

< 資 料 V >

FOMFEIA の概要

(FEDERATION OF MALAYSIAN FOUNDRY &
ENGINEERING INDUSTRIES ASSOCIATIONS)



FOMFEIA

馬來西亞機器廠商總會
GABUNGAN PERSATUAN-PERSATUAN
INDUSTRI FONDRI DAN
KEJURUTERAAN MALAYSIA
FEDERATION OF MALAYSIAN FOUNDRY &
ENGINEERING INDUSTRIES ASSOCIATIONS

8, (1ST FLOOR), JALAN 1-77B, OFF JALAN CHANGKAT THAMBI DOLLAH,
55100 KUALA LUMPUR, TEL: 03-2421384

DIRECTORY OF STANDING COMMITTEE
& STATE REPRESENTATIVES
常務委員及州代表名冊
1985-1986



FOMFEIA

馬 來 西 亞 機 器 廠 商 總 會
GABUNGAN PERSATUAN-PERSATUAN INDUSTRI FONDRI DAN
KEJURUTERAAN MALAYSIA
FEDERATION OF MALAYSIAN FOUNDRY &
ENGINEERING INDUSTRIES ASSOCIATIONS

8, (1ST FLOOR), JALAN 1-77B, OFF JALAN CHANGKAT THAMBI DOLLAH, P.O. BOX 6183 PUDU, 55720 KUALA LUMPUR. TEL: 2421384, 2418843

FOMFEIA IN BRIEF

1.0 FOMFEIA

FOMFEIA stands for Federation of Malaysian Foundry & Engineering Industries Association. It is the representative body, at the national level, for the foundry and engineering trade and industries and its members are the various State Associations.

FOMFEIA was established on 7th January 1977 and all State Associations were invited to be members. Its membership covers the following groups of industries.

1. Foundry (iron, steel and alloy steel, etc.)
2. Engineering workshops.
3. Steel fabrication, metal and welding works.
4. Machinery manufacturers.
5. Precision engineering.
6. Trailer assembly.
7. Repair and maintenance of motor vehicles, tractor, etc.
8. Other related engineering industries.

2.0 OBJECTIVES OF FOMFEIA

The objectives of the Association are to:

1. establish and maintain close contact between all member associations of the foundry and engineering industries/trades in the various States of Malaysia;
2. promote and protect the commercial interest of its members;
3. assist and promote the development of the foundry and engineering industries/trade in the country;
4. upgrade the skill and level of technology of all its member – firms;
5. seek and promote opportunities in the fields of engineering, metal and foundry trades for all its members (both in local and foreign markets);
6. keep close liaison with all members with the eventual aim of promoting social welfare and national development.

3.0 ORGANISATION

The organisation of FOMFEIA is as follows:

1. The General Meeting (Assembly) of the representatives of the State Constituent Associations shall be the Supreme Authority of FOMFEIA.
2. The Standing Committee is elected at the General Meeting. The Standing Committee consists of:-
 - a) A President;
 - b) A Deputy President;
 - c) 8 Vice-Presidents (Presidents of the State Constituent Associations by virtue of their status shall hold this post);
 - d) An Hon. Secretary.
 - e) An Hon. Assistant Secretary;
 - f) An Hon. Treasurer;
 - g) An Hon. Asst. Treasurer and
 - h) Not more than 11 Ordinary Standing Committee Members
3. The Executive Committee consists of the President, Deputy President, Hon. Secretary, Hon. Asst. Secretary, Hon. Treasurer and Hon. Asst. Treasurer and its functions are to supervise, decide and oversee operation and administration of the day to day running of the Association.
4. Sub-committees are also appointed/formed whenever necessary for trade and industries groups such as foundry, metal and welding work, machine shop, precision engineering and trailer assembly, and also for social and welfare, etc. The role and functions of the various sub-committees would be to supplement and complement the various activities for the benefit of its members.

4.0 ACTIVITIES

The activities of FOMFEIA include:-

- 1) Providing assistance to its members in:-
 - a) sourcing of industrial land;
 - b) arranging, securing and providing expertise in solving technological problems and
 - c) providing consultation and assistance to members for resolving problems arising from the implementation of government policies.
- 2) Organise study and exposure tours for its members to obtain technical expertise and technology transfer from other countries.
- 3) Hold dialogues and discussions with the various ministries such as trade and industries, labour, finance, environment ministries and statutory bodies like MIDA, SIRIM, HICOM, MIDF, etc with regard to the members' problems, requirements and better understanding.

各州分會地址
ADDRESS OF STATE CONSTITUENT ASSOCIATIONS

雪蘭莪機器廠商公會

The Selangor Foundry & Engineering Industries Association
8, (1st Floor) Jalan 1-77B, off Jalan Changkat Thambi Dollah, K.L.
P.O. Box 6183, Pudu, 55720 Kuala Lumpur. Tel: 03-2483461

吡叻機器廠商公會

Perak Foundry & Engineering Industries Association
No. 79, (Tingkat Pertama) Jalan Sultan Idris Shah,
30000 Ipoh, Perak. Tel: 05-549824

森美蘭機器廠商公會

Negeri Sembilan Foundry & Engineering Industries Association,
352 (2nd Floor), Taman Yoon Fook, Jalan Tampin,
70450 Seremban, Negeri Sembilan. Tel: 06-715110

馬六甲機器廠商公會

Malacca Foundry & Engineering Industries Association
No. 91-E2, Jalan Bachang, 75300 Malacca. Tel: 06-229373

吉打機器廠商公會

Kedah Foundry & Engineering Industries Association
No. 1345, Lorong Perwira, 05200 Alor Setar, Kedah.
Tel: 04-724316

彭亨州機器廠商公會

Pahang Foundry & Engineering Industries Association
A-7976 (2nd Floor), Jalan Beserah, 25300 Kuantan, Pahang.
Tel: 09-525185

檳城州機器廠商公會

Penang State Foundry & Engineering Industries Association
No. 229-B, Jalan Jelutong, 11600 Pulau Pinang. Tel: 04-375736

登嘉樓機器廠商公會

Trengganu Foundry & Engineering Industries Association
216, (Belakang Tingkat Satu), Jalan Bandar,
20100 Kuala Trengganu. Tel: 09-621260

吉蘭丹機器廠商公會

Kelantan Foundry & Engineering Industries Association
3949 (Tingkat 2), Jalan Post Office Lama, 15000 Kota Bahru,
Kelantan. Tel: 09-749228

柔佛州機器廠商公會

Johore State Foundry & Engineering Industries Association
No. 31-2A, Jalan Penchoran Air, 83000 Batu Pahat, Johor.
Tel: 07-443648

永久名譽會長兼會務顧問
PATRON AND ADVISOR



准拿督江尙蘇局紳
Mr. Kong Seong Soo A.M.P., J.P.



蔡榮興先生
Mr. Choy Wing Hing P.J.K.

會長
PRESIDENT



拿督王俊達
Dato' Roland Wong Choon Tat D.S.N.S.
Wong Heng Engineering Sdn. Bhd.
539, Jalan Tunku Antah,
P.O. Box 90, 70710 Seremban,
Negeri Sembilan.
Tel: 06-723026, 722297, 723331, 719730

署理會長
DEPUTY PRESIDENT



丘鴻章先生
Mr. Hew Hong Cheong
United Casting Sdn. Bhd.
No. 27, Jalan 3A,
Kawasan Perusahaan Balakong,
Taman Cheras Jaya,
43200 Batu 9 Cheras,
Selangor.
Tel: 9051827, 9052136/37/39

副 會 長
VICE PRESIDENTS



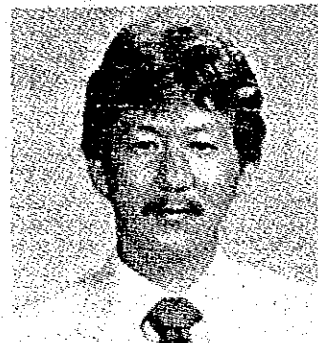
丘慶安先生
Chiu King Ang
Hup Soon Mechanical Works Sdn. Bhd.
4863, Mak Mandin Ind. Est.,
Jalan Permatang Pauh,
13400 Butterworth, P.W.
Tel: 04-345916, 345280



謝有山先生
Chih You Sun
You Sun Kilang Besi
54, Jalan Kluang,
86000 Batu Pahat, Johor
Tel: 07-441306, 443664

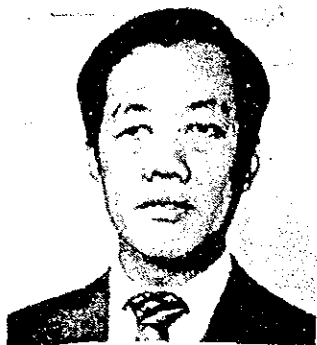


謝開華先生
Chia Khooi Wah,
Sri United Engineering Sdn. Bhd.
29-A, Jalan Bukit Kecil,
21100 Kuala Trengganu
Tel: 09-621260



李源福先生
Lee Ngan Fatt
Lee Engineering (K.B.) Sdn. Bhd.
4080 A-B, Jalan Pasir Puteh,
15400 Kota Bharu.
Kelantan.
Tel: 09-785126, 747126

副會長
VICE PRESIDENTS



劉潤泰先生
Mr. Lau Yoon Thye,
Menglembu Wah Cheong Foundry Sdn. Bhd.
2³/₄ miles. Ipoh Road,
31450 Menglembu, Ipoh, Perak
Tel: 05-542745, 546175



麥生先生
Mr. Mak San
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88, Jalan Kilang,
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黃愛成先生
Mr. Ooi Ai Seng
Syarikat Hong Seng Engineering,
Batu 2³/₄, Jalan Langgar,
05460 Alor Setar, Kedah.
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夏廣基先生
Mr. Ha Kwang Kee
Ha Kee Cheong Engineering Sdn. Bhd.
Lot 36-37, Kawasan Perindustrian,
Semambu, P.O. Box 180,
25350 Kuantan,
Pahang.
Tel: 09-520411, 520412

義務秘書
HON. SECRETARY



余持賢先生
Mr. Yee Chee Sian
Tai Heng Lian Engineering Sdn. Bhd.
A-10, Lot 9824, Jalan Connaught Bridge
41300 Kelang, Selangor.
Tel: 03-3325414, 3322726

副義務秘書
HON. ASST. SECRETARY



林雲飛先生
Mr. Lim Yuen Fee
Wah Soon Iron Works
No. 334, Rahang New Village,
70450 Seremban, Negeri Sembilan.
Tel: 06-711301, 714259

義務財政
HON. TREASURER



陳定華先生
Mr. Chan Teng Wah
Hup Heng Engineering Works,
12, Kampong Ampat, Jalan Kubu,
75300 Melaka.
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副義務財政
HON. ASST. TREASURER

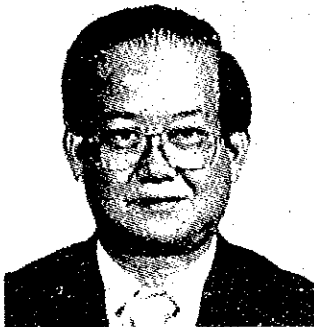


區天保先生
Mr. Ow Tin Poh
Pan Malaysia Engineering Works,
19, Jalan Segambut Atas,
Segambut Industrial Area,
51200 Kuala Lumpur.
Tel: 03-6265622, 6265730, 6276908

常務委員
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黎漢池先生
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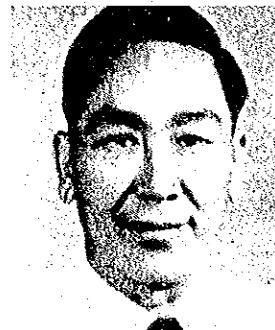
鄭炎成先生
Mr. Teh Ah Ba
(Eam Seng)
Eng Hardware Engineering Sdn. Bhd.
410-C, Jelutong Road,
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羅超鴻先生
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李志才先生
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黎孔田先生
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STANDING COMMITTEE MEMBERS



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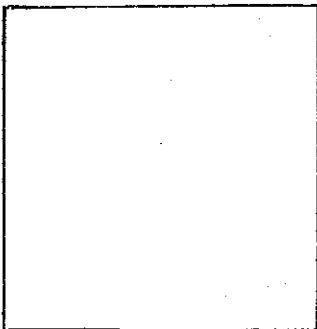
蔡貴國先生
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254, Jalan Tuanku Antah,
70100 Seremban. N. Sembilan.
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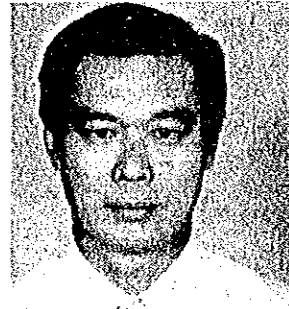
林英華先生
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周慧球先生
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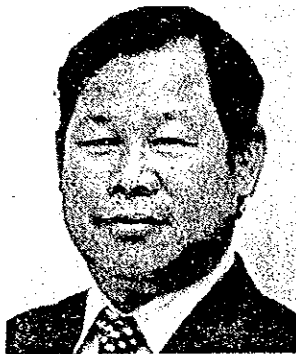
雪蘭莪州分會代表
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周全忠先生
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Num Soon Metal MFG. Sdn. Bhd.



余持賢先生
Mr. Yee Chee Sian,
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區天保先生
Mr. Ow Tin Poh
Pan Malaysia Engineering Works,



譚潮石先生
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吡叻州分會代表
PERAK STATE REPRESENTATIVE

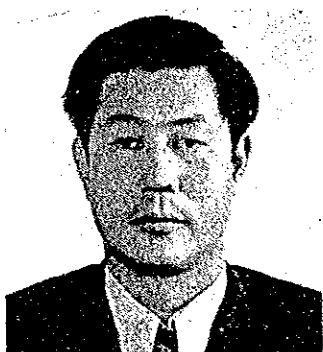
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Menglembu Wah Cheong Foundry Sdn. Bhd.



