

Question A-1

Government Policy and Directions

- The Singapore Government recognises that Information Technology has two key roles for Singapore :
 - 1) the exploitation of IT in the various economic sectors to improve productivity and enhance business competitiveness
 - 2) the development of a strong viable IT industry that can produce new software products and services for export.
- In 1986, a National Information Technology Plan was formulated. This Plan is a blueprint IT development in Singapore - *to achieve the establishment of a strong IT Industry and to effectively exploit IT for international competitiveness.*

(Please refer to :

the Economic Committee Report Chapter 17
and National IT Plan

- Annex 1
- Annex 2)

- To meet both the objectives of the National IT Plan, IT manpower development is a critical issue for Singapore. This is a necessary ingredient for both IT industry development and IT exploitation and application by the industries.
- The National Computer Board, set up in 1981, is the lead Government Agency to implement the National Information Technology Plan.
- The Singapore Government, through the NCB and other related organisations, play the role of a facilitator, to develop the environment and infrastructure to allow for the development and growth of IT in Singapore, including *A.I. technology*, identified under the National IT Plan as a priority technology for Singapore to develop.

Question A-2

AI Related Computer Utilisation

- (1) Operating systems -- Currently most work is done on UNIX, DOS, TI Explorer.

UNIX and DOS will remain important for AI development in at least the next few years. Lisp machines will remain important in the academic and research sectors. There are signs that mainframes and DEC are being used increasingly.

- (2) Software -- Currently the following software packages / programming languages are being used for AI development in Singapore: ESE, KEE, Knowledge Craft, S.I, Guru, Personal Consultant Plus, Xi Plus, Nexpert Object, Common Lisp, Prolog, Objective-C, Pascal.

- (3) Hardware -- Currently AI developments are being done mostly on the following hardware: PCs, SUN Microsystems, HP9000, Apollo, TI Explorer / MicroExplorer. There are signs that there may be more developments done on mainframes and 386-based machines in the near future.

Question A-3

AI/KE Research in Singapore

- **Researchers estimated at 30 - 50, distributed at the National Computer Board's Information Technology Institute, National University of Singapore's Institute of Systems Science and the Department of Information Systems and Computer Science, Economic Development Board's French Singapore Institute, Ngee Ann Poly's Centre for Computer Studies, Singapore Poly's Japan-Singapore Institute of Software Technology, private companies, etc**
- **Researchers are generally Degree or Postgraduate Degree holders in an IT discipline such as computer science, electrical and electronics engineering.**
- **Current research topics include: intelligent user interface, planning and scheduling applications, Chinese character recognition, AI in manufacturing, industrial diagnostics.**

Question A-4

AI/KE Manpower Development in Singapore

- (1) To produce the required number of IT professionals to meet Singapore's requirement, the Government has set up a comprehensive IT Manpower Education framework. This framework covers the Universities, Polytechnics, specialised training institutes, private and public schools, which together are producing 800 to 1000 'entry-level' IT professionals annually.
(see Annex 3)
- (2) The next stage of our manpower development programme is in *specialisation* - to develop professionals with the specialised knowledge in specific IT fields.
- (3) One of the major technology fields is that of A.I.

A.I. Manpower Needs of Singapore in 1993

- i. 600 KE Specialist
 - defined as IT professionals working full-time in one or more fields of knowledge acquisition, knowledge representation, and expert system development. The KE Specialist should be fully conversant in selecting and using the appropriate tools, methodologies, and techniques in solving a specific complex KE problem.
- ii. 1800 KE General Practitioners
 - defined as IT professionals or domain specialists working full-time or part-time in the field of knowledge acquisition and knowledge representation. A KE General Practitioner should have working knowledge in selecting and using simple tools and techniques to solve a simple and specified KE problem.

Required Annual Output of AI Professionals :

i) 100 KE Specialists

ii) 360 KE General Practitioners

**The training requirements for these professionals are as follow:
For KE Specialist :-**

- i. Postgraduate studies in KE such as PhD/MSc or postgraduate diploma**
- ii. Full-time 1-2 years apprenticeship programmes which combine coursework and on-the-job training offered by institutions**
- iii. Intensive in-house programmes run by multinational corporations or large organisations which are very similar to the apprenticeship programme**

For KE General Practitioner :-

- i. Full-time professional short courses and seminars organised by tertiary institutions, vendors or private institutions for IT professionals or domain experts**
- ii. Residency programmes organised as a follow-on activity after students have attended professional courses**
- iii. Part-time evening KE courses for skill enhancement**
- iv. Optional or compulsory KE courses in undergraduate curriculum**
- v. Special programmes for the managerial-type practitioners**

Question A-5

AI/Knowledge Engineering(KE) Training in Singapore

The following are the training institutions/organisations that have some forms of A.I. / KE training courses

Training Institution

- Institute of Systems Science(ISS)

Proposed 9-month full-time postgraduate diploma in Knowledge Engineering

Resource Centre

- Knowledge Engineering Resource Centre(KERC)

Resource centre to train sponsored employees to carry out prototype development on real-life industry initiated projects

Some institutions running short AI/KE courses/electives

- National University of Singapore(NUS)
- Nanyang Technological Institute
- Japan-Singapore Institute of Singapore
- The Centre for Computer Studies
- NUS Department of Information Systems & Computer Science(DISCS)
- French Singapore Institute of Electro-technology (FSI)
- Ngee Ann Polytechnic

Some professional bodies/societies running short AI/KE courses

- Institute of Electronics and Electrical Engineering (Singapore)
- Singapore Computer Society

Question A - 6

Present activities of AI related foreign computer makers

Some companies running short AI/KE courses

- TI -- teaches short courses on the Explorer and expert systems, and arrange for training attachments in the USA for ITI and ISS.

In addition, the Airline Systems Group has some marketing activities in the region and may start development work in the near future.

- DEC -- Opens DEC AI Fellowship Programme to Singapore.
- HP -- Provides training opportunities in the USA.
- NEC -- Training and on-the-job development opportunity.
- NIXDORF -- Has plan to train Singapore staff in AI development

Question B - 1

Establishment of the Center

- (1) Please refer to Section 4.3, 4.4, 4.5, 6.1 and 6.2 of the proposal.
- (2) Please refer to Section 6.3 of the proposal.
- (3) Please refer to Section 2.4 and Chapter 4 of the proposal.

The Singapore software industry in the future is geared towards high value-added orientation, supported by strong R&D capability, and high quality technical services. To achieve this, there is a need to shift information technology (IT) training from one that is focused on quantity (producing enough IT professionals), to one that is focused on quality.

In addition, the productivity of a slow growing workforce has to be increased substantially for the Singapore industry to remain competitive and for Singapore to achieve the desired annual growth.

IT is seen as one of the essential factors in achieving this objective. Within IT, AI has been singled out in the National Information Technology Plan as a key technology for Singapore to develop and exploit. Thus, it can be said that AI development has been accorded very high priority. This is evident from the amount of support the Singapore government has been giving to AI development so far, and the fact that it plans to set up a centre dedicated to AI development before it conceives similar plans for other technology areas.

- (4) This is to be discussed and finalised. The main institutions concerned are ITI (Knowledge Systems Laboratory and Knowledge Engineering Resource Centre), ISS (Knowledge Engineering Diploma Programme and AI research), JSIST and GINTIC.

Areas of collaboration could involve exchange of technical information, joint training, joint project, cross-attachment of staff, etc.

- (5) The Government can provide grants to private companies for skills training through participation in AI Centre-type of projects. These centres will also be able to provide technical support to these companies, such as for AI development.

Question B - 2

Organisation of the Center

- (1) Please refer to page 19 of the proposal. This is preliminary and should be improved further.
- (2) The Director will assist the Head of Project in managing the Centre and overseeing the day to day operation of the Centre.

The Assistant Director (Admin) is in charge of all administrative matters of the Centre. This includes clerical and secretarial support, facility management and support.

Project Managers are responsible for the project management of the projects.

Project Leaders are responsible for technical matters of the projects.

Experts are consultants providing technical leadership to the projects and giving advice on project management.

The Industry Liaison Officer provides the interface between the Center and the industry. Tasks here includes publicity, promotion, establishing dialogue, establishing collaboration agreements.

- (3) Please refer to page 17 of the proposal.

Question B - 3

Budgetary condition

- (1) Funding has been approved in principle by the Singapore Ministry of Finance in support of this project. Final approval has to be obtained once the plans and details are finalised.
- (2) To be finalised.

Question B - 4

Building condition

(1) The Center will likely be located in the Singapore Science Park, within walking distance from the National Computer Board. It will probably be leasing the premise from the Jurong Town Corporation, which builds and manages the Science Park.

Question B - 5

Man-power condition

These will be recruited. The number of each category can be found on page 17 of the proposal. Some of the lecturers and instructors need to be trained in Japan.

Question C - 1

Purpose of the Project

Please refer to Section 4.3, 4.4, 4.5, 6.1 and 6.2 of the proposal.

Question C - 2

Program for Training Courses

- (1) Please refer to Section 6.3 of the proposal.
- (2) Please refer to Section 6.4 of the proposal. The detailed of the training curriculum is to be finalised, preferably with input from the Japanese experts.
- (3) The majority of the trainees will be in the Center on a short term basis -- about six months. So there can be a turnover of two batches of trainees in about a year. There will be some trainees who will work on advanced prototypes or software tools who may be with the center for a longer period of time, up to two years.
- (4) Trainees will primarily be invited from the industry. Most of them will come to the Center sponsored by their companies / organisations. They can also be fresh graduates seeking practical training before joining the industry. The Center will work with the university and polytechnics to identify such graduates.
- (5) Please refer to Page 17 of the proposal.
- (6) Trainees will be university graduates already well-versed with the computers. Some exceptions may be granted to special cases who may not be graduates but possess the relevant technical experience.
- (7) This is to be finalised. The tentative approach is to charge a nominal entrance fee. The training will be subsidised by the Center.
- (8) Please refer to Section 6.3a of the proposal.
- (9) These refer to software tools that will aid in the efficient development of good quality expert systems. They may include intelligent user interface construction tools, expert system testing tools, knowledge acquisition aids, software modules that aid the development of special classes of expert systems such as real time systems, embedded diagnostic systems, planning and scheduling systems, etc.

