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THE MACHINE TOOL INDUSTRY IN THE ASEAN REGION: OPTIONS AND STRATEGIES.
MAIN ISSUES AT REGIONAL LEVEL

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Sectoral Studies
Studies and Research

SECTORAL WORKING PAPERS

In the course of the work on major sectoral studies carried out by UNIDO, Studies and Research, several working papers are produced by the secretariat and by outside experts. Selected papers that are believed to be of interest to a wider audience are presented in the Sectoral Working Papers series. These papers are more exploratory and tentative than the sectoral studies. They are therefore subject to revision and modification before being incorporated into the sectoral studies.

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Preface

At the recommendation of the 9th Session of the ESCAP Committee on Industry, Technology, Human Settlements and Environment held in Bangkok from 10 to 16 September 1985, UNIDO, Sectoral Studies, and the ESCAP/UNIDO Division for Industry, Human Settlements and Technology will organize a meeting on "Production and use of machine tools in the engineering industry of ESCAP developing countries". This meeting, to be held in Singapore between 17 and 21 November 1986, will be a direct follow-up of the UNIDO/ESCAP project on "Review and appraisal of industrial progress at regional level".

The meeting should formulate concrete recommendations to be followed by industrialists and policy-makers in the countries concerned and by UNIDO and ESCAP to assist in developing the use and production of machine tools in the engineering industry in the ESCAP developing countries. This study, consisting of two volumes, will be one of the background documents for this meeting. Volume I presents the main issues at regional level for the machine tool industry and volume II gives detailed country information and analyses.

The study was prepared by Sectoral Studies in collaboration with TECHNUNET, Singapore, as consultant to UNIDO. Tables without specific mention of source were produced by the consulting firm.

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1. INTRODUCTION

This study on the machine tool industry in the ASEAN region aims to provide a general appraisal of the sector with the view to defining some possible strategies for development. The study consists of two volumes. The present volume I covers a review of immediate past developments, the present situation, machine tool development policies, basic problems and issues, formulation of strategic options and policy formulation aspects at regional level. Volume II of the study presents an analytical appraisal of the situation of the machine tool industry at country level.

This study shows that except for a few, most machine tool enterprises in the region are small. As such, it is difficult to determine the overall magnitude (establishment, employment levels, etc.) of the machine tool industry in each ASEAN country.

Except for Singapore, the region's existing technology level in the machine tool industry is generally low for the upgrading to CNC/NC technology. The emerging pattern is that Singapore will focus on relatively higher technology level machine tool products, the Philippines, Malaysia and Thailand on a medium level technology products and Indonesia, on low level technology products.

It is too early to call for a machine tool industry development policy on an ASEAN level at the present time. But existing regional initiatives covering co-operative activities on technology development, human resources, economic intelligence, promotion of joint ventures, joint marketing, etc. should be continued and supported.

For each ASEAN country, however, there is an urgent need for a specific machine tool promotion and development policy. Indonesia's policy on simple machine tool promotion may be an appropriate starting point. Country policies should specify the industry definition, create baseline information, formulate a strategic approach, and organize a co-ordinative authority with an appropriate institutional framework. Finally, the study outlines some concrete recommendations to stimulate a sustainable machine tool industry development within the region.

2. GENERAL CHARACTERISTICS OF THE MACHINE TOOL INDUSTRY

2.1 Definitions

The study covers only metal-working related machine tools and, as much as possible, excludes other machine tools for wood-working, stone working, etc. Metal-working related machine tools shape or surface metals and metallic carbides by cutting away or otherwise removing material or changing its shape or form without removing any of it. The term excludes rolling mills and hand directed or hand-controlled tools. Generally, machine tools are of two types, metal cutting (or metal removing) and metal forming. Metal cutting machine tools are those that shape or surface work metal by removing metal either in the form of chips, dust, swarf, etc. or by spark erosion, ultrasonic, electrolytic, and other chipless methods. Metal forming machine tools are metal-working machine tools other than metal cutting machine tools.

Machine tools are power-driven devices designed to cut or form metal (or workpieces) to a specified size and shape within allowable tolerances and finishes. The cutting or forming of a metal part is accomplished by the precisely controlled relative movement between the workpiece and the tool. The workpiece and the tool are generally both mounted on and rigidly supported by the machine tool, although in large applications, the workpiece may be mounted externally to the machine, requiring the machine's precise movements.

Essentially, five basic types of relative motions are provided by machine tools. These five are accomplished when:

(a) A workpiece is rotated and the cutting tool is simultaneously fed into the workpiece and traversed along its length, essentially, a lathe's task;

(b) There is reciprocation between a workpiece and the tool. On a planing machine, the workpiece reciprocates and the tool is fed and traversed, and on a shaping machine, the workpiece is traversed and the tool is fed and reciprocated;

(c) The workpiece is held stationary while the cutting tool is rotated and fed as in drilling operations;

(d) The workpiece is traversed and fed while the cutting tool rotates, as in milling and grinding operations; and

(e) The workpiece is positioned between opposing tools which move together to strike, squeeze, or shear the workpiece, as in punching, bending, stamping, forging, or similar operations.

Metal cutting machine tools include machines for boring, drilling, gear-cutting and finishing, grinding (special-purpose, surface, and tool and cutter grinding), polishing, lapping, honing, milling, planing, shaping, slotting, broaching, sawing, filing, threading, and for multiple functions (machining centres). Metal forming machine tools include machines for punching, pressing, shearing, bending, forging, forming and other special purpose machines.

2.2 Technological development in the machine tool industry

Through technological innovations, machine tools with improved design and better efficiency have been produced resulting in a high degree of specialization (e.g. type and size) among manufacturers and even among producing countries themselves. This development has made even the technically most advanced countries dependent on some machine tools from other countries. Likewise, this development has led to breaking up the monopoly of developed countries as regards machine tool production. Presently, there is a polarization in machine tool production with the high technology machines produced by the developed countries due to their highly advanced industrial base and infrastructure on one end, and the similar and general purpose machine tools being produced by the developing countries, on the other.

The machine tool industry in the developing countries is, however, beset by major problems. These include the proliferation of many inefficient small and medium size companies whose outputs and technology are below international standards of quality and quantity; poor quality raw materials; lack of skilled

machine shop and tool room operators; obsolete machinery and equipment; and poor production methods. The result is uncompetitive products both in terms of quality and price.

Over the years, the basic functions of machine tools in terms of metal cutting and metal forming have remained virtually unchanged. What has undergone a radical evolution is the machine tool design and construction, particularly in the technology that dictates the method of motion insofar as metal cutting and forming are concerned. Where early machine tools were manually controlled, the machine tools of today are becoming more sophisticated and will even be more so in the future as technological advances in computer hardware and software are incorporated into the industry.

