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STUDY OF THE AEROSPACE MACHINE SHOPS IN CANADA

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STUDY OF THE AEROSPACE MACHINE SHOPS IN CANADA

MAY 1989

Prepared by: John MacNamara, Consultant

On behalf of: The Specialist Firms Division
Aerospace, Defence and Industrial Benefits Branch
Department of Industry, Science and Technology

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I

INTRODUCTION

This is a report on a study of the aerospace machine shop industry sector in Canada. It was conducted on behalf of the Specialist Firms Division of the Aerospace, Defence and Industrial Benefits (ADIB) Branch of the Department of Industry, Science and Technology. The primary purpose of the study was to gain insight into the direction in which the machine shop sector is heading in Canada. It was designed to further ADIB's understanding of the market so that the Branch might continue to develop the strategies necessary to ensure long-term growth and competitiveness in the industry. The study concentrated on the role played by machine shops in building and supporting a strong, viable aerospace industry in Canada, and examined the relationship which has developed between the machine shops and the prime contractors.

The study collected data including the size and location of selected machine shops, their specialist capabilities, plans for the future and the expected impact of new technology. It attempted to identify trends with respect to new materials and equipment that will be used in the years ahead. Also, the study examined the participants' perception of the Defence Industry Productivity Program (DIPP), its purpose, its impact and, as well, specific suggestions for improving the program.

Also covered was the strategic relevance of the machine shops to the prime contractors and the latter's views as to the strengths and weaknesses of the machine shops in general. In this regard the study was designed to gather sufficient information to permit better informed decisions respecting the ongoing delivery of DIPP assistance to the machine shop sector.

The study was not intended to be a critique of DIPP, its procedures, assessment criteria or levels of support. No consideration was given to the appropriateness of the existence of such a program, but rather to ways of improving it.

Further, the study was not a statistical exercise and very little quantitative data was collected.

The work was conducted in two phases. In order to assess the machine shops' position, it was decided to examine their relationship with the primes. Accordingly, through the use of a structured questionnaire, Phase I addressed five prime contractors and two subsystem suppliers in Canada, and asked about their dealings with machine shops. Specifically discussed were the services provided by machine shops, the criteria used to select machine shops, new aerospace programs and technological changes expected, policies regarding supplier development including Canadian content and the primes' general observations. Taken together, this was deemed to comprise the "state of the nation".

In Phase II, the study examined responses from 41 machine shops to several issues including those raised in Phase I. Again, a structured questionnaire was employed to gauge machine shops' present capabilities, their perceptions and plans, in order to assess their preparedness for dealing with the primes in the future.

II

EXECUTIVE SUMMARY

The aerospace machine shop industry sector in Canada is strong, vibrant and very competitive. It is managed by entrepreneurial shop floor veterans who often wear many hats within their organization rather than bear the extra overhead of having more people on the management team. Most of the machine shops that participated in this study serve primarily the aerospace sector. They have little, if any, presence in the commercial area and are, therefore, vulnerable to changing fortunes of the prime contractors.

The very existence of the machine shops, or third tier, allows the prime contractors and major subsystem suppliers, or first and second tier respectively, to retain control over their operations and focus on final assembly of larger components. The machine shops compete for work on the basis of price, ceteris paribus. They are constantly driven to upgrade equipment and facilities to improve productivity and maintain cost competitiveness.

The primes let out all kinds of work to the machine shops. For the most part, it is build-to-print machining sub-contracted for cost savings. While the parts may be very complex or susceptible to scrapping or may require specialized equipment, the underlying technology is readily available to the sector if not already resident within most machine shops. In a sense, the outside shops provide extra capacity for the primes. Much of the work is described by the machine shop operators as "headache" work. By and large the buyers focus on quality, price and delivery, in that order.

Not only are they customers of the machine shops, the primes become competitors for work when the business cycle turns down. Most possess the same equipment and capabilities as the machine shops, but have the added advantage of being

able to lure away trained people because of their generally higher wages and other employment benefits.

There appear to be no burning issues confronting the machine shops in today's market. They generally respond to the demands of the primes and often this requires speedy turnaround and up-to-date, highly productive equipment to be competitive. The majority of machine shops stated they could absorb more work but are limited by their size and availability of trained personnel. New equipment being installed is primarily for productivity and capability reasons. Increased productivity allows lower prices and extra capability allows the shops to offer a broader range of services to their customers. When productivity and capability are increased, higher capacity results as well.

Future work is expected to be essentially the same as that of today according to primes and sub-contractors alike. However, the market will be more competitive because there is more and more highly productive equipment becoming available. Now, since most shops have found and exploit specific niches in the market, e.g. structural components, intricate components such as engine shafts, gears, sealing rings, manifolds etc., special alloys, advanced 5-axis machining, not all will adopt the same new technology. But within distinct groups of competitors, as soon as one player upgrades his capability, the rules of the game change. The bottom line remains price, and, to compete, others will have to follow suit.

Other possible developments include a change in the face of the players. The old guard consists of machinists who responded to the urge to go it alone and start their own company. The people on the shop floor now are either quite young, just recently out of school, or approaching retirement. Just who will replace the shop owners and managers is unclear, save for some family run businesses where sons and daughters are involved. What we are also seeing, although to a much lesser degree, is professional management in the form of holding companies and large diversified organizations seeking to expand their range of operations.

Whatever the nature of the work, whoever the players are, one fact remains clear: in a competitive market, a most important concern is price and to compete on price requires high productivity. If Canada is to maintain a strong, competitive aerospace machine shop industry, a process of never ending improvement in productivity is

necessary. This sector is essential to the infrastructure of a competitive and profitable aerospace industry in Canada. The DIP program, despite some wrinkles, is now and will continue to be an important element of that process.

III

PHASE I, THE PRIME CONTRACTORS IN CANADA

This chapter is a review of the findings of the in-person interviews with five prime contractors and two subsystem suppliers. First is a summary of the major findings and the thrust of their comments. This is followed by a list of those consulted and the specific issues discussed. These are: the services contracted to Canadian machine shops; the criteria used to select a particular shop; the number and general nature of new aerospace programs expected over the next three years; supplier development and Canadian content policies used by primes; new technology and new materials being introduced; and, the strengths and weaknesses of the Canadian machine shop sector as perceived by the primes.

A. MAJOR FINDINGS

Prime contractors in Canada use outside machine shops for three fundamental reasons: they can get their work done better, cheaper, and faster than if they do it in-house. Most report that they subcontract because of their own lack of capacity. This is in part true because primes intentionally keep the level of in-house machining activity at a constant moderate level. This allows them to adjust to business swings by putting more work out when they are busy and repatriating work when they are not.

