Report on the

CANADIAN FERROUS FORGING INDUSTRY — 1980 NATIONAL SURVEY

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THE CANADIAN FERROUS FORGING INDUSTRY

REPORT OF THE 1980 NATIONAL SURVEY

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FOREWORD

This report is the result of a co-operative effort between a segment of the Canadian ferrous forging industry and the Federal Department of Industry, Trade and Commerce. It is presented as the statistical summation of the data gathered during 1980, reflecting the conditions of the closed impression die section of the industry in 1979. This presentation has two purposes: to inform the management of the Canadian ferrous forging industry, and specialists in the industry of the results of the study; and secondly, to present a study of the industry to governments and other interested people not directly associated with the industry.

The need for such a study has often been expressed by members of the forging industry, but the timing and method of procedure were a problem. Recognition should be given to the Canadian Forging Association for the opportunity to co-ordinate the approach to the study, and to the Forging Industry Association of America for its encouragement and for supplying data on the North American forging

industry sector. Acknowledgement should also be given to those people in the various Provincial Ministries of Industry who contributed in one way or another toward the data base and the completion of this study. Of equal importance were the efforts of those in the Department of Industry, Trade and Commerce who contributed toward the collation of the data and the preparation of this report.

Special recognition, however, should be given to those in the forging industry who gave their valuable time and efforts to supply this data, without which this report would not have been possible.

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SUMMARY

Following completion and distribution of the 1974 and 1976 national surveys of the ferrous foundry industry, some members of the forging industry suggested such a study of their sector would be worthwhile. After much delay, the study was completed in 1980, based on 1979 operating results.

This report is aimed at offering information as a tool for management, as background information to non-industry people, especially government officials who have a need to understand the industry, and can serve as a basis for a sector strategy report. The questionnaires were mailed to each company and followed up with a personal visit by an officer of the Resource Industries Branch of the Department of Industry, Trade and Commerce to clarify any points of misunderstanding. All closed impression die forging companies were canvassed, regardless of their major manufacturing activities. No attempt has been made to rationalize data in this report with data published in any other form, or by any other group, or institution.

The original intent of this survey was to cover all open hammer and closed impression die forging shops, with the single exception of

those making grinding balls. The reason for this exclusion is that the manufacture of grinding balls is a single purpose operation and in most cases, an operating section of a steel mill. While the intent was to include the open hammer shops, some shops preferred not to be included. Due to the need for confidentiality and because of the small numbers of companies engaged in open hammer forging operations, it was not possible to include the them.

Of the 20 known companies engaged in closed impression die forging operations, 19 responded to the request for information by answering most, or all of the questions. Due to the small numbers of companies involved and their geographical distribution, it is not possible, for reasons of confidentiality, to record their activities on a regional basis, except for a few minor items. Of necessity, we must report on a single Canadian industry.

During the period under review, most companies reported a shortage of skilled labour. The primary shortage is in the shop skills such as mill-wrights, die-makers, etc. Only seven companies indicated a shortage of technical skills such as engineers and technicians. Most companies, however, indicated no shortage of unskilled help. It is interesting to note that the average age for all categories of employment, with the single exception of the clerical group, range from 38 years to 45 years; the average age of the clerical group was 35 years. The highest average age groups were management and die-makers at 45 years. Almost all other groups were in the 39 to 41 year age group.

The forging industry is a major consumer of energy. An attempt was made to obtain quantitative figures for energy consumption for the years 1977 to 1979 inclusive. Some companies, however, only record dollar values and a search of their records would have been necessary to obtain the results in other units. Other companies, where the forging operation was a section of a larger organization, could not segregate the energy consumption for the forging shops due to plant-wide metering.

Except for noise, the forging industry has very little impact on the plant exterior environmental conditions. Most money allocated to this area has been spent on in-plant environmental conditions and employee health and safety. During the period 1975 to 1979 inclusive, 13 companies spent $1.53 million and eight companies estimated that for the 1980 to 1985 period, they will spend a further $3.17 million for environment, health and safety. Noise is the biggest single problem facing the industry, and in many cases, this can only be overcome or reduced by extremely large capital expenditures.

Forging equipment is essentially self-destroying, consequently, maintenance costs are high. The demand for higher productivity, increased efficiency, reduced noise level and operating cost, means a demand for newer and better equipment. During the period 1975 to 1979 inclusive, 18 companies spent $39 million for capital equipment, exclusive of that spent on environmental, health and safety factors. These same companies predicted that during the period 1980 to 1985 inclusive, they will spent a further $50.4 million in capital cost.

Concerning tonnage and value of sales for the period 1975 to 1979 inclusive, company returns were difficult to compare, some replies specified both tons and dollars, others gave one measure only, others again volunteered no information on sales. Sales values in particular are difficult to compare. For most companies, the sales value is a true market value, but for some it is a transfer cost from the forge department to the machining department. An indication of the industry size can be shown, in that 17 companies reported shipments in 1979 of 164,669 tons for a reported value of $178,813,000. The major domestic markets for 1979 are shown in "PART FOUR" of this report, as a percentage of total tons shipped.