方川文先生

Mr. Foong Choon Mun
Fong Yat Engineering Sdn. Bhd.



黎漢池先生

Mr. Lai Hon Chee,
Teak Heng Foundry Sdn. Bhd.



盧灌生先生

Mr. Lo Kon Sun
Hup Yik Foundry Sdn. Bhd.

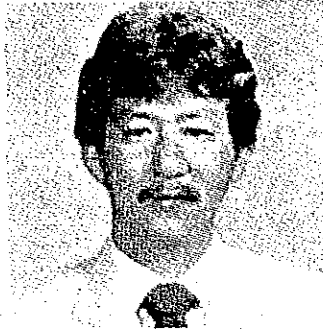


黃潤強先生

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李志才先生
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Kejuruteraan Keong Fatt



譚福華先生
Mr. Tuem Fook Hwa
Sing Chew Brothers Welding Co.



周經利先生
Mr. Chew Keng Lee
Seng Lee Engineering Works Co.



蔡福義先生
Mr. Chua Hock Gee
Abad Engineering,

吉打州分會代表
KEDAH STATE REPRESENTATIVE

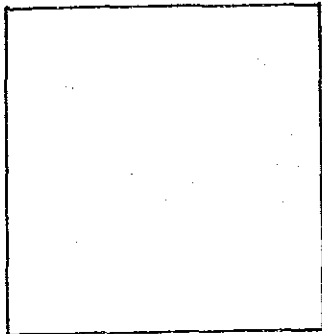
吉打機器廠商公會

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05200 Alor Setar, Kedah. Tel: 04-724316



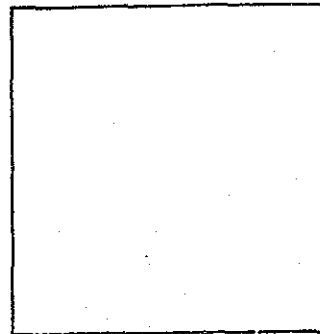
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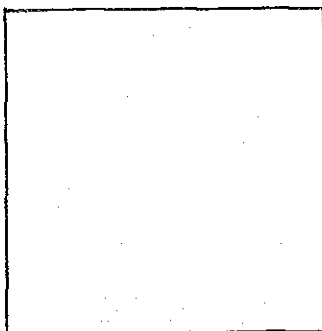
陳古榮先生

Mr. Tan Ku Yoon
Sin Kean Hin Iron Works Sdn. Bhd.



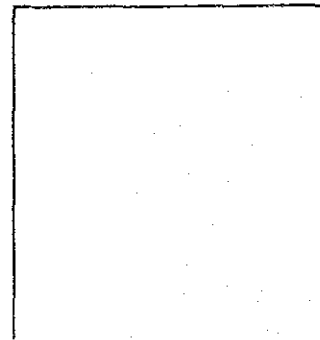
江進興先生

Mr. Kang Siam Hin
Sin Tah Sdn. Bhd.



許金枝先生

Mr. Khor Kim Kee
Lee Leong Motor



鄭金先生

Mr. Chang Kam
Hoe Heng Foundry

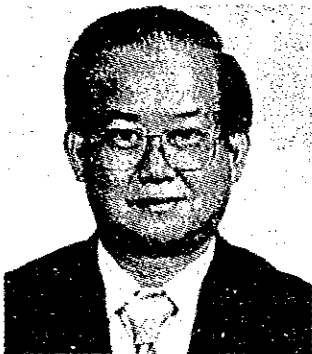
檳城州分會代表
PENANG STATE REPRESENTATIVE

檳城州機器廠商公會

Penang State Foundry & Engineering Industries Association
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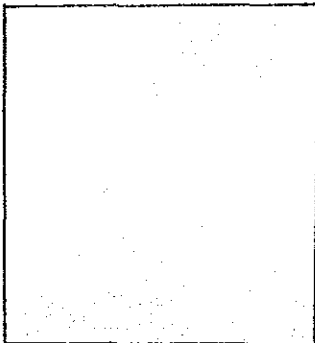
丘慶安先生
Mr. Chiu King Ang
Hup Soon Mechanical Works Sdn. Bhd.



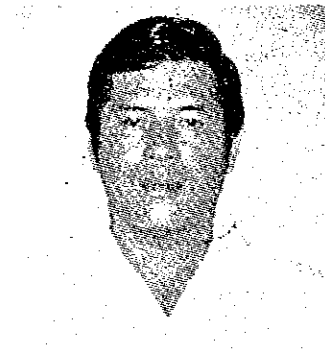
鄭炎成先生
Mr. Teh Ah Ba (Eam Seng)
Eng Hardware Engineering Sdn. Bhd.



蔡柏福先生
Mr. Choy Pak Fook,
Sun Fook Foundry Co.,



梁添榮先生
Mr. Leong Thiam Yong,
Syarikat Hup Hin Engineering Works,



伍晉民先生
Mr. Ng Chin Ming
Kilang Besi Khee Tatt Sdn. Bhd.

柔佛州分會代表
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謝有山先生
Mr. Chih You Sun
You Sun Kilang Besi



黎孔田先生
Mr. Lee Koon Tiam
Tampoi Engineering Sdn. Bhd.



詹添程先生
Mr. Chiam Tat Seng
Hiap Heng Iron Foundry & Company,



李觀寶先生
Mr. Lee Kun Poo
Mow Hing Bros Engineering Sdn. Bhd.



溫仲榮先生
Mr. Woon Chong Weng
Bengkel Kejuruteraan Wan Bersaudara,

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麥生先生
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Mak Sang Motor Service,



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Mr. Chang Teng Wah
Hup Heng Engineering Works,



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Mr. Chan Chan Lin,
Chan Brothers Engineering Works



張作良先生
Mr. Cheong Chok Loong,
Chan Fatt Engineering,



蔡志標先生
Mr. Choy Ah Pew
Choy Engineering (Soon Seng) Sdn. Bhd.

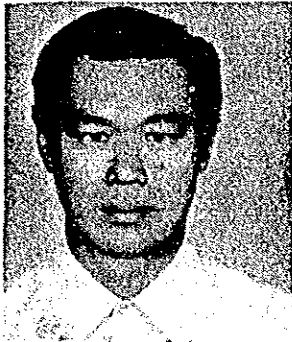
丁加奴州分會代表 TRENGGANU STATE REPRESENTATIVE

登嘉樓機器廠商公會

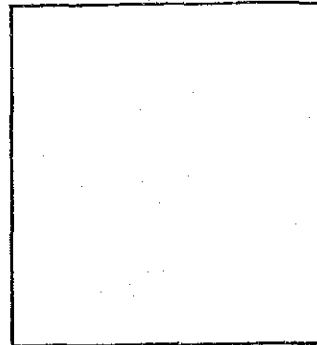
Trengganu Foundry & Engineering Industries Association
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謝開華先生
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Sri United Engineering Sdn. Bhd.



黃輝鵬先生
Mr. Wong Fai Phang
Stesyen Perkhidmatan Kenderaan Ipoh,



彭師春先生
Mr. Pang See Chong
Pembaik Kereta-Kereta See Wide,



黃國磊先生
Mr. Ng Kok Loy
Soong Hoe Engineering Sdn. Bhd.



黃新按先生
Mr. Wong Sin Onn
Syarikat Wong Engineering

彭亨州分會代表
PAHANG STATE REPRESENTATIVE

彭亨州機器廠商公會

Pahang Foundry & Engineering Industries Association
A-7976 (2nd Floor), Jalan Beserah, 25300 Kuantai
Tel: 09-525185



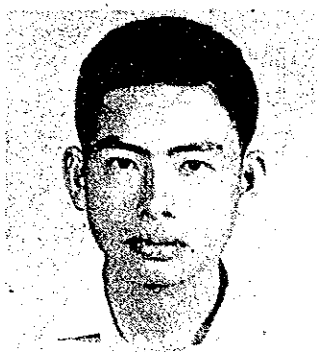
夏廣基先生

Mr. Ha Kwang Kee
Ha Kee Cheong Engineering Sdn. Bhd.



羅超鴻先生

Mr. Loh Chew Hoong
Choong Hin Engineering Works Sdn. Bhd.



黃煜成先生

Mr. Wong Yook Seng
Syarikat Mun Wil Seng



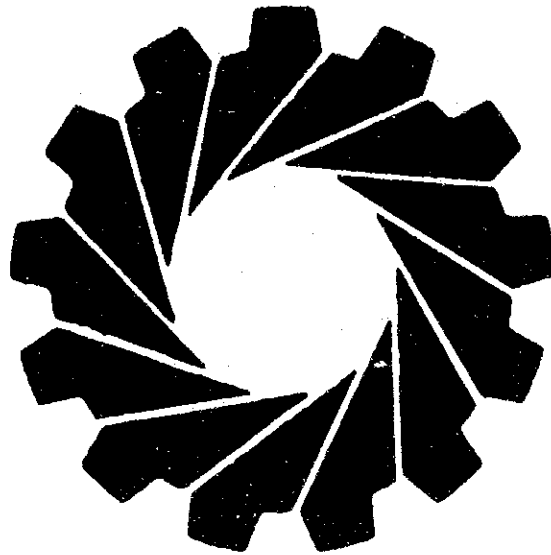
丘健宏先生

Mr. Hew Kan Fon
Meng Meng Motors Con.,



孫永發先生

Mr. Son Yong Fat
Tong Mak Vehicle Body Works,



FOMFEIA

FOMFEIA is the abbreviation of the Federation of Malaysian Foundry & Engineering Industries Associations.

1. **Shape**

The Logo is in a circular shape of a rotary cutter made up by 13 gear-teeth.

2. **Structure**

The 13 gear-teeth are divided into 13 equal parts.

3. **Content**

The 13 gear-teeth represent our 13 states. The whole structure with white lines dividing each part shows individual state has its unity movement towards each other under one Federation.

Each individual state will have its own "State Constituent Association's name" stated below the logo.

4. **Colour**

The dark blue colour and the moving structure gear represent the movement of the Foundry & Engineering Industries.

＜ 資 料 VI ＞

本事前調査に関する新聞記事抜粋

マレーシアの鑄造技術センター

通産、設立に全面協力

通産省は、マレーシア政府が計画している鑄造技術センターの設立に全面協力する方針を固めた。

マレーシア規格・工業研究所(SIRIM)の要請に基づき、

国際協力事業団を通じて事前調査を行った結果、同国の基礎産業を育成するためには、製造業に不可欠な鑄造技術の向上が必須と判断、センターの設立、機械類の設計から専門家派遣、鑄

造技術の確立など、総合的なプロジェクトタイプの技術協力を実施することにした。協力期間は五年間で、予備段階として来年二月にセンター設計のための専門家派遣を行うと決まり、同

七月にも正式調印し、機材搬入を含めた本格的な技術協力に着手する方針。

同国は、一九九〇年を目標に工業化政策を推進しており、その一環として強い機械工業

の技術力育成のため八〇年に金屬工業技術センター(MITEC)を設立、続いて八四年には金屬工業研究開発センター(MIRDC)を設置している。鑄造技術センターの設立は、これらに続く技術センターの第三弾。

センター設置に当たっては、まず人材教育に力を入れる考えで、鑄造方案・品質管理、溶解、造型、金砂処理、模型・機械加工、機器分析、非破壊検査の各項目を中心に重点教育する。

< 資 料 VII >

鑄造技術センター設立計画

(1985年1月：SIRIM案・日本語訳)

再調査、鑄造技術センター設立

ヘルム・ビン・ハシム

1985年1月

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1. モハマッド・マンソール・サレ博士 (SIRIM 長官)
2. モハマッド・アミン氏
3. ユソフ・ザカリア氏
4. アスマディ・サイド氏

概 要

このレポートでは SIRIM の鑄造技術センター設立の再調査について述べる。このセンター設立の初期計画は 1981 年 8 月の日本人専門家による提案書に基づいている。この提案はペラ州のイポーにセンターを建設するというものであった。再調査の結果、セラングール州シャーアラムに建設する方がより適していることが分かった。

1. 序

鑄造工業は金属工業の基礎をなしている。それは鑄造製品が工具類、機械、自動車等の部品として金属機械工業で使われるからである。故に鑄造工業の発展は一国の金属工業の発展に多大な影響を与える。マレーシアの鑄造面の技術は複雑で高質な製品を作ったり、大量生産をするまでには至っていない。それは我国の鑄造活動に関する調査 (1, 2, 3) で日本人専門家が述べているような、我国の鑄造業者が直面している幾つかの問題による。この専門家の調査結果の正当性を基に政府は SIRIM に鑄造技術センターを設立することを提案した。このセンターの設立は第 4 次マレーシア計画の一環として政府の認可を得ている。センター設立に対する政府の認可は我国の金属業者援助の為に完璧な金属技術センターを作りたいという SIRIM の強い希望にも合っている。この鑄造センターは 3 つの金属技術センターの内の 1 つになる。他の 2 つは MITEC と MIRC C である。

1.1 設立の初期計画

当初この鑄造技術センターはペラ州のイポーに設立を予定されていた。1981 年 8 月、日本人専門家 3 人が鑄造センター設立案の調査をする為に招かれた。調査した専門家はこのセンターには鑄造設備のある仕事場と共に機械及び熱処理場、分析及び試験研究室も必要であるとの結論を得た。それはセンターがシャーアラムの SIRIM から遠いので、完全な鑄造技術センターにする為には上述のような設備が全て必要になる。以下は鑄造技術センターをイポーに建設する場合に必要なとされる設備費の見積りである。

- | | |
|----------------------|-----------|
| i 鑄造場の完成 | 340 万 M\$ |
| ii 分析及び試験研究室、機械室等の完成 | 440 万 M\$ |