The initial advancement was triggered by the development of numerical control (NC) which was evolved from an electronic control system developed through a US Air Force project in the late 1940s and early 1950s. The offshoot was the production of the first commercial NC machine tools and their availability on the market in the mid 1950s. This technological innovation, was, however, slow in getting acceptance. After two decades, it is reported that only one per cent of all types of machine tools in use in the United States were NC. This slow acceptance was attributed to its price and the size of the control unit. The development, however, of integrated circuit (IC) brought significant improvements in NC units both in terms of price and size of control unit. In addition, other major advantages included simpler operation and reduced programming complexity, faster and more flexible machine tool control, and the ability to interface computers with the control unit. Despite the limitations of NC, they are considered as the forerunners of computer-aided manufacturing (CAM).

The most important function of NC is its accurate positioning of the tool in relation to the workpiece by means of signals or commands from a pre-programmed source in the form of numerical coding on punched paper tape, or in the form of magnetic tape or punched cards. Other NC functions include selecting the proper tool from a magazine and controlling the speed and

direction of spindle rotation. The advances brought about by NC were instrumental in the development of machining centres, as heretofore it was impossible to control more than two axes simultaneously.

Besides NC, other types of control for machine tools are programmable control (PC), direct numerical control (DNC), and most notably - the computer numerical control (CNC). Programmable control allows the machine tool operator to interrupt the programme at any time and insert another operation or machining sequence. Direct numerical control is a method by which a common computer directly controls one or more numerically controlled machine tools. The computer can also be used to provide information on machine utilization and for production reports.

CNC systems utilize microcomputers to store machining programmes in read-only memories (ROM). Their advantages include their adaptability to different types of machine tools, ease of programming and information retrieval, and the ability of one computer to simultaneously control one or more machine tools.

3. INDUSTRIAL STRUCTURE OF THE ASEAN COUNTRIES

3.1 Review of past developments in the capital goods industry

Practically all ASEAN countries have undergone a slow but observable structural transformation in the past 20 to 25 years. Emerging with a predominantly agricultural base after World War II, these countries have succeeded to make their manufacturing base become as important, if not more important than their agricultural sector.

To accentuate manufacturing, the ASEAN countries initially concentrated on establishing simple import substituting industries, including food, textiles and clothing. But the ensuing gradual saturation of these labour-intensive industries shifted some countries' emphasis to the development of capital goods industries, including non-electrical machinery, electrical machinery and transport equipment. Hence, significant economic activities - either of global, regional and local consequences - took place in each ASEAN country's agricultural machinery, electronics and motor vehicles manufacturing industries.

The gradual shift from labour intensive to capital goods industries resulted in many expected, as well as unexpected, economic consequences. For example, the metal-working industries, traditionally neglected in most ASEAN countries before the period, suddenly emerged as a significant manufacturing subsector. In fact, the metal-working industry was instrumental in launching the agricultural machinery, electronics and motor vehicles manufacturing subsector for each country.

Unfortunately, ASEAN's metal-working industries - except for Singapore - did not develop as rapidly as their capital goods industries' counterparts. Recent surveys claimed that while metal-working industries' GDP contribution has generally been increasing in all ASEAN countries, significant qualitative improvements in technology, managerial competence, productivity, capital management, subcontracting infrastructure and promotion of linkage industries have been slow and inadequate. To a very large extent, the rising oil prices

of the 1970s and the mounting trade protectionism of the early 1980s have considerably slowed down the industry's growth. The more recent concern for agricultural development may further impede current initiatives.

The machine tool is a vital, if not the most vital, component of the metal-working industry. The machine tool industry either produces the machines to produce the end products or the end products themselves. In the immediate past, almost akin to the metal-working industry, very little significant developments occurred in the machine tool industry. In fact, as shown in the country reports, a few machine tool enterprises within the region did not withstand the various national and global economic upheavals of the late 1970 and early 1980s.

3.2 The machine tool industry in the ASEAN countries

3.2.1 The present situation

This section describes the existing situation of the machine tool industry on four levels, namely: global, regional, national and enterprise.

Globally, there are 33 countries reputedly producing machine tools. Of the ASEAN countries, only Singapore is included as a major producer as of 1982. However, while the global machine tool output amounted to an estimated \$US 22.7 billion, Singapore's contribution was only \$US 40.2 million. Since it joined the producers rank in 1977, when the aggregate global output was \$US 15.1 billion, Singapore's contribution showed a steadily increasing trend (see table 1). It should, however, be noted that while it has a relatively short machine tool development history, Singapore's dramatic performance may be due to three major factors:

(a) The presence of major international machine tool producers - either as sub-production units or distribution channels - in the country;

(b) The availability of stronger support industries, such as heat treatment facilities, precision engineering industries, ecc.;