The United States continues to be our major foreign market for forgings, with shipments in excess of 95% of total exports; France, the United Kingdom and Mexico represent other export areas. Total export represent approximately 37% of total shipments. The major exports markets are automotive parts, railroad, mining and materials handling applications.

Statistics Canada does not offer any reliable figures for the forging industry. This is due largely to the Statistics Canada practice of classifying a company by its major activity, or market sector serviced. For export and import data, Statistics Canada figures are for "forgings in the rough" only. Any further processing removes them from this category to one of an end-use component. Precisely how many tons of forgings were actually imported or exported is not known. Exports, as defined in this report are, "those forgings that go directly from the forging company to a foreign customer, regardless of function, or machine work done on them."

OBSERVATIONS AND CONCLUSIONS

1. When discussing the ferrous forging industry, there is a tendency to compare it with the steel foundry industry. To some extent this comparison is valid in that there are some segments of the market in which they compete; both industries are composed of small to medium sized companies and both suffer many of the problems and constraints of small industry. One should be careful, however, of generalizing on this comparison, since the differences are greater than their similarities.

2. Considerable funds are being invested in modernization programs, but the industry is still very much labour intensive. In some specialized categories such as skilled trades, (millwrights, mechanics, electricians, etc.), management and supervisory skills, engineers and technicians, a definate shortage exists. It is contended that this shortage is due largely to our system of education, which accentuates the non-skilled and non-technical programs.

3. Environment, health and safety is a continuing problem with the industry. The industry has spent large sums of money to improve the working conditions and will probably continue to do so.

4. Modernization of the manufacturing process can, to some extent, alleviate the problems of skilled manpower shortages and working conditions. The capital costs, however, are high. In recent

years the industry has spent many millions of dollars in capital equipment and many more millions are forecast for future expenditure.

5. 35% to 40% of the industry output is destined for export markets (37% in 1979). Of this amount, 95% goes to the U.S.A. Problems arise when we try to determine the balance of trade in this commodity. Canadian trade statistics only record exports and imports of "forgings in the rough". If any work, other than normal factory clean-up is done on a forging, it is reclassified and not recorded as a forging. The United States offers no statistics on forging shipments at all, since all forgings are classified as to their end-use. Two other problems arise from Canadian statistics: our statistics do not distinguish between open-hammer and closed impression die forgings, and we cannot determine how much of our forging business is exported as forgings, only to return as finished manufactured components.

6. There is a perceived lack of co-ordination and co-operation at the management level in their dealings with governments. Due to an absence of a strong industry management association, this sector cannot speak with a single voice in opposing, or supporting, any government action, at any level of government. The Canadian Forging Association, which does an excellent job in the area of

technical and shop training, is not entirely management-orientated nor does it speak for the majority of the industry. This can be regarded, on some occasions, as a detriment to the industry sector. Having no strong management organization to represent their views, many companies present their individual views, often without the support of others in the business. This situation does not allow for a consistent, comprehensive presentation of a statement of the industry's problems.

7. Research and development, in the industrially accepted terms, is non-existent in Canada. The industry utilizes the results of foreign technology and, if necessary, pays a royalty for its use. This is due, in part, to the size of the industry sector, with its lack of funds and expertise, and in part to a failure to investigate a co-ordinated approach toward technological development, taking advantage of government supported programs.

PART ONE

INTRODUCTION

A closed impression die forging is one in which a piece of steel is hammered or squeezed to a predetermined shape between two halves of a die, into which a cavity has been cut, conforming to the desired shape of the forged piece. It is an economical method of forming steel to produce relatively complex shapes in large volume. Although in many cases forgings compete with steel castings and with parts machined from solid steel, the physical properties are such that, on a weight-for-weight basis, forgings are generally superior to each of the others, and in terms of end-product price, often cheaper. The range of applications is extensive and many segments of industry have a direct or indirect need for this commodity.

The history of the forging industry in Canada is, to a large extent, a parallel to the development of the automotive and railway industries. Although some forging operations date from the middle of the last century, the industry, as we know it to-day, really commenced in the early part of the twentieth century. The increased demand for forged products during the second world war induced many companies to expand their forging operations and other companies to enter this field. Some of this capacity was highly specialized, single-purpose equipment that could not readily fit into a peace-time economy, such as

Canadian Arsenals Ltd., in their Lindsay, Ontario plant. Such operations had to be shut down. Other companies, however, were able to adjust to post-war conditions and fit into the new economy. In the three and half decades since the end of the last war, several companies have come into being, while a few have disappeared. There is no reliable historical data on the size of this industry sector, since much of it has been classified, for statistical purposes, as parts of other industry groups.