C - 3

Duration of Project

The total duration of the first phase of the project is 5 years.

C - 4

Implementation Schedule

To be finalised

C - 5

Requests from Singapore

Please refer to page 20 - 22 of the proposal. The details of hardware, software and other equipment are to be finalised.

Since the Center is meant for advance training and development in AI for university graduates, and *not* meant to be providing beginner level AI training, it is essential that the Japanese experts dispatched have deep knowledge and a substantial amount of experience (more than 3 years on a full time basis) in AI application development.

Similarly, the software engineering experts should have first hand experience in software engineering tools development (not just as a user), coupled with a good knowledge in AI.

These expert should be prepared to design training curriculum, prepare course material and work jointly with the Singapore countered part and the trainees on a *hands-on* basis to develop prototypes and systems. They should be in a position to function as training and technical advisor who can advice in :

- a. the overall design of the software,
- b. development methodology,
- c. detailed technical design,
- d. technical implementation,
- e. project planning and management.

Question C - 6

Management of the Project

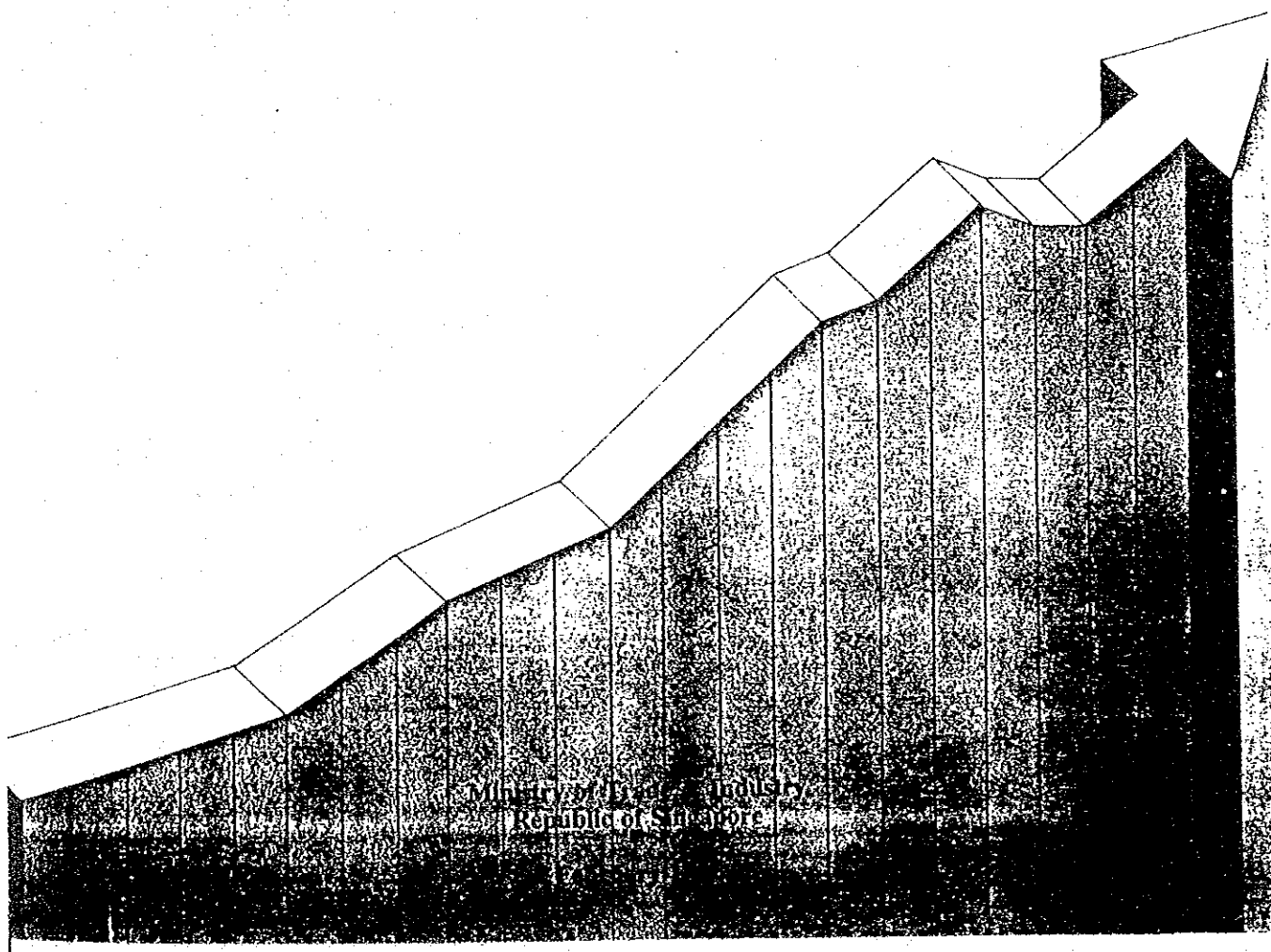
On the Singapore side, the National Computer Board (NCB) will be the implementation agency.

A management council should be formed consisting of members representing both the Japanese (nominated by the Japanese Government) and the Singapore sides (nominated by NCB).



REPORT OF THE ECONOMIC COMMITTEE

THE SINGAPORE ECONOMY: NEW DIRECTIONS



Ministry of Trade and Industry,
Republic of Singapore

KEY RECOMMENDATIONS**Importance of IT**

- 1 Companies in both manufacturing and services must fully exploit the advances in IT to gain a competitive edge.
- 2 It is not enough just to computerise. To be able to compete better, our industries need strategic and creative exploitation of IT.
- 3 Singapore should exploit the opportunities of IT as a new growth industry.
- 4 A consolidated national IT strategy should be implemented, to be spearheaded by NCB, subsuming the present national computerisation effort.

Proposed IT Strategy

- 5 The following IT strategy is proposed:

- (1) **IT Manpower.**

We must develop a group of IT professionals and experts to enable our enterprises to exploit IT fully.

- (2) **IT Culture**

Efforts must be made to overcome resistance to change. IT should be taught more extensively in schools.

- (3) **Information Communication Infrastructure.**

We must continue to improve our telecommunications facilities.

- (4) **IT Application.**

Many new users, especially the small enterprises, must be provided assistance to overcome their resistance to technology.

- (5) **IT Industry.**

Every encouragement must be given to promote the development of an IT industry in Singapore.

- (6) **Creativity and Entrepreneurship.**

We must also develop a local capability in applied research in IT.

- (7) **Coordination and Collaboration.**

We must coordinate the individual efforts of various organisations involved in promoting various aspects of IT. The NCB should play the leading role.

17. INFORMATION TECHNOLOGY

IT: A Key Technology

1 Information technology (IT) covers the use of computer technology, telecommunications and office systems in all aspects of information flows — from collection and processing, to storage, packaging and dissemination. It has been estimated that by 1990, IT will have direct impact on the production of 30% of world GDP. Present trends indicate that IT will become a key technology in improving business efficiency and labour productivity, and generating new businesses.

2 Advances in IT are already being exploited by business organisations in many countries. The fast-expanding services industry, e.g. health care services, legal services and engineering services, are poised to make vast improvements in service levels through the exploitation of expert systems, large databases, computer-aided design and other IT-related technologies. Large corporations, which used to base their production in countries with low labour costs, have found that with IT-based automation, labour costs can become an insignificant component of total production costs. They can therefore manufacture at home at a low unit cost, despite high local labour costs. IT has also spawned many new businesses utilising micro-electronics, electronic publishing, videotex, satellite TV, etc.

3 The total revenue of the IT industry worldwide in 1984 was estimated to be US\$530 bn. It is projected to grow by more than 10% p.a., to exceed US\$1,000 bn by the early 1990s. This will make it one of the largest industries of the next decade.

4 The advances in IT cannot be ignored by companies. Those that lag behind in exploiting IT will be unable to compete. Their productivity will not improve as fast as their IT-oriented competitors, and their competitiveness will decline from lack of innovation.

Importance of IT to Singapore

5 For Singapore, as international competitiveness is a matter of survival, our companies must be efficient, productive and innovative. Companies in both manufacturing and services need to exploit fully the advances in IT.

6 The service sector is primarily knowledge-based. At present, the average investment per service worker in Singapore is small. Use of IT will result in improved service levels and higher productivity.

7 In the manufacturing sector, we are no longer competing with countries with low labour cost. We will increasingly be competing with advanced countries that are using IT and other advanced technologies to be low unit-cost manufacturers, despite their high wage levels. Singapore manufacturers must similarly exploit IT to reduce the labour content of their manufactured goods to remain competitive.

8 It is not enough just to computerise. What is needed is strategic and creative exploitation of IT by our industries. Our companies must use IT to position themselves in the right market niches, and exploit IT applications in more far-reaching ways than our competitors. Only then can our companies compete better through improved products and better efficiency and productivity.

IT as a New Growth Industry

9 While the major impact of IT will be to raise efficiency and productivity, IT should itself be a growth industry. New IT products, such as optical disc drives and customised chips, are constantly being developed. These are high value-added products which Singapore can manufacture, especially early in the product life cycle, when prices are high, and volumes are relatively low. Manufacturers will look for production bases which offer quick start-ups, a workforce that can be trained up quickly, and good infrastructure for the use of sophisticated technologies. Singapore has these strengths.