This perceived lack of in-house capacity leads to the image of outside machine shops as being "overflow capacity". In fact, one can imagine the notion of renting capacity from outside.

Primes will put just about any machining job outside and it is for the most part essentially build-to-print work. Overall, only about 5% of it really requires highly specialized equipment like 5-axis machine centres or electric discharge machines

(E.D.M.). They like to see, and indeed encourage machine shops to install such equipment because of the resulting increases in their productivity, capability and capacity. This allows the machine shops to respond readily to schedule changes, to do jobs faster and less expensively due to fewer set-ups.

Some primes use, or have approved the use of, as many as 200 outside shops. They do not classify them as to type or service offerings, although as many as 70% of these shops do roughly the same kind of work for the prime.

The selection of a machine shop for a job centres on three basic criteria; quality, price and delivery. There are certain situations in which a buyer must look beyond these, though. This is when specific capabilities are in short supply. For example, swaging, gear cutting and chemical milling are services which are difficult to source in Canada and buyers will often source this work in the U.S.

Current proportion of machine shop work sub-contracted is reportedly about 65% by part number and 50% by dollar value. As a result of offloading of work to outside shops, this volume is expected to grow at about 20% per year.

New aircraft programs expected to come on stream over the next three years are expected to add an additional 15% volume growth during that time. However, it is also expected that this new work will be essentially the same as that currently being done. That is, the same equipment and skill sets will be able to do it. Of course, as new technology develops, those shops adopting that technology will be advantaged in terms of cost-competitiveness.

All the primes interviewed maintain that they have supplier development and Canadian content policies in place. However, these policies were not formally documented but rather existed as credible intentions to support their supplier base and to buy the maximum amount from Canadian vendors.

New technology implemented by the prime contractors includes flexible manufacturing systems (FMS), just-in-time (JIT) delivery systems and computer aided design and manufacturing (CAD/CAM). New materials gaining ground are precision castings and hard alloys. Composites do not appear to be practicable at least for components that are now machined. That is, the primes do not see composites as materially affecting the level of machining in the next 10 to 15 years.

The primes observed that Canadian machine shops generally provide good quality, prices and delivery. They would prefer the machine shop operators to be more aggressive in following-up sales calls and to be less risk averse in terms of acquiring new capabilities in anticipation of a demand rather than reacting only after the need has been recognized. They also remarked that some business management skills could be sharpened. Those mentioned include costing and shop floor controls.

B. RESULTS OF INTERVIEWS WITH PRIME CONTRACTORS

1.0 Prime Contractors Consulted

The seven prime contractors and major subsystem suppliers in Canada participated willingly and openly discussed their views and concerns. These companies are listed below:

United Technologies Pratt & Whitney Canada
Canadair Aerospace Group
McDonnell Douglas Canada Ltd.
de Havilland Aircraft Co. Ltd.
Bell Helicopter Textron
Menasco Aerospace Ltd.
Heroux Inc.

2.0 Services Contracted to Canadian Machine Shops

2.1 Reasons for Sub Contracting

The primes listed eight major reasons for contracting out work. Most often cited was the lack of capacity in their own machine shops. That is, they consider the outside shops to provide extra or overflow capacity. Six of the seven primes listed this reason. The only other reason mentioned by more than one prime was cost. Two correspondents said it is less costly to get work done outside than in-house. This is likely because of lower overhead costs at the outside shops.

Other reasons included security of supply since outside shops represent a second source, lack of space, lack of skilled workers, and one respondent stated that company policy mandates the use of outside shops. All things considered, the use of machine shops allows the primes to increase the level of their own business without having to absorb related capital expenditures or to undertake plant expansions.

2.2 Nature of Work Sub-contracted

With the exception of one company, all participants described the work they sub-contract as build-to-print machining. It may be small, medium or large parts and in a variety of materials. Just about any part may go to an outside shop, according to those interviewed.

As a rule, none of the primes questioned expect design or engineering work from the machine shops other than some tooling. Tool design is normal because tooling has to be compatible with the equipment on which it will run and which will vary from shop to shop.

2.3 Work Requiring Specialized Equipment or Skills

Participants were asked whether the work they sub-contract requires machining on highly specialized equipment such as 5-axis machine centres. Most reported that the proportion of such work is low, typically about 5% and is not anticipated to grow significantly.

They regard such equipment as only one way of approaching a job and they realize that with a little ingenuity, some extra fixtures and a little time, what is often considered as 5-axis work can often be done by some machine shops, competitively, on 4- and sometimes 3-axis equipment.

Similarly, most participants felt that very little of the work they sub-contract requires any unique or special skills which are not available in-house. Exceptions may be in the area of gear making, chemical milling and E.D.M. It was observed that the advent of CNC equipment has changed the manner in which machine tools are integrated into the manufacturing process and has created the need for a new breed of skilled personnel, i.e. machine programmers. CNC has de-emphasized the operator's

conventional skills and put more emphasis on set-up capabilities. The result of this is that one operator can monitor several machines, once they are set-up. And, in instances of sufficiently large cycle times, machines may be set-up during the day, and run through the night which provides better equipment utilization, increased production, and a greater distribution of overhead costs. Further, it obviates the need for duplicate equipment that would be run on day shifts to get the same production in 8 or 10 hours as is possible by running around the clock.

2.4 Volume of Work Sub-Contracted

In terms of part numbers, the proportion of work sub-contracted by primes reportedly ranges from about 25% to 100%, with a median of about 65%. The proportion, by dollar value, ranges from about 30% to 100% with a median of about 50%. The value of work sub-contracted to machine shops ranges from 7% to 90% of the total value of purchases. The median is 25%. The fact that the median number of parts sub-contracted is higher than the median dollar value may suggest that the primes are inclined to offload parts which can be machined more economically outside while they keep the more difficult and more expensive work in-house.

All but one prime said that volume of work being sub-contracted is increasing. Estimates of growth ranged from 10% to 100% with a median of about 20%. Participants cited business expansion and offloading as the reasons for this growth. That is, they are putting proportionately more work out, and the volume is growing as their business grows. This, in turn, is a result of new aerospace programs expected to come on stream as well as the continuation of existing ones. With one exception, all the primes said they sub-contract more work to Canadian machine shops than to those in the U.S. Estimates by part number ranged from 15% to 90% of the work being given to Canadian shops, with a median of 80%. Responses were similar in terms of dollar value. Reasons given for choosing U.S. machine shops will be discussed below in Section 3.2 "Relative Importance of Criteria".

