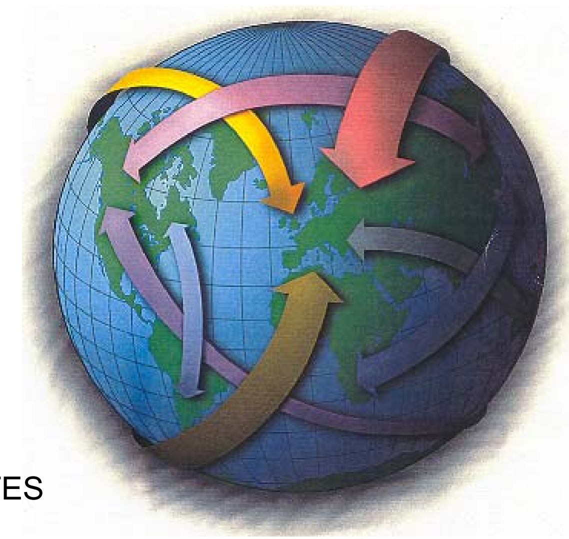
GLOBAL MARKET INTELLIGENCE REPORT

"TOOL, DIE AND MOULD INDUSTRIES"



- CANADA
- UNITED STATES
- MEXICO
- JAPAN
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- HONG KONG
- TAIWAN
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- GERMANY
- PORTUGAL

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Department of Foreign Affairs and International Trade
Ministère des Affaires étrangères et du Commerce international

CANADIAN TOOLING & MACHINING ASSOCIATION

CANADIAN ASSOCIATION OF MOLDMAKERS INC.
CAMM
NORTH AMERICA'S QUALITY MOLD SOURCE

Canadian Plastics Industry Association
Association canadienne de l'industrie des platiques

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■ Preface / Acknowledgements

The report contained herein represents a summary of a very comprehensive research study conducted by the U.S. International Trade Commission (USITC). The research findings were, subsequently, documented into a report entitled "Tools, Dies and Industrial Moulds" (investigation No. 332-435, USITC publication 3556, dated October, 2002), which examines the competitive conditions in the United States and selected foreign markets.

The purposes of the summarized report are to:

1. Present the international trends and competitive conditions facing Canada's tool, die and mould industry (TDM);
2. Provide a basis for focused strategic business planning at both, the industry and operating firm level with the objective of countering competitive threats / enable meaningful growth; and,
3. To provide federal and provincial government trade agencies with a perspective of Canada's current competitive posture in the global TDM industry and the trends that are evolving.

The scope of this report examines the TDM industries in Canada, U.S., Mexico, Japan, China, Hong Kong, Taiwan, E.U., Germany and Portugal, including discussion on each of the following key subject areas:

1. Industry Overview.
2. Strengths and Weaknesses.
3. Supplier Infrastructure.
4. Manufacturing Infrastructure.
5. Production and Sales.
6. Market Characteristics and Trends.
7. Purchase Decision Variables.
8. Trends – International Trade and Domestic Consumption.
9. Government Support Programs.

Also included in this report is an appendix section which features tables highlighting the trade statistics for imports (via sourcing points) and exports (via shipping destination) for each of the aforementioned countries. The report concludes with a bibliography which identifies the sources of information used to compile the original USITC report and, consequently, this Canadian derivate.

All currency figures shown in this report are expressed in U.S. Dollar amounts unless stated otherwise.

■ Executive Summary

The major environmental factors that are currently challenging the Canadian TDM industry, and must be addressed in the near–term to reinforce its' sustainability, are as follows:

1. An increasing share of the automotive market (68% of the Canadian TDM shipments) is dominated by newer, foreign–owned automotive manufacturers that tend to source tooling from Non–North American firms;

2. The North American automotive firms (primarily the Big Three) are stretching out payments to Canadian TDM suppliers, sometimes by more than one year after delivery of the tooling;

3. Automotive producers are pressuring TDM's 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 of TDM firms;

4. The recent downturn in the U.S. economy and its slow recovery, which has caused significant delays in manufacturing activity that would have otherwise created demand for tooling;

5. A contracting North American market resulting from some Canadian TDM customers shifting production to foreign locations, particularly China and Southeast Asia;

6. Growing shortage of skilled workers in the Canadian TDM industry, and,

7. Rising cost base, particularly labour–related costs.

In conclusion, many of these environmental factors (which have an increasing adverse effect on the TDM's operating performance) may be alleviated via A) increased investment in productivity improvements, B) reduced leadtimes (many Asian TDM's frequently operate their facilities 24 hours a day to supply customer orders) and C) more aggressive marketing relative to both, traditional and non – traditional markets.

Finally, it is strongly recommended that this document be utilized as the base for a new collaborative strategic business planning initiative with participants from industry associations, TDM suppliers and government. Effective planning and implementation are viewed as the "keys to success" for the TDM industry.

1.0 CANADA

1.1 Industry Overview

- 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 new North American Manufacturers (NNAM).

- 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 moulds are very similar to those in the United States in terms of raw materials and capital costs. These sources state that Canadian mouldmakers purchase materials and equipment on a U.S. dollar basis and have no advantage over U.S. mouldmakers as far as material costs are concerned.

- Labour costs are affected by fluctuations in the Canada/U.S. exchange rate. The current impact of the lower Canadian dollar is estimated by Canadian sources to provide an advantage of less 10 percent to Canadian mouldmakers in terms of overall costs.

1.2 Strengths and Weaknesses

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 firm's relative to those in the United States promotes efficiencies of scale.

Weaknesses:

- High labor rates versus all but the U.S. market.
- Canadian North American customers have moved production to foreign locations, particularly China and Southeast Asia.
- Growing shortage of skilled workers in the Canadian TDM industry.

1.3 Supplier Infrastructure

The 8 largest Canadian mouldmakers rank in the top 20 mouldmakers in North America 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 Moulding Systems Ltd.	100.0*	100.0*	**	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	40.0*	325	3
9	Hallmark Technologies Inc	**	40.0*	325	2
12	Windsor Mould Inc.	30.0*	30.0*	230*	3
15	Build – A – Mould Ltd.	25.0*	25.0*	200	1

Notes: *Estimated, **Not Available.

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

Most Canadian TDM producers specialize in particular types of products, market sectors, or a select group of customers. These regions and their products focus are (1) southwest Ontario–automotive and building products; (2) Montreal–

recreational vehicle, 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.

1.4 Manufacturing Infrastructure

As in the United States, the primary market served by the TDM industry in Canada is the North American automotive market (68 percent of the market for tooling in Canada); 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, components and machine tools in U.S. dollars.

The Canadian steel industry satisfies a significant portion of the domestic demand for tool steel commonly used in TDM production. Other grades, sizes and geometric shapes required by the TDM's, that are not produced by the local steel industry, must be imported to comply with customer specifications. There is some concern by the industry about the possible imposition of tariffs on the imported steel requirements as a safeguard remedy to support the domestic steel producers. The Canadian International Trade Tribunal (CITT) has conducted a safeguard inquiry and made recommendations to the Canadian Government who has not yet announced its official remedy.

1.5 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.

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.

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

1.6 Market Characteristics and Trends

The main domestic customer base for Canadian (Windsor area) TDMs consists primarily of processing plants that mould 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. Aside from domestic auto–related customers, 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 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. 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. 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 automotive 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. In addition to the payment constraints imposed on automotive tooling suppliers, automobile producers are also pressuring TDM builders to reduce lead times and purchase 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.

Finally, several large customers of the Canadian TDM industry have moved production offshore. For example, all Canadian television and electronics manufacturing have relocated overseas; automobile manufacturers Hyundai and Volkswagen closed facilities in Quebec 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.