10 Advances in IT have also generated a tremendous demand for application and systems software and associated services, e.g. consultancy, turnkey systems, and training. In addition, developments in communications are bringing about new telecommunications services such as value-added networks. Singapore should exploit these opportunities.

Impact of IT on Society

11 Over the next decade, IT will also have an increasing impact on the way we live. Work patterns will gradually change, with growing acceptance of teleworking, i.e. working from homes using computers linked to the office, videotex systems offering opportunities for home transactions in banking, shopping and other remote-based applications. In the home, the most immediate significance of IT will be in education. This is particularly relevant to Singapore, as we should encourage use of home-based instruction packages to learn new skills.

The Need for a National Strategy

12 Over the past few years, the national computerisation effort, spearheaded by the National Computer Board (NCB)

and overseen by the Committee on National Computerisation (CNC), has created the necessary infrastructure and conditions for us to take advantage of computer technology. We have made considerable progress. Many organisations have responded positively to computerisation. This enthusiasm, however, needs to be properly focused so that maximum results can be achieved. As IT is critical to our future economic well-being, it should not be left to fragmented approaches by different agencies. It is important that a new consolidated IT strategy be introduced, to be spearheaded by NCB, encompassing the full spectrum of potential activities. The present national computerisation effort should be converted into a national IT strategy. Such an integrated IT strategy will help organisations in Singapore to exploit IT fully.

PROPOSED IT STRATEGY

13 The following IT strategy, drawn up by a Working Committee with representatives from NCB, EDB, Telecoms and NUS, is proposed:

IT Manpower

The quality of manpower will be the key determinant of our overall IT capability. We must develop a group of IT professionals and experts to enable our enterprises to exploit IT fully.

IT Culture

We must prepare our citizens for the emerging information society. Efforts must be made to overcome resistance to change. IT should be taught more extensively in schools.

Information Communication Infrastructure

Our infrastructure will be the backbone of our information-based businesses. We must continue to

improve our telecommunications facilities.

IT Application

To achieve growth, all economic sectors must try to exploit IT to the full. For the many new users, especially the small enterprises, assistance must be provided to overcome their resistance to technology.

IT Industry

A strong IT industry will be a key driving force for our economy. Every encouragement must be given to promote the development of an IT industry in Singapore.

Climate for Creativity and Entrepreneurship

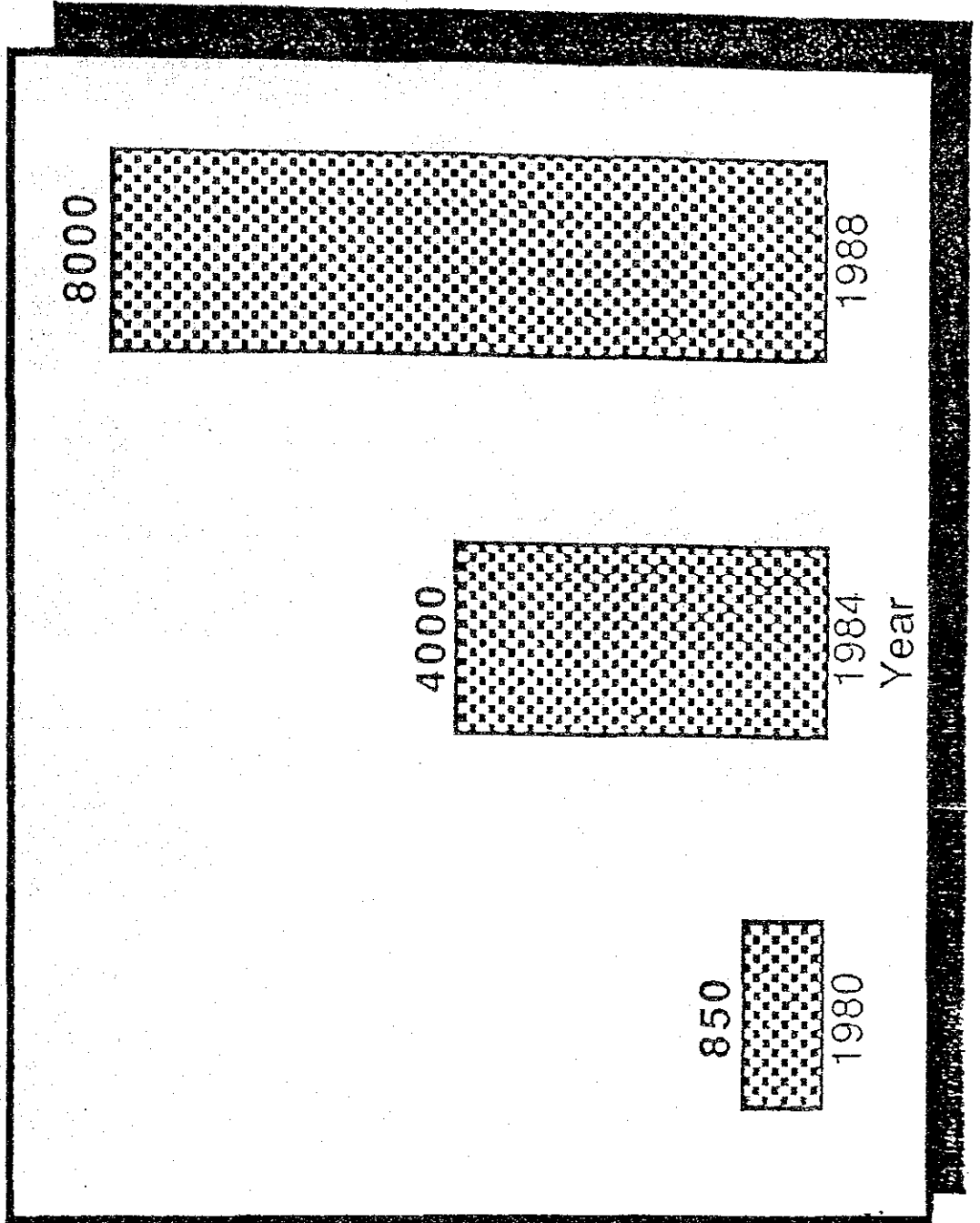
A stimulating environment which promotes creativity and enterprise is a prerequisite to transform ourselves into an information economy. We must also develop local capability in applied research in IT.

Coordination and Collaboration

To realise the full potential of IT, we need to coordinate the individual efforts of various organisations involved in promoting various aspects of IT. The NCB should play the leading role in this.

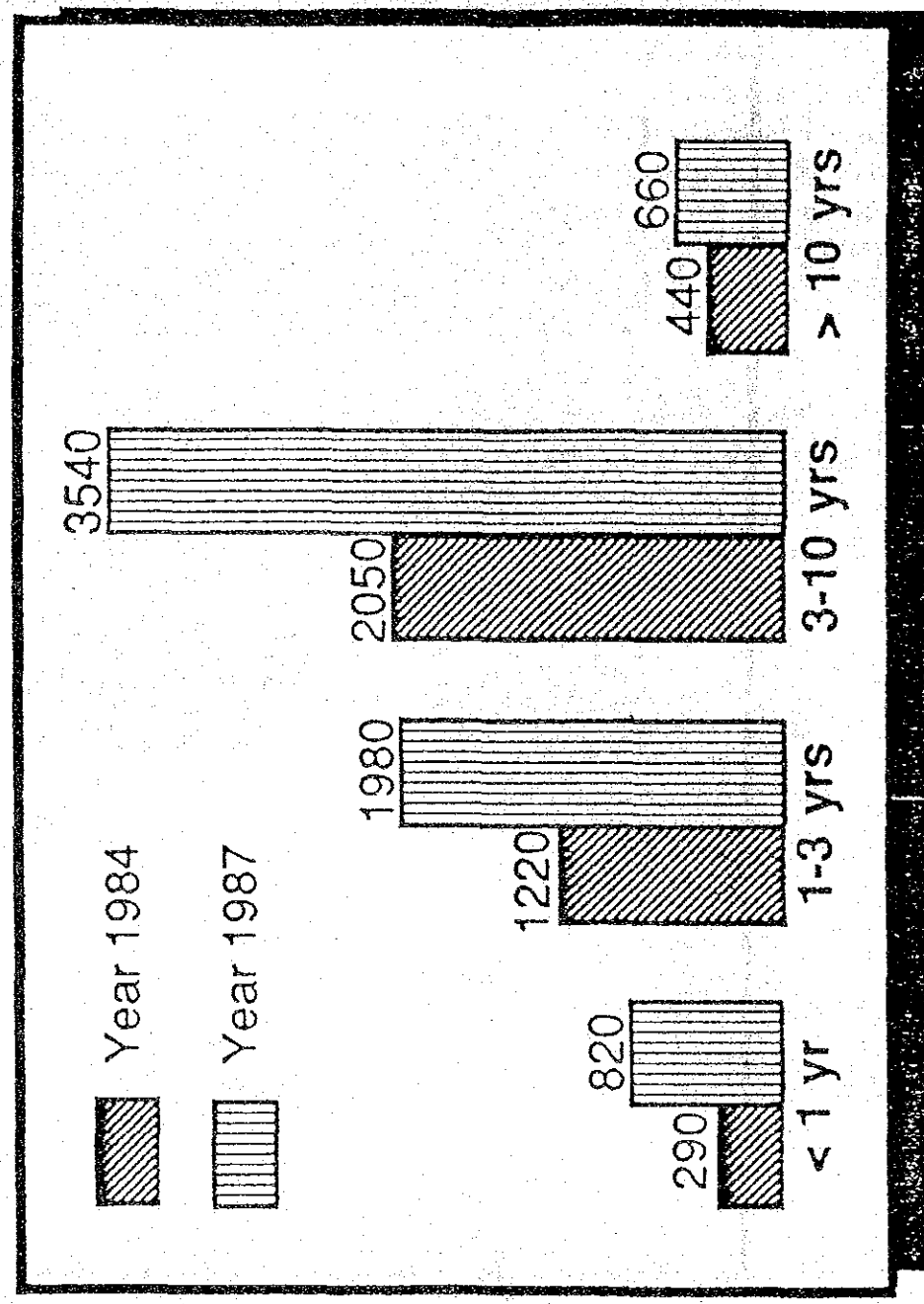
Growth of IT professionals

Annex 3(A)