2.5 Number and Classification of Machine Shops Used

The primes reported that they deal with up to 200 outside machine shops in some cases. The median number was 110. Further, a significant proportion (as much as 70%) of the work done at these shops is interchangeable from shop to shop. The remaining 30% is more specialized work which is traditionally performed by only a few machine shops (can be single source in some instances) which have the required expertise and/or equipment.

The primes do not systematically categorize the machine shops in any way. They maintain approved vendor lists which identify the machine shops approved to supply work on a particular part.

Therefore, while it may be that different machine shops service different needs for the primes, and while they may have certain capabilities and marketing thrusts that really could be used to define groups of machine shops, this is transparent to the prime contractors.

2.6 Material and Tooling Supplied by Prime Contractors

Historically, the primes have used their purchasing power to buy material and supply it to the machine shops less expensively than the machines shops could buy it themselves. While this practice allows the primes to control what was being used for their parts, it also adds some administrative as well as inventory costs.

As competition increases and the primes are forced to better control costs, there is a move to require the machine shops to accept the responsibility for purchasing, controlling and tracking their own raw material. This will add to their costs and put pressure on their pricing. Inventory financing will thus become an added factor for the machine shop operator to consider.

Whereas tooling costs are normally quoted when the job is bid, the primes will supply tooling if and when it is available. Otherwise, the machine shop will supply the tooling and the associated costs will be paid by the prime, either up front or over the life of a specific contract. No changes are anticipated in this area by the prime contractors questioned.

3.0 Selection of Machine Shops

3.1 Criteria Used

The prime contractors agreed that the following were the major criteria used in selecting a machine shop. In order to give recognition to the relative importance of a first, second or third ranking, each criterion was weighted in accordance with its order of selection by the prime. A first selection ranking was awarded 3 points, a second place 2 points and a third place 1 point. The resulting scores are listed below.

	No. Times Ranked			
	1st	2nd	3rd	Score
. Sophisticated quality control and demonstrated good quality	4	2	-	16
. Price	2	1	3	11
. Specialized equipment not available at other shops	1	1	1	6
. Delivery	-	1	2	4
. Experience of management and shop floor personnel	-	1	2	4
. Favourable dealings in the past	-	1	1	3

3.2 Relative Importance of Criteria

As can be seen in the summary of rankings above, the two criteria scored most highly were quality and price with scores of 16 and 11 respectively. Also, since "favourable dealings" were thought of as good service and delivery, it is fair to say that delivery is one of the key criteria. This is consistent with the comments of several of

the primes who said that their objective in sourcing work is to find service that is "better, cheaper, faster".

Concerning the relative importance of price, the correspondents were asked if there were circumstances under which they might pay a premium for machine shop services if they had reason to expect some form of favourable treatment such as expedited service. The answer was no, unless quality and delivery would be improved commensurately.

The primes were asked why they would consider using U.S. machine shops rather than ones in Canada. The two common responses were price and lack of capability in Canada. There appears, at least to the prime contractors, to be a need for some specialized capability not presently available in this country. Specifically, they note insufficient capabilities for swaging, some gear cutting, chemical milling and E.D.M.

The primes were also asked if there are any machine shop services which are only available from one or two machine shops in Canada. Gears, splines, swaging and, to some degree, material processing appear to be the areas of most concern in this regard. Some primes mentioned that 5-axis capability was limited, but also pointed out that the volume of purely 5-axis work is small and is not expected to grow appreciably, at least in the near to medium term. One correspondent nevertheless indicated that he supports those machine shops having 5-axis equipment with multiple spindles because the speed of this equipment allows the machine shops to respond quickly to the primes' schedule changes.

4.0 New Aerospace Programs

4.1 Expected Increase in Volume

The primes interviewed all anticipated undertaking new aerospace programs in the next three years. This is in addition to ongoing programs and modifications to existing systems. Partly as a result of the new programs, they expect the volume of work subcontracted to outside machine shops to increase in those three years, in some cases by as much as 100%. The median estimate was 15%. It should be noted that some of this will be as a result of deliberate offloading of machine shop work by the primes.

This, they say, is to enable them to focus their efforts on final assembly, while maintaining a core machine shop operation that can be held at a fixed level of output by farming out the overflow to outside shops.

4.2 Expected Nature of New Work

Those interviewed said that the nature of the new work will remain essentially the same as at present. No new equipment or skills or substantially different materials are anticipated. A few of the primes indicated, however, that they expect that machine shops will have to adapt to changes in technology both in the shop and in the office. This issue is further examined below in Section 6.0, "New Technology".

5.0 Supplier Development, Canadian Content Policies and Industry Infrastructure

5.1 Supplier Development

All the primes interviewed described some sort of supplier development policy. Most of these were implemented in the past two years. These were not formally documented, but rather existed as management's intentions regarding supplier development. These intentions sprang from the recognition that to have a good, reliable, cost effective supplier base, it is necessary to cooperate with the machine shops. Accordingly, the intentions are, while not spelled out, to "develop Canadian suppliers". It appears that some progress has been made to set quantitative targets and/or measures of support.

5.2 Canadian Content

Canadian content policy appears to be largely reactive, a direct result of conditions placed in Memoranda of Understanding (MOU's) with Ottawa. Again, no formally documented or quantified policies were evident. However, corporate policy was usually stated as "maximum possible Canadian Content", or "Canadian wherever possible".

5.3 Industry Infrastructure

In the past two years, most primes interviewed have become aware of an increasing number of machine shops which are soliciting aerospace work in Canada. Many of these new entrants appear to be in southern Ontario. During this time, though, some primes have sought to rationalize their supplier base and have in a number of cases chosen to deal with fewer shops. This appears to be somewhat of an anomaly considering the increasing demand by primes for machining services and their clear intentions to step up their supplier development initiatives.

The correspondents were asked whether they might acquire an outside machine shop to broaden their capability or expand capacity. Most said no, that they are not in the machine shop business. However, one or two mentioned that it might be considered in order to have a low-cost facility at their service. One also said it could be attractive because it represents some measure of integration, which would allow the company to grow faster.

6.0 New Technology

6.1 Manufacturing

The primes reported some significant technological advancements in the past two years. These range from the establishment of a new computer integrated manufacturing facility in Halifax, to a complete re-thinking of the manufacturing operation at existing facilities. Included in these advancements have been CAD/CAM, FMS, JIT production, Materials Requirements Planning (MRP) and cellular production.

6.2 Materials

New materials introduced include precision castings in aluminum, new aluminum alloys and harder steels. The impact of these new materials, both in-house and at the outside shops, appears to be minimal beyond requiring better cutting tools and a slight reduction in the amount of machining required in the case of precision castings.

Composites are still being investigated, but have not reached the level of importance that they were once expected to achieve. Over the next five, ten and fifteen

years, those interviewed at the primes expect the impact of composites on the level of machining required to be minimal, minimal and medium respectively.