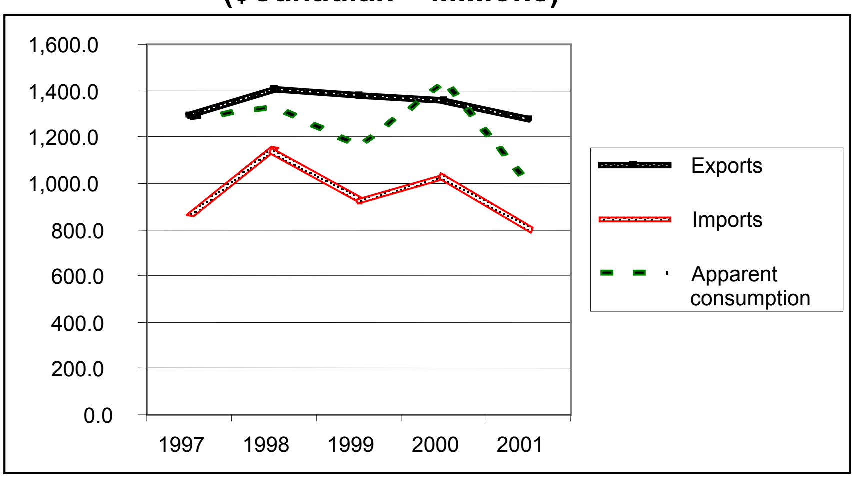
1.7 Purchase Decision Variables

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 mould. The Canadian price was about 1.8 percent lower than the U.S. price ($667,482 and $679,388 in U.S. dollars, respectively).

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 moulds are very similar to those in the United States in terms of raw materials and capital costs. These sources state that many Canadian mould makers purchase materials and equipment on a U.S. dollar basis and have no advantage over U.S. mould makers. Labour 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 mould makers in terms of overall costs.

1.8 Trends - International Trade and Domestic Consumption

($Canadian – Millions)



1.9 Government Support 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 United 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.
Program for Export Market Development (PEMD)	Federal program which provides financial support for new exporters planning to engage in a foreign market initiative.
Materials and Manufacturing Ontario	Provincial program which promotes Ontario's new technology, materials and processes.
Export Development Corporation (EDC)	Federal crown corporation which provides a variety of financial services in support of Canada's exporting businesses.

Source: Canada – Ontario Business Centre.

2.0 UNITED STATES

2.1 Industry Overview

- Outsourcing of tooling, component production and assembly is increasing.
- The TDM industry has significant over capacity.
- Customers' demands for engineering capability, innovation, decreases in time to market, better quality, lower cost, suppliers assuming the debt burden of work in process and rebates are forcing marginal producers out.
- Domestic manufacturing in general is declining as low cost sources offshore become more available, thus exacerbating industry pressures

2.2 Strengths and Weaknesses

Unique industry characteristics and significant strengths and weaknesses of the American TDM industry.

Unique industry characteristics:

- Large but shrinking industry
- Generally firms specialize in mould or die production
- Many firms, 90% employing 50 or less and ship $2M or less (average firms employ 20 or less)
- Some firms also stamp or mould parts
- Foreign direct investment into the domestic industry is higher than U.S. TDM producers investing abroad

Strengths:

- High quality
- High technology
- Capabilities include high-precision and highly complex TDMs
- Well-developed design capability
- Large and diverse customer base

Weaknesses:

- High prices versus foreign competitors
- High labour costs including training and benefits versus much of the world

2.3 Supplier Infrastructure

Shipments by US TDMs totaled almost 13.4 billion in 1997. There are approximately 7000 firms in this market segment. Even the largest firms in this industry are considered SME's, with 400 or fewer employees and sales revenues under $100 million.

Most establishments are privately held as proprietorships, partnerships, or a Subchapter S corporation. Owners make the day-to-day as well as strategic decisions and often several generations of the owner's family are employed in the firm. There are exceptions to this model, as a trend toward alliances and partnerships among companies is starting to show.

Only the largest competitors currently have the resources to carry out sophisticated market analysis and intelligence activities, act as a "one stop" shop, carry on other activities such as moulding and stamping product, or pursue other geographic or product opportunities. Larger firms also have the ability to offer more services, hence more value to their customers

Leading U.S. tool, die, and mould firms, 2001

Company		2001 Sales	Employees	Plants
H.S. Die & Engineering Inc	Grand Rapids, MI	80.0	360	5
Atlas Tool, Inc	Roseville, MI	60.0	340	1
Hi-Tech Mould & Engineering Inc	Rochester Hills, MI	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	42.3	260	1
R&D Tool & Engineering Co	Lee's Summit, MO	30.0	200	1
Sekely Industries, Inc	Salem, OH	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

Notes: *Estimated, **Not Available.

The majority of TDMs are located near manufacturing centers in the states of Michigan, Illinois, Ohio, California, Pennsylvania, Indiana and Wisconsin, as their customers have generally preferred their suppliers to be local, as this facilitated tryout, maintenance and repair.

Primary geographic market range served by domestic tool, die, and industrial mould 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

TDMs tend to specialize in particular product niches and tool sizes. Larger shops usually produce larger moulds and dies, as they have the financial means to invest in the larger equipment required.

2.4 Manufacturing Infrastructure

US TDMs have ready access to domestic supplies of modern machining equipment and software as well as components and raw materials. Some tool steels must be imported from offshore.

The industry is highly capital-intensive, with significant investment required in equipment and software to increase productivity and lead time demands of customers. New technologies such as integration of CAD/CAM, high-speed machining, unattended machining and hard milling are actively pursued as the means for remaining competitive.

2.5 Production and Sales

In addition to the automotive market, TDMs supply the domestic needs of the electronics, appliance, medical, construction, cookware office equipment, furniture, packaging, toy and agricultural industries.

The past 18 – 24 months saw a significant downturn in TDM as the major automotive customers delayed or cancelled a significant portion of their new vehicle programs.

2.6 Market Characteristics and Trends

Automotive clients have driven the industry in three key directions: reduced time to market, increased quality and reduced costs. Successful competitors have adopted advanced computer-aided design, sophisticated “high-end” capital equipment and production software, as well as labour and time saving shop practices. While some firms have achieved success in these areas, marginal producers have been and are continuing to be forced out of the market, as they are unable to compete. Rapid deployment of leading edge technologies has also resulted in excess capacity and further “bottom line” pressures as the use life of new technologies is shortening while tax regulations regarding the depreciation of capital equipment remains stable. Downsizing by domestic automotive producers, particularly in the engineering ranks has forced considerable design responsibility down the supply chain. Larger TDMs in particular are forced to develop significant engineering resources in order to support customer initiatives.

2.7 Purchase Decision Variables

Price and cost have become the key determinants in deciding where component manufacture, assembly and tooling functions are performed. Several domestic industries have re-defined themselves as marketing, project management and design centers, choosing to outsource tooling, component manufacture, assembly, packaging and order fulfillment. Others have established manufacturing sites in low-cost regions (Mexico and increasingly Asia), and/or have chosen to source tooling from low-cost regions.

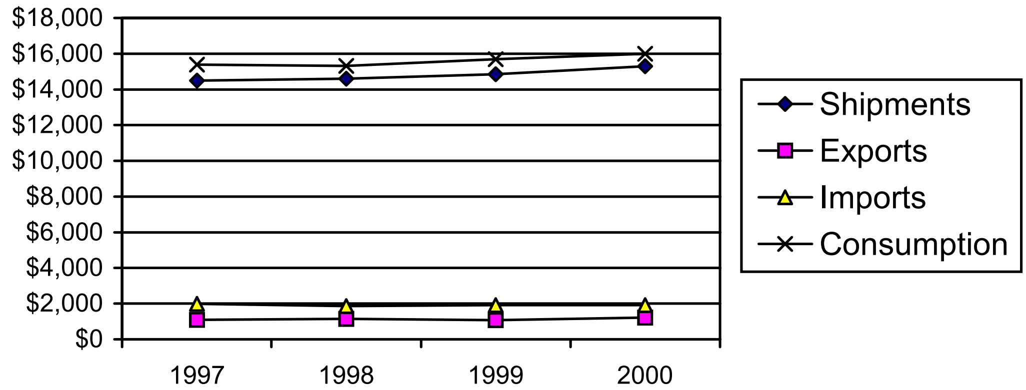
Most of the manufacturing industries who remain do so because it is uneconomical to move production elsewhere. In these cases, shipment of finished goods over long distances is cost-prohibitive, the complexity of the products they produce requires their “hands on” involvement, or capable tooling and manufacturing are unavailable in low-cost regions. Quality, innovation, financing, and time to market influence the purchase decisions of those industries who remain domestic.

2.8 Trends - International Trade and Domestic Consumption

Tools, dies and moulds are used in the manufacture of a variety of products, though the majority of TDM production (64% of stamping dies in 1999 and 41% of moulds in 2001) goes directly to automotive manufacturers.