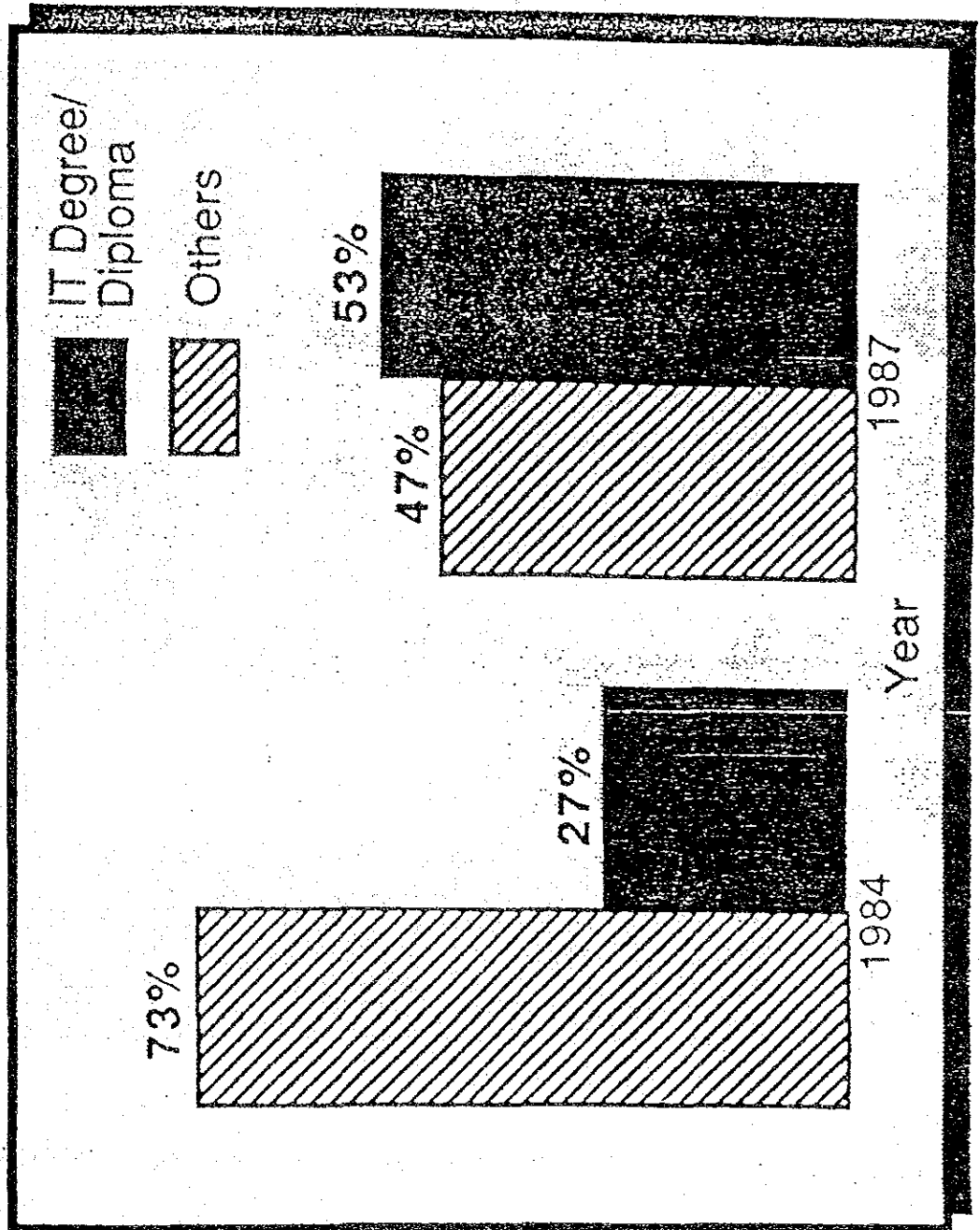
Distribution of IT professionals By years of experience

Annex 3(B)



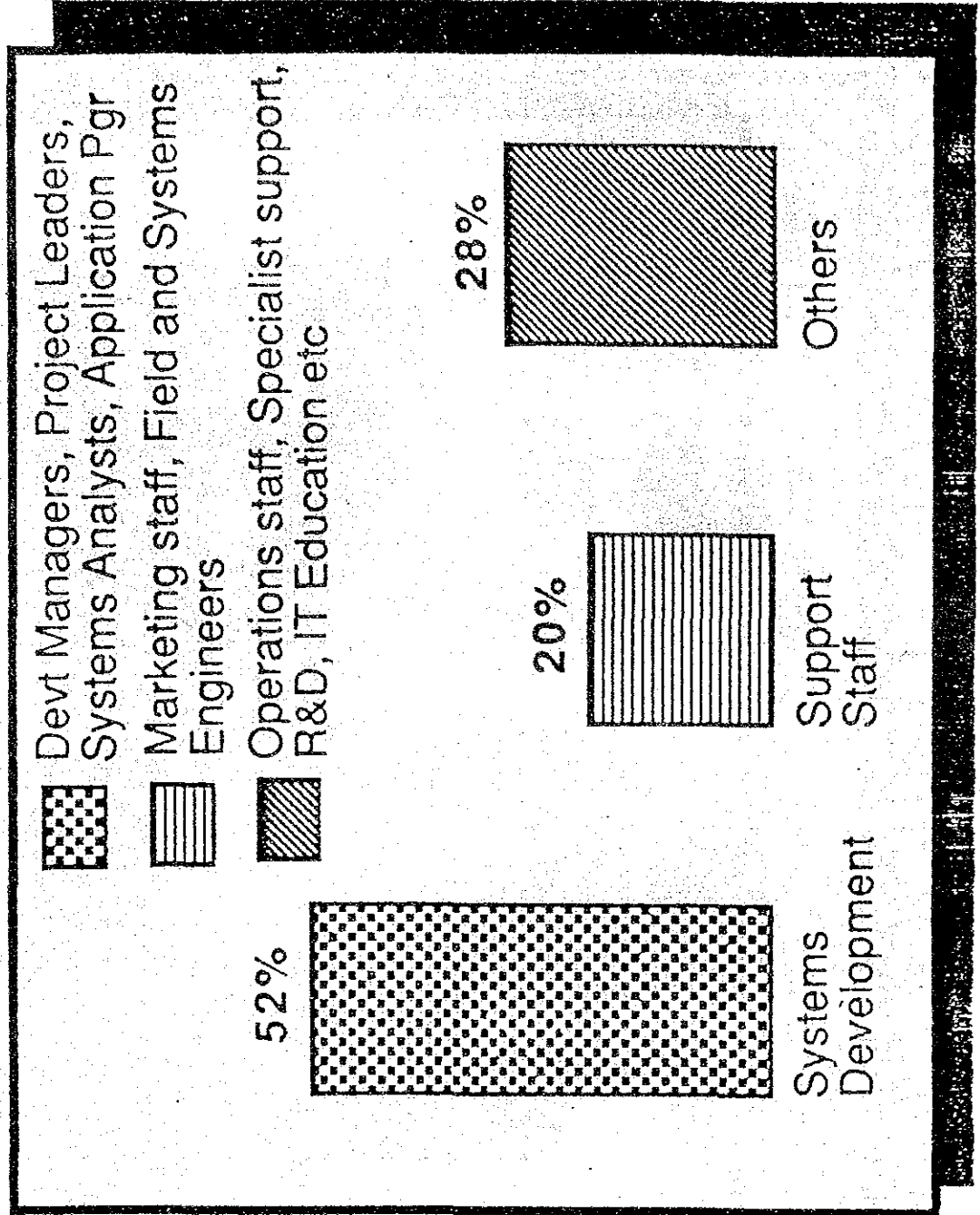
Qualification of IT professionals

Annex 3(C)

