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The Development of Ocean Engineering Education in Indonesia

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This paper begins by outlining the maritime composition of Indonesia with its islands and seas. The background to opportunities in marine transportation and the exploitation of ocean resources is then described. Challenges in marine education and the response of the Institute of Technology Surabaya are highlighted. Issues such as international co-operation, staff training, funding considerations and experience gained are examined. The main conclusion is that success in ocean engineering education programmes in Indonesia depends on the availability of financial support, careful management of resources and staff commitment.

1. INTRODUCTION

IN ORDER to understand the role of maritime and offshore activities in Indonesia it is useful to start with a short description of the country. Indonesia has often been described as a country made up of islands and seas. It does, in fact, comprise about 13 000 islands, and the sea takes up around three million square kilometres of its total area. The distance from one extremity to another is almost 5500 km, and there are about 81 000 km of coastline. It is, therefore, not surprising that activities relating to the sea represent a most significant part of the national life. The seas provide a vast wealth of resources ranging from approximately two million tonnes of fish per year to around half a million barels of offshore oil per day. Indonesia is a country that recognises the importance of education and training [1], and it is giving attention to activities related to maritime and offshore engineering.

The paper sets out to provide the background of opportunities in the marine and offshore markets before going on to examine educational opportunities. The response of the Institute of Technology Surabaya (ITS) is then highlighted, and specific issues considered include international co-operation, staff training, funding considerations and experience gained.

2. BACKGROUND

The exploitation of offshore resources and sea transportation both require the support of many scientific, technological, economic and social activities. It would, therefore, be helpful to highlight the needs of maritime markets together with the relevant support from the higher levels of education.

(a) *Transportation by sea*

Traditionally, ships have been used to carry people and goods between the islands and there are over 8000 ships of various types operating in Indonesian waters. Educational support needed here includes courses in shipbuilding, naval architecture, marine engineering, navigation, civil engineering and other disciplines in providing equipment and software for marine use.

(b) *Harbour development*

To support the marine transport industry, suitable port and harbour facilities are needed at many locations on the islands. These vary from the simplest types of pier for local ferries to major facilities which can handle container ships and tankers. Educational support required here ranges from courses in harbour and coastal engineering to those in port management.

(c) *Living resources*

Available living resources include fish, hard-shelled marine species such as prawns and lobsters, and plants such as seaweed. Relevant educational disciplines include marine biology, instrumentation engineering and oceanography.

(d) *Hydrocarbon resources*

The Indonesian seas offer rich resources of offshore oil, gas and minerals. The water depths are generally regarded as shallow and the weather is relatively temperate throughout the year, providing good conditions for exploitation. Educational needs here involve the total spectrum of engineering and scientific disciplines, with ocean engineering playing a dominant role.

(e) *Environmental protection*

With so many offshore resources on offer, it is vital that Indonesia's marine environment is protected from pollution. This can occur as a result of shipping accidents or illegal discharges during tank-cleaning operations. Discharges from land, air and rivers can also cause pollution. Educational disciplines of interest would include: environmental management, oceanography, chemistry, biology, physics, instrumentation and other scientific topics relevant to pollution control.

Clearly there are considerable market opportunities for Indonesia in shipping, living resources and the exploitation of hydrocarbons and minerals. Central to the possibility of responding to these opportunities is the call for a strong educational and training base to support the activities in question. Many of the required disciplines are covered in various state and private universities but the 'missing link' is education in technologies relating to shipbuilding, marine engineering and ocean engineering.

3. MARINE EDUCATION IN INDONESIA

Education in marine-related subjects in Indonesia is organized at three levels, as follows:

- university degree level;
- diploma level;
- senior secondary/vocational school level.

From the third level come those with 'trade' and 'craft' qualifications, but this paper will be focusing attention on the first and second levels of education.

(a) *University level*

Nine-semester first degree (Sarjana or S1) courses in Naval Architecture and Marine Engineering have been available since 1960. The three public universities offering these are:

- The Institute of Technology Surabaya, Surabaya, Faculty of Ocean Engineering since 1960;
- The University of Hasanuddin, Ujungpandang, Faculty of Engineering—since 1960;
- The University of Pattimura, Ambon, Faculty of Engineering—since 1970.

Between 1972 and 1992 these three institutions produced more than a thousand naval architects, marine and offshore engineers for the shipbuilding and marine industries, shipping and marine consultancy, and educational and research institutions. Today around 150 graduates emerge each year, with ITS contributing about two-thirds of the total.