The United States is a net importer of TDMs, though imports represent less than 10% of consumption. Canada is the leading supplier of imported product, with most Canadian TDM exports supplying automotive industries. Japan is also a large exporter to the U.S., again with much of its TDM product supporting Japanese automotive companies’ in the United States. Of late, very low cost producers have attempted to enter the market with varying degrees of success. China in particular has been cited as aggressively pursuing TDM opportunities, but appear to be using low cost as a means of attracting product production as well as the manufacture of tools, dies and moulds.

US Shipments, Exports, Imports and Production (US$,Millions)



2.9 Government Support Programs

There are 10 federal and 16 state programs of note as detailed 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

Generally, loan programs offer loan guarantees or financial assistance. In most cases, the assistance is meant to facilitate loans to companies who cannot qualify for regular financing or have short-term needs. Both the federal government and state governments offer consulting assistance and advice for the improvement of daily operations, and dealing with competitive challenges. Additionally, training assistance programs are in place to facilitate training for apprentices and journeymen.

There is close cooperation between federal and state employees, and most states involved in TDM have designated offices to assist applicants with application requirements.

Research and development assistance programs are also available through the National Institute of Standards and Technology (NIST) as well as the National Science Foundation, and the U.S. Department of Energy.

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

Employees	Firms	Employees	Shipments	Capital expenditures	Shipments per Employees	Shipments per Firm
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	N/a	N/a
20-49	17.0	28.8	28.6	28.1	N/a	N/a
50-99	5.0	19.6	20.4	19.7	N/a	N/a
100-249	2.2	16.3	18.7	17.6	N/a	N/a
250-999	0.3	6.6	8.2	8.9	N/a	N/a
Total	100.0	100.0	100.0	100.0	N/a	N/a

	Ratio to net sales		
Sales ranges and numbers of firms	Total net sales	Operating income or (loss)	Net income or (loss)
		1999	
Over $20 million (15 firms)	660,617	41,106	30,971
$10 to $20 million (26 firms)	367,865	23,045	19,479
$5 to $10 million (49 firms)	336,821	21,870	17,705
$1 to $5 million (120 firms)	303,936	10,297	5,723
Less than $1 million (54 firms)	31,194	(482)	(1,018)
Total/average for 264 firms	1,700,433	95,836	72,860
		2000	
Over $20 million (15 firms)	753,026	61,164	50,380
$10 to $20 million (26 firms)	403,473	23,019	14,821
$5 to $10 million (49 firms)	303,897	20,382	16,439
$1 to $5 million (120 firms)	342,754	6,178	3,265
Less than $1 million (54 firms)	28,017	(479)	(738)
Total/average for 268 firms	1,831,167	110,263	84,167
		2001	
Over $20 million (15 firms)	510,830	16,948	7,324
$10 to $20 million (26 firms)	326,926	(3,251)	(9,835)
$5 to $10 million (49 firms)	308,262	8,088	1,313
$1 to $5 million (120 firms)	305,821	(6,106)	(4,818)
Less than $1 million (54 firms)	28,672	(2,503)	(2,717)
Total/average for 267 firms	1,480,511	13,176	(8,733)

3.0 MEXICO

3.1 Industry Overview

- Mexico's indigenous TDM shops are relatively small and few in number. Due to limited production capabilities and capacity, Mexico is highly dependent on imports to meet domestic consumption needs. Trade in TDMs is enhanced by preferential import duties and tax–treatment programs.

- 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 labour 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.

3.2 Strengths and Weaknesses

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 labour 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.

3.3 Supplier Infrastructure

Indigenous producers are relatively few in number and are predominately small–scale operations (1-12 employees), generally family–owned or with a single owner. Generally they service a primary customer or are captive operations. Mexico's TDM industry is clustered in three major industrial and manufacturing centers. 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, are concentrated along the U.S.–Mexico border area, particularly in the cities of Tijuana, Cuidad Juaréz, and Reynosa, among others.

In the Mexican TDM industry, there are reportedly some good class "B" shops, but reportedly, no world–class mould makers. High–quality class "A" tools are largely sourced from the United States. For indigenous firms, shortages of skilled TDM builders and limited technology hamper their ability to produce high–quality TDMs. Likewise, there is the perception that some Mexican shops can produce smaller or less–complex TDMs for small customers at lower prices, 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. Moreover, the vast majority of Mexican TDM vendors typically do not have ISO 9000 certification and would likely be unable to meet the ever–increasing production standards of major TDM–using customers.

The TDM industry in Mexico also has been augmented by U.S. producers that have set up operations in the border region (e.g., Anchor Tool & Plastic, Beach Mould & Tool, Catalina Tool & Mould, Precision Mould & Tool, Tech Group, and Tooling Science, among others), along with a few that have established themselves in the Guadalajara area. 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.

3.4 Manufacturing Infrastructure

Although of limited technology (despite improvements), machinery is present in abundance at indigenous TDM operations in Mexico. 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. 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.

According to an industry source, some major foreign–based customers operating in Mexico are willing to develop selected Mexican TDM shops. These customers seek to procure more of their TDMs from local sources in the long–run. 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.

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. 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.

3.5 Market Characteristics and Trends

Expection are that the Mexican TDM sector will grow only slightly. If at all, 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. 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, and almost any product requiring extensive assembly work. 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

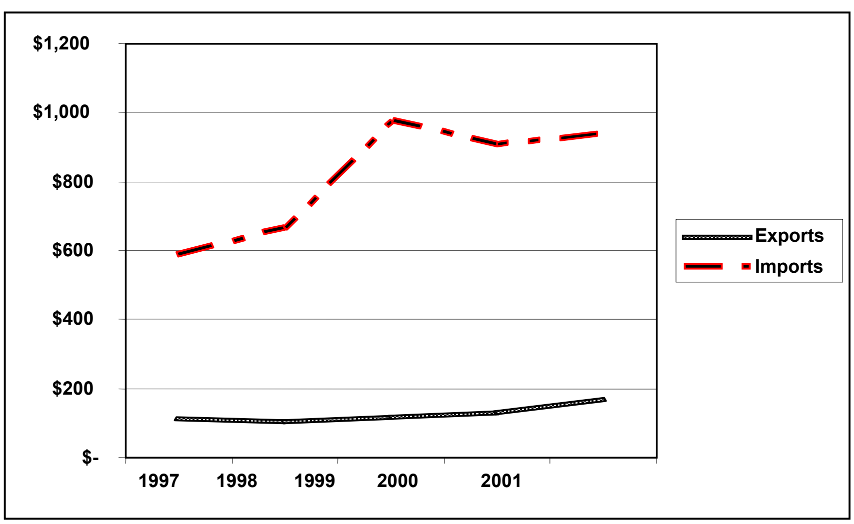
2001 in contrast to the almost 7 percent economic growth experienced in the previous year. Some low–technology manufacturing of electronic circuit boards, cordless telephones, video games, and golf club parts, has moved abroad in recent years, particularly to China.

3.6 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 basic. 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. Further, pre and post sales service are key factors for buying or selling moulds (and other types of TDMs) in Mexico, given indigenous shops limited building and repair expertise. With these issues, industry sources suggest that only about one–quarter of purchases by foreign–based firms operating in Mexico are from Mexican vendors. Customers in Mexico prefer to source TDMs (injection and other associated machinery) from abroad, particularly more complex products. Among products originating from sources other than the United States, Italian and Japanese TDMs reportedly enjoy reputations for good quality in Mexico. China is beginning to penetrate the Mexican market for industrial moulds, 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.

3.7 Trends – International Trade and Domestic Consumption

($U.S. – MILLIONS)



Trade in TDMs between Mexico and its partners reflect not only new purchases but also shipments for repair or upgrading. For example, many of the very large moulders such as Carplastic (for a moulding facility in Monterréy) source most of their new moulds from the United States and send them back to the United States for major repairs. Mexico's total trade 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.

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. In that year, industrial moulds 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 TDM 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 moulds, 69 percent of tools and dies, and almost 64 percent of jigs and fixtures in that year.

Other important suppliers of TDMs to Mexican users in 2001 were the European Union (almost 16 percent), Canada (9 percent), and Japan (7 percent). During 2000–01, Mexico purchased significantly more TDMs (predominantly of industrial moulds) 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. Many companies operating in Mexico have recently begun buying Chinese – made TDMs, and imports from China and Hong Kong (almost exclusively of industrial moulds) 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 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 moulds accounted for 88.7 percent, tools and dies for 11 percent, and jogs 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 moulds, 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.

3.8 Government Support 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 promotions programs. Mexico has negotiated FTAs with 32 countries, 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 enjoyed by U.S. and Canadian TDM producers exporting to the Mexican market.

