near term. As requested by the Committee, the Commission plans to submit its report to the Committee by October 21, 2002.

Public Hearing

A public hearing in connection with the investigation will be held at the U.S. International Trade Commission Building, 500 E Street SW., Washington, DC, beginning at 9:30 a.m. on May 21, 2002. All persons shall have the right to appear, by counsel or in person, to present information, and to be heard. Requests to appear at the public hearing should be filed with the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436, no later than 5:15 p.m., May 7, 2002. Any prehearing briefs (original and 14 copies) should be filed not later than 5:15 p.m., May 9, 2002; the deadline for filing post-hearing briefs or statements is 5:15 p.m., May 30, 2002. In the event that, as of the close of business on May 7, 2002, no witnesses are scheduled to appear at the hearing, the hearing will be canceled. Any person interested in attending the hearing as an observer or non-participant may call the Secretary to the Commission (202–205–1806) after May 7, 2002, to determine whether the hearing will be held.

Written Submissions

In lieu of or in addition to participating in the hearing, interested parties are invited to submit written statements (original and 14 copies) concerning the matters to be addressed by the Commission in its report on this investigation. Commercial or financial information that a submitter desires the Commission to treat as confidential must be submitted on separate sheets of paper, each clearly marked "Confidential Business Information" at the top. All submissions requesting confidential treatment must conform with the requirements of § 201.6 of the Commission's rules of practice and procedure (19 CFR 201.6). All written submissions, except for confidential business information, will be made available in the Office of the Secretary to the Commission for inspection by interested parties. To be assured of consideration by the Commission, written statements relating to the Commission's report should be submitted to the Commission at the earliest practical date and should be received no later than the close of business on May 30, 2002. All submissions should be addressed to the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436. The Commission's rules do not authorize filing submissions with the Secretary by facsimile or electronic means.

Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2000. General information concerning the Commission may also be obtained by accessing its Internet server (*http://www.usitc.gov*).

List of Subjects

Tools, dies, industrial molds, competitiveness, and imports.

Issued: January 11, 2002.

By order of the Commission.

Marilyn R. Abbott,

Acting Secretary.

[FR Doc. 02–1123 Filed 1–15–02; 8:45 am]

BILLING CODE 7020–02–P

APPENDIX C
Hearing Participants

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject: Tools, Dies, and Industrial Molds: Competitive Conditions in the United States and Selected Foreign Markets

Inv. No.:332-435

Date and Time: May 21, 2002 - 9:30 a.m.

Sessions were held in connection with this investigation in the Main Hearing Room (room 101), 500 E Street, SW, Washington, DC.

CONGRESSIONAL APPEARANCES:

The Honorable Donald A. Manzullo, U.S. Congressman, 16th District, State of Illinois

The Honorable Phil English, U.S. Congressman, 21st District, State of Pennsylvania

ORGANIZATION AND WITNESS:

Panel 1:

American Mold Builders Association
Medinah, IL

Olav L. Bradley, Chairman, Government Affairs, American Mold Builders Association

Tooling & Manufacturing Association
Park Ridge, IL

Bruce Braker, President, Tooling & Manufacturing Association

- MORE -

ORGANIZATION AND WITNESS:

Panel 1 (continued):

National Tooling & Machining Association
Ft. Washington, MD

Matthew B. Coffey, President, National Tooling & Machining Association

TCI Precision Metals
Gardena, CA

John D. Belzer, President, TCI Precision Metals; and Chairman of the Board, National Tooling & Manufacturing Association

Dykema Gossett
Washington, DC
on behalf of

Coalition for the Advancement of
Michigan Tooling Industries

Jay Baron, Director, Manufacturing Systems Group, Center for Automotive Research; and President, Coalition for the Advancement of Michigan Tooling Industries

Michelle Cleveland, Vice President, The Right Place Economic Development Program of Greater Grand Rapids; and Vice President, Coalition for the Advancement of Michigan Tooling Industries

David L. Rasmussen, President, Progressive Die & Automation; President, Quality Die & Mold; and Board of Directors, Coalition for the Advancement of Michigan Tooling Industries

Sanford Ring) – OF COUNSEL

- MORE -

ORGANIZATION AND WITNESS

Panel 2:

