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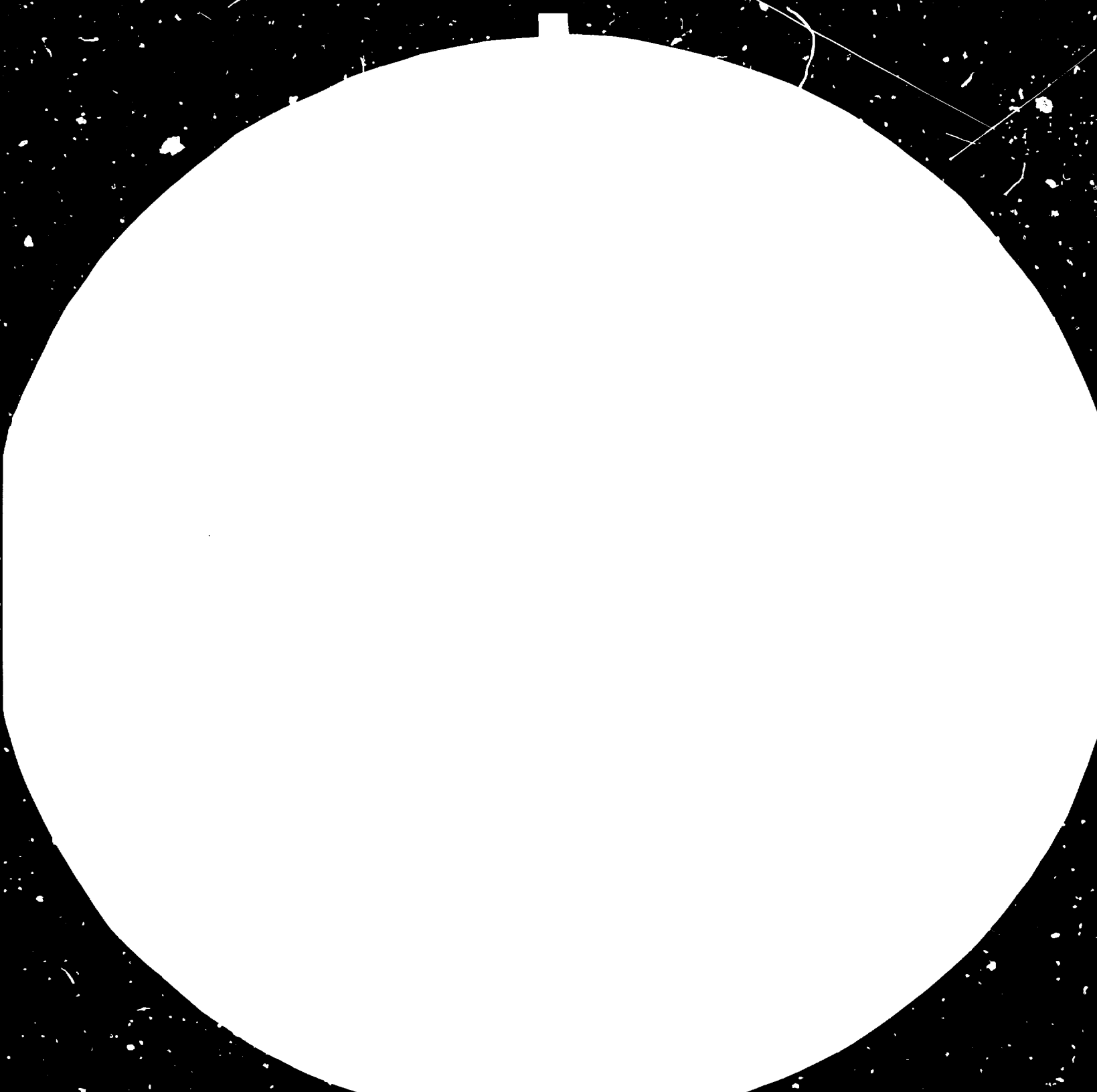