Foreign–owned, export–oriented manufacturing facilities and their suppliers that use TDMs, operate in Mexico under 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,) but also exempt machinery and components from value–added taxes (VATs), confirmation of compliance with *Normal Official* regulations (for labeling, safety standards, etc.), and return requirements to the country of origin. Likewise capital equipment is exempted from the 25 percent inventory tax under these programs.

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. 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.

4.0 JAPAN

4.1 Industry Overview

- 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 transfer 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–á–vis domestic firms.

- 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.

4.2 Strengths and Weaknesses

Unique industry characteristics:

- Large number of small firms.

Strengths:

- Tradition of craftsmanship on the production of dies and moulds.
- High quality.
- Short lead times (time required to produce a die or mould).
- Skilled in producing relatively high–precision and complex dies and moulds.

Weaknesses:

- Relatively high labor rates.
- Japanese customers have moved production to foreign locations, particularly China and Southeast Asia.
- Many Japanese die and mould producers tend to be small companies and lack financial and management resources.

- Late in adopting CAD/CAM software and 3–dimensional computer modeling of dies and moulds.

4.3 Supplier Infrastructure

The TDM industry in Japan is large and well established. In 2000, there were 12,125 producers manufacturing TDMs in Japan, down form a peak of 13,115 producers in 1990. According to industry sources, an irregular flux of new entrants as well as exiting firms 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. Of that amount, more than 89 percent employ only 1 to 9 workers, with the remaining 11 percent supporting 10 to 19 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 domestic and international establishments, are publicly traded. 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.

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, a key centre 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 moulds, and plastic injection moulds. Osaka prefecture, the second largest production centre for forging dies, plastic injection moulds, and rubber and glass moulds, 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 centres 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. 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. 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.

At the present, the Japanese TDM sector is in a stage of overcapacity, with industry sources gauging average capacity utilization at around 60 percent. 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. 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. 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.

4.4 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 mould 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 markets. 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.

Despite unfavorable conditions facing the Japanese TDM industry, some Japanese manufacturers are adding leading–edge electrical discharge machines and CNC machines. Even rapid prototyping machinery is evident in the smaller tooling shops. Although some U.S. sources consider the Japanese TDM sector as primarily a 3–axis market, shops are increasingly introducing more 5–axis machines into their factories, along with high–end inspection machinery, and more modern machining centers. According to Japanese industry sources, the trend toward reducing cost by replacing labour 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 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 also behind in implementing electronic transfer of designs 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; currently, only 40 percent of models in the mould sector are created in 3–D. Although Japanese TDM firms indicate their desire to adopt computer technologies, several factors hinder their ability to advance in these areas:

1. Japanese mould and die makers do not see the necessity in promoting CAD/CAM because of the high design and manufacturing capabilities of their technicians and engineers;
2. The tradition of craftsmanship and emphasis on skilled labour has created a reluctance on the part of some firms to adopt the latest computer technologies; 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.

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 date are available. With production equipment running upwards of $40,000 per machine and software packages costing several thousand dollars per seat, 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 extend loans to small–size TDM manufacturers. Industry officials further opine that Japanese TDM manufacturers are greatly disadvantaged vis–á–vis other Asian producers, who allegedly have access to pirated software and often receive deep discounts on machinery from machine tool makers looking to penetrate key markets.

4.5 Production and Sales

Japanese production of TDM decreased from just under $15.2 billion in 1997 to an estimate $13.2 billion in 2001, or by 13 percent. 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 yean (about US$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.

Japanese production of TDMs is largely concentrated in two product segments. In 2000 the latest year for which data area available, plastic moulds 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 moulds. 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. 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. 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. Industry sources indicate that in the next 3 to 5 years, decreased in–house production of TDMs will become particularly visible trend in the automotive sector, as U.S. and Japanese automakers become increasingly disinterested in producing their own tooling. 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 moulds used in the production of its automobiles.

4.6 Market Characteristics and Trends

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, 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 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. 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. 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. However, 60 percent of those surveyed report that they will increase local procurement of TDM in the future. 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 moulds 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 if 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 moulds 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. 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.

Since Japanese transplants abroad initially produce 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 Japanese transplants, followed by Asia. 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. 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 moulds. 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. 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.

4.7 Purchase Decision Variables

Price

Depending on the type and class of die or mould, 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. By comparison, prices for dies and moulds originating from Korea and Taiwan are approximately 25 to 30 percent below Japanese prices. 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.

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.

Lead times

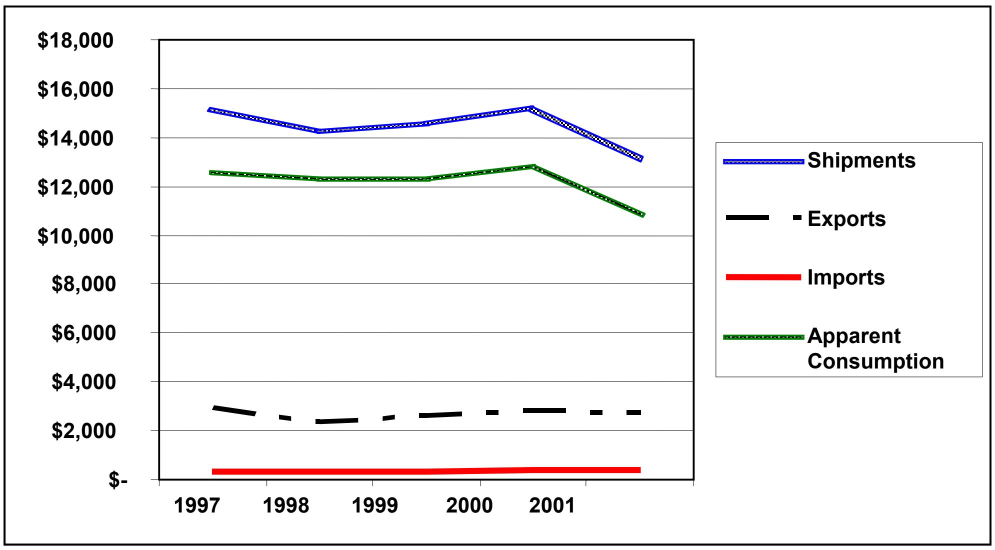
Japanese firms are quite competitive with respect to lead times and meeting delivery targets, primarily because of the level of advanced machinery in the industry, the tendency for suppliers to subcontract or distribute portions of the work for simultaneous production, and the regimented work ethic of 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. Although rates of production and delivery depend on several factors, including the complexity of the part and the size of the cavity, industry sources allege cases where Japanese producers might need only 1 month for production, but Chinese and U.S. producers need 2 to 4 months.

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. 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. 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 detail, accuracy, and raw – material selection. Japanese producers are viewed as more proficient in the production of dies for various metal stampings but less skilled at mould production. Japanese moulds are reputedly designed for short production cycles and are less durable than U.S.–made moulds that are constructed for higher–volume production runs. Durability of Japanese moulds may also be compromised because production often begins early in the engineering phase before the design is set, resulting in successive alteration and repair work.

4.8 Trends – International Trade and Domestic Consumption

($U.S. – MILLIONS)



Japan is a net exporter of TDMs, with about 20 percent of total production shipped overseas. The value of Japanese exports reached $2.7 billion in 2001, down 7 percent from 1997 exports of approximately $2.9 billion. Measured in yen, the drop in exports war 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 beset by lingering domestic recessionary conditions view the United States as a prospective growth market, inasmuch as consumption of dies and moulds is high and Japanese automotive transplants in the United States have increased production and can provide future business opportunities. 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.

4.9 Government Support 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 process.

Few Japanese TDM firms report receiving benefits from Government policies and programs. 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.

5.0 CHINA

5.1 Industry Overview

- The large and growing industry is estimated to be the third largest die and mould 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.

- Well educated labour 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.

5.2 Strengths and Weaknesses

Unique industry characteristics:

- About 70 percent of the TDM industry is captive, allowing for such companies to provide both TDM and parts production.
- Substantial numbers 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 labour, especially engineers and designers.

- Well educated labour force.
- Relatively quick lead times (time required to produce a die or mould).

Weaknesses:

- Lack of sophistication and creativity in TDM design.
- Lack if experience in producing high–precision and complex TDMs.
- High costs for imported inputs, low–quality domestic TDM inputs.

