OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

18039

Distr.
LIMITED

IO.43(SPEC.)
26 February 1990

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ORIGINAL: ENGLISH

ASEAN/COIME Workshop for the Heads
of Metal Industry Development
Centres and Service Institutions*

Manila, Philippines, 20 to 24 November 1989

WORKSHOP PROCEEDINGS**

---

* Organized by UNIDO in co-operation with the Government of Philippines

** This document has not been edited.

V.90-82161

CONTENTS

PREFACE

Article 2(j) of the Constitution of UNIDO, resolution ID/CONF.5/Res.2 adopted by the Fourth General Conference of UNIDO, conclusions and decisions adopted by the Industrial Development Board during its fifteenth to eigthteenth sessions, decision IDB.3/Dec.6 adopted by the Industrial Development Board at its third session and General Assembly resolution 39/323 (paragraphs I.6 and I.7) all call for closer technical co-operation in order to facilitate the transfer of technology.

Many developing countries have already made some progress in developing indigenous technologies and achieved significant results; others are still at the initial stage.

Through its mandate, UNIDO would like to promote and accelerate the process of industrialization of developing countries in order to enable them to increase their share of the world industrial production, thereby raising their standards of living.

Under the project XP/RAS/89/037, UNIDO has convened an ASEAN/COIME Workshop for the Heads of the Metal Industry Development Centres and Service Institutions in Manila, the Philippines.

INTRODUCTION

The purpose of this Workshop was to bring together Heads of the Metal Industry Development Centres from the ASEAN countries to:

(a) take stock of accomplishments;

(b) highlight existing physical facilities and technical specializaitons;

(c) identify mutual points of interest;

(d) identify areas of individual specialization and opportunity for training;

(e) consider the emerging process of industrialization and need for modernization;

(f) exchange technical know-how in the spirit of ASEAN industrial co-operation;

(g) work out a joint programme with existing facilities;

(h) elaborate national programmes of specialization.

Such a programme would have to be within the framework of the ASEAN regional directions in industrialization, the national-level policies and plans and international industrialization processes and technological trends.

Therefore, this workshop was the first step in formulating an ASEAN Network of existing engineering/metalworking industry institutions with a work programme on helping themselves with existing facilities and to develop practical steps towards modernization.

I. PARTICIPATION

The Workshop was attended by Heads and their Alternates of the Metalworking Industries Development Centres (MIDC) from the following ASEAN member countries: Indonesia, Malaysia, Philippines, Singapore and Thailand. The representatives of the following organizations also participated in this Workshop: Ministry of Science and Technology, COIME, UNDP and the Metalworking Industries Association of the Philippines (MIAP).

II. OPENING SESSION

1. Introduction of the national organizer

Dr. Adolfo Jesus Gopez explained the set-up of the Workshop, the Organizing Committee and the Administrative Supporting Staff.

2. Welcome remarks

Dr. Leopoldo V. Abis, Chairman of the National Organizing Committee and the Executive Director of MIDC Manila, welcomed the participants and the quests. He recalled all delegates to take the objective of the Workshop as a guideline of the deliberations and discussions.

3. Inaugral address of the Senior Industrial Develoment Field Adviser

In his inaugral speech, Mr. Christian Newman, SIDFA, spoke on behalf of the United Nations Development Programme (UNDP) Resident Representative and the Director-General of the United Nations Industrial Development Organization (UNIDO). He stressed the importance of this Workshop of Heads of MIDCs to pave a way for closer co-operation and possible networking of the centres under the auspices of ASEAN/COIME.

4. The subregional scene

In the absence of Attorney Lilia R. Bautista, who was supposed to deliver a speech of the Honorable Jose S. Consepcion, Jr., Minister of Trade and Industry, Ms. Edna Espos presented the paper on the subregional scene.

To build a stable region--both economically and policitally--ASEAN has pursued and shall continue to pursue a three-pronged strategy to development. This strategy consists of:

(a) economic growth and development of national economies;

(b) regional prosperity through regional co-operation;

(c) a joint approach to international developments and issues affecting the well-being of member countries.

The development of an engineering and capital-goods sector of the ASEAN countries would serve two critical objectives. Firstly, it would strengthen then national industrial structures of the ASEAN countries, which would provide a solid base for long-term economic development and accelerated technological progress. Secondly, it would provide a vehicle for ASEAN industrial complementation which by nature, occurs at the industrial sector.

Engineering technology is basic to industrial development. A domestic goods industry is important to reduce ASEAN's dependance on imported capital equipment.

5. Host country statement

On behalf of the Honorable Ceferino L. Follosco, Minister of Science and Technology, Dr. Gopez delivered the host-country statement.

The Philippines' metal industry was second in Asia about 20 to 30 years ago. After some intensive planning sessions between the Department of Science and Technology and the Department of Trade and Industry, Leaders of the Metal Industry Associations and Academic Institutions an elaborated "Metals and Engineering Industries National Action Plan 1990-2000" was approved by the Cabinet.

The major components of the Plan are the following:

(a) The most immediate one calls for the establishment of the Design and Engineering Center Foundation Incorporation (DECFI). The country shall have to immediately acquire machinery design and engineering expertise to alleviate the imports of machineries and components, accounting for 18 per cent of the total imports of the Philippines. The DECFI is supposed to provide consultancy for design engineering, prototype development and industry training services.

(b) The development of Basic Metal Industries to ease the dependance on imported raw materials by effectively harnessing the indigenous metallic ores and processing them to ready raw materials for industry.

(c) Modernization of industry covering metalcasting, tool- and dye-making, heat treatment, welding, electroplating, forging and machining. This plan also includes nationalization, standardization, shop accreditation, incentive package, technology upgrading, raw materials sourcing, manpower development, institution development and financing packages.

(d) The manpower development component covers: upgrading of skills in the metal trades, redirection of B.S. engineering curriculum to meet the specific needs of the industry, promotion of post-graduate courses in mechanical engineering up to the Ph.D. level, particularly in machinery and process design.

In the midst of the implementation of this planning, MIRDC is expected to be responsive to its role as a technical partner of industry. Therefore, the Government attached its priority in the development of its manpower and upgrading of its facilities in the basic metalworking technologies and metal testing and quality control.

III. ORGANIZATION OF THE WORKSHOP

The workshop consisted of morning and afternoon sessions, where country papers and technical papers were presented and discussed under the chairmanship of the technical leader.

1. Election of officers

Dr. Abis (Philippines) was elected to be the chairman; Ms. Doris P. Acoyno, Ms. Elisabeth B. Samela, Ms. Josefina C Lara and Ms. Joan B. Dioso were in charge of the report of the Workshop and Messrs. Aslam Djanun, Alberto Fenix, Adolfo Gopez, Damri Sukhotanang, Yap Liong Chai and Ahmad Zaki were elected to the office of chairman of technical sessions.

IV. PRESENTATION OF COUNTRY PAPERS

A. Country paper of MMIRDC Indonesia by Aslam B. Djanun and Komarna Mihardja

B. Country paper of MIDEC and SIRIM Malaysia by Megat Ahmad Zaki bin Megat Mohamad Nor

C. Country paper of MIRDC Philippines by Leopoldo V. Abis and Adlofo Jesus Gopez

D. The Precision Tooling Industry of Singapore by Yap Liong Chai

E. Engineering Industries in Thailand: Status, Constraints and Measures by Damri Sukhotanang and Pasu Loharjun

COUNTRY PAPER OF MMIRDC INDONESIA
BY ASLAM B. DJANUN AND DOMARNA MIHARDJA

SECTION 1

PRESENT STATUS OF NATIONAL ENGINEERING AND CAPITAL GOODS SECTOR

The present status of the engineering sub-sector in Indonesia is actually the outcome attained during four Repelitas.

Repelita is well known as the National Development Plan of Indonesia which is divided into stages of five years each and termed as Five Years Development Plan. The fiscal year 1989/1990 is the first year of Repelita V.

In the last year of Repelita III, industrial products represented 63,4% of the non-oil & gas export revenues, while by the end of Repelita IV (early 1989) this revenue is accounted for almost 80%.

The target set on the growth rate in the industrial sector during the course of Repelita IV stands at an average of 9,5% per annum.

Based on the latest data collected by the National Economic Census during the same period, it was noted that the annual growth of the industrial sector has surpassed the target.

It has reinforced the national conviction that the industrial sector will be able to become the prime mover of the development in coming years.

This reflection gives an overview of the present situation in industrial development in Indonesia.

To have a better review on the present status of the engineering sub-sector, could be represented buy the average level of the technological capability performance in this sub-sector.

Approaching the end of Repelita IV, a study on the engineering sub-sector was conducted to have a clear picture of the technological capability status of the engineering industries.

The study distinguished technology into two major areas, namely product technology and manufacturing technology. Specific field of technology identified as specialization could be derived from each area of technology.

These specializations are the evaluation parameters expressed in figures from 1 to 10 depending on the capability level performed by the observed engineering industries.

The study came out with the following result:

a. Six specializations are derived from product technology and the best performer is on product design-component selection at a rate of capability level 3.
b. Fourteen specializations are derived from manufacturing technology and the best performer is on metal joining at a rate of capability level 9.

Both measures, e.i. the outcome of the industrial development and the technological capability level as described above, may give an overall view of the present status of the engineering sub-sector in Indonesia.

SECTION 2

MAJOR ENGINEERING CONSTRAINTS

As a government development institute, MMIRDC Indonesia plays an important role in the development of the engineering sub-sector as stated in the Ministerial decree outlined below:

> MMIRDC has to carry out research and development activities in the subject matters of product technology and manufacturing technology (including industrial management), so as promote the improvement of productivity and quality as well as stepping up the capability of the engineering industries.

This mission is performed by the Centre through services to the industries. In providing these services, several constraints appear in the following matters:

a. Keeping pace with the current technology.
b. Insufficient of testing and laboratory facilities.
c. Modernization of facilities.
d. Internal bureaucracy.
e. Lack of skilled manpower.
f. Obtaining spare parts for maintenance activities.

One of the services rendered to the engineering industries to improve the skill of the industrial personnel is done by conducting the job training.

In this regard, most of the constraints are still within item a. up to c. as described above, but less substantial.

Every personnel of the centre should have their individual professionalism in their respective subjects. The very common ways to build this professionalism are sending out them to undergo training abroad, study visit to industries to enrich the know-how, giving them opportunities of exchanging experiences with other potential colleagues in other institutes, etc.

The most common constraint in building up professionalism is the shortage of fund which makes the centre cannot bear the expenses needed to improve the personnel's know-how and ability through those ways.

Opportunities for undergoing overseas training attending seminars or industrial exhibition abroad is very much dependent on the sponsorship offered by other parties, particularly international/regional organizations and donor countries.

To sustain the activities of the engineering industries, in some cases the domestic market has some weaknesses in view of granting the availability of particular standard parts, either mechanical components or electronic components needed for control system.

This condition does not rouse creative action to the technicians and in some cases creates obstruction to maintenance activities. In the case of breakdown occurred on particular machines requiring replacement of parts which has to be purchased abroad, it may require months to obtain the parts. That means the machines will be idle for several months.

Regarding this matter, a body or a private firm created and supported by the engineering associations in the country having the market source of those particular parts will be a big help through which channel may be applied.

SECTION 3

GOVERNMENT POLICIES AND STRATEGIES

To encourage the acceleration of the industrialization, the government launched the following guide lines:

a. Industrial development which as far as possible is directed to a penetration and stabilization of the industrial structure and to integrate it with other economic sector.
b. Development of machinery and electronic industries, producers of capital goods.
c. Development of small scale industries.
d. Expansion of industrial commodities export program
e. R, D & E capacity improvement, particularly in software, development programs and inventions.
f. Improvement of manpower ability: management, expertises, specialization, skill and self-employment.

These are the emphasis of the industrialization attempt in Repelita IV.

Meanwhile, Indonesia is now entering Repelita V, and will continue all undertakings carried out in Repelita IV, aiming at further development of this ability and to direct the industry in the following measures:

a. Industry will gradually be able to produce a greater variety and number of industrial machinery and equipment.
b. To develop the mastery of technology, design and engineering.
c. To continue the development of centres for industrial growth throughout the country based on the potency of the region concerned.

Government has given high priority to industries producing parts and components and machines, more specifically those which are aiming for export.

To sustain this aim, government has also issued the so called "de-regulation policies" in order to create a better industrial climate adapted to present circumstances.

Besides MHIRDC which assumed as a national level centre, in the country there are several other centres to support the activities of the Provincial Office of the Ministry of Industry.

Another measure where government has given much attention to is the manpower building problem.

To work on the problem, government introduces two different ways, namely:

a. Through formal education, particularly polytechnic package program.
b. Job training organized by the Ministry of Manpower, through establishing vocational training centres in almost every province.

SECTION IV

TECHNICAL INSTITUTIONAL SET UP

To pave the ways in resolving the industrialization problems heading towards attaining a solid industrial structure in the country, the Government of Indonesia has recently launched new policies. One of them was the recent de-regulations in economic aspects including banking and foreign investment which are anticipated to enhance the industrialization efforts to arrive at facilitating of domestic as well as foreign capital investment.

In the line with this effort, a serious attempt has also to be devoted to the technological capability development of the existing industry likewise, engineering industries in particular.

Being aware of that circumstances, government has established several service centres for different industrial subsectors.

These are nine service centres dealing with different area of process under the Ministry of Industry, and one of the centres is Metal and Machinery Industries Research and Development Centre (MMIRDC).

The general mission of the centre is as follows:

1. To conduct research and development for the benefits of metal and machinery industries through different actions:
   - Applied research on subjects demanded currently by the industries or predicted as future demand.
   - Manufacturing process experimentation which is mostly product oriented activities, aiming at the development of appropriate process to be practiced and implemented by the industries.
   - Prototyping of different equipment to be later on introduced to industries.
2. To provide consultancy and services in subject matters of product technology, manufacturing technology and industrial management.

3. Services for calibration and product testing.
4. Dissemination activities through different ways and means, i.e publishing technical information, conducting training for the industrial personnel and seminars.
5. To participate in industrial standard establishment and implementation.