(b) *Diploma level*

The qualification gained at this level is the Diploma III in Naval Architecture and Shipbuilding and two state universities were involved between 1988 and 1987. Since then, however, this level of training has been consolidated at the Polytechnic for Shipbuilding located on the campus of ITS, Surabaya. This Polytechnic has been developed by a World Bank fund and the courses produce higher technicians in shipbuilding, marine engineering and marine electrical engineering, with an average of around 100 emerging each year. The emphasis is on practical skills.

(c) *Vocational school level*

These 3-year courses are directed towards producing tradespeople for shipyards and marine engineering works. The suppliers include both public-supported and private institutions. The most 'vocational' school in this field is the shipbuilding vocational school in Sidoardjo, Surabaya, which has been associated with PT.PAL Indonesia.

In addition to these courses on shipbuilding, marine engineering and ocean engineering, courses on coastal engineering are offered by the Civil Engineering Department of some universities.

4. RESPONSE OF THE INSTITUTE OF TECHNOLOGY, SURABAYA

When ITS was formed as a technological institution in 1957, it was intended to offer engineering courses in most common subjects, such as civil and mechanical engineering, for which there was a practical need. At the same time, the opportunity existed for the institute to persuade the Ministry of Education and Culture to support courses in other topics of national relevance, and for it to achieve a level of excellence that would be recognised throughout Indonesia. With seas and islands making up so much of the country's area, Ocean engineering was an obvious choice for a new course, although at the time there were few shipyards of hydrodynamic facilities, and little academic tradition in this field. The perceived strengths of ITS were as follows:

Firstly, Surabaya is a well-situated maritime city, with both port facilities and shipbuilding capabilities. It is located on the heavily populated island of Java and is the second-largest city in Indonesia, while the presence of the PT.PAL shipyard and a support installation give it a 'maritime' atmosphere. Its position is such that many offshore installations can be easily reached by sea.

Secondly, ITS does not have any direct competition in Indonesia in the area of ocean engineering, and it can expect to win a significant amount of support if its programmes fulfil the needs of the marine and offshore industries.

Following the formation in 1960 of the Faculty of Shipbuilding (later renamed the Faculty of Ocean Engineering) a degree course was offered in naval architecture and shipbuilding. This was taught in nine semesters over a period of 4.5 years and the students had to gain 160 credits in order to receive their qualification. Two courses of similar duration and number of credits were later offered in marine engineering (1982) and in offshore

engineering (1983). These courses all take the traditional engineering approach, with a strong bias towards technical topics.

5. INTERNATIONAL CO-OPERATION

The basic aims of the international co-operation which has been initiated are to achieve mutual benefits such as the exchange of technical information and personnel, and to take a part in joint research work. It was recognized that in the early stages this co-operation would have to be directed towards establishing contacts with academics in countries strong in marine and ocean-related activities. This has been followed up by two key developments.

Firstly, selected members of ITS staff are being sent overseas to take postgraduate degrees in subjects ranging from shipbuilding to ocean engineering. The hope is that they will thus acquire all the skills required for doing research up to Ph.D. level. During their time abroad, these staff members will also develop working relationships with academics and industrialists with whom they come in contact in the host-country. Generally speaking, there is no direct requirement for staff to upgrade their teaching skills. However, some of the programmes which are undertaken abroad include a strong emphasis on students' communication skills and the staff members involved can find that their teaching benefits from this in various ways.

Secondly, academic staff from Britain, Germany and the USA have been invited to give short courses and guest lectures at ITS, and to review the curriculum of the existing programme. In general, the visitors' guest lectures were delivered to both staff and students on topics of personal expertise. These include ship hydrodynamics, computer-aided design, ship motions, ship structure, ship production and marine business. The visitors were also invited to suggest areas in which ITS staff should devote their research efforts.

This co-operation has led to link programmes and recognition and typical examples of these are as follows:

(a) in marine technology, a link between ITS and the Universities of Newcastle and Strathclyde in the UK during the period 1990–1993;
(b) a joint M.Sc. programme between ITS and the University of Newcastle, starting in 1992;
(c) the initiation of split Ph.D. programmes whereby ITS staff can be registered for Ph.D. study at the University of Strathclyde, Glasgow, while spending most of their time doing research involved in Surabaya under a local supervisor and visiting the main supervisor at Strathclyde for only limited periods;
(d) accreditation of all courses offered by the Faculty of Ocean Engineering ITS (naval architecture and shipbuilding, marine engineering, and offshore engineering) by the Royal Institute of Naval Architects, the Institute of Marine Engineers and the United Kingdom Engineering Council.

6. STAFF DEVELOPMENT

The policy of the Directorate General of Higher Education on the teaching staff states that for an undergraduate programme or Sarjana (S1), at least 35% of the staff should have a Master's or doctoral qualification. They should also have appropriate industrial experience.

