Industry, Science and Technology Canada
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REVIEW OF THE CANADIAN TOOL, DIE AND MOLD SECTOR

AND

ITS RELATIONSHIP TO THE AUTOMOTIVE SECTOR

Canada

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PREFACE

The purpose of this review is to increase the awareness of the technologies used and the growing importance of the skilled tradespeople in Canada's tool, die and mold producing sector. The impact that these skilled people have on the users of this tooling is particularly important to the automotive parts producers. The changes in the availability of these skilled people and the demands for them have been accelerating through the 1980s and will continue into the 1990s due to the growing deficit of these skills.

The most important asset that the tool, die and mold sector has is its skilled people. Accordingly the availability of these skills and the safeguarding of the supply of these skilled tradespeople must receive careful consideration and requires priority treatment.

The high level of industrial activity in Canada since the recession of 1982 when coupled with major and rapid technological change necessitates a re-examination of the adjustment in the employer skills requirements, the demand for new worker skills and the capacity of the workers to meet these requirements. Industrial restructuring, technological innovation and the availability of interesting and challenging alternative employment options give workers the opportunity to make employment choices which are quite different to vocations that have been chosen traditionally.

Demographic trends, changes in the sex and age composition of the work force, and skills mix raise concerns as to the need for new approaches to human resource development and management policies and practices. Management in the tooling industry is being tested severely, trying to find new approaches and solutions in assuring the availability of qualified workers for the growing need for highly skilled technically oriented multiskilled and multifunctional tradespeople. The accelerated rate of change further aggravates the situation.

The market is changing. Foreign competition is increasing as the market globalizes. The organization of this sector must be re-examined and changed to meet the new requirements.

The Industry Development Branch of the Ontario office and the Automotive Directorate of the Surface Transportation and Machinery Branch of Industry, Science and Technology Canada have made the resources available to do this review.

EXECUTIVE SUMMARY

The automotive industry is the engine that drives the secondary manufacturing sector in Canada. The tool, die and mold sector (TDM) is an essential ingredient that keeps secondary manufacturing functioning efficiently through the provision of state-of-the-art tooling. This tooling is the product of highly skilled journeymen employed by the TDM companies. These skilled tradespeople are the most important asset that the TDM sector has.

The prominence of the TDM sector as a keystone of secondary manufacturing in no small way flows from the influx of highly skilled people who came to Canada from Europe in the 1950s and early 1960s trying to re-establish themselves in a milieu that offered significant opportunities and scope to lead productive and fulfilling lives.

Success has been achieved through the provision of excellent tooling to a market that to 1986 grew at a rate of about 20% per year. This has not been a continuous growth as there have been market corrections. The last correction took place during the 1982 recession when the sector by virtue of very strong exports was only able to maintain shipments at a level commensurate with the performance of the previous year. 1987 shipments were at the same level as 1986 ($725 million) and the statistics signalled that very major changes were taking place in the market place.

The issues that the sector is facing include:

- Globalization of Markets.
- Plant Modernization/Investment.
- Adequate Supplies of Skilled Labour/Recruitment.
- Management Development/Enhanced Engineering Capability.
- Retraining and Raising Skills Levels.
- New Technologies (for product and production equipment).
- Strategic Planning and Public Awareness.

The importance of these various issues varies from company to company and from year to year.

The sector had been succeeding in meeting the domestic market demand and at the same time maintaining a very positive trade balance ratio of exports/imports in excess of 3:1. Exports in 1986 were $269 million with a very significant portion being molds for plastic components and products. The main export market was the U.S. but exports to Europe and even Japan were being realized. The dies and molds being produced were very competitively priced and of excellent quality.

The reasons for this excellent performance were:

i) the highly skilled work force as previously indicated and
ii) major capital expenditures which had upgraded plant capability equal to or better than most industrialized countries in the world.

This combination of assets was demonstrating that Canada could hold its own as globalization of the TDM market began to be a real force.

During this time however the automotive assemblers who were fighting off strong competition from Japanese imports began to change and modernize. Canadian parts producers did well, particularly as significant investments in new capacity were initiated. The more noteworthy examples were stamping plants for the production of automotive exterior skins and plastics plants for the production of plastic components.

This unprecedented demand had the effect of saturating the production capacity of the TDM sector. Companies found that they could not meet the market demand. This trend which became apparent in 1986 continued with very significant increases in imports in 1987 and 1988 and large reductions in exports. 1988 exports were 13.1% below 1987 and the trade balance while it remained positive had a ratio of only 1.1:1.

The sector which had been performing well was under duress. It was short of capacity and could not maintain the momentum it had generated after 1982. During the period up to 1986 the sector demonstrated it was prepared to invest to maintain its technological edge. It was coping with its technology requirements through the acquisition of capital goods and software technologies and by technology transfer for its products.

It was not as fortunate in its recruitment. This sector had to draw its people, both skilled journeymen or apprentices, from the same pool as the entire secondary manufacturing industry. As a sub-sector the TDM companies in many instances were at a disadvantage when recruiting. As small business these employers did not have the same appeal as large companies. At the same time many small manufacturing companies were being formed. The job responsibilities and conditions of employment in these small plants were less onerous drawing skilled journeymen away from TDM plants.

The sector has been growing slowly in keeping with the demand for its product. The company population which stood at 584 establishments in 1987 is only increasing at about 1% per year. The employment however from 1984 through 1986 was increasing by 17% per year. This is a positive sign both from the standpoint of employment creation and also from the viewpoint that larger companies tend to be stronger companies in that management has at its immediate disposal a larger indigenous resource that it can bring to bear in meeting its objectives.

Management in the main was very strong technically as most of the managers/owners had been trained under strong apprenticeship regimes generally in Europe. Younger managers who are now starting to supplant the old guard are bringing with them stronger managerial strengths even though they may not be as strong technically. They have a better feel of computer and other modern technologies which they can harness to the advantage of the sector.

Management has had a strong bias towards modernization and since 1982 has materially improved its plant capacity and capability through the acquisition of state-of-the-art machine tools and computer capability. The sector as a whole is very strong on CAD, CAM, CNC, CMM as well as the more recent requirements such as EDM (wire electric discharge machines), digitizers etc. This is particularly the case where the individual company employs 30 or more people. Smaller companies and companies in more remote areas may not have had the same incentive to acquire state-of-the-art equipment as the market they serve may be more local and not as demanding.

As a whole this sector is as well or better equipped than its foreign competition.

The Canadian TDM sector appears to be more research and development conscious than its foreign competition. The emphasis is on applied development which includes a broad spectrum of activities including software, optical systems, material stretch characteristics in dies, plastic molding and foaming processes using new types of polymers for laminates etc. There is a strong commitment to technological superiority.

There are some constraints to be noted however. The sector is relatively weak on engineering capability and this aspect will have to be addressed. As small business, companies can only undertake a certain level of meaningful development work. A means must be found whereby these companies can have better access to good development capability.

In 1987 the TDM sector found itself under severe strain as it could not recruit skilled people in adequate numbers. Exports were reduced. Imports began to increase dramatically. Investment programs were cut back due to lack of people. The sector could not even recruit adequate numbers of apprentices.

A review of the underlying reasons suggests that certain circumstances had not been adequately addressed. These included:

- as a small business sector TDM companies do not have a high public image compared to other corporations to attract people.
- strategic planning and the ordering of priorities is not a strong attribute particularly on image building.
- public awareness of this sector is low and the perception is negative.
- skills requirements are very high particularly in the moldmaking categories without commensurate recognition from a remuneration standpoint causing journeymen to gravitate to less demanding occupations.

- perception as well as familial, counsellor, and peer pressures tend to dissuade youth from apprenticing in this sector.
- the sector has not organized a good and effective lobby for itself (trade association) to enhance its image and reputation.
- a need for more external focus, more information and more involvement in the community is indicated.

The apparent softening of the tooling market since 1988 may give the sector some breathing room to address the aspects of image, training and skills shortages. The seriousness of the problem however should not be underestimated and a lull in the market will not assist the solution materially.

In the light of the origins of its skilled people the TDM sector is saddled with an aging work force. A large percentage of this group is now on the threshold of retirement. While it may be possible to replicate the numbers of journeymen retiring, it will be impossible to replicate the know-how domiciled in these tradespeople. The sector will be weakened as a result.

The TDM sector will have to place greater emphasis on retraining and upgrading as a first priority while apprentices complete their training. The sector will have to come together and strengthen its association representation in order that it can adequately address its problem of awareness and image.

Likewise it will have to re-examine its stance, its priorities and programs for developing and training its people. Failure to do this will result in loss of markets, further entrenchment of imports in the market place and ultimate loss of more people.

There are many factors contributing to the problem of the skills shortage which will have to be addressed. The more important ones include:

- a very high turnover rate for apprentices.
- failure of the sector to attract good apprentices.
- inadequate mathematical and technical competence of the high school graduate.
- the demographic situation resulting in reduced numbers of young people being available for training.
- an extended period of very strong economic expansion which has used up the available pool of skilled people.

There is also a reticence on the part of semi-skilled people (and even skilled people) to upgrade themselves suggesting that the questions of motivation and compensation should be re-examined.

The lack of skilled people is serious and requires immediate attention. Failure to do so will weaken secondary manufacturing in Canada as a whole and will have a significant detrimental effect on sectors such as automotive, plastic products, defense, aviation and electronics who must have quality state-of-the-art tooling for their production processes.

Initially these sectors will have the buying power to import their requirements. However ultimately they would become subservient to their suppliers and competition. This must be resisted.

1.0 INTRODUCTION

There is a pervasive concern on the part of automotive component producers and automotive assemblers that the supply of skilled tool, die and mold trades people be adequate, thus enhancing the introduction of new technologies, the quality of the product they produce and as a result their competitiveness. An examination of the state of the tool, die and mold (TDM) industry focusing on the use of advanced technologies and on current skills existing in the shops of the TDM industry catering to the needs of the automotive sector has been made.

1.1 Objectives of the Study

This review has four objectives as follows:

- prepare an overview of the TDM industry identifying the new technologies they are using, the new technologies they deem necessary to acquire or develop, the new advanced materials they are processing and the trend toward more sophisticated processes and exotic materials, determine the impact of their requirements on recruitment and training of the skills to meet the new demands;

- identify the extent of the skills supply, and identify the reasons for the shortages if, in fact, shortages do exist.

- establish the commitment of the industry to develop skilled workers through apprenticeship and other training and consider the effect of company size or its ability to train its own skilled people and;

- develop an appreciation of the impacts resulting from a skills shortage.

1.2 Methodology

Recognizing that the TDM sector, in the main, is a "small business" activity made up of small companies employing, on average, 18-19 people, and that management capacity was very limited, the decision was taken to interview a select group of TDM companies, community colleges and some auto parts producers and assemblers. It was considered that a mailed questionnaire would not derive an adequate response or develop in-depth data.

In selecting companies to be interviewed, an initial selection was made of companies who had an involvement in the automotive sector or who had skills appropriate to the sector. From this list, choices were made to assure that a spectrum of companies by size was included. Secondly, choices were made by geographic location to identify local and regional variations. Thirty four TDM companies in Ontario, Quebec and British Columbia were interviewed (see appendix 2). Discussions were also held with companies in Michigan for comparative purposes.

Similarly, five community colleges were interviewed (Appendix 3). Again the same general criteria were used in selecting the colleges. Discussions were also held with a college in Michigan that has a significant involvement in automotive and apprenticeship training.

A standard questionnaire was used in all instances to make sure that comparable data was being gathered. All companies interviewed had at least 20 employees.

Discussions were held with other government departments as follows:

Ontario Ministry of Industry, Trade & Technology
Ontario Ministry of Skills Development
Employment and Immigration Canada.

2.0 THE TOOL, DIE & MOLD MANUFACTURING (TDM) SECTORS

The TDM sector stands at the core of all secondary manufacturing as "tooling" is required to shape, form and mold metals, plastics and other materials and to hold and gauge materials while they are being worked on. This is a sector that has quietly and efficiently met the needs of auto parts producers and assemblers, plastics molders & extruders, producers of consumer durables, electrical and electronic components and a myriad of other secondary manufacturing establishments. Yet the TDM sector in Canada is a sector that is not well known or understood perhaps because one of its unique characteristics has been meeting the requirements of the client in the best manner possible without any fanfare and then go on to the next challenge.

2.1 The Company Population

In calendar year 1987 as reported by Statistics Canada (Catalogue 41-251B3062) the number of establishments in Canada was 578. The number of establishments has continued to grow at a slow but steady rate as follows:

Year	No. of Establishments
1982	508
1983	516
1984	526
1985	569
1986	578
1987	584

The increase in 1985 was, in large part, a recognition by entrepreneurs of the opportunities resulting from a very good economic and investment climate after the recession of 1982/83.

The average employment per establishment confirms that the TDM sector while being very important to secondary manufacturing in Canada is truly a "small business" sector. This is illustrated in Table I.

TABLE 1

AVERAGE EMPLOYMENT BY ESTABLISHMENT (1986)

Number Employed Per Establishment	No. of Establishments	Average Employment/ Establishment
0-4	174	2.1
5-9	130	6.6
10-19	117	13.7
20-49	101	30.8
50-99	43	68.8
100-199	13	139.3
200-499	-	-
	578	18.5

The average employment per establishment in Canada compares with other countries as follows:

Country	Average/Establishment	Source of Data
Canada	18 - 19	Statistics Canada
United States	18 - 20	NTMA
Japan	8 - 9	Japan TDM Assoc.
United Kingdom	7 - 8	GTMA

The variations in the average size of establishment are a result of the manner the industry is organized in each country. The American model is very similar to the Canadian model. The National Tooling and Machining Association reported that 69% of their membership has 20 employees or less, 23% of the membership is made is made up of shops employing 5 or less and 3% employ over 100 people.

In Japan, the structure is different in that a company may have several workshops/establishments. With the Japanese committed to J.I.T. the result is more small shops, catering to local client requirements, i.e., 79% have less then 20 workers. A company could have 3 or more workshops/establishments depending on the location of its clients. About half the companies in Japan maintain membership in their TDM Association.

2.2 Geographic Distribution

The geographic distribution in 1986 reflects the concentration of secondary manufacturing in Ontario and Quebec.

TABLE 2

GEOGRAPHIC DISTRIBUTION OF ESTABLISHMENTS (1986)

	No. of Establishments	% of Total
Newfoundland	--	--
Prince Edward Island	--	--
Nova Scotia	1	0.2
New Brunswick	--	--
Quebec	85	14.7
Ontario	464	80.3
Manitoba	6	1.0
Saskatchewan	--	--
Alberta	5	0.9
British Columbia	17	2.9
	578	100.0%

A significant number of the companies in Ontario cater to the automotive requirement either in the provision of new tooling or in the servicing and maintenance of existing tooling. In Quebec, while there are several excellent companies servicing the automotive sector the main concern is servicing the local industry requirements such as aerospace, plastics and electronics. Some automotive involvement was also identified in British Columbia.

Small companies (less than 20 employees) tend to cater to local client requirements only. Locally they are very important but their overall impact is relatively small.

2.3 Markets

Shipments by this sector have been increasing significantly.

TABLE 3

SHIPMENTS

	Value of Shipments (000 dollars)	Value Added	% Change in Value of Shipments
1982	$ 376,261	$ 276,166	--
1983	372,259	272,502	- 1.1%
1984	474,902	347,143	27.6%
1985	623,385	447,594	31.3%
1986	710,320	479,235	13.9%
1987	744,990		4.9%

Statistics Canada is changing the reporting format on catalogue 41-251B 3062 - the main source of statistical information on this sector - as a result final data on shipments for 1987 will be the last year where there is a direct comparison with previous years.

As Statistics Canada criteria require that statistics on establishments whose main activity is directed to the manufacture of a certain product be identified there in total, the TDM output of many companies is not included in the data as the production was ancillary or secondary to a company's main product line e.g., General Motors, Huron Steel, Butler, Simpson and many other enterprises have significant TDM activities but these do not appear in the data as this is not the companies' main activity. Accordingly, the data on shipments and value added are on the conservative side. Total actual TDM product shipments are higher than the figures reported by StatsCan.

Exports*

Data on the export and import of dies and molds is accumulated by Statistics Canada under two code numbers as follows:

Code #52387 - Dies for metal working
#52947 - Dies & molds for plastics machinery.

Data is available for 1988 and is included in the tables for exports and imports.

TABLE 4

EXPORTS
(000 dollars)

Code	1982	1983	1984	1985	1986	1987	1988+
52387	$ 14,900	17,900	22,079	24,958	29,574	28,070	
52947	$109,800	143,132	173,048	199,776	239,468	244,741	
Total Exports	$124,700	161,032	195,127	224,734	269,042	272,811	237,183
% Change		29.1	21.2	15.2	19.7	1.4	-13.1

Imports*

TABLE 5

IMPORTS
(000 dollars)

Code	1982	1983	1984	1985	1986	1987	1988+
52387	$ 24,200	23,942	28,033	33,180	48,188	79,250	
52947	$ 18,900	21,137	25,933	34,973	34,231	54,598	
Total Imports	$ 43,100	45,079	53,966	68,153	82,419	133,848	208,523
% Change		4.5	19.7	26.2	20.9	62.4	55.8

* Automotive assemblers make a practice of moving production dies & molds across the border between fabricators in the two countries. The fair market value of these items appears in the import and export data and causes some small variations in the data reported.

+ Statistics for 1988 are now accumulated under the new harmonized system but are not detailed to the same extent.

The Canadian TDM sector historically has had a positive trade balance ratio as follows:

	1982	1983	1984	1985	1986	1987	1988
Exports/Imports	2.9	3.6	3.6	3.3	3.3	2.0	1.1

This position however appears to be eroding rapidly due to the shortage of skilled tradespeople and the lack of capability on transfer dies for the production of automotive body skins. Traditionally the automotive sector was responsible for this excellent trade balance. Today however the situation has changed materially. Contributing to this change has been the import of tooling for new stamping and plastics component plants and the inability of the sector to hold their market share.

TABLE 6

THE APPARENT CANADIAN MARKET
(000 dollars)

	1982	1983	1984	1985	1986	1987
	294,661	256,306	333,741	466,804	571,357	606,027
% change	-	-13.0	30.2	39.9	22.4	6.0

(The figures for the Canadian market have been calculated by adding the total imports to the value of shipments and reducing the sum by the amount of the total exports).

