Document of
The World Bank

Report No: 17896

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$300 MILLION

TO

MEXICO

FOR A

KNOWLEDGE AND INNOVATION PROJECT

May 22, 1998

Finance, Infrastructure and Private Sector Management Unit
Mexico Country Management Unit
Latin America and the Caribbean Regional Office

CURRENCY EQUIVALENTS

(Exchange Rate Effective May 15, 1998)

Currency Unit = Mex$
Mex$8.51 = US$1

FISCAL YEAR

July 1 - June 30

ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
CCC	President's Science Advisory Council - *Consejo Consultivo de Ciencias*
CONACYT	National Science and Technology Council - *Consejo Nacional de Ciencia y Tecnologia*
DO	Development Objective
ESW	Economic and Sector Work
FIDETEC	Research and Development Fund for Technological Modernization - *Fondo de Investigación y Desarrollo para la Modernización Tecnológica*
FORCCYTEC	Fund for Scientific and Technological Capacity Strengthening - *Fondo para el Fortalecimiento de las Capacidades Científicas y Tecnológicas*
FSD	Financial Sector Development Department
FY	Fiscal Year
GDP	Gross Domestic Product
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IADB	Inter-American Development Bank
INEGI	National Institute of Statistics, Geography, and Informatics - *Instituto Nacional de Estadística, Geografía e Informática*
IP	Implementation Progress
KIP	Knowledge and Innovation Project
LIBOR	London Interbank Offer Rate
MSTQ	Metrology, Standards, Testing and Quality
NAFIN	Nacional Financiera, S.N.C.
NAFTA	North American Free Trade Agreement
NIST	National Institute of Standards and Technology
NSF	National Science Foundation
OECD	Organization for Economic Cooperation and Development
PACIME	Support Program for Science in Mexico - *Programa de Apoyo a la Ciencia en México*

Vice President: Shahid Javed Burki
Country Management Unit Director: Olivier Lafourcade
Sector Management Unit Director: Krishna Challa, Acting
Task Team Leader: Daniel Crisafulli

PAHO	Pan American Health Organization
PCD	Project Concept Document
PROMTEC	Technology Modernization Support Program - *Programa de Apoyo a la Modernización Tecnológica*
R&D	Research and Development
RFP	Request for Proposals
S&T	Science and Technology
SECOFI	Ministry of Commerce and Industrial Development - *Secretaría de Comercio y Fomento Industrial*
SECODAM	Ministry of the Comptroller General
SEP	Ministry of Education - *Secretaría de Educación Pública*
SME	Small and Medium Enterprise
SHCP	Ministry of Finance and Public Credit - *Secretaría de Hacienda y Crédito Público*
SNI	National System of Researchers - *Sistema Nacional de Investigadores*
TBD	To be determined
UAM	Autonomous Metropolitan University - *Universidad Autónoma Metropolitana*
UNAM	National Autonomous University of Mexico - *Universidad Nacional Autónoma de México*
WB	The World Bank
WHO	World Health Organization

Mexico
Knowledge and Innovation Project

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Knowledge and Innovation Project

Project Appraisal Document

Latin America and the Caribbean Regional Office
Mexico Country Management Unit

Date: May 22, 1998	Task Team Leader: Daniel Crisafulli
Country Management Unit Director: Olivier Lafourcade	Sector Management Unit Director: Krishna Challa, Acting
Project ID: MX-PE-44531 Sector: Industry - Other (IY)	Program Objective Category: Private Sector Development
Lending Instrument: Specific Investment Loan	Program of Targeted Intervention: [ ] Yes [X] No

Project Financing Data [X] **Loan** [ ] **Credit** [ ] **Guarantee** [ ] **Other [Specify]**

For Loans/Credits/Others:

Amount (US$m): 300.0
Proposed terms: [ ] Multicurrency [X] Single currency, specify: US Dollar
Grace period (years): 3 [ ] Standard Variable [X] Fixed [ ] LIBOR-based
Years to maturity: Standard for medium-disbursing loans
Commitment fee: 0.75% less applicable waivers

Financing plan (US$m):

Source	Local	Foreign	Total
Government	209.3	0.0	209.3
IBRD	4.0	296.0	300.0
Private Sector	153.5	0.0	153.5
Total	366.8	296.0	662.8

Borrower: Nacional Financiera, S.N.C.
Guarantor: United Mexican States
Responsible agency: CONACYT

Estimated disbursements (Bank FY/US$M):	1998	1999	2000	2001	2002	2003
Annual	6.0	26.0	60.0	68.0	70.0	70.0
Cumulative	6.0	32.0	92.0	160.0	230.0	300.0

Project implementation period: 5 years
Expected effectiveness date: September 15, 1998
Expected closing date: December 31, 2003

A: Project Development Objective

1. Project development objective and key performance indicators (see Annex 1):

The Project aims to promote the generation, diffusion, and application of knowledge for innovation in support of economic and social development. Emphasis would be placed on stimulation of linkages and effective diffusion of knowledge for innovation, via the following actions:

- Support excellence in science and technological research, increase the availability of scientific and technological human capital, and institute an integrated strategy for development of fields of science of strategic importance to Mexico's economic and social development.
- Support increased firm-level productivity through provision of decentralized, demand-driven technological services for small and medium enterprises and creation of a pilot private sector-led venture capital scheme.
- Facilitate linkages between private firms, universities and research institutions through financial support for joint activity and technical assistance to bridge institutions.