To satisfy this requirement it was necessary for the staff in the Faculty of Marine Technology to be encouraged to acquire the necessary qualifications. At present it has 61 members of staff, of whom 22 have Masters' degrees and seven hold doctorates. Eight members of the staff are currently being trained overseas. The areas of specialization available range from hydrodynamics and structures to marine transportation and marine engineering, offshore engineering, shipbuilding technology and shipyard management. As regards the overseas institutions being selected for the higher degree studies, the choice is governed by the following factors:

- the availability of a course covering subjects being sought by the Faculty of Ocean Engineering;
- the ability of the candidate to meet the qualification requirements of the relevant institution, including that of adequate language-skills;
- the motivation of the individual staff member to complete a higher degree—this can be a difficult point for those with family commitments, such as children at critical stages in their schooling;
- the availability of funding to enable the staff member to do the course in question.

7. FUNDING CONSIDERATIONS

In order to develop the required number of staff and attract overseas academics to spend time in Surabaya, it was necessary to seek the support of funding agencies. The commitment of the government of Indonesia to education has enabled funds to be allocated to ocean engineering topics, as, for example, when ITS received support under the World Bank XVII Project in Indonesia between 1987 and 1992.

Additional resources have been obtained through the building up of contacts by ITS with foreign educational agencies. Two agencies that have provided strong support are the British Council and the German government.

The British Council supplies assistance with visits by British academics to Indonesia and ITS staff visiting UK institutions, and is also involved in the special link programme between ITS and the

Universities of Newcastle and Strathclyde (1990–1993).

The German government gave a grant of DM 8 million, during the period 1978–1986 for the development of the Faculty of Shipbuilding Engineering at ITS. During this same period, academics from German technological universities/institutions (TU Berlin and the University of Hamburg) made various visits to Surabaya to give courses.

8. EXPERIENCE GAINED

Over the years, considerable experience of various kinds has been gained and it would be helpful to examine three key issues, as follows.

(a) *Staff research*

A good level of staff research in the faculty is still to be enhanced, and there are several reasons for this.

Firstly, it takes considerable time to develop the 'research habit', even if selected staff members were relieved of most of their teaching load for a given period of time. In general, those returning from abroad with higher degrees have been involved in doing a project under the guidance of a supervisor. It takes at least 5 years to achieve maturity, and transfer completely from a 'following' to a 'leading' role.

Secondly, it can also be difficult to select suitable research topics. Ideally, the staff should be tackling problems of relevance to the marine and offshore industries, but it is often extremely hard to identify correctly what requires attention and what support can be expected. In addition, because this is a time-consuming task, few members of staff have yet taken advantage of their industrial contacts.

Thirdly, lack of time is also a problem. In addition to their teaching duties at ITS, many staff take on other appointments to supplement their salaries and, as a result, have little time for research work.

Lastly, the facilities for research are limited. This applies to both hardware and software for laboratory use and to the necessary recent technical publications for reference purposes.

(b) *International support*

The Faculty of Ocean Engineering at ITS has received generous support from both official government agencies and academics in many institutions. A number of the staff have benefited from studying overseas and others have gained valuable knowledge from seminars given by visiting academics. These visitors have also had the opportunity to acquire an understanding of the organisation of ITS and the local conditions. Generally, however, the visits are too brief to allow development of a working programme that could be continued over a longer period.

(c) *Industrial contacts*

ITS has appreciated the need to have good industrial contacts and has been involved in the following:

- design studies for shipyards;
- consultancy work and studies;
- materials testing;
- ship model testing;
- training courses.

The duration of these activities have varied from 1 month to 2 years. Service has been rendered to more than 20 organisations, ranging from oil companies to government departments. Typical examples of projects handled are:

- designing a helicopter deck for use on a storage tanker;
- training staff from government departments/institutions;
- testing materials to be used on ships constructed by PT.PAL and other shipyards in Indonesia.

These projects have provided selected staff in the faculty with useful experiences, beneficial contacts and additional financial reward.

9. CONCLUDING REMARKS

On the basis of the information presented, the following concluding remarks can be made:

(a) Indonesia is a country made up of islands and seas offering vast opportunities for the development of people to support the responsible exploration and exploitation of ocean resources;
(b) the first stage of staff development at ITS in topics relating to ocean engineering has been completed, with many members acquiring higher degrees from universities in overseas countries, but it will take time for them to build up a research tradition;
(c) successful development of the ocean-engineering education programmes in Indonesia depend on the availability of financial support, careful management of resources and staff commitment.

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