The domestic TDM market has continued to grow since 1983. It must be borne in mind that the 1983 Canadian market data reflects the nadir caused by the 1982/83 recession. Subsequent years reflect some "catch-up" on demand which peaked in 1985. Furthermore, the demand for tooling by the automotive sector due to the construction of new plastics and stamping facilities such as Complast, Karmax (MAGNA), General Motors, A.G. Simpson and others starting in 1985 and going on through 1987 was such that it could not be supplied by domestic suppliers and had to be met by imports - particularly dies for steel stampings for automotive outer skins.

Exports in 1987 show this impact. The high rate of export increases could not be maintained. There was a levelling of shipments from domestic plants as well as indicated in the 1986 data, indicating a saturation of domestic productive capacity.

2.4 Employment

(Source of data, Statistics Canada Catalogue 41-251B 3062)

The employment in the sector is a function of market demand and shipments.

TABLE 7

EMPLOYMENT

	No. of Establishments	Production Workers	Management & Support	Total Employment	Employees Per Establishment	Shipments Per Employee
1982	505	6,158	872	7,030	13.8	$ 53,522
1983	516	6,079	944	7,023	13.6	53,005
1984	526	6,731	1,081	7,812	14.9	60,791
1985	569	8,451	670	9,121	16.0	68,346
1986	578	10,084	624	10,709	18.5	66,335
1987	584	-	-	10,886	18.6	68,436

Close scrutiny of the data indicates an aberration in the employment numbers starting in 1985. This stems from a change by StatsCan in the method of collecting data. However, the information is presented here as it still provides a useful guide as to what is happening.

Discussion with the companies interviewed indicated that there have been reductions in support staff resulting from the computerization of office functions. This is generally the case in the instance of companies employing more than 30 or more people. There would appear to be a certain threshold of support below which you can not go.

Notwithstanding the above, the employment statistics indicate the companies are growing in numbers and in size. The employees per establishment ratio is very comparable with the situation in the United States as reported by the NTMA.

2.5 Sector Growth and Human Resource Utilization Trends

In general the human resource is the most important resource that companies involved in secondary manufacturing have. The data as developed by Statistics Canada (See Table 7), confirms that the TDM sector is growing, albeit slowly. In a four-year time span, the size of establishments on average has grown 36%. This is an encouraging indication because the growth of individual establishments signals the availability of more indigenous resource, which with proper management, translates into enhanced competitiveness.

The increase in total employment between 1982 and 1986 of 54.8% signals a considerably stronger sector. The 27.9% increase in shipments per employee also demonstrates that productivity is being maintained.

While employment suffered some attrition between 1982 and 1983, the impact of the recession was neutralized to a large extent by a very strong performance on exports, particularly on molds for plastic, signalling a very competitive capability.

2.6 Observations

The TDM sector has been performing reasonably well. It has been driven by the very strong performance of the automotive sector and to a lesser extent by the demand for electronic and plastic products. Together with Aerospace, these latter activities have contributed to the good performance of the sector in Quebec and in Western Canada as well.

The recession did cause some restructuring in that many small companies and even some larger ones, such as ITL, could not cope with adversity and shut down their operations. However, the end result was stronger companies better able to cope with the competitive situation that developed in 1984 and 1985.

One sobering fact however was reported by many of the companies interviewed. Their apprenticeship and re-training programs were eliminated or seriously curtailed during the 1982-1984 period.

While the sector has performed well it does not appear to have been able to cope with the demand when the automotive sector was restructuring, starting in about 1985. The demand was so strong that auto parts companies and assemblers had to import significant quantities of tooling particularly in 1986 and 1987 (See Table 5).

By 1986 the TDM sector appeared to have lost some of its momentum. Imports were up substantially by 62.4% over 1985. While the market was still maintaining good momentum (22.4% increase over 1985) exports had levelled out (1.4% increase). Shipments also in 1986, when adjusted for inflation, were on a plateau. There was not enough energy remaining in the sector to generate new momentum in 1987.

One of the major constraints is that the Canadian TDM sector is tied to the North American practice where clients tend to buy at lowest first cost. The established business relationship tends to be more important in Europe and Japan. It is always easier to compete globally if you have reasonable assurance that your domestic market is with you.

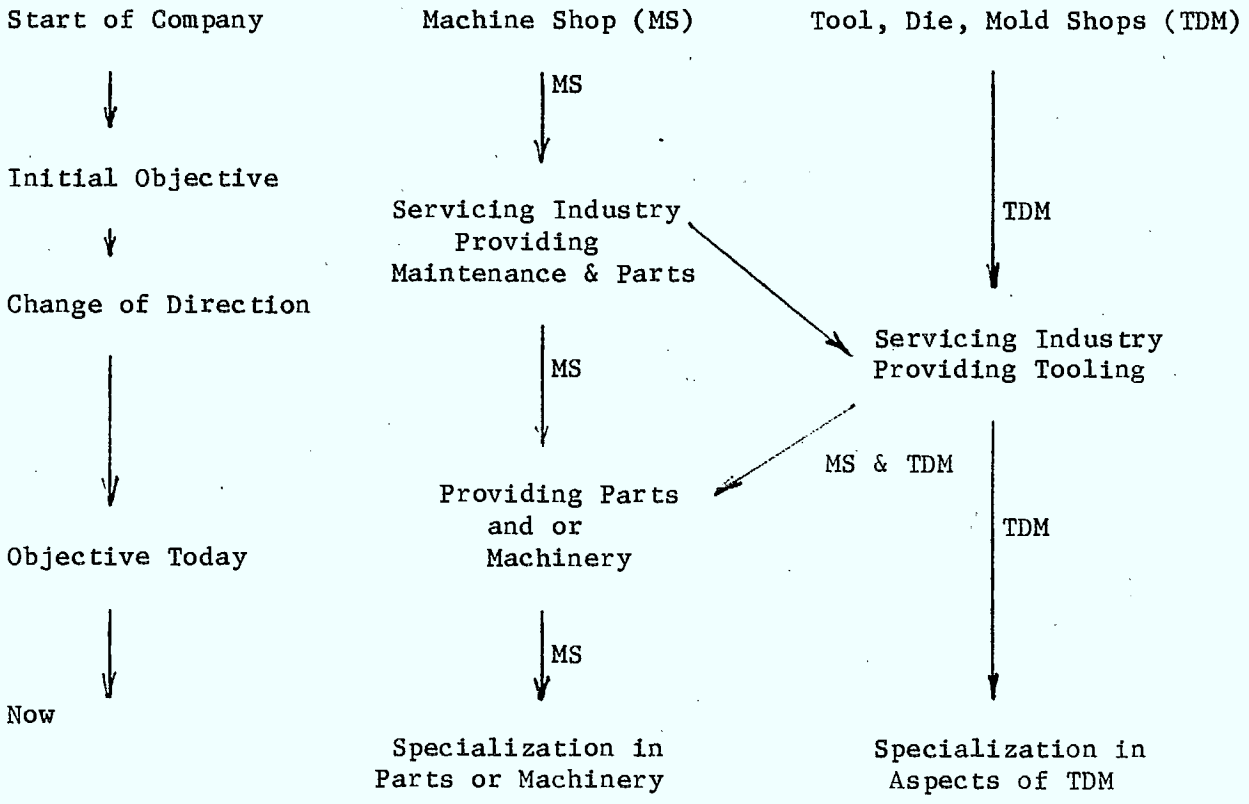
3.0 MANAGEMENT - BACKGROUND & CAPABILITIES

The tool, die and mold industry, while not large in size relative to many other industries, occupies a vital position because the products (tooling) which it produces are a basic requirement for secondary manufacturing. The TDM industry is not separately defined. It is difficult and in some cases impossible to define it properly as the TDM sector is a subset of the machine tool industry which is in turn a part of the machinery sector.

3.1 Historical Background

If we look at TDM companies in the sense of their development through time this history generally identifies origins as being either machine shops (MS) or TDM shops. Diagramatically we find variants of the following structure which facilitates the tracing of the development of a company from the time of its establishment until the present:

COMPANY DEVELOPMENT THROUGH TIME



Generally TDM shops require a higher order of technical skills and versatility to meet the market requirements.

Usually beginnings are very small. A highly skilled tradesperson wishing to be master of his own destiny establishes a 2-3 person business based on his technical capabilities. The nature of the business is predicated on the geographic location and the opportunities that exist in the area. The business tends to be responsive to the needs of the community.

As a consequence marketing is not a significant requirement. Furthermore functions such as accounting can be brought in, in the form of the local auditor. The manager/proprietor remains a technically oriented individual and the company grows slowly. Delegation is not an imperative requirement and the manager operates the company effectively on his own.

A review of the 34 TDM shops interviewed indicated that over 50% have been in business for over 20 years, 25% have been operating for over 30 years. In the latter group the ages of some of the companies were 75, 67, 57, 52 years etc. With one exception they were still Canadian owned. The exception was owned by a multi-national because there was no family remaining to run the business. In three instances, in the latter group the employment had reached 100 people i.e. growth is very slow.

Further review indicated that TDM companies had started ancillary business activities such as producing machinery or components and grew far more rapidly and ultimately lost their identity in the eyes of StatsCan, as TDM shops. In the latter group we find companies such as Magna, Husky Injection Molding Systems Ltd., and many others. They had changed direction because the owners had more marketing skills, could build a management team more effectively and most importantly had been able to identify and capitalize on new market opportunities. Often the initial gamble was significant. It should be stressed that geographic location had a strong influence on the ultimate rate of growth of a company as does the aggressiveness and initiative of the entrepreneur.

The TDM industry had always been very susceptible to economic fluctuations. Economic cycles affect demand by the secondary manufacturing industry. Periods of economic growth give rise to demand for more manufacturing of goods and components, boosting the demand for tooling. Major contributing factors to the volatility in the demand cycle for tooling have been the traditionally important roles of the automobile and electronic industries (aerospace in Quebec). The TDM sector tends to face periodic extremely heavy demands during the time of re-tooling by major domestic automobile manufacturers. Ontario had to cope with this through 1985 to 1988. When the cycle is concluded the industry faces a slow down due to reduced demand unless cushioned by diversification into other domestic markets or by exporting.

The TDM sector demonstrated its ability to cope with adversity during and immediately after the recession of 1982/83 by increasing exports significantly. The interviews, however, did identify instances where companies were limiting their commitment to automotive in order to reduce the impact of these activity cycles.

3.2 TDM Management & Policies

To be effective management must establish goals and objectives for itself. Generally these are incorporated into a company's business plan.

Fifteen per cent of the companies interviewed indicated that they did not have a business plan. A further 20% while indicating that they had a business plan had an annual budget tied to a sales forecast. No strategic or forward planning was involved. Just over 50% advised that they had a business plan covering at least 3 years and on occasions 5 years. Twenty percent of the companies indicated they had been involved in a long term business planning process for 10 years and just over half had been doing business planning formally for 3 years or more.

Analysis of the companies that had commenced doing business planning in the last 3-4 years identified two reasons for initiating this practice. First many of these companies had applied for modernization support under the Federal Industrial and Regional Development Program (IRDP) and were required to develop a business plan as part of the evaluation process. Secondly, many instances were identified where new management was taking over control of the company and had initiated a business planning process. In several cases these new managers were younger family members who had business administration training and while not having the depth of technical know-how and experience as their predecessors they relied on more planning, more delegation and less involvement in many aspects of the company operations.

Effective planning is an important factor in a firm's ability to adopt technical change for competitive success. The nature and requirement for planning and its relationship to competitive success may however, be different for different market niches.

The TDM companies indicated that in planning their manufacturing equipment and their product requirements that the following factors were duly evaluated (in descending order of importance):

- client requirements;
- sales forecasts;
- competitive pressures;] (equally important)
- production cost reduction.

Sixty-two per cent of the companies signalled that the client requirement entered into one of the top three priority considerations. Market trends also received honourable mention. Business and long-term planning did not enter into the equation as reasons for making decisions.

Half the companies interviewed indicated that they had well established procedures for evaluating their technology/equipment requirements and the costs that would result from the selection of competitive makes. Generally the General Manager got intimately involved in the process.

In projecting work-force requirements, the companies showed greater unanimity on factors they considered in reviewing and planning their needs. Companies identified the following in descending order of priority:

- Sales forecasts;
- Planned equipment changes;
- Rate of employee turnover/attrition/retirements, etc.

There was recognition of the need for adequate trained human resource. In this regard about 60% of the companies interviewed made a practice of tracking their in-house skills inventories and about half of these kept close watch on training in process and its progress while monitoring the availability of qualified new hires.

Half the companies had procedures for employee appraisals which evolved from their planning process. Over 60% indicated their companies had clearly understood delegations of authority. In some instances this could imply delineation of authority as the management cadre was small.

Companies place great emphasis on the impact of technical change. The change in the skills mix has been rapid resulting in anxiety about training and the availability of recruits for training. Generally there is an awareness for the need for change and new approaches but little new policy has been put into practice.

3.3 Management Capabilities

There is a wide spectrum of capabilities displayed by the various managers interviewed. The older managers have excellent technical backgrounds and companies have prospered as a result of being able to respond to the clients technical requirements well.

The above expertise flows from the fact that they had probably gone through rigorous apprenticeship training. This training, has served these companies well and they have built on it. If there is a problem technically, it is the required adaptation to the advanced uses that the computer is being put to on the TDM shop floor today.

This reliance in the past upon mechanical skills was usually sufficient to meet the product design needs and manufacturing requirements. With the pervasion of electronics dramatic changes in skill requirements are resulting. Managers with an aptitude for delegation and building good staff are coping well. In other instances, it was noted that new

managers were taking over. These new managers may not have the same technical skills but have better overall managerial skills in order to cope with the new business environment.

The evaluation identified that there was a serious deficiency in strategic business planning by the companies in many instances. This will need to change as the market is changing. Companies must have a well thought out strategy as to how they will meet their objectives.

Management have had to emphasize training and re-training because of the skills shortage and mix change. Some have also recognized the need to initiate training of people for management to safeguard the well being of companies in the future.

During the data gathering process managers stressed that there was a need for more engineering competitance. There is a serious short coming here as there are few people with formal engineering training in the TDM sector as opposed to trades training. There was little R&D activity identified. Current managements do not have a facility for this. If TDM companies are to stay competitive, they will need to do more engineering in-house, do more R&D to maintain a competitive edge and to prepare for tomorrow's market demand.

It was noted that many of the companies still continued to operate in a reactive manner meeting the client's requirement. They continue to count on proximity as being a sales aid. The recent incursion of imports from Asia, Spain, Germany etc., signals that a change is in process, competition is increasing and Canadian companies are going to have to market. Many of these marketing skills are lacking.

3.4 Observations

While management is changing to cope with today's business environment it remains to be seen whether it is changing rapidly enough. Management has been reactive to the clients' requirements and it was identified that this is still considered to be the proper mode. The Free Trade Agreement with the United States is changing this. The duty protection will disappear with the resultant improvement in the competitiveness of companies stateside. Canadian TDM sales people will have to be out there selling their expertise.

The lack of research and development will place many companies under duress trying to cope with die and mold imports from outside Canada. An example of this are the transfer dies for producing the outer skin for automobiles, in keeping with today's quality expectations. This lack of R&D will reflect ultimately in technical deficiency to deal with new and advanced materials particularly in the mold niche.

The area of human resource development is a problem area. New attitudes must be developed, the level of awareness of the importance of the TDM activity needs raising. Today's managers have to come together to address this need.

The sector has been aware of the need for new investment and has met this challenge using the profits from the current high level of activity to acquire state-of-the-art manufacturing equipment (see section 4.0).

Product engineering strength while good must be strengthened as this remains an important aspect of the successful adoption of technology change in the industry. Notwithstanding this, new developments in technology and in the competitive environment have made other factors as indicated above equally important for competitive success.

4.0 TDM Sector Capability, Capacity & Investment

The TDM industry in Canada when considered company by company is small business. It is entrepreneurial with owners/managers directly involved in the day to day operations. The companies are independent and self centered, competing for the available markets with specialized products and expertise (tooling) on the basis of price, quality and technology.

Collectively these companies are the keystone for the secondary manufacturing industry in Canada providing tools, dies and molds for the manufacturer of parts, assemblies and finished products. The industry relies almost entirely on the skill and art of the traditional craftsman. The sector must maintain its competitive advantage in the new technology-intensive economy based on the products of research, science and technology, knowledge and know-how.

4.1 Products Produced & Services Supplied

In general the TDM sector supplies dies for metal-working, dies and molds for plastics, metals and other materials together with the jigs and fixtures required for complete component manufacturing systems. These products or systems are not completed without having had the benefit of a tryout which assures that the tooling will do the job properly.

These tryout capabilities coupled with maintenance and overhead services round out the service package.

Certain industry sectors, such as the automotive and aerospace industries, for reasons of confidentiality and control, have made a practice of designing their own tooling and having the TDM companies produce the requirements on a "build-to print" basis. This practice inhibits the development of major design and engineering capabilities. TDM companies merely provide the highly skilled trades-people to bring the clients designs and drawings to fruition. The TDM company is the purveyor of human resource expertise and machining capability.

On the other hand there is a broad requirement by the secondary manufacturing sector where the client requires a particular type of tooling but does not have the expertise to do the design. He expects the TDM company to do this for him. Here the company must draw on expertise acquired and provide the design and tooling. This service is invaluable to the client and is very fundamental to maintaining good manufacturing capability in Canada.

There is a considerable amount of specialization in the sector. Generally there is clear distinction between companies making dies as opposed to molds. Jigs, fixtures and gauges are tied to dies but some companies specialize in the production of jigs, fixtures, etc., only.

Molds require a somewhat higher level of technical expertise as the technology of resins, plastics and composites as well as ceramics is still evolving very rapidly. The complex shapes of plastic components and products impose higher reliance on computer aided design (CAD).

As indicated in Section 2.3 on Markets, Canada has a good positive trade balance on TDM signifying that the sectors' total capability is good and that it is generally meeting the supply and service requirements. This is confirmed by the Machinery and Equipment Advisory Board. The Board holds almost all dies and molds as being "available from Canadian production". The major exception is transfer dies for producing the stampings for automotive outer body skins. The indigenous design capability was not considered adequate by the Board to meet the skin quality requirements by the major automotive assemblers. As a result these dies are being sourced in Spain, Germany, France, Japan and the U.S.A.

This latter point highlights the fact that there maybe a developing engineering capability deficiency if Canadian TDM companies do not anticipate new requirements and improve their engineering and R&D capabilities to meet the challenge by increasing their technological competence.