7.0 Perceived Strengths and Weaknesses of Canadian Machine Shops

Overall, the primes interviewed agree that Canadian machine shops have good equipment, produce good parts, are competitively priced and deliver reasonably well on time. Since quality, price and delivery are the three most important aspects of dealing with machine shops, the Canadians appear well-positioned to enjoy the growth in work sub-contracted over the next three years.

There are also some weaknesses, as perceived by the primes. Foremost among these is a lack of aggressiveness and desire to get out and chase the work available. Coupled with this is, in their minds, an aversion to risk that prevents the machine shop owners from upgrading their equipment without first being certain that there is a demand for the improved capability.

Some of the primes would like to see a broader range of services offered by the machine shops. Material processing was cited as an example. They believe, though, that many shop owners are content to stay small and are not all interested in expanding their services.

A few of the primes thought that some basic management skills were in need of improvement. They believe that, in some cases, controls over business aspects such as costing, shop floor operations and quality could stand strengthening. They realize that the smaller shops, at least, are often owner operated and the main strength is machining, not business administration. They understand, also, that to affect the improvements they would like to see would be expensive in that they would require adding permanent overhead in the form of business professionals. Small machine shop operators are likely to resist taking this step.

IV

PHASE II, THE MACHINE SHOPS

In this chapter, we identify the issues raised for investigation in Phase II and review the responses from the 41 machine shops that participated in the study. Of this number, 10 were visited in person; the remainder corresponded by mail. In some cases, follow-up telephone conversations were held to clarify certain points or complete missing information.

We begin with a list of the issues covered and a summary of the major findings from Phase II. This is followed by a detailed review of participant characteristics and the equipment they use, their perception of their role with the prime contractors, their understanding of the selection criteria used by the primes in choosing a machine shop, an examination of how they compete with each other, and their views on emerging technology and of the DIP program.

A. ISSUES RAISED FOR INVESTIGATION IN PHASE II

1.0 Identification of Issues

A major consideration in Phase I was the identification of issues that are likely to confront Canadian aerospace machine shops in the near to medium future. The questionnaire employed was designed to provoke thought and hopefully raise issues in the minds of the prime contractors interviewed. The questionnaire employed in Phase II to interview machine shop operators was designed around these issues. Topics covered included the following:

a) Characteristics of machine shops
   - Structure
   - Sales

- Areas of specialization
- Labour force
- Facilities
- Capacity utilization

b) Competitiveness
   - Attempts at differentiation
   - Competitive advantages/disadvantages
   - Strengths/weaknesses vis-a-vis U.S. shops
   - Importance of new equipment
   - Need for training
   - Value of expanding range of services offered
   - Value of forward integration

c) Perceptions Regarding Equipment
   - Importance of sophisticated equipment
   - Degree of computerization
   - Capital expenditures

d) Relations with Prime Contractors
   - Reason for sub-contracting
   - Perceptions regarding nature of sub-contract work
   - Barriers to more work
   - Technological advances expected
   - Amount of repeat business
   - Expected impact of supplier rationalization
   - Amount of pure research and development performed
   - Complaints voiced by primes

e) Technology
   - Volume of work requiring specialized equipment
   - Availability of design, engineering services
   - New aerospace programs, volume and nature of sub-contract work expected
   - New materials and trends observed

f) Selection of Machine Shops by Prime Contractors
   - Criteria used
   - Relative importance
   - Fundamental qualifications

g) Role of Government
   - Perceived intent of DIPP
   - Weaknesses observed in DIPP
   - Changes to DIPP

B. MAJOR FINDINGS

The 41 machine shop participants are located across the country; the majority are in the Montreal and Toronto areas. The median experience in aerospace is 13 years; average is 16 years; median sales last year were $1.9 million, average was $3.2 million; median employment is 36 people, average is 51 and most shops reported difficulty finding skilled machine operators, particularly for their CNC equipment.

Most shops run 2 shifts per day and a half day on Saturday. Generally, the participants felt they could absorb some additional work. This is consistent with the utilization rates reported. However, many shops reported they could not absorb more work because they don't have the people to do it.

Most companies have CAD/CAM (83% of responses), over half have a co-ordinate measuring machine (CMM) (58%) and almost three quarters have a 4-axis machine. Many shops do "5-axis work" on 4-axis machines by using specially designed fixtures and a number of set-ups.

There is still a lot of conventional equipment in use. However, CNC is becoming more and more prevalent. At the time of this study, about 45% of equipment used is CNC. Respondents noted that, in order to be competitive, and maybe even to qualify as a supplier to the prime contractors, more and more equipment will have to be CNC.

Seventy-five percent of the machine shops in this study installed new equipment recently without which, at least one contract would have been lost. The main

reason for installing this equipment was to increase productivity in order to be competitive.

In the past three years, median spending on equipment has been 51% of the sales realized during the last completed fiscal period. Average expenditure was 53%. Forecast expenditures are greater at 63% of sales (median) and 79% average. Historic and forecast median expenditures on buildings are zero and 13% respectively. Averages are 7% and 24% respectively.

The machine shops believe that the main reason that the primes put work out to sub-contractors is a lack of capacity in their own shops. This is followed by quality, price, and delivery considerations.

Machine shops are of the opinion that the primes sub-contract work that, for one reason or another, they don't want in-house. In many cases, it is complex machining, i.e. headache work; it may be especially susceptible to irreparable errors causing scrap or it may be less expensive to do outside than in-house. Often primes turn to outside shops when they have a scheduling problem and need work done quickly. Much of the work machine shops get is repeat business. Seventy-five percent repeat business is median. Most of the participants (80%) feel that they will not be negatively impacted by the supplier base rationalization that primes are currently going through. The obvious reason is the rapidly increasing demand for machining work.

In the short-term, machine shops report they expect to have to install new equipment that will produce parts faster and less expensively than at present. Some of this will include high speed and multiple spindles, special cutters for the new harder alloys, electronic data interchange (EDI) and more sophisticated CNC.

Whereas the primes' biggest complaint about machine shops was a lack of aggressiveness, the machine shops perceive it to be slow delivery. Evidently, whether it is a problem or not, delivery is a "hot button". Participants believe that the primes use quality, price and delivery as the most important criteria in selecting an outside shop.

While there does not appear to be much attempt at deliberate differentiation, most shops have identified and pursue specific niches in which they excel. As such, there are shops that do large structural components, others focus on landing gear components, some do small electronics components and so on.

Many respondents believe that their competitive advantages are quality, price and delivery. It is evidently a very competitive market. Disadvantages cited often focused on a lack of highly productive equipment needed to compete in that market.

