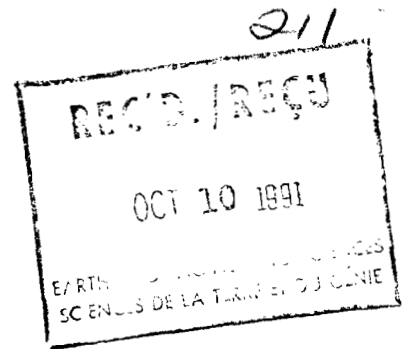




**EVALUATION OF
TECHNOLOGY TRANSFER PROJECTS FOR
SMALL AND MEDIUM SIZED INDUSTRIES IN
SINGAPORE, MALAYSIA AND THAILAND**

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EXECUTIVE SUMMARY

During the past eight years IDRC has supported a series of four Technology Adoption Projects in Malaysia, Singapore and Thailand. The projects were undertaken to do an indepth survey and develop economic and needs profiles for Small and Medium Scale Enterprises (SMEs) in each country, to assess the capabilities of SME support institutions in each country, to recommend a framework for improving the access and linkages required to provide technology support to SMEs, and to design and conduct operational tests for new delivery systems. To date the Malaysian projects are complete, however the Singapore project will be complete by year end, and the Thailand project is currently requesting Phase II funding to conduct operational testing.

While the results obtained from the projects have met the stated objectives, the emphasis has been in data gathering and tabulation, similar to a market survey, to develop the SME profiles. The remaining activities have received less attention. Many SME needs and problems can be defined and classified as common to all companies regardless of where they exist with specific needs dependent upon the uniqueness of the industrial sub-sectors and particular cultural differences between regions.

The project design criteria would have provided more timely and unique results by doing a much reduced needs survey. This could be accomplished by focusing on public and private support institutions available to SMEs and the determinations of their effectiveness, ability to respond and identification of what is missing in each country. The activity of determining SME needs is an ongoing program activity which can be incorporated into the normal technology support system provided by delivering organizations. The projects have shown this to be an effective method of promoting services, training staff and identifying potential clients.

The selection of project partners is crucial to project success. In an effort to increase the possibility of project continuity and full implementation with long-term benefit, the recipient selection criteria must consider the ability of the organization to develop support, and

consensus and provide the kind of extended project support which can have a lasting impact. From this perspective project results vary, however the Thai project would appear to have the most potential for lasting benefit consistent with IDRC objectives.

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OVERVIEW OF THE PROJECT

During the past eight years the International Development Research Centre (IDRC) has funded a series of projects concerning Technology Adaptation by Small and Medium Scale Enterprises (SMEs) under the mandate of the Technology and Local Enterprises Program (TLEP) of the Earth and Engineering Sciences Division (EESD). These research projects, conducted on a collaborative basis, have joined two research teams from Canada (University of Saskatchewan and Saskatchewan Research Council) with cooperating organizations from three countries, Malaysia, Singapore and Thailand, to examine the technology needs of SMEs in each country and the existing technology assistance framework for SMEs, review alternative models of technology transfer processes and to develop models of linkages among technology developers, technology users and technology disseminators.

The specific projects considered in this report include Malaysia Phase I (84-1048), Malaysia Phase II (85-1033), Thailand Phase I (87-1034), and Singapore (87-1052). Only Singapore remains to be completed with approximately 60 percent of funds expended to July 31, 1991 and completion, with final report projected for December, 1991.

PROJECT OBJECTIVE

The principal objective of this study was to evaluate the effectiveness of a series of projects concerning Technology Adoption and Small and Medium Scale Enterprises, to provide EESD management and program staff with a retrospective and analysis on projects supported to date and suggestions for possible future directions.

CONSULTING ASSIGNMENT AND METHODOLOGY

The assignment to John Holub of Technology Services Group Inc. (TSG) was to review the available project documentation including summaries, final reports and file data; hold discussions with EESD staff, recipient institutions, project leaders and researchers in both

Canada and in the listed developing countries; and visit and hold discussions with owners of SMEs and government ministries.

Specific tasks include the preparation of a report which provides:

- a) An evaluation of research methodology, including the novelty of approach and the scientific and technical merit.
- b) An evaluation of the projects contribution in building up research capacity and capability in the recipient institution.
- c) An evaluation of the research institutions and research participation.
- d) A review of the quality of the face to face collaborative aspects of the projects and relationship between partners.
- e) An evaluation of the training activities for utilization of the results.
- f) An evaluation of the suitability of the research methodologies and of the project achievements as compared to their stated objectives.
- g) An assessment of the potential for application of research results both short-term and with regard for sustainability.
- h) An overall evaluation of the approach to technology transfer problems.
- i) A determination of the significance of concerns for proprietary knowledge, e.g., patents or licensing of technology.
- j) consideration regarding environmental questions and activities of SMEs.
- k) consideration of the attention given to the role of women in technology adoption.

The project requirement included a visit to Saskatoon, Saskatchewan to meet with project leaders from the University of Saskatchewan and the Saskatchewan Research Council to hold direct discussions regarding the four projects. IDRC project files were reviewed in Ottawa followed by direct discussion with IDRC staff prior to travelling to Singapore, Kuala Lumpur and Bangkok to visit recipient institutions in each country and to conduct discussions with project leaders and researchers. On-site visits included discussions with

relevant government ministry officials, discussions with various support institutions for SMEs, and factory visits and discussions with owners of SMEs in each country.

A verbal report on the project was provided to IDRC staff in Ottawa following the on-site visits.

PROJECT I

TECHNOLOGY ADOPTION BY SMEs IN MALAYSIA (Phase I & II)

RESEARCH OBJECTIVES - PHASE I

- Development of SME profiles
- Determination of the relative economic performance of SMEs within four priority industrial sub-sectors
- Development of interview guides for SMEs and SME support institutions
- Validation of research methodology through pilot study.

