

DEVELOPING RESEARCH AND TECHNOLOGY TRANSFER CAPABILITY
IN THIRD WORLD COUNTRIES : A VIEW FROM INDONESIA

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INTRODUCTION

In 1984 the Indonesian Institute of Road Engineering (IRE) was established as the primary research organisation responsible for carrying out research studies to satisfy the needs of the highway sector and to coordinate the production of relevant national standards. It's role also includes studies aimed at adapting road technology and undertaking specialist investigations to support on-going road investment programmes.

Previously it was under Directorate General of Highways (DGH), the organisation responsible for the planning, design, maintenance and construction of roads in Indonesia.

Whereas IRE's former role involved it in special investigations of engineering problems and testing, which was reflected in its organisation and management, its new, expanded role brought with it the need to develop its capability for executing its wider research responsibilities.

A number of hurdles have been faced in aiming to fulfil this new role. The primary constraints have included limited post-graduate staff resources and funding. IRE has sought to tackle these constraints through staff training programmes, seeking increased funding and carrying out locally funded research and collaborative research studies with world-renown organisations.

This paper will describe the background and development of the Indonesian IRE and the results of the various collaborative programmes carried out to enhance the Institute's capability. It will cover the problems faced, some of which are likely to be typical of other developing countries, and record the Indonesian experience in tackling them.

1. BACKGROUND AND HISTORICAL INFORMATION

1.1. Role of IRE

IRE's current area of responsibility was defined by Ministerial Decree No. 211/KPTS/1984 when the former Indonesian Road and Research Institute (under DGH) was transferred, with a change of name, to the Agency for Research and Development (ARD), Ministry of Public Works.

IRE's role was more precisely defined in the Decree as follows :

- to build up, coordinate and implement research and development in road engineering based on the policies of the Directorate General of the Agency for Research and Development.

IRE's function was explicitly expressed as follows :

- to organise road research and development programmes.
- to build up, coordinate and implement road research studies.
- to analyse and evaluate the results of road investigations, research and development.
- to compile and disseminate the result of road research, investigations and development.

In performing this function it was further stated that IRE should seek to adapt road technology appropriate for the use in Indonesia and seek to maximise the use of local products. The output should lead to the setting up of appropriate standards, guidelines and manuals for use in highway engineering works in Indonesia.

In practice it means that IRE conducts both long and short term research activities but overlaps this with giving technical advice, conducting training courses and undertaking specialist pavement and geotechnical investigations. It also has an important role in supporting the development of the Provincial Laboratories of the Ministry of Public Works.

IRE performs all these duties principally in support of DGH's road development and maintenance programmes, including those for bridges, and in response to requests from other agencies, eg. Jasa Marga, the Toll Road Authority.

1.2. Organisational Structure and Management

Structurally, IRE together with two other sister institutes, the Institute of Hydraulic Engineering (IHE) and Institute of Human Settlement (IHS), is under the Directorate General of Agency for Research and Development (ARD), Ministry of Public Works. Operationally, IRE supports the Directorate General of Highways, as a "technology backbone" for highway engineering.

IRE itself is divided into three research divisions, two experimental stations and two supporting divisions.

The three research divisions are :

- (1) Road Engineering
- (2) Structures and Construction Engineering
- (3) Traffic Engineering

and their primary role is to carry out applied research.

The two experimental stations are :

- (4) Soil Investigation (Geotechnical Engineering)
- (5) Road Investigation

and their primary responsibility is for site investigation and material testing.

The two supporting ("structural") divisions are :

- (6) Administration
- (7) Dissemination

and their primary function is to administer IRE's activities and to disseminate the products of IRE to end-users.

IRE is managed by a Director who is directly responsible to the Director General of the Agency for Research and Development for the work of IRE. Within IRE there are managers at the head of each of the divisions and experimental stations. Within the "structural" divisions, heads of sub-divisions have been defined to better manage the wider range of activities carried out by these divisions. Within each of the "functional" divisions project teams are created to undertake the work programme.