In terms of numbers of establishments producing closed impression die forgings, excluding the manufacture of grinding balls, 20 have been identified. Of these, 19 companies responded to part, or in whole, to this survey. The sizes of the establishments range from a small segment of an otherwise large manufacturing company, to very large forging houses with sales in the multi-million dollar range. Due to its proximity to the United States market, and its relationship to the automotive trade, approximately 75 per cent of the total tonnage capacity is in southern Ontario. The remainder can be found in Quebec, Manitoba, Alberta and British Columbia.

PART TWO

PURPOSE AND PROCEDURE

The Need for a Study of a Forging Industry

Statistics Canada, in their various reports, do not identify the closed impression die forging group as an industry sector. Because of the terms of reference employed by Statistics Canada in classifying industry, this sector is distributed throughout various other industry groups, dependent on the major activity of the company, or the major industry sector served. The lack of statistical information and a need to identify the numerous problems of the industry led to the suggestion that a survey of the industry, similar to the surveys conducted for the ferrous foundry industry, would be very useful. The objective would be the identification of major problem areas within the industry and the development of possible solutions.

Method of Approach

Following the release of "The Report of the Canadian Ferrous Foundry Industry (1974) National Survey", and a similar study in 1976, some managers of Canadian forging companies felt such a study of their industry would be worthwhile.

A meeting was held with forging industry representatives; representatives of the Industry Research Branch, Ministry of Industry and Tourism; Government of Ontario; the Secretary of the Canadian Forging Association; and an officer from the Resource Industries Branch, Department of Industry, Trade and Commerce (ITC). The meeting was held in the office of the Director, Industry Research Branch, Ministry of Industry and Tourism, on January 28, 1977. This meeting was a result of a request by Mr. Garner, Secretary of the Canadian Forging Association, to explore the possibilities of having an industry survey conducted, similar to the report of the Canadian Ferrous Foundry Industry (1974) National Survey. Nothing was resolved at this meeting, except there was a general interest in examining the proposition further. It was agreed that Mr. Alex Wilson, Executive Vice-President of the Canadian Foundry Association, would be invited to the next meeting of the Canadian Forging Association so that Mr. Wilson could explain the benefits of such a study, as seen by the foundry industry.

For a variety of reasons, very little was accomplished with respect to this study until mid 1978, when the subject was re-introduced. At the annual meeting of the Canadian Forging Association in February 1979, an officer of the Resource Industries Branch, ITC, outlined an approach to this survey on the understanding that the project would be undertaken if the industry felt it was worthwhile and a majority of the industry would agree to participate. It was agreed by those present that the study was worthwhile. At the

request of the Canadian Forging Association, the ITC officer agreed that the association would not be involved with the survey, either by implication, as a sponsor for the study, or as a donor of information.

On April 17, 1979, letters were sent to all companies in Canada who were known to be, or believed to be, in the ferrous forging business, requesting their opinion of the value of such a study. Of the 37 letters sent out, 27 responded in favour of the study, two were negative and one did not respond, the remaining seven were not involved in this business.

A meeting of industry representatives, along with the officer from ITC, was held in the ITC regional office in Toronto on September 17, 1979. The objectives of this meeting were:

a) identification of some of the major problems in the industry;

b) drafting of a questionnaire that would be acceptable to the industry and, at the same time, produce sufficient information to enable the desired analysis of the industry;

c) decision on a method of collecting the data and preparing a report.

Since all closed impression die forging companies were in favour of the study, it was agreed that the study should start with that group.

It was agreed that Mr. Roy Ellis, Commerce Officer of the Resource Industries Branch, ITC, should be identified as the one responsible for gathering the data and preparing the report. A questionnaire was prepared and the data was gathered by a series of personal interviews between Mr. Ellis and the individual company management representatives. A start was made on the survey in November of 1979, but due to a number of factors, including a re-organization of the Resource Industries Branch, completion took much longer than originally anticipated.

PART THREE

PRODUCTION DETAILS

General information

Before considering the specifics of production, marketing and capitalization of the industry, a few general remarks on ownership and available production are appropriate.

Ownership

The question of ownership was divided into three categories:

1) Privately owned;

2) Wholly owned subsidiary of a Canadian company;

3) Wholly owned subsidiary of a foreign company.

Of the 19 companies reporting, six are privately owned Canadian companies, seven are wholly owned subsidiaries of Canadian companies, and six are subsidiaries of foreign companies. In terms of monthly production capacity, with capacity being defined as, "the maximum tonnage of finished forgings both captive and jobbing, assuming a normal mix that the forge shop would be prepared to ship on a economical basis, using existing facilities, in one month", total monthly capacity is reported to be 32,595 short tons. The ownership breakdown is as follows:

1) Privately owned, 14.1%;

2) Canadian subsidiaries, 36.8%;

3) Foreign subsidiaries, 49%.

For the purpose of this report a "custom jobbing", or simply, "jobbing" shop, is one that does custom work for other clients to the customers specification and usually with the customers tooling. It keeps none of the products for its own use. By comparison, a "captive" shop is one whose total production is used within the corporate structure to make, or be incorporated into other products that are sold by the corporation. A third category is a company that is partly captive and partly jobbing.