RESEARCH OBJECTIVES - PHASE II

Overall Objectives:

To understand the processes of technology acquisition and adoption with SMEs in Malaysia and to develop a framework for more effective flow by completing the following:

- To review the levels of technologies utilized by the SMEs within the four manufacturing sub-sections; light engineering, construction materials, wood based products and food processing.

- To review the processes of technology selection and acquisition of SMEs, focusing on interaction between the SMEs and research institutes.
- To identify the technical, financial and managerial constraints to the adoption of particular technological improvements by SMEs in Malaysia.
- To assess the capabilities of SME-support institutions.
- To suggest a framework for improving the technological competitiveness of Malaysian SMEs through better linkages among all institutions bearing on the process of technology development and technology utilization.

COOPERATING INSTITUTIONS

1. Institut Teknologi MARA (ITM)
Shah Alam
Selangor, Malaysia
2. Universiti Pertanian Malaysia (UPM)
Serdang, Selangor
Malaysia
3. Saskatchewan Research Council (SCR)
30 Campus Drive
Saskatoon, Saskatchewan
S7N 0X1
4. University of Saskatchewan (U of S)
Saskatoon, Saskatchewan
S7N 0W0

For the purpose of this evaluation Phase I and II will be addressed as a single project as Phase I essentially developed and tested the methodology as a pilot study exercise, while Phase II produced the data and research results leading to the final conclusions and recommendations.

PROJECT II

TECHNOLOGY ADOPTION BY SMEs IN THAILAND

RESEARCH OBJECTIVES

Overall Objectives:

- To design a system for improved access and adoption of technology by focusing on the efforts of SME support institutions directed toward the individual SME.
- To conduct an operational test of the system.

Specific objectives include the following:

- An economic performance review of the SMEs within the Thai manufacturing sector in general and also within four priority sub-sections.
- Development of a common database on technology needs of SMEs and their interaction with technology support institutions.
- Review of the capabilities and the scope of activities of technology support institutions and program activities directed toward SMEs.
- Review of the policy framework of the Thai SME support system within both the public and private sectors to establish parameters within which improvements can be made.
- Designing a test system for improved access and adoption of technology including consideration of various mechanisms for improving the cooperation between different SME support institutions.

COOPERATING INSTITUTIONS

1. Industrial Development Centre
Department of Industrial Promotion (DIP)
Rama 6 Road, Bangkok
Thailand
2. Technonet Asia
291 Serangoon Road
Singapore 0821
3. Saskatoon Research Council (SRC)
30 Campus Drive
Saskatoon, Saskatchewan
4. University of Saskatchewan (U of S)
Saskatoon, Saskatchewan
S7N 0W0

PROJECT III TECHNOLOGY ADOPTION BY SMEs IN SINGAPORE

RESEARCH OBJECTIVES

Overall Objectives:

- To identify the characteristics of SMEs successful in the adoption of technology.
- To design and conduct an operational test of a system designed to see how the Singapore Institute of Standards and Industrial Research (SISIR) can improve the effectiveness of its technology assistance to SMEs based on the findings.

Specific sub-objectives include:

- To develop diagnostic tools that can be used to derive the technological needs of SMEs from the perceived problems/opportunities.
- To analyze the data in terms of successful SMEs vs. unsuccessful SMEs.
- To design a technology delivery system capable of enhancing the performance of SMEs in the target manufacturing sub-sectors; and to evaluate the new technology delivery system on a limited number of SMEs in an operational setting including a cost benefit analysis.

COOPERATING INSTITUTIONS

1. Singapore Institute of Standards and Individual Research (SISIR)
2. Saskatchewan Research Council (SRC)
Saskatoon, Saskatchewan
3. University of Saskatchewan (U of S)
Saskatoon, Saskatchewan

EVALUATION

RESEARCH METHODOLOGY

Malaysia

The research methodology employed to generate the desired specific information focused on the development of a standardized interview form, as a collaborative activity in conjunction with the Malaysian partner institutions. This included the development of the questionnaire, selection of priority industries, selection of companies to be interviewed and the training of on-site interview staff. These activities are well known standard

techniques which are typically used in market research work to determine market needs. In this project the survey related to the unique industry requirements and technology use and adoption practices in Malaysia for specific, selected industry groups. The uniqueness of the research related to the standard, organized format to gather specific information of Malaysian SMEs and the specific local needs. SMEs regardless of which country they exist in, have for the most part very similar problems and needs; with their owners being subjected to the similar business pressures and technology upgrading needs; there are specific local business and cultural conditions with unique structural differences which require detailed analysis to determine effective means of providing technology support. There are also significant country to country differences in the number, type and effectiveness of support and research institutions providing assistance to SMEs.

The work as completed in Malaysia provides a profile of SME corporate development, their approach to technology adoption and use, perceived business opportunities, as well as methods of dealing with operational problem solving for a selected group of industry sectors. The analysis also includes a summary and review of SME support institutions, their area of activity and capability and perceived problems.

The research results provide a study and analysis of Malaysian SMEs and support organizations which adds specific knowledge with regard to their unique industrial mix, however it does not provide significant new insight into the field of providing support to SMEs. The conclusions result in recommendations that contain many of the elements of the support system which has been adopted and used through various institutions in Canada under the umbrella of the National Research Council's (NRC) Industrial Research Assistance Program (IRAP). This program, previously known as the Technical Information Services, offered an Industrial Engineering Service component both directly through NRC and through the Provincial Research Councils. The program offered technical information and in-plant assistance to diagnose problems and implement solutions, with several of the Provincial Councils taking a multidisciplinary approach to provide hands on direct assistance in technology support. The unique aspects of the recommendations relate to providing management and marketing support as part of a technology adoption

evidence

What about
choice of
subsections
would that
affect
results

assistance program as a state operated activity. It is recognized that these management support activities are required, however in other jurisdictions they are often provided for in other ways.