4.2 Manufacturing Capability, and Investment

Statistics Canada data indicates that the TDM sector had adequate capability to meet the domestic demand and to make significant exports until 1986. The 1986 and 1987 data suggests that plant capability is saturated. The reasons leading to this are the 1986 shipments when viewed in constant dollars decreased from 1985. Exports in 1987 also when viewed in constant dollars dropped below 1986. Imports increased significantly (by 62.4% in 1987).

Recognizing that on large dies and molds the Canadian lead times from date of order receipt to date of shipment could be 36-52 weeks and the Japanese and some European suppliers' lead times are in the 24-36 week range the possibility exists that some orders are leaving Canada on the basis of better delivery schedules. The impact of the lack of Canadian capability for producing transfer dies for the stamping of automotive outer skins was discussed in section 4.1 (above) but the imports of molds for plastics also increased by 60.0% as compared with an increase trend that was running at about 20% annually for the previous three years.

During the interviews with TDM companies a re-occuring commentary kept surfacing, namely that the shortage of skilled labour was slowing expansion and that certain investments were being delayed. In actual fact the lack of engineering capability was also putting the Canadian TDM companies at a disadvantage when new applications not previously encountered were suddenly required by the automotive sector.

The interviews indicated that the TDM companies had invested heavily in the last 4-5 years. Investments have been made in all the latest technologies as follows:

Design Capability	Use Technology Currently	Plan to Invest or Invest More
Computer-aided design (CAD)	68% of companies	50%
Computer-aided engineering (CAE)	38%	21%
Integrated CAD/CAM	62%	35%
Manufacturing Capability		
Computer-aided manufacturing (CAM)	68%	38%
Coordinate measuring machines (CMM)	53%	12%
Computerized numerical control (CNC)	79%	32%
Numerically controlled (NC)	76%	6%
Other Equipment		
Wire EDM	41%	6%
Digitizers	15%	6%
Duplicators	9%	3%
Tryout facilities	6%	-
Profilers and super abrasive capability	6%	-

Only one company indicated having no CAD capability or planning to acquire capability. The Canadian Tooling Manufacturers Association (CTMA) conducted a survey of their members in March 1989 as to their position on CAD/CAM systems. The results indicated that 60% of the companies reporting had invested in CAD/CAM and a further 25% planned to invest.

From the viewpoint of management planning and control the situation was as follows:

Computerized financial systems	71%	29%
Manufacturing resource planning systems	38%	18%
Shop floor data collection	21%	24%
Computer links - with customers	26%	18%
- with suppliers	9%	6%

Companies reported that where they acquired their first CAD/CAM systems 4 or 5 years ago they were having to replace these due to absolescence. The data confirms this. Today's PC can handle the requirements, in most instances, better than the original computers bought. The PCs can be bought at a fraction of the cost and are easier to operate and maintain.

Users of computer links with their clients reported some problems with the loss of data on the telephone lines. Generally, this is caused by poor wiring connections but can go unidentified for some time to the frustration of both parties.

It was evident that companies who had made recent acquisitions of computerized design and production equipment were not getting full use of the equipment due to the shortages of trained people. Furthermore due to the brisk market demand the releases of personnel for training were difficult to make because of supply commitments made to clients. Discussions with Employment and Immigration Canada in Ontario elicited the information as well that shortages of skilled labour are retarding growth and expansion of this sector.

OECD studies show that during the 1960s a process of mechanization took place in the form of the adoption of NC which raised the productivity index from 200 to about 430. The 1980s have brought about a new wave of innovation, as a result of the electronification of machine tools (CNC) as used in TDM shops. The index has been creeping up to about 600. While the TDM sector has been investing heavily as a result of this process of electronification it as yet, is not achieving its full output potential, because of constraints caused by the lack of skilled labour.

While considerable new capacity has been added and continues to be added, this capacity is not being used to optimum advantage due to labour constraints. Indications point to the fact that productivity (Section 2.4, Table 7 shipments per Employee) appears to be on a plateau and could actually be decreasing. The use of extensive overtime may not be producing the desired result.

Investment generally has been at a very high level. The selection of companies to be interviewed resulted in meetings with 5 companies out of 34 who were operating new plants some of which were in the shake-down period. Traditionally TDM facilities have tended to be old.

Fixed asset financing has been a major pre-occupation of the TDM sector, and government assistance programs have aided and abetted the circumstances. About 60% of the smaller IRDP expenditures and FBDB authorized loans have been directed this way. The sector was a major recipient receiving R&D funding assistance as well. Unfortunately this pre-occupation with capital goods acquisition skewed the decision making process and the companies placed too little emphasis on their most important asset - their human resources. Training took a back seat to the improvement of the fixed asset base.

Notwithstanding the above comment the TDM sector is a high risk industry from an investment standpoint. Going it alone without funding assistance places a very severe burden on a small company particularly when new technologies are involved. One can appreciate the reasons for the rush for government assistance. The capital investment per employee is high and the opportunity cost must be paid up front before an order is received.

Investment in new computerized machine tools and particularly specialized tools such as coordinate measuring machines and wire EDM has been unprecedented. The driving force necessitating the investment has been primarily the automotive sector but has been added to by the requirements of the plastic molding industry producing consumer items and for aerospace. Consequently there has been a proportionately higher level of investment in Ontario by companies due to the servicing of automotive needs.

Companies found investment money hard to find in the 1981-1983 time frame. The ILAP (Industry Labour Adjustment Program) helped the TDM sector immeasurably in bridging this gap and investing in modernization. This investment made possible the strong export performance by many companies during this period. The IRDP (Industrial and Regional Development Program) helped maintain the investment momentum until its sunset in 1988. Current tardiness by companies in completing their investment programs (including IRDP projects) indicate that many of them are finding it difficult to take advantage of their investments and are delaying them or stretching them out. One unquantifiable aspect of the impact of DRIE assistance programs is that approved IRDP projects gave the banks "comfort" and they were more amenable to extending loans or lines of credit. Canadian banks do not fully understand the process of technological development and their role as partners in the process.

This stretchout of investment programs is not the result of tight money as the researcher's knowledge of the companies in the sector suggests that they have been doing very well financially. The sector invested heavily until about 1987 but now is pre-occupied with pushing product out the door.

4.3 Research and Development

The National Science & Engineering Research Council of Canada in its March, 1989 Strategy Document - The Challenge to Canada, Ten years to 2000 quotes:

> "If an advantage over competitors is to be gained, a technology must be adopted early in its life cycle, and then adapted or improved. The ability to do so is dependent upon the existence of a well developed scientific and technological base. It is also critically related to adequate numbers of highly trained and specialized personnel who are aware of current developments. They must have the expertise needed to invent or enhance technologies and where technology acquisition is necessary the capability of identifying and adapting the needed product, process or system".

These comments apply in no small measure to the TDM sector.

4.3.1 Research and Development-Innovation

Companies in the TDM sector are involving themselves in meaningful R&D. Ten of the thirty-four companies interviewed reported meaningful R&D activities. Funding allocated to R&D programs covered a range of amounts from ½% of gross sales to 4% with one company reporting a higher level. Analysis indicates these companies have an employment of 40 or more people and one or two people are dedicated to R&D.

The nature of the R&D being undertaken covers a broad spectrum of projects, which include software, optical systems, material stretch characteristics in dies, special tooling, plastic foaming and molding processes using new type polymers, and parameters for standardization. A significant portion of the effort is directed to plastics as this is a newer product and the technology is evolving rapidly. In this regard several companies were working on laminates and particularly researching the compatibility of steels and plastics in various configurations. The molding industry is relatively young as it did not start to develop rapidly until the early 1960s.

Companies identified their priority areas for R&D as being (in order of priorities indicated):

- improving their product;
- improving their production processes;
- adding value to their product;
- developing new product technology.

4.3.2 Applied Engineering & Development

Over and above innovation, most companies commented on their efforts to improve their work practices with a view to improve their image and their product. These were not specific projects but rather a continuing process tied to employee training and attitudes, improving investment priorities and criteria and some limited statistical analysis.

Companies indicated these activities were necessary as a part of their commitment to improving the quality of their product and staying competitive. Canadian TDM companies have invested heavily in CAD, CAM, FMS (flexible manufacturing systems), and significant procurements of special equipment such as EDM and CMM.

The objective was to improve the quality and precision of their dies, molds, etc. This tooling produces a better product. Errors are reduced by virtue of computer control and defect rates also decrease as a result. New tryout facilities have given clients greater assurance that the tooling will perform to specification. As computer skills are enhanced in the areas of design, modelling and simulation the need for tryout capability will be reduced.

These investments have given Canadian companies a significant edge in the export market. So much so that during the time of the recession American TDM companies lodged an official complaint with the American International Trade Commission (ITC) claiming that Canadian companies had an unfair competitive advantage using these state-of-the-art machine tools - machine tools that had been procured using government programs such as the ILAP. Ultimately, the ITC ruled that an unfair advantage had not resulted.

Canadian companies report they made a significant effort in educating their employees in improving accuracy and reducing errors using CAM and CNC. When coupled with more stringent QC (quality control) procedures the product is excellent. Detailed attention to production scheduling is also helping although the interviews identified that some companies had not made a commitment to this latter point.

Companies identified significant effort to increase life expectancy where this was justified even though there may have been a cost penalty. These efforts started with improving designs and then if applicable and suitable using plasma sprays, chrome alloy overlays and various other coatings as well as induction heating and exotic heat treat processes.

The product is good and reports from the U.S. confirm this.

In view of the orientations of management and the technical capabilities considerably more effort and progress has been achieved by the evolution of improvements then have been achieved by innovation. Advanced manufacturing technologies such as CAD and CAM give the companies more flexibility, permit a more varied product line and allow far greater product customization. This has given Canadian companies competitive advantages.

4.4 Forthcoming Technological Requirements

During the interview stage a question was asked as to what technological advancements the companies anticipated and would prepare for in the next 3 to 5 years. One could arrive at certain assumptions but there were a broad spectrum of interesting expectations.

Foremost, companies expected further advancements in advanced manufacturing technologies with 21 of 31 companies indicating this. AMT was expected to require further investment. Evolving technologies such as lasers, laser blanking, wire EDM and planetary EDM wire were identified. Companies were resigned to the fact that AMT would be the continuing investment priority.

17 out of 31 companies identified human resource skills advancement as a high priority requirement. It was anticipated that skills of a higher order of magnitude would be required. More specialization in AMT, CAD, SPC, engineering, QA and computerization in general were part of the comments together with more emphasis on youth, communication skills,

higher levels of skills and special skills that the average journeyman today would require. The availability of highly trained and better educated personnel were considered an imperative for the future.

New product technology was identified by 15 out of 31 companies as essential. Expectations were that they would have to consider plastic prototype tooling, plastic/steel sandwich construction, foaming of plastic and polymers, exotic materials in molds and dies for durability. It is expected that some of these technological advancements would result from closer working relationships between the client and the TDM company.

Twelve of the companies identified better communications with their clients and their suppliers as being an important short term development. The rationale was that on-line ordering, matériel expediting and tracing etc., had to show a quantum improvement if the clients expectations on just-in-time delivery and QA were to be met. In the longer term this was essential for client development.

With the accelerated rate of technological development the availability of all the required technical information and technology places a major burden on small companies. Companies below a certain size need help either from their association or from some dedicated agency.

Companies identified the following approaches for resolving production technology needs (largest no. of companies first):-

- determine how your competition is resolving problem (copying);
- investment;
- strategic partnering - outsourcing, sub-contracting, co-operation on production etc.;
- licensing a process;
- foregoing the opportunity.

While about 25% of the companies indicated that they would walk away from an opportunity if they did not have the equipment or the capability, they did express concern about their client relations and the reaction about competitiveness. Some indicated they would consider modifying their product line as an expedient.

In the case of product technology deficiencies the importance of various items changed. The resolution would include the following considerations:

- offer equivalent technology (copying);
- walk away from the opportunity;
- joint venture with a competitor;
- license.

The major North American automotive assemblers have expressed an interest in having their component producers supply total systems (black boxes). To do this component suppliers would have to do product research and

systems engineering as well as taking full responsibility for the system. Many of the component suppliers are too small and cannot accede to this requirement. There is interest however by the TDM companies to work out arrangements for supporting the component producers.

In this regard the interests expressed (in order of interest) were as follows:

- increase engineering capability to do die and mold engineering design to work with parts producers;
- form strategic partnerships/working arrangements with auto parts producers to enhance the auto parts producers position in responding to the assembly requirements;
- develop/acquire production systems to do some of the "black box" requirement;
- develop proprietary designs in association with the parts producer;
- buy-in engineering capability.

The interviews determined that some companies would still prefer to do business in the traditional manner - responding to a client requirements by building to print etc., however there is a growing realization that - that era is gone and that the TDM company has to go out and market its capability.

There is an appreciation that the commercial relationships must change. The response to the automotive assemblers' evolving requirements is seen as an opportunity to carve out market niches. Appreciating the requirement for technology, companies today must make judgements as to whether they develop or acquire. The responses signaled that companies were split 50-50 on the last approach. An equal number would develop as opposed to buying-in engineering capability. Buying-in may be quicker and safer but you still do not control your own destiny.

Companies appeared ready to work together addressing the technology expectations. It's a question of identifying suitable working partners.

4.5 Observations

The Canadian economy is in a state of transition. With an increased emphasis on technology by both large and small companies in the transition to a more knowledge based economy TDM companies are experiencing very significant changes in the way they do business. As small businesses, with limited managerial capability, the changes taking place in many instances are traumatic as a result of the information gap. Small companies cannot keep abreast of all the changes and taking advantage of these changes without somebody sorting, identifying and priorizing the more relevant changes for them.

The sector has demonstrated a propensity to invest. As small business, companies have made major investments. As a job shop sector there has been a good acceptance of technology. There is a realization that they

must use it or fail. They appreciate the cost of upgrading their technological capabilities as they have been bearing them for the last seven years. The technological weakness are being strengthened.

As a sector that has developed by responding to client requirements for a commodity they have become quite parochial. They want to keep doing the same thing. However, the industrial environment is changing causing companies to move away from traditional approaches.

Companies must become more focussed in what they do. They must organize to respond to demand and even anticipate and initiate changes in the demand. More specialization is indicated. Some companies have gone the route of being "Small Specialized" shops. Vendor relationships are changing. More out-sourcing is the new custom. Do what you do best.

Sophistication is the credo, yet flexibility is the modus operandi. Closer client relations demand this; a customer with a problem wants to speak with the individual responsible, and not the sales department. Organizations must change to facilitate this. The organizational structure flattens out and becomes more horizontal. With fewer people in manufacturing, the employees must become multi-functional, they must be better educated, highly trained and must be highly motivated.

While the Canadian environment at present does not appear to place a high value on productivity or to encourage productivity improvement the TDM sector has at least recognized one aspect of this. This is the use of state-of-the-art production equipment. In general, the progressive Canadian shops are better equipped than most like shops around the world.

Having operated in a responsive mode through time companies have not developed a significant capability for research and development. There are indications that this is changing. More progressive shops have or are considering active R&D programs. This augers well for the future.

5.0 Human Resource Skills Requirements

The TDM sector is dependent on highly skilled tradespeople. These skills are realized after extensive training as apprentices building on good educational backgrounds at the high school and community college level. The ultimate know-how is only achieved after years of exposure to actual client requirements on the TDM shop floor.

Today the rapid technological changes being encountered are impacting strongly on the know-how achieved after years of effort by imposing an overlay of computer skills that have come to the fore in the last decade. Advanced manufacturing technologies are initiating an era of product customization demanding high quality and outstanding performance at minimum cost. Markets, because of computerization, are breaking out into smaller segments, - niche markets. Product life cycles are getting shorter, product complexity is increasing - and yet the TDM sector is providing better quality products that provide improved performance.

Manufacturing matters. The application of microelectronics is revolutionizing the production processes. Canadian companies and the people who are the companies must maintain the competitiveness of the processes. This competitiveness to date has been achieved by highly skilled tradespeople and innovative management - not paradigms, perspectives and discourses on conventional economics. It remains to be seen whether the sector can maintain its position.

5.1 Skills Required and the Supply Situation

The TDM sector as an employer of skilled tradespeople has been able to hold the skilled person once he has established his credentials. The rates of pay have been good and with overtime the annual gross salaries have been high.

Twenty four companies reported data for rates of employee turnover. Over 50 per cent of these reported turnover rates of 5-6 per cent. Two relatively young companies reported rates in excess of 15 per cent. When the reasons for leaving are reviewed retirement accounts for a significant part of the turnover rate. The sector has an aging work force.

The skilled people working in the sector include:

- technicians used for design, computer programming, quality assurance and procurement;
- supervisors and group leaders;
- machinists (NC/CNC);
- mold makers;
- tool makers;
- die makers; and
- welders.

Companies also reported using polishers, engravers and bench men. A small number of companies reported employing graduate engineers. Generally it was one engineer and in many instances was the owner/manager.

Twenty four of twenty six companies reported serious difficulty in recruiting skilled tradespeople. Reasons indicated for this short supply included:

- just not available (20 companies);
- sudden increase in requirement (4 companies);

Furthermore 23 of the companies indicated it was more difficult to recruit skilled people today than it was a year ago. Three indicated it was about the same. Reasons given for the problems with recruitment included:

- the supply dried up;
- very active economy;
- smaller community college graduating classes; and
- lack of apprentices for training.

It was reported that Class A journeymen were most difficult to find followed by technicians, engineers and machinists (in that order).

Many companies reported that their expansion plans were on hold due to shortages of skilled people. There was no justification for investing if people were not available to run the new machines.

When asked the question as to why trained people were not available a certain pattern of responses was evident. Reasons given included:

- immigration cut off;
- increased demand;
- companies not training adequate numbers of people;
- big companies don't train;
- low awareness of the TDM sector as a good employer; and
- declining availability of apprentices for training.

There was dissatisfaction with Canadian immigration regulations. Historically the sector has met most of its skilled people requirements by immigration. Suddenly the government had cut off this avenue of supply and was permitting large scale immigration at the lower end of the skills spectrum. There is little appreciation of the fact that Canada can't attract the skilled tradesmen from Europe that we have in the past because their own countries are now more prosperous relative to Canada. As a result the main source of future immigrants is likely to be from less industrialized countries - and there will be a need for more training here. The problem is compounded by the fact that the economy is entering its seventh year of sustained growth and all the slack has been taken up.

In confirmation of the above Employment and Immigration Canada (EIC) in Catalogue # MP22-1/1986 show the following "Intended Destinations" for immigrants with metal machining skills (machinists, journeymen, etc.) landing in Canada in 1986.