In order to attract new work and level-out the business cycle, many machine shops are planning to acquire new capability. Most plan some vertical integration, generally into sub-assembly work. This has low entry and operating costs and can be profitable. The primes are likely to respond favourably because this would allow them to focus their efforts on final assembly of larger components.

New aerospace programs are expected to generate a median 35% more work over the next three years. Machine shops believe that the nature of the work will generally be the same as now but they expect that competitive pressures, including pricing, will cause them to upgrade their equipment just to be cost-competitive, not because the work itself demands it.

New materials are, and will continue to be, harder and will require better cutters to work them. Nobody expects much impact from composites for at least 5 years.

Almost every participant endorsed the DIP program. They report that it has allowed them to upgrade their facilities in order to maintain cost-competitiveness and to grow. Many said that they could not have undertaken some of their modernization projects without DIPP assistance.

Three quarters of respondents understood that DIPP is primarily intended to foster the creation, development and implementation of new technology in order to acquire new capabilities and be more productive. A handful, though, believe that it is simply there to help them increase existing capacity.

One or two complaints were voiced regarding the DIPP application process. It is complicated for the first-time applicants. A number of people expressed a wish that the approval time could be shortened from current levels. Some suggested that more emphasis should be placed on helping machine shops, and less on helping the primes.

C. RESPONSES FROM MACHINE SHOPS

1.0 Number and Nature of Machine Shops Participating

1.1 Number and Location

In all, 41 machine shops involved in aerospace work participated. Of these there is one in the Maritimes, 16 in Quebec, 15 in Ontario, two in Manitoba, three in Alberta and four in British Columbia. All but three are privately held companies and only eight have some kind of affiliation to another company. Twenty-five of the respondents own their facilities while the balance lease.

1.2 Experience in Aerospace

Years experience in aerospace work ranges from 1 1/2 to 48 with a median of 13 years and an average of 16 years. Taken together, these 41 companies had sales in 1988 of $130 million with individual sales ranging from $500 thousand to over $16 million. The median sales value for last year was $1.9 million; average was $3.2 million.

1.3 Employment

The companies participating in this study employed, at the time of the study, a total of just over 2,000 people. Total employment ranged from 4 to 250 with a median of 36 and an average of 51. Management, supervision, inspection, and office staff ranged from 2 to 50 with a median of 5. Shop floor totals ranged from 2 to 243 with a median of 30. Total counts of professional engineers or technically accredited people ranged from zero to 50; median here was 4. People on staff with formal business training ranged from zero to 2 with a median of 2 as well.

1.4 Recruiting

The majority of respondents reported difficulties in recruiting staff. The problem most often cited involved finding experienced, skilled operators, set-up personnel and programmers capable of working independently without further training. As a result, many machine shops are having to provide in-house training to upgrade the skills of

their employees, many of whom are recent graduates from community colleges. This places an additional burden on the shops since trainees may not be as productive as experienced personnel. Also, many shop operators reported that they are often raided by the primes and major sub-contractors which are also continually looking for trained people. Thus, machine shops often act as a training facility for their own customers.

1.5 Capacity

Participants were asked to report overall capacity utilization relative to an arbitrarily defined scale. For the purpose of this study, 100% utilization was taken to mean operating two ten hour shifts per day, five and a half days per week, 50 weeks per year. This is a common practice. This was used as a benchmark for comparison and to ensure uniformity in the responses.

It should come as no surprise that many shops reported utilizations somewhat lower than 100%. Given problems in recruiting set-up personnel, managers often prefer not to run night shifts unless machines can be set-up during the day and run all night. Also, the shortage of skilled machine operators often precludes operating second and third shifts. Even so, key equipment normally is fully utilized during operating hours. Generally, most shops cannot run 24 hours per day because they lack the necessary supervision and manpower to run the equipment. It should also be noted that many companies have had bad experiences with night shifts. Excessive scrap, absenteeism, vandalism and other problems are not uncommon.

Some shops are running 24 hours per day and capacity utilizations of over 100% were reported based on the above definition. The managers of these operations recognize the importance of getting the productivity from their equipment, fully absorbing overhead and the cost savings of running one machine around the clock rather than duplicating equipment and only running it on one shift. But, as noted above, not everyone can do this. It was interesting to note that some respondents were stirred to thinking about their practices when they calculated their utilizations to be low. At least one manager said that his company was now actively reconsidering its current practice which is to operate one shift and then have the equipment idle for 14 to 16 hours.

Current capacity utilization reported ranged from 37% to 136%. The median and average was 80%.

Thirty-five of the participants felt that they would absorb more work. Those that said they couldn't, felt the problem was lack of manpower. Some managers said they could take on significantly more work, provided that sufficient human resources were available.

1.5 Exports

Twenty-nine of the shops participating export directly to another country. In all but one case, the receiving country is the United States. The exception was Switzerland.

2.0 Production Equipment

2.1 Sophisticated Equipment in Place

In order to gauge the amount of modern or current generation equipment in place, participants were asked whether they had the following in their shops:

Electric Discharge Machine (E.D.M.)
4-axis machine centre
5-axis machine centre
Coordinate measuring machine (CMM)
CAD/CAM

Only 15% of the shops surveyed have an E.D.M. Seventy percent have at least one 4-axis machine and 25% have 5-axis capability, often multi-spindle gantry profilers. Fully 58% have a CMM and 83% have CAD/CAM equipment.

2.2 Control Systems

Almost all the participants have some conventional equipment still in use. In some shops, conventional machines account for 80% or more of the equipment. In fact, the proportion of conventional equipment ranges from zero to 93%. The median is 50%.

In terms of numerical control, most shops have a majority of CNC equipment. Very little basic numerical control remains. Proportion of equipment that is CNC ranges from zero to 100%. The median is 45%.

Some shops have adopted direct numerical control and one company reported that 90% of its equipment is now DNC. Only 9 of the respondent companies have installed DNC.

2.3 Equipment Necessitated by Contract

Over 75% of the participants reported that they had installed new equipment in the past year without which at least one contract would have been lost. Two of those that did not install new equipment in this context did actually lose or turn away work as a result.

Those that did install new equipment mandated by specific contracts were asked whether the primary reason was to improve productivity, increase capacity or broaden capability. As expected, the majority did so to improve productivity. This makes sense in light of the fact that it is a highly competitive market and cost savings generated by more productive equipment give a competitive edge.

Twelve of the companies acquired new equipment in order to broaden their range of capabilities and which, in turn allowed them to offer a greater range of services and, hopefully, gain a larger volume of work from the primes.