Table 1.1. International trade in motor vehicles and accessories, 1973-1982

Country	Year	1982 (E)	1981	1980	1979	1978	1977	1976	1975	1974	1973
West Germany		3,498.4	3,952.7	4,707.6	4,006.8	3,288.9	2,635.8	2,410.6	2,395.5	2,265.2	2,192.8
United States		3,615.0	5,111.1	4,811.3	4,059.1	3,088.0	2,438.8	2,169.3	2,364.9	2,144.0	2,143.3
USSR*		2,934.0	2,932.5	3,065.0	2,902.6	2,453.0	2,201.9	2,010.0	1,984.4	1,849.3	1,726.0
Japan		3,886.4	4,798.1	3,826.1	2,892.7	2,337.7	1,608.8	1,126.9	1,059.9	1,659.7	1,482.8
Italy		1,254.5	1,513.6	1,728.1	1,354.0	1,059.1	876.0	750.9	889.0	789.3	615.0
Switzerland		768.4	845.7	994.1	930.4	797.0	581.9	535.6	626.8	499.7	361.8
United Kingdom		735.5	932.9	1,395.8	1,001.4	768.8	587.8	645.5	728.3	502.7	506.1
France		619.8	809.6	953.9	877.2	718.7	580.6	657.2	678.3	549.3	472.2
East Germany*		808.0	827.7	891.5	805.8	700.0	641.4	568.8	585.2	506.5	439.8
Poland*		C 280.0	U 310.0	U 405.0	420.0	636.5	583.4	510.0	422.8	353.8	280.0
China, People's Rep. of*		C 470.0	U 440.0	U 420.0	420.0	410.0 C	355.0 C	315.0 C	300.0 C	140.0 C	130.0 C
Czechoslovakia*		438.8	357.8	331.5	357.7	357.4	309.1	337.9	305.4	292.7	290.0
Brazil		210.5	305.0	314.8	387.0	330.0 C	282.9	222.5	137.0	111.3	60.2
Spain		299.6	319.6	352.9	315.8	227.4	193.1	181.1	226.2	207.0	151.7
Yugoslavia		303.8	276.7	231.8	189.2	200.4	141.5	125.8	69.0 C	86.0 C	86.0 C
Sweden		214.1	204.8	231.7	220.7	133.7	146.8	175.0	147.4	108.3	105.0
Belgium		86.8	103.3	137.2	129.3	132.3	106.4	118.3	106.7	84.8	63.2
Taiwan**		199.9	249.4	(231.18)	(198.0)	(126)83.0	(71.3)58.3	(44.3)	(36.0)	(31.8)22.1	(23)16.5
Romania*		615.5	624.9	590.0	459.0	120.0 C	120.0 U	120.0 U	106.0 C	20.0 C	20.0 U
Austria		105.3	107.8	166.5	101.1	92.1	96.4	83.0	69.6	54.9	46.1
India		211.3	208.0	165.3	127.1	116.0	81.8	96.1	93.0	81.3	58.9
Hungary*		130.6	127.7	121.3	112.3	109.0	104.8	59.0 U	50.0	59.0	58.5 U
Netherlands		54.2	60.5	64.7	62.9	86.0 C	68.8	45.5	32.9	46.4	34.2
South Korea		200.0	178.1	135.0	163.7	80.0	57.0	10.0 C			
Canada		221.5	269.7	193.8	159.0	78.0	70.8	72.0	72.8	63.0	52.5
Denmark		38.9	41.6	52.0	49.4	51.0 C	34.6 a	34.7 U	34.8	29.2 C	19.4
Argentina		C 35.3	U 35.3	U 50.0	62.0	40.0 C	60.6	50.0 C	42.0	40.0	39.7
Bulgaria		C 221.0	201.5	U 43.0	41.0	30.0 C	30.0 Uj	28.0 U	25.5 C	27.3 C	27.3 C
Australia		Cj 61.7	Cj 68.9	U 18.0	Cj 18.0	18.4 Cj	17.9	22.7 j	36.0 Cj	36.0 Cj	45.0 Cj
South Africa		21.2	36.8	29.5	21.3	10.4	13.8	15.0	15.5	19.4	12.8
Portugal		C 16.0	U 16.0	16.0	U 14.3	10.2	9.6	6.3	5.4	6.1	5.8
Singapore		40.2	15.5	36.9	26.1	10.0	5.7				
Mexico		C 18.0	U 24.0	U 21.6	C 15.5	8.5 C	6.0 C	5.0 C	4.5 C	2.0	5.0
TOTAL		22,693.8	29,418.7	26,734.08	22,920.4	18,582.5	15,106.7	13,552.0	13,640.0	12,656.3	11,548.1

note a: Includes production of parts and accessories
 C: Data incomplete, rough estimate
 E: Estimate
 J: For year ending June 30
 U: Figures unadjusted
 *: Nations with state-controlled trade

(c) The ease of establishing subcontracting relationships across the border (with Malaysia and to some extent Thailand).

Regionally, the need for an ASEAN-wide initiative for machine tool industry promotion and development is yet to emerge. But there are ample indications that the need is gradually being felt. For example, ASEAN's Committee on Industry, Minerals and Energy (COIME) has recently commissioned the "Sharing of Technology in the Metal-Working Industries Project (SoT)" through the financial and technical assistance of the Government of Japan and implemented by the Japan International Cooperation Agency (JICA). Briefly, phase 1 of the SoT project pinpointed areas where possible regional technology sharing and transfer can be effected within the metal-working industry. Completed in 1985, SoT phase 1 endorsed specific sharable technologies in the following metal-working fields:

- (a) Ship building and ship repairing;
- (b) Hand and cutting tools;
- (c) Machine tools;
- (d) Tool and die; and
- (e) Agricultural machinery.

Late in 1985, COIME commissioned the subsequent SoT phase 2 which will generate at least ten actual technology sharing transactions or co-operative ventures consisting of 15 ASEAN technology recipients and five Japanese technology donors. Definitely a beginning, but still inadequate to trigger a sustainable regional metal-working and machine tool industries' development initiative.

Nationally, the recent concerns for metal-working industry development, the establishment of relevant metal-working related infrastructure, and push for specialization were observed in practically all ASEAN countries. Individual governments seem more concerned about the whole rather than specific metal-working industry components. Similarly, all governments are busy establishing the needed infrastructure through various forms of bilateral and multilateral arrangements. Apart from traditional sources of technical and financial assistance (Federal Republic of Germany, United States and

the United Kingdom), the Japanese Government has recently increased its visibility in the region. Japan's assistance focuses on hardware (setting up of metal-working research and development centres, etc.) and software (training and other forms of human resources development schemes). Finally, there has been a resurgence of the concern for either product or process specialization. This is clearly evident in the Philippines (perhaps due to the current economic structural adjustments), Malaysia (perhaps, due to the recent efforts to develop the capital goods industries in general and the Malaysian car industry in particular) and in Singapore (perhaps due to the pursuit of high technology industries inducing specialization).

On the enterprise level, the absence of widely-acceptable industry definitions in each ASEAN country, makes recent developments intractable and less precise. Qualitatively, however, a comprehensive sampling of each country's recent enterprise level developments (include demand patterns and market conditions, materials inputs, number of establishments, number of workers, technology levels, productivity, etc.) are briefly described in the country reports presented in volume II. Moreover, the actual field surveys conducted for this study, showed some significant enterprise level developments. These were:

- (a) Difficulty of defining the industry's size and magnitude;
- (b) Predominance of small enterprises;
- (c) Relatively low technology level;
- (d) Absence of engineering and sales departments;
- (e) Raw material problems;
- (f) Inadequacy of entrepreneurial resources;
- (g) Absence of national marketing networks;
- (h) Unavailability of durable after-sale services; and
- (i) Prevalence of very long delivery time.