Besides the above centres, there are other centres which are established in several provinces aiming at having direct access to the industries in the region and to assist the activities of the Province Office of the Ministry of Industry.

The initial intention of the provincial centre establishment is to provide testing services to industries in the province. Since the type of demanded services is increasing, the centre will be extended and strengthened.

In carrying out it's mission, MMIRDC may co-operate with these provincial centres or with other potential institutes possessing the desired capabilities and facilities to undertake a particular activity, such as laboratory of the universities, agricultural research institutes and others.

Nevertheless, we have to admit that in a particular activity MMIRDC is circumscribed by its own limitations:
1. In certain technology we are still to be improved.
2. The existing facilities for testing and prototyping are relatively out-dated and need modernization.

Since the centre has an important role to play in the industrial development, collaboration and exchange of experiences with similar centre in other countries will be very beneficial. In fact, Indonesia is in great need of this collaboration. In view of specialization, we are applying the approach, both technological wise as well as commodity wise.

In technological wise we have still to improve ourselves in Forming Technology, particularly forging, machining and tool making technologies, and specific casting processes.

In view of constraints as described earlier in the previous sections there are tow main constraints faced by MMIRDC, namely

1. The mastery in certain area of technology, such as:
   - specific casting processes
   - tool design and tool making
   - machining (CAM)
   - forming process, particularly forging process.
2. The modernization of facilities:
   - prototyping facilities for foundry, particularly related to specific casting processes
   - machining facilities more specifically the NC and CNC machine tools and non conventional machines
   - laboratory facilities, which include measurement and various testing facilities. In this regard, the availability of CMM which could be linked with CNC machines is of the utmost importance to keep pace with the current technology in machining.

In addition to the above measures, collaboration among similar centres of different countries will give positive contribution and support to the strengthening of the centres and rendering the opportunities for exchanging information and experiences.

COUNTRY PAPER OF MIDEC AND SIRIM MALAYSIA
BY MEGAT AHMAD ZAKI BIN MEGAT MOHAMAD NOR

1. The Malaysian economy, industrial structure and scenario

Basically, Malaysia is still a developing country with the manufacturing sector becoming the largest contributor to the Gross Domestic Product (surpassing the agricultural sector) only in 1987. The 1989 contribution of the manufacturing sector to the GDP (total about US 28 billion dollars) was estimated to be about 16% compared to the agricultural sector at 13%.

The country has a land area of 330,000 square kilometres and a population of 17 million. It's Gross National Product is about US26 billion dollars while it's major exports are electrical and electronic equipment and appliances especially airconditioning equipment and television sets followed by crude petroleum, palm oil, rubber, sawn logs, textiles, chemicals, petroleum products as well as other machinery and transport equipment. It's major imports are also machinery and transport equipment valued at about US 4 billion dollars for 1987. Among the imported items are civil engineering equipment, metalworking machines, furnaces, vehicles and machinery components as well as metal ores and scraps. Generally, mineral resource-wise, Malaysia is also not very rich in metal ores except for tin and copper.

On a more micro level, the metal industry in Malaysia can be considered to be just moderately developed. While there is no big iron ore mine, there are a few tin and copper mines in operation in the country. Apart from that presently there are five iron and steel mills, about 500 machine shops, 80 foundries and 470 fabricators. The fabricators include such firms involved in one or a combination of the following operations: welding, presswork, electroplating, extrusion, pipe making, boiler making, cable making as well as heat treatment and forging. The iron and steel mills are presently involved in producing billets, bars, rods, angle irons and wire products for the civil engineering and building developments in the country as well as for exports.

The machine shops in the country either appear as :-

(i) Independent factories/shops,

(ii) Part of electronic components or appliances manufacturing firms,

(iii) Part of foundries,

and (iv) Part of presswork or plastic injection molding factories.

The independent machine shops/factories are normally involved in specialised and precision machining activities. Among the products produced by these independent machining factories are dies, molds and their components; gears, machine components, screws, automotive components, hydraulic systems nozzles, and other turned or milled components. The machine shops attached to electronic/electrical components and appliances manufacturers (normally multinational corporations) are also involved in precision and specialised activities. In fact,

they are involved primarily in making of very high precision components of electronic and electrical parts dies and molds.

The machine shops attached to foundries are involved in finishing of cast components. Among the items manufactured are augers; parts of pumps, diesel engines, pistons, compressors, palm oil processing machines, rubber processing machines, and woodworking machines. In otherwords, some of the local machine shop cum foundry firms can also be considered as machinery manufacturers.

The machine shops attached to presswork and injection molding shops are mainly geared towards complementing their primary operations. They may carry out precision or non-precision operations. Nevertheless, on some occasions these machine shops also offer jobbing and/or manufacturing services to other companies.

Most of the foundries in Malaysia have had its beginnings in the 60's following the increase in demand for tin mining pumps, parts for the tin mining dredges, rubber and palm oil processing machines. Apart from making components for these machines, the foundries have been active in making items for use in the buildings and civil engineering works in the mid 80's. Among the items produced were cast iron pipes and fittings; parts of quarry, cement and water treatment plants as well as earthmoving machinery components, concrete mixers components,rollers, impellers, manhole covers, taps, cast bolts and screws, cast gears, pulleys and parts of agricultural machinery. Most of the local foundries are also small and medium in size. It operates as a family business and normally carry out jobbing services. Following the slowdown of the tin mining and construction industry in the 1987 - 88 period about 10% of the foundries closed down. Apart from the grey cast

iron, cast steels, aluminium, bronze, copper, ductile iron, spheroidal iron and manganese steel casting operations undertaken by the companies, a small number also carry out diecasting operation. This latter kind of companies produce components mainly for the household appliances, motorcycle and bicycle assembly industries operating locally.

Generally, it could be summarised that the level of technology employed by the local metal industry is primitive to moderately modern. The primitive practices mainly occur in the foundry sector while the moderate to modern practices and facilities are employed in the dies and molds, electronic and electrical as well as automotive components machining manufacturing companies. While some of the primitive foundry companies are still using the older copula system and without proper material handling facilities (probably 20% of the total) some of the machining factories have started to acquire and use sophisticated machines such as computerised numerical control lathes, machining centres, spark erosion and wire cut electro discharge machines as well as numerical control and copy milling machines. However, the number of machine shops with sophisticated machines is still very small (possibly 10% of the total).

One of the major problems expected to be encountered by the metal industry in Malaysia in the future is shortage of manpower especially the higher skilled personnels. It is reported in the Malaysian Industrial Master Plan that the local metal industry will require yearly a total of about 3500 freshly trained and newly skill upgraded production, mechanical, instrumentation, metallurgical, chemical, materials, tools and dies engineers and technicians for the period 1991 - 1995. This requirement is expected to increase further in the future following the governments continued emphasis on the development of the metal,

electrical/electronic, automotive components, machinery and other engineering industry.

2. Role of the Metal Industry Development Centre, Standards and Industrial Research Institute of Malaysia

Established in 1986, the main objective of the Centre is to assist in the upgrading and strengthening of the local metal and metallurgical technology and industry so as to be competitive in the domestic and international markets.

Basically, the activities of the Centre can be classified as follows :-

(i) research and development,

and (ii) manpower development and routine services.

The research and development activities of the Centre are mainly focus in the areas of :-

(i) metallic and complementary materials development,

(ii) systems, products, techniques and facilities development.

Examples of the projects undertaken are :-

(i) Failure analysis and development of ship propeller material for a medium size foundry,

(ii) Establishment of Corrosion Map of Malaysia,

(iii) Research and development of investment casting technique, products and facilities for upgrading of some of the traditional handicraft brass industry,

(iv) Failure analysis of a boiler pipe,

(v) Design and development of press dies for a small radio speaker frame,

(vi) Design and development of press dies for washing machine part,

(vii) Design and development of press die for irradiation can for nuclear power test plant,

(viii) Design and development of a motorcycle cover diecasting die,

Under the category of manpower development and routine services, the Centre undertakes to implement :-

(i) courses, seminars and lectures in the areas of electroplating, welding, presswork, heat treatment, non-destructive testing and later foundry as well. (i.e. once the facilities have been established) Some of the courses conducted have also involved foreign participants eg. Third Country Training Program on Metalworking Technology sponsored jointly with Japan International Cooperation Agency (JICA). An NDT officer of the Centre have also been appointed as Short term expert for a course on Ultrasonic Inspection (Level 2) conducted under the sponsorship of the International Atomic Energy Agency, United Nation Development Programe (UNDP) and Regional Cooperation Agreement, at Bandung, Indonesia in August 1989.

(ii) entrepreneur development (through 'incubator' program). In this program, new entrepreneurs are allowed to have an office and use the facilities in the Centre for initial production and business development.

iii) inplant training and instructions for university and technical institute students,

(iv) equipment time leasing/technical services eg. electroplating, presswork, heat-treatment, and non-destructive testing. Apart from these support, the facilities and personnels of the Centre have also been utilised for skills examination conducted under the supervision of the National Industrial Trade and Technical Certification Board, Ministry of Labour.

and (v) advisory, consultancy and information services. eg. to the Ministry of Trade and Industry, the Economic Planning Unit, Ministry of Labour, Ministry of Youths and Sports as well as to companies such as Heavy Industry Corporation of Malaysia (HICOM) and National Automobile Industry Ltd. (PROTON).

In implementing the programs and projects of the Centre, various challenges are encountered.

Among them are :-

(i) High expectation and fast implementation of projects with very limited manpower and financial resources-made available,

(ii) Reluctance of clients and participants from industry to pay for the services provided,

and (iii) Reluctance of the government to have too big a metal research and development centre.

In conclusion, in view of the above constraints, the future direction of MIDEC is to concentrate on activities and services that is of basic importance to the existence, development and sustenance of a viable and competitive local metal industry. In this respect, it is considered that priority need to be given to activities in the areas such as

(i) metallic materials and metallurgical products and facilities research and development (including computer, automation and instrumentation applications)

(ii) manpower and skill development in areas such as (a) foundry and casting (including furnace operations) (b) electroplating and metal coating, (c) heat treatment (d) welding (e) non destructive testing (f) presswork (g) metallography (h) entreprenuership and management. Some of these courses may have to be conducted jointly with complementary organisation and industry personnels.

Acknowledgement

The author/presenter of the paper wish to thank :-

(i) United Nations Development Organisation (UNIDO) and Government of Philippines, the sponsors and organisers of the 20 - 24 November 1989 ASEAN Heads of Metal Industry Development and Service Institution Workshop,

(ii) The Controller of SIRIM for the support given in preparing the paper,

(iii) Dr. Mustaza Ahmadun and Dr. Yusof Zakaria, Senior Officers of MIDEC for their comments and inputs,

and (iv) Other staffs of MIDEC for the valuable input into the paper.

COUNTRY PAPER OF MIRDC PHILIPPINES
BY LEOPOLDO V. ABIS AND ADOLFO JESUS GOPEZ

Section I: Present Status of the National Engineering and Capital Goods Sector

The Philippine metals and engineering sector is involved in a vast field of industrial activities namely the manufacture of metal products, electrical machinery and appliances, non-electrical machinery (such as agricultural, metalworking, and other process machineries) and transport equipment. UNIDO Industrial Monographs defines this sector simply as the engineering industries.

1988 apparent total demand for the sector's products was estimated to be US $ 2 700 million. Imports dominated more than 55 % of this demand, valued at US $ 1 580 million. Local production was estimated to be $ 1 120 million, 83 % of which ($ 930 million) was absorbed by local demand and the remaining 17 % ($ 190 million) was exported. The sector accounted for 2.5 % (=P= 19.8 billion) of the total Philippine GNP which was estimated to be =P= 816 billion for 1988. (Annex A traces the apparent total demand for the sector's products from 1981-1988, while Annexes B and C shows Philippine import and export of major metalworking product groupings with accompanying graphs.)

The sector is composed of about 2,661 establishments, with an employment of about 268,000 offering various engineering services. The largest subsector can be classified as machine and fabrication (welding) shops, (about 1400 firms), generally

providing jobbing and repair services and utilizing all-purpose second-hand imported machine tools and welding units, 60% of which may be considered as 10 years old and above. Enterprises are slowly adopting advanced processing technologies with the presence of about 130 CNC and NC machines in their production lines. Machine tool production, known to be undertaken by at least 5 firms, is confined to simple metalforming and cutting machines, such as bending, shaping, drills, hydraulic and mechanical presses. Lathe machine production was halted in 1979 due to poor marketability. Two companies have been identified with credible expertise in machine rebuilding.

Metalcasting services are offered by about 153 firms with a combined annual capacity of 400,000 MT. 24 % of these firms have been classified to be capable of producing precision castings of exportable quality. Only two firms offer steel forging services with a combined capacity of 10,500 MT. About 20 firms in and around Metropolitan Manila are offering tool and die making services capable of producing several types of stamping dies and plastic injection and compression moulds. Tool engineering services are available at four known tool manufacturers with one company producing diamond-tipped cutting tools for mining.

Only large corporations can afford materials and product testing facilities. A government agency, (MIRDC), provides comprehensive testing and inspection services specifically for metals while another offers general testing services, both located within Metro Manila. South of the Philippines, there is

only one minor facility. There are about 40 metalfinishing firms offering electro plating services. Currently, there are 5 heat treatment facilities serving the metals industry.

Generally, the technologies for most of the engineering services available in the country are 5 years behind those of the NIC's and 15 to 20 years behind to those of the developed countries. This is quite lamentable considering that up to the early 60's, the Philippines was still ahead of Taiwan and Korea in this sector.

There are limited design and product engineering activities with more than 90 % of jobs mainly performed as adaptations or innovations of existing products. Very few original product activites are carried out.

There is an abundance of technical human power sourced mainly from the 18,000 engineers and 36,000 vocational graduates produced annually by at least 125 engineering schools and a proliferation of vocational/technical institutes offering six months to 3 years courses. Philippine labor rates are lower than that of ASEAN counterparts. Newly graduated engineers receive an average starting pay of about $ 120 a month, while the highly skilled technicians usually get $ 150 a month. This highly-trainable, low-cost human resource pool is perhaps the most important comparative advantage of the Philippine engineering and metalworking sector.