Thailand

The methodology employed during the Phase I project was in accordance with normal practises associated with the development and design of standardized interview questionnaires and guides for both the specific SMEs and the support institutions with the subsequent training, sampling and completion of the total survey. This work, while similar in nature and technique to that previously conducted in Malaysia, developed information specific to Thailand which has a very different industrial base and, even more important, is at a different stage of industrial development. Also, the Thai industrial support structure and institutions are unique. The exercise of defining the existing situation within the country is a first step in determining what the approach to the development of a workable national system based on regional and local direct SME support should be. → why?

A large number of common problems and basic SME shortcomings exist in individual firms that preclude the opportunity to upgrade the firms technological capability. These common limitations exist in firms located in both developed and underdeveloped countries, although the scope and level of company satisfaction may vary from country to country and the level of understanding of concepts and education related to technology may be significantly different.

The infrastructural inputs required, including financial assistance, access to information, and the availability of trained people to support technology development and management activities such as marketing and finance, etc., remain constant.

Singapore

The methodology employed reflects the experience and results of work conducted in Malaysia and Thailand. The method of approach and type of survey information developed provides specific performance data and perceived company problem and opportunity assessments for SMEs as previously developed, although specific to the selected industrial sub-sectors in Singapore. The profile data has been analyzed in this case to determine the elements leading to success. The SMEs which were surveyed represent, for the most part, industrial sectors at a different stage of development and satisfaction than that which exists in Malaysia and Thailand. The novel aspects of the research relate to the determination of why Singapore companies have progressed to the point of being able to act as effective, sophisticated subcontractors to a large cross section of multinational corporations, and whether a new formalized diagnostic survey guide can be effective in allowing SME support groups such as SISIR to be more effective in technology assistance projects.

Although various types of diagnostic tools are available and the elements are generally known, it has been tailored to this particular project and is directed specifically to the needs of Singapore which has a unique industrial mix. The development of a technology adoption action plan and technology delivery system have also been tailored to the specific industry needs which exist, and the institutional system at SISIR.

PROJECT CONTRIBUTION TO BUILDING RESEARCH CAPABILITY

The projects have provided new insight into the various types of technical and operational problems faced by SMEs in all their countries and their methods of coping. This has highlighted the areas of opportunity for support institutes to provide assistance, and supports the recommendations to be proactive and adopt new practises of reaching out and visiting companies as a normal course of providing assistance.

The research has shown the inadequacies of company based technical and other management capability and the lack of experienced well-trained people either available at the support institutions or to provide the necessary assistance.

The projects have contributed to recipient institutions in the following ways:

- Increased awareness and understanding of the nature and magnitude of problems faced by SME's in the adoption and use of technology.
- Researchers participated in the design of the process, interview questions and format.
- Interviewers were trained to conduct effective in-plant interviews.
- The ability of the recipient institutions to conduct other surveys of a similar type has been made possible through these projects thereby increasing their capacity and capability to do further research.

MALAYSIA

The research capability of both UPM and Teknologi MARA have been upgraded to a degree, however the carry over from the project has not been maintained at the same level as in Thailand and Singapore. The reason for this is mainly due to the types of institutions chosen to participate. At Teknologi MARA there have been a number of shifts in personnel resulting in a break in continuity whereas at UPM the project has provided the basis for additional work through their Small Business Development Centre.

THAILAND

The research capability of the Thai Department of Industrial Promotion has been increased in improving the capacity to determine industry needs. The group which has benefitted the most is the Textile Industry Division which provides services to the country's largest industrial sector. There is no question that of all of the participants in all of the projects this group has provided the most support and in turn gained the most. The project has provided the basis for a new perspective and insight on technology adoption

and development problems faced by local SMEs and produced a real ongoing sustained ability to conduct further work.

The projects have contributed to the recipient institutions by:

- Providing a greater understanding of SME operations and problems surrounding technology access, use and adoption.
- Researchers participated in project design and were trained and carried out in-plant interviews. This is a significant learning experience and will be retained.

SINGAPORE

The sustained capacity to conduct ongoing needs assessment and survey work has been absorbed into the organization at SISIR. They have in fact used this survey as a marketing tool for their services and have been quite successful in developing projects with companies that are being contacted. They intend to carry on with this activity.

As a result of the Project, SISIR has established a Technology Diagnostic Centre as a part of its ongoing activities and due to the proactive experiences gained through participation they are able to market government funding programs and support services while developing consulting projects which the companies require.

RESEARCH INSTITUTION SUPPORT

All of the participating institutions have supported the projects through a variety of ways including:

- The provision of staff to support the project work.

- Input in determining priorities.
- Selection of SME participants.
- Liaison with government officials and technology support institutions.

The institutional research teams worked well together and the projects were completed with each participant making a worthwhile contribution.

Certainly the most supportive partner has been Thai Textile Industry Division, dedicating a large number of staff and resources to the project.

In the case of Singapore, although the project results are positive, I feel that the reasons for delay in completing the project are due mainly to the lack of adequate provision of dedicated staff to complete the task in the projected time frames.

The liaison role undertaken by Technonet Asia included assistance in arranging for surveys of SME support institutions in other Asian countries. These activities were adequately supported.

COLLABORATIVE ASPECTS OF THE PROJECT

The projects were conducted with the Canadian partners providing the lead in planning and organizing the various activities. The process included the appointment of a consultative committee whose members were drawn from potential research results users. The committee's role was to review the proposed program and to provide input and information, while attempting to have the various players "buy in" to the projects.

MALAYSIA

The research team consisted of members of the four partners with the Malaysian members of the team providing the on-site staff to conduct interviews with SMEs. In addition the Canadian partners reviewed the pertinent literature and conducted the training seminars for interview staff.

The Malaysian research team conducted on-site visits to the Canadian partner organizations. The total research team also visited Japan and Hong Kong to meet with officials and discuss technology transfer models in current use.