3.2.2 Main difficulties in the analysis of the machine tool industry

Formal interviews with relevant public institutions during the survey revealed their inherent difficulties in defining what the machine tool industry really consists of. These difficulties were noted from country to

country and from institution to institution within a country. Consequently, while all those interviewed in each country agreed that a local machine tool industry exists, they cannot specify the size, magnitude and employment levels. Moreover, the fact that many machine tool enterprises produce several other products in addition to machine tools and are consequently not officially recorded as machine tool producers made estimating more difficult. Best estimates, however, show that in Indonesia, about 13 enterprises are said to be manufacturing machine tools of various types. Malaysia has 47 metal- and wood-working machine tool enterprises. The Philippines has possibly 5 to 10 machine tool enterprises. Singapore has possibly 10 to 15, and Thailand has 13 machine tool enterprises. Furthermore, as the field survey noted, except in Singapore, most enterprises tend to produce more metal forming than metal cutting machines.

The survey results indicate that most existing machine tool enterprises are relatively small ones. While most produce simple machine tools (mostly presses, tool and dies, simple lathes, etc.), production is not on a continuous basis. In fact, apart from one or two machine tool items in stock (presumably for display or promotion purposes) all other productions were done on a job-order basis. Generally, intermittent and highly diversified production of machine tools results in low productivity, high capacity underutilization, poor quality and longer delivery time in the short run. In the long run, technology capacity build-up will be relatively slower, time to attain economic scale of production will be longer and learning curves-related mistakes will be costlier.

The survey reveals that the existing machine tool manufacturing technology level within the region, except in Singapore's case is relatively low. The survey likewise observed the prevalence of old machines (more than 10 years old) within the industry. While some are apparently unusable, these machines are still maintained within the factory. The operable machines are not properly maintained and the tolerances are not checked daily. Low productivity and high capacity underutilization (specially, if one includes the unusable machines which continue to occupy otherwise productive space) prevail in the industry.

Only a few machine tool enterprises have sustainable engineering and sales departments. Functionally, the engineering department of a machine tool enterprise will handle product and process development tasks. The sales department, on the other hand, will ensure that orders flow to the enterprise guaranteeing continuous production. In the majority of enterprises, these two basic functions are performed by the owner-manager or by one of two partners.

Practically all enterprises are using a significant amount of imported raw materials, particularly special steel alloys. Most of these enterprises complained of materials unavailability, high prices and unnecessarily long procurement times. Complaints on exorbitant raw materials prices were particularly more pronounced in the Philippines and Indonesia. Raw materials traders and suppliers insist that these complaints may be due to low special steel consumption and unorganized market structures. Still some others blame the country's excessive import duties and sales taxes on key machine tool raw materials (see table 2).

Despite the fact that some machine tool items have always been listed in each country's investment priority plans since the mid-1970s, there have been very few local and foreign investors, except in Singapore's case where more foreign than local investors applied. Apparently, the machine tool industry - highly sensitive to equipment investment fluctuations and being a relatively high technology area requiring high initial capital investments, sophisticated engineers and skilled workers - is viewed as a relatively risky business proposition by many potential entrepreneurs and investors. This coupled with ASEAN's prevailing weak support industries, limited local markets, strong overseas competition, availability of low priced secondhand machines, and low priced imported machine tools from NICs further discourage foreign investors.

To some extent, the survey also noted the absence of national marketing distribution centres specializing in machine tools. In fact, in all countries except Singapore, most marketing efforts are performed by the machine tool makers themselves. Marketing practices are generally passive and weak compared to those employed by local distributors of major international machine tools brands. Although extremely rare, some local distributors of

Table 2. Import duty and sales tax on key materials used in machine tool industry in selected ASEAN countries

Heading No. (BTN Code)	Description of Goods	Indonesia		Philippines		Thailand	
		Rate of Duty (%)	Rate of Sales Tax (%)	Rate of Duty (%)	Rate of Tax (%)	Rate of Duty (%)	Rate of Business Tax (%)
73.01	Pig iron	0	0	10		5	1.5
73.01	Cast iron	2.5	2.5	10		5 ^{*1}	1.5 ^{*1}
73.02	Ferro-alloy - Fe-C, -Si, -SiMn	0	0	30		5	1.5
		2.5	2.5	10		5	1.5
73.03	Scrap, waste metal of iron or steel	0	0	10		5	1.5
73.11	Angles, shapes, sections of iron or steel	30	5	30		(0.30/kg)	7.0
73.13	Sheet & plates of iron or steel surface treated	30	2.5	50		15	7 (flat surfaced: 1.5%)
		5	2.5	10			
73.15	Alloy steel, high carbon steel	2.5	2.5	10		20	1.5
73.32	Bolts, nuts, screws, cotters and washers	40	10	50		30 ^{*2}	7 ^{*2}
73.35	Springs of iron or steel	20	5	30		30	7
82.05	Interchangeable tools for machine tools	15	5	20		15	7
84.10	Pumps for liquids	30	10	10		30	7
84.45	Machine tools, for metal working	10	10	10		15 ^{*3}	3
84.46	Machine tools, for stone, ceramics	10	10	10		15	3
84.47	Machine tools, for wood, cork	10	10	10		15	3
84.48	Accessories & parts work and tool holders, diehead, dividing head	20	10	10		15	3
84.61	Valves	10	10	10		30	7
85.01	Motors	30	10	30		30	3
		(CKD) ^{*4} (15%)	(CKD) (5%)	Under 30H.P.: 50% Parts: 30%/50%			
85.01	Transformer	40	10	30/50		30	3

Note: Importation of raw materials in Singapore is duty-free.

international brands also carry locally-made machine tools, but these items are not displayed side-by-side with the foreign brands. As such, all local machine tool enterprises have neither national spare parts supply depots nor reliable repair and maintenance networks.

Finally, some machine tool users interviewed reported incurring unnecessary delays in procuring locally-made machine tools

3.2.3 Machine tool development policies

Except in Indonesia's case, no specific policy statement to intensify machine tool industry promotion and development has been issued by the four other ASEAN member countries, besides investment incentives. The absence of specific policy statements brought about a variety of approaches which each country considers unique and appropriate.

For example, in its effort to attract high technology investments, Singapore has as a by-product developed its machine tool industry, conveniently employing the latest technology (CNC, machining centres, etc.). While heavily relying on its existing technology resources, Thailand has persistently produced intermediate technology level machine tools (presses, shearing, forging hammers, jigs and fixtures, etc.). While undergoing an economic adjustment process, the Philippines founded a machine tool reconditioning and rebuilding industry. In the last two years, 30 to 40 per cent of imported machines were reconditioned or brought in for reconditioning. And while aggressively developing its capital goods industry, Malaysia like Singapore, might also develop its machine tool industry. Indonesia, unlike the others, has initiated a modest simple standard machine tool development policy.