上記のようにこのセンターの設備費総額は780万M\$になる(1981年の見積り)。この見積りには設置費は含まれていない。1年に10%値上がりするとして1985年における設備費を計算すると1000万M\$になる。建物にかかる費用は約950M\$である(現在の値段で)。故に、この鑄造技術センター計画にかかる総費用は2000万M\$前後になる。

上記の説明からイポーにセンターを設置する費用が非常に高いことが明らかである。現在の我が国の経済状態を鑑み、SIRIM当局がセンター設立初期計画を再調査する段階となった。

1.2 新しい提案

鑄造技術センター設立について再調査し、セランゴール州シャーアラムに建設するのがより適しているとの結果を得た。提案する場所はバハット通りSIRIMセンターの倉庫である。以下にこの移動案の正当性を述べる。

- i) こういうセンター業務の必要性の面では(ペラ州だけでなく)セランゴール州にも多くの鑄造業者がいる。重要なことは、必要な鉱物のほとんどを産出しているイポーの鑄造と比べて、セランゴールの鑄造は一般に鑄型技術の面で活発、ということである。セランゴール州周辺の急速な鑄造業発展はPROTONのようなHICOMによる重工業技術の必要性からである。鑄造業者は東海岸にたくさんいる。(銅、銀業者も)そして、大多数がブミプトラ(マレー系)の人種であり、彼らがセンター業務を必要とすることが予想される。よって、地の利、交通の面からセランゴールは東海岸との連絡により適している。
- ii) センターで産出される物は実際に使用する前に機械にかけ、熱処理しなければならない。これには完全な設備と機械室が必要である。センターをイポーに建設すると、前述の日本人専門家の初期提案のように機械室を1つ作らなければならない。センターをシャーアラムに建てるとすると、機械・熱処理場を作る必要はない。それらの設備はMITECと構造製作ユニットにすでにあるので。
- iii) 金属の調査・試験の為の設備のある研究室も作る必要がない。これらは科学調査ユニット、技術調査ユニット、MIRDC、MITECにあるから。足りない設備を足すだけで良い。
- iv) 交通とコミュニケーションの面からセンターは現在のSIRIMに近い方が良い。
- v) センター設立の重要な目的の1つはSIRIM、MIRDC、MITECにある他の部門を助けることである。例えば機械部門などで流し込みの方法で作らなければならない道具を得られるようになる。故にこのセンターは上記2つのセンターに近いことが望ましい。
- vi) 金属関係者に訓練をする場合、3つの金属センターが近くにあった方が便利である。

以上述べた要素、特にii)とiii)の要素から鑄造技術センターは当然シャーアラムに建設されるべきである。ii) iii)はセンター設立費を軽減する上で重要な要素である。

2. プロジェクトの計画

2.1 目的

再調査の結果、以下が鑄造技術センターの設立目的である。

- (i) 我国の鑄造業者に鑄型作り、溶解、流し込みの方法で近代技術に基づく鑄造を紹介する。
- (ii) 高質の製品を作る為、鑄物作りの工程で科学的に材料調整法を示しながら、近代鑄造で使われる最新の鑄型材料(“Sand Casting”や“Investment Casting”の材料のような)を紹介し、使用を勧める。
- (iii) 鑄造に使えるような我国にある材料を見つけ出す。
- (iv) 新しく産出された産物(多様化産物)鉄鑄物合金、S. G.、スチール合金、亜鉛合金、アルミニウムを紹介する。また、自動車、機械類、電気などのような技術工業に必要な新しい鑄造工程を紹介する。
- (v) 工業家が高質の物を作るのに適した金属材料と工程を使うよう指導する。
- (vi) 新経済に合った鑄造業にブミブトラの人種が入るように推進する。
- (vii) 鑄造従事者を鑄造に関する全ての分野につき訓練する。また、教育の高い学生を技術訓練する。
- (viii) 教育ユニットと共同作業し、鑄造生産教育の質をチェックする。
- (ix) 鑄造技術発展に係る情報を集め、鑄造業者に提供する。
- (x) 鑄造が必要なSIRIMの他のセンターを援助する。

2.2 センターの活動

センターの活動は3つの部門に分けられる。「鑄型」部門、「溶解及び管理」部門、質をチェックしながら材料を分析する部門である。各々の部門の内容は組織チャート(図1)にある。

「鑄型」部門は“Sand Casting, Investment Casting” “Shell moulding” “Permanent moulding” の工程で使われる型を作ると共に調査活動を行なう。その他に我国の鑄造業者を鑄型作りと注入技術において訓練しながらアドバイスする。

「溶解及び管理」部門では「鑄型」部門で必要な金属溶解作業を行なう。この部門はセンターで製造する製品の「仕上げ」に責任を持つ。又、設備、主にセンターにある炉と鑄型設備の管理も行なう。

このセンターでなされる他の業務は材料(金属材料と鑄型を作る材料)の分析である。製品を調べ、質をチェックする。この部門の業務はセンター内の鑄造場、そして外部に対しても行なわれる。ある製品を調査しながら材料を分析するのに、この部門では科学調査ユニット、技術ユニット、更にはMITEC、MIRDCの協力を得る。

2.3 職員

図1はこのセンターの職員の状態を示している。下記はセンターが完全稼働した時に必要な職

員総数である。

地 位	人 数
センター長	1
調査員長	3
調 査 員	8
調査員補	5
技 師	11
研究室助手	1
設計担当	1
事 務 員	1
倉庫管理	1
速 記 者	1
タイピスト	2
オフィスボーイ	1
計	36

2.4 建 物

(i) 建物の敷地の提案

鑄造センターの建設用地としてシャーアラムのパハット通りSIRIMセンターの倉庫位置を提案する。図2はこの用地の広さ、状態と倉庫の建物を示している。

(ii) 建物の形状の提案

図3は建物の形状の提案図である。一階全体を鑄造場として使う。2階、3階(10m×23mの床)は事務室及び研究室になる。増築が必要だが、鑄造場の床・壁・ジェネレーターなど現在の建物の一部を使うことができる。増築が必要というのは現在の建物の広さが十分ではなく、高さが適していないからである。1平方フィートあたり150\$と計算すると建築費は300万\$である。

図4は鑄造センターの設備の配置と事務所の場所を示す。

2.5 設 備

センターで必要な設備のリストは表-1(1~4)に載せる。設備リスト準備にあたり下記の事柄が考慮された。

- 構造及び組立てユニット、MITEC、MIRDCにある機械、板金、熱処理の設備をセンター業務に使用する。
- 科学調査ユニット、技術調査ユニット、MITEC、MIRDCにある化学分析・材料調査用設備をセンター業務に使用する。

リストに従えば設備費総額は295万9千\$である。これは日本人専門家の見積りと同じく1981年の値段である。1年に10%の値上がりを想定すると1986年には50%上乗せすることになる。1985年の設備費は443万9千\$になる。

3. プロジェクトの完成

この鑄造技術センタープロジェクトは表2のように計画される。このセンターは1988年初めに完全稼動すると予想される。

表3、4はセンターの職員獲得計画を示す。この計画は表3に示すように訓練も含む。センターが完全稼動する時、36人の職員がいる。センター長1人、調査員11人、調査員補5人、技師11人、研究室助手1人、設計担当1人、事務室職員6人である。

4. プロジェクトの経費

このプロジェクトの経費は表5に示す。

4.1 建設費

この技術センターの建設費は総計750万\$である。下記は建設費の内訳である。

(i) 建物

1985年 — 以下の為に約100万M\$の予算が必要である。

- (a) 外観工事人件費
- (b) コンサルタント技師人件費
- (c) 古い建物撤去工事人件費
- (d) 基礎工事

1986年 — 建物の建築費の75%を支払うので約150万M\$の予算が必要である。

1987年 — 残りの建築費を支払うので約50万M\$の予算が必要である。

(ii) 設備

1985年 — 設備は必要ない。

1986年 — 溶鉱炉購入に130M\$必要である。

1987年 — 以下の設備購入に242万8千M\$必要である。

- | | |
|------------------------------------|------------------------|
| (a) moulding | (b) core making |
| (c) sand preparation | (d) permanent moulding |
| (e) air compressor with dehydrater | (f) sand test |
| (g) investment casting | (h) pattern shop |

1988年 — 以下の設備購入に71万1千M\$必要である。

- (a) 仕上げ
- (b) 化学分析

(c) 機器分析

(d) 物理テスト

4.2 管理費

1985～1988年の管理費総額は表5の通りである。

5. 結 論

鑄造技術センター建設を費用の面から見るとイポーで2000万M\$かかり、シャーアラムだと750万M\$だけである。シャーアラムにセンターを建てれば1250万M\$浮く。1、2で述べた事柄とこのことを鑑み、鑄造技術センターをセランゴール州シャーアラムに建設することをここに提案する。