5.3 Supplier Infrastructure

The Chinese TDM industry is both large and growing. 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, Foreign Direct Investment in the Chinese TDM sector has reportedly led to a substantial increase in the size of the industry.

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. Another large toolmaker is Altrust Precision Tooling Company, Ltd., with approximately 1,200 to 1,500 employees. Typically, large TDM firms have 600 to 700 or more employees, and smaller producers have at least approximately 50 employees.

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 moulding or 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. 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. A related concern to industry officials is that many indigenous Chinese TDM producers lack financial management skills, particularly with regard to debt management.

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 moulds are produced in this province, with a sizeable portion being of captive or in–house production. Production in the Shanghai metropolitan area is focused on the manufacture of small, high–precision moulds, 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.

In Guangdong Province and around Shanghai a number of large contract manufacturers specialize in serving the multinational electronics companies with designing, moulding 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 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.

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. 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. 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, but to a much smaller extent than in Taiwan and Japan. State–owned TDM producers reportedly rely on subcontractors for grinding, polishing, and finishing.

5.4 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 form 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 mould steels are imported from Sweden, Austria, Germany, Japan, and the United States. Also, imported are TDM parts and components, such as high–quality mould bases or die sets, and ejector pins and springs.

China has indigenous production of metal–cutting machine tools, cutting tools and accessories, rapid–prototyping machines, steel and TDM components. There are 14 Chinese producers of mould and tool steels. Recently, Shanghai No. 5 Steelworks, a subsidiary of Shanghai Baosteel Group, announced its intent to add tool and mould steel capacity. The new capacity is expected to reduce China's reliance on imports of high–grade mould steel for the automotive, major household appliance, and machine–building industries. 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.

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 cost 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.

Despite concerns about quality, indigenous TDM producers tend to rely on Chinese machinery and materials in large part because of their low prices. 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. Small Chinese producers that typically produce TDMs for common, everyday articles reportedly do not use software for design or manufacturing.

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 labour. Some firms have advanced machines capable of unattended overnight operation, but will not utilize this capability because there is available low–cost labour. The use of advanced technology is also dictated by the precision level and complexity of the TDM. A number of firms perform high–speed machining. But there is little use of 5-axis machining, since this type of machining is predominantly used in making large–sized high–precision TDMs with complex curvatures, such as for automobile lights. Rapid prototyping is taught at some universities in China. However, there has been little, if any, adoption of rapid–tooling production and technology.

5.5 Production and Sales

In 2001, China's production of TDMs was approximately $3.6 billion and consumption was around $4.6 billion. Production and consumption have grown at rates consistent with growth in China's economy. Overall, China has rapidly expanded its production of industrial moulds. However, it is further behind in the manufacture of dies which are more difficult and time–consuming to produce than moulds. Also, as noted earlier, the Chinese TDM industry lacks production capacity for both, high–precision and large–sized TDMs.

5.6 Market Characteristics and Trends

The current domestic customer base in China for TDMs is growing as foreign manufacturers continue to expand in China, and as indigenous companies expand production. The rise in Chinese disposable income, and hence consumer demand, will, in turn, generate additional demand by producers requiring TDMs. A number of large Japanese appliance and automobile manufacturers have moved production to China. Currently, there are 10 foreign automobile producers in China, and some if these companies have announced further expansion plans. 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 centre in Shanghai. 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,

5.7 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, depending on the type and class of die or mould. Compared with other Asian TDMs, for similar TDMs, ex factory, Chinese TDM prices are 50 to 75 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.

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. When TDMs are made to U.S. specifications, the price differential is 25 to 30 percent. 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. Chinese and other foreign industry sources attribute the significant differences in prices to China's low–cost TDM labour 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 mould 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

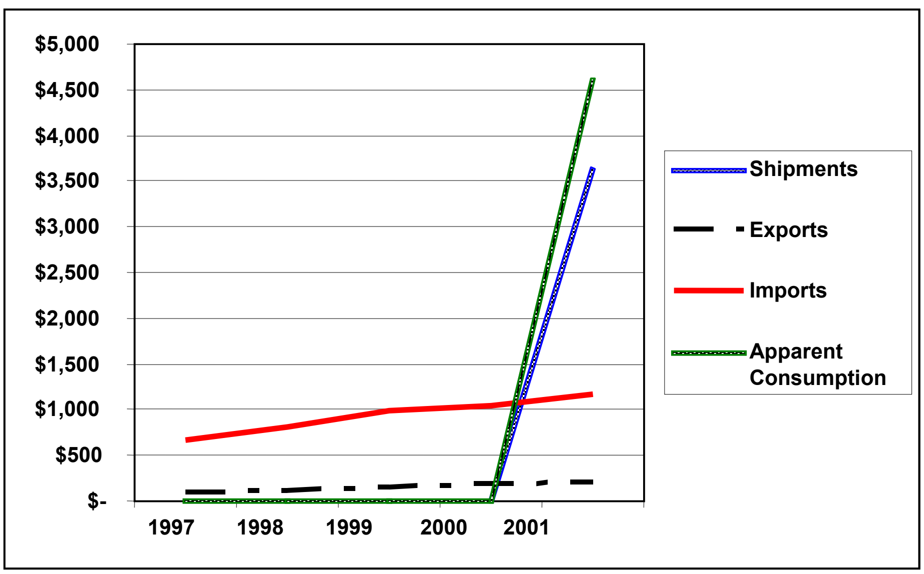
Chinese TDM industry sources indicate that their lead times are generally shorter than those of U.S. TDM producers. One of these sources stated that for a given TDM, the lead time in China is 6 weeks compared with 3 months in the United States. However, other sources indicated that lead times in China might be higher than those in Japan, for example, 8 weeks versus 5 weeks. 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 labour, Chinese TDM producers can divide a job into many specific tasks and use more workers concurrently on that job.

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. 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. 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. 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. 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.

5.8 Trends – International Trade and Domestic Consumption

($U.S. – MILLIONS)



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. 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 moulds accounted for 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. 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 moulds for producing medical goods.

Chinese TDM exports grew by 126 percent to $192.3 million in 2001 from $85.0 million in 1997. The largest market was Hong Kong, where they may be used in 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 moulds, 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.

5.9 Government Support Programs

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.
Economic and Technical Development Zones / FIEs	29 locations, including Tainjin, Ningbo, Shanghai, Wenzhou, and Huangzhou.	Preferential income tax rate of 15 percent.
SEZ of the Pudong Area of Shanghai / FIEs	SEZ of the Pudong Area of Shanghai	Preferential income tax rate of 15 percent.
Foreign – invested enterprises	In non preferential areas.	For foreign – invested productive enterprises operating for more tan 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 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.

**The normal income tax is 33 percent.*

6.0 HONG KONG

6.1 Industry Overview

- 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 allows 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.

6.2 Strengths and Weaknesses

Unique industry characteristics:

- 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 moulds.
- Quick lead times (time required to produce a die or mould).
- 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 labour rates.
- Shortage of skilled TDM workers, particularly entry level workers.
- Hong Kong customers have moved production to foreign locations, particularly China.

6.3 Supplier Infrastructure

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. 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. 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. 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 labour force.

6.4 Manufacturing Infrastructure

At the same time, while many Hong Kong TDM producers have focused on developing production operation 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 centre and a number of private companies have purchased rapid–prototyping machines. 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 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. 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 moulds for two or more colored plastics, as well as medical moulds, which are mainly imported from other countries.

6.5 Market Characteristics and Trends

The Hong Kong customer base 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.

Hong Kong's production of dies is primarily for local consumption. 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.

6.6 Purchase Decision Variables

According to Hong Kong industry sources, in general, Hong Kong TDMs prices, ex factory, are lower by up to 40 percent compared to pricing in the United States. Hong Kong moulds, built with standard parts, high–quality steel, and to the standards of the U.S. Society of Plastics, are 30 to 40 percent lower in price than similar U.S. moulds. 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. 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 mould production, and communication with the customer.

