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ADDRESSING THE DISCONNECT BETWEEN INDONESIAN R&D AND THE NEEDS OF THE INDONESIAN ECONOMY

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Abstract- In 1995 a World Bank Staff Report on the Indonesian science and technology system identified what it called a major disconnect between the research of the publicly funded research and development agencies and the needs of the Indonesian economy. In response to that report the Government of Indonesia obtained a loan from the World Bank to establish the Industrial Technology Development Project (ITDP) to address the problem in the Agency for the Assessment and application of Technology (BPPT), the Indonesian Institute of Science (LIPI) and the Ministry of Industry and Trade. The Commonwealth Scientific and Industrial Research Organisation (CSIRO), from Australia was selected as the twining partner for LIPI. The project was called Management and Systems Strengthening –LIPI (MSS-LIPI), commenced in 1997 and concluded in July 2001. MSS-LIPI had three components. The aim of the first component was to implement modern electronic information and management systems. The second component was to establish systems for the management of technology including business development, contract administration, intellectual property management and public affairs and communication. The final component was with change management and the development of future leaders. The paper examines why some aspects of the project were very successful and other aspects less so. The reasons have to do both with the external environment in which LIPI is operating, and the stultifying effect this has on attempts to change the organisation. Some conclusions will be drawn which will be valuable to other countries planning changes in their public R&D systems.

INTRODUCTION

In 1995 Dr Dipo Alam, a senior official at the Indonesian National Development Planning Agency (BAPPENAS) formed the view that the major Indonesian research and development agencies were in need of reform if they were to play a part in the economic development of Indonesia. He called a meeting of representatives of the Indonesian Institute of Sciences (LIPI), the Agency for the Assessment and Application of Technology (BPPT) and the Ministry of Industry Research Agencies to discuss his concerns. It was decided to invite the World Bank to make a staff assessment of the situation in Indonesia and this was presented to the Indonesian government in 1995.

The Staff Report on the Indonesian science and technology system identified what it called a major disconnect between the research of the publicly funded research and development agencies and the needs of the Indonesian economy. In response to that report the Government of Indonesia obtained a loan from the World Bank to establish the Industrial Technology Development Project (ITDP) to address the problem in the three agencies represented at the original meeting. The World Bank sent an expert to assist in the development of the proposal and that expert obtained inputs from the staff of the agencies concerned.

The current authors were involved in the LIPI component of the ITDP. The paper examines why some aspects of the project were successful and other aspects less so. The reasons have to do both with the external environment in which LIPI is operating, and the stultifying effect this has on attempts to change the organisation

POSSIBLE APPROACHES TO ADDRESSING THE DISCONNECT

In a 1993 study sponsored by UNIDO, the Higher Council for Science and Technology and the Islamic Foundation for Science and Technology Development, Martin Bell [1] observes that R&D as we know it today evolved in Europe and the USA as an integral part of the firms involved in production. Governments were latecomers to the activity and in most of the industrialised countries government expenditure accounts less than half of gross expenditure on research and development. In the US it is 21%, in South Korea it is 26% and in Germany it is 32%. Even in Australia, which is still

highly dependent on the agriculture and minerals industries for its wealth creation, the government accounts for 52% of R&D expenditure. As discussed below in Indonesia 92% of R&D expenditure is by the Government.

In his paper Martin Bell has analysed the various approaches to integrating R&D with industrial production and technical change that have been used in the industrialising countries. He suggests that none of these have worked and that more radical approaches should be contemplated.

He identifies four ways that have been used for developing linkages within existing structures:

- Integration via planning and improved allocation of resources. This approach assumes that there is little inherently wrong with the R&D system or with industry. All that needs to change is the orientation of the R&D undertaken. R&D plans were constructed that should meet the 'needs' of the industry. This was a supply driven plan and seldom worked
- Integration via organisational and managerial 'change' on the supply side. Once again it was assumed that there was little wrong with the system and that the problem was with the organisation, management or structure of the R&D institute. Bell suggests that these approaches also did not work. That may be so; however, the changes introduced probably improved the R&D institutes.
- Integration via changes in the policy environment influencing industrial demand for R&D. This approach locates the source of the problem in the behaviour of the firms that generated weak or non-existent demand for local R&D outputs. As discussed below Australia has used this approach with more success than Bell credits.
- Integration via bridge building between institutes and firms. This approach says that if there is a gap then it should be filled! Bridging mechanisms often in the form of technology transfer companies or technology brokers were set up. They usually did not survive for long because when the firms did want to interact with the R&D institutes they wanted to do so directly not through an intermediary.

Bell argues that none of the above approaches will work in the long run because the structure is fundamentally flawed. He suggests that since in the original model R&D was closely integrated with production the R&D institutes should 'spin in' to companies (either existing or start up). However, as our experience with the project suggested, we argue that the concurrent implementation of the four approaches might result in an improved collaboration between public research institutes and industries.