B: Strategic Context

1. Sector-related Country Assistance Strategy (CAS) goal supported by the project (see Annex 1):

CAS document: 16135-ME; Progress Report R98-49. Date of latest CAS discussion: March 26, 1998

The project would aim to support the CAS objective of **Growth with Stability** via actions to increase firm-level productivity in Mexico over the medium- and long-term. The CAS Progress Report states the problem clearly: "Productivity collapsed with the crisis in 1982 and it failed to grow significantly since.... Output per worker for the economy as a whole declined by 22 percent between 1981 and 1994 (Progress Report, p. 5)." In order for Mexico to achieve higher growth in total factor productivity (TFP) and thereby sustained growth in income and real wages, firms must improve levels of quality and technology. The potential impact of increased amount and effectiveness of investment in science and technology is illustrated by the *maquila* (in bond processing) sector. For Mexico as a whole, the average value added in the *maquila* sector is 3-5 percent. However, in areas with strong private sector-oriented universities and technological support services, such as Monterrey, the value added among *maquiladoras* exceeds 20 percent. Survey data indicate that the technical capacity of local firms plays a large role in determining export linkages. Increasing the performance of the system for knowledge and innovation throughout Mexico could therefore result in large gains in productivity and quality. The project would aim to strengthen firm-level capacity over the medium- to long-term via the restructuring of the system for knowledge and innovation - the set of institutions responsible for generation, diffusion and application of knowledge for productive purposes.

Each component of the project would also support the objective of **Modernization of the State**. The project would streamline CONACYT administration overall in support of the CAS aim to "increase the effectiveness of public programs, e.g., improving efficiency and transparency." (CAS, p.7). The restructuring of most of the SEP-CONACYT system of science and technology centers would increase cost recovery while improving client orientation and effectiveness of service provision in support of industry. The firm-level technology enhancement component would be executed via a decentralized network of private agents.

The project would also support the CAS objective of **Social Development** through increased educational opportunities in both public and private universities. Social benefits may also accrue from development of health sciences, biotechnology, and environmentally-friendly technologies. The Field Development sub-component would channel resources to emerging and lagging areas of science with important social impact.

2. Main sector issues and Government strategy:

Poor Performance of System for Knowledge and Innovation.

The Mexican innovation "system", comprised of the enterprises, universities, and other public and private institutions involved in the generation, diffusion, and application of knowledge for productive purposes, remains inefficient in channeling science and technology (S&T) investment into productive applications. Under the protection of a closed economy prior to 1986, Mexican industry developed in an environment in which enhancements in quality and technology were largely unrewarded. Even large firms apparently invest low amounts in adapting and developing new technologies: an estimated 66 percent of research and development (R&D) is financed by the government[1], and fewer than 10 percent of researchers are employed by the private sector.[2] Similarly, the academic and public research sectors developed largely in isolation from the needs of industry. A 1997 evaluation of the PACIME project by international experts found "the scarce connection with productive sector or societal needs to be a matter of serious concern," and private sector use of the research infrastructure available at universities and technological institutes to be insignificant.[3] Furthermore, institutions which could serve as bridges between universities and firms, including the system of SEP-CONACYT science and technology centers, have operated as academic research centers (in accordance with original objectives) rather than firm-oriented service organizations. Other bridge institutions have been slow to develop. Since the advent of economic liberalization, enterprises and researchers across Mexico have begun to work together on problems of industrial importance. However, Government policy and institutional framework do not yet provide support to these incipient joint initiatives. One result is that university-based researchers perform only 1.4 percent of R&D funded by the business enterprise sector (second lowest percent among OECD members).[4]

Low Public and Private Investment in Science and Technology.

In addition to the low effectiveness of spending on science and technology, overall S&T investment levels remain low. Although small, open economies (even the most advanced) rely primarily on imported sources of technology, substantial investment in local human resources and infrastructure is required to ensure the absorption, adaptation and application of world-class technology. The percentage of GDP spent on R&D, for example, is the lowest in the OECD (0.31 percent for Mexico versus 0.38 percent for Turkey), and about one seventh of the OECD average.[5] This figure is also less than half of that spent by non-OECD comparator countries, such as China (0.7 percent), and India (0.8 percent). Mexico has the lowest concentration of researchers per population of OECD members, with only 6 researchers per 10,000 inhabitants vs 48 in Korea and 29 in Poland[6], and compares adversely with other developing countries such as India (4.8).[7]

Low productivity growth/investment in firm upgrading

Despite more than a decade of structural reform, productivity growth among Mexican firms has continued to lag. Total factor productivity in industry grew by only 0.9 percent during 1988-94; performance in the manufacturing sector was more positive at 2.4 percent for the same period.[8]

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[1] 1995 data. Source: CONACYT.

[2] Indicadores de Actividades Científicas y Tecnológicas, CONACYT, 1995.

[3] 1997 Evaluations of PACIME by J.M. Rojo, Universidad Complutense de Madrid, A. Kuppermann, CalTech, and D. Newlon, NSF.

[4] University Research in Transition, OECD: Paris, 1998.

[5] 1995 data, source: OECD MSTI Database, November 1997.

[6] Ibid.

[7] 1992 data cited in Science & Engineering Indicators, National Science Foundation, National Science Board, 1996.

[8] Barry Bosworth, 1997, cited in Mexico: Enhancing Factor Productivity Growth. Country Economic Memorandum, World Bank, draft, 1998.

Furthermore, productivity gains have apparently been concentrated among large firms, which have been far more successful in acquiring and applying new technologies than small and medium enterprises (SMEs). As a result, large firms have successfully linked with international markets for both goods and services (including financial markets). Notably, large Mexican firms maintained access to international financial markets even during the crisis of 1994-5[1], an indicator of their ability to achieve a certain level of quality and technology.

In comparison to large firms, small and medium enterprises have faced significant barriers to increased productivity and quality. Lack of linkage to international and local sources of technology has inhibited upgrading of capacity. Furthermore, investment in SMEs has been limited largely to family resources - particularly in the wake of the 1994-5 financial crisis. Causality is difficult to establish, but survey data indicate that low investment in technology among SMEs is driven by low managerial administrative capacity and awareness of available alternatives rather than simply a lack of access to capital.[2] In addition, data suggest that relatively small investments in external advisory services and equipment could have a large impact on productivity among SMEs.