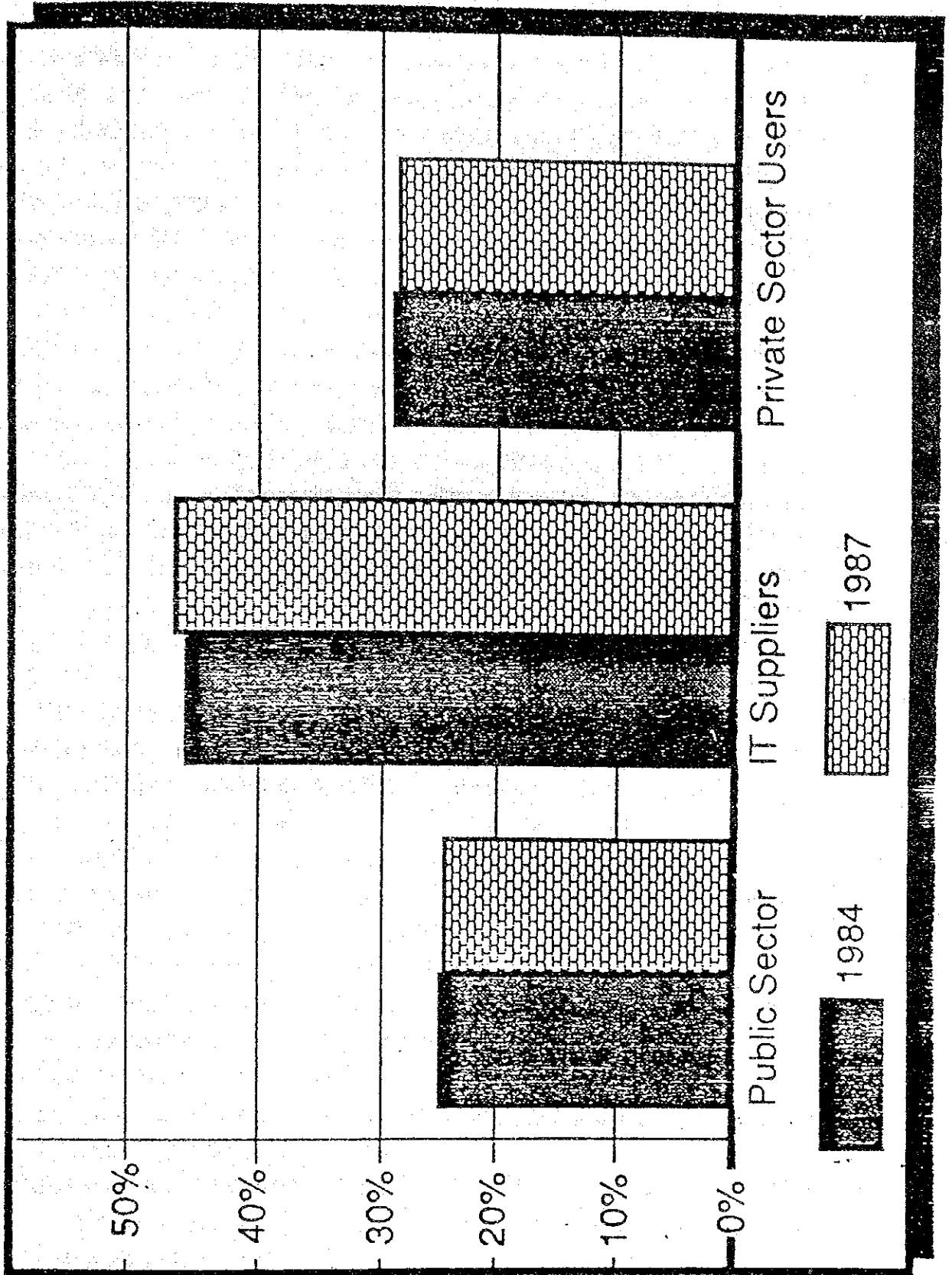


Distribution of IT professionals By occupation

Annex 3D



Distribution of IT professionals By Sectors



「日本シンガポールAIセンター」に関する日本側からの
質問に対するシンガポール政府の回答要約 ('89.Feb.14)

質問-1 シンガポール政府におけるIT政策について

- *シンガポール政府は、IT (Information Technology: 情報技術) が、シンガポールにおける各種の経済的分野の生産性を改善し経済競争力を高めるために、また、新しいソフトウェア製品および各種サービスを輸出することができる強力なIT産業を育成するために、基本的役割を担うものと認識している。
- *1986年にNITP (National Information Technology Plan: 国家情報技術計画) が作成された。この計画は、シンガポールにおけるIT開発に関する青写真であって、強力なIT産業 (企業) を育成し、国際競争のために有力なITを開発することを目的としている。〔参考: Economic Committee Report Chapter 17およびNITP〕
- *NITPを推進するためには、IT人材の開発が切実な問題である。これは、IT産業の育成および企業におけるITの開発および適用を促進するために必要な条件である。
- *NITPを実施するための政府機関として、1981年にNCB (National Computer Board: 国家コンピュータ庁) が設立された。
- *シンガポール政府は、NCB 及び他の関係機関を通じて、シンガポールにおけるITの開発と成長を促すための環境と基礎構造を作り出すための役割を果たしている。これには、NITPのもとで優先的に開発すべき技術として承認された中にAI (Artificial Intelligence: 人工知能) 技術を含んでいる。

質問-2 AI関連のコンピュータ利用について

- *オペレーティングシステムについては、MS-DOSが使用されている。LISPマシンは、学術及び調査研究の分野で、メインフレームは、DEC マシンの使用が増加している。
- *AI開発のために、ESE, KEE, KC, SI, GURU, PC Plus, Xi-Plus, Nexpert Object, C Lisp, Prolog, Objective-C, Pascal等のソフトウェアパッケージ/プログラミング言語が使用されている。
- *現在、AIの開発は、PCs, SUN, Microsystems, HP9000, Apollo, TI Explorer/Micro Explorer等の機種によって行われている。今後は、メインフレームがAIシステムの開発に使用されることになろう。

質問-3 シンガポールにおけるAIの研究開発状況について

- *研究者は30~50名と推定される。これらの人々は、NCBのITT (Information Technology Institute), 国立シンガポール大学のISS (Institute of System Sciences) 及び情報システム・コンピュータ科学学部, 経済開発庁のFSI (France Singapore Institute), JSIST (Japan Singapore Institute for Software Technology), 私企業等に分散している。
- *研究者の多くは、コンピュータ科学, 電気工学, 電子工学の学位あるいは修士の資格保持者である。
- *現在の研究トピックは、知的ユーザーインタフェース, 中国文字の認識, 製造業における生産計画, 工程管理, 工場内の各種故障診断等へのAIの利用などである。

質問-4 シンガポールにおけるAI/KEの人的資源開発について

*シンガポールにおいて必要なIT専門家を育成するために、政府は、IT人材教育計画を作成した。この計画では、大学、技術専門学校、専門教育機関において、年間800人から1,000人のIT技術者を育成することとしている。

*われわれの人材開発計画の次の段階は専門化である。これはITの特定の分野に関する専門的知識を持つ専門家を育成することである。

*主たる技術分野の1つはAIである。

*1993年までに、シンガポールで必要とするAI人材はつぎのとおりである。

①、600名のKE (Knowledge Engineer)が必要になる。

KEは、1つあるいは幾つかの分野の知識ベースの構築及びエキスパートシステムの開発をフルタイムで行う者で、適切な開発ツールを選択し利用することに精通して、複雑なKE問題を解決するための方法論及び技法に完全に精通している必要がある。

② 1,800名のKE従事者が必要となる。

KE従事者とは、知識ベース構築業務にフルタイムあるいはパートタイムで従事する者で、単純あるいは特殊なKE問題を解決するために、単一のツールを選択し使用するための技術について作業上の知識を持っている必要がある。

*年間に必要とするAI専門家の数は、100名のKEおよび360名のKE従事者。

*これらの専門家に対する訓練の要件は、次の通りである。

・KEに対しては、

① PhD/MSc用に大学院あるいは同等の資格を付与するために行うKEの教育プログラム

②教育機関が提供するフルタイムの1年乃至2年の現場作業を組み合わせた初級の教育プログラム

③国際企業あるいは大企業が実施している充実した社内教育と同程度の教育プログラム

・KE従事者に対しては、

①IT従事者あるいは熟練者養成のために、教育機関や企業が行うフルタイムの専門コースあるいはセミナー。

②上記の専門コース終了後これをフォローするために行われる実習 (Residency Programmes)。

③技術向上のために、パートタイムで行われるKEコース。

④カリキュラム終了者のための、選択的あるいは義務的なKEコース。

⑤経営者向きの特別プログラム。

質問-5 シンガポールにおけるAI/KEの教育状況について

*AI/KEの教育について、ある種の定まったコースを持っている教育機関または組織はつぎの通りである。

①ISSは、KEに関し、大学院相当の9か月フルタイムコースを提案している。

②KERC (Knowledge Engineering Resource Centre, ITI, NCB) は、企業からの委託により従業員に対し、AI実用システムの開発ができるようにプロトタイプの開発実習を主体に訓練を行っている。

③NUS等以下の機関において、短期のAI/KEコースを行っている。

- ・National University of Singapore(NUS)
- ・Nanyan Technological Institute
- ・Japan Singapore Institute of Software Technology
- ・The Center for Computer Studies
- ・Department of Information Systems & Computer Science of NUS
- ・French Singapore Institute of Electrotechnology
- ・Institute of Electronics and Electrical Engineering(Singapore)
- ・Singapore Computer Society

質問-6 外国コンピュータメーカーにおけるAI教育の状況について

- ①TI----米国において研究者および専門家に対するAI教育短期コースを持ち、これにITIおよびISSの専門家が参加した。
- ②DEC----シンガポールのために、DEC-AIフェローシップ(給費生)プログラムを開設している。
- ③HP----米国内においてトレーニングの機会を提供している。
- ④日本電気----トレーニングおよび企業内開発の機会を提供している。
- ⑤NIXDORF----AI開発に関する訓練を計画している。

質問-7 AIセンターの設立について

*シンガポールのソフトウェア企業は、将来、強力な研究開発能力と高度な技術サービスを確保して、高付加価値化を目指している。この目的を達成するために、IT教育は、量(十分のIT専門家を得ること)から、質を目的としたものに移行する必要がある。これに加えて、企業が競争力を維持し、期待する年間の成長を達成するためには、実質的な労働力の生産性を高める必要がある。ITは、この目的を達成するための主要な要素の一つとして位置付けられている。AIはIT分野の中で、NITPにおいて、シンガポールが開発し、かつ、利用しなければならない基本技術として選択された。AIの開発が、極めて高い位置におかれていると言うことができる。AIに対して多くの支持を受け、そして他の技術分野における同様の計画に、先んじてAIセンターを設立しようとしていることが明らかである。

*他の機関との関連については、討論の上、結論づけられる。関連する主要機関は、ITI、ISS、JSIST、GINTICなどである。協力する分野は、技術情報の交換、合同訓練、合同開発プロジェクト、スタッフの相互交流等が考えられる。