Of the 19 companies reporting total monthly capacity figures of 32,595 tons, eight companies are totally jobbing, four are totally captive, while seven serve both markets. According to these figures, there was, at the time of reporting, 15,353 tons of jobbing capacity and 17,142 tons of captive capacity.

Manpower

The industry is capital intensive, but tends to be labour intensive as well, and is a comparatively large employer, as shown in the summary table of the 19 respondents. Not all companies could respond for each year.

YEAR	NUMBER OF COMPANIES	TOTAL EMPLOYMENT
1977	13	2,020
1978	15	2,234
1979	19	2,677

Modernization and expansion programs underway, or contemplated, will have an effect on total employment. New automated, or semi-automated equipment, will tend to reduce the man-hours per tons of output and increase productivity. Increases in production capacity within the industry, however, will give a net increase in the total employment. The employment for 1979 figures are shown in detail in chart #1, Appendix "A".

Company size, in terms of total employment for 1979, is shown on the following table:

TOTAL EMPLOYMENT	UNDER 50	50-99	100-200	OVER 200	TOTAL
No. of Companies	5	3	7	4	19
Employment by Group	150	203	984	1,340	2,677
% of Total	5.6	7.6	36.8	50.0	100

It will be noted that of the 19 companies, eight employ less than 100 people, representing 13.2% of total employment; seven employ between 100 and 200 people, or 36.8% of employment, while four employ over 200 people, or 50% of total employment.

By comparison with many other industries, a forging operation is not a particularly attractive environment in which to work; noise and heat are the major deterrents. Most companies express some difficulty in finding good employees; this, of course, varies from region to

region in Canada depending, to some extent, on the skills of the labour pool, or lack of a labour pool.

It has been recognized that industry in general is facing a serious shortage of technically trained help. Those forging companies that use this category of employee, face the same problem. The most general complaint, however, is a lack of trade skills such as millwrights, electricians, mechanics, etc. The following table shows a breakdown of the companies responding to the question on labour shortage:

	No. of Companies	
	YES	NO
Does a skilled labour shortage exist?	15	4
Technical skills?	7	12
Shop skills?	14	5
Other?	3	16

Among the "other" categories, the various companies listed supervisory personnel, electronics repair persons, hammer set-up men and hammer operators. For many companies, training on the job is the only way to obtain skilled people.

An analysis of the opinions given for a lack of skilled people shows that most managers blame our educational system. People are simply not being trained for skilled jobs. Too much emphasis is placed on non-skilled work and non-technical education. A lack of a labour pool is a problem for some companies, especially those in western Canada, where unemployment is very low and labour mobility is high. Working conditions and competitive wage rates were mentioned, so far as obtaining skilled employees were concerned, but these factors played a greater part in obtaining general shop labour.

One of the more interesting points concerning employees was the relatively narrow spread of average ages, varying from a low of 35 years for clerical personnel to a high of 45 years for senior management and tool and die-makers. The majority rested between 39 and 41 years average age. See Chart #1, Appendix "A".

Production

In the forging industry, as in many other industry sectors, there are three terms that are commonly used, frequently interchangeably and, in the minds of many people meaning essentially the same thing. These are: "maximum plant capacity", "production" and "shipments". For the purpose of this study, capacity, as defined above, is a calculated, or estimated figure based on a number of variables, when each stage of the production process is taken into consideration. To some extent it is a hypothetical value.

Production would represent the actual numbers of tons, or pieces of acceptable forgings produced, whether for shipment or inventory. Shipments mean the numbers of tons, or pieces delivered to the customer, whether from inventory or directly from the production line.

By using broad category definitions as to the grade of steel, an attempt was made to determine the tonnage produced in each category, as a percentage of total production. These are: carbon steel, low alloy steel and high alloy steel. By definition, "high alloy steel" is any grade of steel with the total alloy content, including carbon, of 8% or more. In addition to the steel grades, a small amount of non-ferrous alloy forgings are produced. The following chart shows the distribution of production of each category by the number of companies reporting:

CATEGORY	PERCENT OF TOTAL PRODUCTION				OVERALL AVERAGE
	UNDER 25%	25% TO 50%	50.1% TO 75%	OVER 75%	
Carbon	2	3	6	8	67.1%
Low Alloy	12	6	1	-	22.4%
High Alloy	19	-	-	-	10.5%

In terms of maximum weight of forgings, ten companies stated their maximum size was 50 pounds; three said they could produce forgings between 50 and 100 pounds; while five companies can produce forgings in excess of 100 pounds in weight.

Production, in terms of tons of forgings produced per year, was a difficult quantity to assess. Many companies do not keep a record of tons, but as a number of forge parts per order. Consequently, some companies arrived at a tonnage production figure as a factor of steel purchased, taking normal yield and scrap loss into account. From these records, 18 companies reported a total production of 188,769 tons of forgings for the year 1979. Seventeen companies for the same period reported sales of $176,813,000.