A follow-up workshop, with the aim of developing an implementation plan, was conducted which included members of the research team, members of the consultative committee, Malaysian public officials and SMEs.

The systematic, formal approach taken in doing the survey was completely new to the Malaysian partners. The scope and content of the information, in particular the interrelationship of company activities and the formal methods for gathering the data had not been considered. Also, the proactive nature of the in-plant interview process had not been previously attempted.

The Canadian partners, through the direct hands-on approach, were able to guide the projects and provide a large amount of new information on technology transfer to the Malaysian members of the research team. Through a sharing of work, the research team and the consultative committee provided insight into the Malaysian industrial scene to all of the partners with the collaborative nature of the four-way relationship working well.

THAILAND

The project is an important factor in the development of an effective program for the Textile Industry Division. The level of understanding of how to determine industry needs

and develop an effective support program for SMEs was not appreciated to any degree before participation in this program. The face-to-face aspects of the project allowed the local interviewers and participants to gain a significant amount of technical and management comprehension which will be retained in the program.

SINGAPORE

The collaborative aspects of the project were important for SISIR in that it provided the staff with the opportunity to expand their knowledge of the technical and management inputs which are important to support local SMEs.

CONCLUSION

All of the partners including the Canadian organizations derive significant benefit from direct face-to-face mode of operation. There is ongoing linkage and activity that cannot be accomplished in any other fashion as major long-term benefit from the projects. Technology transfer takes place most effectively through this type of concerted, planned activity which also remains true for the said projects.

I recommend that for future projects of this nature, the majority of the activity be executed with the partners preparing, executing and analyzing the results, and maximizing the amount of direct face-to-face contact, for although the amount of time committed to this activity was adequate to complete the projects and meet the stated objectives, the lasting benefits could have been increased with more emphasis on this point.

TRAINING ACTIVITIES AND UTILIZATION OF RESULTS

The research results from the various activities provided a basis for a number of follow-up activities including:

- additional data collection
- seminars and workshops for CEO's and government officials
- a number of papers being written and presented in different forums
- the final written reports being distributed to a number of organizations and individuals, which can be used as the basis for further work.
- trained personnel resident in all the partner institutions who have greatly increased understanding and the ability to do future work related to surveys and participate in, and provide technology transfer assistance for industrial users. This also holds true for the Canadian partners and provides a benefit which flows in both directions.

Training activities and associated benefits, particularly in Thailand, have been substantial. Due to the initial level of understanding of the management and interview staff of the Department of Industrial Promotion, the project leaders understood the opportunity which was available to develop their program and train participants. As a result, a large number of human resources were dedicated to the project and the result is the continuing ability to popularize and disseminate results. The project has allowed the Department to make use of survey results in planning, modifying and delivering assistance programs.

CONCLUSION

- Although the activities of the program resulted in a number of specific recommendations the implementation of Phase II results has not as yet been achieved in Malaysia.
- The results reflect the general nature of the stated project objectives.

SUITABILITY OF RESEARCH METHODOLOGIES AND ACHIEVEMENTS

The research methodologies used in all the projects were consistent with the stated objectives. The focus of the project was to determine the present status and profile of SME development at the firm level and to determine the technology needs from the "demand side" followed by a review of the technology suppliers.

The sectoral approach to selection of companies was based on the relative importance of the chosen sectors to the economy (food processing, wood based products, construction materials, light engineering, textiles, precision engineering, etc.). Consideration was given to the nature and ownership of firms (Bumiputra or native Malay) and regional distribution and size.

The study of support institutions included a survey of all levels of institutional support including local, regional and national groups.

The needs as determined for the Projects reflect the fact that SMEs require:

- Information and awareness of new technology, products and processes
- Industrial engineering assistance for manufacturing management, quality control, production and inventory planning and control, and plant maintenance.
- Technical assistance for product and process development.
- Marketing management assistance.
- Financial management assistance.
- Improved linkages with both private and public support institutions.

- Human resources development assistance.

The specific information gathered regarding SME technology support institutions and program activities included:

- The type of programs and activities.
- Market response.
- Relationship with other support institutions.
- Program response by users.
- Obstacles to program effectiveness and development.
- Program marketing to SMEs.

Although the objectives of the project have been fulfilled, the area of policy review for Thai SME support systems requires more detailed analysis to initiate a well designed and coordinated national effort to provide the required resources and inputs to support SME development. **This area of activity and definition of the significant differences of types of support institutions, access to resources, access and availability of trained people from country-to-country are the most important activities.**

CONCLUSIONS

Malaysia

The projects provided an in depth review of the sought after statistical information regarding SMEs and support institutes resulting in a series of recommendations which addressed the technology adoption and use by SMEs. In Malaysia the State of Johore

is presently proposing to build an industrial technology park which will include a Local Technology Centre. The concept of a regional Centre is the result of recommendations made under the project, which would provide hands-on management support to SMEs. Due to financial considerations and ongoing discussion as to how it would be structured and staffed the project remains under active discussion.

Major impediments to the establishment of a regional Centre of this nature include:

- Financial considerations of who will pay for the services.
- Lack of trained personnel in various required disciplines to staff the Centres.
- A sponsoring body to create a national or regional program to lead and coordinate Centre development.

Thailand

The research methodologies employed have provided the information required to fulfil the project objectives. The results reconfirm the basic ongoing needs and requirements of Thai SMEs which as in all countries require management and technical inputs to supplement their internal staff and operational characteristics.

The major benefits from this project are yet to be achieved as both the design and implementation of the test system for the delivery of technology assistance has not been completed to date.

Singapore

The project results in Singapore, while providing added insight into the structure and needs of SMEs and the operation of support systems and institutions, have produced the most direct practical hands-on results. The interview and needs assessment has provided the opportunity for SISIR to identify SME requirements, discuss financial and consulting services available and market their services directly. The project continues to

be operated on this basis while providing the sought after information with regard to SMEs. This has been a very effective program for SISIR although it could have been completed in a more timely fashion.