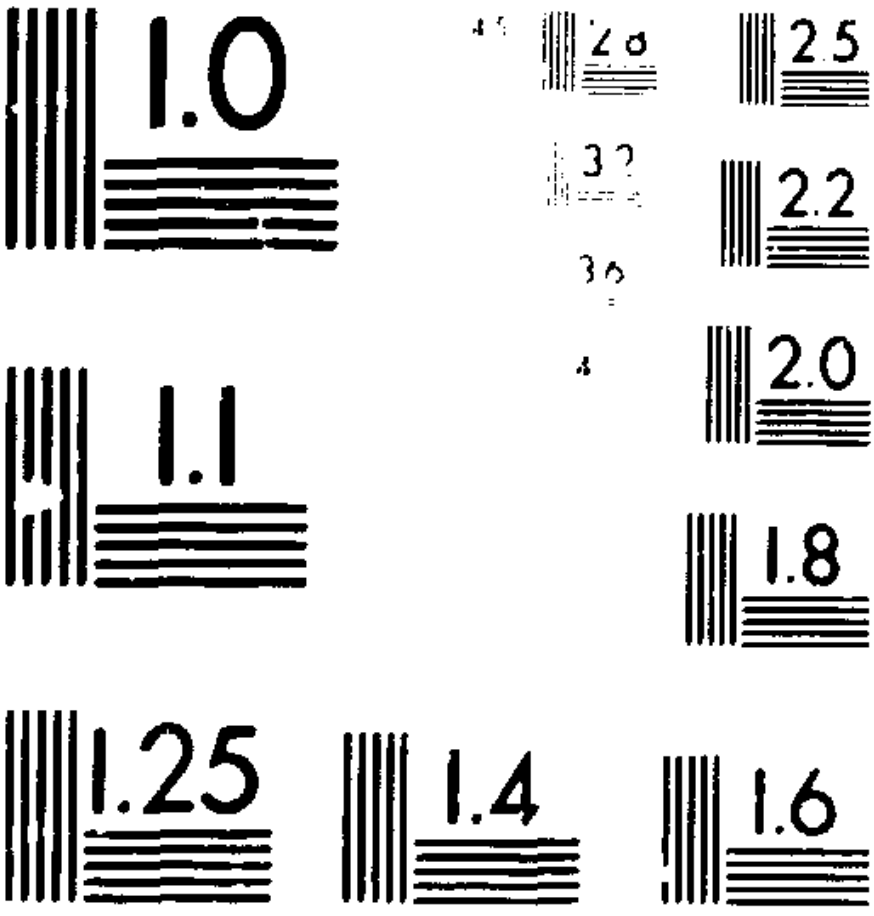

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INFORMATION TECHNOLOGIES FOR DEVELOPMENT:

Ongoing Research at the Research Policy Institute*

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Contents

INFORMATION TECHNOLOGIES FOR DEVELOPMENT
A PRESENTATION OF ONGOING RESEARCH AT THE RESEARCH POLICY INSTITUTE

PART I: A Presentation of the Institute

1. Introduction

The Research Policy Institute (RPI) is an interdisciplinary research unit directly under the governing board of the University of Lund. At the Institute, 15-20 researchers are at present engaged in research projects.

Approximately 25 percent of the total resources of the institute come from the University of Lund. The rest is project funded. Specific research projects have been financed by agencies such as the Swedish Agency for Research Cooperation with Developing Countries (SAREC), Committee for Future Oriented Research (SALFO), Swedish Council for Planning and Coordination of Research (FRN), Swedish Board for Technical Development (STU), Salén Foundation and the bank of Sweden Tercentenary Fund (RJF). Individual researchers have also served as consultants for various international organisations. Formal and informal research collaboration has also been conducted with institutions throughout the world.

The overall objectives of the RPI are:
- to serve as a forum for formal and informal education on science and technology policy at the University of Lund,
- to create a documentation base and offer documentation services as an official complement to the University library,
- to organize and carry out research projects on national as well as international problems associated with science, technology and research policy,
- to organize conferences and workshops with both national and international participation,
- to stimulate and develop a network of individuals, organisations and institutions active in the same general area, and collaborate more formally with relevant institutes,
- to receive visiting scholars doing research on subjects related to the work of the institute.

2. Research Areas

Out of the broader research interest in science, technology and society three more specific research programmes have developed:

1. **Technology and Development** - Studies of technological change and technology policies with a focus on the capital goods sector in the Third World.
   The research in this programme deals with research on technical change, industrialization and policies for building up a technological capacity

in developing countries. The programme focuses particularly on the capital goods sector in developing countries and its relation to other economic sectors. At present, thirteen projects are included in the programme.
In the programme, emphasis is given to empirical fieldwork in developing countries. This part of the research is carried out in cooperation with researchers and institutions in these countries. Many of the projects deal with more than one country in order to make a comparative perspective possible. Another important component is the development and application of new analytical and methodological instruments. The research programme also has an explicit policy orientation, aiming at analysing and discussing strategies and options for technology and development.
The research activities can be grouped into three broad areas of study:
(A) The international context, within which the developing countries have to formulate their industrial policies and technology policies,
(B) The national capacities and resources in the developing countries themselves, which condition their options,
(C) Technology policies for development with particular emphasis on the formation of human skills and technological capabilities.