*政府は、AIセンターのようなタイプのプロジェクトへの参加を通じて、私企業に対する技術指導を行うことができる。AIセンターは、さらに企業に対して、AI開発の技術的援助を与えることができる。

質問-8 AIセンターの組織について

*提案の組織は予備的なものであって、さらに改善されるべきものである。

Directorは、センターの経営において、プロジェクト責任者を助けるとともに、日常のセンター運営を監督する。Assistant Directorは、センターのすべての管理業務について責任を持ち、事務員あるいは書記的事務の管理および施設の維持管理を行う。プロ

プロジェクトマネージャは、当該プロジェクトの管理について責任を持つ。プロジェクトリーダーは、当該プロジェクトの技術的業務について責任を持つ。企業との連絡員は、AIセンターと企業との間でパブリシテイ、意志の疎通、協力協定の設定などのインタフェースの役割を担当する。専門家は、当該プロジェクトに対して、技術的指導とプロジェクトの管理について助言を行う。AIセンターは、大学卒業者に対するAIの高度な技術の訓練および開発を行うもので、初心者レベルのAI訓練は行わない。このため、日本から派遣される専門家は、AIアプリケーションの開発に関して、豊富な知識と、実質的な量の経験（フルタイムベースで3年以上）を持っていることが必要である。ソフトウェアの専門家は、AIに関する十分な知識とともに、ソフトウェアツールの開発について第一級の経験を持っていることが求められる。これらの専門家は、シンガポール側の関係者および研修生とともに、各種のプロトタイプおよびシステムを開発するために、訓練のカリキュラム作成、研修コースの設定のために、合同で作業を行う必要がある。また、訓練および技術的アドバイザーとしての地位にあり、各種のソフトウェアの開発に関して基本設計、開発の方法論、技術的な詳細設計、実用化における技術的事項、プロジェクトの計画および管理などの諸事項について助言することができる。

質問-9 AIセンター関連の予算措置について

*資金の提供について、シンガポール政府（大蔵省）の承諾を得ており、最終的には、実行計画の詳細が決定したときに承認を得ることとなっている。

質問-10 AIセンターの土地および建物について

*AIセンターは、NCBの建物があるシンガポール・サイエンス・パークに設置される予定である。これは、サイエンス・パークを建設・維持するJurong-Town Corporationから、賃貸することになる予定である。

質問-11 AIセンターの人的資源について

*AIセンターの要員は公募する。要員の人数は、提案書に示してあるが、何人かのインストラクタは、日本国内において訓練をする必要がある。

質問-12 AIセンターの訓練コースのプログラムについて

*カリキュラムの詳細は、日本人専門家の助言により作成する。短期間（約6カ月）の講習を年間に2回、長期間（2年までを限度とする）のAdvanced proto-types及びソフトウェア・ツールについての研修を行うコースを計画している。

*研修生は、主として企業から派遣される。企業に入社する以前に実際の訓練を受けようとする新卒業者の場合もある。このような新卒者には、大学あるいは技術専門学校と協力して訓練することになる。

*研修者の資格については、コンピュータに精通している大学卒業者。また、大学卒業者ではないが、同等の技術的経験を持つ者が例外として認められることがあろう。

質問-13 AIセンターの訓練コースの受講料について

*受講料には、センターからの助成金が予定されている。入学金については徴集することが試案として考えられている。

質問-14 AIセンターにおいて開発するプロトタイプについて

*ソフトウェア・ツールに関するもので、Intelligent User Interface Construction Tools, Expert System Testing Tools, Knowledge Acquisition aids, Real-time Systems, Embedded Diagnostic System, Planning and Scheduling Systems などを含んでいる。

質問-15 AIセンタープロジェクトの実施期間について

*プロジェクトの最初のフェーズは、5カ年の期間を予定している。

質問-16 AIセンタープロジェクトの実施機関、Management Councilについて

*シンガポール政府は、NCBが、実施機関となっている。Management Councilは、日本側代表（日本政府が任命）およびシンガポール側代表（NCBが任命）によるメンバーで構成される必要がある。

Proposal for the Establishment of the "Japan-Singapore AI Center
(tentative name)" Project-Type Technical Cooperation Program

February , 1989

Preliminary Survey Team

1. Objectives

The "Japan-Singapore AI Center (tentative name)" (hereinafter referred to as the "AI Center") project-type technical cooperation program, through which Japan is to provide technical assistance related to expert system-based artificial intelligence (AI) to Singapore, has the following objectives.

- (1) Japan will transfer technology related to expert system-based AI to Singapore.
- (2) Japan will train knowledge engineers to a technical level sufficient for constructing expert systems to be operated by Singapore.

2. Project Outline

Singapore will provide an environment for the development of expert systems as well educational facilities for an AI center to be established for training Singaporean knowledge engineers. At this center, trainees will be able to receive technical guidance by attending special lectures and expert system development workshops presented by Singaporean instructors who were trained by Japanese experts. In this way, technology related to expert system-based (AI) will be transferred from Japan to Singapore.

3. Project Plan

(1) Comprehensive schedule
See Table 1.

(2) Cooperation period
Five years from the time when the R/D is concluded.

4. Study and Training Plan

The following four educational courses will be established to train knowledge engineers.

(1) Expert System Development Applied Workshop

To enable high-level system engineers to master the techniques required of knowledge engineers, this course will provide study and training based on hands-on workshops in which expert systems actually are developed. These workshops will cover such topics as the expert system development process, system evaluation techniques, and so on.

In addition, to provide information related to expert system-based AI techniques, lectures will be presented together with hands-on workshops, covering such topics as an overview of AI, an overview of expert systems, languages used for AI, and so on.

The principal object of the study and training is to provide practical experience through hands-on workshops.

(2) Expert Systems for Business Professionals

To expand the practical application of expert systems to a wide range of industries, this course will provide business people having professional experience in various fields with an overview of AI (including expert systems), teach them analysis and design methods applied to expert systems, and, through hands-on expert system development workshops, enable them to understand how to incorporate their own skills and experience in expert systems.

(3) Overview of AI for Information Processing System Managers

To accelerate the spread of expert system-based AI technology to the field of information processing, this course will provide information processing system managers with general knowledge about AI (including expert systems) and information about installation requirements to enable them to make informed decisions as to whether expert systems can be applied in their own businesses.

(4) Expert System Research

To further improve the technical ability of trainees who have gained actual experience in business situations after completing the course entitled, "Expert System Development Applied Workshop" described above in (1), this course will familiarize trainees with the latest technical trends and provide them with skills that will enable them to play leading roles in the development of expert systems.

5. Personnel Assignments (See Table 1.)

The Japanese staff, by creating the curriculum, training the instructors, and so on, will solely assist in providing the

capability wherein the Singaporean staff ultimately will be able to operate the center alone. The Japanese staff will not directly engage in research. Singaporean instructors will guide researchers.

(1) Long-term assignment (See Table 3.)

- . Chief advisor 1 person
- . AI and expert system development experts 4 persons
- . JICA coordinator 1 person

(2) Short-term assignment

To transfer specialized knowhow in specific fields to the AI Center, additional Japanese specialists will be assigned when necessary.

6. Acceptance of Singaporean Instructors

Before the inauguration of the AI Center, candidates for instructors from Singapore will undergo training in Japan. These staff members will be trained so that, upon their return to Singapore, they will form the core group of the staff that will operate the AI Center.

In addition, after the establishment of the AI Center, further training, as described below, will be provided in Japan to upgrade the Singaporean staff.

- . Initial training
- . Upgrading training

7. Equipment Furnished

Principal furnished equipment

- (1) Computer hardware and software
 - . Engineering workstations (EWS)
 - . Local area networks (LAN)
 - . Expert system shells
 - . Computer languages
 - . Technical manuals
- (2) Educational equipment
 - . VCRs
 - . Monitor TVs

Table 1 Comprehensive Schedule

Activity	1st year	2nd year	3rd year	4th year	5th year
Overall planning	Preparation period ← →	Inauguration of center and implementation of training course △ ← → Establishment			
(1) Equipment (computers, etc.)	Contract /	Preparation Start of operation △ Delivery			
(2) Assignment of specialists ① Long-term assignment • Chief advisor (1 person) • Coordinator (1 person) • Experts (4 persons) ② Short-term assignment • Specialists					
(3) Training courses ① Expert system development applied workshop ② Expert systems ③ AI overview ④ Expert system research					
(4) Training of instructors in Japan ① Initial training ② Upgrading training	← →				

Table 2 Overview of Training Courses

Course name	Training period	Principal training topics
Expert System Development Applied Workshop	6 months	<ul style="list-style-type: none"> ① Expert system development applied workshop ② Overview of AI (including expert systems) ③ Overview of expert system construction support tools ④ AI languages
Expert Systems for Business Professionals	2 months	<ul style="list-style-type: none"> ① Overview of AI (including expert systems) ② System analysis and design methods ③ Expert system development applied workshop
Overview of AI for Information Processing System Managers	3-5 days	<ul style="list-style-type: none"> • Overview of AI (including expert systems)
Expert System Research	6 months	<ul style="list-style-type: none"> ① Latest technical trends ② Expert system development applied workshop

Table 3 Areas of Expertise of Assigned Staff

No.	Areas of expertise
1	Chief advisor
2	AI in general and expert system construction support tools
3	Expert systems and expert system construction support tools
4	EWS in general and expert system construction support tools
5	Expert system shells for EWS and expert system construction support tools

「日本－シンガポール AIセンター（仮称）」プロジェクト方式技術協力実施案

平成元年2月

JSAIC 事前調査団

1. 目的

「日本－シンガポール AIセンター（仮称）」（以下、AIセンターと略す。）プロジェクト方式技術協力は、日本からシンガポール国に対し、エキスパートシステムを中心としたAI（人工知能）に関する技術援助を行うものであり、その目的は以下の通りである。