D-M-E Company
Madison Heights, MI

Jerry R. Lirette, President and Chief Executive Officer, D-M-E Company

Jepson Precision Tool, Incorporated
Cranesville, PA

Daniel W. Jepson, President, Jepson Precision Tool, Incorporated

Caco Pacific Corporation
Covina, CA

Manfred Hoffmann, President and CEO, Caco Pacific Corporation

Penn United Technology, Incorporated
Saxonburg, PA

Carl E. Jones, President, Penn United Technology, Incorporated

W.G. Strohwig Tool & Die, Incorporated
Richfield, WI

Michael Retzer, Controller, W.G. Strohwig Tool & Die, Incorporated

Forma Tool & Mold, Incorporated
Largo, FL

Robert E. Smith, President, Forma Tool & Mold, Incorporated

Sandor Manufacturing, Incorporated
Lawrence, MA

Joe Pedulla, Owner, Sandor Manufacturing, Incorporated

- MORE -

ORGANIZATION AND WITNESS

Panel 2 (continued):

M.S. Willett, Incorporated
Cockeysville, MD

David R. Sandy, Vice President, Systems Group, M.S. Willett, Incorporated

Schmald Tool & Die, Incorporated
Burton, MI

Laurie Schmald Moncrieff, President and Owner, Schmald Tool & Die, Incorporated

Tech Tool & Mold, Incorporated
& Tech Molded Plastics
Meadville, PA

Mark A. Hanaway, Marketing Director, Tech Tool & Mold, Incorporated & Tech Molded Plastics

Apollo Tool, Incorporated
Westfield, WI

Mark A. Milbrandt, Plant Manager, Apollo Tool, Incorporated

Quality Mold, Incorporated
Akron, OH

Steve Zoumberakis, CEO and President, Quality Mold, Incorporated

Trio Mold & Engineering, Incorporated
Greenville, MI

Steven R. Prahl, President, Trio Mold & Engineering, Incorporated

BesTech Tool Corporation
West Bend, WI

Mike Korneli, President, BesTech Tool Corporation

- END -

APPENDIX D
U.S. and Selected Foreign Tariffs

Table D–1
TDMs: U.S. and selected foreign tariffs, 2002 and final WTO staging if applicable

Harmonized System 6-digit subheading	Description	United States	Canada: NAFTA	Canada	Mexico: NAFTA	Mexico	EU	Japan	China	China, final WTO staging	Taiwan	Taiwan, final WTO staging
4016.99 (pt.)[1]	Other articles of vulcanized rubber other than hard rubber	Free-2.5	5.0	6.5	Free	10.0-15.0	2.5	Free	15.0	15.0	9.5-10.0	7.5 in 2006
6815.10 (pt.)[1]	Nonelectrical articles of graphite or carbon, nesoi	Free	Free - 3.0	3.0 - 6.0	Free	10.0-15.0	Free	Free	15.0	15.0	11.0	10 in 2004
6903.10 (pt.)[1]	Refractory nonconstructional ceramic goods nesoi (retorts, muffles etc.), containing over 50% (wt.) Singly or combined, of graphite or other carbon	Free	Free	Free	Free	10.0-15.0	5.0	3.5	8.0	8.0	9.6-10.0	6.0-6.8 in 2006
6903.20 (pt.)[1]	Refractory nonconstructional ceramic goods nesoi (retorts, muffles, plugs etc.), containing over 50% (Wt.) Singly or combined, of alumina or silica	Free	Free	Free	Free	10.0-15.0	5.0	3.5	8.0	8.0	9.6-10.0	6.8 in 2006
6903.90 (pt.)[1]	Refractory nonconstructional ceramic goods (retorts, muffles, nozzles, plugs etc.), nesoi	Free	Free	Free	Free	10.0-15.0	5.0	3.5	8.0	8.0	9.6 -10.0	6.0-6.8 in 2004-2006

Table D–1—*Continued*
TDMs: U.S. and selected foreign tariffs, 2002 and final WTO staging if applicable

Harmonized System 6-digit subheading	Description	United States	Canada: NAFTA	Canada	Mexico: NAFTA	Mexico	EU	Japan	China	China, final WTO staging	Taiwan	Taiwan, final WTO staging
7020.00 (pt.)[1]	Articles of glass, nesoi	Free-5.0	Free	6.5	Free	10.0-15.0	3.0	Free	19.0	15.0	2.5-11.5	10.0 in 2004-2006
8207.20	Dies for drawing or extruding metal, and parts thereof, of base metal	3.9	Free	Free - 3.5	Free	15.0	2.7	Free	8.0	8.0	5.0-10.0	5.0-10.0
8207.30	Tools for pressing, stamping or punching, and parts thereof, of base metal	2.9 - 5.7	Free	Free - 2.5	Free	10.0	2.7	Free	8.0	8.0	2.5	2.5
8436.99	Parts of agricultural, horticultural, forestry, bee-keeping machinery, including germination plant fItted with mechanical or thermal equipment, nesoi		Free	Free	Free	Free	1.7	Free	6.0	6.0	2.5	2.5
8438.90	Parts of machinery for the industrial preparation or manufacture of food or drink, nesoi		Free	Free - 2.5	Free	Free-10.0	1.7	Free	5.0	5.0 in 2002	2.5	2.5