2. **Sweden's Industrial Future** - a science and technology perspective
This programme has been started in order to help build up a scientific picture of how the society's R&D policies function in a country such as Sweden. The programme seeks to combine two analytical perspectives.
- the first and major perspective directs attention to the national R&D system; its productive capacity and organizational form
- the second looks at the effects of different "actors" both national and international in the operation of the system
An important feature of the programme is to create a research environment and an analytical understanding of the border area between policies for scientific, technological and industrial development.

3. **Technology and Culture** - a comparative study of technological development in Asia and Western Europe
This programme aims at establishing an international forum for debate and research on the issue of technological change and its relatonship to social and cultural contexts in Asia and Europe. The theoretical and empirical research conducted at RPI is organized under two themes
- the technological imperative; promoting technological development in Asia and Europe
- the cultural imperative; technocratic and alternative paradigms.

PART II: Research on the Implications of Information Technologies

1. Background

The application of information technologies in the world economy is gradually affecting more and more of today's society. Virtually all nations are already today experiencing changes brought on by the new technologies.

Given this impact, it is natural that all three programmes presented above to a certain degree involve examining implications of introduction of information technologies. However, the contexts in which the programmes have been formulated, and thus the reasons for the interest in microelectronics, are somewhat different.

Technology and Development, starting as a loosely organized group of researchers, has recently developed into a more coherent research programme dealing with technological change, industrialization and technology policies in developing countries, in the context of their relationship with the industrialized countries. The central role played by the capital goods industry in most economies has led the programme to focus its research on this sector. As a consequence of this focus several projects within the programme deal directly with different aspects of the application of information technologies/microelectronics in developing countries. (The projects are presented in section II.4 below). The main activities in this area include (1) analysing the attempts to build up an indigenous technological capability in the developing countries. By this is meant not only user capability but also R&D, design, maintenance and production capabilities of information technologies. (2) Monitoring the technological change that mainly emanates from industries in the developed countries and analysing its implications on the industrialization efforts of the developing countries.

Sweden's Industrial Future, was established as an attempt to develop a scientific understanding of the ways in which R&D policy function, and can function, in small industrialized countries. By analysing their possibilities and limitations in relation to the technological change, the research is aimed at improving the conditions for realistic policies in this area. Although specifically aimed at R&D policy in small industrialized countries, the programme has a universal applicability in some of the research areas, e.g. the study of the relations between R&D strategies and long term industrial goals, and studies of corporate R&D strategies and innovative capacity. In the area of information technologies, one project is specifically aimed at examining the case of fiber optics and the role of government, industry and universities in the development process of fiber optics.

Technology and Culture, was estalished as an instrument to study the issue of technological change in various social and cultural contexts. The programme studies the technological developments in Asia and Europe in a comparative perspective. The main activities regarding information technologies/microelectronics are directed towards three issues: (1) The role of information technologies in facilitating the dissemination of scientific and technological knowledge in India and China; (2) How to create a socially relevant strategy for the application of microelectronics in India; and

(3) Discussion of technology policies regarding electronics and automation technologies. The principal aim has been to evaluate the possibilities for appropriate use of technologies in cultural and social environments which differ significantly from those which in the technologies are designed.

2. Objectives

The main objective is to carry out research on issues related to the efforts of building up an indigenous technological capability in information technologies/microelectronics in developing countries. The research is aimed at studying threats against and opportunities for the industrialization effort in developing countries, brought on by the technological change in microelectronics.

A second objective is to collaborate with relevant institutes, particularly in developing countries, and to stimulate contacts with researchers and organizations which are active in the same field. This includes inviting guest researchers to carry out research tasks specifically related to the programme and to organize meetings and seminars at the institute with researchers - both from Sweden and abroad - who are active in the same general area.

Thirdly, it is the objective of the programmes to provide advisory services to developing countries, international organizations and Swedish development assistance institutions.