Section II: Major Engineering Constraints

It is acknowledged that the main strength of the sector lies in the highly adaptive capability of its manpower and the large unutilized capacity of its production facilities, estimated to be 40 % to 45 %. However, these two factors shall remain passive due to several pressing constraints:

1. The biggest constraint stems from the fact that most engineering firms utilize out-dated equipment and facilities which are relatively less productive, less efficient and less accurate, such that in terms of unit costs and quality, they can not compete with their ASEAN counterparts, with the possible exception of custombuilt jobs.

2. A tripartite Presidential Task Force on Science and Technology for the Metals and Engineering Sector, composed of industry captains, leading members of the academe, and government officials has clearly identified that the lack of trained personnel for design and engineering of machineries and components as the most important constraint that should immediately be addressed.

3. The sector is also burdened by the limited supply of raw materials, marked by heavy dependence on imports when quality is essential. Basic metals such as copper, nickel, gold and to some extent iron are all indigenous to the Philippines, with the country among the top ten world's suppliers of the first three mentioned.

National efforts to process these metals into secondary forms for local industrial consumption have fallen short of adequate.

The country's sole smelting plant, PASAR, produces 138,000 MT of copper cathode annually, only 8% of which is processed locally into secondary forms mainly by wire and cable manufacturers. The country's only nickel processing plant (nickel briquettes) has been non-operational since 1986. The substantial output of widespread small-scale gold-panning activities, using potentially dangerous extraction methods, are smuggled out of the country.

4. Even with the abundance of a highly trainable workforce, several training constraints are still felt, most especially for the metals and engineering trade. A National Manpower and Youth Council study indicated that by 1993, 78,000 additional workers must be trained in various skills such as machining, welding, foundry, press and sheet metalworking, etc. To compound this, engineers and technicians with substantial industry experience and training are easily lost to foreign jobs at an alarming rate. Moreover, there is a perceived considerable shift in student enrolment towards computer courses leaving out mechanical, chemical, metallurgical and electrical engineering batches in major universities with barely one class each. This holds true for trade school enrollment.

5. Low product quality output from most of the small and medium enterprises inhibits their marketability not only for exports but also for local consumption. Only large corporations, and very few without foreign affiliates, have successfully exported engineered products. This may be attributed partially to the lack of testing facilities especially outside Metro Manila. More importantly, medium to small firms often say they can not justify the cost for test apparatus or even to pay for testing fees. Such an orientation towards quality could be a formidable stumbling block towards promoting marketability.

Section III: Government Policies and Strategies

The Board of Investments (BOI) of the Department of Trade and Industry (DTI) and the Metals Industry Research and Development Center (MIRDC) of the Department of Science and Technology (DOST) are the government bodies directing policies and strategies for the metals and engineering industry.

The BOI has initiated several programs to promote a more conducive manufacturing climate. One such program is the Investments Priorities Plan (IPP), which classifies firms as pioneer and non-pioneer enterprises and entitles them to varying incentives, most significant of which are the income tax holidays. Among the areas of economic activities identified by the IPP are the manufacture of agricultural, fishing, and industrial machinery, electrical components and motors, shipbuilding and shipbreaking, automotive parts, and rehabilitation/reconditioning of industrial plants.

To revitalize the motor vehicle manufacturing sector, the car, commercial vehicle, and motorcycle development programs grant fiscal incentives to participants but in return they are expected to exert aggressive effort to increase the local content component to reach a level of 40% for cars and about 45% to 50% for commercial vehicles in a period of three years. A similar program was implemented for consumer durables. The formulation of a development program for the manufacture of industrial machines has been appealed by metalworking industry associations.

MIRDC is the mandated government agency which promotes the metals and engineering sector through the introduction of modern technology and efficient utilization of science and technology resources. The Center carries out its technical assistance thrust through industrial manpower training, product development services, testing and inspection services and technical consultancy activities. A centerpiece strategy currently being implemented is a countryside assistance program, known as the Metals and Engineering Industries Assistance Program, funded by the US-AID, in six regions of the country. This program will be made available to the small and medium enterprises in the countryside with emphasis on technical assistance in the form of skills training, consultancy, product/process design and development, and support to common service facilities for the following technologies: heat treatment; metalcasting; smithery; electroplating; brassware-making; and small industry equipment manufacturing.

To complement this, the Metals and Engineering Board Foundation, under the NMYC, brings together the government, labor

sector and major industry associations to harmonize their various training programs to ensure an adequate supply of workers trained in relevant skills and technologies.

Section IV: Technical Institutional Set-up

The Center is comprised of three main facilities: the metalcasting center, metalworking center, and the testing and inspection laboratories. All these facilities are harnessed to extend technical assistance to the industry. Annex C shows the Center's organizational structure.

The core of its technical manpower rest on about 83 engineers mostly holding metallurgical, mechanical and chemical degrees, close to half of whom have had specialized training abroad.

To maximize its resources for industry assistance and avoid competition with the industry, the Center limits its manufacturing support activities to those jobs which have low economic production runs or have complex designs that private firms refuse or could not undertake profitably.

With its testing and inspection laboratories being accredited by the Bureau of Product Standards (BPS), MIRDC is thus responsible for setting quality standards for metal products.

The Center has maintained collaborative consultation with various industry associations such as the Metalworking Industry Association of the Philippines (MIAP), Philippine Foundry Society (PFS), Philippine Iron and Steel Institute (PISI) and Society of Manufacturing Engineers (SME), among others. Its countryside

assistance program is currently being implemented with the MIAP and PFS. This ensures maximized utilization of both government and industry resources towards relevant assistance programs.

The Center's modernization efforts can be highlighted by its recent acquisition of a CNC milling machine. Computer-aided-drafting is now being utilized with computer-aided-design being the ultimate target application. For the Center to stay relevant, it realizes that it must keep pace with the industry which is already slowly employing these machines.

The upgrading of its laboratory equipment is also necessary to achieve faster analysis turn-around time and greater accuracy as required by the advancing industry.

Since early 1987, the Center's specialization has been refocused towards introducing relevant modern technology within the reach of industry through its training programs and technical consultancy services in such areas as investment casting, tool and die making, quality control and inspection procedures, and more efficient foundry techniques.

Based on the comments of industry captains, the Center needs to enhance its design and engineering capability. This would entail massive upgrading of technical expertise for design and engineering of machineries and components which up to now are being conducted only via limited "reverse engineering". Technical cooperation and assistance from ASEAN counterpart institutions with extensive experiences on "reverse engineering", or even original equipment design and manufacturing shall considerably shorten the expertise acquisition period and cost for MIRDC.

Section V: Conclusion

Design and engineering capability has been aptly described as the technology link between the primary iron and steel industry and the engineering and metalworking sector, which transforms the basic industrial material -- steel, into machineries and components utilized by all other industries.

The ASEAN, emerging dominant industrial tigers going into year 2000, definitely should be free of any constraint poised by the lack of design and engineering capability. In this respect, the Philippine engineering sector needs nothing short of a massive upgrading to attain this technical capability, such that the Presidential Task Force on Science and Technology has impressed the urgency of the creation of a Design and Engineering Center.

The timely conduct of this workshop provides for the creation of an ASEAN/COIME technical co-operation network, to be known as, **ACDEC - ASEAN/COIME DESIGN AND ENGINEERING CENTER.**

The ACDEC shall:

1. Lead in the generation of design and engineering expertise for all ASEAN member nations by engaging in rationalised, highly relevant projects for the engineering sector.
2. Employ higher technologies, (as often as permitted) in the conduct of its activities such as computer-based techniques namely Computer-Aided-Design/Engineering/Manufacturing CAD-CAE-CAM, to cope with the rising international standards of quality and productivity.

3. Serve as the network for ASEAN technology transfer not only within metal industry service institutions but down through ASEAN's small and medium enterprises.
   (A rationalization of the region's engineering sector can also be developed by coordinated specialized activities for each member nation, eliminating duplication of efforts.)

4. Promote comprehensive industrial assistance services through technical advisory, highly specialized training courses, research and prototyping and other specialized manufacturing services.

5. Equally focus on other engineering disciplines, such as inspection, testing and quality control procedures and proper raw material selection.

To perform these functions, the ACDEC shall:

1. Be adequately equipped with the necessary facilties to comprehensively engage in advanced technologies for design, engineering, prototyping, testing and research.

2. Maintain a highly competent, permanent, technical staff comprised of experts on various engineering disciplines from member nations and (as necessary), from other technologically-advanced countries.

To ensure maximized utilization of resources, each member nation shall be represented by a delegation of tripartite composition, consisting of concerned government officials, industry captains and leading members of the academe.

Only through such an integrated approach can the ASEAN engineering sector rise up the challenge of technology going into year 2000.

References:

1. Foreign Trade Statistics of the Philippines, 1981-1988
National Census and Statistics Office, NCSO

2. National Income of Accounts, 1988, NCSO

3. Annual Survey of Manufacturing Establishments, 1987, NCSO

4. Philippine Metal Products Directory, 1989, MIRDC

5. Metalworking Industry of the Philippines, 1979, MIRDC

6. Metalcasting Industry of the Philippines, 1988, MIRDC

7. Machinery and Components Sector, Metals Industry,
10 year Development Plan, 1988-1998 , MIAP

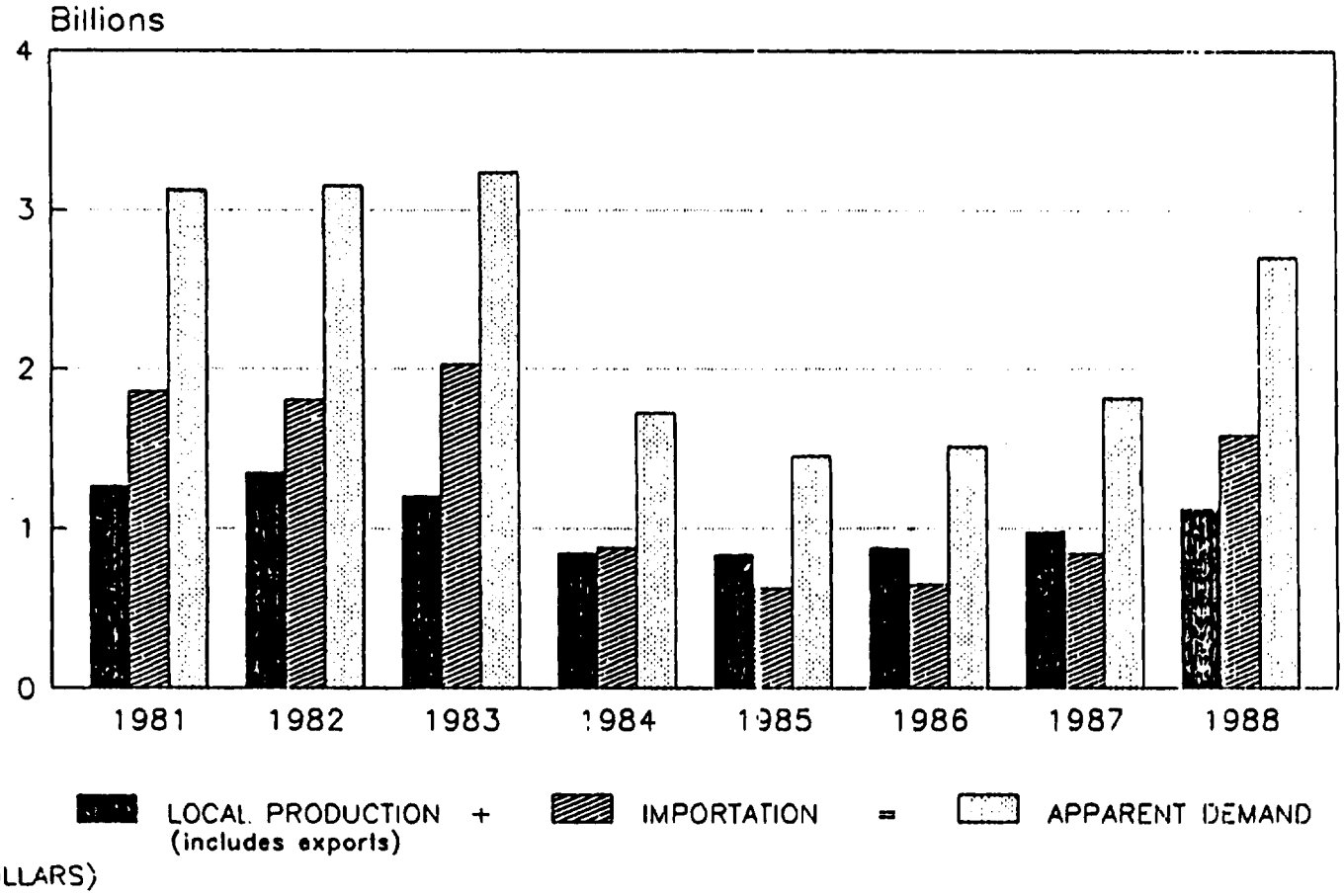
8. Technical Panel for Engineering Education, TPEE-DECS