Together with the Directorate of Road Planning (Bipran) of DGH, the Directorate of IRE chairs a Research Management Committee (RMC). This is an advisory body whose role is to coordinate research in the highway field throughout Indonesia. The RMC also includes representatives from other branches of DGH, the Institute of Technology of Bandung (ITB-S2), and the United Kingdom's Transport and Road Research Laboratory (TRRL).

The RMC is supported by Advisory Working Groups (AWG) in each of the subject areas of road, geotechnics, structures, traffic and systems development. These are headed by the respective IRE research managers. Their role is to review the research programme in detail and to produce recommendations on how it should be implemented.

1.3. Staff

Total staff (1988) at IRE number 512. Of this total, 200 (39%) were directly involved in research or engineering activities. The remaining 312 (61%) staff provide managerial, administrative and technical support.

The composition of the 200 staff engaged in technical activities comprised 26 senior researchers, 50 junior researchers, 12 laboratory engineers, and 112 technicians. The current educational background of these staff is as follows: 10 S2 (post graduate/Master), 40 S1 (graduate), 38 S0 (undergraduate) and 112 Highschool/Technical Highschool. Only 7 staff had attained national accredited researcher status.

1.4. Research Capability

The above figures show that the composition between the staff engaged in mainstream activities was unbalanced compared to those who were engaged in a supporting role. However, the research and engineering staff possess wide practical knowledge and are extremely competent at site investigations, surveys and the like. Experience in these areas has resulted from the function and role of the previous organization.

However, an assessment of a sample of the published research reports, the typical output of IRE, has indicated that their scope is often much more limited than their titles suggest. The assessment also indicated that some of the authors lacked a proper understanding of the scientific method itself and the techniques of application.

1.5. Funding

IRE has access to 2 types of funding, namely routine expenditure and project expenditure.

Routine expenditure covers fixed costs, such as basic salaries, consumables, maintenance of facilities, etc. A lumpsum budget is allocated by ARD each year.

Project expenditure is provided separately each year as additional funds to cover all expenses incurred in carrying out research and development activities. IRE obtains these funds from several sources, including (a) ARD (b) Overseas Grant Aid (c) Overseas Loan Agreements (eg. IBRD).

Whenever IRE engages in collaborative research projects additional Rupiah (counterpart) funding is often provided by ARD for supporting local project costs.

Prior to 1985/86, when IRE was still involved in investigation works for DGH annual project funding was approximately Rp 1.6 billions (US\$ 830,000). In 1987/88 when IRE was no more involved in investigation works but fully engaged in research work project funding dropped to Rp 0.3 billions (US\$ 160,000). During the same period routine funding remained nearly constant or grew slightly in line with national price inflation.

2. PROBLEM FACED

IRE's change of role from special investigations of engineering problems and testing to its new, expanded role of research and development has brought with it the need to develop its capability for executing its wider responsibilities.

A number of hurdles have been faced in fulfilling its new role. The primary constraints have included limited staff capability in conducting research and development works and insufficient funding.

IRE has sought to tackle these constraints and substantial progress has been achieved through staff training programmes, seeking increased funding and carrying out locally funded research and collaborative research studies with world-renown organisations.

3. CAPABILITY IMPROVEMENT

3.1. IRE-TRRL Research Collaboration

A programme of collaborative research involving IRE and TRRL was initiated in 1980, with studies being undertaken in the field of pavement engineering and geotechnics. The collaboration was expected to give mutual benefit to both institutions. For TRRL it provided the opportunity to widen

their experience in studies in tropical and developing countries, while for IRE it provided the opportunity to strengthen it's research capability and develop research-based solutions for local problems.

During the collaboration, many handicaps have been found, including the limited knowledge of IRE staff in conducting research works and in their English language capability. This has hindered the effective transfer of technical knowledge at both a personal level and when staff are working independently searching for problem solutions.

To overcome the above problems, IRE staff have attended formal post-graduate studies in UK and an English Language Centre has been established at IRE.