Six participants cited capacity increase as the prime motivator in acquiring new equipment. It is interesting to note that three of these same companies reported capacity utilizations that were quite low. It may mean that they increased capacity in the expectation of work that did not materialize. Given that most of the participants have taken advantage of DIPP, and that the majority understands that the intent of this program is primarily to foster new technology, not simply to increase capacity, it is hoped that there were other considerations involved in acquiring the equipment.

2.4 Volume of Work Requiring Specialized Equipment

Participants were asked about the equipment needed to do the work required by the primes. Specifically, they were asked how much of this work mandates the use

of highly specialized equipment, such as 5-axis machine centres, as opposed to other, less sophisticated machines.

Twelve respondents said that none of their work required such equipment. Fifteen others said that they had devised methods of handling what might be done more efficiently on a 5-axis machine, on their 3- and 4-axis equipment. Such methods included designing special fixtures and jigs and using a greater number of set-ups.

The point to be made is that there are many ways to do things. With some ingenuity and perseverance some machine shops have managed to make do with less highly specialized equipment. However, whether they can continue to compete with a shop equipped with such specialized machines is another matter. The bottom line is cost and time is money.

2.5 Capital Expenditures

Actual historic and planned expenditures on plant and equipment are impressive. Excluding some recent start-up operations from the analysis, capital expenditures over the past three years and those forecast for the next three years were expressed as a percentage of the sales generated during the last completed fiscal period only. For this discussion, no effort is made to separate external assistance from internal financing; the expenditures refer to amounts paid to suppliers, contractors etc., by anyone.

In the past three years, spending on equipment has ranged from as little as 4% of sales to over 140% of sales. The median was 51% of sales and the average was 53%. Forecast spending over the next three years varies from 10% to 450% of last year's sales. The median forecast is 63% and the average is 79%.

Expenditures on physical plant have ranged from zero to 50% of sales. Since a number of people lease their facilities and since most spend available funds on equipment, it is not surprising that the median here was zero. Estimates for future spending are higher, ranging from zero to 143% of sales with a median of 13% and an average of 24%.

2.6 Ancillary Operations

A number of participants have installed some form of finishing capability such as painting or heat treating. Slightly less than twenty percent are in this category. Many of the others feel that the environmental problems and capital requirements associated with much of this work outweigh the potential benefits. However, 12% of those not presently involved in finishing are actively considering it because it represents one more service that they can offer their customers in the hope that they can lock up the machining work if follow-on operations are available too.

3.0 The Machine Shops' View of the Prime Contractors

3.1 Perceived Reasons for Sub-Contracting

In Phase I, the prime contractors were asked why they sub-contract work to outside machine shops. In Phase II, the machine shop operators were asked for their perceptions on this matter to see how well they understand their market.

The most common reason, according to the primes, is lack of capacity in their own shops. This is also the reason most often given by the machine shops. That is, both groups recognize that primes use outside machine shops for extra capacity, especially in overload situations.

The second reason given by the primes for sub-contracting was cost. They often find it less expensive to get work done outside. The machine shop operators are aware of this. The second most common response from them was price as well.

The only other reason given by both groups was lack of skilled labour. Primes and machine shops alike complained of a shortage of trained, qualified CNC programmers, set-up personnel and machine operators.

The machine shop operators provided some other reasons for sub-contracting by the primes. Often mentioned was the idea that a lack of specialized equipment causes the primes to put work outside. Examples cited were E.D.M. machining, gun drilling machines, 5-axis machine centres, and processing equipment.

There is also a perception at the machine shops that the primes sub-contract work to get better quality and to get the jobs done faster than would be possible in-house.

3.2 Nature of Work Sub-Contracted

The prime contractors stated in Phase I that the work they sub-contract is normal machining although it tends to be the fussy work that causes headaches. That is, while the underlying technology is readily available, the work is often intricate or difficult to perform. By and large, the machine shops agree that the primes will put any work out under certain circumstances. First, it has to be less expensive than doing it in-house. The machine shop operators perceive that the primes regard them as a lower cost alternative to doing their own machining. This may result from lower overheads or lower labour costs.

Another condition for sub-contracting appears to be the maintenance of a core volume of work in-house. That is, the machine shops are of the opinion that the primes try to keep their own shops busy, and farm out the overload. The downside of this is when business slows, and the primes' machining facilities need work, they bring back jobs that were sub-contracted to keep their own operations busy.

Many machine shops felt that the primes will sub-contract a job if there is a higher than normal risk associated with it. The risk referred to here is the chance of scrapping some expensive material.

Also noted was the fact that often lead times provided are quite short. It appears that when the primes fall behind schedule or some other difficulty arises, they may turn to outside machine shops on short notice to get themselves out of trouble.

All in all, the machine shops have the impression that they are getting the work the primes don't want in-house for one reason or another. They feel that as a result of the nature of the work and the pressure to keep prices down, it is often not very profitable.

3.3 Barriers Facing Machine Shops

The participants were asked what they thought prevents them from obtaining more work from prime contractors in Canada and in the U.S. In Canada, the machine shop operators perceived that primes were not sub-contracting as much work as could be handled by available capacity in Canada. Many shops feel that if they had a dedicated sales representative available to call on the primes, they could increase their business. However, this would increase their overhead and they are reluctant to do it.

A number of respondents feel that they face regional barriers. They believe, for example, that prime contractors in Quebec will choose a Quebec machine shop over one from Ontario and vice versa. This may be due to the convenience of close proximity and there may also be cultural elements.

It was observed that primes having U.S. parents are encouraged by their parents to utilize the same machine shops that they themselves do in the U.S.

A large number of the machine shops feel that U.S. work is not available to them because of "Buy American" policies at the U.S. primes. Some feel that the fact that they are in a different country has negative connotations because buyers perceive them to be far away and therefore too inconvenient to deal with.

3.4 Technological Advances Required

Machine shop participants were asked about the technological enhancements they thought they would need to implement over the next three to five years to remain competitive. The responses were varied but could be broadly described as improvements that will allow them to respond quicker, work the material faster and do more things automatically or by computer; in other words, to be more productive and competitive.

A number of people spoke of high-speed spindles and improved cutters that are needed for the new hard materials. Computerized job costing, fast change-over equipment and just-in-time deliveries are anticipated by a large number of shops. It is expected that more and more shops will use CAD/CAM and EDI is widely foreseen as imminent. Shop managers expect to upgrade more and more equipment to CNC and even DNC.

3.5 Ongoing Relationships

Most of the shops have a high percentage of repeat business. Volumes ranging from 30% to 95% of sales were of either the same product or service or to the same customer. The median was 75%. Evidently, once a relationship is established it tends to endure. This may indicate that buyers don't like to shop around and possibly rock the boat.