6. 参 考 文 献

1. 鑄造センター計画案 1981年8月

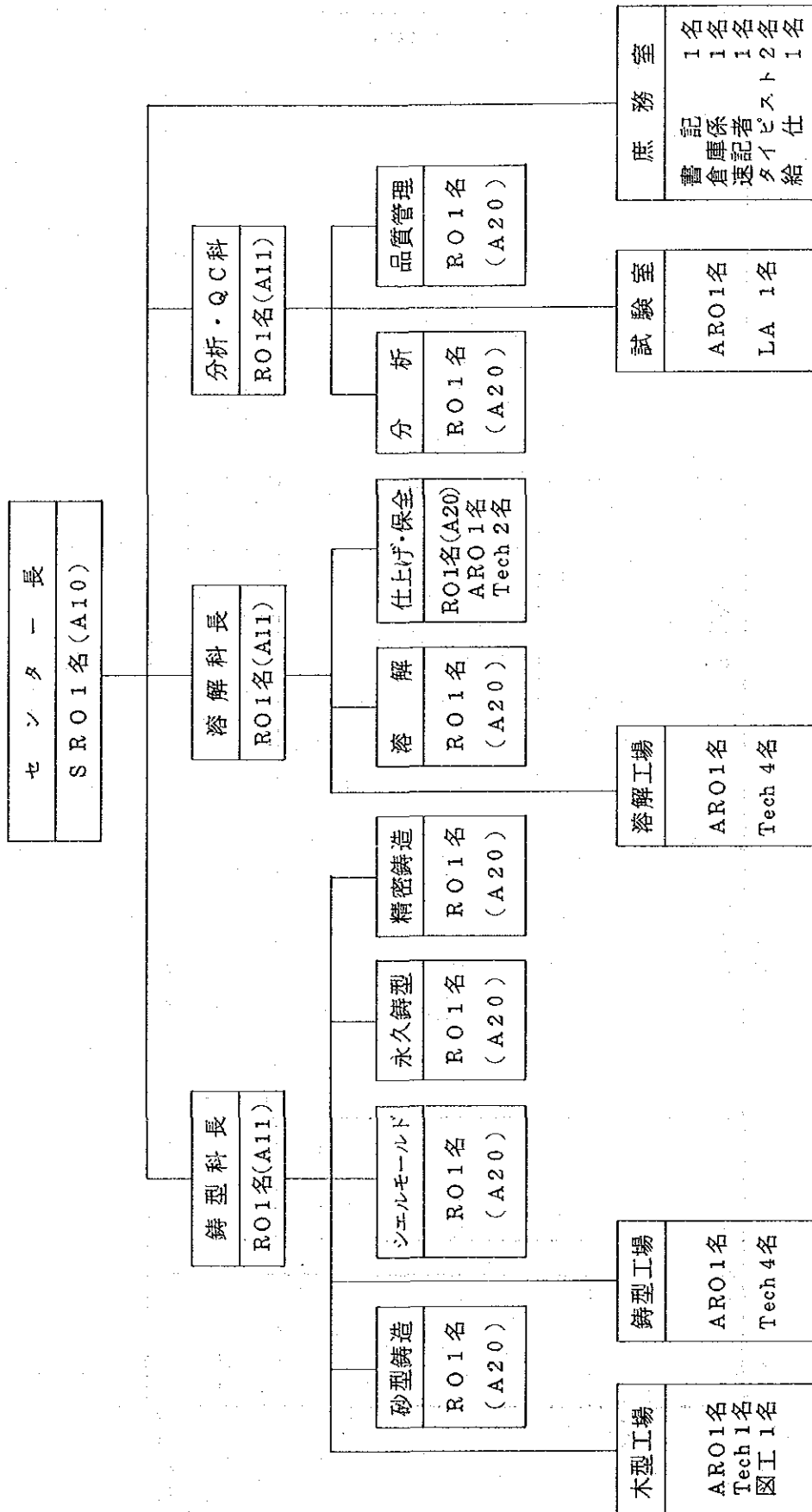
杉浦拓、市川博、佐藤光男 — JICAからSIRIMへの短期専門家

2. インドネシア・マレーシアにおける小中規模金属工業 1981年

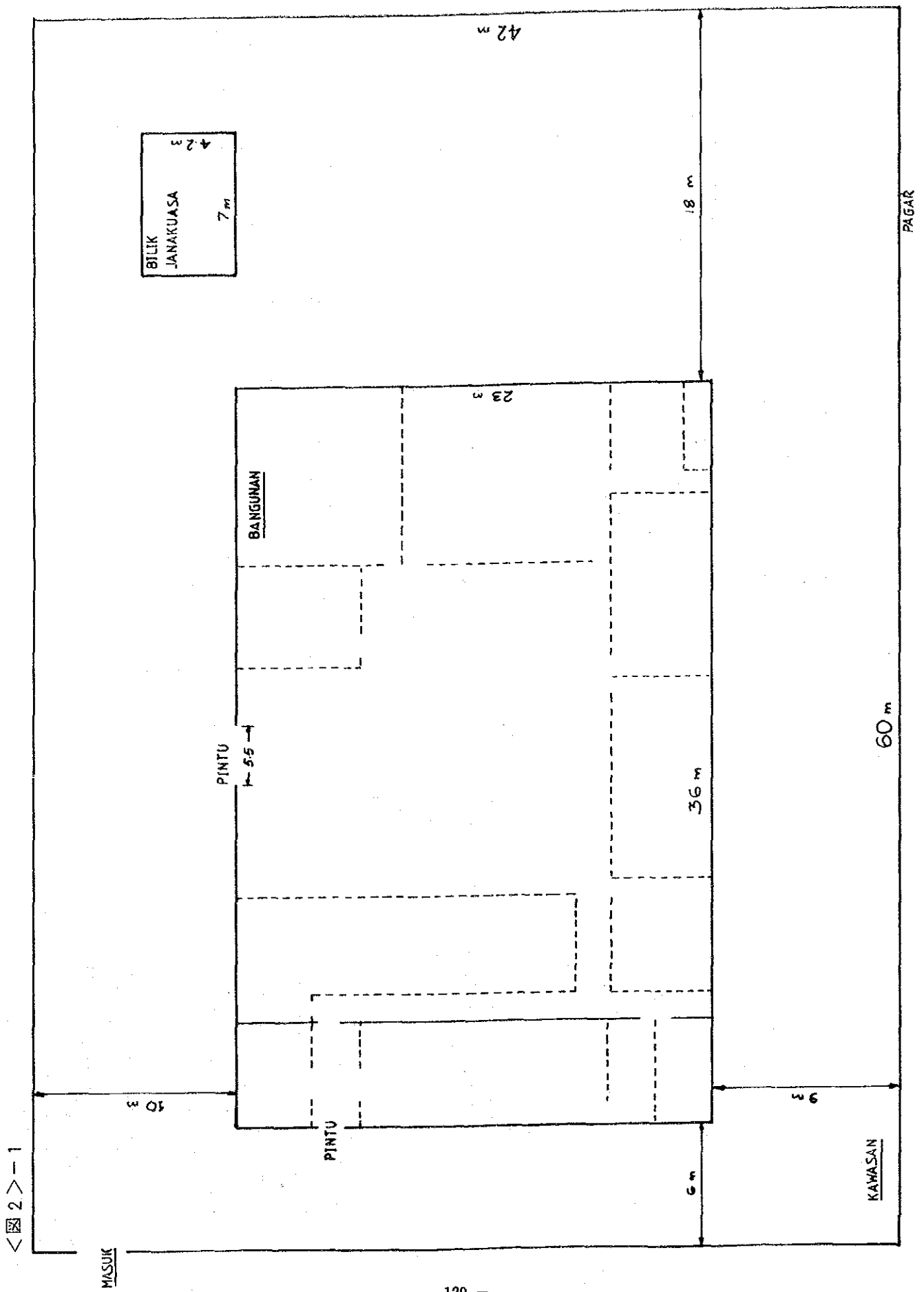
共同調査プロジェクト：TECHNONET ASIA/JICA/ インドネシアの通産省/マレーシアのMARA

3. JETRO プロジェクトの提案「マレーシア自動車工業の近代化」SIRIMへのJETRO 専門家による非公式レポート

＜図1＞ 鑄造技術センター組織図



SENIOR RESEARCH OFFICER [SRO] 1名
 RESEARCH OFFICER [R.O.] 11名
 ASSISTANT RESEARCH OFFICER [ARO] 5名
 TECHNICIAN [TECH] 11名
 LABORATORY ASSISTANT [LA] 1名
 DRAFTSMAN [図工] 1名

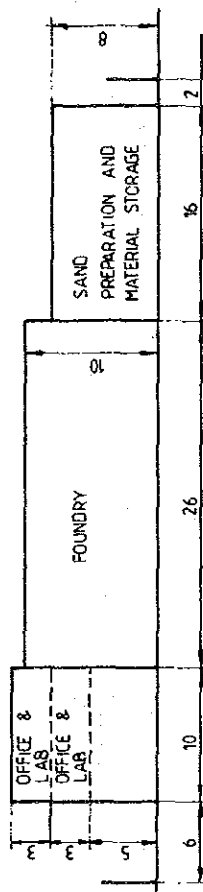


KAWASAN DAN BANGUNAN STOR PUSAT

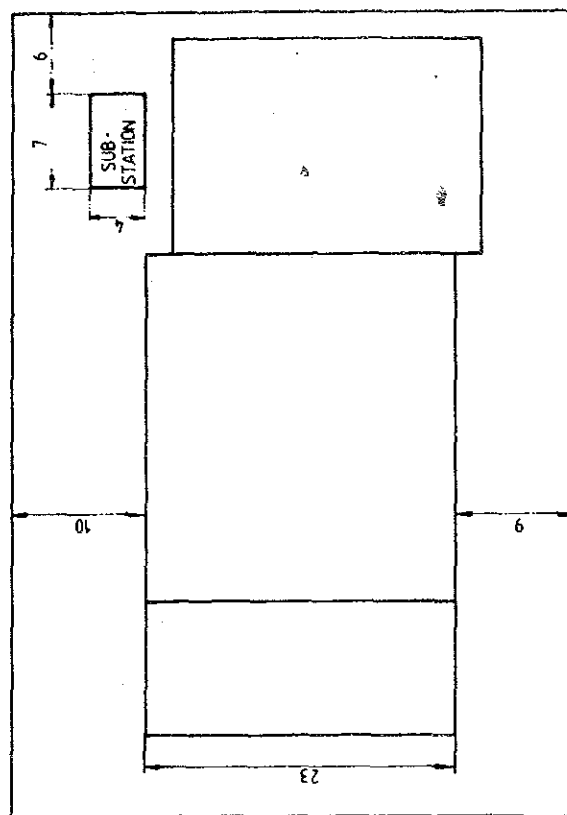


RAJAH 2

CADANGAN SCHEMATIC BENTUK
BANGUNAN PUSAT FOUNDRY



SIDE ELEVATION



PLAN

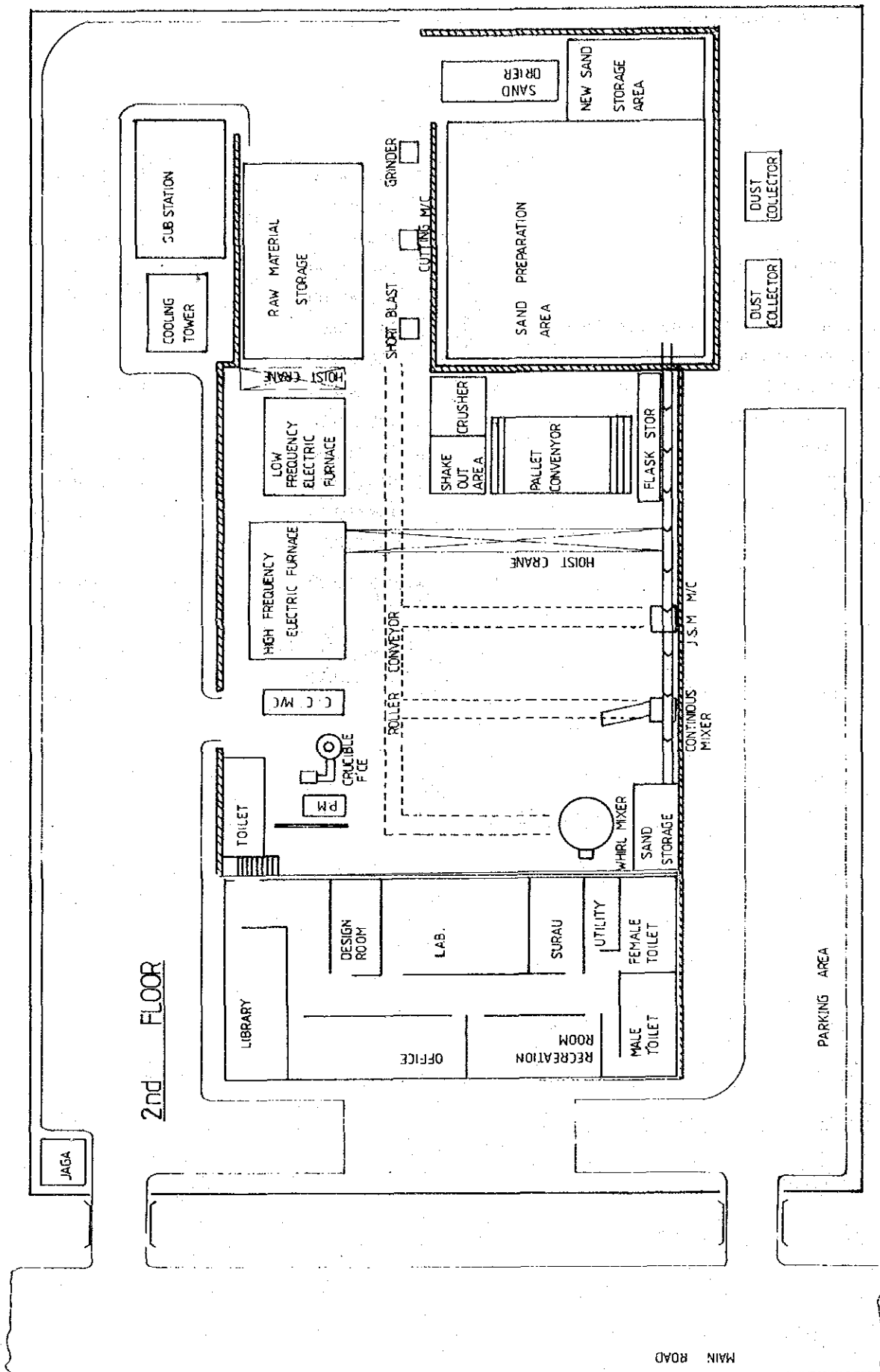


表 - 1 (1)

Equipment for Foundry Centre

1. Melting	\$ 839,000.00	\$1,258,500.00
2. Moulding	\$ 178,500.00	\$ 267,000.00
3. Core Making	\$ 120,000.00	\$ 180,000.00
4. Sand Preparation	\$ 390,000.00	\$ 585,500.00
5. Finishing	\$ 190,000.00	\$ 285,000.00
6. Metal Mould Die/Cast/Centrifugal Machine	\$ 110,000.00	\$ 165,000.00
7. Air Compressor with Dehydrater	\$ 30,000.00	\$ 45,000.00
8. Chemical Analysis	\$ 35,000.00	\$ 52,500.00
9. Instrumental Analysis	\$ 138,000.00	\$ 207,000.00
10. Physical Test	\$ 204,500.00	\$ 306,000.00
11. Sand Test	\$ 511,600.00	\$ 767,400.00
12. Precision Casting	\$ 157,600.00	\$ 236,400.00
13. Pattern Shop	\$ 54,700.00	\$ 82,100.00
	<u>\$2,958,900.00</u>	<u>\$4,438,500.00</u>

(1981年に日本人専門
家が見積った価格)(年10%の物価上昇をふ
まえた1986年の価格)

表 - 1 (2)

Equipment	Specification	Quantity	Price
1. Melting			
i) High Frequency Electric Furnace (with power unit)	100 kg/100 kW	1 set	200,000.00
ii) Ditto	20 kg/30 kW	1 set	104,000.00
iii) Low Frequency Electric Furnace (with power unit)	0.5 ton/150 kW	1 set	260,000.00
iv) Crucible furnace (gas fired)	80 kg/(for Cu)	1 set	60,000.00
(filtering type)	25 kg/(for Al)	1 set	
v) Cooling tower with pond	6 m ³ /Hour (for Electric furnace)	1 set	20,000.00
vi) Scale	100 kg/max 500 kg/max	2 set	
vii) Ladle	100 kg x 1P 200 kg x 1P	3 set	45,000.00
viii) Burner (gas fired)	500 kg x 1P	2 set	
ix) Lifting magnet	500 m ϕ , 1.5 kW	1	20,000.00
x) Overhead hoist crane	3 ton x 10 ^m span x 2	2 set	100,000.00
xi) Forklift car	1.5 ton	1	30,000.00
			839,000.00
2. Molding			
i) Joint squeeze moulding machine	Table size 450 x 520 (mm)	1	8,000.00
ii) Coil-Dump Type shell Moulding Machine	(with sticking machine) Mould size 600 x 500 x 160 (mm)	1	85,000.00
iii) Roller Conveyor	800 mm (width)	1 set	15,000.00
iv) Flask	700 x 700 x (25 + 250) x 5 sets	17 set	
	300 x 300 x (100 + 100) x 10 sets		30,000.00
	100 x 100 x 300/500 x 2 sets		
v) Pneumatic rammer		1 set	
vi) Monorail air hoist	0.3 ton	1 set	15,000.00
vii) Others (Rack, etc.)			25,000.00
			178,000.00
3. Core Making			
i) Core Blowing machine	size: 130(W) x 180(H) x 200(L) (mm)	1	20,000.00
ii) Shell core machine	size: 300 x 300 x (70 + 70) (mm)	1	80,000.00
iii) Continuous Core Dryer (gas fired)	500 x 300 x 3,000 2,000°C/max	1	20,000.00
			120,000.00

表-1(3)