Heating

Before steel can be forged to shape, it must be heated to a temperature that will permit rapid plastic deformation in the die. Traditionally, this is done in an oil, or gas-fired furnace known as a "slot" furnace. A slot furnace is a refractory insulated box with a long opening along one side, in which the bars to be forged are placed side by side on the hearth. A gas, or oil flame is blown over the bars to heat them. Generally speaking, this type of furnace is very inefficient in the use of energy. However, for many operations, it is still the most economical method of heating. As can be seen from Chart #2, Appendix "A", it is still the most common method. Many companies using oil-fired furnaces are converting to gas-fired and in some cases a combination of gas and oil. In recent years, electric induction heating is replacing the slot furnace, this system is thermally very efficient. Due to the relatively high capital cost, however, it is primarily used where longer production runs justify the installation.

There is some limited use of other systems of heating such as oil, or gas-fired rotary hearth furnaces, electric and/or gas heated box furnaces and electric resistance furnaces.

Forging Practices

The actual operation of forging is accomplished in one of three methods: hammering, pressing or upsetting. Within each of these categories, a wide range of equipment can be used, both in terms of size and variety of machines. The numbers of hammers outnumber presses by almost three to one, as shown in Chart #3, Appendix "A". There are twice as many gravity drop hammers as power assisted drop hammers. The majority of the gravity drop hammers are board hammers, whereas the majority of the power assisted hammers are air operated.

Of the 11 companies using a total of 51 forging presses, 42 are mechanical presses and only nine are hydraulically operated.

Fourteen companies reported using a total of 71 upsetting machines ranging in size from 3/8 inch diameter up to 7½ inch diameter. Five companies reported employing a total of 15 cold forging machines.

Almost all companies reported the use of trimming presses. Seventeen companies show a total of 199 trimming presses in service. These range in size from a low of 40 tons to a high of 600 tons with the majority being in the 100 to 300 ton capacity.

In addition to the major forging and trimming equipment listed above, there are two other operations frequently employed, these are "roll forging" and "coining". Ten companies have a total of 31 roll forging machines varying in size from two inches to 7½ inches. Also ten companies report a total of 38 coining machines. While these range in size from a low of 40 tons to 1,100 tons, the majority are in the 200 to 800 tons size range.

EQUIPMENT	NO. OF COMPANIES	NUMBER OF UNITS
Forging Rolls	10	31
Coining Presses	10	38
Trim Presses	17	199

Heat Treating

Following the forging, trimming and coining operations, most companies anneal their forgings before sending them on to their customers. The purpose of this heat treating operation is to relieve the forging stresses and render the steel in its best machinable condition. Most heat treating furnaces are of the "batch" type, i.e., a fixed quantity in the heat treat furnace at one time, then the furnace is emptied and another batch is processed. The most common type of batch furnace is the "box" furnace, which can be oil, gas or

electrically heated. The other two methods reported for the batch type are "car-bottom" and "pit" furnaces. The alternatives to the batch type furnaces is the "continuous" furnace, in which the stressed forgings enter at one end of a refractory lined, heated tunnel and leave at the opposite end in the annealed condition. All of these various types of furnaces can be built to operate with a normal oxidizing atmosphere, i.e., no attempt is made to keep the air out, or they can be sealed and a special neutral, or reducing atmosphere can be inserted.

The sizes of all types can vary widely from a few pounds to several tons to a batch. The question was asked as to how many of each types of furnaces each company had. The results are inconclusive since a few companies merely indicated they had some but gave no numbers. Only those companies which supplied numbers are shown below.

TYPE OF HEAT TREATING FURNACE	NUMBER OF COMPANIES	NUMBER OF UNITS	
		NO ATMOS.	ATMOS.
Box	12	18	14
Car Bottom	3	3	-
Pit	1	1	-
Continuous	7	16	7

Quality Control

Quality control is a continuing program in the forging industry. There was a time, in days gone by, when the only quality assurance program was the eye of the inspector. To some extent this is still

done today, but the demand for quality assurance, coupled with some very restrictive legislation regarding product liability, means that the company can no longer rely on visual inspection only. Whether captive or commercial jobbing, all forging companies strive, one way or another, to maintain a quality level commensurate with the customers' demands and the end-use requirement of the forged part. To illustrate this latter point, one need only consider the relative amounts of damage that could be sustained between the claw of a hammer breaking as the carpenter pulled a nail, and the undercarriage of a large commercial aircraft failing to lock down due to a faulty forged component. To accommodate all levels of quality assurance between these extremes, a wide variety of testing, both destructive and non-destructive, is employed. To some extent the quality of the forged part is dependent on the raw material supplier. Chemistry and basic cleanliness of the steel, as well as soundness of the original bar or billet, is the responsibility of the steel supplier. This does not, however, relieve the forging company of the obligation to test for these factors if the customer demands it.