9. Board of Investments, Dept. of Trade and Industry

10. Training Plan for the Machinery and Components Sector
1988-1993 , NMYC

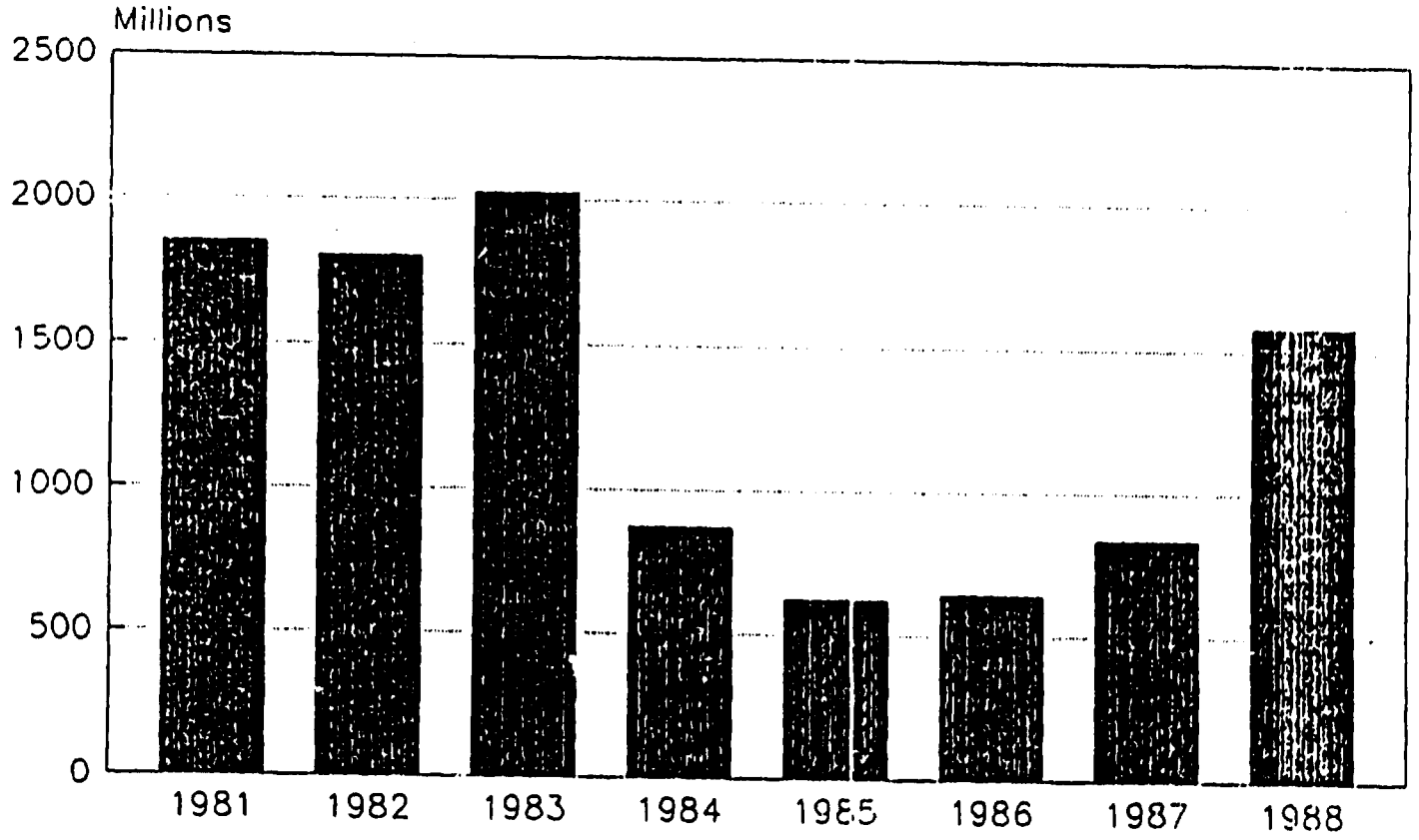
11. Presidential Task Force on Science and Technology
Metals and Engineering Technical Panel Report, 1988

METALWORKING PRODUCTS
APPARENT TOTAL DEMAND



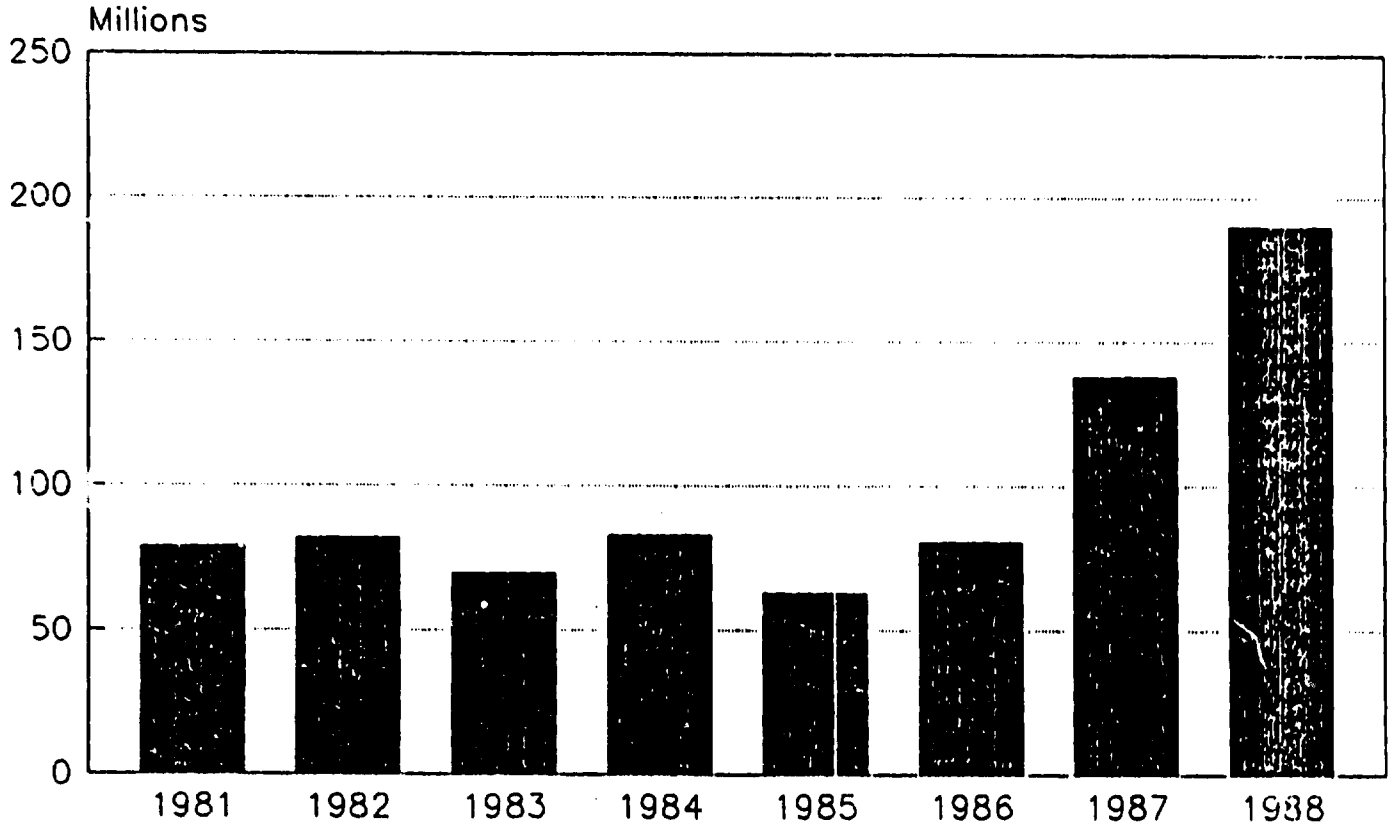
(CIF. DOLLARS)

PHIL. METALWORKING IMPORTS



(CIF, DOLLARS)

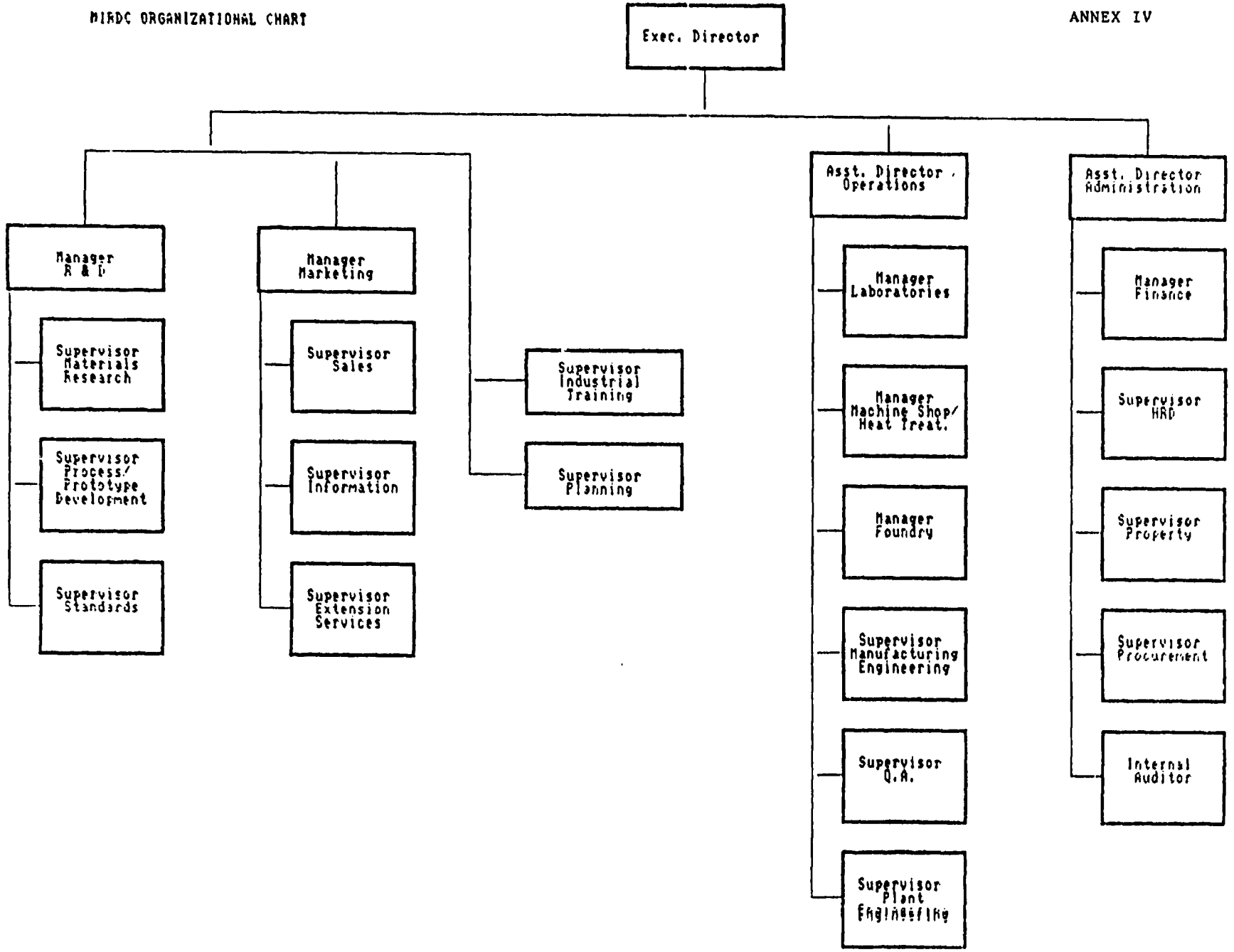
PHIL. METALWORKING EXPORTS



FOB. DOLLARS

MIRDC ORGANIZATIONAL CHART

ANNEX IV



ANNEX V

THE INVESTMENT CASTING PROCESS

Overview

The Investment Casting of "Lost Wax" process was introduced to MIRDC by the Japanese experts in 1979. A Japanese team of experts was sent to MIRDC to train Filipino counterparts and to set up a pilot plant in 1983. In January 1986, the project was completed and MIRDC operated independently. It has since developed cast products for such industries as textiles, armaments, dentistry, bottling, fishing and logging.

The process

Investment casting (lost wax) method is a process for casting industrial parts and has a large potential. Parts can be produced to the required surface finish and dimensions thus eliminating subsequent machining operations after casting. The process consists of the following steps:

(a) Die and mould manufacture

Pattern dies in wax injection moulds consist of simple low-cost dies or machined dies. Low-cost dies are non-metallic and may be made of plaster of paris or silicone rubber. Fully machined dies can be made of steel or aluminum, depending on the quantity and complexity of parts to be produced.

(b) Wax melting and curing

Wax is melted in a wax melting tank maintained at 132°C. Melted wax is then held in a wax-curing tank for eight hours at 60°C.

(c) Wax injection

Wax is injected into the die mould and the wax pattern is produced, which is an exact shape and geometry of the desired product with certain allowance for wax and metal shrinkage.

(d) Wax repair and assembly

Upon withdrawal from the die mould, the wax pattern is cleaned, caused and fins are removed. This is then checked for defects. Defective patterns are repaired. Wax patterns declared good are assembled to form a cluster or tree.

(e) Wax coating

Wax clusters are cleaned with acetone to remove the grease caused by the silicone oil sprayed to the die mould cavity before injection, and all other minute particles that may be attached to the surface of the pattern. After cleaning, the clusters are coated with refractory materials following the procedures as shown below:

	Slurry	Stucco stand	Drying time
First coating	Primary Slurry	Zr Sand	4 hrs
Second coating	Back-up Slurry	Fused Silica Flour (G2)	3 hrs
Third coating	Back-up Slurry	Fused Silica Flour (G1)	3 hrs
Fourth coating	Back-up Slurry	Chamote Sand	3 hrs
Fifth coating	-do-	-do-	3 hrs
Sixth coating	-do-	-do-	3 hrs
Seventh coating	-do-	-do-	24 hrs

The above procedure may vary depending on the complexity of casting design and its weight.

SLURRY COMPOSITION

MATERIAL/ SLURRY	SNOWTEX 30	G-5	ZIRCON FLOUR	KUNIPA	SURFACE ACTIVE AGENT	ANTI-FORM AGENT
Primary	1 li	-	3.3 +0.1 -0.1 kg	10 g	5-10 cc	Proper amount for debubbling
Back-up Slurry	1 li	2.6-2.7kg	3.8-4.0 kg	--	--	------

(f) Dewaxing

The moulds are now ready for dewaxing and the sprue of cluster is fixed so that the wax can flow out freely during dewaxing. The autoclave equipment used maintain the following operating conditions:

(i) temperature - 160°
(ii) pressure - 7 kg/cm^2
(iii) time - 10-15 minutes

(g) Preheating

The moulds now ready for pouring are preheated in a shell-firing furnace in order to melt out wax residues and to improve the strength and permeability of the ceramic moulds. Preheating (firing) is done for at least one hour at 1,000-1,050°C.