Lack of demand-driven technological support institutions

Mexican policy to support firm-level technological enhancement has been reduced in effectiveness due to a variety of factors, including: a narrow definition of individual program objectives; inadequate integration of support services provided by various public and private agencies; a tendency toward centralized control by federal agencies; and an over-emphasis on creation of the supply of services versus incentives for articulation of demand.

The CIMO program (*Programa de Calidad Integral y Modernización* - Program for Integral Quality and Modernization), established under the Mexico Labor Market and Productivity Enhancement Project, Loan 3542-ME and administered by the Labor Ministry, has provided the largest window of support for firm-level technology modernization to date. This decentralized, locally-managed program provides firm-level training for upgrading administration, quality, and productivity in addition to traditional worker technical training. Subject to an in-depth evaluation in 1995, this ongoing program channeled resources to over 30,000 firms and trained over 200,000 workers during 1988-92. The program remains limited, however, in the extent to which technological upgrading may be supported. Consultancies are limited to approximately US$2,000 per participating firm, well below levels needed for any work beyond an initial diagnostic.

Low effectiveness of research programs

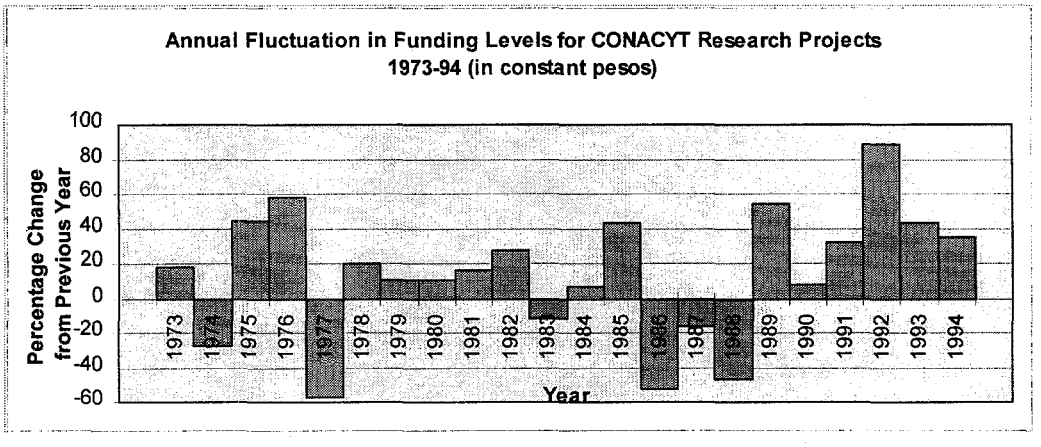
The effectiveness of Mexican investment in science and technology research may be viewed as a function of productivity of researchers (in terms of publications, training of human resources) and relevance of output to social and economic development. Regarding the first factor, significant improvement in productivity of Mexican research has occurred in recent years, as evidenced by the 9.6 percent *per annum* increase in scientific and technological publications in refereed international journals during 1990-95.[3] Despite this impressive growth, productivity remains low in international terms at 0.42 publications per researcher *per annum*.[4] Human resource formation, a critical output of research projects, also remains disappointingly low. Mexico trains fewer Ph.D.s per year than comparator countries, granting about 3 Ph.D.s annually in science and engineering per million inhabitants compared to 5 in India, 6 in Brazil,

[1] Mexico: Financing the Real Sector, World Bank, draft, 1998.
[2] Competitividad de la Indústria Manufacturera de la Zona Metropolitana de la Ciudad de México: Indicadores de Calidad y Productividad 1995, CONACYT, 1996.
[3] ISI Science Citation Index, cited in Indicadores de Actividades Científicas y Tecnológicas, CONACYT, 1997.
[4] Average publications for SNI members during 1993-95, Indicadores de Actividades Científicas y Tecnológicas, CONACYT, 1997.

and 19 in Korea per million inhabitants.[1] The second determiner of effectiveness, *relevance,* also remains at apparently low levels. Although more difficult to measure than traditional academic output, available data on placement of students in industry and patents indicate a low level of linkage between academia and industry.

Fluctuation of Support to Research Programs

Fluctuation in support to scientific and technological research project has been severe, often increasing or decreasing by as much as 50 percent annually over the past 25 years[2]:



Research grants tend to be relatively small (averaging less than US$30,000 *per annum*) and of short duration (approximately two years on average). These levels are approximately one-third the amount and one half the duration considered to be most effective for research. Availability of funds has fluctuated greatly due to high variability of Government budget in real terms, driven in part by macroeconomic cyclicality.

Such fluctuations are disruptive to the research and training system and introduce unnecessary delay that drives down researcher productivity. The predecessor Mexico Science and Technology Research Project (Loan 3475-ME) played an important role in providing stability in support to science during the financial crisis of 1994-95. CONACYT and the Government support the goal of increased stability of financing in the future.

Regional Disparity in S&T Capacity

The existing infrastructure for science and technology is located disproportionately in the Mexico City area. For example, as of 1996 over half of the members of the National System of Researchers were located in the Federal District. Over 75 percent of all doctoral degrees are awarded by schools in the Mexico City area (1994).[3]

Inadequate Research and Graduate Training Policy at Universities

A growing number of Mexico's largest and most important centers for graduate training have acknowledged that their educational and research programs need to change in order to better meet the needs of a modern economy. Students tend to take a very long time to complete their degrees. As new Ph.D.s become researchers they face unnecessary delays establishing themselves. Salary incentives at the

[1] Data from 1990 Science and Engineering Indicators, National Science Foundation, 1993.
[2] "*Proyectos de Investigación Cientificos: Análisis de Apoyos Otorgados,*" Ciencia y Desarrollo, CONACYT, Sept/Oct. 1995.
[3] Indicadores de Actividades Científicas y Tecnológicas, CONACYT, 1996 and 1997.

national and university level give *de facto* priority to publishing over training. A series of university-level reforms are underway or being planned: the National Autonomous University (UNAM) is in the midst of a restructuring of graduate education policies aimed at shortening the average time spent obtaining a degree; new mechanisms for evaluation of post-graduate programs have been introduced. Measures under consideration include the elimination of full Masters requirements (including thesis) as a prerequisite for doctoral study. The UAM has integrated cooperative programs with potential employers and has closely tracked graduate employment patterns.