- (1) エキスパートシステムを中心としたAIに関する技術を、日本からシンガポール国に移転する。
- (2) シンガポール国が実施する、エキスパートシステムを構築できる技術レベルを有する知識情報処理技術者の育成を、日本が支援する。

2. プロジェクト概要

シンガポール国が同国の知識情報処理技術者育成を行うため開設する、AIセンターに対し、エキスパートシステムの開発環境及び教育用設備を提供する。ここでは、日本人エキスパートの指導を受けた現地人インストラクタの下で、専門的な講義及び演習用エキスパートシステムの開発実習を行いながら技術指導を受けることができる。これによりシンガポール国はエキスパートシステムを中心としたAIに関する日本からの技術移転を受けることになる。

3. 事業計画

(1) 総合スケジュール

表1参照

(2) 協力期間

RD締結から5カ年

4. 研修コース概要（表2参照）

以下の4つの研修コースを設定し、知識情報処理技術者の育成を行う。

4.1 エキスパートシステム開発実習コース

上級システムエンジニアに対し、知識情報処理技術者としての技術を修得させるため、エキスパートシステム開発手順、システム評価技術等、実際に演習用のエキスパートシステムの開発実習を主体とした研修を実施する。

また、エキスパートシステムを中心としたAI技術に関する知識を修得させるため、AIの概要、エキスパートシステムの概要、AI用語等についても実習を交えた講義を行う。

研修に当っては、実習を主体とした実務的技能の養成に主眼を置くこととする。

4.2 実務専門家のためのエキスパートシステムコース

幅広い産業界におけるエキスパートシステムの適用を拡大するため、実際に各専門分野での経験を有する専門家に対し、AI（エキスパートシステムを含む。）の概要、エキスパートシステムへの適用方法を修得させるとともに、エキスパートシステムの開発実習を行わせ、自己の持つ技能をいかにシステム化するかを理解させる。

4.3 情報処理システム管理者のためのAI概要コース

情報処理分野においてエキスパートシステムを中心としたAI技術の普及を加速するため、情報処理システムの管理者にAI（エキスパートシステムを含む。）の一般知識、導入のポイント等を修得させることによって、業務への適用等に役立てられるようにする。

4.4 エキスパートシステム研究コース

4.1のコースを修了した後、実務経験を経た技術者に対し、さらに高度な技術力を育成するため、最新の技術動向を修得させるとともに、エキスパートシステムの開発において指導的役割を果たせる能力の育成に努める。

5. 要員派遣（表1参照）

日本人スタッフはカリキュラムの作成、インストラクタの指導等を行いながら、最終的にシンガポール国側のみでセンターの運営が行える能力の育成を支援する。日本人スタッフは直接研修を実施するのではなく、現地人インストラクタが研修者指導に当たる。

(1)長期派遣（表3参照）

- | | |
|-------------------------|----|
| ・チーフアドバイザー | 1名 |
| ・AI及びエキスパートシステム開発エキスパート | 4名 |
| ・JICAコーディネータ | 1名 |

(2)短期派遣

特定分野のノウハウをAIセンターに移転するため、日本人のスペシャリストを派遣する。

6. 現地人インストラクタの受入

AIセンター開設に先立って、シンガポール国からインストラクタ候補者を受け入れ、日本において研修を受けさせる。これらの要員は帰国後、AIセンターの運営に当たる中核的なスタッフとして活躍できる様、日本側が養成する。

また、AIセンター設立後もシンガポール人スタッフの質的向上を図るべく、日本での段階的な研修を実施する。

- ・導入研修
- ・グレードアップ研修

7. 機材供与

・主な供与機材

①コンピュータハードウェア及びソフトウェア等

- ・EWS（エンジニアリングワークステーション）
- ・LAN（ローカルエリアネットワーク）
- ・エキスパートシェル
- ・コンピュータ用言語
- ・テクニカルマニュアル

②教育用設備

- ・VTR
- ・モニタTV

表1 総合スケジュール

事業内容	第1年目	第2年目	第3年目	第4年目	第5年目
総合計画	準備期間 ←————→	▲ センター運営 設立		研修コース実施	←————→
(1)機材 (コンピュータ等)	契約 設営 △ △△▲ 搬入	▲ 運転開始			
(2)専門家派遣					
①長期派遣					
・リーダー 1名	←————→				
・コーディネータ 1名	←————→				
・エキスパート 4名	←————→				
②短期派遣					
・スペシャリスト		←————→			
(3)研修コース					
①エキスパートシステム 開発実習コース		←————→			
②エキスパートシステム コース			←————→		
③A I 概要コース	←————→				
④エキスパートシステム 研究コース					←————→
(4)インストラクタ日本研修					
①導入研修	←→				
②グレードアップ研修		←→	←→	←→	←→

表2 研修コース概要

コース名	研修期間	主要研修項目
エキスパートシステム開発実習コース	6ヵ月	①エキスパートシステム開発実習 ②AI（エキスパートシステム含む。）の概要 ③エキスパートシステム構築支援ツールの概要 ④AI用語
実務専門家のためのエキスパートシステムコース	2ヵ月	①AI（エキスパートシステム含む。）の概要 ②システム分析設計手法 ③エキスパートシステム開発実習
情報処理システム管理者のためのAI概要コース	3～5日	・AI（エキスパートシステム含む。）の概要
エキスパートシステム研究コース	6ヵ月	①最新の技術動向 ②エキスパートシステム開発実習

表3 派遣スタッフの専門分野

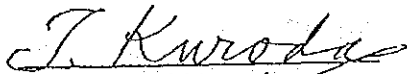
No	専門分野
1	チーフ・アドバイザー
2	AI全般及びエキスパートシステム構築支援ツール
3	エキスパートシステム及びエキスパートシステム構築支援ツール
4	EWS全般及びエキスパートシステム構築支援ツール
5	EWS用エキスパートシェル及びエキスパートシステム構築支援ツール

MINUTES OF MEETING
BETWEEN THE JAPANESE PRELIMINARY SURVEY TEAM
AND THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF THE REPUBLIC OF SINGAPORE
ON THE TECHNICAL COOPERATION FOR THE PROJECT
ON JAPAN - SINGAPORE AI CENTRE

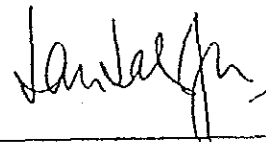
The Japanese Preliminary Survey Team (hereinafter referred to as "the Team") organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Teppei Kuroda, Director, Data Processing and Service Office, Data Processing Administration Division, Minister's Secretariat, MITI visited the Republic of Singapore from 20 February to 24 February, 1989, for the purpose of clarifying the outline and background of the Singaporean proposal as well as studying the feasibility of the Japanese Project-type Technical Cooperation for the Project on Japan-Singapore AI Centre. During its stay in Singapore, the Team had a series of discussions to exchange views on the Project with the officials of the National Computer Board, Ministry of Finance (hereinafter referred to as "NCB"), and also made a field survey to the proposed project site and the relevant facilities.

As a result of the discussions, both parties reached understandings concerning the matters referred to in the document attached herewith.

Singapore, 24 February, 1989



Mr. Teppei Kuroda
Leader,
Preliminary Survey Team,
Japan International
Cooperation Agency,
Japan



Mrs. Chin Tahn Joo
Leader,
NCB AI Team,
National Computer Board,
Ministry of Finance,
Republic of Singapore

THE ATTACHED DOCUMENT

Japanese Preliminary Survey Team

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Deputy Director, IT Manpower Department

Mr Lim Joo Hong
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NCB's Proposal

The discussion began with a presentation by NCB of their proposal for the setting up of the Japan-Singapore AI Centre (hereinafter referred to as "the Centre") with Japanese assistance. The objective of the Centre proposed by NCB was to provide an environment for the development of Expert Systems applications, training of skilled engineers and the development of software engineering tools to help in Expert System development.

The Team's Counter-Proposal

The Team explained the procedure for the Project-type Technical Cooperation. NCB understood this procedure. The Team then presented their counter-proposal for the establishment of the Centre. This proposal emphasised the role of the Centre as a training centre. The Team explained that recruitment of experts in Japan to help in development of prototype Expert Systems would be difficult.

NCB's Response

NCB commended the Team for its excellent counter-proposal and welcomed Japanese assistance in setting up such a training centre. NCB views the incorporation of prototype development expertise as important. This will prepare the Centre to evolve into a key component of the centre of excellence in AI development in Singapore. NCB therefore suggested the Team consider including Expert System development in the later part of the period of technical cooperation.

Conclusion

In view of the counter-proposal suggested by the Team and the feedback from NCB about the counter-proposal, both sides agreed that time was needed for each side to study the proposals further. Both sides agreed to exchange views as soon as possible through the Singapore office of JICA.

The following pages summarise the tentative agreements reached by both sides and also requests made by NCB.

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Tentative Proposal

1. Name of the Project :

Project-type Technical Cooperation on Japan-Singapore AI Centre (hereinafter referred to as "the Project").

2. Implementation Agency of the Project :

National Computer Board of Ministry of Finance.

3. Duration of the Project :

The duration of the technical cooperation by the Government of Japan would be five (5) years from the date agreed by both sides in the Record of Discussions (R/D).

4. Site of the Project :

The Team visited the site of the Centre for Information Technology (CINTECH) II Building, that is currently being constructed by the Jurong Town Corporation (JTC) in the Science Park, as a probable site for the Centre. Construction work on CINTECH II Building is expected to be completed by August 1990.

5. Brief Outline of the Centre :

The Centre will be operated on the following guidelines:

1) Objective

Both sides agreed that the Centre will help in transferring technology related to Expert Systems-based AI from Japan to Singapore. It will do this by training local engineers in Expert Systems-based AI to a technical level sufficient to allow them to construct and maintain Expert Systems in Singapore.