(h) Melting and pouring

Preheating of the ceramic moulds is done simultaneously with melting of the material for the required casting. It is necessary that molten metal be poured in the ceramic mould while it is red hot. This is to prevent a rapid temperature drop that would cause cold-shut problems in the castings. For ferrous castings, melting is done in an induction furnace while for non-ferrous castings, a crucible is used.

Equipment costing

This is the required equipment for the process and their costs:

Equipment	Capacity	Cost (Pesos)
1. Wax melting tank	20 liters (approx. 6 kg wax)	-P- 85,000
2. Wax curing tank	5 cyl @ 1.5 kilo wax	-P- 125,000
3. Wax injection machine	1.5 kilo wax; 70 kg/cm injection pressure	-P- 690,000
4. Turntable type stirring machine (2 units)	75 x 300 mm	-P- 270,000
5. Propeller type stirring machine	240 rpm	-P- 135,000
6. Fluidized bed (3 units)	500 x 460 mm	-P- 16,000
7. Dewaxing autoclave with boiler	6 - 8 ceramic moulds per batch	-P- 1,100,000

8. Shell firing furnace	600 x 650 x 1,000 mm	-P- 1,820,000
9. Induction furnace	2 crucibles @ 10 x 50 kg	-P- 3,100,000
10. Accessories (hot plate, soldering iron, spatula, etc.)		-P- 50,000

Investment casting applications

1. Automotive parts
2. Sewing machine parts
3. Electronics
4. Machine tool accessories and parts
5. Food machinery parts
6. Artwork
7. Mechanical and dental equipment
8. Arms and rifle parts
9. Office equipment parts
10. Pump and air compressor parts
11. Other metalworking equipment parts

ANNEX VI

TECHNOLOGY TRANSFER/UPGRADING THROUGH TRAINING

Program Cost -P- 1,930M

	Actual 1988	Target 1989	Target 1990
No. of Training Programmes			
Packaged training programmes	6	13	16
Regular seminars/workshops	22	41	54
Income generated (-P-)	0.4M	0.85M	1.4M
Number of participants/establishments	619/140	700/350	1,400/400
Impact on Industry			
Improvement in productivity	-P- 150M/year		

RESEARCH AND DEVELOPMENT/TECHNOLOGY TRANSFER

Programme Cost -P- 4,698M

Sub-activity	Impact
A. Research and Development	
1. Development of special alloy for denture and orthopedic application	Import substitution -P- 40M/yr
2. Development of manual type surface grinder	Import substitution -P- 175M/yr
3. Development of single cylinder gasoline engine	Import substitution -P- 175M/yr
4. Increased application of investment casting	Import substitution -P- 15M/yr
5. Development of CAD/CAM technology for mold and die design manufacturing	Foreign exchange Savings -P- 120M/yr
6. Process development of brassware casting	Export potential -P- 10M/yr

7. Development of local substitutes for foundry molding sand	Utilization of indigenous raw materials 300,000 mt of new sand per year
8. Capability upgrading in failure analysis and metallurgical evaluation of engineering structures	Availability of appropriate raw materials for engineered products
9. Selection of a few standard alloys for use in design and fabrication of equipment and for industry wide use	Increase safety in utilization of old and engineering products

	Location	Industry impact
B. Technical Consultancy		
(a) Cutlery manufacturing	Albay Laguna Batangas Pampanga Cagayan Camiguin Ilocos Norte	Import substitution -P- 4M/yr
(b) Brassware manufacture	Lanao del Sur Cotabato	Export potential -P- 10M/yr
(c) Upgrading of industrial electroplating	NCR Cebu Ilocos Norte Laguna Iloilo Legaspi Davao del Sur	Improvement productivity -P- 3M/yr
(d) Upgrading of precious metal plating	NCR Bulacan Davao Cebu	Improvement in productivity -P- 20M/yr
(e) Programme for development of quality consciousness of metal consuming public	NCR and nearby regions	Free service to foundry industry
(f) Creation of counterpart center in two pilot regions	Cagayan de Oro Cebu	Access to MIRDC services and prompt delivery of services

ANALYSIS, TESTING AND INSPECTION

Programme Cost -P- 6,428M

	Actual 1988	Target 1989	1990
No. of companies to be served	1,290	1,000	1,000
No. of samples to be tested/analyzed	10,642	11,000	12,000
Income generated (-P-)	2.1M	2.2M	2.7M

Impact on Industry

Quality improvement to support -P- 5B export in five years
Reduction of technical smuggling

Services Rendered

- Chemical analysis
- Non-destructive testing
- Mechanical and metallurgical testing
- Corrosion testing
- Metrology testing
- Instrumentation and process control
- Surface treatment

PRODUCTION AND REPAIR

Programme Cost -P- 16,098M

Sub-activity	Actual 1988	Target 1989	1990
Metalcasting			
Companies to be served	60	90	100
Income (-P-)	3.6M	4.0M	4.4M
Maching			
Companies to be served	75	100	120
Income (-P-)	1.15M	2.0M	2.2M
Heat Treatment			
Companies to be served	95	100	120
Income (-P-)	0.99M	1.0M	1.3M

Impact on Industry

Each activity has a foreign exchange savings of $2M per year.

INFORMATION DISSEMINATION

Programme Cost -P- 3,129M

Sub-activity	Actual 1988	Target 1989	Target 1990
1. Technical information services/ library services	27 Subscribers/ 1,164 researchers	36/ 2,000	28/ 2,500
2. Publications			
(a) Metals industry trends and events	1,000 copies	6,000	12,500
(b) Metal products delivery	---	1,500 copies	---
(c) Metalcasting industry of the Phils.	---	500 copies	---
(d) Primary iron and steel industry			500 copies
3. Educational plant tours	90 tours 2,067 participants	90/ 2,000	90/ 2,000
4. Exhibits and fairs	As necessary		

THE PRECISION TOOLING INDUSTRY OF SINGAPORE BY YAP LIONG CHAI

Singapore initiated the industrialization programme some 25 years ago. Over these years, significant increase and growth of the MNCs and the local small and medium enterprises (SMEs) supporting industries have been achieved and a distinct transformation from a traditionally labour intensive to a technology intensive based industry evolved. With the MNCs requirements to meet the stringent functional requirements of the manufactured products and facing global competitive market, the technical competence of the precision tooling industry is often challenged. This skill-oriented industry is regarded the backbone of the manufacturing sector, as its capabilities are crucial in attracting more high technology companies into Singapore. The manufactured products, being an value-added exportable items also contributed to the growth of the GDP.

Recognising its strategic importance to the manufacturing sector and economic benefits derived, the Government has identified the precision tooling industry as a priority industry for further development. This paper outlines the historical development, current status and development of the precision tooling industry in the Republic of Singapore.

1.1 Terminology of the Precision Tooling Industry

Precision tooling is a collective name for dies, moulds, inserts, jigs and fixtures, tooling components used in the manufacture of products. Depending on the manufacturing of processing operations, the precision toolings are designated accordingly. Typical examples are :

- o metal forming, stamping moulds / dies
- o plastic injection moulds / dies
- o jigs and fixtures for precision machining, milling, cutting processes
- o die casting moulds, tools and dies.

2.0 STATUS OF THE PRECISION TOOLING INDUSTRY IN SINGAPORE

2.1 Historical Development and Current Status

The precision tooling industry started in the early 60's, manufacturing simple low end toolings to support predominantly the cannery and fluorescent ballast manufacturers. The Economy Development Board (EDB) created the Light Industry Unit (LIU) to upgrade the skills of the toolmakers towards the late 60's.

With time, the precision tooling industry increased in number, size and capability. A few MNCs were attracted to Singapore by these local supporting industries. In the 70's substantial number of consumer electronics MNCs established their manufacturing operations in Singapore, this lead to the growth and further upgrading of these local companies. The strategic planning of EDB through its industrial promotion programmes provided the catalysts for the significant industrial transformation.

Between the late 70s and early 80s, there was a distinct change from the low end toolings towards medium end tooling. With the use of cost-effective modern precision machinery like Computerized Numerical Control (CNC) Machines, Electrostatic Discharge Machines (EDM), better educated and trained entrepreneurs, and the continuing industry promotion programmes spearhead by the EDB; the precision tooling industry secured a unique position of importance in the manufacturing sector. Today, Singapore toolmakers are reputed for its medium end tooling capabilities by the International Purchasing Offices and Singapore-based MNC customers.

2.2 Structure of the Precision Tooling Industry

The structure of the precision tooling industry is described by a broad-based pyramid; foundation of large number of toolrooms and workshops, a small number of medium size toolshops and several large MNCs.

Manufacture of moulds and dies is a skill-oriented, value-added activity. The development of the precision tooling industry is a slow and time-consuming process which was moulded over the decades.

2.3 Small and Medium Enterprise (SME) Toolshops

The Singapore Precision Engineering and Tooling Association (SPETA) recorded 200 SMEs toolrooms in Singapore. 95% of these toolshops have less than 30 workers.

2.4 Large Toolshops

These are of MNCs origin and consists of more than 30 people. Large toolshops represents 5% of the tooling industry. The technical capability is invariably higher and the operation is better managed. Much of the know-how are technologically transferred from their parent companies. Being established internationally, the export of the manufactured tooling products is facilitated.

The toolshops are categorized by activity into :

- o Dies and Mould manufacturing
- o Dies/Moulds manufacturing accessories components and parts manufacturing

The end users of these manufactured moulds and dies are as follows :

- o Plastic Injection Moulding (50%)
- o Metal Stamping, Machining and Die Casting (42%)
- o Others (8%)

The consumer electronics and micro-electronics sector is the major customer for the above supporting industries, accounting for more than 70%. The growth of the consumer electronics and microelectronics sector is expected to continue. It will therefore continue to dominate the manufacturing industry over the next few years.

2.5 Infrastructural Support for the Precision Tooling Industry

(a) Supply and Distribution of Raw Materials

Eight major raw materials suppliers, whose activities range from direct material sales and tooling accessories, to local hardware agents, are available.

(b) Machinery / Equipment Suppliers

More than 90 suppliers in this lucrative business. Investment in CNC machines, CAD/CAM systems and QC equipment continues to grow at about 5-10% per annum.

(c) Training Facilities

Three major EDB training centres and numerous vocational training schools (VITB) were set-up by the EDB to provide technical education and training for the toolmakers. The precision tooling course consists of two years in-centre training followed by two years industrial attachment. A wide spectrum of courses in precision engineering was offered; metrology, engineering design/ drawing, metal machining, toolroom technology, joining processes, CNC, EDM, CAD/CAM manufacturing etc.

These training centres are also well equipped with the latest toolroom machinery in manufacturing.

(d) Design Advisory Service (DAS)

The technology of precision tooling fabrication/manufacture, among the SMEs is adequate. However, they lack the in-depth experience in tools design capability, which is needed for excellence in sophisticated progressive toolings development. A Design Advisory Service (DAS) was also established in 1987 with the aim of :

1. Upgrading the design capability of the precision tooling industry

2. Providing consultancy on tool design improvement and manufacturing processes

3. Training industrial-sponsored designers

4. Providing CAD/CAM services to the manufacturing industry.

(e) Singapore Precision Engineering and Tooling Association (SPETA)

The Singapore Precision Engineering and Tooling Association (SPETA) was established in 1981 with the following objectives :

1. To marshall and assist the management of resources and manpower skill requirements to the development of an excellent Tool and Industry in Singapore

2. To act as the advisory, consultative and co-ordinating body for the tool and die industry.

3.0 CONSTRAINTS

As it is in most countries, the development and growth of the precision tooling industry is constrained by skilled labour shortage, and tool design capability.

(i) Skilled Labour Shortage

Manufacture of moulds/dies is a skill-oriented activity where craftmanship is crucial. The nature of the mould/dies production inhibit production line operation. The activity relies heavily on the number and skill levels of the toolmakers. The rapid growth of the consumer electronics and micro-electronics has created an accurate shortage of tool-makers.

(ii) Weakness in Tooling Design Capacity

The MNCs toolshops are strongly supported by their parent companies which have well-established design capabilities. In contrast, the SMEs showed weakness in tool design capacity due to four major reasons :

1. Good business order conditions kept them busy focusing on production to fulfill orders. Little time is available for design capability development.

2. Prior to the establishment of the Design Advisory Service (DAS) little expertise and consultancy is available in precision tooling.

3. The work orders received by the toolmakers were custom-designated and the financial margin for technical improvement is small.

4. Poor human resource management and the image of the SME toolshops make it difficult for them to attract very skilled staff (in comparison to MNCs).

4.0 IDRC-SISIR JOINT PROJECT ON TECHNOLOGY TRANSFER AND TECHNOLOGY UPGRADING PROGRAMME

In January 1989, Technology Transfer consultants from International Development Research Council (IDRC) of Canada and the Singapore Institute of Standards and Industrial Research (SISIR) initiated a joint development project to :

1. technically upgrade the SMEs and increase their competitiveness
2. diagnose and identify any existing or potential difficulty facing the SMEs being surveyed.

A total of 120 local SMEs were selected for this joint project; 30 companies from each of the following four manufacturing industries were short-listed for survey :

- o Precision tooling and engineering
- o Plastic manufacturing
- o Food processing
- o Electronics and electrical.

A summary of the recent findings of the Precision Tooling and Engineering sector surveyed in the IDRC-SISIR joint project* is given in the following pages.

A. SECTORAL PROFILE

A.1 Manufacturing Management

	Average
o Utilization ratio of main production machinery	72 %
o Percentage of production costs over sales	44 %
o Percentage of time, machinery is not available for production due to breakdown or maintenance	5 %
o Percentage of defects at outgoing quality control (identified by factory)	4
o Percentage of defects after it leaves the factory (identified by customer)	1
o Percentage of set-up time compared to total running time	8

A high utilization ratio of the main production machinery is shown in the survey reflects the robust state of the precision tooling business in Singapore. The use of modern precision machinery coupled with skilled learned labour has reduced the percentage of defects remarkably as indicated in the survey.