POTENTIAL FOR APPLICATION OF RESEARCH RESULTS

MALAYSIA

The research results have documented a large amount of detailed information. The recommendations attempt to provide a framework for an improved system of providing technology and assisting in its application and use by SMEs.

The results have been cited as supporting information in a publication entitled, *Malaysia: Study on Small and Medium Enterprises with Special Reference to Technology* by the Asian Development Bank, April, 1990. The Asian Development Bank is apparently conducting a major study at the present time focusing on the role and effectiveness of technology development and support institutions for specific industrial sectors in Malaysia with a view to developing a model whereby these organizations can be more effective in serving industry needs. The two Canadian partners are directly involved as participants in this project.

The prospect of application of research results in the short term are mainly based on the Johore State proposal. Ideally in order to carry forward the program on a national basis the implementation would require a strong base of commitment and consensus for support at the appropriate decision-making level at the outset. The support should normally be from government officials, private sector groups and support institutes.

To maximize the potential benefits of the projects and ensure ongoing effort, the selection of partners and the development of a "champion" or lead person or group to promote the results is crucial to provide continuity.

Although the projects have been completed and the objectives met there has been limited follow through as the two Malaysian partners do not have the means or continuity within their own organizations to maximize results. In particular, in the case of Institut Teknologi Mara the participating staff has either moved or are pursuing other interests. At the Universiti Pertanian Malaysian, Dr. Ghazali, while maintaining interest and attempting to move the Johore State project forward, requires much more support in order to make an impact.

THAILAND

To date the Thailand Phase I Project has completed the SME needs assessment which has resulted in a number of trained and willing participants within DIP. In order to achieve any significant medium or long-term results Phase II of the project should be completed. Sustainability is dependent upon demonstrating a workable technology support system which is effective, provides the desired results and is supportable by government resources.

SINGAPORE

On a cost recovery basis for SISIR, this project has been quite successful. The institution and its programs, along with other government support programs are now much more widely known, with the project convincing SISIR to establish new technology support mechanisms and services through their Technology Diagnostic Centre as part of the Technology Adoption Program. The project has resulted in a number of consulting projects related to technology development, adoption, and quality control.

TECHNOLOGY TRANSFER APPROACH

MALAYSIA

The approach taken to improve the technology transfer support systems and solve technology adoption and implementation problems for Malaysian SMEs is, I believe, an appropriate model to follow. The need for easier access to well trained professional advisors and consultants is certainly an approach which has proven to be effective in other jurisdictions when considering government participation, however there are a number of additional requirements necessary to be effective, including:

- The availability of experienced personnel who can be effective in a hands-on role within the SMEs
- The appropriate trained and/or willing staff within the SMEs who can accept the technology changes to integrate and implement the improvements
- Some form of incentive or financial support to assist in deferring costs associated with technology upgrading or improvement
- Access to well trained professionals either technical or managerial, to support projects acting as private consultants or available to be hired as staff.

The development of a national program for Malaysian SMEs, all of which should have access to newer technology and assistance in technology adoption and application, will initiate a large number of ongoing projects which are capable of absorbing a tremendous amount of both human and financial resources. To implement a model for assistance as envisioned, to provide proactive, in-plant, hands-on support on a country wide basis, the problem becomes to find experienced locally based professionals who are prepared to visit the companies and who can be effective in offering advice. Because each business is unique, the technical needs are different and the solution to technical problems or

technical upgrading must be tailored and explained at the level at which the particular in-plant people can accept and absorb the information and assistance. In order to be effective the program must have experienced local multidisciplinary people who have access to resources such as technical and other information, laboratory and technical services, project financing funds, etc. In addition, the people supplying the services must be knowledgeable about where to obtain specialized assistance and be able to draw on, or refer clients to needed additional services.

Some of the limiting factors for assistance provided on this basis are the decisions regarding who will finance the program, the amount of payment or contribution from the SME for services rendered, the length of projects per company, and the prioritizing of which companies or industry groups will be served. In general the program would of necessity have to limit the projects to short-term assistance or short-term consulting, based on the availability of consulting staff.

PROPRIETARY KNOWLEDGE

The projects found very little concern with patents or licensing of technology among SMEs, although there is a desire among a percentage of the companies to initiate new product development.

ENVIRONMENTAL CONCERNS

There has been no consideration given to the environmental concerns or activities of SMEs during this study, although it is a major factor in the development of the textile industry in Thailand and the resources and food processing industries in Malaysia. Presently the Thai textile industry is limited in its development due to environmental constraints on the dying industry.

WOMEN IN TECHNOLOGY ADOPTION

The role of women in technology adoption has not been examined in the projects to date although a large number of women participated directly in the Thai project.

GENERAL COMMENTS

In considering the three projects it is instructive to look at the comparison of SME development and the operation of infrastructure and support systems for Malaysia, Singapore and Thailand.

SINGAPORE

The economy has many of the attributes of a developed country including the unique characteristics of being physically small, with a small highly motivated population. SMEs have ready access to well educated people, good training programs operated in a cooperative fashion between government and industry, and a prioritized well planned government and industrial strategy to work within. The infrastructure provides a good communications system which allows direct access to industrial information, technology support groups and private companies. Although there are shortages of skilled people, the SMEs encountered have all taken steps to add both technical and other middle management staff to their companies, and use consulting services regularly. The consulting services available locally are considered to be adequate for certain types of technology support such as quality control however specialized consultants are often recommended under the IDRC sponsored project, unfortunately these are usually Japanese and American consultants.

The government has invested heavily in the areas of communications, transportation and education directly involving industry groups and the SME community in the design and delivery of hands-on oriented training programs. These programs involve the active participation of multinational companies which place the latest equipment and technology

at the disposal of organizations providing the training. These programs have been highly successful resulting in a very effective technology transfer activity to provide an ongoing supply of well trained employees which allow SMEs to continually upgrade the technology within their own company. While Malaysia and Thailand are attempting to duplicate this activity they have tended to rely on programs which are designed and delivered by government organizations with minimal involvement of the private sector and SMEs in particular. Industry associations in Singapore tend to be strong and very proactive with a high level of participation by the individual owners. In contrast this does not hold true for Malaysia and Thailand.