Government Strategy:

CONACYT has requested Bank support to build on the *Programa de Ciencia y Tecnología 1995-2000*, which aims, *inter alia,* to support the "acquisition of a greater capacity to participate in the worldwide scientific advance and to transform this knowledge into useful applications, particularly with respect to technological innovation".

The program includes a series of actions, as follows:

Human Resource Formation - to increase the quality and quantity of high-level professional human resources available for employment in both the private and public sectors and in research. The challenge of increasing the quality of graduates in emerging disciplines, such as informatics, is particularly critical given the rapid increase in student populations.

Science Policy - to increase the quality and quantity of scientific research and development; to promote linkages with the private sector; to improve policy coordination. Mexico's stated target in the *Programa de Ciencia y Tecnología 1995-2000* of doubling the percentage of GDP spent on R&D over the next seven years, assuming the CAS's medium growth scenario of 4-5 percent *per annum* implies nearly tripling R&D spending by 2005. This target may be difficult to achieve given prevailing budget austerity, but the government would like to maintain a smooth upward trajectory in R&D investment under any given economic scenario. Critically, an expanding proportion of the new spending would be expected to come from the private sector - with government policy intended to catalyze the necessary increase in private investment.

Technology Policy - to continue and strengthen support for the technological upgrading of Mexican industry in recognition of the increasing competitive demands resulting from globalization of production.

3. Sector issues to be addressed by the project and strategic choices:

The project aims to address elements of each of the main sector issues raised in para. 2, within the limits of project scope indicated below:

- Improve performance of system for knowledge and innovation. The project aims to increase the effectiveness and overall amount of investment in innovation in Mexico via measures directed at universities, enterprises and bridge institutions. From the university side, the project will (i) strengthen formation of skilled human resources; and (ii) generate knowledge with potential application to economic and social development. Enterprise investment in science and technology will be encouraged through increased involvement at the university level; support for bridge institutions (restructuring of SEP-CONACYT system, creation of university outreach units); and joint university-industry projects.

- Support productivity enhancement through effective technology policy. The project would aim to improve firm-level technology through a series of measures emphasizing the articulation of demand. The project would support the strengthening of locally-based, privately-managed agents providing

demand-driven services for technological modernization. Under the Technology Modernization and Joint Industry-Academia Projects sub-components, matching grant schemes would provide direct (and declining) incentives for firm upgrading. The regional/sectoral technology centers would be privately owned and operated - supported by a matching credit for initial investment and start-up costs. Project activities are designed to work closely with existing programs and initiatives underway in the public and private sectors. For example, the firm-level technology development component would build on the existing CIMO program by enlarging the continuum of technological services currently supported under the Labor Ministry program.

The restructuring of nineteen (approximately) public S&T centers (Centros SEP-CONACYT) would aim to increase the productive impact of the largest concentration of scientific and technological capacity in Mexico apart from the national university (UNAM). While encouraging the SEP-CONACYT Centers to rely increasingly on private and competitive funding sources, the project would support technical assistance and minor infrastructural investments to help the Centers meet the needs of industry.

- Improved effectiveness of investment in research and human resource formation. The project would aim to increase the effectiveness of investment in research projects in terms of efficiency, quality, and relevance. The project would support incentives for greater productivity while maintaining criteria for excellence in science. The Science and Technology Research Component and the Industry-Academia Linkage component are both aimed toward improving the productivity, quality, and relevance of research and human resource formation.

- Continuity and consolidation of support to science. The project would support a second generation of reforms to propel the peer review system created under the Science and Technology Infrastructure Project, Loan 3475-ME, to a higher level of effectiveness, as discussed above. In addition, the project would provide important stability beyond the current political cycle in terms of budgetary support and policy design. The reforms would integrate and consolidate the windows of support to science and aim to build a strategic role for CONACYT as facilitator of the strategic development of emerging and existing fields of science.

- Decentralization of S&T capacity. CONACYT maintains a variety of policies to promote to regional S&T capacity, actively encouraging development of scientific and technological capacity outside of the Mexico City metropolitan area. Policies toward this end include a regional network of offices to promote joint projects with local entrepreneurs and state governments; and the SEP-CONACYT system of research centers. CONACYT is promoting policies to generate more local economic and social benefits.

  The project would support decentralization in several ways. The system of SEP-CONACYT centers would be linked (i) to local industry needs and (ii) to universities and technical schools in order to strengthen the quality of local institutions. The Firm-level Technology Development component would support a pilot network of agents to address needs of industry in selected cities. The Science and Technology Research Component also encourages strengthening of regional capabilities through delegating authority over distribution of research funds to evaluation committees with a regionally balanced membership. In addition, CONACYT will maintain existing incentives and programs for decentralization, such as the Regional Research System (*Sistema de Investigación Regional).*

- Higher education reform. The project does not attempt to undertake a comprehensive reform of higher education policy in Mexico where a significant effort is required. The project is designed to make use of CONACYT's limited influence over the system in order to maximize the impact of reform in cooperation with parallel efforts underway in other leading institutions, including the Ministry of Education through the Undersecretary of Higher Education and Scientific Research, the

Undersecretary of Technological Education, National Association of Universities and Institutions of Higher Learning (ANUIES), and the National Researcher System (SNI).

C: Project Description Summary

1. Project components (see Annex 2 for a detailed description and Annex 3 for a detailed cost breakdown):

The activities supported by the Knowledge and Innovation Project form part of a broader set of programs administered by CONACYT. The Project, including Bank and Government contributions, represents approximately one-third of projected CONACYT funding during the five-year project implementation period. The total CONACYT program of support is indicated in the following table.