From a marketing viewpoint, the diversity of approaches becomes more pronounced. It is apparent that Singapore, the Philippines, and Thailand are all pursuing a domestic-cum-export-oriented machine tool industry development thrust. Singapore can claim a global market orientation as opposed to the three others' highly regional focus. Indonesia and Malaysia, unlike the others, are pursuing an inward market policy approach.

From a South-South co-operation perspective, statistics gathered confirm that significant and increasing inter-ASEAN machine tool trade exists. Despite the absence of specific programmes to promote ASEAN made machine tools in neighbouring less developed countries (Afghanistan, Bangladesh, Bhutan, Sri Lanka, Laos, Burma, Fiji, Samoa, Nepal, Vietnam, etc.), a limited amount of machine tool trade exists. Inter-ASEAN machine tool trade, however, outweighed the trade with the lesser developed countries. In inter-ASEAN machine tool trade, Singapore - despite its apparent preference for Malaysia's and more recently, Brunei's machine tool markets - emerges as the main interchange and Thailand trades with the less developed South countries. With the NICs, however, ASEAN's machine tool trade volume exhibits an increasing trend.

Another form of South-South co-operation that has recently gained significant impetus in the ASEAN scene is technical co-operation. Several initiatives were undertaken by some countries with ASEAN countries in this field. For example, a reputable Indian machine tool maker has recently established a machine tool factory to transfer relevant technologies to Indonesia. Similarly, Taiwan Province of China is seriously considering a machine tool joint venture programme with selected private Malaysian investors. Although not directly machine tool focussed, the Republic of Korea has also been fairly active in technical co-operation with ASEAN.

4. BASIC CONSTRAINTS AND ISSUES OF THE MACHINE TOOL INDUSTRY

Based on the survey and interviews conducted, the following basic constraints and issues confront ASEAN's machine tool industry (see table 3):

4.1 Technical production constraints

Some of the technical or production-related constraints of machine tool enterprises in the region (generally except Singapore) are as follows:

(a) Shortage of skilled engineers. The machine tool industry is a high technology-intensive one which requires sophisticated design engineers. These engineers must be specialized and have working experience. They should have received a relatively long training.

(b) Low productivity and low efficiency. Manufacturing companies are generally on a very small scale, adopting family style management. Therefore their productive and operating efficiency is rather low.

(c) Poor quality and outdated technology. Due to inadequate personnel, finance, business and materials management techniques, product quality is generally unstable. The directly copied or imitated technologies without innovations are not always suited to local conditions.

(d) Small volume sales. To operate successfully, an enterprise must sell in large volume. To obtain this sales volume business, it must have customers buying its products because of confidence in quality.

(e) Poor quality of production facility and measuring instruments. Generally, product quality suffers due to poor production facilities and the type of measuring instruments used.

(f) Weak supporting industries. The machine tool industry generally relies on inputs from supporting industries (casting, gear-cutting, heat treatment, etc.) for raw materials, parts, components and technical services.

Table 3. Summary of major constraints encountered in the ASEAN machine tool industry

Items	Indonesia	Malaysia	Philippines	Singapore	Thailand
Marketing					
o Demand situation for new machines	Δ gradually improving	○	X	Δ	X
o Inability to find new customer	-	Δ	X - with second hand machines ○	Δ	
o Inability to meet delivery dates	-	Δ		○	
o Terms of payment	-	Δ		○	
o Stiff competition	-	X		○	
o Collection of receivable	-	Δ		○	X
o Brand consciousness	-				-
Management/Labour/Financial					
o Difficulty in getting finances from traditional markets	○	○	○	○	
o Interest rate	X	-	X	○	X
- Prime rates		-	17%	8%	
- Commercial bank		9.5%	24%	10%	17-18%
o Lack of skilled labour	Δ	Δ	Δ	○	Δ
o Excessive labour turnover	Δ	Δ		○	Δ
o Low productivity	Δ	Δ	Δ	○	Δ
o Existing labour force do not have sufficient skills	Δ	Δ	Δ	○	Δ
o Sales network	X	X	X	○ Joint Venture	X
Technical/Production					
o Inability to buy new machine due to high price	X	Δ	X	○	X
o Existing machine available are not accurate enough		Δ		○	
o Existing machine available are not capable of performing all required works		Δ		○	
o Shortage of raw material/Difficult to get right size or proper kind of steel	Δ	○	Δ	○	Δ
o Difficult to get good quality heat treatment services	X	Δ	Δ	○	Δ
o Difficult to get special machining services from outside	X	Δ	Δ	○	Δ
o Difficult to get casting/forging services from outside	X	Δ	Δ	○	Δ
o High price of raw materials	X	○	X	○	Δ
Government Activity					
o MIRDC, MIDC	○	○	○(Rebuilding)	○	-
o Institute of Technology	○	Δ	-	-	-
o University	○	-	-	-	-
o Government Company	○	-	-	-	-

○ : Not Affected

Δ : Moderately Affected

X : Seriously Affected

- : No Activity

The current situation of the supporting industries can be gauged from the following examples:

- (i) The key parts and basic metals--tool steel, carbon steel and alloy steel--for machine tool manufacturing within the region are of low quality grade, they are expensive and lack durability;
- (ii) High forged components such as spindles, bearings, gears and pumps, as well as imported precision parts are in short supply domestically;
- (iii) Very few enterprises perform heat treatment services which are critical in producing durable and precision parts;
- (iv) Standardization of parts (bolts, nuts, etc.) is still insufficient and inadequate.

4.2 Labour constraints

The following are the major labour-related constraints:

- (a) The existing labour force does not possess sufficient skills,
- (b) There is an excessive labour turnover (average service of workers ranges between 2 to 5 years), and
- (c) The labour productivity is low.

4.3 Financial constraints

The following are the major finance-related constraints:

- (a) High prime rates and commercial bank interest rates.
- (b) In the case of the Philippines, raw materials tariffs are higher than completed units.

5. STRATEGY AND POLICY OPTIONS TO DEVELOP THE MACHINE TOOL INDUSTRY

5.1 Formulation of strategic options

Practically all strategic options to develop the machine tool industry open to ASEAN and the individual member countries fall within the purview of the specialization theme. Whether such issues and options involve industry definition, markets, technology, human resource development, interdependency with other industries, or are institutional, the specialization theme seems to apply to them all.

5.1.1 Industry definition

Formal interviews with relevant public institutions reveal that significant discrepancies exist as to what a machine tool industry consists of. Some institutions ventured their own definitions which are either more or less comprehensive than other institutions' definitions. In fact, all ASEAN countries still refer to importation classification codes to define the industry. Consequently, it makes targeting of specific machine tool enterprises administratively cumbersome. The absence of precise and widely accepted industry definitions in each ASEAN country constitutes a single major bottleneck in promoting the industry. Attempts to define the industry will open policy and development possibilities hitherto unexplored.