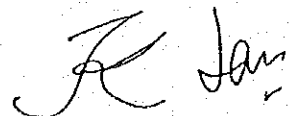
NCB also suggested that the Centre should consider engaging in some development of prototype Expert Systems later during the period of cooperation, once the critical mass of engineers capable of building such systems has been built up.

2) Function and Activities

In order to meet the training objective of the Centre, the following training courses will be conducted:

- a) Expert System Development Applied Workshop.
- b) Expert Systems for Business Professionals.
- c) Overview of AI for Information Systems Managers.
- d) Expert Systems Research.

The contents of these courses is shown in Annex A.



NCB also requested that the Team consider if it might be possible for the Japanese experts in the Centre to advise their Singaporean counterparts on project management and design issues during the phase when the Centre also engages in prototype development. The actual work of building the prototype would be done by trainees under the supervision of the Singaporean counterparts.

3) Organization

The organization chart of the Centre is shown in Annex B.

6. Brief Outline of the Project

NCB requested the project-type technical cooperation which consists of dispatch of Japanese experts, provision of equipment to the Centre and acceptance of the Singaporean counterpart personnel for training in Japan.

1) Objective

The objective of the Project is to transfer appropriate technology to the Singaporean counterpart in the field of Expert Systems-based AI technology so as to enable them to carry out the activities of the Centre.

2) Scope of the technical cooperation

a) the fields of technology transfer

The appropriate technology transfer to the Singaporean counterpart will be for the following fields :

Expert Systems construction techniques.
Use of Japan-supplied hardware and software for the above.
Latest technical trends in Expert Systems-based AI.

b) Dispatch plan of Japanese experts

Japanese experts will be required to fill the following roles:

Chief Advisor;
Expert in AI in general and Expert System construction support tools;
Expert in Expert Systems and Expert System construction support tools;
Expert in EWS in general and Expert System construction support tools;
Expert in Expert System shells for EWS and Expert System construction support tools;
JICA Coordinator.

Other skills required include project management and design of Expert Systems.



Other Japanese experts will be needed for short-term assignments (about 2 weeks long) during which they will conduct seminars and offer specialised consultation.

NCB requested that if the NCB proposal to incorporate prototype development work during the later phase of the Project is accepted, some of the Japanese experts will also need extensive project management skills and Expert System development experience.

c) Training plan of the Singaporean counterpart personnel in Japan

Before the inauguration of the Centre, the Singapore staff will undergo training in Japan. On their return, these staff will form the core group of the staff that will operate the Centre.

In addition, after the establishment of the Centre, further training will be provided in Japan to the Singapore staff to upgrade their skills.

In view of the requirement for practical experience on the part of the Singaporean counterparts, NCB requested that hands-on experience to build practical Expert System projects in the industry be arranged for the Singaporean counterparts during their training in Japan.

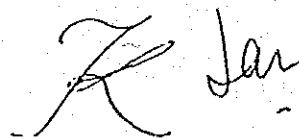
d) Provision of equipment by Japan

A study will be carried out later to provide the detailed specification of the computer equipment needed. This will be done with the inputs of Japanese experts. The computer equipment required is likely to include engineering workstations (EWS), local area networks (LAN), Expert System shells, computer languages and technical manuals.

NCB also requested that 30% of the budget for hardware and software be set aside for the acquisition of new hardware or software during the later stage of the Project. This is to ensure that the Centre will be equipped with state-of-the-art hardware and software throughout the entire period of cooperation.

Educational equipment in the form of VCRs and monitor TVs will also be provided.

The tentative implementation plan of the Project is shown in Annex C.

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ANNEX A : Course Outlines

Expert System Development Applied Workshop

To enable high-level system engineers to master the techniques required of knowledge engineers, this course will provide study and training based on hands-on workshops in which expert systems actually are developed. These workshops will cover such topics as the expert system development process, system evaluation techniques, and so on.

In addition, to provide information related to expert system-based AI techniques, lectures will be presented together with hands-on workshops, covering such topics as an overview of AI, an overview of expert systems, languages used for AI, and so on.

The principal object of the study and training is to provide practical experience through hands-on workshops.

Expert Systems for Business Professionals

To expand the practical application of expert systems to a wide range of industries, this course will provide business people having professional experience in various fields with an overview of AI (including expert systems), teach them analysis and design methods applied to expert systems, and, through hands-on expert system development workshops, enable them to understand how to incorporate their own skills and experience in expert systems.

Overview of AI for Information Processing System Managers

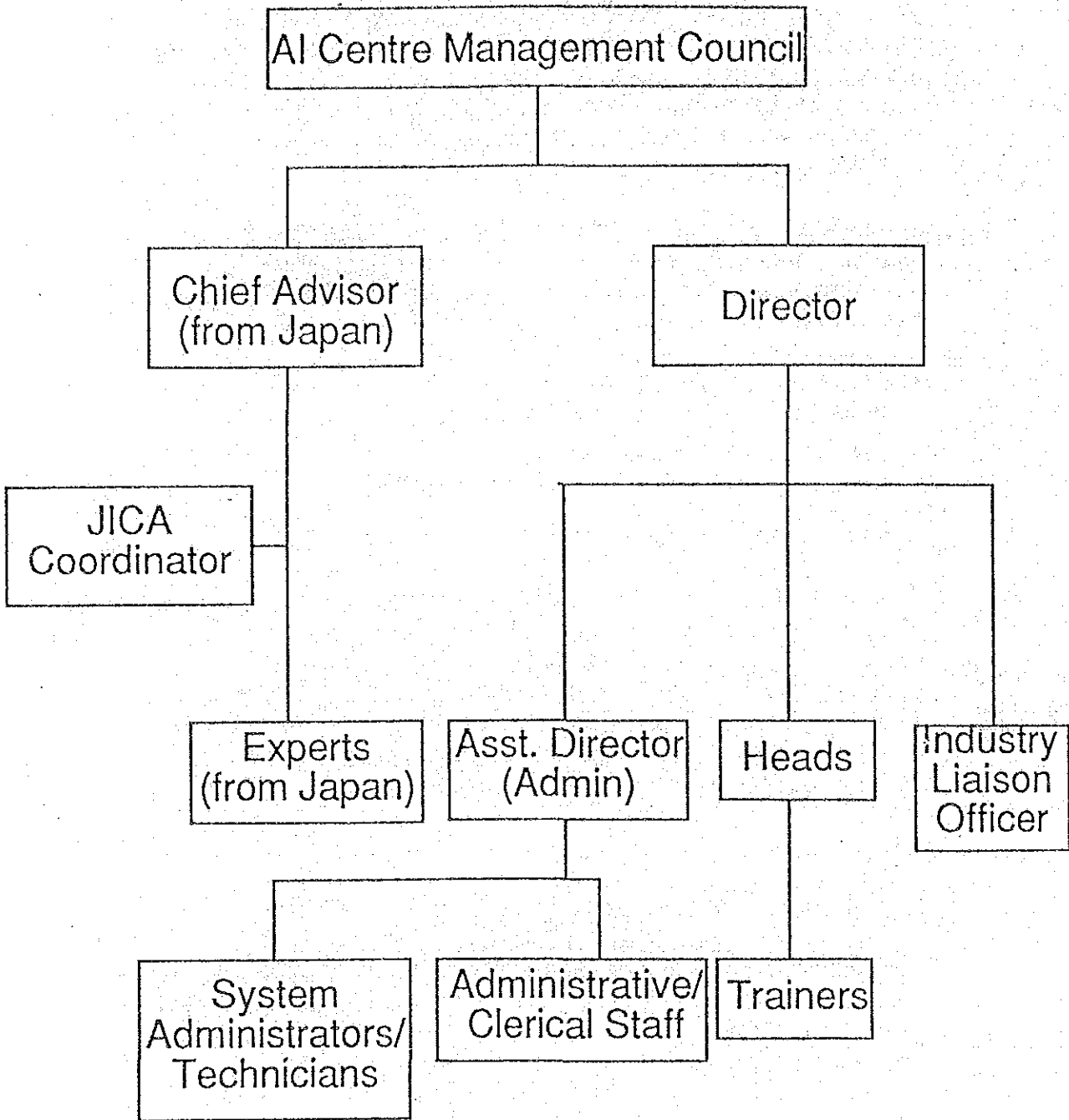
To accelerate the speed of expert system-based AI technology to the field of information processing, this course will provide information processing system managers with general knowledge about AI (including expert systems) and information about installation requirements to enable them to make informed decisions as to whether expert systems can be applied in their own business.

Expert Systems Research

To further improve the technical ability of trainees who have gained actual experience in business situations after completing the course entitled, "Expert System Development Applied Workshop" described above in Annex A, this course will familiarize trainees with the latest technical trends and provide them with skills that will enable them to play leading roles in the development of expert systems.



ANNEX B: Organisation of the Centre



R Jan

ANNEX C: Tentative Implementation Plan

Activity	1st year	2nd year	3rd year	4th year	5th year
Overall planning	Preparation period ←→	Inauguration of center and implementation of training course △ Establishment ←→			
(1) Equipment (computers, etc.)	Contract △ Delivery	Preparation △ Start of operation			
(2) Dispatch of Japanese experts					
① Long-term experts • Chief advisor (1 person) • Coordinator (1 person) • Experts (4 persons)		←→	←→	←→	←→
② Short-term experts • Specialists		←→	←→	←→	←→
(3) Training courses					
① Expert system development applied workshop		←→	←→	←→	←→
② Expert systems			←→	←→	←→
③ AI overview		←→	←→	←→	←→
④ Expert system research					←→
(4) Training of instructors in Japan					
① Initial training	←→				
② Upgrading training		←→	←→	←→	←→

K. Jan