The machine shops seem to be pretty positive about the way they get along with the primes. When asked whether they thought they might be affected by the current rationalization of the supplier base by primes, most (80%) said they either expect no impact, or that they would probably get more business when their competition is eliminated. Only eight shops thought that the impact would be negative.

3.6 Research and Development

A few (11) machine shops perform R &D activities on behalf of the primes. These shops reported that from 2% to 20% of their sales was R & D. Since no specifics were discussed, it is not possible to say with certainty that pure research and development is being done. However, in the case of one or two shops that have developed proprietary products, it was apparent that the capability does exist in this sector.

3.7 Complaints About Machine Shops

The machine shop operators were asked what they thought to be the major complaints that primes have about them. In Phase I, the primes mentioned what they felt were weaknesses on the part of the machine shops. It is interesting that the two groups gave different responses. The primes listed a lack of aggressiveness in seeking work, a narrow range of services and business management skills as the major weaknesses of Canadian machine shops.

The shops themselves thought that the primes' biggest complaint would be slow delivery. Almost half of those responding cited delivery as their first guess. The machine shops also thought that price, quality and poor communication and sales follow-up would be the problem areas. Evidently the primes are not making their complaints known to

their suppliers, or they stress delivery to the point that the machine shops think that it is a complaint.

4.0 Machine Shops' Perceptions of Selection Criteria Used by Prime Contractors.

4.1 Selection Criteria Involved

In Phase I, the prime contractors were asked to identify the criteria they use in selecting machine shops. They were also asked to rank them in terms of relative importance.

In Phase II, the machine shop respondents were asked about their perceptions of the criteria used by the primes. In this case, they were shown a list of criteria and asked to rank them in accordance with the importance they thought each represented to the primes. This list was essentially the same as that provided by the primes. The criteria discussed were:

- Specialized equipment not at other shops
- Sophisticated quality control procedures
- Ability of management or shop personnel
- Favourable dealings in the past
- Availability of design, engineering services
- Price
- Registration on an approved vendor list
- Other (specify)

4.2 Perceived Relative Importance

Machine shop operators identified quality and price as the two most important selection criteria used by the primes. This is entirely consistent with the primes' own comments in Phase I. Also, while delivery was not specifically identified on the questionnaire, a number of participants included it in the "other" category. So, the primes' message that they want to get work "better, cheaper, faster" is getting through.

It is interesting to note that the machine shop operators ranked the ability of people (management and shop floor) and a history of favourable dealings right behind

quality and price. This would tend to support the argument that once a satisfactory liaison is established, there is a tendency for buyers to stay with a particular supplier, all other things being equal.

A number of machine shops felt that buyers put significant emphasis on equipment. That is to say that one shop will be selected over another because the former has some equipment that the latter has not. This is apart from the fact that equipment varies from shop to shop because of the kind of work they do. It has to do with selecting from competing shops that have more or less the same type of equipment, but one of them has something extra. That might be faster, a more sophisticated control system or even just newer. There appears to be a perception that new equipment makes better parts than does older equipment.

4.3 Equipment Essential to Qualify as a Supplier

Participants were asked whether there is any equipment that is now, or will be soon, essential in order to be qualified as a supplier to prime contractors. By far the majority felt that up to date CNC equipment was critical. This could be lathes or machine centres (3- and 4-axis). It was not felt by many that 5-axis machines would be essential.

After CNC machines, the next most commonly mentioned required equipment was coordinate measuring machines (CMM). But while 22 respondents identified CNC equipment, only 7 said CMM's were important.

As many people said it is essential to have modern, quality control equipment and well documented procedures and systems in order to qualify.

5.0 Competitiveness Among Machine Shops

5.1 Differentiation

The machine shop participants were asked how they attempt to differentiate themselves from their competition. This is important because it goes to the matter of whether there are pockets of machine shops serving a number of niches, or simply a

large number of similarly oriented shops that differ only in the size of part they can handle.

The responses would indicate that there are niche players but there are others who choose to go after whatever work their equipment and capabilities will allow.

Some shops have essentially differentiated themselves from other shops by concentrating on large parts, others on parts requiring extremely high precision; some specialize on small parts, and some on one-offs.

This was evidently a difficult question for a number of participants. Apart from those described above, most shops appear to not have thought about the issue. They have certain skills and abilities in specific areas, they have the equipment necessary to work in those areas and their business strategy is to continue doing what they know best. This fits nicely with the buyers who like to maintain existing stable relationships with their suppliers.

5.2 Competitive Advantages and Disadvantages

The participants identified a wide range of competitive advantages that they feel they have. Responses included jigging and fixture design expertise, an aggressive sales effort, proximity to a major customer, reputation, sophisticated production control systems, responsiveness and flexibility. A surprising number of people, though, felt that they had an advantage in terms of price, quality and delivery. Not every shop can have the best price, quality or delivery, so the explanation must be something else. It may be that the buyers have hammered away at these three issues so much, and since they're still customers, the machine shops assume that they are pleased in this regard. It might only mean, on the other hand, that it is such a competitive market that everybody's price is low, the quality is high and the delivery is about the same; they may be getting the work because it's easy for buyers to keep giving it to the same shop.

Competitive disadvantages listed include a lack of skilled people, not enough CNC equipment, not enough market presence, cramped space and old equipment. A few companies felt that their geographic location was a disadvantage. This came mostly from participants who actually are out of the main stream compared with those in Toronto or Montreal.

5.3 U.S. Competition

The survey participants were asked to rank themselves against their U.S. counter-parts in terms of strengths in the following areas:

- capacity
- capability
- marketing
- external support

With respect to capacity, the split was about even; roughly half thought their capacity was a strength relative to the U.S. shops.

Canadian shops felt that their capability and price were two distinct strengths. Only a few thought they were at a disadvantage in these areas.

On the other hand, most felt that their marketing and the amount of external financial support was not as strong as those of the U.S. shops.

5.4 Training and Skills Development

Participants were asked whether they felt that some form of training, either for management or the work force, would make them more competitive. The question was asked with respect to management because in Phase I, some of the primes consulted felt that business management skills could be upgraded at the machine shops. Half the respondents felt that no specific training was required for management personnel. Of those who thought some training might be worthwhile, the areas of weakness mentioned most often were marketing, production planning and control, costing, people management and computer programming.

There seemed to be more consensus on the urgent need for training on the shop floor. In keeping with the reported shortage of qualified machine operators, participants thought that CNC operator training would be useful.

Also mentioned was the need to train set-up personnel and CNC programmers. A number of machine shops have established in-house training programs for their operators and set-up personnel. They often find, though, that once their people are well

qualified, they are lured away by bigger shops and some of the prime contractors who offer higher wages.