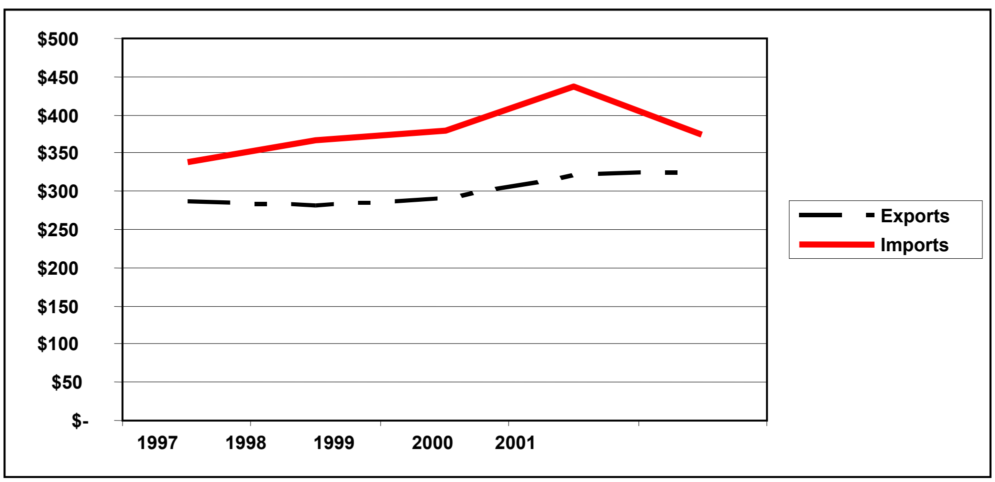
Reportedly, U.S. customers purchase from Hong Kong TDM producers because of shorter lead times. Hong Kong TDM producers report that customers rank lead time as the most important factor in their purchase decision, followed by quality and then price. One Hong Kong TDM producer reported a lead time of 4 to 6 weeks for a two–cavity mould for a cellular telephone compared with 8 weeks in the United States. 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 complete jobs on time.

6.7 Trends – International Trade and Domestic Consumption

Hong Kong maintains a trade deficit in TDMs, as calculated from trade data shown below. 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 2000, but up from $338.9 million in 1997. 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 moulds, 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. 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. Exports of moulds 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.

($U.S. – MILLIONS)



6.8 Government Support 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 moulds 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. This center also sells rapid–prototyping services, and thus competes with private companies offering such services. Hong Kong Polytechnic has established a Rapid Product Development Resource Center equipped with rapid–prototyping machinery to train students in rapid–prototyping production. The City University of Hong Kong, Hong Kong Polytechnic, and Hong Kong University also conduct specific research projects on TDMs. Some projects for the TDM industry are funded by the Innovation and Technology Commission of the Hong Kong Government. Hong Kong Polytechnic opened a Centre for Advanced Manufacturing Research with almost $ 6.5 million in equipment in 1996 that, among other projects, researches ultra precision machining for the mould industry. The centre was funded by the Industry and Technology Development Council of the Hong Kong Government.

7.0 TAIWAN

7.1 Industry Overview

- 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.

7.2 Strengths and Weaknesses

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 mould).
- Skilled in producing medium–precision and relatively complex dies and moulds.
- 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 labour rates relative to China.
- Taiwan customers have moved production to foreign locations, particularly China.
- Many Taiwan die and mould producers tend to be small companies with limited financial resources.

7.3 Supplier Infrastructure

There are an estimated 3,400 TDM producers in Taiwan, 60 percent of which are small, family–owned businesses. 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. As the bulk of Taiwan's TDM firms have fewer than 40 workers, companies are generally not listed on the stock exchange. Reportedly, only those companies involved in additional commercial pursuits such as moulding or stamping operations are publicly traded. 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.

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. The industry reports a recent increase in the number of high–school graduates in its workforce; however, the majority of production workers join the trade after finishing the 9th grade. Those workers who complete their education are often from local technical high schools, trade colleges, or technical training centres. 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.

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 of subcontractors in times of high demand, or when the subcontractor can perform certain tasks at a lower cost than in–house staff.

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 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. 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. 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 moulds in the overseas location but keep design and management operations headquartered in Taiwan. 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.

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. There are reportedly few, if any, foreign–owned shops that exclusively manufacture TDMs, and only minimal foreign investment in TDM shops with related stamping, moulding, or assembly operations.

7.4 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. 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 volume purchases. 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.

7.5 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. Domestic shipments of TDMs consistently declined during the period; however, the most sizeable reduction occurred between 2000 and 2001, over 24 percent when measured in U.S. dollars. The pronounced declined 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 mould sector. However, industry sources expect that in the future, die production will increase relative to mould production.

7.6 Market Characteristics and Trends

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 centres 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 moulding 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 moulds 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. 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. 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.

7.7 Purchase Decision Variables

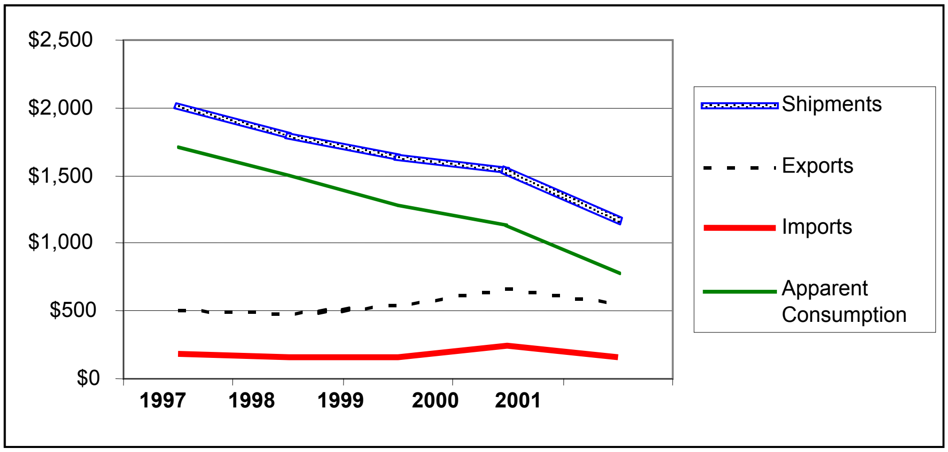
Taiwan industry sources report that ex factory prices for TDMs produced in Taiwan are about 30 percent higher than Chinese prices and roughly 60 percent lower than U.S. prices for the equivalent product. Concerning quality, the transition of domestic producers from medium–precision TDM production into the manufacture of high–precision, complex dies and moulds indicates that quality has improved; however, there are still high–end TDMs for which the quality level offered by Taiwan TDM industry ranks itself below Germany, the United States, and Japan in terms of accuracy and product life. 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.

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. 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 mould, and process it through the first tryout. 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.

7.8 Trends – International Trade and Domestic Consumption

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. The Taiwan industry's specialization in mould production is evident in the trade data, with exports of industrial moulds, primarily moulds for plastics and rubber, 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 transshipments to end users in China. 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.

($U.S. – MILLIONS)



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 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 moulds 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. End–users also import products that cannot be replicated in Taiwan because of patent rights or technology–transfer concerns. The unit price of imported TDMs is reportedly 1.5 times of exported products, further evidence that foreign sources serve a narrow, high–end market for precision products.

7.9 Government Support 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. 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. Sources also report that in any given year, there are no more than four TDM companies that apply for R&D grants.

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 moulds, with certain plastic injection and compression moulds having a tariff rate of “free.

8.0 EUROPEAN UNION (E.U.)

8.1 Industry Overview

- 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 labour cost 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 labour cost in Spain, Portugal, and Eastern European countries such as the Czech Republic, Poland, and Hungary.

8.2 Strengths and Weaknesses

Unique industry characteristics:

- Relatively small number of TDM producers in each EU member country.

Strengths:

- Tradition of craftsmanship in the production of dies and moulds.
- Some EU TDM producers have short lead times (time required to produce a die or mould), but others do not.
- Skilled in producing high–precision and complex dies and moulds.
- 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 labour costs, particularly in northern Europe.
- EU customers have moved production to foreign locations, particularly China and Southeast Asia.

8.3 Supplier Infrastructure

As a region, the European Union (EU) likely ranks as the largest producer and consumer of TDMs. 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 the leader in the production of high–precision and high–complexity TDMs, and relies on extensive R&D, but has high labour 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.

8.4 Market Characteristics and Trends

The principal issues affecting the EU TDM industry rising labour 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. For example, EU moulders are investing in the Czech Republic, Poland, Hungary, Slovenia, and Croatia as demand in these countries rises for automobiles, consumer and business electronics, and disposable medical products. 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 labour costs and restrictive labour 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 labour costs in Spain, Portugal, and Eastern European countries such as the Czech Republic, Poland, and Hungary.

8.5 Trends – International 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. 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. 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. 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.