Additional funds have been sought from other sources to expand the collaborative effort. This has involved identifying priority research studies that could support DGH and which could be funded by international loan agencies, such as IBRD. Funding from the latter source enabled the initiation of the Technical Assistance and Research Training Project (TARP), Phase I in 1988/89. This has been followed by a Phase II in 1991-1993.

3.2. TARP

Two subsequent projects (TARP I and TARP II) have been funded by IBRD through DGH with additional funds from TRRL as part of UK's overseas aid programme.

The main objectives of TARP are (1) to strengthen IRE capabilities in conducting research and development in highway engineering, (2) to complete a number of research and development studies in order to support DGH. A mixture of formal research training programme and direct technology tranfer through a learning-by-doing process contributes to achieving the first objective.

Research projects are being undertaken in the following areas:

- a. Pavement Engineering
 - Road strengthening
 - Road Management Systems
- b. Geotechnical Engineering
 - Road Materials Inventories
 - Slope Stability

- c. Traffic Engineering
 - Road safety and low cost traffic management
- d. Structure Engineering
 - Bridge performance
 - Corrosion
- e. Research Training
 - Technical support staff
 - Basic and advanced research methodology.

The interesting aspect of the project is that although the projects have been administered by consultants (TPO'Sullivan for TARP I and TRRL Technology Transfer Unit for TARP II), technical supervision and responsibility for the project is that of the Overseas Unit of TRRL. Such an arrangement has secured the additional inputs needed from TRRL.

3.3. Other Research Collaboration and Training Inputs

IRE has collaborated with other overseas organisations and in each case similar importance has been given to strengthening the Institute's research and technical capability.

The studies have included:

- (1) Asbuton Refining Feasibility Study (1989)
 - in collaboration with Alberta Research Council (ARC)
 - funded by IBRD (through DGH)
- (2) Asbuton as a Road Building Material (1989/90)
 - funded by JICA (through ARD)
- (3) Evaluation of the Bearing Capacity of Roads using the Falling Weight Deflectometer (1990/91)
 - in collaboration with the Danish Road Directorate
 - funded by DANIDA (through ARD)
- (4) Development of Rural Road Infrastructures (1989-91)
 - in collaboration with UN-ESCAP
 - funded by UNDP
- (5) Development of an Indonesian Highway Capacity Manual (1990/93)
 - in collaboration with Swe-Road
 - funded by IBRD (through DGH) and additional input from Swedish Government (grant)

IRE has also benefitted from access to training at the ITB-S2 Post-Graduate Programme (IBRD funded) and to Post-graduate scholarships at the University of New South Wales, Sydney (funded by AIDAB Scheme).

The RMC plays an important role in the coordination and monitoring of such studies and in the identification of needs. The IRE-TRRL collaboration has also sought to review IRE's requirements and provided guidance on matching the technical needs and available resources.

3.4. The Achievements 1988 - 1992

Improvements in the capability of IRE staff resulting from the above assistance is illustrated by the following figures:

- (1) The number of post-graduate staff has increased from 10 in 1988 to 17 in 1992.
- (2) The number of staff trained through in-house research training has reached 70 persons or approximately 35 percent of the research complement.
- (3) The English Language capability of research staff has increased from only 26 persons at or above intermediate level in 1988 to 84 persons in 1992.
- (4) The number of accredited researchers has increased from 4 in 1988 to 17 in 1992.

Progress in further developing IRE's capability has also been reflected in the number of published reports. IRE staff have been involved in publishing 17 reports in international seminars and 42 reports in national seminars over the past 3 years.

A further aspect of interest is that employment in research works, particularly at IRE, is becoming more attractive to fresh graduates (S1 level). In the period 1990-91 8 new engineering graduates have been recruited.

Improvements have also occurred in the availability of funds. In 1988/89, an additional US\$ 500,000 was available from loans and grants for TARP I, while the rupiah project funding was still limited to Rp 0.32 billions (US\$ 168,000). Since then the total project funding for both foreign and local currencies has increased significantly, to approximately US \$ 1.8 million foreign currency and US\$ 0.8 million local currency for 1992/93.