Singapore companies are aware of the need for improved technology and increased ability to compete, and there is a significant desire to move from the mode of sub-contractors providing components and products designed and developed by large multinational companies to developing their own product lines with improved technology. There is an emphasis on entrepreneurship and sustained growth.

The government has provided support by developing funding programs and technical assistance to encourage SME development. The IDRC project has enhanced the delivery of assistance programs and provided the basis for an ongoing needs survey and marketing effort to promote both government funding for projects and SISIR's technical assistance support.

Although the support programs in Singapore contribute to SME development there remains a shortage of funding for SMEs as seed funding for new start-ups and new product and process development. As part of a program to encourage this type of development, an increased awareness to support technology development and adoption would include an increased management awareness of marketing and its significance in corporate performance.

While Singapore has managed to develop a successful strategy of home grown SMEs operating mainly in the electronics and electrical, plastics, metal finishing and food

processing sector built upon sub-contracting to large companies, Malaysia and Thailand SMEs are at a different stage of development and are pursuing strategies to mimic their success.

MALAYSIA

Malaysian SMEs represent a more diverse set of problems and opportunities. The complicating cultural and ethnic issues of different programs being available for select companies (Bumiputra or native Malay companies vs. non-Bumiputra) has the effect of uneven access to support for technology adoption. There are apparently government policy changes which will phase out this discrepancy.

SMEs in Malaysia have access to many sources of government sponsored assistance including technical, financial and training however the effectiveness, especially in the training area, is marginal at best. Generally the programs do not market themselves well and the program managers interviewed did not feel that the right people are participating. There is a strong emphasis on selecting and training entrepreneurs however there is little information available on program effectiveness. Although the government has invested heavily in training and education, the emphasis has been less concerned with hands-on, technical or trades related training programs although these are vital to SME development. There are presently approximately 40 organizations providing support services to Malaysian SMEs, many of which are attempting to duplicate each other's programs, specifically in the area of training. It appears they overlap to a large degree and operate with little direct industry input.

The availability of other support requirements which include, easy access to industrial information, demonstration equipment, laboratory and consulting services and well trained, competent, management, marketing and financial expertise is limited. There appears to be a growing government-industry consensus that the emphasis of support activities and organizations must change to achieve the desired economic goals.

Government policy is to encourage the development of SMEs to act as sub-contractors to the large multinational companies to gain access to technology and expertise in company operations such as production planning and control, quality control, cost control, human resource planning and utilization, etc. The intent is to develop and encourage entrepreneurs that will eventually develop Malaysian branded products and services with international recognition. There are a large number of multinationals operating in Malaysia however they do not sub-contract to local entrepreneurs to any great degree at this point. There is an ongoing effort to develop closer linkages and encourage this method of production.

The Malaysian SMEs have very few middle managers and technical support people. In order to undertake technology adoption projects one component is to have people on staff that can absorb the technology from the providing organization and incorporate it properly into the company. This is also true for Thailand.

THAILAND

The level of technical and technological development of Thai SMEs is to some degree comparable to that of Malaysia, however the amount of resources which have been designated to such areas as funding for new product development and human resources training have not been on the same scale. The needs of SMEs are similar however the population size, country size, and diversity of the industrial base make the problem more difficult to deal with. While the basic SME support requirements remain constant, the delivery systems, access to expertise and trained people, and access to information require structural changes and policy shifts to have a country wide impact. The fact that Thailand has approximately 95,000 SMEs compared with Singapore's 4,500 indicates the scale of the system design criteria. The added problems of a less educated population with limited access to industrial information, the added dimension of almost no awareness among SMEs of either the benefits of improved technology or how to acquire and use it and who to turn to for assistance, require a well supported multidimensional solution to make a real impact. The level of management awareness among SMEs of traditional

management techniques and operating procedures is generally higher in Malaysia and much higher in Singapore. The awareness of alternatives in those countries of public and private support services are also more generally accessible and available when a company encounters problems or wishes to adopt or develop new technology. A major challenge for Thailand is not only to design and implement technology adoption support systems but to market the services in a way which supports the total effort to increase the general knowledge and understanding by SMEs of the criteria for successful corporate development.

Thai SMEs have developed a large capability in the textile industry (37% of GNP) and a successful export based activity. The technology presently in use must be upgraded on a continuing basis if this industry is to sustain itself and grow. Presently many SMEs due to the low wage scale and other factors do not give priority to technology awareness and upgrading. The impact of the type of activity envisaged by the IDRC project is one component in the development of a support system which should encourage the use of private sector services while supplying government sponsored assistance.

CONCLUSIONS

The following conclusions are based upon a review of the relevant project documentation and the result of visits and discussions with project leaders and participants, selected SME owners and managers on site in their place of business, and government officials and support program managers providing assistance to SMEs in their respective country.

- The projects have provided detailed information regarding the present performance of SMEs and perceived needs for three different jurisdictions. While the information is valuable in acquainting the local partners, plus a portion of the SME industrial community and some government officials with specifics related to selected industrial sub-sectors, the exercise provides a base for analysis, discussion and consensus building to develop technology assistance programs. These programs may be designed to be more suited to the particular recipient country's industrial needs at the individual SME level as a result of the extensive information gathering exercise.
- The direct interview format provides the opportunity to train local partners in problem identification and needs assessment while exposing the interviewee to the programs and support systems available through various government and non government programs. This activity which could be classified as market research should, and can, be carried out as a normal course of selling technology support services to the SME industrial community.
- The survey work as conducted in each country has led to a much greater appreciation across a wide range of participating individuals and organizations of the contributions of SMEs and their input requirements for new technology adoption and organizational upgrading to improve their competitive performance. The support requirements generally include human resources upgrading and training, marketing assistance, financial assistance, quality control, industrial engineering,

new product and process development and access to technical and management consultants.