The programmes at the RPI are carried out at a short term basis with most of the individual projects being subject to annual evaluation for funding. This points at the difficulties involved in formulating long term objectives, especially in the area of action programmes where we have no control over fundings.

3. Methodology

The research programmes have an emphasis on empirical research but include research of a methodological and a theoretical nature. In terms of the theoretical framework, the programme is pragmatic and pluralistic. Each researcher uses the theoretical framework which he considers to be most appropriate.

In addition, we consider a comparative perspective to be useful. Therefore, similar phenomena in two or more countries are investigated and compared in most of the projects. The countries compared are at different stages of development, have dissimilar development strategies or are characterized by diverse socioeconomic systems.

An important element of the research activities is to monitor the technical changes which are underway and assess them in the context of the current economic and social conditions in the world. A main point of entry into such an analysis is to study the behaviour of the actors involved - both those who are directly engaged in the innovation process, and those who will benefit from or be affected by the new technologies at the user end of the system. Among these actors the transnational corporations have a strategic position both as innovators and carriers of technology. The rapid advance of the newly industrialising countries (NICs) in the trade in technology also deserves special attention.

It is within the framework of this international (economic and technological) environment that the developing countries have to formulate their industrial policies and technology policies. The dynamics of this environment and the role of technical change within it have not been studied sufficiently. Technological trends in specific sectors constitute threats or opportunities for developing countries. These trends and tendencies have to be estimated when discussing which sectors or branches developing countries are competitive in, or may become so through the development of a dynamic comparative advantage.

All research projects include fieldwork in developing countries and cooperation with research institutes, individual scholars or policy makers in the countries studied. In order to create closer links with research institutes in these countries, guest researchers from developing countries are invited to carry out research at the RPI during shorter periods. Furthermore, it is an objective of the programmes at the RPI to ensure that the research has direct relevance to the countries studied. A workshop with the intention of testing preliminary some of the conclusions from our research will be held during the Autumn 1984. Persons with concrete experience in technology policy-making and capable of evaluating policy implications, will be invited to comment on papers produced for the workshop.

4. Research Projects

Currently about 20 projects are in progress at the RPI. The projects presented in the following are those directly related to the application of microelectronic technologies in developing countries.

(1) THE LUND MONITOR ON TECHNOLOGICAL TRENDS AND CHALLENGES TO THE THIRD WORLD - THE CASES OF MICROELECTRONICS AND BIOTECHNOLOGY (to be completed 1984)

The project has studied technological trends in selected technological fields and interpreted the challenges and implications of new technologies for the developing countries. Two highly topical fields having potentially revolutionary impact on society were reviewed, namely, microelectronics and biotechnology.

The challenges can have both positive and negative dimensions, consisting of potential advantages (new possibilities offered by the new technology) and disadvantages (threats). The realization of potential benefits and, conversely, the minimization of adverse effects that may follow from the use of new technologies require adequate preparation. Therefore special emphasis was given in this project to policies and strategies that Third World nations may develop for meeting the new challenge.

(2) SCIENTIFIC AND TECHNOLOGICAL INFORMATION SYSTEMS FOR DEVELOPMENT - A COMPARATIVE STUDY OF THE INDIAN AND CHINESE EXPERIENCE (Completed 1982/83)

Erik Baark, Mag.art. (Sinology/Information Science), Univ. of Copenhagen

The aim of the project has been to analyse the influence of economic, social, and cultural contexts of developing countries on information systems and their effects on technological development. A better theoretical knowledge on these relationships will make it easier to evaluate the efficiency

of different strategies for the establishment of scientific and technological information services; in addition, such knowledge can contribute to strategic political decision-making on for instance the choice of technology for information systems in developing countries.

Status

The investigation of how the organization of dissemination structures for scientific and technological information has been established in India and China has led to three conclusions of major importance: Firstly, a comparison between the information infrastructures in India and China shows that these are heavily influenced by the context of political economy, etc. Secondly, a strong integration with the international network of information exchange (in the case of India) is not necessarily an advantage, particularly since it may reduce the feasibility of local information exchange. Thirdly, a case study of the utilization of information in technical standards literature shows that many of the decisive factors influencing the process of information utilization must be located in the domestic socio-economic context. The implication of this study is thus that India and China may improve their information infrastructures provided they pay closer attention to their local contexts. Furthermore, the study leads to a questioning of the need to formulate universal guidelines for the establishment of information infrastructures in developing countries.