* IDRC-SISIR joint project :
Phase 1 : Workshop Analysis of Precision Engineering Sector
- 14 February 1989

A.2 Product and Process Development

o	Percentage of companies which do product/ process development	62 %
o	Percentage of sales coming from product/ process development over the last five years	48 %
o	Average number of products/process developed in the last five years	8
o	Average number of products commercialized	6

Since the identification of weakness in tooling designing capacity as a constraint to the progress of the precision tooling industry in the late 70's, considerable efforts have been devoted by both the Government and the private industries to minimize the constraints. The recent survey reflects the overwhelming change towards the product/process development.

A.3 Manpower Profile

	Admin Staff	Clerical Staff	Engineer	Technician	Production Workers
Primary	0 %	0 %	0 %	6.4 %	77.9 %
Vocational	0 %	3.8 %	0 %	48.7 %	2.7 %
'N'/'O' Levels	59.6 %	84.6 %	0 %	25.6 %	18.9 %
'A' Levels	14.0 %	7.7 %	0 %	1.3 %	0.2 %
Polytechnic	17.5 %	3.8 %	68.2 %	17.9 %	0.4 %
University	8.8 %	0 %	31.8 %	0 %	0 %

The manpower profile and the educational levels of the precision tooling industry are show in the table. The Engineering and Technical positions are invariably filled by the University / Polytechnic and Vocational / Pre-university graduates predominantly. In general, the overall educational levels for the various position levels held is considered high.

A.4 Sales of Precision Tooling Products

All the precision tooling industry cater for the local manufacturing sector, servicing mainly the consumer electronics/microelectronics MNCs. The excess capacity is exported to neighbouring ASEAN countries and the United States.

B. PROBLEMS OF THE PRECISION TOOLING INDUSTRY

B.1 Problems with Manufacturing

The following problems associated with manufacturing were identified and the percentage of companies facing each categories of problems are indicated as follows (in order of frequency of occurrence in all the companies) :

B.1 Problems with Manufacturing Operations

- o Vendors/suppliers not meeting schedule
- o Not adequate plant capacity
- o Materials not available
- o Unable to meet delivery dates
- o Too high inventory
- o Products not meeting specification
- o Too high defect rate of high material wastage
- o Too much plant breakdown
- o Others

B.2 Problems with Human Resource Management

- o Lack of adequate motivation of path of employees
- o Lack of adequate skills in employee
- o Employee dissatisfaction with salary
- o Need foreign manpower
- o Problem of getting shift workers
- o Percentage of absenteeism (excluding MC)
- o Too much management time spent on dispute settlement
- o Others

B.3 Problems with Marketing

- o Low profits
- o Not enough export sales
- o Not enough sales
- o Others

C. SOLUTIONS/UPGRADING TECHNOLOGIES

Numerous business and management solutions were proposed to the precision tooling industry. The following tables depict the proposed solutions and areas for improvement.

- o Upgrading of expanding plant facilities
- o Expansion into new products
- o Expansion into new markets
- o Improve product quality to meet export standards
- o Improve profitability
- o Introduce new cost control processes.

C.1 Manufacturing Management Techniques Practised

- o Preventive Maintenance
- o Recorder Point System
- o Statistical Quality Control
- o Method Study
- o Company Wide Quality Control
- o Work Study
- o Value Analysis and Engineering
- o Quality Control Circle
- o Others

C.2 Human Resource Management Techniques Practised

- o Formal Employee Performance Appraisal
- o Recognition Award
- o Job Analysis
- o Interviewing Techniques
- o Merit Pay System
- o Quality of Working Life
- o Management by Objectives
- o Job Rotation
- o Profit Sharing
- o Production Bonus
- o Straight Seniority System for Pay
- o Flexi Time
- o Others

C.3 Marketing Techniques Practised

- o Market Research
- o Competitive Product Analysis
- o Sales Forecasting
- o Break-Even Analysis
- o Market Planning
- o Sales Training

5. IDENTIFIED FUTURE NEEDS OF THE INDUSTRY

From the survey of the IDRC-SISIR project on precision tooling and engineering sector, some of the identified needs of this particular group of industries are :

Technology

- o Quick Die Change
- o Progressive Design Tooling Technology
- o Deep Drawing Technology
- o EDM - Wire Cutting Technology Upgrading
- o Vacuum Die Casting Technologies

Manufacturing Management

- o Automation
- o Plant Layout and Material Flow
- o Process Inventory

Quality Management

- o QC Systems and Documentation

Product Diversification

- o Product Identification and Diversification

Manpower (Human Resources)

- o Marketing Expertise
- o Skills in Appropriate Technologies

6 CONCLUDING REMARKS

To develop Singapore into a global node for precision tooling production, specialising in supplying a comprehensive range of toolings to the micro-electronics and general manufacturing industries, several developmental strategies have been suggested :

(i) Enhance the existing infrastructure to accelerate the growth of the industry

(ii) Adopt new technology. This is to increase product competitiveness through shorter lead time, competitive pricing and reliable quality and develop a comprehensive range of tool making capability.

(iii) Accelerate the supply of skilled workers. This will be through attracting school leavers to the industry, encouraging MNCs to train die/mould engineers and recruiting from foreign sources.

ENGINEERING INDUSTRIES IN THAILAND: STATUS, CONSTRAINTS AND MEASURES
BY DAMRI SUKHOTANANG AND PASU LOHARJUN

I. Present status of National Engineering and capital goods sector

1.1 The whole picture

The engineering industry, which are defined to encompass fabricated metal products, electrical and non-electrical machinery and transport-equipment, includes manufacturers of intermediate products, parts and components, as well as assembly operation. The parts and components manufacturing industry provides inputs to other producers (assemblers) and can be considered as a supporting industry. Apart from the production of parts and components, the supporting industries also cover the industries providing services to engineering firms, the production of accessories, the production of packaging items and some materials processing industries.

Production outputs of the engineering industries can be classified into end products and inter-mediate products, components and parts. It is also obvious that a major portion of the engineering industries can be dassified as supporting industries especially those manufacturing intermediate products, components and parts. Table 1 shows the output and growth of basic metals and engineering industries in Thailand in 1970, 1975, 1980, 1985, 1986, 1987 at 1972 prices. In the period of 1970-1980, the production of base metal and engineering industries grew at an average annual rate of 11.35 percent, above the 10.15 percent for the whole manufacturing sector. Between 1980 and 1987 growth in the basic metals and engineering industries fell of an average rate of only 2.73 percent as against the 6.10 percent average rate of the overall manufacturing sector. Table 2 shows production of the

industries at current market prices. In 1987, the production of basic metals and engineering industries amounted to 41,477 million baht in term of value added at current market prices, representing 14.9 percent of the total value added of the whole manufacturing sector in the same year.

Table 3 and 4 show imports and exports statistics of basic metals and engineering goods respectively. The statistics suggested that Thailand has low self sufficiency in these industries, however, the country already has some basis for further development in the future

Table 1. Output and Growth of Basic Metals and Engineering Industries in Thailand, 1970, 1975, 1980, 1985-1987 (At 1972 prices)

(Millions of Baht)

	1970	1975	1980	1985	1986	1987	Average annual growth rate (%)		1988[e]
							1970-80	1981-87	
Basic metal industries	678	665	1,180	1,427	1,457	1,465	6.05	4.75	1,541
Fabricated product	769	904	1,202	1,488	1,611	1,839	4.74	6.15	2,088
Machinery	774	1,245	2,174	2,994	3,215	3,624	11.03	7.71	4,126
Electrical machinery & supplies	481	794	1,901	2,415	2,720	3,247	15.17	7.8	3,776
Transport equipment	1,379	2,509	5,054	3,175	3,769	4,677	15.59	-3.18	5,929
Total Basic Metal & Engineering Industries (A)	4,081	6,117	11,511	11,499	12,783	14,852	11.35	2.73	17,460
Total Manufacturing	24,893	40,708	64,984	81,463	89,305	101,414	10.15	6.10	114,033

SOURCE : NESDB

Table 2. Production of Basic Metals and Engineering Industries in Thailand in 1970, 1975, 1980, 1985-1987 (At current market prices)

(Millions of Baht)

	1970	1975	1980	1985	1986	1987	1988[e]
Basic metal industries	637 (2.71)	1,235 (2.18)	3,655 (2.61)	3,709 (1.65)	3,201 (1.26)	3,396 (1.15)	4,124 (1.15)
Fabricated products	756 (3.22)	1,565 (2.76)	3,920 (2.80)	6,250 (2.78)	6,552 (2.57)	7,459 (2.52)	8,705 (2.43)
Machinery	733 (3.12)	1,717 (3.03)	3,674 (2.63)	5,602 (2.50)	6,095 (2.39)	7,128 (2.41)	9,044 (2.53)
Electrical machinery & supplies	442 (1.88)	1,039 (1.83)	3,389 (2.42)	5,938 (2.65)	7,656 (3.00)	8,377 (2.83)	9,911 (2.77)
Transport equipment	1,221 (5.20)	3,774 (6.66)	11,416 (8.16)	10,961 (4.88)	12,470 4.89)	17,804 (6.02)	27,000 (7.55)
Total Basic Metal & Engineering Industries (A)	3,789	9,330	26,054	32,460	35,975	44,164	58,784
Total Manufacturing (B)	23,503	56,636	139,936	224,456	255,029	295,512	357,851
(A) x 100%/(B)	16.1	16.5	18.6	14.5	14.1	14.9	16.4

SOURCE : NESDB

Figures in parentheses are percentage shares

Table 3. Imports by Commodity of Basic Metals and Engineering Industries

Unit : Million Baht

Commodity	Fifth Plan					6th Plan	
	1982	1983	1984	1985	1986	1987	1988
Basic Metal	19,487	24,767	24,606	27,670	25,416	38,417	67,811
Iron and Steel	15,199	19,712	19,188	23,296	21,536	32,237	56,110
Copper	970	1,293	1,315	1,371	1,288	2,249	4,749
Nickel	246	103	127	128	130	280	231
Aluminium	2,173	2,607	2,598	2,307	2,162	3,185	6,141
Lead	225	293	186	130	141	264	327
Zinc	654	734	1,163	395	133	149	149
Other Base Metals	20	25	29	43	26	53	104
Metal Products	1,492	1,789	1,951	2,106	1,882	2,553	4,304
Hand Tools & Cutlery	937	1,170	1,296	1,377	1,170	1,676	3,043
Metal Products	555	619	655	729	712	877	1,261
Machinery	19,426	31,154	33,196	33,392	31,151	47,726	89,890
Machinery	19,426	31,154	33,196	33,392	31,151	47,726	89,890
Electrical Machinery & Appliances	13,747	19,696	21,539	18,691	28,743	38,245	58,975
Electrical Machinerys Appliances	13,747	19,696	21,539	18,691	28,743	38,245	58,975
Transport Equipment	12,490	16,655	18,108	16,779	12,673	19,787	52,165
Railway Goods	60	788	115	1,710	122	65	865
Vehicles	10,261	14,441	14,816	11,576	10,909	18,430	34,194
Aircraft	547	364	2,519	2,583	916	398	15,658
Ships	1,622	1,062	658	910	726	894	1,448
Total	66,642	94,061	99,400	98,638	99,865	146,728	273,145
Proportion to Total Import (%)	34	40	41	39	41	43	53

Table 4. Exports by Commodity of Basic Metals and Engineering Industries

Unit : Million Baht

BTN Chapter	Commodity	Fifth Plan					6th Plan	
		1982	1983	1984	1985	1986	1987	1988
	Basic Metal	9,518	7,228	7,777	9,625	7,254	7,354	9,829
73	Iron and Steel	1,070	1,174	1,816	2,639	3,028	3,737	5,683
74	Copper	74	72	80	53	68	134	225
75	Nickel	-	-	-	-	6	64	17
76	Aluminium	423	476	401	482	459	630	1,097
79	Zinc	23	10	7	443	524	379	391
80	Tin	7,885	5,472	5,436	5,995	3,164	2,402	2,408
77,78,79	Others	43	24	37	13	5	6	8
	Metal Products	296	266	264	253	424	521	922
82	Hand Tools & Cutlery	195	175	160	142	183	229	313
83	Metal Products	101	91	104	111	241	292	609
	Machinery	676	826	1,892	4,704	3,948	8,926	22,175
84	Machinery	676	826	1,892	4,704	3,948	8,926	22,175
	Electrical M/c & Appliances	7,344	6,947	9,663	11,758	17,813	25,560	37,315
85	Electrical Machinery & Appliances	7,344	6,947	9,663	11,758	17,813	25,560	37,315
	Transport Equipment	249	280	363	514	1,021	1,019	3,950
86	Railway Goods	37	6	7	6	5	5	361
87	Vehicles	243	256	346	417	573	983	3,408
88	Aircraft	1	15	9	48	41	-	40
89	Ships	18	3	1	43	402	31	141
	Total	18,133	15,547 (-14)	19,959 (28)	26,854 (35)	30,459 (13)	43,380 (42)	74,191
	Proportion to Total Exports(%)	11	11	11	14	13	15	18

Source : Department of Customs; Figures in parenthesis are growth rate

1.2 Selected industries

1.2.1 Foundry and casting

Foundry products and casting play an essential part in the Thai economy, specifically in meeting the requirements of equipment, machinery, vehicle and spare parts manufacture. It is expected that there are 400 foundry shops in Thailand ranging from small scale to larger operations. To understand the industry, we may refer to the information on the investigation of 56 foundries in 1984 by MIDI. The study suggested that the technology level of 60 percent the surveyed foundries were at the average levle while 20 percent were at low and high levels. The study also indicated that the factories at average level group faced some problems due to lack of basic engineering knowledge and by the lack of program to improve their technological capabilities. It can also be concluded that the casting industry in Thailand can satisfy most of the required original parts in domestic and export markets but there were still several small and medium scale foundries which cannot produce casting with international standard quality.

1.2.2 Metal components and parts

The production of components and parts are considered to be one of the main supporting industries. The component and parts industries in Thailand are heavily dependent on the automobile and other machinery industries. For the automobil industry, there are 13 automobile assembly plants with a total production capacity of 162,460 units annually. For more than 25 years of automobile assembly in Thailand, local parts manufacturers have learned production technology

mainly from their mother companies, and are capable of producing many high-quality, low cost parts. The government of Thailand has also assisted these auto parts manufacturer by adopting the local content requirement polioy. At present, automobiles are required to have up to 54 percent of local contents.