Table D–1—*Continued*
TDMs: U.S. and selected foreign tariffs, 2002 and final WTO staging if applicable

Harmonized System 6-digit subheading	Description	United States	Canada: NAFTA	Canada	Mexico: NAFTA	Mexico	EU	Japan	China	China, final WTO staging	Taiwan	Taiwan, final WTO staging
8466.20	Work holders for machine tools	Free - 4.6	Free	Free	Free	10.0	1.2	Free	7.0	7.0	2.5	2.5
8475.90 (pt.)	Parts of machines for assembling electric or electronic lamps, tubes etc. in glass envelopes and for manufacturing or hot working glass or glassware	Free	Free	Free	Free	10.0	1.7	Free	8.0	8.0	5.0	5.0
8477.90 (pt.)	Parts of machinery for working rubber or plastics or parts of machinery used in the manufacture of products from rubber or plastics materials, nesoi	Free - 3.1	Free	Free	Free	10.0	1.7	Free	Free	Free	Free-5.0	Free-5.0
8479.90	Parts of machines and mechanical appliances having individual functions, nesoi	Free	Free	Free	Free	10.0	1.7	Free	Free	Free	2.5	2.5
8480.10	Molding boxes for metal foundry	3.8	Free	Free	Free	20.0	1.7	Free	10.0	10.0	4.0	4.0
8480.20	Mold bases	3.4	Free	Free	Free	15.0	1.7	Free	8.0	8.0	4.0	4.0
8480.41	Molds for metal or metal carbides, injection or compression types	3.1	Free	Free	Free	15.0	1.7	Free	8.0	8.0	4.0	4.0

Table D–1—*Continued*
TDMs: U.S. and selected foreign tariffs, 2002 and final WTO staging if applicable

Harmonized System 6-digit subheading	Description	United States	Canada: NAFTA	Canada	Mexico: NAFTA	Mexico	EU	Japan	China	China, final WTO staging	Taiwan	Taiwan, final WTO staging
8480.49	Molds for metal or metal carbides, other than injection or compression types	3.1	Free	Free	Free	10.0-15.0	1.7	Free	8.0	8.0	4.0	4.0
8480.50	Molds for glass	Free	Free	Free	Free	10.0-20.0	1.7	Free	8.4	8.4	4.0	4.0
8480.60	Molds for mineral materials	Free	Free	Free	Free	15.0-20.0	1.7	Free	8.4	8.4	4.0	4.0
8480.71	Molds for rubber or plastics, injection or compression types	Free - 3.1	Free	Free - 6.1	Free	10.0-15.0	Free - 1.7	Free	3.0	Free in 2003	Free-4.0	Free-4.0
8480.79	Molds for rubber or plastics, other than injection or compression types	Free - 3.1	Free	Free - 6.0	Free	10.0-15.0	1.7	Free	5.0	5.0	4.0	4.0

[1] Molds made of rubber for tariff processes are classified under HS 4016; of graphite or carbon, HS 6815; and of ceramic HS 69; of glass, HS 70. For a discussion of classification issues of molds, see U.S. Customs Service, *Classification of Molds and Their Parts Under the HTSUS*, January 2001.

Note.—Table does not include tariff rates for parts. However, parts of molds are classified as parts of machines that use the mold, and therefore, some parts are captured in the above HS subheadings; notably missing are parts of molds for die-casting machines.

Source: U.S. International Trade Commission, *Harmonized Tariff Schedule of the United States (2002)*, USITC Publication 3477, 2002; Canada Customs and Revenue Agency, Customs Tariff amended 2002, *http://www.ccra-adrc.gc.ca/customs/general/publications/customs_tariff-e.html*; Chinese tariffs and staging listed by the U.S. Department of Commerce, found at Internet site http://www.mac.doc.gov/China/Docs/searchableothertariffs.pdf, derived from World Trade Organization, *Report of the Working Party on the Accession of China*, WT/MIN(01)/3/Add.1, Nov. 10, 2001; European Communities, "Commission Regulation (EC) No. 2031/2001 of 6 August 2001 amending Annex I to Council Regulation (EEC) No. 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff," *Official Journal of the European Communities*, L 279, Oct. 23, 2001; Japan Tariff Association, *Customs Tariff Schedules of Japan*, 2002; Mexican non-NAFTA tariffs are from the APEC tariff database found at Internet address *http://www.apectariff.org*; and World Trade Organization, *Report of the Working Party on the Accession of the Separate Customs Territory of Taiwan, Penghu, Kinmen, and Matsu*, WT/MIN(01)/4/Add.1, Nov. 11, 2001.