(3) TECHNOLOGICAL CAPABILITY GENERATION AND INFORMATION SERVICES IN INDIA AND TANZANIA - A STUDY OF THE RELEVANCE OF UNITED NATIONS INFORMATION STRATEGIES (started 1983/84)
Erik Baark, Mag.art. (Sinology/Information science), Univ. of Copenhagen

Recent investigations of scientific and technological information services in developing countries have indicated that they are generally under-utilized and ineffective in terms of contributing to the development of these countries. It has moreover become apparent that developing countries to a large degree rely on information strategies promoted by United Nations organizations when they establish new information services; examples are India and Tanzania. Key issues in this project are thus whether UN information strategies have paid sufficient attention to contextual factors of developing countries, and to what extent they have recognized the specific requirements of technological capability generation. Consequently the objectives of the project are to analyse the main features of UNESCO and UNIDO information strategies, their implementation in the national information services of India and Tanzania, and their relevance in terms of satisfying the information requirements for technological capability generation. Case studies of the Indian electronics sector and the Tanzanian capital goods industry will analyse the role of major actors in the information dissemination process and their ability to meet information requirements. Finally the results of this analysis will be useful for a discussion of options for improvement of information services in developing countries.

Status

The project activities for 1983 included three achievements: Firstly, the conceptual basis for a description and critique of dominant information strategies for the Third World was developed. In particular, the conclusions from a recently completed study of India and China were further elaborated for use in the methodological approach in this project, the role of

information in technology transfer was examined, and the role of policy-making in Indian electronics sector was analysed. Secondly, trends in information science and systems theory were examined to provide background material for analysis of UN information strategies. Thirdly, the concrete planning of the visits to UNESCO and UNIDO during Spring 1984 has taken place.

(4) TECHNICAL CHANGE AND PATTERNS OF SPECIALIZATION IN THE CAPITAL GOODS INDUSTRIES OF INDIA AND THE REPUBLIC OF KOREA (started during 1983/84)
Charles Edquist, PhD. (Economic History) Univ. of Lund
Staffan Jacobsson, M.A. (Development Economics), Univ. of Susses, UK

Many developing countries have as an explicit policy to develop or strengthen their capital goods industry. The capital goods industry is, however, very heterogenous and a policy of specialization within it must be formulated, by each country. The project will first of all describe the patterns of specialization in Cuba, India and the Republic of Korea in a time perspective of 30 years. It will subsequently analyse the determinants of these patterns of specialization. Among the determinants, the following four will be placed in focus:
(a) the nature of the domestic market, (b) the nature of the international market, (c) comparative advantage and how it is affected by technical change in products and in processes, (d) the conscious policy of the state. The patterns of specialization and the government policies will then be compared and evaluated. Two issues are to be studied in particular: firstly, given that the development of the skills needed in the capital goods industry is a lengthy, uncertain and costly investment, to what extent has this investment payed off in the countries chosen? Secondly, given that a number of countries have followed an import substitution policy in the capital goods industry and that smaller countries in the industrialized world are increasingly forced to integrate themselves more deeply in the international economy, it is pertinent to ask what the limits are to an economically efficient reduction in the import content of investment? Finally the project will discuss future strategies of specialization for the countries studied.

Status

Visits were paid to both India and the Republic of Korea during 1983. Data was collected and exploratory interviews were carried out with researchers, policy makers and firm representatives. Research collaboration was established with the National Council of Applied Economic Research (NCAER) in New Delhi and a cooperation agreement was signed with the Korea Institute for Industrial Economics and Technology (KIET) in Seoul. (Copy of the agreement is enclosed). In the case of NCAER, Dr Ghayur Alam visited the RPI in August to discuss matters of collaboration. A junior researcher at the NCAER, Mr Kishore Jethanandani, was during Summer and Autumn 1983 actively involved in the project work by collecting and analysing information regarding automation in the Indian Engineering Industry.