Estimated CONACYT Budget 1998-2000[1]
(Millions of US$)

Program	Amount	% of Total
I. Science	1,341	80
Science and Technology Research	359	
Academy-Industry Linkage	111	
Scholarship/Credits	591	
National Researchers System	280	
II. Technology	173	10
III. Others (including international affairs, diffusion, administration)	171	10
Total	**1,685**	**100**

The Knowledge and Innovation Project prepared by CONACYT and supported by the World Bank is described below:

Component	Category	Cost Incl. Contingencies (US$M)	% of Total	Bank-financing (US$M)	% of Bank-financing
A. Science and Technology Research Component: to improve the quantity, quality, and relevance of research and human capital formation include:		285.00	43.0	135.00	45.0
• Field Development: to stimulate research in new and lagging fields with scientific, economic and/or social importance.	Policy/Other				
Research Projects: to promote quality in research, consolidate and improve peer review, and participatory planning; incentivize human resources training; and prioritize timely integration of young researchers in the system.	Policy/Other				
• Institutional strengthening of Deputy Directorate of Scientific Research of CONACYT, including enhanced monitoring, evaluation, and strategy.	Project Management				

[1] Source: CONACYT

B. Industry-University Linkage Component: to support joint action between universities/ public research institutes and the private sector.		156.44	23.6	62.50	20.8
• Restructuring of Public S&T Institutes: to increase cost recovery while improving client orientation and effectiveness of service provision in support of industry.	Institutional Strengthening				
• Matching Grants for Joint Industry-Academia Projects, allocated under peer review process with industrial representation.	Policy/Other				
• Technical Assistance to Universities to create and strengthen university outreach offices.	Institutional Strengthening				
C. Enterprise Technology Enhancement Component: to directly impact the productivity and competitiveness of firms, particularly small and medium enterprises.		191.33	28.9	72.50	24.2
• Technology Modernization Program to support upgrading of SMEs via matching grant scheme administered by decentralized network of local agents.	Policy/Other				
• Private Regional/Sectoral Technology Support Centers to promote creation of demand-driven services.	Institutional Strengthening				
• Special pilot programs of emerging importance, including (a) Technology Foresight for consultation between government, academia and the private sector and (b) a Strategic Technology Information Service.	Policy				
• Pilot Venture Capital fund, managed and controlled by private sector, to provide financing during pre-commercial stage for technology-based startup firms.	Other				
D. Unallocated		30.00	4.5	30.00	10.0
	Total	662.77	100.0	300.00	100.0

2. Key policy and institutional reforms supported by the project:

Strategic development of Innovation System with participation of Private Sector. The project would increase involvement of the private sector in science and technology policy, with a view toward increasing the impact of investment on innovation in the productive sector. The Linkage component is designed to increase private sector input into S&T policy at the university level via supporting joint projects. The Field Development program directly involves the private sector (along with academic

representatives) in selection of areas to receive support. A new, smaller CONACYT advisory board would be launched to increase direct communication with industry. The technology enhancement component would provide support for firms to upgrade technical capacity from most effective supplier of services - in academia or industry. This component also includes a Technology Foresight pilot exercise to spur dialogue between the private sector, government and academia on issues of national importance.

Increased productivity of research and development. The project would support actions to increase the productivity of investment in science and technological research activities in terms of economic/social impact and human resource formation. Existing science research support would be redesigned to incentivize greater training of students at both the graduate and undergraduate levels. The Field Development program would encourage growth of emerging and lagging areas of science of strategic importance to Mexico's scientific, economic, and social development. These fields would be selected in consultation with industry and the academic sector. Beyond the immediate gains to relevance from new fields, the project will signal an important new orientation toward consideration of the social and economic impact of research. The aggregate result of new fields and performance criteria for continued support to traditional areas of research will improve productivity by encouraging the connection of research to social and economic development. Improved monitoring and evaluation under each component would support strategic management across all S&T support programs.

Consolidation of research funding programs. Under the project, CONACYT's wide array of programs would be integrated into one main window of support (the Research Projects program). Means of support, which had been administratively separate programs in the past, will either be eliminated or consolidated into a smaller number of program, each with resources adequate for its task.

Decentralization of Technology Support Services. The project would support a decentralized system of private agents to provide firm-level technology services. A matching grant scheme executed at the local level would support individual and multi-firm projects aimed at technological upgrading. The new matching grant schemes would establish tight controls on use of funds (e.g., *ex-post* reimbursement of firm expenditures on qualified projects) while incentivizing successful outcomes. The decentralized, private agent model would facilitate direct contact with firm needs at the local level.

Reform of SEP-CONACYT System of S&T Institutes. Based on the pilot restructuring of four centers supported under a Japanese grant, a phased program of reform of the overall system will be supported by the project. This system of 27 independent public institutes is coordinated by CONACYT, which would incentivize greater cost recovery from private contracts and institute a new competitive mechanism for public funding. CONACYT aims to gradually reduce the direct subsidy to the technology centers by 50 percent during the five-year implementation period of the project, and reallocate these resources to specific projects through a competitive mechanism. While reducing the direct subsidy, the project would support technical assistance to increase outreach to industry and improve administration.

University-Industry Linkage. In addition to the linkage of the SEP-CONACYT centers to the needs of industry, the project would support a set of programs to increase joint activity between academia and the private sector. At the university level, the project would provide support for strengthening and creation of outreach units. The matching grant fund for joint projects would provide additional financial support.

3. Benefits and target population:

- Increased effectiveness of public investment in science and technology to benefit social development and firm productivity.

- Facilitation of firm-level technology upgrading and diffusion to increase productivity.

- Higher levels of private investment in research and development through increased contact with academic and research institutions.

- Increased quality and efficiency in formation of skilled human resources.

- Greater involvement of private firms and academia in science and technology policy-making.

- Increased self-sufficiency and reduced direct subsidy to network of public S&T institutes.

- Improved monitoring and evaluation of science and technology support programs to allow ongoing improvements in project design during implementation.