Ontario	406
Quebec	85
Alberta	45
British Columbia	36
Others	37
Total	609

While EIC doesn't provide an exact indication of the Country of Last Permanent Residence for these immigrants some indication of the origins is provided in data showing the country of Last Permanent Residence by Intended Occupation. The metal machining category is lumped in with metal shaping and forming for a total of 1316 immigrants. Forty three per cent were in the machinist related skills.

These immigrants came from the following countries in 1986:

Poland	185
Vietnam	143
Guyana	85
England	78
India	67
El Salvador	57
Others	701
Total	1316

When we examine immigration from other traditional sources we find the following in the 701 others shown above:

Czechoslovakia	30
Germany	23
France	12
Italy	12
Ireland	7

Immigration of tool, die and mold makers and machinists was as follows:

SOC NO. -		'81	'82	'83	'84	'85	'86*
8311	Tool, die mold						
	Permanent visas	166	55	36	40	33	46
	Employment visas	32	23	15	38	70	104
8313	Machinists						
	Permanent visas	405	315	85	77	109	
	Employment visas	155	135	160	346	199	

Source: C.O.P.S. Databank, EIC

* estimate
- Standard Occupational Code Number

The possibility exists that many of these immigrants would not meet the high skills requirement of the TDM sector and were assimilated by machine shops, assembly shops and other like activities.

It is evident that many of these people came to Canada for political as much as for familial and economic reasons. Suffice it to say that immigration does not appear to offer a quick fix for the present problem of skills shortage as the immigrant if he is available still has to acclimatize to the Canadian culture and probably is in need of training over and above the language consideration.

The demand for skilled people follows the level of economic activity. At this time, while there are indications there is some slackening in the activity the economic projections are still quite positive suggesting that there will be no opportunity for the supply to catch up with the demand.

During the interviews companies indicated their training preferences. These preferences were:

i) retraining certain employees;
ii) training apprentices; and
iii) upgrading semi-skilled workers.

The reasons indicated for this ordering were that managements felt an obligation to their employees to keep developing and advancing them. Furthermore the cost of retraining was considerably less. The existing employee was a known quantity and a safer bet.

While the apprentice situation will be discussed in more detail in the next section, suffice it to say that employers find that the risk of losing apprentices is high. The investment in training an apprentice could be as much as $30-40,000 with the heavy cost being at the front end

of the training cycle. Tied to this is a conviction that large companies do not train recruits but rather endeavour to recruit trained people. While this may be true in some instances the likelihood exists that the training priorities are different and are not clearly understood. Generally a big company has a better benefits package and offers - in the eyes of the recruit - a better work environment.

However the interviews indicated that there was a disenchantment on the part of some TDM companies about training and this was tempering their decisions on training. More pertinent to the situation was that the TDM sector was not looked on in high regard as a good place to work. Companies acknowledged that there was a low awareness and perception that the TDM sector companies were good employers. This impacts on the availability of new apprentices. Indications also point to the fact that if employees leave the TDM sector the likelihood exists that they will not return.

The acuteness of the supply problem varied from area to area. Cities like Windsor, Montreal and others had severe shortages. In other instances the demand/supply situation was in balance. The findings indicated that the mobility of the tradespeople was quite limited. The tradespeople had made choices as to which community they wished to live in and stayed there.

In cities such as Windsor where the population of TDM companies was large the competition for skilled people was fierce. Apprentices and younger workers were inclined to move around trying to capitalize on the greatest reward available. In locations where the TDM company population was small the tradespeople tended to lock in with a company and stay. Companies indicated a strong commitment to keeping and protecting their employees.

A review of the benefits packages provided employees indicated significant similarities. Medical benefits were available. About 85 per cent of the companies absorbed the total premium cost. The remainder picked up at least 50 per cent of the cost. The situation was about the same with dental plans, and life insurance benefits.

Vacation entitlements as a minimum followed the legislated requirements. Some companies provided additional statutory holidays and other expedients of this nature.

Social programs for the employees including such items as picnics, Christmas parties for the children, organized and sponsored sports activities, etc. were universal. Management in general was very supportive of these.

There was a significant departure from the norm on pension plans. Only half the companies offered employees the benefit of a pension plan. About 30 per cent of the companies providing a plan paid the full cost of the pension plan. The remainder shared the cost.

The companies not providing a pension plan, as an alternative, provided a profit sharing or a bonus plan. The onus was on the employee to look after his own pension requirements. The 1989 CTMA Wage and Fringe Benefit Survey reported similar ratios and circumstances.

Wage rates generally in 1988 were in the $16.00 to $20.00 range depending on classification and experience. Overtime was available in almost unlimited quantities as companies pushed product out the door. Companies considered that their wages scales were better than wage scales in auto parts plants and higher than their competition on the American side.

Employment and Immigration Canada in their 1988-1989 edition of Job Futures - An Occupational Outlook to 1995 provide the following data on employment trends and projections for tool, die and mold makers etc.

Canadian Employment
(Standard Occupational Code No. 8311)

1981	12,400	
1986	12,100	(annual Growth Rate is 1.7% in the
1995	14,100	period 1987-95)

The 1986 figures reflect the impact of the 1982/83 recession. Today the employment has surpassed the 1981 total. Tradespeople working in the TDM sector have been subsumed into these totals.

Projected job openings are as follows:

	1987-95	% of 1987 jobs
Net new job openings	1800	14.8
Replacement openings	8000	65.1
Total job openings	9800	79.9

The replacement openings reflect the situation to be faced as a result of the aging work force as well as losses to other occupations. The challenge is to adequately fill the 8000 replacement opportunities which translates into an annual demand of 1,000 skilled tradespeople.

Machinists (SOC #8313) show similar projection patterns except the population is about 42,000 and the average projected annual growth rate is only 1.3 per cent.

5.2 Recruitment and Training of Apprentices

Traditionally the training of skilled tradespeople has been accomplished by apprenticing. Most of Canada's skilled trades people in the older age category probably received their apprenticeship training in Europe and were instrumental in making the Canadian TDM sector a strong and viable activity.

Until 1982 significant numbers of these tradespeople emigrated to Canada. In 1982 with the recession and high rates of unemployment the "Open Occupations" list was suspended and the immigration regulations were changed substantially. Simultaneously improved economic conditions in Europe reduced the attractiveness of Canada as an emigration destination.

While the TDM sector traditionally has trained apprentices a full commitment to training did not exist and a skills shortfall commenced. The rates of completion of apprenticeship training has done little to increase the available supply. Apprenticeship completions were as follows:

	'81	'82	'83	'84	'85	'86
Tool, Die, Mold Makers	50	154	156	332	328	35
Machinists	74	429	283	713	686	186

Source: C.O.P.S. Databank, EIC

Smaller numbers of tradespeople also became available from the post-secondary educational system (about 150 per year).

While the system responded to the new employment opportunities in 1984 and 1985, the supply pipeline went dry in 1986 as a result of the recession in 1982/83 and the layoffs of apprentices and other trainees at that time. With a four year training cycle it is difficult to ramp up quickly. As a result hundreds of tradespeople were not trained and aren't available to the system today.

During the interval other factors started to impact on the supply situation. The replacement requirements of aging tool, die and mold makers began to absorb new entrants to this occupational classification. The 1981 census indicated that 18 per cent of these workers were over age 54.

New technologies as a result of the major incursion of the computer placed many of the older workers under duress. In the mean time small companies were being formed in large numbers. As these shops tend to specialize in custom work they require highly skilled tradespeople. As a result these companies absorbed large numbers of tradespeople as foremen, QA specialists and many other activities. This is an upgrade of the journeyman category. These skilled people do not return to their previous trades. This results in a perpetuation of the skills shortage in the TDM and allied sectors.

At this time the apprenticeship process shows serious signs of stress. The flow of new recruits has dropped badly. TDM companies identified certain reasons for this. Research done by EIC and the Ontario Ministry of Skills Development confirmed these and uncovered others. The reasons identified included the following:

- changes in labour force composition;
- altered demographic trends;
- failure of TDM sector to attract recruits;
- industry started to demand higher educational requirements;
- familial pressures;
- low status of blue collar occupations;
- greater demand for apprentices by small business; and
- misdirection of educational priorities.

Changes in the labour force composition were brought on in large measure by computerization. With the introduction of CAD, CAM and direct numerical control (DNC) the traditional relationships on the shop floor began to change. Computer programmers and designers changed the responsibilities of machinists and the tradespeople. Programmers generally are much younger and have the advantage of being computer literate. When teamed with good tradespeople the aspect of work teams comes into play. Trends to subcontracting by large companies such as the automotive assemblers puts further stress on the process.

The lower birth rates in the '60s has altered the demographic trend by reducing the numbers of potential candidates for apprenticeship. The smaller supply of potential apprentices is being fragmented by new demands for apprentices. For instance the sophistication of today's automobile engines requires computer trained mechanics for service work. This occupation also may have more appeal than TDM apprenticing.

The TDM sector as well as other sectors have not been pro-active in selling the TDM activity as being a good vocation. This failure to attract recruits in significant numbers exacerbates the situation because there is only a small reservoir of trainees to choose from when companies indicate a desire to train people. Aspiring apprentices have many options to choose from. As a consequence each sector must promote the merits of its activity.

With the onslaught of technological change companies realized that they needed higher educational levels on the part of their employees, particularly their newer employees. Companies started to specify higher educational standards. A requirement for grade twelve or thirteen became the norm. During the interview process for this review it became apparent that many companies would only take recruits with grade twelve or thirteen if they could not attract suitable community college graduates. Companies were raising their requirements in the realization that as technology requirements increased the calibre of their staff educationally had to be upgraded.

Parental expectations for their children are having a major impact on this process. Parents are taking the attitude that they have worked long and hard to achieve a certain lifestyle. They do not want their offspring to go through the same process. These familial pressures are causing many youths to stay in the educational process longer going to college or university. Their ultimate aspirations do not include working in a plant, even though it may be bright, clean, and well run providing an excellent work environment and a challenging life vocation.

The public at large tends to attribute a low status to a blue collar occupation. Skilled tradespeople are accorded status in the community in Europe in recognition of their accomplishment. This is not the case in North America. The perception is that you will get your hands dirty and therefore you should strive towards an office or selling occupation even though your talents are more mechanically inclined and you would enjoy the challenge of creating with your hands.

There have been significant numbers of small manufacturing companies formed in the last 5-6 years. With the trend to subcontracting entrepreneurs see new opportunities to exploit. This trend towards small businesses in manufacturing and particularly as these shops specialize in customized low-volume work means they require highly skilled multifunctional tradespeople. Small companies traditionally also do a large portion of the skills training because these apprentices can meet their requirements at a lower labour rate. This demand for apprentices by small businesses reduces the pool of potential apprenticeship recruits for the TDM sector. These apprentices in small business when teamed up with skilled tradespeople however provide a substantial benefit to the economy.

Companies taking on apprentices are looking for bright high school graduates with versatility as a minimum . The high school system however as a result of streaming is directing these youths to the professions. Companies complained vociferously that this misdirection of educational priorities together with undue emphasis on electives results in a large proportion of students who cannot cope with the demands of higher education being channeled into apprenticing. The system does not seem to realize that students who have problems coping with higher education also have problems with training for skills in TDM.

The remuneration for apprentices does not appear to be attractive to recruits. Surveys indicate that wage scales for apprentices for 1989 fall into the following ranges:

	Range	Average
First year	$6.00 to $11.00/hr.	$ 7.50
Second year	7.50 to 11.50	9.50
Third year	8.50 to 17.00	11.50
Fourth year	10.00 to 18.00	14.00

Minimum rates are legislated but companies find it necessary to exceed these depending on the competitive situation and the attitude displayed in various locations. Legislation generally stipulates a percentage of the average journeyman rates which currently, depending on the experience, are in the $16.00 to $20.00 range.

The risk of unemployment for apprentices is high as they tend to be the first to be laid off in times of economic adversity.

These aspects when added to the negative social attitudes towards the trades makes recruitment very difficult.

Even if a company succeeds in recruiting apprentices the drop out rate is about 50 percent. During the interviews companies were indicating drop out rates as high as 75 percent in the case of apprentices coming out of high schools. These high rates suggest that many of the resources spent on training are not bearing fruit. The industry sector fails to realize the benefit of its investment in people, and, the workers once they leave are assimilated elsewhere, generally never to return without realizing the full benefit of the training received.

The main reasons for the high turnover appear to be the inability to cope with the training regime, peer pressure - friends getting higher paid jobs in lesser skilled disciplines - and economic pressures - inadequate pay to cope with rising expectations having to do with girl friends, marriage and a new family. These aspects of job security, training difficulties and wages must be re-examined by industry.

Retraining and upgrading of existing employees on the other hand assures a better return on the investment in the employee, makes for a more contented employee as a result of management's interest in him and facilitates a progression of advancement on the shop floor. This accounts for the training preference ranking.

5.3 Government Funded Training Programs

Companies in the TDM sector have relied heavily on government support over a long period of time and would like to see the levels of support increased . This aspect when coupled with a reliance on immigration to meet their requirements has mitigated against the development of an ingrained "training culture". Companies are still not accepting the argument that irrespective of what government does they have to put a regime in place which will assure them of a reasonable supply of skilled tradespeople.

All companies interviewed advised that they relied on apprenticeship training support. Other special programs are accessed when they are available.

Joint Federal/Provincial programs such as the Canada/Ontario Agreement on Training have played an important role in meeting the need for skills development and upgrading. Companies and government representatives will argue that these funding levels are inadequate. This may be the case but until companies make a stronger commitment to skills training additional funding will not bring a commensurate return. The Community Industrial Training Committees (CITC) have achieved varying levels of success.

Other elements of the Federal EIC Canadian Jobs Strategy (CJS) programs have had limited application in the TDM sector. The thrust of various elements of the CJS have been difficult to access. Small companies in the sector complain of inadequacy of funds and that large corporations draw down available funds before small companies are aware of the circumstances.

TDM companies responding to the questions as to whether the initial level of skills of high school graduates and community college graduates met their expectations demonstrated a 2:1 bias in favour of the community college graduate. Reasons cited included lack of adequate mathematics, science and communication skills on the part of the high school graduate. They viewed the community college as a finishing school for the high school graduates as they received more theory on relevant subjects. The recurring complaint however was that even the college graduate had inadequate and insufficient practical experience and training.

The above signals that a higher level of skills in theory etc. are necessary if apprentices are going to meet the skills requirements demanded by the burgeoning technological advances.

Consultations with community colleges indicate that they do not have the capital resources to procure state-of-the-art equipment for training purposes. This is further compounded by the fact that the plethora of machining skills required by industry just cannot be addressed.

Accordingly the division of responsibility that is evolving is that the colleges will address the aspects of theory and some very basic machining skills. It follows that the role of companies will be to teach the machining skills and know-how specifically targetted for their specific operations. While an indication was identified that certain CITCs (Wallaceburg) were succeeding in getting high schools to teach some technical subjects this was only a beginning but if it could be fostered then the community colleges could pick up from there and advance the level of practical training they provided. Colleges were meeting with various levels of success in this regard. Colleges who had co-operative programs were succeeding better in providing more advanced practical training as a result of joint industry/college training programs.

There is however a need for more rationalization on the part of community colleges. They are complaining they do not have enough TDM apprentices for training. This is further exacerbated by the fact that the Ministry of Skills Development cancels courses if registration does not reach certain minimum levels. A greater need for co-ordination is needed with perhaps fewer colleges involved but with more specialization and better instructors. Under current regimes (with cancellations etc.) instructors are not keeping abreast of technology trends, particularly in diemaking where the technological evolution is more dynamic.

The applicability of the skills upgrading courses offered by CITCs to the needs of the particular requirements of a company depended to a considerable extent on the industrial infrastructure of the community. For instance KITAC - the Kent Industrial Training Advisory Committee - offers skills training courses heavily oriented to agriculture. The TDM companies in the area would only benefit from some of the CAD/CAM and computer literacy instruction.

It follows that in areas with a significant TDM company population they should strive to be well represented on the CITC to make sure that they were afforded a high representative number of relevant courses.

Until now there has been a reticence by universities and colleges to accept each others' credits for training successfully completed. This has made it difficult for a student who on completion of the college curriculum for skills training and deciding to further his education to build on his completed studies and proceed to a technical degree in a university. It is noted that various junior colleges and universities in the U.S. have developed working arrangements. Durham College of Oshawa is holding like discussions at this time. This is very timely and appropriate as the TDM sector has a deficiency in engineering capability if it is to meet the technological challenge being encountered at this time.

The CITCs and various communities are coming forward with innovative suggestions as to how the training process can be speeded up. One such concept is the School-Workplace Apprenticeship Program (SWAP). The SWAP will allow students who are at least 16 years old and have completed grade 10 to work as apprentices and at the same time complete the requirements for the Ontario Secondary School Diploma. Such students would be considered both a full-time student and a full-time employee. The school portion of the program is tailored to reflect the requirements of the specific skilled trade in which the student is apprenticed, but at the same time it ensures that the student meets the requirements of the school system. These arrangements have to be negotiated with the school boards.

Students work as apprentices under contract and must be paid according to the Apprenticeship Act regulations. The objective is to have students start at an earlier age and by working during school vacations and holiday periods to build up apprenticeship hours so that by the time they graduate from high school they will have completed a considerable part of their apprenticeship training.

5.4 Observations

The quantum advances in technology demanding higher levels of skills have TDM firms under duress. There is a severe shortage of skilled tradespeople which is impacting negatively on the sector's ability to meet the market demand and at the same time train people.

The new era of "high performance manufacturing" as Ken Jones, president of the Ontario Centre for Advanced Manufacturing calls it, is exerting pressures on the TDM companies beyond their expectations. The need to fully understand statistical process control (SPC) in order to produce dies and molds that will produce a better quality product, the objectives of synchronous manufacturing (JIT) facilitating shorter lead times and improved responsiveness to the client, the prevention of defects, etc. are important requirements on the shop floor today.

Through the application of basic concepts to the production of dies and molds to assure that these dies and molds meet total quality control in the product they produce the TDM sector is demonstrating that it has mastered the base technologies. They have through significant investment and extensive training of their employees progressed well down the road

mastering advanced technologies such as CAD/CAM/CAE/CNC/DNC etc. Work remains to be done on database management and manufacturing information systems, which will assist them in the integration of the advanced technologies for further productivity advances, as well as preparing for new technologies which unquestionably are coming down the line.

Most TDM companies do not have the engineering expertise to anticipate these new requirements and are responding to the market demand as best they can. This becomes difficult under present circumstances with extreme shortages of skilled tradespeople.