5.5 Plans for Expansion

Most of the participants plan to broaden their range of services offered. They expect to acquire new capabilities that will allow them to do more things for their customers and hopefully get more work. Some even feel that it is critical to their survival to be able to offer a broad range of services, because this will attract work that can help keep them busy in the business slowdowns. Most felt that added capabilities would give them a competitive edge over the shops that offer a limited number of services.

Of the companies that have no such plans, most reported that they would like to, but either their people are too busy to look into it or they cannot afford it financially at the moment. One other company said it was not interested; that it would prefer to focus on one well-defined service. Yet another felt it would be preferable to arrange joint ventures with other companies that already offer services different from, yet compatible with its own.

Most participants also plan some form of vertical integration and the rationale is much the same as above. There is another logic as well, however. The people interviewed noted that to integrate forward into some sort of sub-assembly work requires very little up-front financing and has low direct operating costs. Generally, the people hired for sub-assembly work will be less skilled than machinists and will be paid less. No expensive equipment is required. Best of all, though, is the fact that the machine shop could offer a complete package to the customer. This makes it easier for the buyer who doesn't have to worry about arranging for sub-assembly at another vendor or in-house. Also, it protects the machining component of the job by burying it within the contract for the whole sub-assembly.

There appears to be a growing demand for this as the primes are tending to focus on assembling larger components and putting the machining and sub-assembly outside.

6.0 Technology and New Aerospace Programs

6.1 New Programs Expected

Most participants indicated that they knew of at least one new aircraft program expected to come on stream in the next three years and in which they expect to participate. Some identified as many as five new programs.

As a result of these, respondents have expectations of new work that will mean volume increases of anywhere from zero to 100%. The median expected increase is 35%.

Generally, the shops expect that the new work will be essentially the same as current work, although the materials may differ somewhat. However, given the increasing demand for faster service, most participants expect that changes in equipment will be required. Five-axis machines with multi-spindles for working several parts at once, fast change-over equipment and faster feeds and spindle rates were mentioned.

6.2 New Materials

About one third of those interviewed reported that there have been some new materials introduced that have different characteristics from those they customarily work. Examples are very hard steels and alloys that require special cutting tools and precision castings that need less machining. The harder steels and alloys are more difficult to machine and result in higher tooling costs and slower speeds. There is also an increased risk of scrap with these materials.

These new materials are causing the machine shops to look around for solutions to the unique difficulties they present. That in itself is not bad as machine shop operators are, by nature, an inventive breed that thrives on challenge. What may be a problem though, is that as solutions become available, in order for shops to remain competitive, they will have to implement them. If the solution includes cutting tools made of new materials themselves, then the impact may not be too severe. If, however, new machining technology is developed, then it is conceivable that drastic changes may result. The impact of this scenario could be very expensive re-equipping of many shops. In this case, external support will be essential in order for a lot of shops to survive.

6.3 Composites

The machine shops participants expect more impact from composites than do the prime contractors interviewed. The primes said that the impact, over the next 5, 10 and 15 years is likely to be minimal, minimal and, at most, medium, respectively. The machine shops expect minimal impact in 5 years and medium impact in 10 years. The 15 year forecast was split between medium and high impact expected.

The fact that the two groups differ with respect to their 15 year estimates is understandable: much can happen in 15 years. The same may be said regarding the 10 year estimates. The machine shop participants may simply be responding with conservatism and picking a middle of the road estimate.

The only important conclusion to be drawn here is that very few people foresee any significant inroads made by composites in the next 5 years.

7.0 The Role of Government

7.1 Perceived Intent of DIPP

The objective of the DIP program is primarily to foster the creation, development and adoption of new technology and not so much to support capacity increases. Of course, as a result of acquiring new technological capability, capacity may also be increased.

It was decided to ask machine shop participants for their understanding of the purpose of DIPP to see whether their perceptions and therefore their requests for assistance were indeed in line with the true spirit of the program.

Thirty-two of the 41 participants felt that DIPP was created to support new technology. The other 9 respondents believe that the purpose is to increase existing capacity.

7.2 DIPP Applications

The actual procedure of applying for assistance under DIPP was reported as satisfactory to all but four respondents. Those four felt that, especially to first-time applicants, the procedure and associated paperwork is complicated and somewhat difficult

to understand. One participant noted that many companies find it necessary to engage the services of a consultant to help prepare the application so that their position appears in the best possible light. This is especially important since it was noted that applications which are complete and properly supported such that DIPP officers can process them without much follow-up clarification with the applicant stand a better chance of speedy approval in the face of growing competition for funding.

The other comment focused on the large amount of forecasting required by applicants in preparing an application.

7.3 Weaknesses Observed in DIPP

By far the most commonly expressed complaint was the long time it takes to receive approval for a project. In many cases, though, this is brought upon the companies by themselves because they have not supplied enough information to make a decision.

Another complaint voiced by respondents dealt with the allocation of funds between prime contractors and the machine shops. It was noted that the primes often receive assistance to buy equipment which effectively positions them in competition with the machine shops. This is especially true in the event of business slowdowns when everyone is competing for work. The primes are well positioned to repatriate the work that they have let to sub-contractors in order to keep their own equipment busy.

7.4 Improvements Suggested by Machine Shops

Most participants could suggest at least one improvement to DIPP. Often, these suggestions came down to streamlining the program for easier application and, subsequently, faster approval and funding. One specific suggestion was to prepare an all-encompassing application form that is uniquely designed for DIPP rather than use the short "Application for Assistance" to simply initiate the process which is then followed by request for additional information.

A few participants suggested that the level of funding be increased and one suggested that other business activities be eligible for assistance under DIPP. Specifically

mentioned were market research, as opposed to market feasibility, and vertical integration projects.

It was suggested by a particular participant that the DIPP budget be allocated on a regional basis, although the distribution of machine shops is far from uniform across the regions of the country. Presumably, some weighing could be applied such that funding was available in proportion to the number of shops in that region.

One respondent touched on the technology development versus capacity increase issue. He suggested that more efforts be taken to ensure that funding under DIPP is only used to create, develop and adopt new technology, and not purely to increase capacity.

7.5 Benefits Received from DIPP

Participants were asked what specific benefits they felt they got out of the DIP program. That is, apart from the fact that financial support was given, what tangible benefits accrued?

The responses focused on the ability to grow, acquire new capabilities and manufacturing technologies, and to compete more effectively. Respondents felt that, without DIPP, they could not have afforded to do this. Given the competitive nature of the market and the rapid advances in machining technology, to survive, a machine shop has to continually upgrade its equipment, systems and procedures. DIPP has been, and will continue to be an affective way of helping them accomplish this objective.

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