Equipment	Specification	Quantity	Price
4. Sand Preparation			
i) Sand Mixer (with Bond Hopper and Batch Hopper)	120 kg/Batch, 3.7 kW (Roll type)	1 set	40,000.00
ii) Whirl Mixer	30 kg/Batch, 3.7 kW	1	20,000.00
iii) Continuous Mixer	3 ton/hour, 1.5 kW	1	50,000.00
iv) Sand Dryer (gas fired) with hopper and belt conveyor	1.5 ton/hour	1	40,000.00
v) Crusher	1.5 ton/hour, 1.5 kW	1	26,000.00
vi) Shakeout machine	1.5 x 1.0(m)/2 ton, 3.7 kW	1 set	21,500.00
vii) Belt Conveyor	0.75 kW	1 set	
viii) Belt Conveyor with scraper and chute	1.2 kW	1 set	
ix) Vibrating screen with belt feeder (for green sand)	5 ton/hour, 0.75 kW 1.2 kW	1 set	20,000.00
x) Bucket elevator	1.2 kW	1 set	6,000.00
xi) Service hopper with feeder	1.2 kW	1	15,000.00
xii) Aerator	0.75 kW	1	10,000.00
xiii) Sand storage with manual gate and skip hoist	1 m ³	1	8,000.00
xiv) Service hopper with belt feeder	1 m ³ , 1.2 kW	1 set	10,000.00
xv) Sand reclaimer with blower and dust collector	3.0 ton/hour, 22 kW	1 set	50,000.00
xvi) Rotary Breaker screen with belt feeder for self setting sand	3 ton/hour, 0.75 kW 1.2 kW	1 set	18,000.00
xvii) Sand Blender	1.5 kW	1	6,000.00
xviii) Others			50,000.00
			390,500.00
5. Finishing			
i) Cutting machine	high frequency	1	20,000.00
ii) Cutting machine	Ordinary ϕ 405 mm	1	10,000.00
iii) Grinder with dust collector		1	5,000.00
iv) Band sawing machine	0.75 kW (for non ferrous)	1	20,000.00
v) Shot Blasting Machine	Swing Table Type (1.5 M ϕ , 5.5 kW x 2)	1	75,000.00
vi) Sand Blasting Machine	Table size 500 mm	1	30,000.00
vii) Others			30,000.00
			190,000.00
6. Metal Mold Gravity Die Cast Machine	Die Plate Size 400 x 600 x 400 (mm)	1 set	60,000.00
Centrifugal Casting Machine	Vertical type (300 ϕ x 1000 ¹) Horizontal type (300 ϕ 500 ^h)	2 sets	50,000.00
			110,000.00

表 - 1 (4)

	Equipment	Specification	Quantity	Price
7.	Air Compressor with dehydrater	22 kW (3 NM ³ /min)	1 set	30,000.00
GRAND TOTAL FOR FOUNDRY SHOP				1,857,000.00
8.	Chemical Analysis			
	i) Scale		1	10,000.00
	ii) Electric crucible	20 ϕ 250 H 1200°C	1	5,000.00
	iii) Others			20,000.00
				35,000.00
9.	i) C, S analyser		1	138,000.00
10.	Physical Test			
	i) CE meter		1	29,000.00
	ii) Si meter		1	18,000.00
	iii) Optical Pyrometer		1	2,500.00
	iv) Immersion Pyrometer		1	2,500.00
	v) High Temp. Microhardness		1	150,000.00
	vi) Tester		1	2,500.00
	vii) Sump set		1	
				204,500.00
11.	Sand Test			
	i) Sand Mill		1	10,400.00
	ii) Universal Mixer		1	11,500.00
	iii) Sand rammer		1	2,000.00
	iv) Sieving apparatus		1	10,400.00
	v) Sand washer		1	2,900.00
	vi) Permeability tester		1	3,200.00
	vii) Sand strength tester		1	11,000.00
	viii) Moisture tester		1	2,900.00
	ix) Hardness tester (green sand)		1	500.00
	x) Hardness tester (dry sand)		1	1,100.00
	xi) Active clay tester		1	7,500.00
	xii) Moldability tester		1	6,400.00
	xiii) Specific surface tester		1	11,500.00
	xiv) Heat expose tester		1	23,000.00
	xv) Gas pressure meter		1	42,200.00
	xvi) Heat expansion tester		1	38,700.00
	xvii) Heat conductivity tester		1	87,400.00
	xviii) Compactability tester		1	26,500.00
	xix) Sand strength tester (high temperature)		1	42,000.00
	xx) Differential thermal analysis		1	47,400.00
	xxi) Muffle furnace		1	86,300.00

表 - 1 (4)

Equipment	Specification	Quantity	Price
xxii) Tomman furnace		1	36,800.00
			511,600.00
12. Precision Casting			
i) Injection machine		1	57,500.00
ii) Slurry tank		2	17,300.00
iii) Fluidised bed		2	13,800.00
iv) Dewaxing device		1	69,000.00
			157,600.00
13. Pattern Shop			
i) Electric hand-planner		1	800.00
ii) Electric hand-planner (for curve)		1	700.00
iii) Electric circular saw		1	600.00
iv) Electric jig saw		1	600.00
v) Electric trimmer		1	500.00
vi) Electric handy router		1	800.00
vii) Universal wood working machine		1	11,500.00
viii) Band Dewing machine		1	11,200.00
ix) Portable drill		1	500.00
x) Finishing sander		1	300.00
xi) Bench drill		1	1,900.00
xii) Wood working lathe		1	7,000.00
xiii) Cutter lapping machine		1	6,300.00
xiv) Manual cutting tools		1	6,600.00
xv) Measuring tools		1	5,400.00
			54,700.00

＜表 2＞ マレーシア鑄造技術センター設立年次計画

事 項	1985	1986	1987
	3 6 9 12	3 6 9 12	3 6 9 12
1. 初期計画	→		
2. 建物建築工事			
2.1 — 基礎測量と設計作業			
— 設計と精査			
— 構造及び一般設計	→		
2.2 契 約（書類整備、選択、決定を含む）	→		
2.3 古い建物の取り壊し	→		
2.4 建 築		→	
3. 設備の購入			
3.1 明細書の準備、選択、発注		→	
3.2 設置と調整			→
3.3 試験運転			→

＜表 3＞ 技術職員の採用と研修計画

職 種	1985	1986	1987	1988	1989
1. 採 用					
センター長	1				
研 究 官（RO）	2	2	3	3	1
研 究 官 補（ARO）		2	2	1	
テクニシャン（TEC）		4	2	2	3
製 図 工（DRA）		1			
実験助手（LA）			1		
2. 研 修					
砂 鑄 造		2RO, 1ARO, 2TEC	→		
シエルモールド		1RO, 1ARO, 1TEC	→		
精密鑄造		1RO, 1TEC	→		
永久／遠心鑄造			1RO	→	
木型製作		1ARO, 1DRA	→		
溶解とメンテナンス		2RO, 1ARO, 1TEC	→		
材料分析			2RO, 1ARO, 1LA	→	
機械加工と仕上げ					1RO, 2TEC
品質管理					1RO

<表 4> マレーシア鑄造技術センター職員採用計画

職 種	職 員 数				
	1985	1986	1987	1988	1989
センター長 (Senior Research Officer)	1	1	1	1	1
科 長 (Research Officer)	1	1	2	2	3
研 究 官 (" ")	1	3	5	8	8
研 究 官 補 (Assistant Research Officer)	—	2	4	5	5
テクニシャン (Technician)	—	4	6	8	11
実 験 助 手 (Laboratory Assistant)	—	—	1	1	1
製 図 工 (Draftsman)	—	1	1	1	1
書 記 (Secretary)	1	1	1	1	1
速 記 者 (Stenographer)	—	1	1	1	1
タイピスト (Typist)	1	1	1	2	2
倉 庫 係 (Storekeeper)	—	—	1	1	1
給 仕 (Office boy)	—	—	1	1	1
計	5	15	25	32	36

<表 5> 建設費と管理費計画

項 目		プロジェクト 費用総額	年 次 別 予 算 (M\$)×60円					合 計
			1985	1986	1987	1988	1989	
建 設 費	建 築		1,000,000	1,500,000	500,000			3,000,000
	設 備			1,300,000	2,428,000	711,000		4,439,000
	投 資							
	土 地							
費	そ の 他							
	(総 額)		1,000,000	2,800,000	2,928,000	711,000		7,439,000
管 理 費	給料・人件費		102,030	195,005	315,285	401,465	478,655	1,492,440
	交 通 費		12,500	15,000	20,000	22,000	24,000	93,500
	光 熱 費(水・電気など)		4,000	6,000	10,000	11,000	12,000	43,000
	訓 練		—	140,000	560,000	560,000	420,000	1,680,000
	ストックと材料		30,000	50,000	100,000	110,000	121,000	411,000
	管 理 と 純 益		—	—	—	—	—	—
	会 計 業 務		1,600	3,800	5,800	6,400	6,400	24,000
	そ の 他		—	—	—	—	—	—
(総 額)			150,130	409,805	1,011,085	1,110,865	1,062,055	3,743,940

< 資 料 Ⅷ >

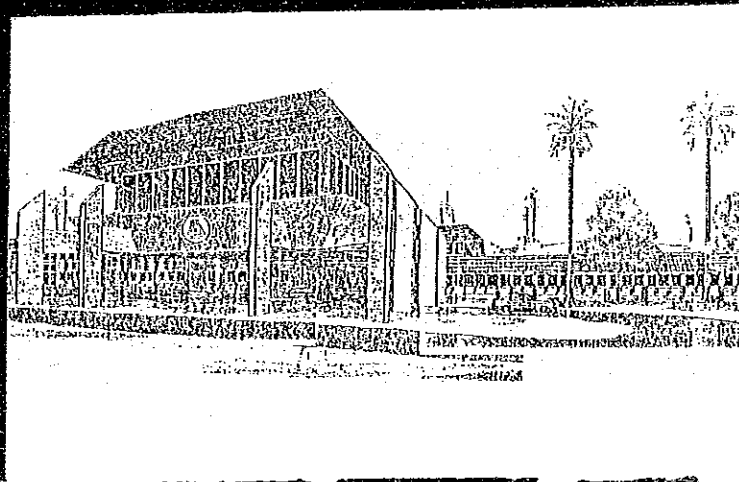
鑄造技術センター設立計画

(1 9 8 6 年 1 2 月 : S I R I M 案)



FOUNDRY TECHNOLOGY CENTRE

INTRODUCTORY

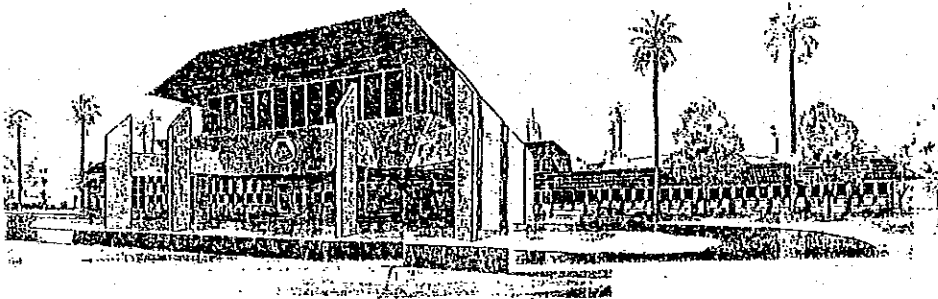


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DECEMBER 1986

INTRODUCTORY



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FOUNDRY TECHNOLOGY CENTRE

INTRODUCTORY

1.0 OVERVIEW

Foundry Technology Centre is one of the three components of the Metal Industry Development Centre (MIDEC) in SIRIM. In so far only two of these centres have been established; MITEC-1981 and MIRDC-1984. Following government approval for the implementation of Foundry Technology Centre in 1981, three JICA experts were appointed in July 1981 to formulate proposal for setting up the Centre. Based on the expert recommendations a local consultant was engaged to design the complex of the Centre on a site in Ipoh, Perak. Complete building plans were submitted in 1984. However, due to budget constraint, construction of the Centre was delayed.

It was estimated in 1981 proposal that the total cost of the Centre to be M\$15 million. A revised allocation of M\$18 million has been approved under the Fifth Malaysia Plan.

1.1 Why should Foundry Technology Centre EXIST?

The interaction of Foundry Technology Centre with respect to the Industrial Structure is depicted in fig. 1

The industrial structure consists of FIVE sectors.

The manufacturing sector consists of the components manufacturers, sub-assemblers and the major assemblers. The main role of this sector is to manufacture component parts which are then sub-assembled and fully assembled as finished products and distributed to public and private consumers both for domestic and export purposes.

The supportive sector with its designers, tool-makers and equipment manufacturers consists of highly skilled technocrats. This sector forms the core of an industrialization movement. These are the people who design and develop new products and machinery for the manufacturing and supportive sectors.

In short, ideas and concepts put forward by designers are translated into reality by the toolmakers and equipment manufacturers.

Hi-tech and capital intensiveness characterise the intermediate sector with its large-scale foundries and forges. The machine manufacturers in the supportive sector require the finished cast and forged items to produce the necessary equipment and machineries for the manufacturing sector.

Modern sophisticated furnaces, laboratory and testing facilities are needed in this sector. As such heavy investment is required to obtain quality equipment and machinery for the supportive and manufacturing sectors respectively.

The primary sector with its rolling mills, steel conversion plants and alloy refiners provides semi-finished raw materials for the intermediate, supportive and manufacturing sector. These "raw materials" are obtained after undergoing various processes from the resource sector.