A study by ministry of industry in 1988 reported that there are 400-500 auto parts manufacutring plants of various sizes with the employment of 20,000 workess.

1.2.3 Mould and die industry

Moulds and dies are metal tools which are essential to the production of plastic, metal, rubber and glass products. Ministry of industry estimated that the number of mould and die factories would be around 400-500 factories in 1988. From the survey of 60 mould and die factories by the metalworking and machinery industries development institute (MIDI) in 1987, it suggested that most of the moulds and dies produced were for domestic use, only a few percent were for exports. Flowever, prospects for exports are on the increase. At the same time, imports of moulds and dies are also on the increare. The government of Thailand has intensively promoted investment in die making factories by granting privileges to more than 16 die making factories in the past couple years.

The survey also suggested that die design and making technology were at primitive level for those of small and medium scaled Thai firms. Besides the technological problem, die making entrepreneurs were facing problems of labor shortage. There are need for educational

and training programs to produce industrial technicians and engineer specializing in die design and making.

1.2.4 Specialized processes

One of the very important characteristics of the engineering industries is its linkages between products and processes and its ability to supply other industries with specialized goods. The manufacturers of metal components and parts notmally subcontract most plating, casting, and heat treatment jobs.

Some of the metal component and part manufacturers have heat treatment facilities in their own factories, there are also several manufactures specialize only in heat treatment. The most conduded heat treatment methods are annealing, normalizing, hardening, and quenching, some other methods such as carburizing, nitriding and induction hardening are carried out as well. As for the products submitted to heat treatment, automotive parts accounted for the largest number, followed by agricultural machinery parts, moulds and dies, and gears.

Plating, another specialized process, is most commonlv carried out in nickel-chrome plating, followed by zinc plating. There are some firms also undertake tin, hard chrome and rare metal plating. Several medium and large scale specialized plating firms employ fully automatic plating equipment. As electronics sector grows, there will be more specialized plating for electronic components firms established in the near future.

II. Major constraints and problems.

Engineering industries comprise a wide range of activities and products. The industries can be categorized into 3 groups. The first group consists of the factories of large companies with high investment and good management large companies with high investment and good management system, in some factories having joint-venture with foreigners and employing modern technology, the second consists of factories which produce components and parts ranging in quality from medium grade to high grade by using engineering design and production, and the third consists mainly small scale factories characterized by family enterprises with no or little technical staff which generally concentrate on the production of parts mainly for agricultural processing and in repair works. From these categories, constraints in development can be identified as follows:

1. Samll and medium scale engineering industries lack knowledge on management and technilogy. The majority of companies which small in size are not accustomed to modern management systems. There are few companies carrying out sales activities. Therefore, it is impossible to recognize the singificance of materials, required durability, the scope of design and manufacture. In some cases, they lack knowledge on the properties of the materials used, on how to use high precision machinery and measuring instruments and on how to design, develop and produce certain parts and components.

2. Small and medium scale engineering industries tend to use old or second-hand or low efficiency machines and ignore the use of

measuring instruments. This is due to many reasons, i.e. they serve the low-price markets, lack of funds, lack of basic information and knowledge, the price of new or high precision machines and measuring instruments are too high.

3. Shortage of technical experts in engineering industries related fields. Serveral engineering industries which produce high precision parts and components required skill and engineering knowledge of engineers, technicians and workers. For example, to design and produce precision moulds and dies, it requires a comprehensive engineering technology for metal processing, moulding and mass production which is based on dynamics, material engineering, mechanical science and measurement engineering of technical staffs of the companies. At present, there are shortage of these type of technical experts.

4. Lack of infrastucture for further development of the engineering industries, such as center for research and development, technological support and promotion measures and industrial support, inadequate cooperation among the supporting and promoting organizations, engineering services, training center, inspection and testing laboratories.

III. Government policies

Up till now, there are no government policies which apply specifically to the engineering industries in Thailand. However, the government has emphasized the industrial promotion policy on 1) promotion of small and medium scale industries and regional industries 2) promotion of export industries, and 3) promotion of engineering and agro industries in the current Sixth Five-year National Development Plan.

The industrial promotion policies in Thailand have been mainly implemented in the form of investment incentives for industries by the Board of investment (BOI). To promote engineering industry, BOI provides incentives to those applied for indirect exports. Apart from BOI, the Department of Industrial Promotion of the ministry of Industry has carried out the promotion activities, mainly providing technical services for small and medium scale industries.

Though, there is no full systems and measures for promotion of engineering industries. The government's current small and medium scale industry promotion policy, which can be applied to engineering industries, has called for improvement of facilities and technology, modernization of management. There is no central organization for handling specific proposals for implementation of this policy. At present, the Ministry which is an governmental organization and the manufacturers' organizations in charge of drafting and executing policies for industrial promotion are not strong enough to deal comprehensively with industrial matters and thus are slow in establishment of full industrial policies.

One measure to develop the engineering industry is to adopt the sector-wise policies. The general method used is to select engineering industries as one of the strategic industries and establishing necessary privileges for the same. In order to materialize this approach, the establishment of an Act, the designation of responsible organization to act as promoters for action on various promotional measures and the establishment of a system of cooperation and planning of organizations concerned both in government and private sectors are necessary. Another measure is to support and promote transfer of technology to existing engineering industries. The last but not least is to provide infrastructure for the development of engineering industries such as research and development center, training center, inspection and testing laboratory. Besides these technological measures, financial and taxes related measures must be considered at the same time frame.

IV. Technical institution

In view of the urgent need for a specialized organization for the promotion of the engineering industries in Thailand, the government of Thailand has established the Metal-working and Machinery Industries Development Institute (MIDI) under the jurisdiction of the Department of Industrial Promotion, Ministry of Industry. It has been established with the assistance of the Government of Japan who provided a grant aid and technical assistance.

4.1 Objectives

MIDI is positioned between academic educational institutions and vocational training institutes. Its objectives are to curry out and provide practical technical guidance, managerial guidance, training, technical services, technological research and development, information services as well as acting as a core institution for engineering industry development. Emphasis is placed on the training of nucleus technicians, craftman, managers and entrepreneurs of medium and small scale metal-working enterpries.

4.2 Specialization

4.2.1 Manufacturing processes

The institute emphasize on 7 manufacturing processes as follows:

1. Casting
2. Welding
3. Machining
4. Heat treatment
5. Automation
6. Electroplating
7. Forging

Necessary equipment and facilities are equipped for actual production run, training and manufacturing of prototypes.

However not all manufacturing facilities are for individual training, they are used for demonstration and production purposes only.

4.2.2 Target products

In order to streamline activities, MIDI selects 6 target products as follows.

1. Agricultural machinery
2. Mould and die
3. Gears
4. Pumps and valves
5. Hand tools
6. Automotive parts

4.3 Trends and the need for co-operation and assistance

Though, MIDI seems to be fully equipped with necessary facilities and equipment to conduct its activities. Technology changes are evident, there are needs for modernization of equipment and facilities to keep up with the changes. It was found that some of the equipment are nearly obsoleted.

During 2 years operation, data were collected from training and seminars participants, results showed that there were needs for practial training in several manufacturing processes and the subject of engineering design especially die design. In connection with the needs for both modernization of equipment and training, MIDI will have to continue searching for assistance in term of expert and equipment from various sources and also adapt its work plan to fit with industry trends and to fullfil training needs. At present, MIDI has submitted a project requesting for technical assistance and equipment in the field of tool and die design. The project is in the process for approval at

the Department of Technical and Economic Cooperation (DTEC) before proceeding to UNDP. The project represents an effort to strengten MIDI's capability in tool and die design.

V. Conclusion

Section 1 has given overall picture of the engineering industry and capital goods sector as well as status of the selected engineering industries. Figure reflect positive growth in all sectors resulting from increasing trend in automobile manufacturing industries. Constraints and problems in development of the engineering industries are raised in section 2. There are needs for qualified personnel, training, center for research and development, inspection and testing laboratories, engineering services, and engineering design. Government policies relating to industry development are reviewed in section 3. It is found that there are no specific policies and measures in promoting engineering industries in Thailand. Measures to develop the engineering industry are suggested.

One of the measure suggested is to establish a core institution for the development of the engineering industry. The institution must provide activities such as training, engineering services and design, research and development. Subject fields to be emphasized should be selected strategically.

Details of the metalworking and machinery industries development institute are given in section 4. The MIDI have been established since 1987, and its main activities are 1) training, 2) engineering services 3) acting as a core institution in development

of the engineering industry. Its specialization includes 7 processes and 6 industrial products Since the operation commenced 1987, date about training needs as been collected. It shows that engineering design particularly die design has been one of the strategic subjects, MIDI foresees this need and has give priority to the die design training. In connection with the training need, a project requesting for technical assistance and equipment has been submitted to UNDP and due for commencing early 1990. Upon the completion of the 2 years project, MIDI's staff are expected to increase their die design capability to some degrees.

MIDI also looks forward to further co-operation and assistance from UNDP. As it is evident that there are needs for practical increasing trend in using computer for in engineering design and analysis. Though, MIDI has fully equipped with facilities and personnel to provide training, the facilities are not for providing practical training in engineering design. A draft proposal on establishing of computer-assisted engineering design and analysis training center is attached for consideration and discussion.

V. TECHNICAL VISIT

A technical visit to the Metal Industry Research and Development Centre (MIRDC) at Bicutan was organized by the National Committee. The participants were met at the hotel and brought to the MIRDC site at Bicutan, a suburb of Manila.

As an introduction, an audio-visual and an oral briefing on MIRDC's organization structure and its activities was presented to the participants. The MIRDC is the sole government entity directly assisting the metals and engineering sector of the country. The MIRDC building is 16,500 m^2 and it houses eight services: material and product-testing services; welding services, heat treatment services, machine rebuilding and reconditioning services, metal-casting services, specialized machining services, technical information services and technical consultancy and specialized industrial training services. These services are rendered by 70 engineers, 200 technicians and 30 administrators. A tour with ensuing technical discussions was made to the above-mentioned srevices, which were very well organized and working properly.

From this visit the participants have identified MIRDC's facilities, capabilities and activities.

VI. SPECIAL SESSION ON FUTURE PROJECTS

To start the meeting, Dr. Alberto Feniz, Chairman of this session, reviewed the objectives set forth in holding the ASEAN-COIME Workshop and he enumerated as follows:

1. To formulate an ASEAN network;

2. To assess the existing facilities;

3. To set forth steps toward modernization; and

4. To propose a work programme.

During the session the participants were asked to make an assessment of their own country's capabilities and eixisting facilities and to identify the common needs and interests. Please see the attachment A. After a long discussion of comparing needs and interests, it was agreed that the most urgent common needs were in CAD/CAM and Tool and Die Design.

The processing of a project proposal was explained to the participants (attachment B).

Attachment A

Existing Facilities	Country INDONESIA	SINGAPORE	MALAYSIA	PHILS.	THAILAND
1. Casting					
Ferrous					
- Cupola	x	-		-	x
- Induction Furnace	x	-	not yet	x	x
Non-Ferrous	x	-	1990	x	x
Die Casting	-	-	x	x	-
Investment Casting	-	x	x	x	-
2. Finishing					
Electroplating	-	x	x	x	x
Painting	-	x	- acc.	- acc.	-
Anodizing	-	-	x	-	x
3. Heat Treatment	x	x	x	x	x
4. Welding					
Basic	x	- acc.	x	x	-
Advanced	x	x +x high tech)	x	x	x
5. Forging					
Hand	-	-	-	x	-
Mechanized	-	-	-	-	-
6. Machining					
Basic	x	x	x	x	x
CNC	x	x	x	x	x
Non-Conventional	x	x	x	x	x
Machining Center	-	-	x	-	x

Existing Facilities	Country INDONESIA	SINGAPORE	MALAYSIA	PHILS.	THAILAND
7. Testing					
Materials	x	x	x	x	x
Component/ Product	-	x	- acc.	-	-
Calibration/ Instrumentation	x	x	- acc.	x	-
8. Pressworking					

A.2 PRESENT CAPABILITIES AND NEEDS

	INDONESIA		SINGAPORE	
	A	B	A	B
1. Tool and Die Design	x presswork x die casting x plastic injection mold	x transfer die - deep die design - forging die	- access	x improve
2. Tool and Die Making	x	x as service	x	x as service
3. Machine Tools - Design/Prototype - - Rebldg./Recond./ Retrofitting	x	- (another center) x	x x	x x
4. Machine/Eqpt. Design/Prototype	x	x	x	x
5. Computer Aided	x simple	x	x simple	+x
6. Automation	-	x	x simple	x
7. Training			x	x
- Institutions	x	x	x	x
- Industry	x	x	x	x
Ind'l. Liason	-	x	x	x
Extn. Services	x	x	x	x
Entrepreneurial Dev't.	-	x		
Info. Service			x	x
Library	x	x	x	x
Computer Data Bank	-	x		
Effective Linkages w/ Mfg. Assns.	x needs improvement	x	x	x
Academe	x needs improvement	x	x	x

A - Indicates on-going activities; x means on-going; - no activity

B - Indicates needs; x means needed; - not needed

A.2 (continued)

	MALAYSIA		PHILS.		THAILAND	
	A	B	A	B	A	B
1. Tool and Die Design	x x plastic injection mold	x progressive quick change diecasting die	x simple	x	x	x
2. Tool and Die Making	x both might be moved to another center	x	x	x	-	x
3. Machine Tools						
- Design/Prototype	- separate center	- separate center	-	x	x	x
- Rebldg./Record./ Retrofitting	- separate center	- separate center	x	x	-	-
4. Machine/Eqpt. Design/Prototype	x	x	x simple	x	-	x
5. Computer Aided	x simple	x	x simple	x	x simple	x
6. Automation	-	x	-	x	x simple	x
7. Training						
- Institutions	x	x	x	x	x	x
- Industry	x	x	x	x	x	x
Ind'l. Liason	x	x	-	x	-	x
Extn. Services	x	x	x very weak	x	x	x
Entrepreneurial Dev't.	x	x	-	x	-	x
Info. Service	x	x	x	x	x	x
- Library						
- Computer Data Bank	x	x	-	x	-	x
Effective Linkages w/ Mfg. Assns.	x minimal	x	x needs improve-ment	x	x start-ing	x
Academe	x minimal	x	x	x	x start-ing	x