Inspection testing is divided into two major categories: "Destructive" and "Non-Destructive" Testing. Destructive testing is where a piece of material, representative of that used in the forging, or a section of a forging, representative of the batch, is deformed, frequently to the point of complete destruction. Non-destructive testing, on the other hand, is testing carried out on the finished forged part, leaving the part in its original unaltered condition.

Hardness testing, though technically a form of destructive testing since deformation of material does occur, is such that the amount of deformation is minimal in most cases and the test is conducted on the surface of the forged part. Other forms of destructive testing are tensile, impact, bend and chemical analysis including spectrographic chemical analysis. Non-destructive testing consists of radiography, die penetrant, ultra-sonic, magnetic particle and eddy current, as well as visual inspection. The most commonly used of all methods, other than visual, are hardness, die penetrant and magnetic particle inspection. Chart No. 4, Appendix "A", shows the various methods employed and the numbers of companies that use each method.

Energy

The forging industry is a major consumer of energy in all its major forms: electricity, oil and gas. In addition to the energy required to operate the machinery to forge, trim and coin the parts being produced, the raw materials must first be heated to the plastic deformation temperature of the steels, approximately 2000°F to 2200°F (1100°C to 1200°C) and usually stress relieved by annealing in furnaces operating at elevated temperatures for several hours at a time. Some companies also use energy in other forms for specific uses, such as propane heaters, gasoline motors, etc.

There were two major difficulties in gathering data on energy consumption and cost. With some companies, the forging operation was one part of a larger manufacturing establishment and energy was tabulated on a plant-wide basis. In other cases, the companies kept records of cost only, on a monthly basis, and only a detailed audit of their records would produce the unit figures requested. Some companies, however, regularly reported both unit and dollar values of energy consumed. Table No. 5, Appendix "A", shows the figures as reported in the survey for 1977 to 1979 inclusive.

Environment, Health and Safety

By the generally accepted definition of the term, "environment" means the exterior conditions that surround the plant and how they contribute or detract from the well-being of the community in which the plant is located. Health and safety, on the other hand, are factors of concern within the plant, the well-being of those that work there and the conditions under which they work.

Except for noise and ground vibration levels, the forging industry is not a serious offender of environmental laws. New installations must take the laws into account and install the necessary safeguards to minimize these conditions. The cost to convert the older equipment, or plants, to comply with these laws would be, in many cases, prohibitive and possibly result in the demise of the company with the resultant loss of jobs and production capacity.

Health and safety, however, are of concern to everyone involved in the industry. Atmospheric conditions, the air which we breathe, is not a serious problem since the forging operation is not a major producer of smoke, dust or toxic fumes. Noise, however, is a major problem. Much can be done to control the noise levels and the harmful effect on the health of the worker. It is a by-product of the production process that can only be eliminated at very high cost. Apart from the fact that we are dealing with moving machinery that can be safeguarded to the point that only deliberate violations of the rules would result in an accident, the products of the plant are, at various stages hot, sharp and heavy.

Programs to improve the health and safety aspects of the industry are a continuing process, involving not only cost, but attitudes of the people involved. Training programs and safety inspections are common in most plants and large sums of money are spent annually to improve these conditions.

Independent of capital cost for modernization and expansion programs for the years 1975 to 1979 inclusive, 13 companies reported spending $1,531,000. Twelve companies predicted that, for the period 1980 to 1985, they would spend $3,167,000 on environmental, health and safety programs.

Modernization and Expansion

The forging industry is capital intensive. No attempt was made in this survey to establish the net worth of the industry, but in current dollars it is safe to say it is in the hundreds of millions. Complete replacement costs would be several times the current net worth.

While much of the industry is operating with old equipment, it is also current state of the art equipment for many purposes. Modern technology has improved the efficiency and productivity of the forging process, especially in steel heating, automatic feed and forging operations and in hammer and press designs. Capital expenditures for the period 1975 to 1979, as reported by 18 companies, were $39,065,000 and the same companies predicted they would spend $50,377,000 over the period 1980 to 1985. These expenditures are in addition to those reported for environmental, health and safety controls.

PART FOUR

SALES AND MARKETS

Method of Comparison

In order to compare the size of one industry with another, various common denominators can be used, viz, total employment, quantities of goods produced, or dollars of annual sales, to name but a few. Every system of reporting has its shortcomings. Employment considerations do not distinguish between a large number of small, inefficient, labour intensive plants and a few very large, efficient, capital intensive plants. Production tonnage figures frequently do not state how much of the purchased steel was subjected to the forging operation and how much was ultimately shipped in its original form, e.g., a long bar or rod that was upset on one end only, or a long rod that had a small eye, or hook formed at the end. This study endeavors to determine the size of the industry in terms of dollars of annual sales. Even here a difficulty arises in that a totally captive shop may report its sales as a simple transfer cost, without including overhead and profit, while another captive shop may sell its products to other divisions of the corporation at a fair market value, including overhead and profit. Also, sales figures do not distinguish between high value alloy steel products made to very demanding specifications and a very low value product made on the same machine.