There is a need to raise the level of engineering competence and to increase the supply of the various skills levels required in TDM shops. It appears that present practices and procedures are not meeting this need. The requirements have changed very quickly since 1982/83 and many management approaches have to be improved and changed accordingly. The concept of simultaneous engineering is not understood completely resulting in long completion schedules on complex dies and molds.

The changes required on the shop floor are a high priority but with the involvement of management and workers as teams of experts the problems can be identified and addressed. The problem of recruiting and training people is not as easy. It is recognized that companies are not doing enough training. Work done by the Ontario Ministry of Skills Development indicates the following data for training done by goods production companies:

Per cent of Small and Medium Sized Firms with Formal Training Programs for 1987

By Employment Size	Per cent of Firms
1-19 employees	23.6%
20-49 employees	52.6%
50-199 employees	60.8%

While a break out isn't available for TDM companies the expectation is that the percentages shown above are higher for TDM. The point is - how many companies are not training tradespeople and should be? How many companies are not using their training resources to advantage because of lack of trainers and good programs?

The perception signalled by the TDM companies interviewed is that they were held in low esteem as employers by the public at large. These perceptions may exist because of limited knowledge of the total situation. The TDM sector has to start helping itself by changing the public's perception.

A study completed in April 1989 by the Kitchener, Waterloo & Guelph Training Advisory Council on Skilled Trades and Career Selection provides some interesting insights. Some of these were as follows:

- 84.5 per cent of parents/guardians expect their children to go to university when they leave high school.
- 43.1 per cent of parents considered that the advice of teachers and school counsellors will be most influential in helping the child decide what to do after high school.
- 71.2 per cent of parents indicated that it was not likely that they would recommend that their child investigate prospects of being a machinist. (70.3 per cent thought similarly for tool and die making)
- 65.8 per cent of employers considered women as capable as men in the skilled trades related to their business.
- 74.8 percent of employers agreed that students know very little about apprenticeship programs.
- 81.1 percent of students thought there are good opportunities in skilled trades.
- 49.5 percent of students relied on teachers/counsellors for help in course selection and 43.6 percent on family members for advice on course selection.

It is apparent that there is an awareness problem. The TDM sector must address this question immediately. An important aspect of this would be the organization of a strong Image and Education Committee by the CTMA and allied associations.

The CTMA, the mold makers section of SPI and the Windsor Alliance of Mold Makers, should combine forces in addressing this problem. The Machinery and Equipment Manufacturers Association (MEMAC), the Auto Parts Manufacturers Association (APMA) and several other manufacturing oriented associations should participate in this activity as well.

The TDM sector has not tapped a substantial pool of likely apprentices - women. With the increasing emphasis on computers and technology women could perform well in this environment. Women are the last big reservoir of TDM skills potential.

The high turn over rate of apprentices suggests that the remuneration being offered is not adequate to hold the youths with potential. The outlook of North American youth has changed. As compared to apprentices of 20-30 years ago its a "now society". They are not prepared to establish themselves from the viewpoint of skills. With job opportunities all around them paying higher wages for lesser skills they develop a negative attitude towards apprenticeship. While it is understandable that the TDM shops want to get a feel for the potential of a recruit it would seem that about 4-6 months should be adequate. At the end of this period an enhanced wage scale could kick in. The recruits are demonstrating the alternate options otherwise. They leave and the TDM shop loses its investment in the trainee.

There appears to be scope for innovation in the remuneration of machinists and tool, die and mold tradespeople. The skills of a good TDM tradesperson are of a considerably higher order of magnitude and yet from a wage standpoint there appears to be limited recognition of this. The pool of machinists is considerably larger than tool, die and mold makers - a ration of 2:1 - perhaps an incentive is required.

With the sector capacity saturated because of skills shortages, the training schedules should continue to have a high priority to accelerate the development of the people. Work schedules and priorities should be re-examined.

6.0 The Skills Situation in the TDM Sector

The TDM sector's success is extremely dependent on highly skilled tradespeople. Traditionally many of these people came from Europe looking for better employment opportunities. Today, however, economic conditions in Europe have improved substantially and the incentive to come to Canada for economic reasons is not there. Skilled immigrants only consider coming for familial or allied reasons. As a result this source of skills has decreased considerably in importance. Immigrants from Asia and South America are available but require more training and do not assimilate into the TDM environment as readily.

As a result of the heavy reliance on immigration to meet the skills requirements Canadian companies have not developed a "training culture". The consequence of this is that companies have not developed awareness programs to attract good apprentices and to keep them in the system.

The facility for strategically planning their human resource requirements has not been refined. The sector as a whole is not identifying its future people requirements on a planned basis and is reacting after the fact rather then planning and scheduling training.

Today it appears to be paying a substantial penalty for this planning deficiency.

6.1 Impact on TDM Sector

The TDM sector saturated its labour capacity in 1986. The increment of increase in the value added component of shipments was only 6.9 percent for 1986 compared to 29.1 percent for 1985. When the correction for inflation is made, essentially the sector was stagnant. Preliminary estimates for 1987 suggest the sector regressed.

Exports for 1986 were maintained but after correcting for inflation the 1987 figures show a decrease of about 3 percent with 1988 showing a further 18 percent decrease. This suggests a significant loss of foreign markets that had been initially won on the basis of product quality and price competitiveness.

At the same time imports into Canada began to show a major increase. Since the recession of 1982/83 imports had been increasing nominally about 20 percent per year. In 1987 the increase in imports was 62.4 percent with a further 55.8 per cent in 1988. Effectively imports increased by $2\frac{1}{2}$ times in 2 years. The consequence of this is that foreign competitors are being permitted to establish a strong foothold in the Canadian market. While it can be argued that some of the increase is attributable to the import of special transfer dies for the stamping of skins for automobiles this upon analysis accounts for only a small portion of the imports. Immigrant automotive assembly plants are going to require replacement tooling. Canadian TDM companies will not be able to respond as they are servicing their other clients.

The TDM sector has made significant investments for new production equipment and technologies, new plants and plant modernizations and cannot generate the volumes to capitalize on these capital expenditures.

The aging labour force is being asked to work significant amounts of overtime. Older employees do not have the stamina to maintain this pace over extended periods of time. Efficiency and productivity starts to drop off. To compound the problem training and retraining is being delayed to meet delivery commitments to clients. This only exacerbates the problem.

The planning for and development of new products and manufacturing techniques suffers due to lack of people which ultimately will reduce the competitiveness of the product.

Initially cash flows and profits will be good but quickly competitiveness will suffer, foreign markets will erode and foreign competition will entrench itself in the Canadian market. The foreign competition initially has to buy a market position causing price and profit erosion.

This latter point implies a significant departure from the historical experience. Part of the domestic suppliers' strength was proximity to the client. With electronic communications and the ability to transmit digitized technical data proximity is not as important as it once was. Auto assemblers are developing their production capabilities and capacity in specific instances on the basis of imported dies and molds. If they feel a constraint it's on the question of being able to maintain this imported tooling.

Doing repair work, while it can be very profitable, does not develop new skills or capabilities. The development of the capability resides at the source, designing and producing new dies and molds. This is where the process of innovation can be fostered and can grow. Most journeymen do not understand the process of innovation fully. The major reason would be limited technology training. While the incorporation of engineering skills appears difficult under today's business conditions it is essential. Only the TDM companies that are strong in technical skills and good management will continue to grow. Each company must have a program of injecting new international technologies to stay abreast of the rapidly changing technological picture world-wide. The TDM sector is now computing in a world market and must manage itself accordingly, keeping abreast of mold trends by visiting international shows and fairs.

The TDM sector will suffer competitively as a result of limited design and engineering capability. Today's sophisticated client wants an all-inclusive package.

Suppliers to the TDM sector will suffer due to reduced volume. The consequence initially is increased costs and ultimately the demise of some of the supply houses with the reduction of supply capability.

The sector must re-establish its initiative and strong market position or:

- its plants will quickly go obsolete through lack of new investment;
- costs will increase due to volume considerations;
- foreign markets will atrophy;
- foreign competition will entrench itself in the Canadian market place;
- the development of individual employee skills will slow down and eventually stop;
- the sector will not be able to maintain its technological edge.

Top priority must be given to the development of a skills strategy immediately.

6.2 Impact on the Automotive Parts Sector

The availability of state-of-the-art tooling is imperative. To this one must add adequate supplies of highly trained human resources if the economic performance of parts producers is to remain viable contributing fully to the competitiveness of the automobile sector. To this end workers and management must work together closely cooperating on the development of their human resource which is at the core of a good skills strategy.

Auto parts producers rely on many of the same skills as the TDM sector. If they have in-house capability to do set-up, maintenance of their tooling and the building of new tooling they must draw from the same overall labour pool as TDM companies. When a valuable commodity is in short supply its cost will increase whether it's in-house or contracted in.

Cost, read as increased cost, will be the major impact on the auto parts sector. Parts producers have more buying power and therefore can demand more attention (at a price). Obviously this starts to impact on competitiveness and profitability. Parts producers will be able to obtain their tooling from other sources. They will have to compete for delivery positions which will incur delays, frustration and inconvenience. They could find themselves in a seller's market when buying tooling as opposed to a buyer's market.

During the interview process TDM companies signalled strongly that even though the supply of skilled labour was going to be very tight product quality would not diminish. There was an indication of high integrity in protecting their own credibility on quality and protecting the interests of the client. Some of the impacts of skills shortages TDM companies perceived were as follows (in order of importance):

- loss of clients (already in progress);
- downsizing;
- investment in more automation;

- loss of skilled people (decrease in opportunities for advancement);
- increased costs; and
- change in line of business.

They acknowledged that if they did not have skilled people the client would buy product/tooling elsewhere or that the client would import product.

There is a cost associated with the changing of suppliers. New working relationships must be established. The parts company is at a disadvantage if they must make a change of suppliers under duress. Their negotiating position is weakened. The further away the supplier is geographically the greater the cost. Communications become more difficult, inspections become more time consuming, etc.. Proximity of the client to the supplier is a very important consideration. The farther the separation the costlier the procurement becomes.

Proximity also impacts beneficially on planning. The client and the supplier tend to be more in tune with each others requirements because they operate in the same milieu. Putting working relationships in place is easier. Mutual respect is enhanced. Strategic partnering, no matter what the ultimate working relationship, is facilitated.

The development of custom tooling is made more difficult if it is not possible to work with a TDM company in the community. The preparation of specifications and vetting of designs is complicated if a working relationship is not in place. Foreign companies may have different standards which could cause variations in designs. Foreign suppliers could be using a completely different standards regime. Adaptation is always done as an ultimate cost to the buyer.

Today technology is the motive power behind competitiveness. It is in the interest of the parts producer to work strategically with companies in close proximity to his operation when developing future technological and supply requirements as he will have more control over the dissemination of the technology. If he works with a foreign company today on the development of a new product/tooling he could find himself competing with an improved version of the development tomorrow.

If the TDM sector goes into decline as a result of skills shortage the impacts on the auto-parts producers will include:

- higher costs;
- reduction in the availability of skills for their own operations;
- necessity of dealing with smaller weaker TDM companies due to downsizing;
- potential technological lag in their tooling;
- have to cope with different design standards; and
- working with companies far removed from their operations.

6.3 Observations

The lack of skills will weaken and reduce the competitiveness of the TDM sector. This will tend to weaken all the client sectors they supply and destroy the uniqueness of tooling used by the secondary manufacturing sector in Canada. Effectively it will weaken secondary manufacturing in Canada.

The TDM sector is just starting to realize the seriousness of the plight it is in. It will lose clients, it will lose people and if it does not take remedial action quickly it will grow smaller as a sector.

The seriousness of the situation is accentuated by a reduction of its export market where it could test, on a continuing basis, its competitiveness on pricing, technology, and quality. The export market is an important component of its total market which is needed to generate volume and reduce costs.

The situation is further exacerbated by the significant increase in imports which will facilitate the entrenchment of foreign competitors in the Canadian market place. Some of this market may never be recovered.

There is no quick fix for the situation. While immigration could provide some relief the availability of suitably skilled immigrants is very small and hard to attract to Canada at this time.

Public awareness of the sector is at a very low level. Many potential recruits do not have enough information on what the sector has to offer them and select other apprenticeship programs. The TDM sector is not appreciative of the fact that it is part of a bigger problem and therefore should be combining forces with other sectors in a frontal attack on the skills shortage. To date it has done some talking, some procrastinating but only in isolated instances has it started to react and try to take remedial action. In actual fact companies are talking of opting out of the training activity instead of heavying up on it.

A focal point is not available around which the sector can rally and make strategic plans. As small business the sector is not inculcated with good strategic planning and currently is suffering the consequences. The CTMA and other associations should be front and centre in this activity but have been slow to react.

The associations need to form strong Image and Training Committees which in tandem with similar committees in other associations could undertake the much needed planning and negotiating.

The skills problem of the TDM sector is more severe than the problem of secondary manufacturing in general. This is due to the fact that the level of skills required by tool, die and mold makers is of a considerably higher order of magnitude than machinists, welders, etc.

The educational requirements must be considerably higher. Acquisition of these skills goes far beyond the completion of apprenticeships. It is a life's endeavour. With the aging of the existing work force these skills are being lost considerably faster than they can be acquired. The advent of the computer further complicates the requirements and relationships on the shop floor.

A large pool of labour has not been addressed - namely women. This should be changed immediately. There is a large pool/reservoir of skill potential if it is trained and used judicially.

The circumstances of wages and benefits should be revisited. Is the current level of remuneration an incentive to recruitment?

The problem needs a total effort to correct. This effort should include governments at various levels, academia, and the companies represented by their associations. Efforts must start immediately in view of the long apprenticeships required.

7.0 Industry Views on Approaches to Ameliorate Skills Shortages

Company managements had many ideas to put forward - some good, some better - as to how the total human resource training process in the sector should be modified to increase public awareness of the sector, how to attract apprenticeship recruits and how to keep apprentices in the training stream. The many ideas presented are outlined here in consolidated form commencing with the ideas put forward most frequently first. Many of the concepts were interrelated and have been combined for ease of presentation.

7.1 Company Views

Companies in the main considered that they should be responsible for training, particularly as the skills requirement varied from company to company depending on their area of specialization. The more frequent ideas presented include:

- Change the educational process - The current system of streaming of students in high schools was always addressed in a negative manner. Management generally considered that students often found themselves directed into areas which were contrary to their interests (i.e. everybody can't be a lawyer or a doctor). Students in the slower streams become frustrated and dropped out. The approach to electives was considered self defeating as students tended to take the easier subjects and ultimately found themselves lacking certain credits (mathematics, science, chemistry) for technical training. Lack of elementary shop training did not give students an opportunity to test their interest in that kind of vocation. School counsellors were not appropriately and fully briefed on the opportunities in manufacturing. Comments on community colleges generally were favourable except that the colleges were not properly equipped to provide practical shop training on state-of-the-art equipment.

- Need for Awareness Programs - The consensus suggests that the sector had not done a good job in publicizing itself, its interests and its importance to the Canadian economy. The need for awareness enhancement broke down into several distinct categories:

- the student;
- the parents and family;
- counsellors in high schools and colleges; and
- the public at large.

Suasion oriented publicity was considered necessary for the student, the family and the counsellor. This would outline the benefits of working in the sector, job satisfaction, opportunities for advancement, etc. Another emphasis was also suggested for all groups above outlining the importance of the sector to Canada, working conditions, the contribution one could make through involvement in the sector, and the recognition derived from an individual's or a company's achievements.

- Incentives for Training - Traditionally the sector has used government support to offset costs of training apprentices. This support only covers a small portion of the annual cost. The apprentice training cost is largely a front end cost with the first year of training being a write-off because the trainee puts very little back into the system. Somewhere in the third year the costs and the benefits start to come into balance on an individual employee basis. With a turnover rate in excess of 50 percent the average is skewed to the point where the company realizes little benefit in total until the apprentice is certified. This however is only part of the cost equation. Managers feel strongly that they lose substantial numbers of employees due to raiding by big companies and that this increases the need for training. As small business they can ill afford to continue training people and losing them. (Section 5.0 identifies some of the reasons for the high turnover)

Various suggestions were offered as to how tax incentives could be utilized to encourage TDM companies to train. The essence of the suggestions indicated that there should be a training tax. Companies who trained and achieved training milestones would be rewarded with tax credits. A tax incentive regime of this nature was considered necessary if companies who currently train apprentices were to continue or to increase the number of trainees in process and all companies would carry some of the burden.

Suggestions on programs of recognition for achievement both by employees and companies in respect to training were put forward. These ideas were derived from ISTC's Awards for Excellence program.

The availability of experienced trainers for assisting and advising companies with their training programs was another expedient. As small businesses few companies had training departments and the effectiveness of the training efforts always comes into question. Access to counsel and advice was deemed essential.

- Immigration - A significant number of companies put this suggestion forward. They considered that the regulations should be eased to facilitate an inflow of skilled people. There is little appreciation of the fact that today the pool of skilled people in Europe interested in emigrating to Canada is very small and that this approach while it will afford some relief is not a viable option. Japan, England and other countries are also reporting serious shortages of skilled tradespeople. (See section 8.0) the problem is wide spread.

- The role of the Association - It was considered that the Association should be the focal point for activities relating to awareness programs and to represent the sector in working with government. The current fragmentation of association representation is not conducive to this as each association tends to put forward its own viewpoint creating an opportunity for the "system" to maintain the status quo. From company viewpoints expressed this is not in their interest. Consultation by associations as a minimum and amalgamation of certain entities was considered essential.

The Association should also maintain an information service for the sector. Suggestions in this regard went beyond awareness programs and included data on skills, dialogue with various communities, technology and technology exchange, training etc.

- Involvement of governments - Aside from comments that the various levels of government should be providing more funding for training other constructive comments included:

- need for strengthening of the association/associations representing the sector;
- providing more information either directly or through associations on sectoral matters; and
- extend recognition and awards programs on items such as training achievements.

As small business, TDM companies consider that they do not have the capability to access available information on the same basis as medium and large sized companies primarily because of a lack of managerial capacity. However pertinent information on materials, products, taxation, markets and trends would be helpful to the sector to grow the various companies more rapidly.

7.2 Observations

In general companies had good comments to make about the services provided by ISTC's regional offices and also provincial government offices. Comments on the need for more government funding surfaced constantly but this in many instances was a knee jerk reaction based on lack of appreciation for the workings of the total government support regimes and the resources available.

While associations such as the CTMA are developing they still did not have the resource to meet the needs of the sector. A case could be made for re-appraisal of the working mechanisms to provide counsel, guidance and information on a universal basis.