5.1.2 Technology

Essentially, three major technology-related issues must be resolved. These are: (a) Where should ASEAN and its member countries focus the machine tool technology development?; (b) What are the required technology development institutions to attain the focus chosen?; and (c) How should the technology be mastered?

(a) Technology development directions. The region's predominantly low machine tool manufacturing technology levels open three product-oriented technology development options. First, high level machine tool technologies which produce wire cutting machines, EDMs, EEMs, CNCs, NCs, milling machines,

etc. Second, medium level machine tool technologies which produce precision lathes, grinders and other special purpose machines. And third, low level machine tool technologies which produce simple lathes, grinders, presses, shearing machines, punching presses, etc. Obviously, Indonesia has opted for low level machine tool manufacturing technology appropriate for the local market. Singapore chose the high level technologies, while Malaysia, the Philippines and Thailand preferred the medium or intermediate level. It appears, however, that machine tool technology choices - decisions which are sensitive to market developments - are being made in the absence of appropriate in-country policies. The direction will define the required policy options, policy implementation mechanisms, and commitment from all parties concerned.

(b) Technology development institutions. Technology development institutions consist of the supporting industries and R+D institutions. The supporting industries (casting, forging, heat treatment, gear-cutting, etc.) which are vital for the development of the machine tool industry are still inadequately prepared in all countries except Singapore. With respect to R+D institutions, the survey noted that none was specially servicing the machine tool industry. The existing R+D institutions focus on the entire metal-working industry. Periodically, some R+D institutions execute machine tool related programmes which, unfortunately, are not sustained over a longer time period.

(c) Technology mastery. Usually taken for granted, technology mastery ensures the effective assimilation and utilization of technology resources. In formulating national initiatives to develop the machine tool industry, the indigenous level of technology mastery is a critical input. This is particularly pressing in the machine tool industry's case, the technology of which involves significant complexities.

5.1.2 Human resource and skills development

Perhaps due to the region's relatively short machine tool history, a scarcity of skilled engineers, machine operators, production managers, and supervisors who have relevant machine tool work experience and training

exists. Except in Singapore's case, available human resources and skills development institutions tend to produce generalists (for employment in general metal-working operations) rather than specialists. Also taken for granted in all countries is entrepreneurship. Many machine tool makers interviewed have never participated in any formal management and entrepreneurship-related training.

5.1.4 Institutional

A number of public and private institutions exist in the region to provide assistance to various industries. Especially in countries where small enterprises predominate in the manufacturing sector, many institutions exist that could provide the required inputs for managerial, financial, etc. assistance. In fact, in these countries, a number of extension service institutions can virtually visit small enterprises and dispense managerial and technical advice. Interestingly, none of these institutions specializes on the machine tool industry.

5.1.5 Interdependency with other industries

Ample opportunities exist in improving subcontracting efficacy in most ASEAN countries not only in the machine tool but in the whole metal-working industry as well. Without such improvements, it may be difficult for machine tool makers to attain a high degree of specialization which can significantly ease some economies of scale obstacles. While there may be negative long term consequences in aggressively promoting subcontracting, these consequences may be outweighed by the short term gains of rapid development, faster technology diffusion, and more equitable distribution of business opportunities.

5.1.6 Use of local material resources

Local availability of appropriate quality raw materials like special steel, cast components, special steel plates and round steel is still very inadequate. Although in each ASEAN country, there exists a considerable capacity for crude steel production, no special alloy steel capacity exists. The bulk of the required materials is currently being imported from Sweden,

the Federal Republic of Germany and Japan and is freely available except in the Philippines and Indonesia, where prices for these materials tend to be high. Raw materials traders and suppliers in the Philippines and Indonesia maintain that low volumes of highly unstandardized and irregular sizes of materials are frequently ordered causing higher prices and excessively long procurement times. End product prices also become prohibitive due to excessive machining time. Besides significant product specialization, enterprise level options include qualitative improvements in inventory management as well as production planning and control systems.

5.1.7 Components standardization

The field survey confirmed that generally all machine tool enterprises do not follow any particular standard. Excepting a few, they apply their own standards which evolved through a long trial and error process. Sometimes machine tool buyers request international standards like AISI, American Society for Testing Materials (ASTM), British Standards (BS), Japan Industrial Standards (JIS), etc. Although some national standards exist these are for components like bolts, nuts, gears, bushes, etc. and are inadequate to constitute a whole product. Unless national standards institutions spearhead the generation and imposition of appropriate standards, local machine tool enterprises will find it difficult to export their products.

5.2 Policy formulation

Considering the existing situation briefly outlined in 4.1, it may be too early to call for a major machine tool industry development policy statement at the regional level. Enhancement of existing initiatives such as the ASEAN-COIME's SoT project will, for the time being, suffice. However, a pressing need for specific country level policies certainly exists.

5.2.1 Country specific policies

For each ASEAN country, a clear policy statement for machine tool industry development is necessary. Essentially the policy should contain the

following measures: (a) industry definition; (b) baseline information; (c) strategic approach; and (d) co-ordinating authority and institutional framework.

(a) Industry definition. The time seems right for each country to start defining their own machine tool industry for administrative and operational convenience. The present importation-based definitions only inform the policy makers on the machine tool sources and destinations but are confusing for the local machine tool producing enterprises. Indonesia's simple machine tool development policy, modest as it may be, could be a good basis.

(b) Baseline information. After the emergence of a generally acceptable machine tool industry definition in each country, baseline machine tool industry information must be created. The baseline information will mirror the existing situation in specific details and derive the required development yardsticks.

(c) Strategic approach. Generally, the baseline information will facilitate the formulation of a strategic approach in developing each country's machine tool industry. For example, the strategic approach should, among others, include measures to:

- (i) Develop indigenous expertise of local engineers in the design and development of machine tools and accessories;
- (ii) Promote research and investigation of machine tool problems;
- (iii) Set national standards for machine tools and accessories;
- (iv) Establish a production-oriented advisory service for the machine tool industry; and
- (v) Support training programmes on NC/CNC machine operations, programming and servicing.

The strategic approach will likewise set the priorities with respect to markets (export/import ratio, product priorities, etc.); technology (product development priorities, standardization, etc.); incentive measures, financial

and non-financial (R+D, industrial extension) assistance. Although less comprehensive, an example of a masterplan was developed by the SoT project for ASEAN machine tool industry (see table 4).