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. 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. Other major markets were the Czech Republic and China, to 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 share are 45 percent and 55 percent, respectively. In terms of product representation, imports of industrial moulds accounted for almost 64 percent of all EU TDM imports, tools and dies, for almost 30 percents, and jigs and fixtures, for almost 7 percent. Exports of industrial moulds accounted for 69 percent of all EU TDM exports, tools and dies, for almost 25 percent, and jigs and fixtures, for 6 percent.

8.6 Government Support 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 T&D in the EU Fifth Framework initiative (1998-2002) under the Competitive and Sustainable Growth program, known as GROWTH. 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 mouldmakers, 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.

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 mouldings and stamped metal parts, both of which use tooling. 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 finding were that Taiwan lead times were significantly shorter than those in the EU, the 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 mouldmakers in France, Portugal and Spain. This effort included an assessment of competitiveness factors and active promotion of strategic partnerships and joint ventures between companies in the various countries. 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. EUREKA has 44 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.

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. 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. 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 moulds 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.

9.0 GERMANY

9.1 Industry Overview

- 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 labour costs and labour regulations hamper German TDM producers, German TDM producers have focused in 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.

9.2 Strengths and Weaknesses

Unique industry characteristics:

- German TDM builders tend to provide not only TDM but also the design and production–process engineering for the parts to be made with the TDM.

Strengths:

- Tradition of craftsmanship in the production of dies and moulds.
- Skilled in production high–precision and complex dies and moulds.
- Strong apprenticeship training program.

Weaknesses:

- High–cost labour
- German customers have moved production to lower cost foreign location, including Eastern Europe and China.
- Larger German producers of dies and moulds have followed customers for foreign locations.

9.3 Supplier Infrastructure

Germany is a major producer of dies and moulds. 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.

According to German industry sources, there are approximately 5,000 German TDM producers, including captive die and mould building operations. Approximately 80 percent of the German TDM firms employ 20 or fewer persons, 19 percent employ 20 to 100 persons, and only 1 percent employs more than 100 persons.

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.

9.4 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 mould steels, which are produced by German, Swedish, and Austrian specialty steelmakers with a reputation for supplying quality products worldwide.

9.5 Production and Sales

German production of dies and industrial moulds, excluding punches, 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. Apparent consumption rose by 15 percent, to $2.7 billion from almost $2.4 billion in 1997.

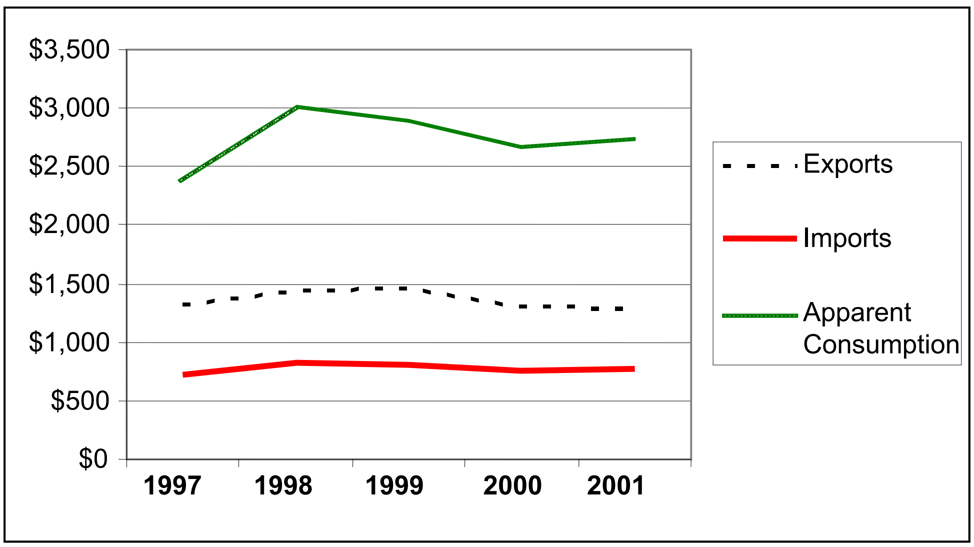
German TDM producers depend on exports to an extent, as apparent consumption of dies and moulds was only 80 to 84 percent of German production. Exports as a share of production fell to 40 percent in 2001 compared with 45 percent in 1997. Imports of dies and industrial moulds as a share of apparent consumption fell to 28 percent in 2001 from 30 percent in 1997.

9.6 Market Characteristics and Trends

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 moulders 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, most recent year for which data are available.

9.7 Trends – International Trade and Domestic Consumption

($U.S. – MILLIONS)



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. The leading supplier of TDMs to Germany was Switzerland, accounting for almost 20 percent of total German TDM imports. 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 moulds 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. 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. Exports to France fell steadily over the 5 year period. In 2001, exports of industrial moulds accounted for 58 percent of total German TDM exports, tools and dies, for 30 percent, and jigs and fixtures, for 12 percent.

9.8 Government Support 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.

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 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 Aschen, with a staff of approximately 600 persons. The Fraunhofer Institute of Production Technology in Aachen has formet a joint venture with the Laboratory for Machine Tools in Aachen and the Fraunhofer Centre 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 mould 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. 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. In Western Germany, machinery can be completed depreciated in 3 years.

10.0 PORTUGAL

10.1 Industry Overview

- Despite Portugal's small size, it has emerged as one of the world's leading exporters of industrial moulds. In 2001, despite limited production of dies, Portugal was the eighth largest producer of dies and moulds 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 moulds going to the United States has declined from 65 percent in 1997 to less than 11 percent in 2001.

10.2 Strengths and Weaknesses

Unique industry characteristics:

- Small industry dedicated almost exclusively to exporting.

Strengths:

- Specialist training colleges.
- Quick lead times (time required to produce a die or mould), technological capability, price, and low labour costs.
- Quality, technology, services, skilled in producing high precision and complex dies and moulds.

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 mould producers tend to be small companies with limited financial and management resources.

10.3 Supplier Infrastructure

Despite Portugal's small size, it has emerged as a world leader in the production of industrial moulds. Portugal is the eighth–largest producer of dies and moulds in the world and it exports to more than 70 countries. Portugal is also one of the world's principal producers of precision moulds for the plastics industry. The Portuguese industry consists of approximately 250 companies that employ nearly 7,500 workers. 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 mould 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.

10.4 Manufacturing Infrastructure

Portuguese mould makers are highly specialized, concentrating in different production areas such as mould cavities, mould bases, polishing, large moulds, and precision moulds. Since Portugal joined the EU in 1986, the share of companies capable of manufacturing highly complex moulds grew from less than 30 percent to more than 80 percent by 1997.

Moulds for less–complex products such as toys and electrical appliances have been supplanted by more complex moulds for the automotive, electrical equipment, pharmaceutical, telecommunications, medical equipment, and computer industries. Recently, several large mould makers 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. Since joining the EU, Portugal's mould industry has steadily evolved from a labour–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 centres, 3-D measuring machines, and DNC and CAD/CAM/CAE systems. Many of Portugal's mould manufactures have instituted Simultaneous or Concurrent Engineering 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 mould 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.

The Portuguese mould industry is represented by the National Association of the Industry of Moulds (Cefamol). The association consists of 130 members and accounts for approximately 90 percent of total shipments by the Portuguese mould industry. 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 Centre for the Moulds and Special Tools Industry (Centimfe) as an advanced R&D centre for Portugal's mould industry. Centimfe was provided with the latest computer–integrated manufacturing technology to support companies desiring to improve their quality control and productivity.

Leading Portuguese mould and die manufacturers

Company	Mould types*	Employees	Industries served**	Percent exported
Mouldit Sa	PI,O	100	A,E,D,P	95
Simoulds	PI,O	173	A,E,M,P,TC	77
ALfamoulde	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
Azemouldes	PI,D	105	A,D,P,TC,T	80
Mould 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
Moulde Matos	PI	100	A,E,M,PH,TC	90
Soamouldes	PI,D	170	A,E,H,M,P	75
Intermoulde	PI	96	G	20
Madumoulde	PI	80	G	80
Cemo	D,PI	125	A,E,H,P,TC,T	100
Tecnimpolás	PI	81	G,A,H	95
Intermoulde	PI	96	G	20
Costa & Rocha	D,PI	80	A,E,M,W	100
Panimoulde	D,PI	75	A,E	95
Somerna	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
Azemouldes	D,PI	105	A,H,P,TC,T	80
LN Mouldes	PI	54	A,C,E,H,PH,TC	95
Sindemouldes	PI	31	A,H	77

**Mould types*: aluminum and zinc (A), mould bases (B), die cast tools (D), Other (O), plastic injection (PI). **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).