Total Production and Sales

Within the limitations stated above, 17 companies reported their 1979 sales as $176,813,000 with a total production of 188,769 tons. The following table shows sales values and production for the years 1975 to 1979 inclusive.

YEAR	NUMBER OF COMPANIES	PRODUCTION (TONS)	NUMBER OF COMPANIES	SALES $,000
1975	10	88,940	13	73,471
1976	10	96,811	13	83,549
1977	12	130,684	15	112,951
1978	14	128,763	16	124,953
1979	17	188,769	17	176,813

Most companies that sell outside their own corporate body handle their sales directly, with company employed people. Of the 19 companies reporting, 15 used their own sales staff. In addition to direct sales, other methods were used, frequently by the same company. Five companies used manufacturer's agents especially for export sales and four used brokers, jobbers, wholesalers and other means of promoting their products.

Total sales, as reported by 18 companies, show that 63% is domestic and 37% is exported. However, the percentage of export sales for 1979 varies widely from company to company as shown in the following chart:

TOTAL SALES (%)	NUMBERS OF COMPANIES	
	DOMESTIC SALES	EXPORT SALES
Up to 25	3	7
25.1 - 50	2	5
50.1 - 75	4	2
Over 75	9	1

The automotive industry was the largest single market in 1979, representing 36.3% of total plant shipments. Of this figure, however, 79% of the automotive shipments, or 28.8% of total shipments went to the truck, bus, trailer and related parts market. Only 7.5% of total shipments were for passenger cars and parts. The second largest market or 30.8% of total shipments was for railway equipment. The balance of total shipments was for a wide variety of applications as shown in Chart No. 6, Appendix "A".

Export Sales

Of the 37% of total shipments in 1979 that went to export, 44.9% was destined for the truck, bus, and trailer parts market and 14% was for passenger car parts. A further 13.1% went to railway equipment, and 12.1% was for mining and material handling equipment. The balance, 15.9%, went to a variety of applications as shown on Chart No. 7, Appendix "A".

Generally speaking, the only constraint to export markets, of which 95% was to the United States, is the normal tariff. One exception to this is a current countervailing duty of 15% on fasteners going into the U.S.A.

The Future

Sixteen companies predicted an annual average domestic growth rate for the industry of 8.7% over the period 1980 to 1985, and 13 companies predicted an export market growth rate of 13.6% annually over the same period. Major areas of growth are expected to be in the manufacture of valves, off-highway equipment, agricultural equipment and truck and bus parts. Of the six companies that forcast some market area declines, both domestic and export, four identified the automotive industry and two identified the agricultural equipment sector.

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APPENDIX A

INDEX OF SUPPORTING DATA CHARTS

CHART NO. 1

MANPOWER DISTRIBUTION

FUNCTION	1977 (13 Companies) EMPLOYEES	1977 (13 Companies) % of Total	1978 (15 Companies) EMPLOYEES	1978 (15 Companies) % of Total	1979 (15 Companies) EMPLOYEES	1979 (15 Companies) % of Total	AVERAGE AGE 1979
Managerial	43	2.1	52	2.3	66	2.5	45
Sales & Marketing	30	1.5	35	1.6	44	1.6	40
Technical Staff	53	2.6	69	3.1	77	2.9	41
Clerical	111	5.5	119	5.3	147	5.5	35
Production Supervisory	97	4.8	107	4.8	130	4.9	43
Hammer Operators	149	7.4	164	7.3	222	8.3	39
Forging Press Operators	105	5.2	117	5.2	145	5.4	39
Upsetter Operators	127	6.3	131	5.9	148	5.5	39
Production: All Others	896	44.4	981	43.9	1,139	42.5	39
Maintenance	253	12.5	274	12.3	327	12.2	41
Tool & Die Makers	156	7.7	185	8.3	232	8.7	45
Totals	2,020	100.0	2,234	100.0	2,677	100.0	-

CHART No. 2

STEEL HEATING FACILITIES

TYPE OF UNIT	NUMBER OF COMPANIES	NUMBER OF UNITS
Oil-fired slot	7	80
Gas-fired slot Furnace	13	65
Combined gas and oil Fired slot furnaces	1	3
Electric induction heating	8	58
Oil-fired box furnace	0	0
Gas-Fired box furnace	6	8
Rotary hearth furnace	3	8
Other	3	4

CHART No. 3

FORGING PRACTICES EMPLOYED

TYPE OF UNIT	NUMBER OF COMPANIES	NUMBER OF UNITS
Gravity drop hammer	11	102
Power-assisted drop hammer	9	46
Mechanical Press	10	42
Hydraulic press	5	9
Upsetting	12	71
Cold forging	3	15
Ausforging (warm forging)	0	0
Roll forging	10	31
Coining press	10	38
Trim Press	17	199