It is clear that the sector has not done enough to portray itself in a favourable light. This must be changed if recognition of the sector, its status, needs, and objectives are to reach a higher level of consideration. The associations will have to be more aggressive in this regard.

8.0 Background Data on the TDM sectors in Japan, the United Kingdom and West Germany

The following background is available through the efforts of the posts of the Department of External Affairs in Tokyo, London, Munich and Dusseldorf.

8.1 Japanese Die and Mold Industry

Scale and characteristics of the Japanese die and mold sector

There are two kinds of Government statistics from which one can note the volume of tooling in Japan. One is a monthly publication called "Machinery Statistics" which cover specific firms having 20 or more employees. The other is "Industrial statistics", in which the production of dies and molds of all the enterprises in Japan are collected and published once a year.

According to the industrial statistics of 1986, the Japanese die and mold industry had 12,200 tool shops, production amounted to Y1,300 billion. The demand for tooling in the free world is said to be about Y5,000 billion. This means that Japan supplies about 25 percent of the total market in the free world.

The Japanese die and mold industry can be characterized as follows:

(i) Diversity of the products

Changes in needs and diversification of needs requires dies and molds to vary in shape, size, production quantity, material, precision required and working conditions.

(ii) Single time and custom manufacturing

Tooling is usually one off (single time) and made to order.

(iii) User's tooling made in their captive shops and impact on competition

Often, users have a captive tool shop employing journeymen who repair and/or maintain dies and molds. This leads to the practice where users who have been having dies or molds made by specialized tool-makers add machines to their own tool shops and start making dies and/or molds themselves. The more they are technically advanced, the more they tend to tool up for themselves. The users tend to use their own surplus labor to produce dies and molds during depressions (slack periods) reducing the market for job shops. Design secrecy was also an important consideration.

(iv) High reliance on skilled workers

Complicated shapes, finishing, and polishing require skilled hands. The many medium and small-sized tool-makers maintain their technical superiority by having talented well trained workers.

(v) Small and medium size enterprises

Because of the characteristics of tooling procurement nine out of ten existing tool-makers are small business with less than 19 employees.

Production, Imports and Exports

In 1987, the production of dies and molds (according to Machinery Statistics which cover enterprises having 20 or more employees) was Y356.5 billion, which represents a decrease of 5 per cent as compared to the previous year. Volume-wise, the 1987 production was bigger than that of the previous year but the overall economic situation led to severe price-cutting. Compared with 10 years ago, that is 1977, the output of dies and molds increased in value by 220 percent. This growth was one of the highest in the material-forming industry in Japan.

Dies accounted for 40.5 percent and plastic molds 38.0 percent, totalling nearly 80 percent of the production. Die-casting dies accounted for 5.5 percent, forging dies 3.8 percent, rubber molds 3.7 percent, glass molds 3.7 percent, casting molds 3.0 percent, powdered metal molds 2.3 percent.

On the other hand, the captive shop production (for own use) was Y73 billion, showing a slight decrease in captive shop production. Of the types of tooling made in the captive shops, forging dies were 52.0 percent, die-casting dies, casting molds, and press dies 30 percent and plastics molds 11 percent, others 7 percent.

Exports show a trend of increases year after year; the year 1987 registered a value of Y112.6 billion, or a 2.6 percent increase over the previous year.

Imports in 1987, registered a negligible value of Y6.8 billion when compared to the total production.

Structure of the Die and Mold Industry

According to the 1986 industrial statistics, the numbers of tool shops with 1 to 3 employees, 4 to 9, 10 to 19, and 20 to 29 was 5,120, 4,605, 1,401 and 549, respectively, accounting for 42.0 percent, 37.7 percent, 11.5 percent and 4.5 percent, respectively, of the total Japanese production of dies and molds. These figures indicate that the Japanese die and mold industry consists of small companies in the main.

Future Prospects and Challenges

The Japanese TDM industry has made steady progress supplying the auto, electric and electronic industries which constitute about 70 per cent of the total Japanese market for dies and molds. These large-scale users, however, have now reached maturity. In addition, factors such as mounting trade frictions, changing needs of the nation, and advancing technological innovation have increasingly been changing the environment surrounding the Japanese TDM industry.

Of the factors contributing to the change in the environment, those of particular importance are discussed below:

(i) The Strong Yen and Mounting Trade Friction

Since autumn 1985, the Japanese yen has appreciated to a level higher than ever, hitting the traditionally export-dependent auto, electric, and electronic industries in Japan. Over and above that, mounting trade frictions have compelled the users of dies and molds to relocate their plants from Japan to overseas countries. Furthermore, there is a small trend toward the import of dies and molds for parts and components to be manufactured in Japan.

In the light of such global development, the Japanese TDM industry is seriously considering the internationalization of its operations in the context of global division of labour and relocation of production overseas.

(ii) Trend to the production of different types of products

As the users of dies and molds have reached maturity, one would expect that the demand for industrial products can no longer be expected to grow rapidly. However, in response to the diversifying needs of consumers, more diverse products are being manufactured in smaller volumes. The new trend in the industry suggests that the demand for dies and molds will continue to increase in the future. In other words, the smaller the yield per die, the stronger the demand for dies and molds.

(iii) Captive shop tooling

The move toward tooling in captive shops arose from the necessity of keeping corporate trade secrets confidential. This move was not very popular. As the specialist companies will remain in a superior position in terms of technological superiority, job standardization, and productivity, the ratio of production in captive shops is likely to decline in the future.

(iv) CAD/CAM

Growing numbers of toolmakers are turning to CAD/CAM for cost reduction. The users of dies and molds are also increasingly using CAD/CAM; some firms are placing orders for dies and molds using magnetic tape containing CAD generated data. CAD/CAM is now essential to companies that want to survive in the TDM industry.

The demand from users for lower prices, shorter delivery periods, and products of better quality is expected to mount in the future. As a result, the die and mold industry is increasingly called on to meet the requirements using high-tech innovations such as CAD/CAM and new materials.

The TDM industry will continue to grow steadily as one of the main engines for the prosperity of Japan. The objectives the industry is expected to address for meeting the requirements include:

(1) Accentuate strong points

In order to cope with the high yen, it is essential to maintain and reinforce the strong points such as high quality and short/fast delivery, which have traditionally been considered decisive advantages Japanese firms have by world standards. To meet such needs, attempts are being made to reduce the loss of time in completing work-in-process by relying on simultaneous engineering and improving capacity utilization.

Small lot production systems for various types of product, which permit quick responses to changes in demand, must be employed, based on information drawn from many other sectors of industry.

(2) Adaptation to the information and technological revolution

As computer technology has advanced, computers have been finding ever-widening use on production lines. Especially, CAD/CAM systems that provide designers and skilled engineers with advanced information, thus enabling them to improve quality and productivity. Furthermore, simulations offered by CAD/CAM systems enable the engineers to perform such analysis and tests which otherwise would have to be carried out by actually fabricating prototypes and testing products. Furthermore, data on products will be accumulated to construct a database to provide engineers with access to vast accumulations of techniques and approaches where expert knowledge counts most.

The TDM industry must adapt to the technological innovations such as lasers, EDM, and other new machining techniques, and the application of ceramic, composite and other new materials.

(3) Adaptation to Internationalization

The high yen and mounting trade frictions have been causing Japanese users of dies and molds to relocate their plants overseas and get dies and molds supplied by the local TDM companies.

The competitive edge of Japanese dies and molds, a high value-added product, has been substantially eroded by the strong yen, so much so that there is little rationale for domestic production of labor intensive dies and molds. To cope with the situation, the Japanese TDM industry is called on to move into high-tech areas.

Furthermore, since Japanese TDM producers will, most likely, go to China, Taiwan, and ASEAN nations for operations overseas, it will also be one of the tasks of the industry to promote internationalization in the Far East and Southeast Asia through co-operation for mutual growth and development.

Additional Comments

Twenty per cent of Japanese TDM companies have full CAD/CAM capability. Many more have CAM and are progressing to full integration. The incentive for more CAD/CAM is the continuing skilled labour shortage which has persisted for many years. On the other hand the disincentive is the reluctance of TDM clients to absorb some of the capital costs brought about by the application of new technologies.

The Japanese government is not providing financial assistance. Small companies experience considerable problems because of non-standardization of equipment. For example they receive orders by magnetic tape but they do not have compatible decoding equipment. Software costs are high and program requirements are becoming more complicated.

R&D work in the sector is generally confined to manufacturing and production technologies. TDM companies tend not to be involved with new material processing technologies until these technologies are brought out of the R&D stage by the materials companies.

The Japanese government, however, to address the issue of R&D at the manufacturing technology level helped organize the Die and Mold Technology Association in 1987. Members are technical universities and laboratories of major companies. The association is used to organize an annual forum for the presentation of technical papers and publishes a monthly news magazine on technology and other issues relevant to the TDM sector. Furthermore the association suggests proposals for research to the Ministry of International Trade and Industry (MITI) which the Small and Medium Enterprise Agency considers. If approved these projects are contracted out for implementation.

Japan has a shortage of skilled TDM journeymen. Reasons for this include:

- a general labour shortage;
- preference by younger people for white collar jobs;
- market expansion for TDM work; and
- change from craft type TDM workers to computer literate TDM workers.

They do not have job/trade classifications in the sector. The TDM worker therefore must have total capability. Benefits are based on seniority. One significant area of skills shortages is TDM designers. CAD/CAM is helping reduce this through productivity improvement.

Japan has abolished the TDM apprenticeship system due to a lack of recruits and the cost of maintaining the system. Companies rely on on-the-job training with the addition of a mix of special training courses.

The following statistics on the Japanese sector have been developed by the Japanese Ministry of International Trade and Industry (MITI). Please note that the statistics include the total "Industrial" as well as "Machinery" data as well as comparisons of the two.

1. Volume of tooling in Japan according to "Industrial" and "Machinery" statistics.

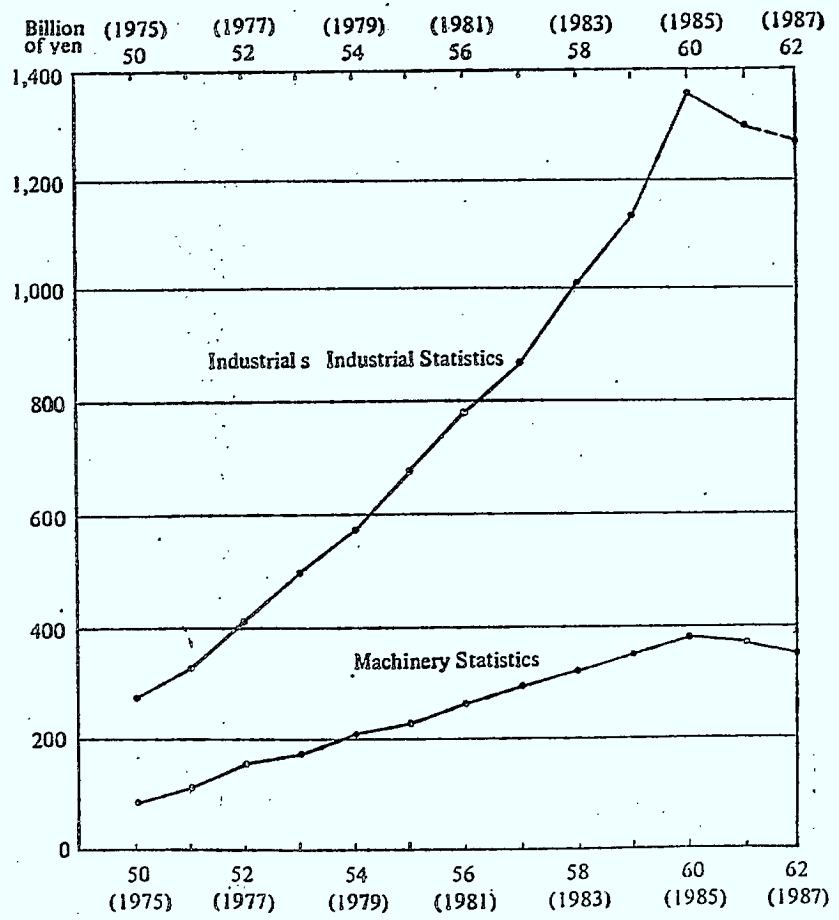
(Unit: Millions of yen)

Year	Industrial	Growth	Machinery	Growth
50(1975)	272,056	△45%	95,361	13.9%
51(1976)	326,760	20.1	121,559	27.5
52(1977)	406,423	24.4	159,001	30.8
53(1978)	492,419	21.2	174,098	9.5
54(1979)	566,554	15.1	201,049	15.5
55(1980)	674,110	19.0	232,464	15.6
56(1981)	785,924	16.6	271,309	16.7
57(1982)	865,121	10.1	297,084	9.5
58(1983)	1,012,718	17.1	322,620	8.6
59(1984)	1,121,367	10.7	352,650	9.3
60(1985)	1,361,310	21.4	386,710	9.7
61(1986)	1,304,201	△4.2	375,498	△2.9
62(1987)	(1,278,117)	(△2.0)	356,476	△5.1

Note: "Industrial" statistics the cover all enterprises in Japan. The figures in the parenthesis are estimated values.

Source: MITI's "Tables of Industrial Statistics". Vol. Manufacturing Industries and "Statistical Report on Machinery"

2. Volume of Tooling



Note: "Industrial Statistics show estimated value for the year 1987.

3. Breakdown by types of the volumes of tooling as seen in "Statistical Report on Machinery"

(Unit: Millions of yen)

Year / Out put / Type	50 (1975)		51 (1976)		52 (1977)		53 (1978)		54 (1979)		55 (1980)		56 (1981)	
	value	%	value	%	value	%	value	%	value	%	value	%	value	%
Press dies	41,030	43.0	55,203	45.4	77,684	48.9	82,208	47.2	94,114	46.8	106,778	45.9	120,595	44.4
Forging dies	5,883	6.2	6,535	5.4	7,304	4.6	7,530	4.3	9,593	4.8	12,793	5.5	12,024	4.4
Casting molds	4,628	4.9	4,292	3.5	5,537	3.5	5,971	3.4	6,680	3.3	7,767	3.3	8,521	3.1
Die-casting dies	6,359	6.7	8,242	6.8	11,099	7.0	12,550	7.2	14,064	7.0	17,373	7.5	23,555	8.7
Plastics molds	26,451	27.7	34,053	28.0	41,176	25.9	48,248	27.7	57,325	28.5	66,164	28.5	82,857	30.5
Glass molds	4,956	5.2	6,210	5.1	7,310	4.6	8,544	4.9	8,542	4.2	9,359	4.0	9,338	3.4
Rubber molds	4,151	4.4	4,427	3.6	5,221	3.3	5,764	3.3	6,839	3.4	8,134	3.5	9,819	3.6
Powdered metal molds	1,766	1.9	2,597	2.1	3,670	2.3	3,514	2.0	3,892	1.9	4,096	1.8	4,600	1.7
Total	95,361	100.0	121,559	100.0	159,001	100.0	174,329	100.0	201,049	100.0	232,464	100.0	271,309	100.0

Year / Output / Type	57 (1982)		58 (1983)		59 (1984)		60 (1985)		61 (1986)		62 (1987)	
	value	%	value	%	value	%	value	%	value	%	value	%
Press dies	126,448	42.6	137,298	42.6	135,913	38.5	154,814	40.0	150,288	40.0	144,312	40.5
Forging dies	11,852	4.0	11,099	3.4	11,517	3.3	13,344	3.5	12,843	3.4	13,715	3.8
Casting molds	9,323	3.1	9,012	2.8	10,997	3.1	11,553	3.0	10,227	2.7	10,662	3.0
Die-casting dies	26,564	8.9	31,490	9.8	18,826	5.3	19,510	5.0	21,287	5.7	19,497	5.5
Plastics molds	98,300	33.1	106,462	33.0	142,659	40.5	151,340	39.1	147,213	39.2	135,421	38.0
Glass molds	9,207	3.1	10,656	3.3	11,529	3.3	13,021	3.4	11,985	3.2	11,400	3.2
Rubber molds	10,615	3.6	11,258	3.5	14,130	4.0	15,222	3.9	13,935	3.7	13,281	3.7
Powdered metal molds	4,775	1.6	5,345	1.7	7,079	2.0	7,907	2.0	7,719	2.1	8,189	2.3
Total	297,084	100.0	322,620	100.0	352,641	100.0	386,710	100.0	375,498	100.0	356,476	100.0

4. Volumes of tooling in captive shops and captive shop production ratio

(Unit: Millions of yen)

Type \ Year / Production	51 (1976)		52 (1977)		53 (1978)		54 (1979)		55 (1980)		56 (1981)	
	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio
Press dies	21,947	39.8	31,210	40.2	30,970	37.7	34,416	36.7	30,954	29.0	40,769	33.8
Forging dies	4,762	72.9	5,027	68.8	5,067	67.3	5,206	53.2	7,208	56.3	8,143	67.7
Casting molds	1,019	23.7	1,105	20.0	1,698	28.4	1,972	31.1	2,374	30.6	2,511	29.5
Die-casting dies	2,894	35.1	3,088	27.8	3,972	31.6	3,818	27.3	5,418	31.0	5,895	25.0
Plastics molds	3,589	10.5	4,236	10.3	4,142	8.6	5,893	9.7	7,366	10.6	11,253	13.6
Glass molds	244	3.9	177	4.0	157	1.8	31	0.4	33	0.4	33	0.4
Rubber molds	229	5.2	271	5.2	484	8.4	756	11.1	1,067	13.1	1,071	10.9
Powdered metal molds	608	23.4	833	22.7	859	24.4	1,036	26.6	1,210	29.5	1,239	26.9
Total	35,292	29.0	45,947	29.0	47,349	27.2	53,128	26.3	55,630	23.7	70,914	26.1

Type \ Year / Production	57 (1982)		58 (1983)		59 (1984)		60 (1985)		61 (1986)		62 (1987)	
	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio	Captive shop	ratio
Press dies	42,158	33.3	45,708	33.3	36,547	26.9	47,479	30.7	39,095	26.0	37,163	25.8
Forging dies	7,152	60.3	7,131	64.2	7,374	64.0	8,685	65.1	7,286	56.7	7,128	52.0
Casting molds	2,738	29.4	3,064	34.0	4,233	38.5	3,767	32.6	2,827	27.6	3,281	30.8
Die-casting dies	5,390	20.3	6,394	20.3	6,445	34.2	5,831	29.9	7,621	35.8	6,473	33.2
Plastics molds	12,125	12.3	15,821	14.9	15,965	11.2	18,589	12.3	17,709	12.0	15,104	11.2
Glass molds	65	0.7	35	0.3	0	0	65	0.5	121	0.1	7	0.1
Rubber molds	1,034	9.7	1,404	12.5	1,783	12.6	2,148	14.1	1,528	11.0	1,444	10.9
Powdered metal molds	1,257	26.3	1,407	26.3	1,754	24.8	2,068	26.2	2,156	27.9	2,387	29.1
Total	71,919	24.1	80,964	25.1	74,101	21.0	88,632	22.9	78,344	20.9	72,984	20.5