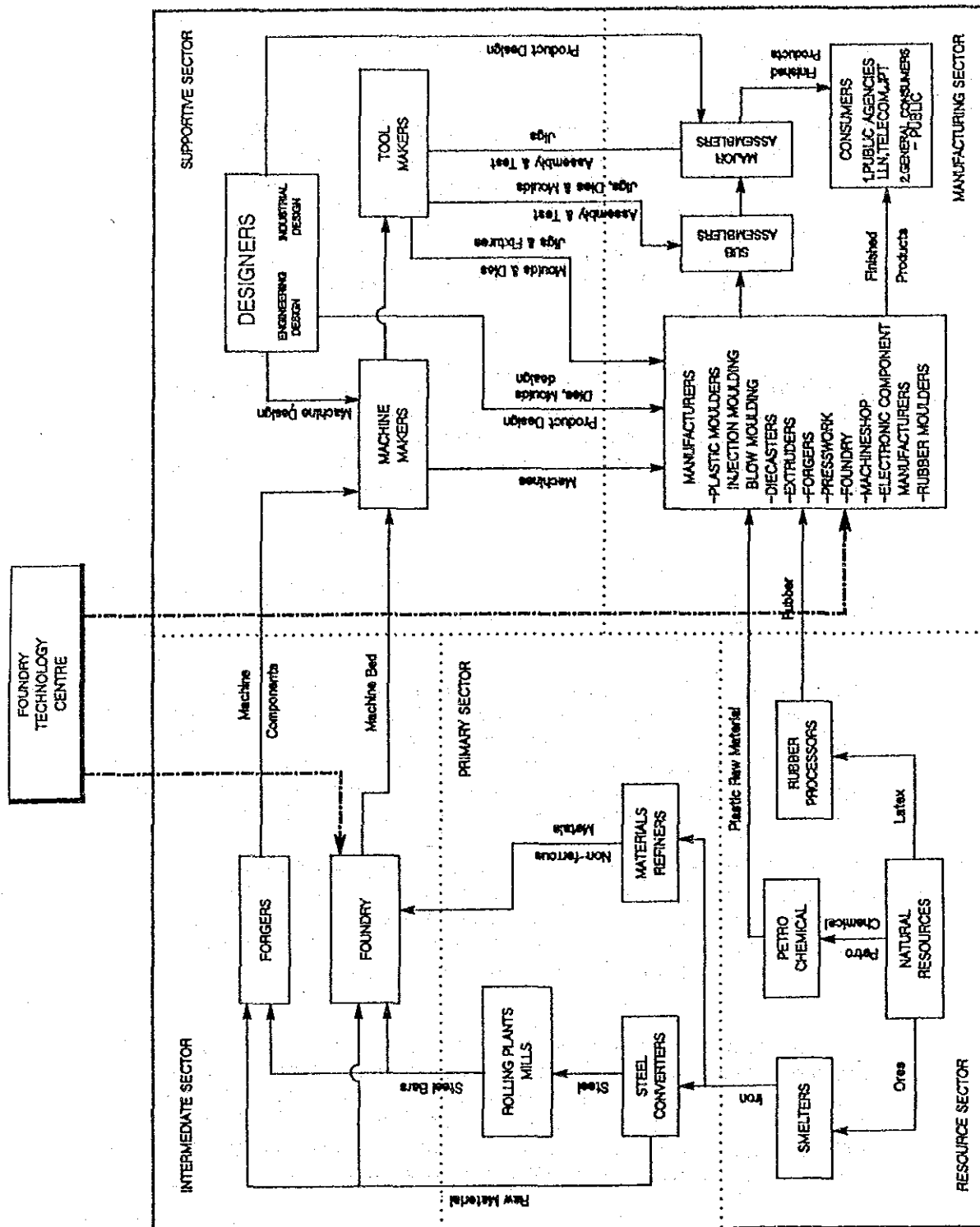


FIG.1 - THE ROLE OF FOUNDRY TECHNOLOGY CENTRE IN THE INDUSTRIAL STRUCTURE

Resource sector translates the natural resources such as iron-ore into basic raw materials, such as pig iron, wrought iron etc, for further consumption of the other sectors.

The industrial structure identifies two levels of foundry industries. One which lies in the manufacturing sector supplying small castings required by the sub-assemblers and major assemblers, whereas bigger foundries in the intermediate sector supply larger castings, such as machine bed, to machine maker of the supportive sector.

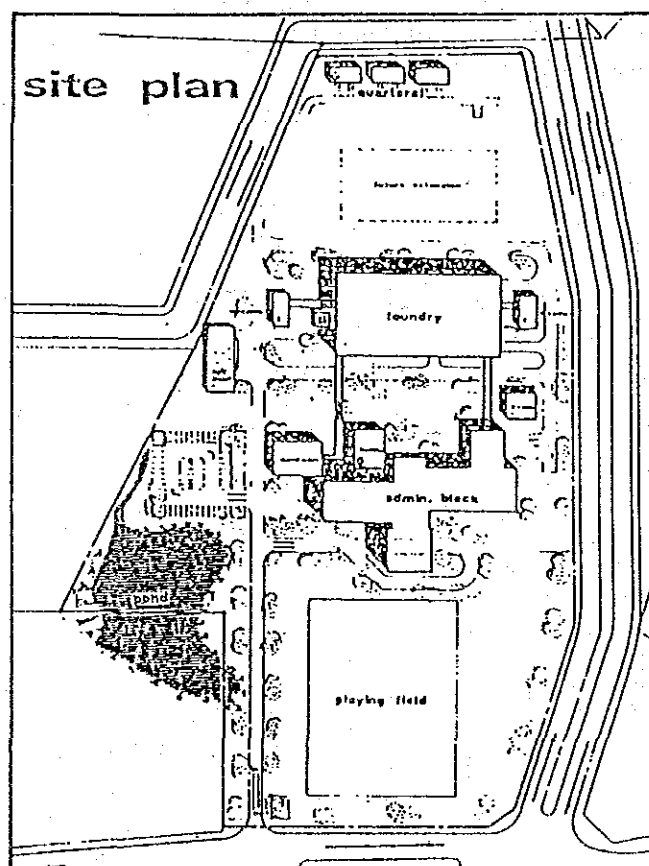
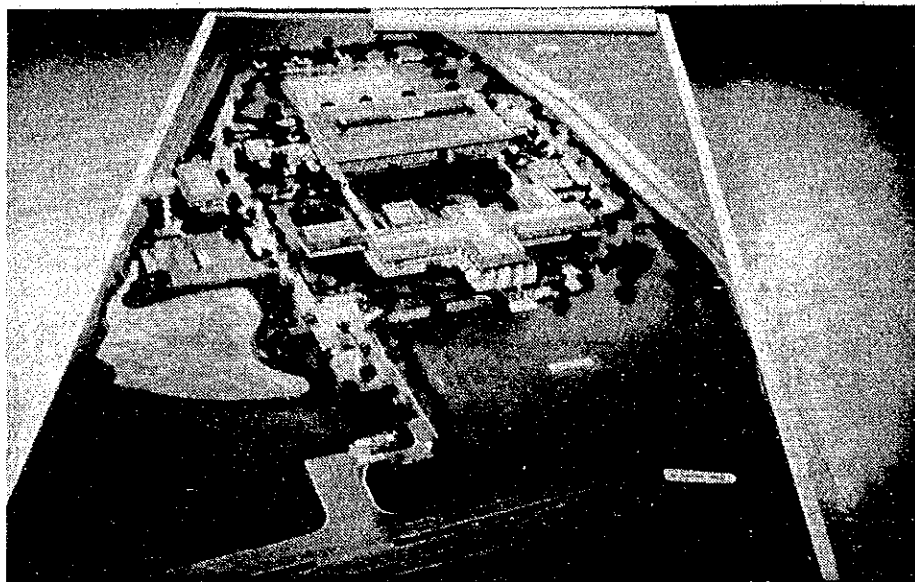
The existing local foundries exclusively belong to the manufacturing sector while bigger foundries needed in the intermediate sector are virtually non-existent.

The vital contribution of the foundries in the intermediate sector will form the backbone of the industrialisation of this country.

The need for upgrading the technological competency of the local foundries to the level expected in the intermediate sector calls for the establishment of the Foundry Technology Centre.

2.0 THE PROPOSED FOUNDRY TECHNOLOGY CENTRE

2.1 Figure 2 and 3 show the model and the site plan of the proposed centre respectively.



2.2 What is our MISSION?

TO BE THE PRIME MOVER IN THE
TECHNOLOGICAL DEVELOPMENT OF
THE MALAYSIAN FOUNDRY INDUSTRY.

2.3 What is our OBJECTIVE?

To provide a continuous support for the technological development of Malaysian foundry industry through the following programmes:

RESEARCH

1. To undertake research activities in relation to the utilization of industrial by-products and the locally available materials with the view of upgrading indigenous foundry technology, improving product quality and reducing the production cost of the local foundries.

DEVELOPMENT

2. To carry out development programmes in order to expand the market horizon of the local foundries through product diversification while complying the need for localization and import substitute.

3. To pursue a technological development activities so as to acquire the capabilities of producing heavy and sophisticated castings by the process of absorption, adaptation and improvement.

SERVICE

4. To render consultancy and advisory services and to offer facilities in the pursuit of upgrading the quality of castings manufactured by the local foundrymen.
5. To support programmes formulated by the Technology Transfer Centre (technical, consultancy, advisory services) in their endeavour to encourage Bumiputra participation in foundry industry.
6. To disseminate information related to foundry activities through programmes of seminars, workshops, training and dialogues with the view of upgrading foundry technology.
7. To assist the Standards Division of SIRIM in formulating Malaysian Standards for the raw materials and cast products produced by local foundries.

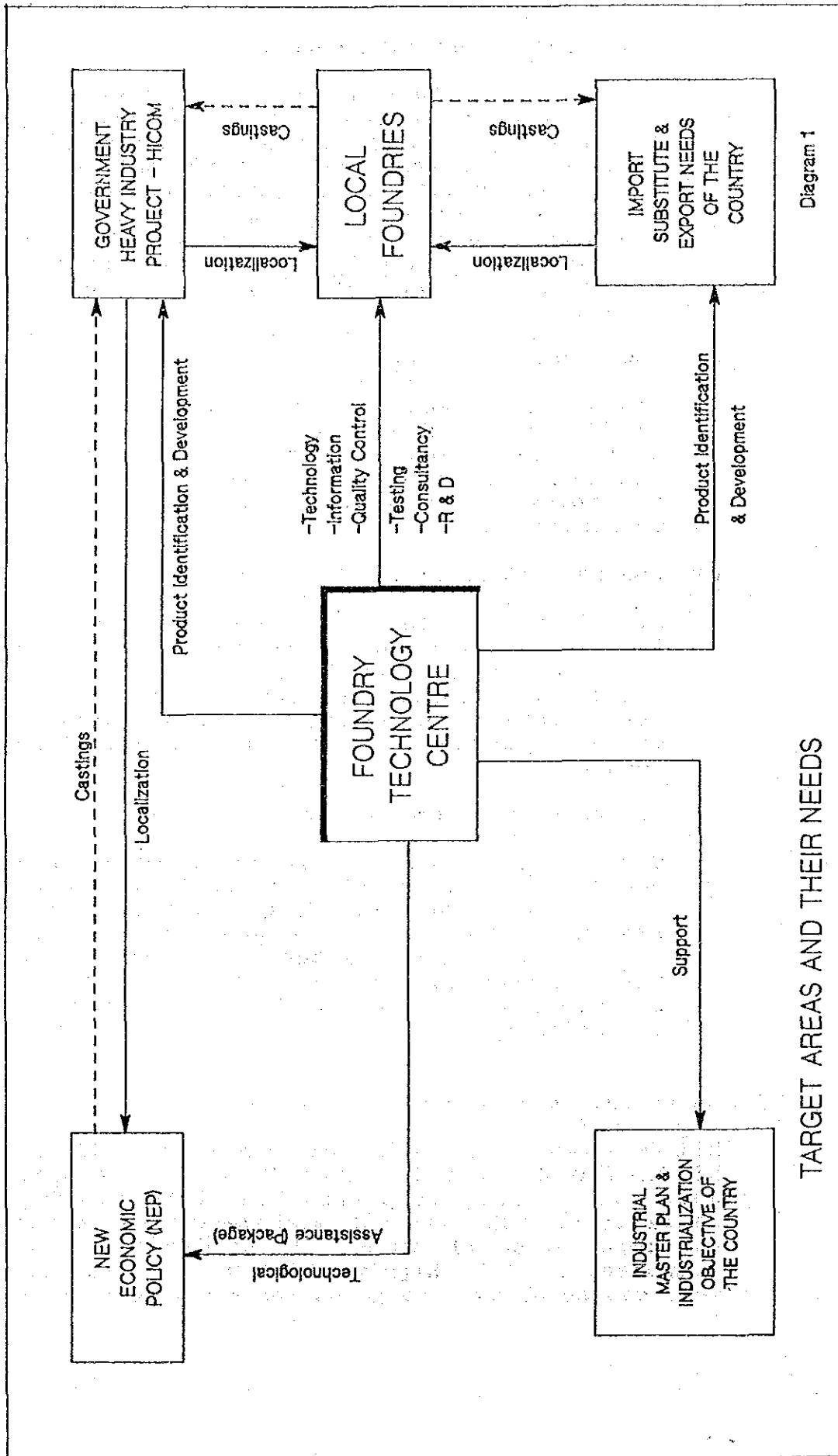
3.0 OPERATIONAL STRATEGIES

3.1 What is our TARGET AREAS & THEIR NEEDS

In understanding the role of Foundry Technology Centre complete analysis of the present needs of the various target areas is essential. Diagram I presents a clearer picture of the linkages of five identified target areas and outlines their needs.

3.1.1 The local Foundries

Survey on the existing local foundries has unveiled a number of problems faced by the foundrymen among which need immediate remedial attentions:-



a) **Small and competitive market**

Inherent attitude to rely on components required by resource-based industries (tin, rubber and palm oil) for their manufacturing activities has resulted in stiff competition among foundry operators. Lately shrinkage in tin mining activity has led to a complete shutdown of a number of foundries. The need for market expansion through product diversification activity is therefore crucial.

b) **Low Level Technology**

Low level of technology in many of foundries limits local foundrymen to produce only simple components and mostly 'jobbing' in nature. Exposure to newer production technology can help to increase the level of mechanization.

c) **Low Product Quality**

Lacking in knowledge, expertise and facilities among local foundrymen resulted in low quality product being produced. This means the products are less competitive in local market let alone for export market. Quality upgrading assistance is therefore needed.

d) **Rising Cost of Production**

Continuous rising cost of imported raw materials for production of castings such as coke, liquid fuel, moulding resins to name a few will increase the production cost. Research into local materials to substitute the imported ones may help to cut down the production cost of local foundries tremendously.

3.1.2 **Heavy Industry Projects**

HICOM downstream projects includes PROTON, HICOM-YAMAHA and HICOM-HONDA will require numerous casting components in their assembly operations. The present arrangement calls for the importation of almost all of these casting components. This highly unfavourable situation must not be allowed to go on forever, and as such

the need to localize these components is of undisputable urgency.