5.2.2 Co-ordinative authority and institutional framework

A co-ordinative machine tool development body within each country's Ministry of Industry could be established to execute the detailed plan. It should contain the following institutional elements:

- (a) Policy research;
- (b) Training (engineering, supervisory, managerial and entrepreneurial);
- (c) Technical consultancy and industrial extension; and
- (d) Technical information unit.

Essentially, the body would execute the machine tool industry development plan by co-ordinating with existing human resources development, R+D, industrial extension, and financial institutions. The body would have a significant private sector participation.

5.2.3 Some ASEAN level projects for machine tool industry development

Some ASEAN level projects can be initiated in the near future to stimulate and support individual governments' efforts to develop the machine tool industry. Some examples are as follows:

(a) CNC/NC machine awareness programme. Like the metal-working industry, the machine tool industry shows a steadily growing trend. Considering the variations in each country's approach to developing the industry as well as technology level variances, it is apparent that only Singapore has the required technological capacity and global market to absorb the NC/CNC machinery. Other ASEAN countries, especially Indonesia, will gradually develop expertise in producing simple and less sophisticated machine tools. But over the long run, the increasing number of CNC/NC machine users in these countries (although not as rapid as in Singapore's case) will force

Table 4. Promoting scheme for ASEAN machine tool industry

Country	Present Situations	Recommendations	
		Short Term	Medium/Long Term
Indonesia	<ol style="list-style-type: none"> 1. The late development project on going, by the government. 2. Private companies watching the market conditions and technological opportunities. 3. Weak supporting industries and sub-contractors. 4. Few forming machine tool makers. 	<ol style="list-style-type: none"> 1. Promotion of the late development project. 2. Assistance of existing and possible manufacturers. 3. Promotion of basic technology. <ul style="list-style-type: none"> - Precision products - Basic metal - Engineering/Designing - Quality Control 4. Extension/training for sub-contracting job. 5. Acquisition of the machine re-building/technology from NIRD, Philippines. 	<p>Mass production.</p> <p>National R & D program.</p> <p>Establishment of the generation private companies.</p> <ul style="list-style-type: none"> - Joint venture - Foreign investment - License agreement - Tax incentives/rebate - Import restriction - Sales guarantee by government - Credit Assistance
Malaysia	<ol style="list-style-type: none"> 1. No cutting machine tool manufacturers. 2. Private sector not interested in investing in machine tool manufacturing. 3. 6 producers are producing metal forming for machine tool. 4. Small scale production. 5. Weak supporting industries. 6. Users of modern machine tool are increasing. 	<ol style="list-style-type: none"> 1. Upgrade the technical capability of casting, forging, heat treatment, precision machining, year-cutting shops. 2. Enhance the subcontracting support services for promoting process specialization. 3. Promote to use modern machine tool for higher production 4. Organize special training courses on NC/CNC machine tool. 	<ul style="list-style-type: none"> - Promote investment in machine tool manufacturing firms. - National institution assist in design and development of machine tool. - Promote supporting industries - Tax incentives/rebate - Import restriction - Sales guarantee by government - Credit Assistance
Philippines	<ol style="list-style-type: none"> 1. No manufacturers after the stopping of MATOOLS, 1979. 2. Reluctant to enter the machine tool business despite the government's incentives. 3. Increasing imports of second hand machines. 	<ol style="list-style-type: none"> 1. An indepth research study on the failures of the machine tool industry. 2. Improvement of business environment: <ul style="list-style-type: none"> - Tax - Interest rate - Sub-contractors - Supporting industries 3. Machine re-building 	<p>Establishment of joint venture companies with foreign companies or drawing foreign investment.</p> <ul style="list-style-type: none"> - Tax incentives/rebate - Import restriction - Sales guarantee by government - Credit Assistance
Singapore	<ol style="list-style-type: none"> 1. few metal cutting machine tool manufacturers. 2. Strong supporting industries. 3. Increased usage of modern machine tool. 4. Predominance of foreign machine tool makers in controlling market. 5. Adequate infrastructure is under establishment. 	<ol style="list-style-type: none"> 1. Enhance capability of local engineers and technicians in design and development in machine tool. 2. Organize study tours to machine tool makers in developed countries. 3. Promote specialised training program for works on subsidised basis. 4. Provide market information on specific machine tool demand. 	<ul style="list-style-type: none"> - National institution formulate national standards - Institution establish testing facilities - Develop infrastructure to promote sub-contracting - Granting tax incentives - Encourage investment - Participate in international industrial fairs on subsidy
Thailand	<ol style="list-style-type: none"> 1. 2 manufacturers: <ul style="list-style-type: none"> - Simple lathe - simple shaper 2. 12 manufacturers for forming machine tool products. 3. Low quality and old-fashioned. 4. Small scale production. 5. Limited number of supporting industries and sub-contractors. 	<ol style="list-style-type: none"> 1. Assistance of existing manufacturers: <ul style="list-style-type: none"> - Technical support - Sales promotion - Management improvement - Marketing 2. Extension/training for sub-contracting job: <ul style="list-style-type: none"> - Casting - Gear - Heat Treatment - forging 3. Acquisition of the machine rebuilding technology from NIRD, Philippines. 	<p>Supporting local manufacturers for innovative products.</p> <p>Establishment of joint venture companies or drawing foreign investment.</p> <ul style="list-style-type: none"> - Tax incentives/rebate - Import restriction - Sales guarantee by government - Credit Assistance

them to absorb CNC/NC technology. In the short run, regional level CNC/NC machine awareness seminars and conferences may be initiated coupled with some practical machine operators courses.

(b) Technology development. To support in-country machine tool industry development initiatives, ASEAN can initiate a series of roving seminars relying on the region's existing mechanisms and agencies to promote technology developments. These seminars will stimulate the development of standard machine tools, quality control methods and procedures, and materials technology. Moreover the seminars can create a pool of trained machine tool specialists and consultants.

(c) Joint market development. To develop durable trade links with other developing markets, ASEAN should initiate the conduct of joint market development activities. These include hosting of machine tool trade fairs, exhibitions, trade missions and trade conferences. In the long run, these activities will facilitate the establishment of a collaborative after-sales services network consisting of repair, maintenance and spare parts supply depots in the developing countries.

(d) Joint economic research unit. An existing regional organization can be commissioned by ASEAN to perform periodic economic and technical monitoring of machine tool industry developments within the region. The outputs of this organization will significantly stimulate individual governments to exploit the potentials of machine tool industry development in the region. Some mechanisms that may be used to disseminate the information generated would be existing newsletters, policy memos, annual machine tool industry situation reports, etc.