Source: MITI's "Statistical Report on Machinery"

5. Number of toolmakers and their production values

(Unit: Millions of yen)

Year / Number of employees	57 (1982)				58 (1983)				59 (1984)			
	Number of toolmakers		Production value		Number of toolmakers		Production value		Number of toolmakers		Production value	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
9 or less	7,991	80.9	252,332	29.2	9,475	82.4	310,112	30.6	9,024	80.7	313,471	28.0
10 – 19	1,090	11.0	163,823	18.9	1,165	10.1	180,666	17.8	1,264	11.3	206,624	18.4
20 – 29	435	4.4	130,108	15.0	446	3.9	139,514	13.8	461	4.1	143,783	12.8
30 – 49	188	1.9	92,417	10.7	214	1.9	101,473	10.0	227	2.0	117,268	10.5
50 – 99	127	1.3	109,040	12.6	142	1.2	128,417	12.7	143	1.3	135,500	12.1
100 – 199	31	0.3	52,574	6.1	40	0.4	71,674	7.1	48	0.4	87,767	7.8
200 – 299	5	0.05	31,956	3.7	6	0.05	26,532	2.6	6	0.05	66,461	5.9
300 or more	7	0.07	32,871	3.8	6	0.05	54,330	5.4	8	0.07	50,493	4.5
Total	9,874	100.0	865,121	100.0	11,494	100.0	1,012,718	100.0	11,181	100.0	1,121,367	100.0

Year / Number of employees	60 (1985)				61 (1986)			
	Number of toolmakers		Production value		Number of toolmakers		Production value	
	Number	%	Number	%	Number	%	Number	%
9 or less	9,566	80.2	351,751	25.9	9,725	79.7	360,411	27.6
10 – 19	1,341	11.2	231,780	17.0	1,401	11.5	238,579	18.3
20 – 29	512	4.3	165,919	12.2	549	4.5	174,334	13.4
30 – 49	265	2.2	142,006	10.4	279	2.3	148,500	11.4
50 – 99	173	1.5	176,066	12.9	183	1.5	180,069	13.8
100 – 199	50	0.4	109,804	8.1	49	0.4	102,171	7.8
200 – 299	7	0.06	31,930	2.3	4	0.03	10,514	0.8
300 or more	9	0.08	152,054	11.2	10	0.08	89,623	6.9
Total	11,923	100.0	1,361,310	100.0	12,200	100.0	1,304,201	100.0

Source: MITI's "Tables of Industrial Statistics", Vol. Manufacturing Industries

6. Exports of molds and dies

(Unit; Thousands of yen)

Year	Press dies Forging dies	Casting molds Die-casting dies	Plastics molds Rubber/ Glass molds	Total	Growth rate (%)
57(1982)	24,276,958	8,099,129	24,342,298	56,718,385	27.2
58(1983)	29,949,123	6,898,536	27,701,598	64,549,257	13.8
59(1984)	34,988,071	6,396,397	30,699,404	72,083,872	11.7
60(1985)	45,417,941	9,802,774	42,601,362	97,822,077	35.7
61(1986)	51,859,269	10,602,933	47,333,162	109,795,364	12.2
62(1987)	46,489,762	11,854,753	54,285,072	112,629,587	2.6

Source: Monthly Tables of Japan's Foreign Trade

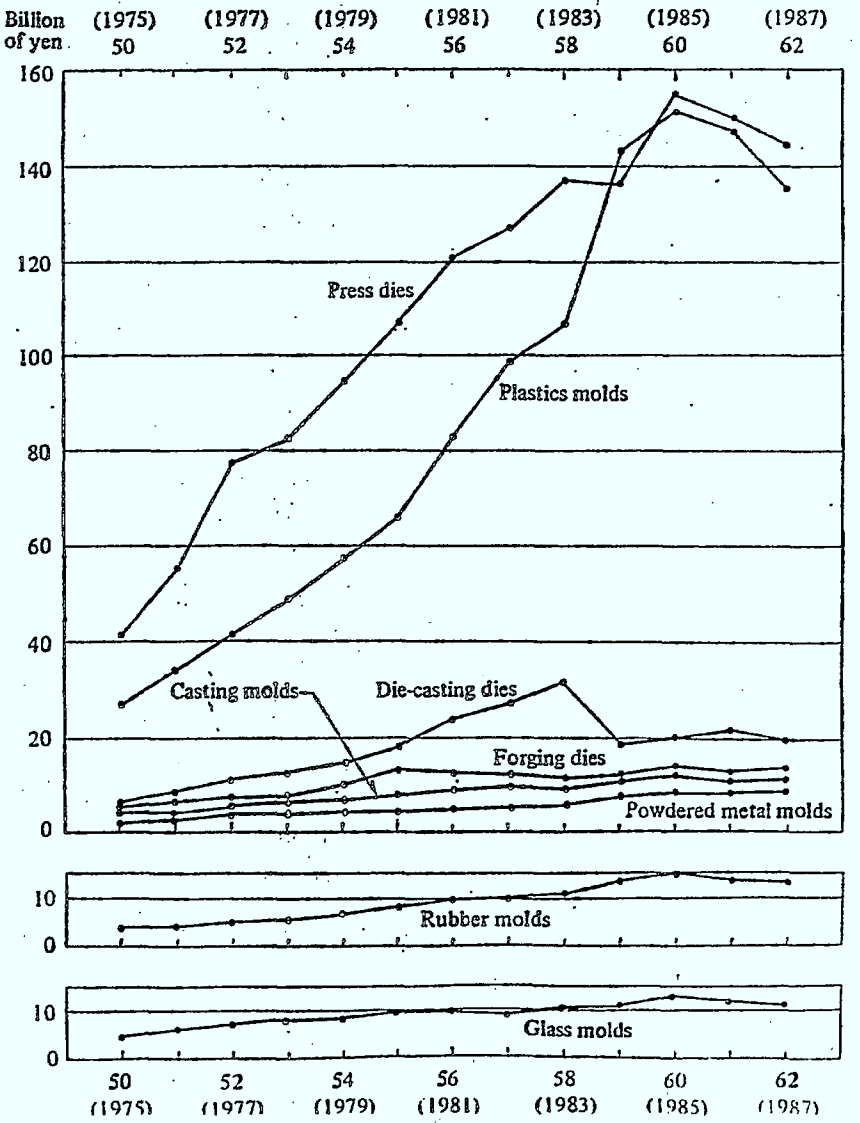
7. Imports of molds and dies

(Unit: Thousands of yen)

Year	Press dies Forging dies	Casting molds Die-casting dies	Plastics molds Rubber/ Glass molds	Total	Growth rate (%)
57(1982)	—	478,140	3,630,124	4,108,264	62.7
58(1983)	—	301,969	3,659,066	3,961,035	△3.6
59(1984)	—	334,293	3,547,824	3,882,117	△2.0
60(1985)	—	449,241	4,301,395	4,750,636	22.4
61(1986)	—	426,463	4,622,931	5,049,394	6.3
62(1987)	—	677,550	6,160,844	6,838,394	35.4

Note: No statistics are taken for Press Dies and Forging Dies

8. Values of molds and dies produced (according to "Machinery" statistics)



8.2 The U.K. Die and Mold Industry

Sector Background (Information Provided by the Gauge and Toolmakers Association - GTMA)

The U.K. TDM sector is composed of approximately 2000 companies employing about 15,000 people. There has been extensive investment in new technology and the trend is increasing. About 25 percent of the member companies in the GTMA have CAD/CAM capability.

These is no significant R&D work done by companies.

There are skills shortages in this sector. Vacancies amongst member firms run at about 8 percent. Some of the reasons contributing to the shortages are:

- high wages are available in other sectors with less job responsibility;
- while there is a reasonable supply of recruits for apprenticing the lack of technical schools is impacting adversely on the calibre of the recruit;
- high turnover of staff; and
- high cost of training.

The commitment of companies to training and of youth to apprenticing is good. There has been a strong tradition - a culture - of training by apprenticing. The indenturing process is still working reasonably well. The nature of the training and the training content is being updated because of the increasing trend to the use of CNC machinery and CAD/CAM. The net cost of training an apprentice over a four year apprenticeship is 20,000 pounds.

Most companies are training young people because of the lack of skilled workers or retraining and upgrading their own employees. Significantly both small and large companies are involved in skills training. The tax regime encourages this.

The TDM sector in the U.K. considers itself price competitive against most major industrial countries and prides itself on the quality of its product.

TA Skills Survey

The Training Agency (TA) of the U.K. Ministry of Employment conducted a skills survey in the manufacturing industry in November 1988. While the survey covers the secondary manufacturing industry rather than just the TDM sector some of the findings are noted below as the data provides insight on the skills situation:

- 65 per cent of the firms indicated that production had been affected because of a lack of skilled labour.
- 39 percent of the firms experienced a shortage of professional engineers and 35 percent reported shortages of machinists, journeymen, technicians, fitters and welders.
- skilled labour was generally unavailable, worker turnover was high and pay and benefits packages were contributing to the problem.
- 86 percent of the firms tried additional recruitment to meet their skills needs, nearly three quarters retrained and upgraded existing employees and just over half improved their pay and benefits packages. (Improving pay and benefits was not as extensive amongst companies facing shortages of machinists and welders only.)

Statistics - (Business Trends provided by GTMA)

SHIPMENTS*

	1985	1986	1987	1988
		(in million pounds)		
Press Tooling	58.8	60.5	55.1	66.8
Jigs, Fixtures etc.	17.4	16.1	15.3	18.2
Dies and Molds	75.3	83.6	94.7	125.2
Metrology equip.	100.3	102.8	169.3	193.5

* The figures covering press tooling, dies, molds, jigs and fixtures are based on shipments reported by companies with a minimum employment of 25. The GTMA considers they represent about 70 percent of the shipments for the TDM sector.

8.3 The West German Die and Mold Industry

Canadian TDM companies have expressed a strong interest in the apprenticeship regime in Germany. Statistics on the West German TDM sector are not available as the data is subsumed into the statistics for the whole machine tool sector. The following data however is useful to have for total machine tool production (including tooling).

1988	Production	Exports	Imports
(in million DM)	13,321	8241	2822

- Employment 94,000
- 44.5% of production is CNC/NC machine tools
- Exports account for 23.8% of world machine tool exports.
- 7% of the workforce is made up of apprentices.

The German apprenticeship training program is a national program involving 35,700 companies engaged in metal working. The Bundesverband Metall (Federal Metal Association) provided the following statistics:

The trades are divided into 7 categories as follows:

A. Blacksmiths and forgers
B. Blacksmith mechanics
C. Machine makers (mechanical engineers)
D. Tool and Diemakers
E. Turners (machinists)
F. Metal formers
G. Precision Mechanics (technicians)

(Participation in the association is mandatory)

The training of an apprentice takes about 3½ years in the above categories, about half is theoretical (technical school) and about half practical. Upon successfully passing their examinations apprentices are classified as journeyman (receive a certificate of apprenticeship). After a minimum of 5 years as a journeyman (geselle) an individual can enter a master (Craftsman) college and/or a Technicians college which normally takes 2 years. After successfully passing the examinations a Master Diploma and/or a Technicians Diploma is awarded. This results in extremely well trained journeymen who can operate at a higher technical level than journeymen in North America.

Of particular importance in this respect is the requirement in Germany that instructors of apprentices must be at the diploma level thus further increasing the excellence of the final product trained.

In 1988 the following certificates of apprenticeship were issued (by category):

Category	Number	Changes from 1987 change +	% change
A	694	-161	-18.8
B	8310	-293	- 3.8
C	2739	290	11.8
D	1128	107	10.5
E	531	158	42.4
F	26	-1	- 1.8
G	690	- 13	- 1.8
TOTAL	14118	+ 87	0.6%

The following Masters Diplomas were issued in 1988

Category	Number	Change from 1987 change +	% change
A	167	51	44.0
B	1953	76	4.0
C	2040	190	10.3
D	977	141	16.9
E	257	27	11.7
F	4	-1	-20.0
G	200	34	20.5
TOTAL	5598	518	10.2%

The availability of apprentices is declining as indicated below for the following reasons:

° demography - lower birth rate

° poor professional prospects

° unclear, uninteresting work situation.

Actual Apprentices in the above professions in 1988

Category	Number	Changes from 1987 change +	% change
A	1,766	-213	-10.8
B	21,991	-1383	- 5.9
C	8,601	-281	- 3.2
D	4,458	+ 26	+ 0.6
E	1,149	-181	-13.7
F	49	-20	-29.0
G	2,196	-92	- 4.0
TOTAL	40,210	-2145	- 5.1%

Some of the skills deficiency is being offset by immigrant journeymen. Large numbers of the apprentices are immigrants, (from Turkey).

The majority of the apprentices in categories C, D and E are educated in the Federal States of Bavaria (BMW) and Baden-Wurttemberg (Mercedes Benz).

The training regime signals that there are two levels of skills. The first is the journeyman level and after shop experience and 2 more years of college training we have the master or diploma level. The discussions at the Grand Rapids Junior College in Michigan indicate that the Americans are working towards this kind of approach.

It would appear that the German apprenticeship system will remain superior by virtue of the level of expertise held by the diplomad journeymen being used as instructors.

8.4 Observations

While data is included in this section from Japan, the U.K. and West Germany it is not possible to make direct comparisons because the exact scope of the data base is not available.

However to people knowledgeable in the TDM industry the information does provide a "read" as to what is happening.

To make conversion of the statistical data possible the exchange rates on the Canadian dollar on August 31, 1989 were as follows:

U.S.A.	$1.1758/U.S. dollar
Japan	$0.008134/yen
U.K.	$1.8495/pound
West Germany	$0.6005/mark

Some very interesting policy considerations flow from the information provided on Japan, the U.K. and West Germany.

First the Japanese emphasis on simultaneous engineering is a very important consideration as it impacts on lead-times required to put production programs in place. The emphasis also on engineering capability in a TDM company is important.

The continuing reliance by the British on a training culture to develop skills remains an important consideration.

The most important observation is the 2-tier approach of the West German apprenticing process. This approach imposes a requirement for practical experience developed on the shop floor before the attainment of a "Diploma" level of skills achievement.

9.0 Conclusions

The TDM sector has been an excellent performer with a good future notwithstanding its current constraints.

This review suggests that after the recession of 1982/83 the sector benefitted from an up-beat economy and pent up demand from 1984 through 1986. Shipments were showing excellent increases (20%) year over year. Toward the end of 1986 however there were indications that the productive capacity was becoming saturated as shipments were not demonstrating the same strong growth.

In 1987 the estimated shipments show that after correction for inflation the output from TDM shops at best was stagnant. Imports showed a dramatic increase while exports also stagnated. The Canadian market was merely holding its own. Some of the increase in imports is attributable to the lack of capability to produce dies for the stamping of automotive outer skins required by new Canadian stamping plants being put into operation.

The level of exports could not be sustained as output was being directed to supply the domestic demand. Efforts will now have to be initiated to recover these markets. The trending away from the supply of local markets to a globalization of markets cannot be ignored by the Canadian TDM sector. The sector is too small to try and stand alone bucking the trend.

Once the automotive industry started to address the problem of computer language standardization with the Manufacturing Automation Protocol (MAP) as put forward by General Motors the TDM companies finalized their CAD/CAM requirements and commenced with the re-equipping of their facilities. Today the Canadian shops, equipment wise, are on a par with TDM shops around the world. With adequate tradespeople, fully trained in the application of computers, Canadian companies would have a distinct market advantage.

Investment in the sector has slowed appreciably in the last 2 years. A lack of skilled people is causing companies to set aside plans for expansion in many instances. While the lack of skilled journeymen was the principle reason given there are indications of softness in the market starting in 1988 which may also be affecting the rate of investment. Companies as a consequence have not been able to take full advantage of their completed investment programs.

Recruitment of skilled people is a pressing problem. The sector has not developed a commitment to training and as a result finds itself severely constrained due to a serious shortage of skilled tradespeople.

° Inadequate attention has been paid to the replacement of an aging work force. Current trainees will not make-up the loss of tradespeople through retirement particularly from the aspect of know-how.

° The sector's experience in training apprentices recruited at the high school level is not good. Turnover is extremely high. A review of the approach is indicated.

° Immigration is not a quick fix for the problem as there is a shortage of skilled tradespeople in all industrialized countries. Canada does not have any special advantages to offer these people. Canada's immigration regulations tend to be a further barrier.

° The sector's recruitment of apprentices is frustrated by the public's negative perception of working conditions and benefits in the sector.

The sector has invested heavily in capital goods for the future but has not invested adequately in its most valuable commodity - its people.

Actions and objectives that must be acted on immediately include:

- Increasing the technical and engineering competence of companies if they are to maintain their technology edge;
- Strengthening the association/associations to more adequately represent the sector's interests;
- Re-examining remuneration and benefits packages;
- Mounting a vigorous image and awareness program directed at the family, students and counsellors in high schools and community colleges, as well as government;
- Recruiting women as apprentices;
- Examining current work practices and organizational structures to alter the skills mix to gain more advantage from the higher skills levels through changes in the delegation of responsibilities.
- Working with government to put data, information and counselling services in place to work with the small business sector.

TDM clients will have to bear higher costs as the skills deficiency increases as quality tooling will be in short supply. Large clients should not be materially affected, however, small manufacturers will find it a hardship as they do not have the financial resource and the managerial capacity to compete effectively against their foreign competition and bigger companies domestically who have better purchasing power. With the capability today of electronically transmitting digitized technical information proximity does not provide the same advantage that it did previously. Companies cannot insulate themselves against foreign competition. They must meet it head on.

APPENDIX 1

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Revised May 1, 1989

QUESTIONNAIRE

TOOLING, DIE and MOLD (TDM)

The purpose of this questionnaire is to obtain data on tooling, die and mold (TDM) operations and the state of this sub-sector in total.