- Strengthening of regional S&T institutions to meet local needs

The beneficiaries of the Science and Technology Research Component in the short- and medium-term will be (a) an estimated 10,000 graduate students; (b) approximately 5,000 researchers; and (c) users of knowledge created in firms, government, and civil society. The beneficiaries of the Linkage and Technology Enhancement components would be the participating firms (approximately 4,500), university researchers (250), and students (500).

4. Institutional and implementation arrangements:

The project will be implemented by CONACYT over a period of five years. A new public-private advisory committee for CONACYT would provide external advice and feedback regarding project implementation. CONACYT would undertake a regular program of monitoring and evaluation as agreed with the Bank. In addition, a mid-term review would be conducted by an independent consultant satisfactory to CONACYT and the Bank. Nacional Financiera, S.N.C., a Government development bank, will serve as financial agent for the loan and coordinate compliance with all Bank requirements in accounting, auditing, and financial arrangements. In addition, the Comptroller General (SECODAM), Finance Ministry (SHCP), and external auditors would monitor project implementation.

CONACYT's Deputy Director for Scientific Research would be encharged with implementation of the Science and Technology Research Component. The Deputy Director for Coordination of the SEP-CONACYT System would manage the sub-component aimed at restructuring the system of S&T centers. The Deputy Director for Technology Modernization would lead implementation of the Joint Industry-Academia Projects, Technical Assistance to Universities, and the Enterprise Technology Enhancement Component. A unit under the Deputy Director of Finance would be encharged with coordination of financial management of the project within CONACYT and would serve as an interface with NAFIN. Implementation arrangements for the project are further described in Annexes 2 and 6.

D: Project Rationale

1. Project alternatives considered and reasons for rejection:

Focus on Traditional Science. At time of appraisal of the Mexico Science and Technology Infrastructure project in 1991, the scientific community in Mexico has suffered more than a decade of severe budgetary retrenchment and declining enrollment. Given the low capacity of the academic institutions at that time, the project focused on upgrading the quality and quantity of scientific research. Due in large measure to the Science and Technology project, the capacity of Mexican academia has risen considerably in a number of disciplines, making linkage more attractive to the private sector. Furthermore, in the wake of NAFTA private firms are more keenly aware of the need to upgrade technological capabilities than they were in 1991. For these reasons, the Knowledge and Innovation project intends to build on the experience of support for science under the first project while aggressively expanding linkages between

academia and industry and supporting the technological development of firms.

Additional Higher Education Reform. A set of critical issues facing higher education in Mexico limits the functioning of the system for innovation. These issues include a variety of policies affecting quality of students and teaching. The project addresses the elements of higher education reform which are viewed as essential to project success, including linkage of research with education; and promotion of linkages between academia and industry through joint research, development, and technological activity. Other issues of higher education reform - including admissions policies, financing of education, teacher qualifications/upgrading, university remuneration, and curricula - would be best addressed via separate Bank sector work and lending.

2. Major related projects financed by the Bank and/or other development agencies (completed, ongoing and planned):

Sector Issue	Project	Latest Supervision (Form 590) Ratings (Bank-financed projects only)	
		Implementation Progress (IP)	Development Objective (DO)
Bank-financed			
Scientific Research and Technology Infrastructure	Mexico: Science and Technology Infrastructure Project (3475-ME: closing date 6/30/98)	S	S
	Brazil: Science and Technology Reform Support Project (4266-BR: not yet effective)	N/A	N/A
	Brazil: Science Research and Training: (3269-BR: closed 12/31/96)	S	S
Industrial Competitiveness Enhancement	Competitiveness Enhancement Project (planned: FY99)	N/A	N/A
Financing of Private Higher Education	Higher Education Financing Project (FY98)	N/A	N/A
Financial Sector Reform	Second Contractual Savings Reform project (FY98); Rural Finance project (FY99)	N/A	N/A
ESW - Knowledge Dissemination and Application	Mexico Knowledge Opportunities Pilot Study		
Enterprise Training and Labor Market Flexibility	Labor Market and Productivity Enhancement Project (3542-ME: closing date 6/30/98)	HS	HS
Industry/University Linkage, Reform of Technology Institutes	India: Industrial Development Project (2064-CR: on-going)	S	S
Science and Engineering Training	Thailand: University Science		

	and Engineering Project (4805-TH: on-going)		
	Korea: Universities Science and Technology Research Project (3203-L: closed 12/31/95)	S	S
Other development agencies			
IADB Financed: Research Funding and Technology Development	Mexico: Science and Technology Program (804/0C-ME 001/SPQ-ME: on-going)		
	Brazil: Science and Technology Development Program (BR-0217 2/91 on-going)		
Enterprise Training and Labor Market Flexibility	Labor Markets Modernization Project II (983/OC-ME)		

IP/DO Ratings: HS (Highly Satisfactory), S (Satisfactory), U (Unsatisfactory), HU (Highly Unsatisfactory)

3. Lessons learned and reflected in the project design:

- Experience under the IDB support to the PROMTEC SME technology support program, and other programs, indicates the following lessons: (i) directed credit schemes for firm technology upgrading are likely to be ineffective due to high transactions costs and poor incentive systems which lead to poor penetration of target market of firms and low repayment rates; (ii) execution should be encharged to independent, private agents to maximize transparency, efficiency and technical capability; and (iii) program design should emphasize simplicity of procedures/application requirements to reduce turn-around time in provision of support.

- Support to science and technology research should not be fragmented across an excessive number of programs, or divided into numerous small and short-term awards. A key corollary to an effective competitive peer review system is (a) providing winners with grants which are large and long enough to permit significant progress in research; and (b) assuring that previous results of research output are taken into consideration in future grant decisions.

- Adequate human resources training is not a guaranteed outcome of funding research projects, even when these projects involve graduate students. Specific incentives are needed in the system for researchers and students alike to overcome obstacles to efficient training. Involving young researchers in human resource training from the earliest possible point in their careers is an important part of this process.