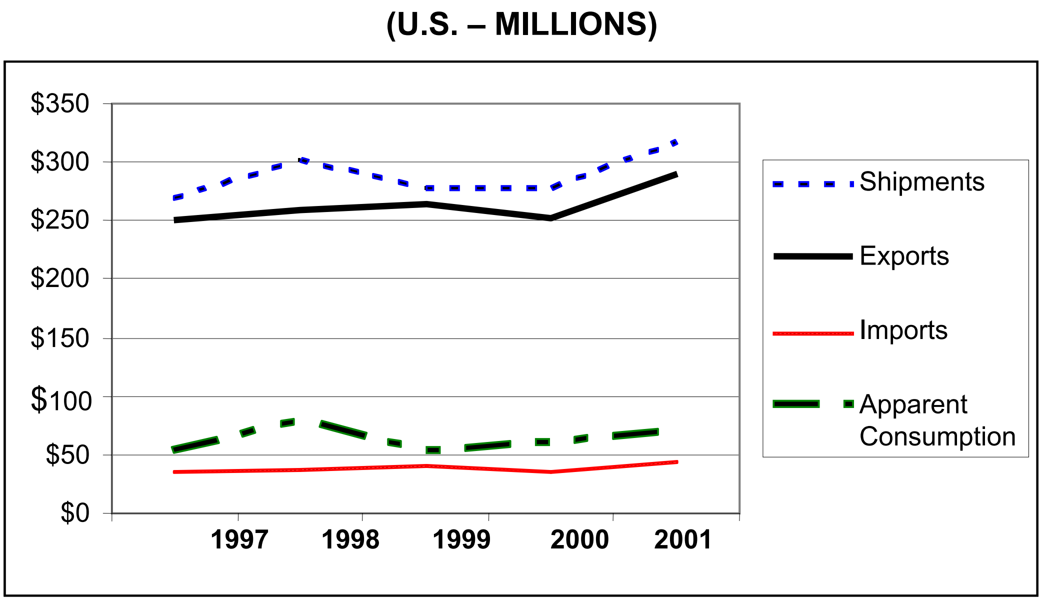
Another private sector entity that supports Portugal's mould industry is Centro de Formacào Profissional da Indústria Metalúrgica e Metalomecánica (Cenfim), a professional training centre for the metallurgy sector. Cenfim offers courses ranging from executive management education for middle managers and technicians to training in areas such as CAD/CAM and CNC programming. Graduates of Cenfim emerge well trained in the fundamentals of mould drawings, drilling, lathing, and machining, and of wire and erosion EDM processing.

10.5 Market Characteristics and Trends

Portugal reportedly has a very small domestic market for TDMs. Apparent consumption of industrial moulds ranged from approximately $53 million to $84 million during 1997–2001. 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 and imports have been relatively small. Imports of TDMs (i.e., tools, dies, industrial moulds, jigs, and fixtures), rose by 25 percent, from $42 million in 1997 to $52.6 million in 2001. In that year, imports accounted for 15 percent of Portugal's total trade in these items. Industrial mould s 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.

Portuguese exports of TDMs increased by 17 percent from $255.5 million in 1997 to $298.6 million in 2001. Principal export markets include the United States, Germany, France, Spain, The UK, and the Netherlands. Exports of industrial moulds to the United States increased from $28.4 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.

10.6 Trends – International Trade and Domestic Consumption



10.7 Government Support 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 mould exports through trade missions and fairs and international conferences. The Portuguese mould exports through trade missions and fairs and international conferences. The Portuguese mould 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 are of advanced technologies among firms, research institutes, and universities with the aim of strengthening productivity and competitiveness of Europe's industries. 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 mould producer, Ibermouldes.

Portugal has common import tariffs with other EU members. 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.

APPENDIX 1-1

Tools, dies, and industrial moulds: Canadian imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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*

APPENDIX 1- 2

Tools, dies, and industrial moulds: Canadian exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
United States	674,195	640,655	697,230	693,080	573,687
Japan	13,604	5,922	10,339	2,721	25,173
Canada	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 & 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	7,323	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
Total:					
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*

Appendix 2-1

Tool, die, and industrial moulds: U.S. imports for consumption, 1997 – 2001, by country

Item	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	38216	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	1986988	1861646	1908139	1911293	1706932
EU-15	290,945	336,557	371,528	326,321	263,935

Industrial moulds (NAICS 333511): U.S. imports for consumption, 1997-2001

Item	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	1,231,331	1,329,781	1,347,979	1,160,624
EU-15	199,670	239,787	267,941	245,125	203,448

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

Item	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	630,319	578,358	563,316	546,307
EU-15					

APPENDIX 2-2

Tools, dies, and industrial moulds: United States (US) exports, of domestic merchandise, by destinations, 1997 - 2001

(1,000 dollars)

Item	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

Industrial moulds (NAICS 333511): US exports of domestic merchandise, by destination, 1997-2001

Item	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	648,491	789,060	794,672	880,799	762,987

Source: Compiled from official statistics of the US Department of Commerce

(1,000 dollars)

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://wwwgtiscom

Special tools, dies, jigs and fixtures (NAICS 333514): US exports of domestic merchandise, by destination, 1997-2001

Item	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	442,608	352,592	276,506	340,220	321,005

APPENDIX 3-1

Tools, dies, and industrial moulds: Mexican imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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 & 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 & 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 & Hong Kong	215	319	402	356	300
Total:					
United States	208,520	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 & 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*

APPENDIX 3- 2

Tools, dies, and industrial moulds: Mexican exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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	1,300	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	10,531	7,810
NAFTA	91,515	81,405	84,758	100,026	131,249
China & 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 & 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 & Hong Kong	0	0	0	0	0
Total:					
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 & 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*

APPENDIX 4-1

Tools, dies, and industrial moulds: Japanese imports, by selected countries and by country groups, 1997-2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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 & Hong Kong	12,988	24,882	15,504	21,320	17,880
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	3,954	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 & 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 & 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
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 & 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*

APPENDIX 4- 2

Tools, dies, and industrial moulds: Japanese exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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 & 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
EU - 15	464,939	376,314	378,537	325,015	341,047
NAFTA	224,636	151,069	160,561	131,889	254,866
China & 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 & Hong Kong	3,584	3,752	5,174	5,713	6,243
Total:					
United States	838,256	662,241	633,693	670,694	618,702
China	269,524	203,980	278,386	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
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 & 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*

APPENDIX 5-1

Tools, dies, and industrial moulds: China imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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	622	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	163,271	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*

APPENDIX 5-2

Tools, dies, and industrial moulds: China exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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
Total:					
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*

APPENDIX 6-1

Tools, dies, and industrial moulds: Hong Kong imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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	6,594	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	1,696
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*

APPENDIX 6-2

Tools, dies, and industrial moulds: Hong Kong exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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	5,475	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	2,644	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	969
China & Hong Kong	8,729	23,365	28,429	23,562	18,256
Total:					
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*

APPENDIX 7-1

Tools, dies, and industrial moulds: Taiwan imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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 & 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 & 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 & 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
Grand 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 & 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*

APPENDIX 7- 2

Tools, dies, and industrial moulds: Taiwan exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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 & 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 & 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 & Hong Kong	793	938	2,141	2,748	2,880
Total:					
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
Grand 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 & 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.

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

APPENDIX 8-1

Tools, dies, and industrial moulds: European Union (EU) imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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
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	1,676,416	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*

APPENDIX 8- 2

Tools, dies, and industrial moulds: European Union (EU) exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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
EU external trade:					
United States	345,840	392,822	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*

APPENDIX 9-1

Tools, dies, and industrial moulds: German imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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*

APPENDIX 9- 2

Tools, dies, and industrial moulds: German exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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
Total:					
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*

APPENDIX 10 - 1

Tools, dies, and industrial moulds: Portuguese imports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
Spain	6,955	3,245	4,193	4,702	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	2,467	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	1,229	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*

APPENDIX 10 - 2

Tools, dies, and industrial moulds: Portuguese exports, by selected countries and by country groups, 1997- 2001

(1,000 dollars)

Item	1997	1998	1999	2000	2001
Industrial moulds:					
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	256,694	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 other	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
Total:					
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*

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