1. COMPANY PROFILE

1.1 What are your annual shipments (sales revenues) from this plant?

Value	Please check one
less than $250,000	( )
$250,000 to $499,999	( )
$500,000 to $999,999	( )
$1 million to $4,999,999	( )
$5 million to $25 million	( )
more than $25 million	( )

1.2 Destination of shipments:

____%	Exports
____%	Domestic
100.0%	

1.3 Major market categories:

	% Total Shipments
Consumer durables	____%
Automotive	____%
Electronic	____%
Packaging	____%
Other	____%
	100.0%

1.4 Number of full-time (over 30 hours/week) permanent employees in your TDM operation:

No. of production/trades people	_____
No. of management/support people	_____
Total no. of employees	_____

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1.5 Please indicate your customer base (major clients) in the automotive sector.

Big Three assemblers: _____

_____

Japanese/Asian assemblers: _____

_____

Parts producers: _____

_____

1.6 Company Name: _____
[optional]

Plant Location: _____

Contact Person: _____

1.7 Number of years in business: _____

1.8 Ownership: Canadian ( )
U.S. ( )
Other ( ) Specify _____

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2. TECHNOLOGICAL CAPABILITY

2.1 Please identify your company's area of principal specialization as follows:

2.1.1 Product (2 most important categories)

dies ( ) jigs, fixtures and gauges ( ) other: (specify)
molds ( ) machines (special) ( ) _____

2.1.2 Materials to be processed by your tooling
(3 most important categories)

steel ( ) glass ( ) die-cast ( )
plastics ( ) polymers ( ) other: (specify)
aluminum ( ) composites ( ) _____

2.2 Please indicate which of the following technologies your company currently uses in your plant and which it plans to acquire.

	Use Currently	Plan to Acquire (by Jan. 1/92)
2.2.1 Design		
- computer-aided design (CAD)	( )	( )
- computer-aided engineering (CAE)	( )	( )
- integrated CAD/CAM	( )	( )
- none of the above	( )	( )
2.2.2 Manufacturing Equipment		
- computer-aided manufacturing (CAM)	( )	( )
- computer-aided inspection and testing devices (CMM)	( )	( )
- computer-controlled (CNC) machines	( )	( )
- numerically-controlled (NC) machines	( )	( )
- none of the above	( )	( )
2.2.3 Other Equipment (please specify)		
- _____	( )	( )
- _____	( )	( )

2.2.4 Management Planning and Control

	Use Currently	Plan to acquire (by Jan. 1/92
- computerized financial systems	( )	( )
- manufacturing resource planning systems	( )	( )
- automated shop floor data collection	( )	( )
- computer links:		
- between your plant and your customer	( )	( )
- between your plant and your suppliers	( )	( )
- none of the above	( )	( )
- other process technologies (please specify): _____	( )	( )

2.3 (a) What is your company's direction in research and development activities?

(b) To meet client requirements, how does your company acquire technologies it does not possess or has not developed?

(a) _____

_____

(b) _____

_____

2.3.1 Please indicate whether your company is doing research and development work in the following areas:

- improving our product to meet market needs/demands ( )
- developing new technology/products ( )
- adding value to our product ( )
- improving our production processes ( )
- diversifying into another client industry sector ( )
- expanding our product line ( )
- none ( )

2.3.2 Please comment on preparatory/development work your company has done/is doing to be able to process the following.

	Comments
- new metals materials (laminates etc.)	_____
- plastics	_____

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Comments

- composite materials _____
- specialty polymers _____
- ceramics _____
- other materials _____

2.3.3 Please comment on the work practices improvement/development your company has done/is doing to facilitate the following:

- improved precision/ accuracy of tools, dies and molds: _____
- reduced time to produce/deliver precision tools, dies and molds: _____
- reduced error/defect rates: _____
- J.I.T. production scheduling: _____
- increased life expectancy of your products: _____

2.3.4 Please indicate how you perceive your competitive position to be in the marketplace for the following and comment on why:

		have advantage	at dis-advantage
(a)	technology	( )	( )
(b)	capacity	( )	( )
(c)	experienced tradespeople	( )	( )
(d)	marketing strength	( )	( )
(e)	costs/price	( )	( )
(f)	external support services (please specify where): _____	( )	( )
(g)	other (please specify) _____	( )	( )

Comments:

(a) _____
(b) _____
(c) _____
(d) _____
(e) _____
(f) _____
(g) _____

2.3.5 Please indicate which technological advancements your company expects to prepare for in the next 3 to 5 years and comment on how:

	Comments
- advanced manufacturing technology	_____
- product technology	_____
- new human resource skills requirements	_____
- computerization of information systems	_____
- communications with clients and suppliers	_____

- new materials (please specify which ones) _____

_____ _____

- other (please specify) _____

_____ _____

2.3.6 Were your company to require new production/product technologies, please indicate the method by which it would acquire these technologies if it did not plan to develop its own?

	Technologies	
	Manufacturing	Product
- licensing	( )	( )
- joint venturing	( )	( )
- buying	( )	( )
- strategic partnering	( )	( )
- copying	( )	( )
- foregoing the opportunity	( )	( )
- having client supply	( )	( )
- other	( )	( )

If you indicated "foregoing the opportunity", please indicate whether the following impacts would be experienced by your company?

	Yes	No
- continued growth	( )	( )
- change in line of business	( )	( )
- loss of competitive edge	( )	( )
- candidacy for buy-out/takeover	( )	( )
- other (please specify): _____	( )	( )

2.3.7 What share of sales revenue does your company allocate to R&D? __ %

Please indicate whether this budget level changed in the last 3 years? Yes ( ) No ( ) + ( ) - ( )

2.3.8 As there appears to be a trend by automotive assemblers (both foreign and domestic) to have their component/systems suppliers do more product research and engineering and supply total systems, (black box approach) please indicate whether, if requested, your company would:

	Yes	No
- increase its engineering capability to do die and mold engineering design	( )	( )
- buy-in engineering capability	( )	( )
- develop proprietary designs that would be offered to the trade	( )	( )
- resort to another expedient to obtain or continue to hold this business	( )	( )

If yes, please comment on the expedient involved.

_____

_____

_____

- develop/acquire production system technology to retain its clients	( )	( )
- consider forming a strategic partnership/working arrangement with an auto parts producer to enhance its position.	( )	( )

3. HUMAN RESOURCE SKILLS PROFILE (MANUFACTURING AND DESIGN)

3.1 Please indicate the categories of skilled people the company utilizes in manufacturing as follows and the percentages (+/-) by which their numbers will change by January 1, 1992.

Rate of employee turnover: ____%

3.1.1 Engineers (university graduates)

- plant (maintenance)	( )	____%
- design	( )	____%
- industrial	( )	____%

3.1.2 Technicians (community college graduates)

- quality assurance and control	( )	____%
- engineering technologist/designers	( )	____%
- computer programmers/designers	( )	____%
- materials procurement and handling	( )	____%
- draftsmen	( )	____%

3.1.3 Line Supervisors

- supervisors	( )	____%
- group leaders/fitters	( )	____%

3.1.4 Tradesmen/Journeymen

- machinists (maintenance)	( )	____%
- machinists (NC/CNC)	( )	____%
- metal formers (pressmen)	( )	____%
- mold makers (A & B)	( )	____%
- tool makers (A, B & C)	( )	____%
- die makers (A, B & C)	( )	____%
- machine tool setters	( )	____%
- set-up operators (please specify)		
_____	( )	____%
- pattern makers, metal	( )	____%
- welders	( )	____%
- other (please specify; i.e., engravers, etc.)		
_____	( )	____%

3.2 Please indicate your company's benefit package as follows:

		paid by company
- pension plan	( )	____%
- medical plan	( )	____%
- dental plan	( )	____%
- vacation plan (please indicate)		
____ weeks after 1 year of service	( )	
____ weeks after ____ years of service	( )	
- profit sharing/bonus (please comment) _____	( )	
- apprenticeship and other training	( )	
- other (please specify) _____	( )	

3.3 Please indicate the % rate (best estimate) as to how your company's pay scale for Class A Journeymen compares with that:

	+/-	
- of your strongest competitor	___	____%
- of your competition in general	___	____%
- for automotive assemblers	___	____%
- of the automotive parts companies	___	____%
- of your U.S. competition	___	____%
- of your Asian competition	___	____%

3.4 Please indicate which method(s) are used by your company to recruit skilled people:

(a) advertising ( )
(b) reference (CEIC) ( )
(c) pre-selection (watching for good people) ( )
(d) recommendation ( )
(e) inducement (e.g., more money, promotion, etc.) ( )
(f) other (please specify):

_____ ( )

3.4.1 For your company, which of the above best meets its requirements? ( )

3.5 Have you been able to recruit your skilled people without any serious difficulty? yes ( ) no ( )

If no, to what do you attribute this (please comment)?

_____

_____

_____

3.5.1 It is ( ) more ( ) less difficult to recruit skilled people compared to a year ago. I attribute this to (please comment):

_____

_____

_____

3.5.2 If your company has recruitment problems, please list (in order of difficulty to fill) the trades categories indicated in question 3.1 (e.g., engineers, technicians, line supervisors, tradesmen/ journeymen).

(1) _____
(2) _____
(3) _____
(4) _____

3.5.3 Please comment on what, in your view, are the reasons are for the shortages of skilled people?

_____

_____

_____

3.6 If your company cannot recruit skilled people, please indicate whether it trains them by the following methods and, if so, rank in order of preference.

	Yes	Order of Preference
- training apprentices	( )	( )
- retraining certain employees (please specify which ones): _____	( )	( )
- upgrading semi-skilled workers	( )	( )
- upgrading community college grads	( )	( )
- other (please specify) _____	( )	( )

3.6.1 From your company's perspective, what are the reasons for the most preferred (rated "1") method (please comment)? _____

_____

_____

3.6.2 Please indicate whether the initial levels of skills of the following meet your expectations? If no, please comment on the reasons why and how this could be ameliorated.

Yes	No		
( )	( )	apprentices	_____
			_____
			_____
( )	( )	community college grads	_____
			_____
			_____

3.6.3 Please indicate your company's estimated total cost for:

- training an apprentice $_____
- retraining an employee $_____
- upgrading a semi-skilled worker $_____
- upgrading a college grad $_____
- other (please specify): _____ $_____

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3.6.4 Please indicate the training programs your company used during the last year?

- apprenticeship ( )
- other Provincial Government programs ( )
- Federal Government programs ( )
- none ( )

3.6.5 Please indicate what, in your view, would be good expedients to:

(a) offset the company's costs of training skilled people

(b) train people by using available facilities when they're idle

(c) train people by using co-operative training (particularly for small companies whose recruitment requirements are small)

(d) encourage fully trained apprentices, etc. to stay with the company

3.6.6 Please indicate how many company employees participated in training programs in the following categories during the last year.

	No. of Employees
- registered apprentices	( )
- other trade skills	( )
- technical (other than computers)	( )
- computer-related skills	( )
- management/supervisory skills	( )

3.7 If your company could not recruit/did not train its skilled tradespeople, please indicate whether, in your view, the following impacts would be experienced by your company, and rate the likely order of probability.

	Yes	No	Probability Rating
- loss of clients	( )	( )	( )
- loss of skilled people	( )	( )	( )
- change in line of business	( )	( )	( )
- candidacy for buy-out/takeover	( )	( )	( )
- downsizing	( )	( )	( )
- diminished product quality	( )	( )	( )
- increased costs	( )	( )	( )
- investing in more automation	( )	( )	( )
- other (please specify) _____	( )	( )	( )

3.8 If your company could not recruit/did not train its skilled tradespeople (resulting in delays and inferior product), please indicate whether, in your view, the following impacts would result, and rate the likely order of probability.

	Yes	No	Probability Rating
- client would buy product elsewhere	( )	( )	( )
- client would buy out my company	( )	( )	( )
- client would change type of product bought from my company	( )	( )	( )
- client would import product	( )	( )	( )
- client would produce its own tooling	( )	( )	( )
- other (please specify) _____	( )	( )	( )

3.9 From your perspective, how can Canada best ensure that its work force achieves and retains the level and mix of skills required for international competitiveness (please list 3 possible expedients)?

(1) _____

(2) _____

(3) _____

3.10 What programs/activities could be effective in encouraging Canadian firms, perhaps through their industry associations, to invest more in training and human resource development? (please give 2 suggestions).

(1) _____

(2) _____

4. MANAGEMENT POLICIES AND PROCEDURES (TECHNOLOGY AND HUMAN RESOURCES)

4.1 Does your company have a business plan that outlines the company purpose, objectives, and a comprehensive product, budget and activity plan?
yes ( ) no ( )

If yes, please indicate the time frame of the planning cycle as follows.

1 year ( )
2 years ( )
3 years ( )
5 years ( )

How many years has your company been doing business planning? ____ years

4.2 Please indicate whether your company projects its technology (product and manufacturing) requirements based on the following and, if so, rank its order of importance.

	Yes	Order of Preference
- business plan	( )	( )
- sales forecast	( )	( )
- cost reductions	( )	( )
- competitive pressures	( )	( )
- market trends	( )	( )
- long-term planning	( )	( )
- client requirements	( )	( )
- other (please specify)		
_____	( )	( )

4.3 Please indicate whether your company projects its work force requirements based on the following and, if so, rank in order of importance.

	Yes	Order of Preference
- business plan	( )	( )
- sales forecast	( )	( )
- planned equipment/ process changes	( )	( )
- rate of employee turnover	( )	( )
- other (please specify)		
_____	( )	( )

4.4 Please indicate whether your company projects availability of skilled tradespeople based on any of the following:

	Yes
- in-house skill inventories	( )
- monitoring training in progress	( )
- monitoring availability of qualified new hires	( )
- monitoring employment statistics	( )
- consultations with trade associations	( )
- other (please specify): _____	( )

4.5 Please indicate whether your company has established procedures for the following:

	Yes
- evaluating technology requirements	( )
- evaluating technology/equipment costs	( )
- delegation of authority	( )
- employee appraisals/evaluation	( )
- training of management people	( )
- other (please specify): _____	( )

APPENDIX 2

List of TDM Companies Interviewed

Brantford, Ontario

Douglas J. Bowman - President
J.P. Bowman Limited

Brampton, Ontario

Max Amtmann - Director
Fujima/Cosma International Inc.

Chatham, Ontario

Jack Ripley - Chairman
Superior Machine & Tool (Chatham) Ltd.

Walter Oudkirk - General Manager
Russell Tool & Die Ltd.

Candiac, Quebec

Gunter Weiss - President
Précimold Inc.

Hamilton, Ontario

Ramon Chalkley - Chief Executive Officer
Wentworth Mould and Die Co. Ltd.

Iberville, Quebec

Serge Labbé - Directeur Production
Les Industries G.L.P.

Kitchener, Ontario

E. Felhaber - Vice-President
Ledco Ltd.

London, Ontario

Greg Prentice - President
GLP Technologies Inc.

Kan Yuk Lam - President
Lamko Tool & Mould Inc.

Ross Strickland - General Manager (now retired)
Canadian Tooling Manufacturers Association

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List of TDM Companies Interviewed (Cont'd)

Midland, Ontario

Reinhart Weber - President
Weber Tool & Mold Co.

Montreal, Quebec

Italo Caroli - President
DBM Reflex Enterprises Inc.

Tony Shatawy - Manager
Harrington Tool - Div. of Ingersoll-Rand Canada Inc.

Oshawa, Ontario

Douglas J. Anderson - Manager, Tool & Die
General Motors of Canada

St. Catherines, Ontario

Ruben Pettersen - President
Densmore Tool & Die Ltd.

St. Jean-sur-Richelieu, Quebec

Marc Bertrand - President
Moules Mirplex Inc.

R. Runser, production manager
K&K Tool Ltd.

Serge Gagné - President
Les Plastiques Hi-Tech Inc.

Toronto, Ontario

Abe Shavel - G&S Management Consultants reprsenting
Accurate Mould Co. Ltd.

Mario Tersigni - Vice-President
New Era Tool & Die Limited

Vancouver, B.C.

W.E. Merritt - Vice-President
Ebco Industries Ltd. (Richmond)

and 1 company wishing to stay anonymous

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List of TDM Companies Interviewed (Cont'd)

Wallaceburg, Ontario

Michael Berthiaume - President
H.E. Vannatter Ltd.

Roy Myers - President
Mylar 2 Mold Ltd.

Windsor, Ontario

Tony Parete - Vice-President
(also President of the Canadian Tooling Manufacturers Assoc.)
Valiant Machine & Tool Inc.

Horst Schmidt - General Manager
Build-A-Mold Limited

Thomas C. Scarlett - Exec. Vice-President
Canadian Engineering and Tool Co. Ltd.

Rick Janisse - General Manager
Cavalier Tool and Manufacturing Ltd.

Ken Watton - President
Kapco Tool & Die Ltd.

Glenn Dennis - President
Kadem Technology Inc.

Lloyd Kirby - President
Kirby Tool & Mold Inc.

Ed Regan - Vice-President
Redoe Mold Company Ltd.

F. Ventrella - President
Saturn Tool & Die Ltd.

U.S. Tool & Die Company Interviewed

Keith Baker - Vice-President
Die-Matic Tool & Die, Inc. - Grand Rapids, Michigan

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Automotive Assemblers & Auto Parts Producers Interviewed

Carl H. Wintermeyer, P. Eng., Manager, Research & Development
Barbara J. Rodgers, Government Relations
General Motors of Canada Limited - Oshawa

William A. Aarssen - General Plants Manager
Solus Manufacturing (Div. of H.E. Vannatter - Wallaceburg)

J. Douglas Morrison - Exec. Vice-President
Huron Steel Products, Windsor

Eric Broger - Exec. Vice-President
F. & P. Mfg., Inc., Tottenham

APPENDIX 3

Community Colleges Interviewed

Canadian Colleges

Daniel B. White - General Manager
Industrial Resource Centre
St. Clair College
Windsor, Ontario

Axel Wallsteiner - Manager
Employer Centred Training
Conestoga College
Cambridge, Ontario

J.A. Weber - Dean
Contract Training Services
Mohawk College
Hamilton, Ontario

Jim Michie - Dean
George Brown College
Toronto, Ontario

Gordon McRae - Chairman
Apprenticeship Training
Durham College
Oshawa, Ontario

United States College

Robert S. Gutek - Special Assistant to the President
Grand Rapids Junior College
Grand Rapids, Michigan

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Magazine Article	-	The Skills Shortage and What To Do About It, Gregor Robinson - Challenges, Winter 1989
A Study	-	Utilization of Advanced Manufacturing Technologies in the Machinery and Electrical Equipment Sector, March 1986
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Report	- Report of the Automotive Industries Human Resource Task Force, January, 1986
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