- The monitoring and evaluation process must be consequential to sectoral planning and to a researcher's ability to receive future funding. The PACIME program has moved Mexican science away from bureaucratic award mechanisms disconnected from outcomes. The new project would include a series of measures to promote a connection between the impact of projects, the amount of resources allocated to a discipline, and the ability of excellent researchers to receive sufficient funding.

- Due to the fragmentation of institutional responsibility for national science and technology policy,

impact of programs must be considered in relation to other public and private initiatives. To this end, the project would address issues of higher education reform in the context of parallel initiatives in the National System of Researchers and the Education Ministry. Regarding firm-level technological capacity, the new scheme would be integrated at the local level with existing programs of the Labor and Commerce Ministries.

4. Indications of borrower commitment and ownership:

The Government indicated strong support for the project during the June 1997 Country Strategy and Implementation Review and has continued to advocate accelerated project preparation. CONACYT has undertaken a series of initiatives showing their strong interest in the project, including the pilot restructuring of four SEP-CONACYT centers; the financing of the Mexican Innovation System study begun in May 1997 with participation of the Bank and OECD; participation in several study tours in support of project preparation; and in-house preparation of the Project Implementation Plan.

5. Value added of Bank support in this project:

The Bank has worked closely with the Government to develop a more demand-driven, interactive role for the state as facilitator of private sector led activities. In addition to providing financial resources to ensure continuity in financing during a period of political transition, the Bank has acted as honest broker in facilitating and sustaining reform in the sector. During the past two years, the Bank has sponsored or participated in sponsored numerous seminars and had conducted intensive policy discussions with the Government. In addition, the Bank has encouraged cooperation between various Mexican agencies responsible for technology and industrial policy and facilitated a top-level dialogue on issues of science and technology policy with institutions including US NIST, OECD, CSIR of South Africa, and the US NSF. A considerable body of expertise on the reform of science funding mechanisms and promotion of peer review-based selection processes has accumulated in the Bank, as a result of large operations not only in Mexico, but in Brazil, China, and Korea.

E: Summary Project Analysis (Detailed assessments are in the project file, see Annex 8)

1. Economic (supported by Annex 4):

[X] Cost-Benefit Analysis [X] Cost Effectiveness Analysis:

Economic analysis for each component is provided in Annex 4. For the Science and Technology Research component, a brief discussion of cost-benefit analysis (including market failures and the rationale for government intervention) is followed by a more detailed cost effectiveness analysis. The cost effectiveness analysis focuses on the Project's aim to increase the effectiveness of investment in science and technology research via greater productivity of researchers and relevance of output. A cost-benefit analysis is attached for the Industry-University Linkage and Enterprise Technology Enhancement components, focusing on the economic and financial gains to participants.

2. Financial (see Annex 5):

The project does not expand total government expenditure in science and technology and falls well within the country's ability to finance the sector. Cost recovery is expected under the credit scheme for Regional/Sectoral Technology Centers and via the restructuring of the SEP-CONACYT system of S&T centers. Please refer to Annex 5 for greater detail.

Fiscal impact: The fiscal impact of the project is expected to be low, representing a maximum of 0.1 percent of total government expenditure during the implementation period. Because the science research component replaces support under the Science and Technology Infrastructure Project, which ended in 1997, much of project expenditure does not represent incremental claims on government resources. CONACYT's budget for research projects is projected to remain constant in dollar terms over the life of the project. Studies of technology matching grant schemes from other countries indicate a potential

positive fiscal impact through increased tax revenues resulting from higher firm profitability.

3. Technical:

The technical design of the project draws on (i) seven years of experience under the development and implementation of PACIME under the Mexico Science and Technology Infrastructure Project; (ii) major program of studies of Mexican Innovation System undertaken by CONACYT and the Bank during 1997-98; (iii) contribution to and assessment of project design by leading academicians and experienced practitioners. New initiatives under the project (joint university-industry projects, restructuring of SEP-CONACYT centers, Regional/Sectoral Technology Centers) draw on successful pilots. Design of the pilot technology modernization matching grant program is based on worldwide best practice and will benefit from extensive external advisory support and supervision, especially during first year of operation.

4. Institutional:

a. Executing agencies: Regarding the science research component, CONACYT has five years of experience as executor of the Mexico Science and Technology Infrastructure Project (Loan 3475-ME) which supported similar activities to the proposed loan. Following a slow start, project implementation recovered rapidly. A number of improvements to project design are proposed under the new loan which would increase operational efficiency and effectiveness. The Linkage and Technology Enhancement components are based on successful pilots conducted by CONACYT prior to and during the project preparation phase (joint university-industry projects, regional/sectoral technology centers, restructuring of SEP-CONACYT Centers). Regarding the matching grant scheme for enterprise technology modernization, intensive supervision and external support will be provided.

b. Project management: CONACYT has demonstrated a strong leadership role in the preparation of the project and has designated experienced and qualified individuals in management positions. Management has also indicated a strong interest in intensive monitoring and evaluation provisions to enable improved strategic decision-making with respect to science and technology policy. Nacional Financiera, financial agent for the project, has extensive experience in implementation of Bank projects.

5. Social:

The project would support research on socially-critical issues including health sciences and would support the public and private education system in formation of skilled human resources. To ensure compliance of research with acceptable ethical standards, CONACYT has agreed procedures of disclosure and review in coordination with researchers and universities.

6. Environmental assessment: Environmental Category [ ] A [ ] B [X] C

The project is expected to have no major environmental impact. The Field Development program would be expected to fund research in areas identified to be of critical national importance, such as water resources, pollution control and abatement, and clean technologies. Research supported under the science research component would include a variety of environmental subjects, such as biodiversity, ecology, and urban policy. The technology enhancement component would also have a modest positive environmental impact through introduction of clean technologies to participating enterprises.

7. Participatory approach:

Primary beneficiaries and other affected groups: University- and Institute-based researchers, evaluation committee members, rectors and directors of institutes, and project administrators were extensively

consulted with regard to the performance of the PACIME project and the means of incorporating lessons learned into the new project.