A.3 COUNTRY RANKING IN TERMS OF CAPABILITIES AND NEEDS:

		INDONESIA		SINGAPORE		MALAYSIA		PHILS.		THAILAND	
		A	B	A	B	A	B	A	B	A	B
B.3.1	Tool & Die Design	3	1	1	3	1	3	5	1	2	1
	Tool & Die Making	4	5	1	3	1	3	3	4		2
	Machine Tools (in 2 yrs.)	1	6	2	2	4	4	2	6	3	3
	- Design/Prototype										
	- Rebldg./Recond. Retrofitting										
	Mach. & Equipment	5	4	4	2	5	5	1	5		5
	- Design/Prototype										
	Computer Aided	2	2	3	2	2	2	4	2	4	4
	Automation	6	3	5	1	3	1	6	3	1	6

A - capabilities 1 - high capability 6 - low capability

B - needs 1 - most needed 6 - least needed

A.3 (continued)

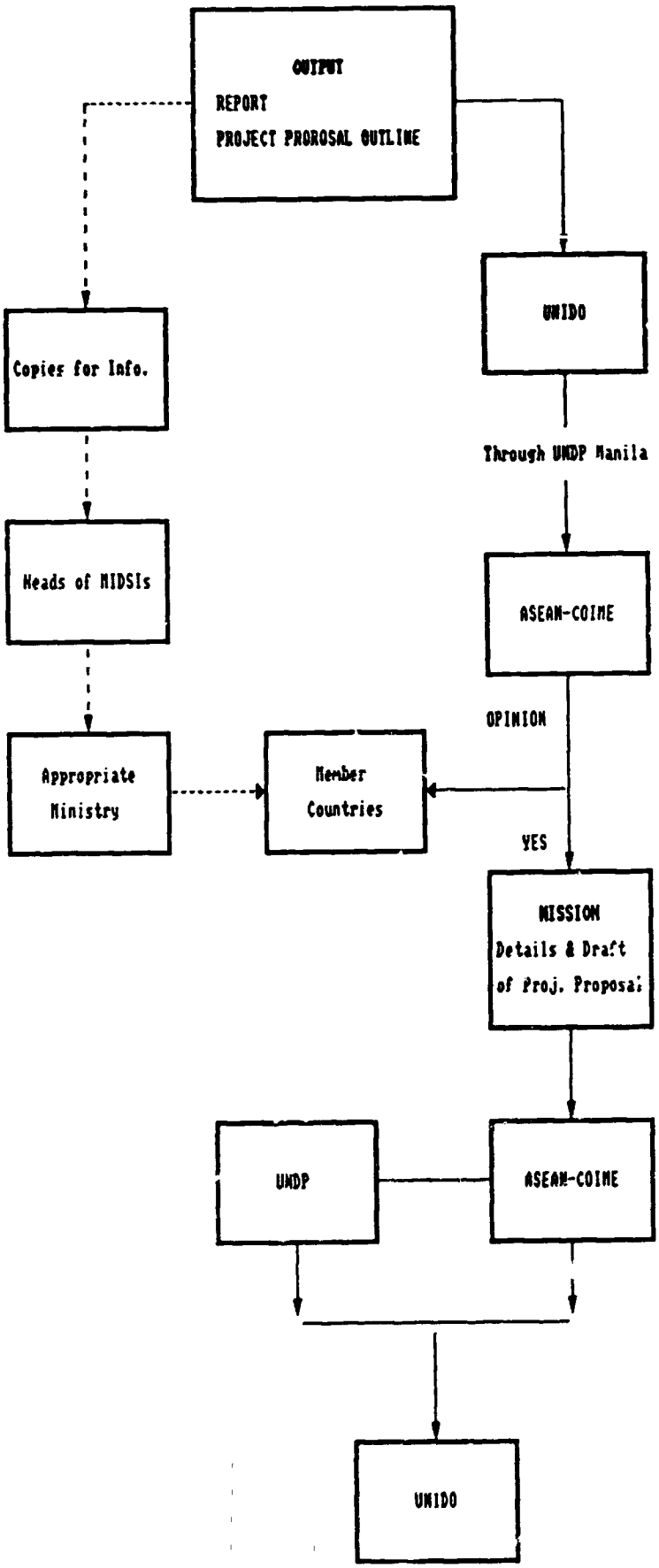
		INDONESIA		SINGAPORE		MALAYSIA		PHILS.		THAILAND	
B.3.2	Casting	2	6	7	8	7	2	2	6	5	2
	Finishing	7	2	2	1	1	8	6	2	1	7
	Heat Treatment	6	7	5	4	6	3	3	8	2	6
	Welding	1	8	6	6	4	5	7	7	3	8
	Forging	8	1	8	7	8	1	5	4	7	5
	Machining	4	4	4	3	5	4	4	1	6	1
	Testing and Calibration	3	5	1	2	2	7	1	3	4	3
	Presswork	5	3	3	5	3	6	8	5	8	4

A - capabilities 1 - high capability 8 - low capability

B - needs 1 - most needed 8 - least needed

N.B.: Ranking reflects each country's perceived capabilities and felt needs independent of other ASEAN countries.

ATTACHMENT B



VII. RECOMMENDATIONS

After six sessions with intensive technical discussions and exchanges of information, the Workshop for the Heads of the Metal Industrial Development and Service Institutions adopted these recommendations:

(a) An ASEAN Network of Metalworking Industry Development and UNDP/UNIDO assistance should be initiated.

The activities of the network should consist of the following

(i) Co-ordinaiton of MIDCs in the ASEAN countries

(ii) Information exchange through technical meetings and exchange of publications and R and D outputs

(iv) Training, study visits and staff exchange

(v) Establishment of CAD/CAM Center

(vi) Establishment of Tool and Die Design Center

(b) It was also recommended to field a prepratory assistance mission to formulate a detailed project documents and its PFF.

VIII. ADOPTION OF THE REPORT OF THE MEETING

The report of the meeting was adopted at its final session and it authorized the UNIDO Secretariat to finalize the report. Upon completion and reproduction of the final report, UNIDO will distribute it to all participants, observers and other organizations/institutions interested in it.

IX. CLOSING SESSION

At the closing session a vote of thanks was proposed by the Chairman, Dr. Leopoldo Abis, on behalf of the participants and his countrymen from the Philippines.

Speaking on behalf of the organizers of this Workshop, a representative of UNIDO extended his particular thanks to the Government and in this respect to MIRDC, Manila, for the excellent facilities and logistical support that they had provided. He also thanks the participants for their contributions to the Workshop.

The participants were awarded a certificate of the Workshop.

X. List of Participants

	Name/Position	Company/Address	Tel./Fax. No.
1.	Dr. Leopoldo V. Abis Executive Director	Metals Industry Research and Development Center Gen. Santos Avenue Bicutan, Taguig Metro Manila Philippines	822-0430 or 822-0431 to 37 Telex No.: 45596 MIRDEC.PM
2.	Dr. Mustaza Ahmadun Sr. Officer, MIDEC	Metal Industry Dev. Center (MIDEC), Standards and Ind'l. Research Inst. of Malaysia, Shah Alam, Selangor, Malaysia	Tel.: 5592601/4
3.	Ms. Gloria P. Cruz Chief, Corporate Planning Division	Metals Industry Reserach and Development Center Gen. Santos Avenue Bicutan, Taguig Metro Manila Philippines	Tel.: 822-0431 to 35 local 451
4.	Ir. Aslam B. Djamun Head of Technological Development Division	Ministry of Industry Metals Industries Development Center JL Sangkuriang 12 P.O. Box 113 Bandung 40135 Indonesia	Office 81171/72 Res. 213756 Residence No. 213756
5.	Dr. Alberto P. Fenix, Jr. President and Director	Metalworking Industries Association of the Philippines 55 Kanloan Street Mandaluyong, Manila Philippines	Tel : 775391
6.	Dr.-Ing. Adolfo Jesus R. Gopez Asst. Exec. Director	Metals Industry Research and Development Center Gen. Santos Avenue Bicutan, Taguig Metro Manila Philippines	822-0431 Telex No: 45596 MIRDEC PM
7.	Ir. H.A. Hutagalung Head, Sub Directorate Basic Metal Industsry for Programme Dev.	Ministry of Industry, Directorate General for Machinery, Basic Metal and Electronics Industry JL Gatot Subroto Kav. 52-53 10th Floor, Jakarta Selatan Indonesia	Tel.: 512185 or 515509 Ext. 2341

	Name/Position	Company/Address	Tel./Fax. No.
8.	Dr. Pasu Loharjun Industrial Engineering and Operations Officerh	Metalworking and Machinery Industries Development Institute - Dept. of Ind'l. Promotion Soi Tree mitr, Kluay nam Thai Rama 4 Rd. Bangkok 10110 Thailand	Tel.: 381-1183; 381-1051-6 Fax: 381-1812
9.	Ir. Komarna Mihardja Section for Program Planning and Production Control	Ministry of Industry Metals Industries Development Center JL Sangkuriang 12 P.O. Box 113 Bandung 40135 Indonesia	Tel.: 81171/72
10.	Dr. Damri Sukhotanang Director	Metalworking and Machinery Industries Development Institute - Dept. of Ind'l. Promotion Soi Tree mitr, Kluay nam Thai Rama 4 Rd. Bangkok 10110, Thailand	Tel.: 381-1813; 381-1051-6 Fax: 381-1812
11.	Dr. Yap Liong Chai Senior Engineer Metals Technology Department	Singapore Institute of Standards and Industrial Research 1 Science Park Drive Singapore 0511	Tel. 772 9570 FAX: 778 0086 Telex: RS 28499 SISIR SISIR
12.	Megat Ahmad Zaki Acting Head	Metal Industry Dev. Center (MIDEC), Standards and Ind'l. Reserach Inst. of Malaysia, Shah Alam, Selangor, Malaysia	Tel.: 5592601/4
13.	G.L. Narasimhan UNIDO Country Director	United Nations Development Programme Jalan M.H. Thamrin 14 P.O. Box 2338 Jakarta	Tel. 321308 Telex: UNDEVPROIA 011-44178
14.	P. Prijapratama Programme and Research	United Nations Industrial Development Organization UNIDO - V.I.C. P.O. Box 300 1400 Vienna Austria	Tel 211 31/4574 Telex: 135612 UNO.A FAX: 232 156

Name/Position	Company/Address	Tel./Fax. No.
15. Swamy Rao A.A. Senior Interregional Adviser	United Nations Industrial Development Organization P.O. Box 300 1400 Vienna Austria	Tel 21131/3386 Telex: 135612 UNO.A Fax. 232156
16. Mikael Winther Junior Professional Officer	United Nations Industrial Development. Organization NEDA sa Makati Bldg. 106 Amorsolo Street Legaspi Village Makati, Malina Philippines	Tel.: 88 25 60 or 85 06 11 to 25 Ext. 251 Telex: RCA 72222250 Fax: 632 8164061
17. C.A. Newman UNIDO Country Director	United Nations Industrial Development Organization NEDA Sa Malcati Bldg. 106 Amorsolo Street Legaspi village Philippines	Tel.: 88 25 60 or 85 06 11 to 25 Ext. 251 Telex: RCA 72222250 Fax: 6328164061

Guests of honor:

1. Dr. Ceferino L. Follosco, Minister for Science and Technology

2. Dr. Jose S. Concepcion, Jr., Minister for Trade and Industry

3. Attorney Lilia R. Bautista, Under Secretary for Trade and Industry

4. Dr. Edna Espos, ASEAN - COIME Secretariat

5. Dr. Ricardo T. Gloria, Governor, Board of Investments

Secretariat:

1. Doris P. Acoymo - Chief, Information Technology Division

2. Elizabeth B. Samela - Supervising Information Officer

3. Josefina C. Lara - Planning Officer

4. Joan B. Dioso - EDP Data Controller

IX. AGENDA

First day, Monday 20 November 1989

Opening Session (9:30)

1. Registration
2. Philippine National Anthem
3. Welcome remarks by National Organizer
4. Address of UNIDO Representative
5. Address of ASEAN-COIME Representative
6. Address of the Government of Philippines
7. Election of Chairman and Rapporteur of the Workshop
8. Adoption of Agenda

Break (12:30 - 14:00)

Session 1

1. Presentation of country paper by Indonesia under the chairmanship of Singapore.
2. Presentation of country paper by Singapore under the chairmanship of Indonesia.
3. Discussion on the papers.

Dinner (19:00)
Welcome-dinner hosted by MIRDC Manila.

Second day, Tuesday 21 November 1989

Session 2 (9:00 - 12:30)

1. Presentation of country paper by Thailand under the chairmanship of Philippines.
2. Presentation of country paper by Malaysia under the chairmanship of Thailand.
3. Discussion on the above-mentioned papers.

Break (12:30 - 14:00)

Session 3

1. Presentation of country paper by Philippines under the chairmanship of Malaysia.
2. Discussion on the country paper.

Third day, Wednesday 22 November 1989

Session 4 (10:00 - 12:30)

1. Technical discussions
2. Assesment of accomplishments, capabilities and existing facilities.

N.B.: The start of this session was delayed due to a hurricane in the morning.

Break: (12:30 - 14:00)

Session 5 (14:00 - 17:00)

1. Continuation of the discussions of session 4.
2. Asessment of need and interests.

Fourth day, Thursday 23 November 1989

Session 6 (9:30 - 12:30)

1. Deliberation on technical co-operation
2. Formulation of project idea.

Break: (12:30 - 14:00)

Technical visit (13:30 - 17:30)

Technical visit and ensuing technical discussion were organized at MIRDC Bicutan.

Fifth day, Friday 24 November 1989

Closing Session (9:30 - 12:00)

1. Agreement on final report.
2. Discussion with ASEAN - COIME Representative on procedure of submission of project document.
3. Closing address by UNIDO Representative.