(5) TRENDS IN THE DIFFUSION OF ELECTRONICS TECHNOLOGY IN THE CAPITAL GOODS SECTOR OF THE INDUSTRIALIZED COUNTRIES AND THEIR LIKELY IMPACT ON DEVELOPING COUNTRIES (short-term project carried out during the first half of 1984) Charles Edquist, Phd. (Economic History) Univ. of Lund
Staffan Jacobsson, M.A. (Development Economics), Univ. of Sussex, UK

The project deals with technical change in the capital goods industry and thereby addresses the diffusion of technologies such as computer numerically controlled machine tools, industrial robots, computer aided design (CAD) and flexible manufacturing systems (FMS). The present level as well as trends and patterns in the use of these technologies in the OECD countries are identified. The factors accounting for the diffusion and its impact are also analyzed. This includes the impact on the product level, i.e. which types of products that are most affected by the use of electronically controlled capital goods. The magnitude and nature (factor saving bias) of cost saving are also addressed. Finally, factors affecting the probable pace and direction of further technological changes in the field are discussed. All this is intended to provide a basis for a discussion of the implications for the developing countries.

Status

The project is carried at the request of UNCTAD and is a short-term assignment. It started in early 1984 and will be completed by early summer this year.

(6) COSTS AND BENEFITS OF BUILDING UP AN INDIGENEOUS TECHNOLOGICAL CAPABILITY - A COMPARATIVE CASE STUDY OF TELECOMMUNICATIONS IN INDIA AND BRAZIL (started in 1983/84)
Bo Göransson, M.A. (Economics), Univ. of California, Santa Barbara, USA
Claes Brundenius, PhD. (Economic History), Univ. of Lund

Telecommunications, traditionally characterized by technological stability, stable world market shares and few new entrants, today is an industry in transition. Technological change in the field of microelectronics has changed the conditions on the market and increased the role of telecommunications in the economy. In respons to changing conditions both equipment supplying TNC's and government buyers (PTT's) of equipment are re-evaluating their respective strategies.

In this project the attempts of India and Brazil to upgrade their technological capabilities in the telecommunications sector will be studied. The analysis will be carried out in three steps: I/ an aralysis of the specific conditions prevalent in the telecommunications sector in the two countries, II/ an investigation of the relationship between the equipment supplying TNC's and the buying PTT's, and III/ a comparative study, drawing from the results of the preceding analyses, of the costs and benefits experienced by India and Brazil in their building up of an technological capability in telecommunications.

Status

Since work on the project was commenced during Summer 1983, it is difficult to already draw any general conclusions from the study. However, some preliminary results can be presented. Interviews with producers of telecommunication equipment have indicated that the barriers to entry into the telecommunication equipment market have increased with the introduction of electronic systems. For the developing countries attempting to build up an indigeneous telecommunication industry, it seems like the main obstacles are the high research and development requirements and the related human resource requirement. To control these two variables is essential for prospective entrants to the industry. If we look at the case of Brazil, it can be established that the Brazilian strategy has been successful in several instances and that the bargaining position of the national telecommunication authority towards the suppliers has increased considerably. However, the Brazilian attempt to build up an indigeneous research and development capability in telecommunications runs serious risk of being hamstrung by insufficient allocation of financial resources.

(7) TECHNICAL CHANGE AND TECHNOLOGY POLICY - THE CASE OF COMPUTER NUMERICALLY CONTROLLED LATHES IN ARGENTINA, THE REPUBLIC OF CHINA AND THE REPUBLIC OF KOREA (to be completed 1984)
Staffan Jacobsson, M.A. (Development Economics), Univ. of Sussex, UK

The project treats the issue whether the introduction of electronics into the control of machine tools will increase the technology gap in machine tool production between DCs and NICs. The specific research question is: 'Under what conditions will the leading lathe producers in Argentina, Brazil and the Republics of China and Korea be able to switch from the design and production of standard lathes to computer numerically controlled (CNC) lathes?

Results

The empirical work was terminated in January/February 1983 with visits to the Republic of Korea and Taiwan as well as Japan. The study is now in the process of being completed in the form of a 350-pages long manuscript. Some of the findings are:

- The substitution of computer numerically controlled (CNC) lathes for conventional lathes is very fast.
- The market for conventional lathes is declining in absolute terms and this applies especially much to the type of lathes that the NICs have specialized in producing, namely engine lathes.
- Some of the leading producers of engine lathes in the NICs are attempting to enter into the market for CNC lathes.
- The barriers to entry into production of CNC lathes are however very much higher than those of entering into production of engine lathes.
- If the technological gap is not to increase, product and firm specific state intervention is required in the NICs.

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- Standards Information Utilization: India and China Compared (forthcoming RPI Discussion Paper).
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