Furthermore, Bell's analysis seems to be based on the dynamics in the manufacturing sector, and therefore does not give a complete picture of the role of R&D institutes in both industrialised and industrialising countries. It is not only in the manufacturing industries that R&D has some relevance. Modern economies have problems in agricultural production, environmental management, mining and energy and in understanding social problems that are never going to be solved in private R&D laboratories. The welfare contribution in these cases will often be in terms of reduced environmental and social impacts and avoided damage to health and amenity. While these are not always easily quantified in economic terms they are nonetheless real and often sizeable. Many of these problems require whole of system solutions. R&D institutes like LIPI (Indonesia), CSIR (India) and CSIRO (Australia) are in a good position to contribute to the solution of those problems. In addition the era of globalisation and free trade has meant that no country will be able to neglect the development of new technologies.

THE INDONESIAN SCIENCE AND TECHNOLOGY SYSTEM

The first thing to note about the Indonesian S&T system is that it is almost entirely funded by the Government and performed in public institutions. The Indonesian total expenditure on R&D for 2001 is 0.16% of GDP and it is estimated that 92% of this is Government expenditure. The Indonesian Bureau of Statistics (BPS) does not publish information on R&D expenditure, but the very small number of papers and patents from private sources in Indonesia indicate a low private R&D expenditure.

The rather low expenditure on R&D by Indonesia should be viewed in conjunction with two other indices from the latest UNDP Human Development Report [2]. The first, the Human Development Index, ranks Indonesia 102 out of 162 countries. This medium to low number is to a certain extent explained by the fact that public expenditure on education in Indonesian is only 1.4 % of GNP compared with neighbouring countries: Australia (5.5%) Thailand (4.8%), Malaysia (4.9%). Philippines (3.4%) and Singapore (3%).

The second, the Technology Achievement Index (TAI) ranks Indonesia, with a TAI of 0.211, 60$^{th\ out}$ of 162, which places it in the dynamic adopters. This group represents countries that are dynamic in the use of technology and is the third group out of five: leaders, potential leaders, dynamic adopters, marginalized and others. Although Indonesia is in the dynamic adopters group, its position is very close to the first country in marginalized group, which is ranked 64th (TAI of 0.185). As a comparison the highest neighbouring country on this index is Australia (9th, TAI of 0.587), Singapore (10th position, with TAI value of 0.585) belonging to the leaders group, while Malaysia takes 30th position (TAI of 0.396) in the potential leaders group.

The public R&D system has three components. The first is under the direction of the Minister of Research and Technology, the second under the control of the Minister for Education and the third under the control of various Ministers including the Ministers for Industry and Trade, for Minerals and Energy, for Defence, for Forestry and for Agriculture. The ITD Project was therefore only concerned with a small percentage of the total public R&D effort.

Research and Development activities within LIPI, like all government research institutes, are financed through a variety of sources, which can be categorized into five types. *First* is government institutional funding. Public Research Institutions traditionally have relied dominantly on government institutional funding provided by the Ministry through the so-called DIK (Daftar Isian Kegiatan) financing scheme that cover the base salaries for scientists, full-time technicians and support staff, support for infrastructure, such as equipment and buildings, and resources that the institutions can allocate according to its particular strategy.

The *second* category is project funding that enables the institutions to carry out R&D projects and related activities. The fund is appropriated through a mechanism called DIP (Daftar Isian Proyek). This fund constitutes a core research funding, by which the majority of R&D activities are funded. It should be mentioned at this point that part of DIP funds supplement the base salaries for researchers.

The *third* category of research funding is research- or service- contracts awarded to institutions by government departments, agencies and various other organizations, including private sectors. Part of these funds can be used to supplement the base salaries. The 'take home pay' of researchers consists of DIK, DIP and DIKS component. Often the sum of these components is inadequate and needs to be supplemented by a second or third job. For this category of funding, although the funding does not come from public money, LIPI should follow the so-called DIKS procedure that are governed by Law No 20, 1997. The law is well known as PNBP Law, governing management and utilization of government institutions' external earnings. This law is perceived as a disincentive for increasing external earnings for the reasons that will be discussed later.

The *fourth* category consists of various project grants and incentives provided by the MRT through a number of schemes such as RUT, RUK, RUSNAS, RUTI and various incentive schemes. Through these schemes, PRI is given incentives to conduct research in collaboration with other national or international research institutions as well as industries. It is important to note that unlike other funding sources, which are more or less determined on incremental basis, this source of funding is distributed to research institutions on a competitive basis.