Present trends indicate the individual ASEAN country's preference for technical co-operation projects. Most projects involve the setting up of technical institutions, common service facilities, prototype testing laboratories, etc. Considering that all ASEAN countries are currently installing various metal-working industry development infrastructures, this trend is expected to continue in the future. Market-oriented technical

co-operation approaches, such as joint ventures, technology licensing, etc. are expected to emerge within the near future. The recently commissioned ASEAN-COIME SoT 2 project will be a major step in this direction.

The sharing of technology project: phase 1 (SoT 1) which focussed on metal-working SMIs engaged in agricultural machinery, machine tools, hand cutting tools, shipbuilding, as well as tool and die successfully confirmed that among ASEAN SMIs, technology resources exist which could be shared and transferred. However, it also hinted that concrete technology movements will only occur if prospective technology recipients and donors (or partners) can resolve the following micro issues: (a) What are the characteristics of the likely partners? (b) What are the economic and non-economic reasons? (d) How will the partners be effectively matched? (e) What factors hinder technology movements?; and (f) What are the costs of technology movements?

The proposed phase 2 of the project (SoT 2) will examine these micro issues by actually bringing together prospective partners for negotiation and undertaking a five-stage process of systematic selection, matching, pairing, technology mastery, and exchange of experiences. Potentially, SoT 2's will be iterated twice, i.e. a transnational transfer (between ASEAN SMI recipients paired with five Japanese donors) and an intra-ASEAN sharing (between five ASEAN SMI recipients and donors), and successively refined to evolve the truly ASEAN model. Consisting of seven major activities (project orientation meeting, systematic selection survey, matching workshop, field pairing, technology mastery, technology sharing workshop, and project monitoring and documentation), SoT 2 will be executed by a four-tier mechanism (consisting of COIME, Technonet - aided by JUCA experts, ASEAN-COIME focal points and Technonet, and other supporting agencies) over a 28 month-period.

6. MAIN FINDINGS AND RECOMMENDATIONS

Based on the above, the following are the main findings and recommendations:

(a) Except for Singapore, the existing machine tool manufacturing technology levels are relatively low for the infusion of CNC/NC technology. In Singapore's case, CNC/NC technology has already been effectively introduced. It is also currently developing all the needed infrastructures. In the Philippines, Thailand and Malaysia, the number of CNC/NC users are increasing but the demand needs to be met by imports. The current technology levels of the machine tool enterprises in these countries require massive upgrading to prepare for CNC/NC technology. Indonesia is taking the lead in developing low level and simple machine tools for the local market.

(b) The emerging pattern of machine tool product specialization within the region is that Singapore will focus on higher technology level machine tool products, the Philippines, Thailand and Malaysia on medium level technology products and Indonesia, on low level technology products.

(c) Regional machine tool development policy. It is yet too early to call for an ASEAN-level machine development policy at the present time. But existing regional initiatives covering co-operative activities on technology development, human resources, economic intelligence, promotion of joint ventures, joint-marketing should be continued and supported.

(d) In-country machine tool development policy. For each ASEAN member country, there is a need for a specific machine tool promotion and development policy.

(e) Meanwhile, each country, except Singapore, can have small pilot demonstration projects on CNC/NC to stimulate awareness of the benefits of computer-controlled machines for high precision and high value added products.

(f) Existing R+D should start disseminating technical information--preferably using local languages--on recent machine tool products to the actual end-users.

(g) Intensive in-plant extension services should be provided through professional and skilled consultants on production, technology and management improvements.

(h) The government should support the organization of local machine tool industry associations to facilitate the delivery of technical assistance.

(i) Subcontracting can be promoted in the machine tool industry to enhance product and process specialization.

(j) Existing standards institutions within each country should begin formulating and issuing simple machine tool standards. They should also assist the enterprises to assimilate these standards.

(k) Reputable machine tool enterprises within each country should obtain access to long-term preferential credits for facilities upgrading.

(l) R+D institutions should undertake machine tool prototype development programmes - inclusive of design and production know-how - for transfer and demonstration to the enterprises.

(m) Relevant public institutions should facilitate the acquisition of foreign know-how through licensing and technical co-operation schemes.

It is rather difficult to suggest any ideal model for developing machine tool industries under any given situation, unless a preferable infrastructure is created. A promotional scheme which is achievable over a period of time is depicted in table 5. In order to promote co-operative venture projects in the ASEAN countries, several methodologies could be pursued:

(a) Indonesia, the Philippines and Thailand could seek technical assistance (through a bilateral or multilateral technical co-operation scheme) from newly industrializing countries and developed countries. Within such a programme, attempts should be made to upgrade the supporting industries such as casting, gear manufacturing, heat treatment, forging and basic metalworks.

(b) The technical experts to be engaged for the above programme of activities should train the local engineers and technicians in machine tool design, engineering, material selection, procurement and quality control elements.

(c) Study tours for the potential entrepreneurs to be organized to obtain adequate exposure to the machine tool manufacturers' situation in developed countries.

In order to execute an action plan on machine tool development in ASEAN countries through an intensive programme, government policy support would be essential to encourage the existing manufacturing sector in diversifying its product lines towards machine tools. The manufacturers may encounter difficulties in the competitive market unless adequate assistance and incentives are provided in the initial period.

SOMMAIRE

Cette étude de l'industrie des machines-outils dans l'ASEAN région donne une évaluation générale du secteur avec l'intention de déterminer quelques stratégies possibles pour son développement. L'étude s'étend sur une aperçue du développement dans un passé immédiat, de la situation actuelle, des politiques de développement des machines-outils, des problèmes et thèmes fondamentaux, des aspects de la formulation d'une politique, recommandations pour activités à prendre y compris.

A la conclusion, l'étude donne quelques recommandations concrètes comment initier une industrie des machines-outils soutenable dans une région.

EXTRACTO

Este estudio sobre la industria de máquinas herramientas en la región ASEAN tiene como finalidad presentar una evaluación global del sector a fin de definir algunas posibles estrategias para su desarrollo. El estudio examina los desarrollos pasados del sector, la situación presente, políticas adoptadas para promover el desarrollo del sector de máquinas herramientas, los problemas que afectan esta industria, así como también aspectos de las diferentes opciones para seguir una estrategia de promoción del sector y la política requerida a tal fin. Se formulan también recomendaciones para definir acciones futuras en el sector.

Finalmente, el estudio formula algunas recomendaciones concretas para alcanzar un desarrollo sostenido de la industria de máquinas herramientas de la región.

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QUESTIONNAIRE

The machine tool industry in the ASEAN region: options and strategies.
Main issues at regional level

(please check appropriate box)

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