- Although the industrial sub-sectors chosen in Malaysia, Thailand and Singapore vary from country to country, the survey results indicate similar findings and experience among owners and managers of SMEs. Their perceived problems and present method of adopting technology present the opportunity to provide a more pro-active support and consultancy service which would include technical, marketing and management specialists and access to information and laboratory functions. The easy access to timely industrial information is crucial.
- The delivery of technology adoption support services should be through organizations which have many of the required resources available to the field staff contracting and identifying SME needs and projects. Organizations such as SISIR or TID are more able to respond quickly to industry needs than teaching institutions and government office based personnel as SME owners and managers expect and require rapid turnaround times.
- The support systems in place in each country vary widely in type, quantity, function, funding and quality. The policies in place in each jurisdiction are significantly different although the interest is to achieve similar goals. As a result, the activity of reviewing and recommending improvements for the SME support institutions, policies related to them, and the resource requirements and delivery systems is the crucial component for making a significant long-term difference in each country. This must be thoroughly considered at the outset.
- The recipient organizations in each country differ greatly from one another with respect to function, size and organization. For projects of this sort, the type and nature of the recipient organization is crucial to the project success when considering benefits such as project continuity, ability to influence government

policy changes, and the capacity to reach a wide audience in order to build consensus for project conclusions and implementation.

- The Thai project has been the most successful from the perspective of training, retention and carryover effect to the cooperating partner (TID). Project activities have provided a real revelation regarding SME problems, performance and opportunities. The project requires a higher profile within the government structure to garner added support.
- The Singapore project has been used by SISIR to market its own programs and consulting services and has had very few resources dedicated to the work. This has caused delays, and concurrently allowed the marketing effort to be extended. As SME needs are identified for technology adoption projects, they are either fulfilled by SISIR staff, directed to Singapore based consultants or referred to American and Japanese experts. There appears to be little concern for accessing Canadian resources.
- The Malaysian projects have resulted in a series of recommendations to implement a country-wide system to provide technology adoption assistance at the state and regional level. The ability of the cooperating partners (UPM and Teknologi MARA) to move the proposal forward and develop the consensus and support to influence implementation is limited. This highlights the need to undertake critical assessment of the project sponsors at the outset to evaluate their ability to maximize results.
- For both the Saskatchewan Research Council and the University of Saskatchewan the projects have resulted in a large number of both real and potential benefits that have followed from the Malaysian Project. These benefits which include new consulting arrangements and continuing opportunities for the development of future technology transfer projects in the region, are a direct result of the exposure and networking from the original projects.

- The projects have provided the basis for the implementation of similar survey work being conducted in Saskatchewan by SRC, which indicates a two-way flow of direct benefits.
- While technology transfer programs offering technical assistance are operating in other jurisdictions, a unique feature of the project recommendations is the formalized use of a specific diagnostic tool coupled with the provision of a multidisciplinary support service which includes management and marketing people.
- The accessing and delivery of industrial information is dependent upon a number of factors including finding the information by:
 - drawing on known information that the provider retains
 - searching information sources such as libraries, information data bases, publications, etc.
 - contacting resource people in their own organization or other public or private groups and arranging for discussions or requesting data
 - developing or generating the information specific to the problem.

This front end activity is required by the entrepreneur to assist in adopting new technology or solving a particular technical problem. The critical part of the adoption process however is that the provider is capable of understanding the need adequately to select the appropriate information and understand it well enough to explain the information directly to SME management at the level of understanding within that particular company and assist in its implementation. The latter activity is hands-on, and is normally carried out over a period of time as a face-to-face in plant activity.

- Recommendations resulting from projects, if they are to be integrated into the local industrial support system, should be compatible with the local infrastructure and preferably be able to be delivered by existing institutions which support the recommended activities.

RECOMMENDATIONS

- Future projects should be developed with an increased sensitivity to continuity and implementation by selecting partners which are able to develop consensus and lobby for implementation and the resources at the right level locally to maximize results.
- The surveys could be carried out in a more timely and cost efficient manner if desired by acknowledging the fact that common requirements for the support of SMEs exist regardless of where the companies are located and focusing on the specific types of technical, training and consultancy requirements of the region. This could be done using a short-term consulting format with a local organization, however this would be weighed against the loss of the local training component and linkage development, etc., of the format which was used.
- The concentrated effort of the projects has been to conduct the industrial survey work with an attempt to determine the status of the SME support institutions and their level of development and effectiveness, followed by recommendations for policy change, and implementation of operational improvements and the addition of new support groups, such as diagnostic centres. The final results obtained from the projects may have been improved by conducting a brief industrial needs survey for priority sub-sectors and establishing this activity as part of an ongoing effort to visit industry. This activity will establish ongoing contact to build experience and rapport between partner organizations and SMEs to promote services and programs and assist in their ongoing development.
- Research results implementation and use would be more likely to occur if more specific objectives and deliverables were developed as part of the initial research plan. The plan should include the expected numbers of people involved, amount of seminars or workshops, type of interactions between partners, etc. The

objectives as outlined in the projects were quite general and consequently the results reflect this.

- To maximize the training and technology transfer component of the projects between the Canadian partners and collaborating organizations it is imperative to structure the research plan to provide for the maximum amount of work occurring on a face-to-face basis.