These achievements have encouraged IRE to seek further funding from international agencies to widen the scope of research studies. The progress achieved so far have also

given confidence to the loan agencies that such collaboration and technical assistance can be effective in improving the research capability of developing countries.

3.5. Handicaps Faced

Such achievements as described above were not easy and many handicaps have been faced. Amongst these are :

(1) Low Salary

The basic salary of IRE staff is relatively low. However, additional income can be earned through increased involvement in research work, in standardization and in technical advisory and training duties. However, depending on the degree of involvement and the amount of pre-planning this may affect the project schedule.

(2) Sudden Re-Assignment of Technical Staff

During the execution of project work the most capable staff may be suddenly withdrawn from the work team at short notice to undertake work of an urgent nature. This may also affect the project programme.

(3) Teaching Curriculum of Graduate Programmes

The teaching curriculum of graduate training programmes in Indonesia aims to provide practical engineers. Often basic statistics, which is crucial in research work, is not sufficiently covered. Additional staff training in both basic and applied statistics is normally required.

Overcoming the above mentioned handicaps requires a step-by-step approach with open communications between all parties involved, as experienced during the execution of TARP and the IRE-TRRL research collaboration.

4. THE WAY FORWARD

It is clear from the Ministerial Decree No. 211/KPTS/1984 that the Government of Indonesia intends that the IRE should continue to provide the Directorate General of Highways with research-based advice and development guidance together with other services, including specialised training, as necessary.

In order to satisfy IRE's stated role, IRE's future activities can be summarised thus :

- a. Applied highways and transport research aimed at progressively improving Indonesia's road transport system.
- b. The modification and adaption of foreign techniques for effective application in Indonesia.
- c. A coordinating role in the dissemination, training, and technical assistance related to Indonesia's highway and transport research activities.
- d. Specialist testing, survey and investigation for DGH and other highway agencies.
- e. Provision of specialised advice on an ad-hoc basis.
- f. Production and revision of engineering standards, design guides and codes of practice.
- g. Assistance to the Provincial Laboratories in the form of training, technical advice and accreditation.

From experiences elsewhere it can be assumed that the quality, and therefore the value, of the advice and services provided will increase in proportion to the quality and extent of the research carried out, provided that the research is directed toward the solution of local problems.

This intention is well-supported by IRE's growth in professional excellence through the course of the current IRE-TRRL and IBRD-funded projects. However, the continuation and expansion of this support is necessary to substantially meet the overall need and consolidate on past gains.

Ultimately the intention is to create a body of indigenous, dedicated, applied researchers and technical experts at IRE, who can be expected to become progressively more knowledgeable and professionally effective in improving practice in Indonesia in all aspects of road planning, design, building and maintenance.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

- (1) The Indonesian experience shows that developing research and technology transfer capability in third world countries is best achieved through collaboration with world-renown research organizations.
- (2) The objectives of such collaboration should be (a) to strengthen the research capability of the third world country, and (b) to conduct research studies of direct relevance to the related national highway agencies.

This approach greatly facilitates technology transfer through the learning-by-doing process.

- (3) The strengthening of staff capability can be achieved through a combination of in-house research training, post-graduate study and direct involvement in well-supervised research and development projects.
- (4) To widen and deepen the scope of the research work, external funding from international loan agencies is needed.
- (5) As experienced by Indonesia, such capability strengthening should also be accompanied by improvements in the technical English capability of the staff.
- (6) Most of the handicaps faced during the execution of such strengthening can be solved by a step-by-step approach and through open communication between all parties involved.

5.2. Recommendations

- (1) Increased information exchange among the third world countries is needed for the further improvement and enrichment of such institutional development schemes in the future.
- (2) Further goodwill by means of grant aid from the more developed industrialized nations is needed to initiate such schemes in developing countries.
- (3) Continuous support and funding from international loan agencies is needed in order to maintain the momentum of such schemes. Investments of this kind results in updated research-based knowledge relevant to the needs of the developing country.

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