CHART No. 4

QUALITY ASSURANCE FACILITIES

TYPE OF TESTING FACILITY IN 19 COMPANIES	NUMBER OF COMPANIES
Tensile	9
Impact	8
Bend	6
Hardness	19
Radiography	3
Dye penetrant	18
Ultrasonic	5
Magnetic particle	14
Chemical	6
Spectrographic	4
Eddy current	3

CHART NO. 5

ENERGY CONSUMPTION

	1977	1978	1979
Electricity:			
Number of Companies	12	13	15
M-Kwh.	141,271	139,314	159,066
$'000	2,527	2,940	3,755
OIL:			
Number of Companies	6	7	9
M-Gallons	3,828	4,142	4,551
$'000	1,333	1,702	2,125
GAS:			
Number of Companies	10	12	13
MM-Cu.ft.	1,828	1,966	2,049
$'000	3,454	4,204	4,830
OTHER:			
Number of Companies	3	3	3
$'000	48	47	47
TOTAL $'000	7,362	8,893	10,757

CHART NO. 6

1979 TOTAL INDUSTRY SHIPMENTS

(Net tons reported by fifteen companies

INDUSTRY SECTOR	Total Plant Shipments: Net Tons:	As a Percent Net Ton
Farm machinery and equipment	11,327	7.2
Aircraft:		
Engines and parts	1,118	0.7
Parts and auxiliary equipment	199	0.1
Automotive:		
Passenger cars and parts	11,170	7.5
Trucks, buses, trailers	45,431	28.8
Internal combustion engines (stationary)	312	0.2
Metalworking and special industry machinery	5,515	3.5
Mechanical transmission equipment	282	0.2
Off-highway equipment: construction, mining and material handling	8,493	5.4
Ordnance (except missiles)	1,853	1.2
Oil field machinery and equipment	1,394	0.9
Plumbing fixtures, valves and fittings	2,831	1.8
Pumps and compressors	598	0.4
Railroad Equipment	48,519	30.8
Refrigeration, air conditioning & heating	68	--
Mining and construction machinery and equipment	2,576	1.6
Electrical power transmission & pole line hardware	8,782	5.6
Other applications n.e.s.	6,601	4.1
TOTALS	157,669	100.0

CHART NO. 7

1979 TOTAL INDUSTRY SHIPMENTS

(Net tons reported by fifteen companies

INDUSTRY SECTOR	Export Shipments Net tons	As a percentage of	
		Total Exports	Sector Exported
Farm machinery and equipment	530	0.9	4.7
Aircraft:			
Engines and parts	6	-	0.5
Parts and auxiliary equipment	56	0.1	2.8
Automotive:			
Passenger cars and parts	8,129	14.0	69.1
Trucks, buses, trailers and related parts	26,085	44.9	57.4
Internal combustion engines	312	0.5	100.0
Metalworking and special industry machinery	2,581	4.4	46.8
Mechanical power transmission equipment	43	-	15.2
Off-highway equipment: construction, mining and material handling	7,011	12.1	82.6
Ordnance (except missiles)	1,465	2.5	79.1
Oil field machinery and equipment	-0-	-	-
Plumbing fixtures, valves and fittings	72	0.1	2.5
Pumps and compressors	523	0.9	87.5
Railroad Equipment	7,592	13.1	15.6
Steam engines & turbines (except locomotive)	-0-	-	-
Mining and construction machinery and equipment	1,323	2.3	51.4
Electrical power transmission & pole line hardware	442	0.8	5.0
Other applications n.e.s.	1,956	3.4	22.3
TOTALS	56,126	100.0	36.9

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APPENDIX B

The names of the Canadian manufacturers of closed impression die forgings contributing data to this study are shown below.

Alberta Forged Products Ltd	Edmonton, Alberta
Canada Forgings Co. Ltd.,	Welland, Ontario
Canadian Racing Plate Co. Ltd.,	Niagara Falls, Ontario
Dominion Forge Co. Ltd.,	Windsor, Ontario
General Drop Forge Ltd.	Welland, Ontario
General Motors Company of Canada Ltd	St. Catharines, Ontario
Haun Drop Forge Co. Ltd.,	Welland, Ontario
Hayes - Dana Ltd.,	St. Catharines, Ontario
Hawker Siddeley Canada Inc. Canadian Steel Wheel Division	Montreal, Quebec
Joslyn Industries (Canada) Ltd.	Lachine, Quebec
List Bolt and Chain Ltd.	Richmond, B.C.
M.B.E. - Dominion Bridge Co. Ltd.	Winnipeg, Manitoba
McGraw-Edisson of Canada Ltd.	Scarborough, Ontario
P.C. Drop Forgings Ltd.	Port Colborne, Ontario
Slater Steel Industries	Hamilton, Ontario
Stelco Inc.	Gananoque, Ontario
TRW Canada Ltd	Welland, Ontario
Western Rock Bit Co Ltd.	Calgary, Alberta

Canada

(aussi édité en français)