Sponge iron, a by-product of upstream HICOM project; PERWAJA, is found to be unfavourable for use by the local foundrymen as their input raw material. Complaints such as unsuitability to be melted on local foundries furnaces is one which need attention. Research in the utilisation of this by-product may help both local foundrymen as well as PERWAJA itself.

3.1.3 Import Substitute and export

Continuous importation of manufactured products leads to tremendous loss of the country's valuable foreign exchange. An annual importation of casting components alone is estimated to be \$3 billion¹ worth. Therefore identification and development of these products for local manufacturing as import substitutes will be beneficial to our country. Assistance to overcome the technological problems coupled with the introduction of these products will help the local foundrymen to supply the local casting demand.

3.1.4 The New Economic Policy

The New Economic Policy (NEP) outlined by the Government calls for a substantial involvement of the Bumiputra in the machineries and engineering sector. To date, the Bumiputra involvement in the foundry sector has been limited to the brassware industry in the East Coast. This very minimal participation of the Bumiputra demands a concerted and major efforts from the Government agencies to rectify this problem.

3.1.5 The Medium and Long Term Industrial Master Plan (IMP)

The ultimate goal of our industrialization programme is to achieve a state of independence as an industrialized nation. In this pursuit, foundry industry will be the backbone to support various sectors as addressed in the IMP; particularly the machinery and engineering industry.

In this context, the foundry industry is in need of an assistance for the development of capability to produce sophisticated and heavy components (e.g. machine bed) as required by the machinery and engineering sector.

The IMP also stressed the importance of both the ferrous and non-ferrous metal industry. This calls for an extensive research to exploit the potential use of these metals in foundry practices.

3.2 SUMMARY OF THE NEEDS

Table 1 below summarises the present needs of various identified target areas:

TARGET AREAS	NEEDS
1. Local foundries	<ul style="list-style-type: none"> - market expansion - upgrading of technology - upgrading product quality - reducing cost of production
2. Heavy industry	<ul style="list-style-type: none"> - localizing heavy industries casting components - utilization of heavy industries by-product
3. Import substitute and export	<ul style="list-style-type: none"> - localization of imported casting products - exploration of export potential of casting product
4. New Economic Policy (NEP)	<ul style="list-style-type: none"> - increase Bumiputra participation in foundry industry
5. Industrial Master Plan (IMP)	<ul style="list-style-type: none"> - development of sophisticated and heavy components required by machinery and engineering sector - utilization of ferrous and non-ferrous materials

Table 1

3.3 Analysis of Needs

Table 2 briefly outlines the steps to be taken to satisfy the needs of all the target areas. Conclusively three major roles are identified for the Foundry Technology Centre; research, development and service.

3.4 What are our operational strategies?

With reference to table 2, the strategies that will be taken in meeting the objectives of the Centre can be analysed.

3.4.1 Research

To address the research needs the Centre will identify the by-products of our local industries (particularly that of heavy industry sector) and the local materials (e.g. sands, clay, limestone) that may be useful for foundry processes. In-house research will then be carried out in order to explore the potential usage of these materials by our local foundrymen.

3.4.2 Development

Table 2 identifies two major developmental role for the Foundry Technology Centre to play.

- i) To expand the market horizon of our foundry industry

To complement this role, the Foundry Technology Centre will identify the products that are produced by casting techniques. There are four main areas where casting products may be identified :-

- a) Those cast products that need to be localized (which at present are imported) such as products that are

ANALYSIS OF NEEDS

IDENTIFIED NEEDS

OPERATIONAL STEPS TO SATISFY NEEDS

ROLE

-market expansion	PRODUCT IDENTIFICATION	IN-HOUSE DEVELOPMENT	TRANSFER	DEVELOPMENT
-localization of heavy industries castings	PRODUCT IDENTIFICATION	IN-HOUSE DEVELOPMENT	TRANSFER	DEVELOPMENT
-localization of imported casting products	PRODUCT IDENTIFICATION	IN-HOUSE DEVELOPMENT	TRANSFER	DEVELOPMENT
-exploration or export potential of cast products	PRODUCT IDENTIFICATION	IN-HOUSE DEVELOPMENT	TRANSFER	DEVELOPMENT
-utilization of ferrous and non ferrous materials	PRODUCT IDENTIFICATION	IN-HOUSE DEVELOPMENT	TRANSFER	DEVELOPMENT
-technological upgrading	TECHNOLOGY IDENTIFICATION	TECHNOLOGY ABSORPTION	TECHNOLOGY ADAPTATION	TRANSFER
-sophisticated & heavy casting	HEAVY PRODUCT IDENTIFICATION	TECHNOLOGY DEVELOPMENT	PROTOTYPE DEVELOPMENT	TRANSFER
-production cost reduction	IDENTIFICATION OF PROBLEM AREAS	IN-HOUSE RESEARCH	TRANSFER	RESEARCH
-by-product utilization	IDENTIFICATION OF INDUSTRIAL BY-PRODUCT	IN-HOUSE RESEARCH	TRANSFER	RESEARCH
-product quality upgrading	FACILITIES IDENTIFICATION & COMPENSATION	KNOWLEDGE AND EXPERTISE DEVELOPMENT	CONSULTANCY ADVISORY TRAINING	SERVICES
-Bumiputera participation	PACKAGE DEVELOPMENT OF BUMIPUTRA THROUGH FORMULATED PROGRAMME	CONTINUOUS TECHNICAL CONSULTANCY, ADVISORY & TRAINING		SERVICES

TABLE 2

required by heavy industries like PROTON, HONDA-HICOM, HONDA-YAMAHA etc.

- b) Cast products that are still being imported for the development of areas such as telecommunications, electrical power supply (NEB), palm oil mills etc. which are in line with the import substitution objective of the Government.
- c) Cast products that may be produced for export such as rubber machineries and wood working machineries which to some extent have already been in the export market. This area will need further development.
- d) Those products that are needed by the general public, tourism, souvenirs etc. In general these products are made of non-ferrous metal. Research in the utilization of non-ferrous alloy as called upon by the IMP can be targetted at encouraging local industry to produce these products.

The Foundry Technology Centre will continuously identify the above four categories of products and to carry out in-house development work accordingly. The results will then be disseminated to our local foundries with the hope of opening their market areas for the production of components.

- ii) To develop technical capabilities to produce sophisticated and heavy casting

One of the sectors that need for development as addressed by the IMP is the machinery and engineering sector. In the development of this sector, it is inevitable that sophisticated and heavy casting is needed. In order for the foundry industry to be able to produce castings of such sizes and with good quality, they must be equipped with sufficient capability and expertise. In

this respect the Foundry Technology sees its major role as technological innovator in developing such capabilities. Products and technology will be continuously identified by the Centre with in-house development work through absorption, adaptation and improvement. This will then be transferred to the local Foundrymen.

3.4.3 Services

The urgent need to upgrade the quality of casting products of the local foundries must be 'urgently' addressed by the Centre. It is vital for the Centre to identify facilities that are already available locally. These facilities that will promote the production of better castings should be geared for maximum use by the local foundries and the Centre intends to take the lead towards achieving this objective. Whenever facilities that are needed are not available, it is the duty of the Centre to provide them.

The Centre will also be leading the local foundries in accumulating and enhancing knowledge and expertise in order to tackle the technological problems in upgrading the quality of castings. It is the responsibility of the Centre to carry out a thorough analysis and to seek solutions to their problems. In this respect, the Centre will provide consultancy and advisory services to the local foundrymen.

A carefully formulated programme to increase the Bumiputra participation in the foundry industry will have to be carried out by the Centre. Realising the minimal amount of participation at present, the Centre will conduct a package development programme to encourage greater participation from Bumiputra. This will involve consultancy and advisory services besides carrying out training programmes to supplement the available trainings provided by other institutions. A continuous technical support will be given by the Centre to

sustain their participations in this industry.

The Centre will also be carrying out programmes of seminars, workshops, training and dialogues for the local foundrymen. Through these programmes, the Centre believes that it will be able to expose the foundrymen to the latest foundry techniques and processes.

The operational strategies laid out by the Centre will be of great benefit to the Malaysian foundries. With these strategies the Centre will be able to serve this country and successfully carried out the mission of being the prime mover in the technological development of the Malaysian foundry industry.

4.0 THE IMPLEMENTATION PROGRAMME

In the light of the objectives set out earlier two proposals for the setting up of the Centre have been prepared. Proposal I calls for the implementation to be completed within the lifetime of the Fifth Malaysia Plan. Taking into consideration the present worsening economic situation, a second proposal has also been prepared. The time frame for the completion of the project has been increased to ten years. The schedules of the implementation programme based on the two proposals are attached as Appendix I.

5.0 CONCLUSION

In view of the present economic situation the proposed Centre may be further delayed in its establishment. This may jeopardise the assistance badly needed by the foundry industry. The Foundry Technology Centre is of the opinion that financial or equipment aids with technical collaboration will be of tremendous benefit in gearing the development of the Centre. This will enable the Centre to play a major role in the development of the Malaysian foundry industry.

APPENDIX I
IMPLEMENTATION PROGRAMME
PROPOSAL I

	1987	1988	1989	1990
	CODE J F H A V J A S C R D	CODE J F H A V J A S C R D	CODE J F H A V J A S C R D	CODE J F H A V J A S C R D
BUILDING CONSTRUCTION				
PHASE I	XXXXXXXXXXXX			
-HEAD OFFICE & LABORATORIES				
-PATTERN MAKING & MACHINE SHOP				
-SHOP				
-CANTINE				
-QUARTERS				
-COMPRESSOR HOUSE				
-CAMPS HOUSE				
-COVERED WAYS				
-EXTRAS				
PHASE II		XXXXXXX		
-FINANCPY				
-TOILET BLOCKS				
-X-RAY HOUSE				
-COVERED WAYS				
-EXTRAS				
EQUIPMENT PURCHASING				
PHASE I				
-PATTERN MAKING SHOP.....	A	SSdTTTAA8B800		
-SAND TEST FACILITIES.....	B	SSdTTTAA8B800		
-INVESTMENT/SHELL MOLDING.....	B	SSdTTTAA8B800		
-MACHINE SHOP.....	C	SSdTTTAA8B800		
-MELT/COMPOSITION ANALYSIS.....	D	SSdTTTAA8B800		
LAB				
-METALLOGRAPHIC LAB.....	D	SSdTTTAA8B800		
-AUXILIARY I		DC00000		
PHASE II				
-SAND PREPARATION PLANT.....	E	SSdTTTAA8B800		
-GREEN SAND MOLDING LINE.....	E	SSdTTTAA8B800		
-CORE MAKING FACILITIES.....	F	SSdTTTAA8B800		
-CO2/CEMENT MOLDING LINE.....	F	SSdTTTAA8B800		
-INDUCTION FURNACE.....	G	SSdTTTAA8B800		
-ARC FURNACE.....	G	SSdTTTAA8B800		
-CRUCIBLE.....	H	SSdTTTAA8B800		
-GAS FIRED FURNACE.....	H	SSdTTTAA8B800		
-CLEANING SHOP.....	C	SSdTTTAA8B800		
-HEAT TREATMENT SHOP.....	C	SSdTTTAA8B800		
-QUALITY CONTROL LAB.....	I	SSdTTTAA8B800		
-CENTRIFUGAL/PERMANENT MOLD.....	K	SSdTTTAA8B800		
-ROTARY FURNACE.....	H	SSdTTTAA8B800		
-AUXILIARY II		SSdTTTAA8B800		

KEY

S - SPECIFICATION
J - TENDER DOCUMENT PREPARATION

R - TENDER BOARD
D - DELIVERY
O - ORDER PLACEMENT

(ID)	FUNCTION	ROLE	YEAR OF ENTRY					QUALIFICATION	TRAINING PLAN (MONTHS)				
			1987	1988	1989	1990	1991		1992				
1	PATTERN MATERIAL DEVELOPMENT	Development of the pattern material and design				H		POLYMER SCIENCE / CHEMISTRY					111111
2	PATTERN MAKING	Setting up of the pattern making shop and its operation	A					MECH. / PROD. ENGINEERING	100X		100X		
3	SAND PREPARATION PLANT (GREEN SAND MOLDING LINE)	Setting up and overhauling the sand preparation plant and the green sand molding line		E				MECH. / PROD. ENGINEERING	100X	111111			
4	CORE MAKING & CO2 PROCESS	Setting up and operation of the core making CO2 process shops		F				MECH. / PROD. ENGINEERING	100X	111111			
5	SAND TEST FACILITIES	Setting up and operation of the sand testing facilities	B					POLYMER SCIENCE / CHEMISTRY	100X	111111			
6	INVESTMENT CASTING/ SHELL MOLDING	Operation of the investment casting and shell moulding section			J			MECH. / PROD. ENGINEERING	100X		111111		
7	CENTRIFUGAL CASTING/ PERMANENT MOLDING	Setting up and operation of the centrifugal casting and permanent mould section			K			MECH. / PROD. ENGINEERING	100X		111111		
8	INDUCTION FURNACE (ARC FURNACE)	Purchasing and operation of the induction and arc furnaces		G				ELECTRICAL ENGINEERING	100X	111111			
9	CUPOLA / GAS FIRED FURNACE	Purchasing and operation of the cupola and gas fired furnace		H				MECH. / PROD. ENGINEERING	100X	111111			
10	MACHINE SHOP	Setting up of the machine shop, cleaning shop and heat treatment shop and the operation of the machine shop	C					MECH. / PROD. ENGINEERING	100X	111111			111111
11	CLEANING SHOP / HEAT TREATMENT SHOP	Operation of the cleaning shop and the heat treatment shop				X		MECH. / PROD. ENGINEERING			100X		
12	MELT / COMPOSITION LAB	Setting up of the melt/composition and metallographic lab and operation of the melt/composition lab	D					METALLURGY	100X	111111			
13	METALLOGRAPHIC LAB	Operation of the metallographic lab			L			METALLURGY / CHEMISTRY	100X		111111		
14	QUALITY CONTROL LAB	Setting up and operation of the quality control lab		I				MECH. / PROD. ENGINEERING	100X		111111		
YEARLY REQUIREMENT			4	5	3	2		KEY					
TOTAL			4	9	12	14		X - SHORT TERM TRAINING (3 MONTHS) L - LONG TERM TRAINING (6 MONTHS)					
EXPERT REQUIREMENT			SHORT TERM (3 YEARS)					LONG TERM - 5 YEAR TERM					
1 - PATTERN	Development of pattern making expertise		X	X	X	X							
2 - MOLDING	Assisting in R&D on moulding techniques			X	X	X							
3 - MELTING	Development of melting capabilities			X	X	X							
4 - MATERIALS IN FOUNDRY	Assisting in R&D in materials technology related to foundry												
5 - O. C. IN FOUNDRY	Assisting in O. C. activity			X									
6 - PRODUCT DEVELOPMENT	Assisting in developing products related to foundry												
								PROJECT TYPE ASSISTANCE					
								PERIOD MARCH 1994					