Finally, the *fifth* source of funding is loans and grants from International agencies or International non-government organizations such as the Ford foundation and JICA, just to mention a few of them. Loans are appropriated through DIP mechanism as will be described below. Some grants are appropriated through DIP mechanism, some through a mechanism agreed upon by the awarding organization, which is far more flexible than DIP mechanism.

In principle all the project funding from BAPPENAS is competitive. Project proposals are submitted to BAPPENAS each year and are assessed by the BAPPENAS and the best projects funded. In practice the DIP funds received by each agency differs little from year to year. In addition BAPPENAS does not have the resources to assess the applications it receives and the process is a battle between the bureaucrats rather than a merit driven funding process. When combined with the small amount of money available the result has been a myriad small under funded projects.

STRUCTURE OF MSS-LIPI PROJECT AND ITS ACHIEVEMENTS

MSS-LIPI had three components. The aim of the first component was to implement modern electronic information and management systems. The second component was to establish systems for the management of technology including business development, contract administration, intellectual property management and public affairs and communication. The final component was with change management and the development of future leaders.

Some of the main achievements of the project are listed below. Also included in the list are areas where the project wasn't 100% effective.

- The introduction to LIPI, through its R&D Centre for Applied Chemistry, of a modern strategic planning and research priority setting framework, that has already enhanced the capacity of that Centre to provide services to the private sector;
- The introduction of this planning framework LIPI-wide, in time for submissions to the Government of Indonesia for the 2002 financial year. While the framework is widely understood throughout LIPI and has been useful in directing the thinking of LIPI scientists it has not been adopted as the LIPI planning framework;
- Development of new businesses in areas such as food production (inoculum), specialty chemicals, catalysts, and biotechnology;
- Negotiation of contracts with private companies who wish to work with LIPI, and the concept of Key Account Managers. Not enough has been made of the broad range of skills available in LIPI;
- The production of the first edition of LIPI Business Development Guidelines that, it is expected, will materially assist LIPI in its interaction with the private sector;
- The dissemination, within LIPI, of information about intellectual property protection through patent drafting workshops, many seminars and workshops on IP protection and the production of a laboratory notebook which is compatible with international IP standards. The notebook has not been universally adopted in LIPI and the number of patents produced is still quite low;
- The installation of comprehensive computer systems, networks and LIPI-wide support structures. There have been severe management difficulties in maintaining and expanding this network;
- Implementation and configuration of an electronic finance system. This system is still not in use;
- Design and development of human resources and project management applications to supplement planning decisions. While these are both modern and user friendly systems, they are not in full use;
- The development of a LIPI marketing and communication strategy, resulting in more effective external communication including initiation of Parliamentary Science Briefings;
- Development of more targeted leadership development strategies. Conducting two Leadership Development Programs for LIPI based on modern principles of adult learning. The first group of 25 completed its program in May 2000 and the second group November 2000. LIPI hopes to offer places in the third group to staff from other Indonesian R&D agencies.
- Skill development of hundreds of LIPI staff, in practical areas that are critical to LIPI such as facilitation skills, effective negotiation skills, business law, contract drafting, patent drafting, business management, media relations, computer skills, network management, database administration and finance system administration;
- CSIRO, from its own funds, has commenced a program of CSIRO-LIPI Awards to develop closer scientific links between the two agencies. So far 22 LIPI scientists have spent up to three months working in various CSIRO laboratories. This program will continue until 2005.

Despite the many achievements of the project as described above which were recognized by the World Bank [3], the disconnect still remains. This is indicated by the fact that LIPI's external earnings have not increased since the completion of the project. Although a number of contracts with companies were resulted from the projects, there are still difficulties to maintain the relationship beyond completion of the project.

IMPEDIMENTS TO SUCCESS

Perhaps, the major lesson derived from the project is the importance of the external environment in which a research Institute is operating. In the case of LIPI, the research funding scheme forms a disincentive for collaboration between LIPI and firms. As mentioned before, the Sajor research funding comes from DIK and DIP, which as will be described below, are very inflexible and does not give enough room for LIPI to be effective and efficient in delivering its services. Even if LIPI is to

have a research contract with industry, its financial management has to be done through DIKS mechanism that is cumbersome.

DIP/DIK

The majority of the funding, including loans and grants from international agencies, is allocated annually through DIP and DIK mechanism. The fiscal year starts off at January and is concluded at the end of December. The mechanism to acquire the funding can be shortly described as follows. At the beginning of the second quarter of the fiscal year, every research institution should submit budget proposals for the next fiscal year to the Ministry of Research and Technology (MRT) and the committee under the parliament. Under coordination of the MRT, the budget proposal is discussed and negotiated with BAPPENAS and the Ministry of Finance (MoF). Final approval should be obtained from the MoF and the parliament (DPR).