APPENDICES

APPENDIX

SINGAPORE

In support of the evaluation, visits and discussions were completed with the following organizations:

Companies

1. Mr. Sunny Lee, Director/General Manager
Stamping Industries Limited
No. 20 Kallang Junction
Singapore
Products: Tooling and metal stamping
2. Mr. Roland Loo, Managing Director
Mr. Kenneth Liang Wai Yin, General Manager
Tat Seng Paper Containers (PTE) Ltd.
28 Senoka Drive
Singapore
Products: Corrugated cardboard cartons
3. Mr. H.C. Leong, General Manager
Mr. Anthony Ong, Managing Director
First Engineering Mould PTE Ltd.
996 Bendemeer Road
Singapore
Products: Plastic parts and moulds
4. Dr. Hari Gunasingham, Managing Director
Eutech Cybernetics
Blk 55, Ayer Rajah Crescent
Singapore
Products: Electronic process control and monitoring instruments

Support Organizations

1. Mr. Phang Cheng Kwang
Singapore Precision Tooling Association (SPETA)
15 Kallang Junction
Singapore
2. Mr. Jason Chun, Head CAD/CAM Clinic
Design Advisory Services
15 Kallang Junction
Singapore

3. Dr. C. Anton Balasuriya, Executive Director
Technonet Asia
291 Serangoon Road
Singapore
4. Teo Nam Kuan, Deputy Director, Technology Transfer Division
Mr. Seow Hang Pheow, Senior Consultant, Technology Transfer Division
Singapore Institute of Standards and Industrial Research
1 Science Park Drive
Singapore

MALAYSIA

Visits and discussions were completed with the following organizations:

Companies

1. Zainal Palil, Managing Director
Ganda Makmur Sdn. Bhd.
44330 Batang Kali
Ulu Selangor
Products: Saw milling and timber products
2. Abd. Razak Yusuff, Manager
Perabat Rayham Sdn. Bhd.
Jalan Cheras
Selangor D. Ehsan
Products: Wood furniture
3. Ross Karim, Managing Director
Fiezaratti Industries Snd. Bhd.
Jalan Merab
Selangor
Products: Food condiments

Support Organizations

1. Dr. Modh. Ghazali Mohayidin, Associate Professor
Universiti Pertanian Malaysia (UPM)
Selangor Darul Ehsan
2. Dr. Hamzah Kassim, Head Corporate Affairs Division
Abullah Zawawi Ali, Head Technology Transfer Division
Standards and Industrial Research Institute of Malaysia
Shah Alam

3. Dr. Hamat Haji Ghazali, Head of MEDEC
Adrian Alias, Senior Lecturer
Humam Bin Haji Mohamed, Senior Lecturer
Malaysian Entrepreneurial Development Centre (MEDEC)
4. Marzideal Bt. Mahmud, Assistant Director
National Productivity Centre (NPC)
Jolan Sultan
5. Fadzil Bin Hj. Ahmad, Senior Development Officer
Zainal Abidim Long, Deputy Director
Entrepreneurial Development Division
Majlis Amanah Rakyat (MARA)
6. Saadual Baharim Bin Abdul Mutalib, Principal Assistant Director
Lim Eng Kok, Assistant Director
Industrial Development Unit (SMI Unit)
Ministry of Trade and Industry
Jalan Data, Kuala Lumpur
7. Mat Hassan Esa, Manager Business and Entrepreneurs Development
Permadalan National Berhad (PNB) and Perbadanan Urahan National
Berhad (PUNB)
 - Function is to provide financing to Bumiputra companies
8. Iskandar Abdullah, Director
Small Business Development Centre
Universiti Pertanian Malaysia
9. Tuan Haji Johari Mdh., Senior General Manager
Johore State Economic Development Corp.

THAILAND

Visits and discussions were completed with the following organizations:

Companies

1. Pilan Dhammongkol, Factory Manager
Thong Thye Chiang
29 Saladaeng Rd.,
Bangkok
Products: Cotton dying

2. Vichae Cheravatana, Managing Director
Jutamas Co. Ltd.
Banga Phrakanong
Bangkok
Products: Garment manufacturer
3. Somaki Amorntrakui, Managing Director
Dhna Pong Co. Ltd.
Nares Road
Bangkok
Products: Polyester knits
4. Punchong Saksureemongkol, Managing Director
Data Home Products Co. Ltd.
Asoke-Dindaeng Rd.
Bangkok
Products: Wood cabinets
5. Kitti Petdasada, Managing Director
K.S.T. Plastic Blowpack Co. Ltd.
New Road 501
Bangkok
Products: Blow moulded plastics and extrusions
6. Suchitra Juengsamranphang, Managing Director
VSC Textiles Co. Ltd.
Bangkok
Products: Woven products

Support Organizations

1. Prani Obhasanond, Director
Nantaya Yanumet, Senior Scientist
Textile Industry Division (TID)
Department of Industrial Promotion (DIP)
2. Chatri Sripaipan, Phd., Director
Science and Technology Development Program
Thailand Development Research Institute Foundation (TDRI)
3. Anat Prapasawad, Senior Specialist (Business Development)
Business Promotion Department
The Industrial Finance Corporation of Thailand
4. Pisal Khongsamran, Director General
Manu Leopairote, Deputy Director - General
Department of Industrial Promotion

5. **Narong Rattana, Director, Technology Transfer Center
Ministry of Science, Technology and Energy**
6. **Thamnu Vasinonta, Director
Thailand Management Development and Productivity Center**

TECHNOLOGY ADOPTION

The normal decision stages in adoption processes by an SME include:

- Problem recognition to analyze and define the internal company need and strategic rationale for adopting new technologies or products.
- Needs analysis and definition including payoffs and risks
- Product analysis and definition of the ideal performance and physical features to fulfill the need.
- Technology choice through analysis, definition and linkage of alternative technologies.
- Financial analysis of viability of alternate technologies or products.
- Product design including analysis and detailed definition of performance and physical attributes.
- Product sourcing by searching for alternative technologies, products and suppliers.
- Commitment of financial resources.
- Process implementation and integration of new technology.

The typical SME regardless of where the company exists requires assistance to accomplish the above. For companies residing in a more developed economy the resources are more readily available through both public and private means with access to information and trained people.