ASSISTANT RESEARCH OFFICER INTAKE & TRAINING PROGRAMME - PROPOSAL 1

NO	FUNCTION	ROLE	YEAR OF INTAKE				TRAINING PERIOD (MONTHS)				
			1987	1988	1989	1990	1991	1992			
1	PATTERN MAKING	Assisting in the operation of pattern making shop		1							
2	SAND PREPARATION PLANT GREEN SAND MOLDING LINE	Assisting the officer in-charge in the running of the sand preparation plant and the green sand moulding line			1				LLLLL		
3	CORE MAKING & CO2 PROCESS	Assisting in the operation of the core making and CO2 process shop			1				LLLLL		
4	SAND TEST FACILITIES	Assisting in the operation of the sand testing facilities		1			LLLLL				
5	INVESTMENT CASTING/SHELL MOLDING	Assisting in the operation of the investment casting and shell moulding section			1				XXXX		LLLLL
6	INDUCTION FURNACE ARC FURNACE	Assisting the officer in-charge in the running of the induction and arc furnaces			1				XXXX		LLLLL
7	CUPOLA / GAS FIRED FURNACE	Assisting in the operation of the cupola and the gas fired furnace			1				XXXX		LLLLL
8	MACHINE SHOP	Assisting in the operation of the machine shop		1					XXXX		
9	CLEANING SHOP / HEAT TREATMENT SHOP	Assisting in the operation of the cleaning shop and the heat treatment shop							XXXX		LLLLL
10	METALLOGRAPHIC LAB	Assisting in the operation of the metallographic lab							XXXX		LLLLL
11	QUALITY CONTROL LAB	Assisting in the operation of the quality control lab			1				XXXX		LLLLL
YEARLY REQUIREMENT			-	7	6	2					
TOTAL			-	7	9	11					

KEY

X - SHORT TERM TRAINING (3 MONTHS)
L - LONG TERM TRAINING (6 MONTHS)

TECHNICIAN, LAB ASSISTANT & DRAUGHTSMAN INTAKE & TRAINING PROGRAMME - PROPOSAL 1

NO	FUNCTION	ROLE	TRAINING PLAN (MONTHS)									
			YEAR OF INTAKE									
			1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	PATTERN MAKING	Operation of the pattern making shop and product drawings										
2	SAND PREPARATION PLANT GREEN SAND MOLDING LINE	Operation of the sand preparation plant and the green sand molding line										
3	CORE MAKING & CO2 PROCESS	Operation of the core making and CO2 process										
4	SAND TEST FACILITIES	Operation of the sand testing facilities										
5	INVESTMENT CASTING/SHELL MOLDING	Operation of the investment casting and shell moulding section										
6	INDUCTION FURNACE	Operation of the induction and arc furnaces										
7	CUPOLA / GAS FIRED FURNACE	Operation of the cupola and the gas fired furnace										
8	MACHINE SHOP	Operation of the machine shop										
9	CLEANING SHOP / HEAT TREATMENT SHOP	Operation of the cleaning shop and heat treatment shop										
10	METALLOGRAPHIC LAB	Operation of the metallographic lab										
11	QUALITY CONTROL LAB	Operation of the quality control lab										
12	CENTRIFUGAL CASTING/PERMANENT MOLD	Operation of the centrifugal and permanent moulds section										
13	MELT/COMPOSITION LAB	Operation of the melt/composition lab										
YEARLY REQUIREMENTS:												
TOTAL:												

KEY
X - SHORT TERM TRAINING (3 MONTHS)
L - LONG TERM TRAINING (6 MONTHS)
J - TECHNICIAN
LA - LAB ASSISTANT
P - DRAUGHTSMAN

IMPLEMENTATION PROGRAMME

PROPOSAL II

PHASE		PHASE I					PHASE II				
YEAR		1987	1989	1990	1991	1992	1993	1994	1995		
BUILDING - PHASE I											
-FURNACE		CCCCCCCC									
-SULF INVESTIGATION		CCCCCCCC									
-PATTERN & MICHIE SHOP		CCCCCCCC									
-COMPRESSOR HOUSE		CCCCCCCC									
-GUARD HOUSE		CCCC									
-TRILET		CCCC									
-ELECTRICAL TRIPS/DISTRIBUTION		CCCC									
-EXTERIOR WORK I		CCCCCCCC									
EQUIPMENT - PHASE I											
-PATTERN MAKING SHOP	A	SSdTTTAA8800									
-COMPRESSOR		SSdTTTAA8800									
-LOW FREQUENCY INDUCTION	G	SSdTTTAA8800									
-COP PROCESS FURNACE	F	SSdTTTAA8800									
-CORE MAKING SHOP	F	SSdTTTAA8800									
-CORES	A	SSdTTTAA8800									
-IMPREGNANT SHELL MOLDING	J	SSdTTTAA8800									
-SAND TESTING FACILITIES	B	SSdTTTAA8800									
-METAL COMPOSITION ANALYSIS I	D	SSdTTTAA8800									
(SPECTROMETER)											
-GAS FIRED FURNACE	H	SSdTTTAA8800									
-CENTRIFUGAL/PERMANT MOLD	X	SSdTTTAA8800									
-CLEANING SHOP	A	SSdTTTAA8800									
-SAND PREPARATION PLANT	E	SSdTTTAA8800									
-GREEN SAND MOLDING	E	SSdTTTAA8800									
-HIGH FREQUENCY INDUCTION	G	SSdTTTAA8800									
FURNACE											
-METALLOGRAPHIC LAB I	L	SSdTTTAA8800									
BUILDING - PHASE II											
-HEAD OFFICE, LABS & LAB											
BENCHES											
-STATION HOUSE											
-SAND											
-COUNTERS											
-COVERED WAYS											
-X-RAY HOUSE											
-EXTERIOR II											
EQUIPMENT - PHASE II											
-METAL COMPOSITION ANALYSIS II	D										
-METALLOGRAPHIC LAB II	L										
-FURNACE EQUIPMENT	C										
-PATTERN SHOP	A										
-HEAT TREATMENT SHOP	A										
-QUALITY CONTROL LAB	G										
-HIGH FREQUENCY INDUCTION	G										
FURNACE											
-ARC FURNACE	G										
-ROTARY FURNACE	H										

KEY
S - specification
d - tender document preparation
T - calling of tender
B - tender Board
O - order of award
C - delivery
C - Construction

RESEARCH OFFICER IN-CHARGE & TRAINING PROGRAMME - PROPOSAL II

NO	FUNCTION	ROLE	YEAR OF ENTRY												QUALIFICATION	TRAINING PLAN (MONTHS)					
			1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998		1987	1988	1989	1990	1991	1992
1	PATTERN MATERIAL DEVELOPMENT	Development of the pattern material and design																			
2	PATTERN MAKING	Setting up of the pattern making shop and its operation		A																	
3	SAND PREPARATION PLANT GREEN SAND MOLDING LINE	Setting up and overhauling the sand preparation plant and the green sand molding line			E																
4	COPE MAKING & COT PROCESS	Setting up and operation of the core making and COT process shop		F																	
5	SAND TEST FACILITIES	Setting up and operation of the sand testing facilities			B																
6	INVESTMENT CASTING/SHELL MOLDING	Operation of the investment casting and shell molding section			J																
7	CENTRIFUGAL CASTING/PERMANENT MOLD	Setting up and operation of the centrifugal casting and permanent mold section			K																
8	INDUCTION FURNACE	Purchasing and operation of the induction and arc furnaces		G																	
9	COUPOLA / GAS FIRED FURNACE	Purchasing and operation of the coupola and gas fired furnace		H																	
10	MACHINE SHOP	Setting up of the machine shop, cleaning shop and heat treatment shop and the operation of the machine shop																			
11	CLEANING SHOP / HEAT TREATMENT SHOP	Operation of the cleaning shop and the heat treatment shop																			
12	MELT / COMPOSITION LAB	Setting up of the melt/composition and metallographic lab and operation of the melt/composition lab			D																
13	METALLOGRAPHIC LAB	Operation of the metallographic lab																			
14	QUALITY CONTROL LAB	Setting up and operation of the quality control lab																			
TOTAL			1	2	3	4	5	6	7	8	9	10	11	12	13	KEY: SHORT TERM TRAINING (3 MONTHS) X - LONG TERM TRAINING (6 MONTHS)					
EXPERT REQUIREMENT			YEAR OF ENTRY												PROJECT TYPE/ASSISTANCE STARTS MARCH 1989	LONG TERM - 3 YEAR TERM					
1. PATTERN	Development of pattern making expertise			X																	
2. MOLDING	Assisting in R & D on molding techniques			X																	
3. MATERIAL IN FOUNDRY	Development of melting capabilities			X																	
4. O.C. IN FOUNDRY	Assisting in R & D in materials technology to foundry			X																	
5. PRODUCT DEVELOPMENT	Assisting in O.C. activities			X																	
	Assisting in developing products related to foundry			X																	

RESISTANT RESEARCH OFFICER INTAKE & TRAINING PROGRAMME - PROPOSAL II

NO	FUNCTION	ROLE	YEAR OF INTAKE										QUALIFICATION	TRAINING PERIOD (MONTHS)									
			1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	PATTERN MAKING	Assisting in the operation of pattern making shop		1																			
2	SAND PREPARATION PLANT GREEN SAND MOLDING LINE	Assisting the officer in-charge in the running of the sand preparation plant and the green sand moulding line			1																		
3	CORE MAKING & CO2 PROCESS	Assisting in the operation of the core making and CO2 process shop		1																			
4	SAND TEST FACILITIES	Assisting in the operation of the sand testing facilities			1																		
5	INVESTMENT CASTING/ SHELL MOLDING	Assisting in the operation of the investment casting and shell moulding section			1																		
6	INDUSTRIAL FURNACE	Assisting in the operation of the industrial furnace running of the induction and arc furnaces			1																		
7	CUPOLA / GAS FIRED FURNACE	Assisting in the operation of the cupola and the gas fired furnace			1																		
8	MACHINE SHOP	Assisting in the operation of the machine shop			1																		
9	CLEANING SHOP / HEAT TREATMENT SHOP	Assisting in the operation of the cleaning shop and the heat treatment shop			1																		
10	METALLOGRAPHIC LAB	Assisting in the operation of the metallographic lab			1																		
11	QUALITY CONTROL LAB	Assisting in the operation of the quality control lab			1																		
TOTAL			2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

KEY: SHORT TERM TRAINING (3 MONTHS)
L: LONG TERM TRAINING (6 MONTHS)

TECHNICIAN, LAB. ASSISTANT & OUGHTON INTRAVE & TRAINING
PROCEDURE : FORMULAR II

NO	FUNCTION	FILE	YEAR OF												TRAINING PERIOD (MONTHS)				
			1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	IN-TEMP WORKING	Operation of the pattern making shop and product drawings		(2), (P)															
2	IN-TEMP PREPARATION PLANT	Operation of the sand preparation plant and the green sand moulding line																	
3	IN-TEMP MAKING & CO2 PROCESS	Operation of the core making shop and the CO2 process line		(1), (2), (P)															
4	IN-TEMP TEST FACILITIES	Operation of the sand test facilities			ILA														
5	IN-TEMP CASTING/SHALL MOLDING	Operation of the investment casting and the shell moulding process			(2), (P)														
6	IN-TEMP FURNACE	Operation of the induction and arc furnaces																	
7	IN-TEMP / GAS FIRED FURNACE	Operation of the cupola and the gas fired furnace and rotary furnaces																	
8	IN-TEMP SHOP	Operation of the machine shop																	
9	IN-TEMP SHOP / HEAT TREATMENT SHOP	Operation of the cleaning and heat treatment shop																	
10	IN-TEMP PETROGRAPHIC LAB	Operation of the metallographic lab				ILA													
11	IN-TEMP QUALITY CONTROL LAB	Operation of the quality control lab																	
12	IN-TEMP CENTRIFUGAL PERMANENT MOLDS	Operation of the centrifugal and permanent moulds section																	
13	IN-TEMP COMPOSITION LAB	Operation of the wet composition analysis																	
TECHNICAL REQUIREMENT:																			
TECHNICAL LAB. ASSISTANT				5	8	5													
OUGHTON				1	2	1													
TOTAL:				5	13	18	18	18	18	18	18	18	18	18	18	18	18	18	18
TECHNICAL LAB. ASSISTANT (OUGHTON)				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

X - SHORT TERM TRAINING (3 MONTHS)
Y - SHORT TERM TRAINING (6 MONTHS)
Z - SHORT TERM TRAINING (9 MONTHS)
LA - FURNACE LAB
P - PETROGRAPHIC LAB

REFERENCE

1. Bank Negara Malaysia Annual Report 1985
2. Engineering Survey : Part I - The Malaysian Foundry Industry

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