The approved budget contains a very rigid and detail description of the kind of eligible expenditures and the amount to be spent for each item. The expenditure items are usually categorized into wages, travelling cost to a particular destination, material, physical equipment, etc. Disbursement is only allowed for those items stated in budget document. One cannot easily shift the use of money from one item to another. Shifting, if allowed, often means long waiting time for approval. This creates inflexibility in the use of money, and is against the very basic nature of research: *uncertainty*. For a research endeavour, one cannot plan with high certainty to which direction research will progress, what material with what volume will be needed, what city to be visited for how long. It is therefore preferable for researchers, if they are given flexibility and autonomy to decide for what item the money will be spent. The only requirement is that the item should be eligible for spending and that the spending is technically well grounded, so that at the end the fiscal year they can justify their spending decisions. Of course, they should do it in a transparent and accountable way by among others keeping spending records.

DIKS

DIKS mechanism is a procedure to be followed by LIPI if it is to have collaboration with private sector that results in an external earning for LIPI. The mechanism is based on the PNBP Law mentioned above. Like DIP and DIK, the proposed amount of money to be earned from research and service contracts should be submitted one year ahead. This is also against the uncertainty nature of research. Most of the times, revision of the proposed budget is needed to suit to practical problems in the fields. Although revision during fiscal year is possible, the revision proved to be time consuming and therefore impede the service delivery to the client.

Furthermore, any payment by the client to LIPI's account should be transferred to the states treasurers' account, from which LIPI can then withdraw the money to finance the activities in the same *bureaucratic* way as DIP or DIK funds. This inflexibility puts constraints on the performance of LIPI in delivering its services.

Another important issue regarding this mechanism is that all the remaining external earning at the end of the fiscal year cannot be carried over to the next fiscal year. It should be transferred back to the states treasurers' account, giving LIPI no opportunity to utilize the fund for its strategic purposes. Had LIPI been given this opportunity, the capacity of LIPI to develop could have been greater.

Apparently, the underlying rationales for justifying this mechanism is that because PRI utilizes public money and facilities, any external earning occur as a result of utilization of the facilities should be returned back to public, i.e. the national treasurers' account. Only in this way, it is perceived, that the return to the nation on public investment in research projects and facilities is secured. However, one should not forget a bigger return in the form of improved capability and capacity of research institutions. In fact, this kind of return is a lever that can deliver bigger returns, i.e. innovation in industry sector. If this is understood and agreed upon, why do not we use the external earning as an investment in LIPI. As such, LIPI should be given more autonomy and flexibility to manage external earning as it sees fit to its strategy. Unfortunately, the ministry of finance does not accept this line of argument.

The discussion above suggests that an important impediment to developing links between Government R&D institutes and the private sector is the way that the Government deals with the institutions non-tax revenue. It has to be returned to Ministry of Finance and can only be got back with great difficulty. This regulation leads of course to methods of circumventing the regulation. In 1996 the World Bank had, as a condition for the loan, that the agencies be granted the right to manage their affairs independently. There was a delay of six months in the commencement of the project because the Government had not made the changes. Eventually the WB agreed that the project could commence without the changes in the regulations.

Another external factor that impede the success of the project is the inflexibility of LIPI in changing its structure as a result of government regulation imposed to it.

Change in organisations is usually driven by the Chief Executive who will usually follow a process something like this. The Chief Executive and the senior managers will formulate a Vision and Mission and Objectives for the organisation, and will clearly articulate this to the whole organisation. The senior management team would then examine the structure and processes within the organisation to see what changes need to take place to enable the organisation to fulfil its mission and achieve its vision. This process is usually done within six months or so, otherwise momentum is lost and there is a risk of morale suffering.

In the Indonesian public sector such a process is difficult to follow in a timely fashion. For example an incoming Chairman of LIPI can set a new Vision, Mission and Function for LIPI only after extensive negotiations with and final approval of the President or at least the Cabinet Secretary. Any restructuring of LIPI that is needed as a result of the former process would in turn have to be approved by the Ministry of State Apparatus (MENPAN) and any new appointments at a senior level approved by the President.

DISCUSSION AND CONCLUSION

Bell identified four ways that have been used to bridge the disconnect. The approach of this project was to use three of the ways. We developed improved planning frameworks and processes for linking this with resource allocation. By our leadership development program we improved the managerial and leadership skills of LIPI, and by the establishment of the Centre for Innovation we set up a system to link LIPI with its customers. One year after the conclusion of the project these measures are still working.

We were unable, however, to change the broad policy environment in which LIPI works. As discussed above, this environment has significant disincentives for LIPI to interact with the private sector and no incentives for the private sector to interact with LIPI.

It is our view that if those changes to the policy environment were made, then, in combination with the successful implementation of the other three ways, LIPI would be able to become well connected to the needs of the Indonesian economy.

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