Private Chambers of Commerce and individual business leaders participated in and were consulted regarding the design of the Linkage and Technology Enhancement components.

F: Sustainability and Risks

1. Sustainability:

The research component is intended to support a second generation of reforms which build on the peer review mechanism created under the previous Mexico Science and Technology Infrastructure Project. The project is intended to reinforce the gains from the first project and provide continuity of reforms into the next administration beginning in 2000.

The linkage component is aimed at (i) catalyzing and deepening industry-university relationships; and (ii) creation of public goods through subsidy to basic R&D relevant to industry. Fulfillment of the first objective would result in self-sustaining activities in the future; achievement of the second objective, however, would require continued future subsidies to encourage continued public good creation. It is reasonable to believe that Mexico will continue to support moderate levels of private sector R&D in accordance with World Trade Organization (WTO) rules.

The technology enhancement component aims to spark the creation of a market for external advisory services, with the goal of self-sustainability in the long term. The matching grant scheme would support a maximum of three projects in an amount not exceeding US$50,000 in subsidy per firm. The program is intended to be a temporary catalyst to spur enterprise investment in external advisory services and technology upgrading through a direct demonstration effect, not a permanent subsidy to firm performance. The credit scheme to support creation of small, demand-led regional/sectoral technology centers is also tailored to ensure an exit mechanism for government support. Repayment of the credit after a five-year grace period would ensure the need for cost-recovery and attention to firm needs.

2. Critical Risks (reflecting assumptions in the fourth column of Annex 1):

Risk	Risk Rating	Risk Minimization Measure
CAS Goal to Bank Mission		
Change in administration in 2000 may result in high staff turnover in public implementing agency for science component	M	This risk is offset through mechanisms to increase participation of science community and private sector in program management and via selective outsourcing of administration to private entities.
Development Objectives to CAS Goal		
Macroeconomic instability reduces private sector co-investment in project activities and reduces availability of government budgetary resources	M	Project assumes base case growth scenario under CAS. Current government response to fall in oil prices indicates strong capacity to manage moderate exogenous shocks
Outputs to Development Objectives		
Impact of Science Research component reduced by capture of Field Development and Evaluation committees by interest groups.	M	The component oversight committee would adjust budgets of committees based on effectiveness. The project

		Advisory Council would monitor overall progress under the project.
Private sector response to incentives in Industry-University Linkage and Technology Enhancement components does not meet expectations	M	Discussions with private sector leaders indicate strong interest in project concept. Advisory Council and Foresight for Innovation pilot study would aim to increase feedback from private firms.
Regulatory barriers to linkage at university level hinder joint activity	M	University-level initiatives currently address this issue.
Private sector agents encharged with execution of pilot Enterprise Technology Upgrading/ Extension program prove ineffective	M	The early pilot phase would be dedicated primarily to selection and development of agent capabilities with close support from experienced international practitioners
Lack of finance impedes participation of smaller firms in matching grant schemes	N	Technology Modernization Scheme designed to maximize participation of SMEs through decentralized network of private agents.
Overall Risk Rating	M	

Risk Rating - H (High Risk), S (Substantial Risk), M (Modest Risk), N (Negligible or Low Risk)

3. Possible Controversial Aspects:

Controversial ethical issues arising from research projects cannot be avoided with complete certainty under the project; however, to ensure compliance of research with acceptable ethical standards, CONACYT has developed procedures of disclosure and review in coordination with researchers and universities.

G: Main Loan Conditions

Disbursement and Other Conditions:

Deputy Directorate for Scientific Research will be restructured along lines of academic disciplines in accordance with the Project Implementation Plan no later than July 1, 1999.

The Deputy Directorate for Financial Administration will be strengthened for the purpose of coordinating all financial reporting requirements under the project.

CONACYT will create a Change Management Unit to support and administer implementation of the restructuring of the SEP-CONACYT system of research institutes.

The Technology Modernization Program will be implemented on a pilot basis. Prior to initiation of the full implementation phase, a detailed operation manual would be agreed between CONACYT and the Bank.

A detailed proposal for operation and financing of the Pilot Venture Capital Fund would be agreed between CONACYT and the Bank prior to disbursement for this activity.

CONACYT shall ensure that all questions of an ethical nature relating to the application process, approval and execution of research grants shall be investigated and resolved in accordance with procedures discussed in the PIP.

H. Readiness for Implementation

[ ] The engineering design documents for the first year's activities are complete and ready for the start of project implementation. [X] Not applicable.
[ ] The procurement documents for the first year's activities are complete and ready for the start of project implementation.
[X] The Project Implementation Plan has been appraised and found to be realistic and of satisfactory quality.

I. Compliance with Bank Policies

[X] This project complies with all applicable Bank policies.

Daniel Crisafulli, Task Team Leader

Olivier Lafourcade, Country Director

Krishna Challa, Acting Sector Director

Annex 1

Project Design Summary

Mexico: Knowledge and Innovation Project

Narrative Summary	Key Performance Indicators	Monitoring and Evaluation	Critical Assumptions
Sector-related CAS Objective			(CAS Goal to Bank Mission)
Growth with Stability	Productivity growth contributing to steady increase in GDP	Macroeconomic data from SHCP, Banco de Mexico, World Bank	Risk: Bank base case scenario in CAS assumes moderate macro growth in the medium term. Chief identified risk is stability of banking system.
Social Development	Research programs support development of environmental and health sciences and promote education/ formation of highly-trained human resources.	Government, PAHO, WHO, World Bank data	
Modernization of the State	Increased efficiency in project administration via outsourcing and client-oriented operating procedures	Overhead costs to be monitored for CONACYT and private agents.	Risk: change in administration in 2000 may result in high staff turnover in public implementing agency for science component. This risk is offset for technology development and diffusion component via outsourcing of administration to private entity. WB participation intended to promote continuity.
Project Development Objectives			(Development Objectives to CAS Goal)
The Project aims to promote the generation, diffusion, and application of knowledge for innovation in support of economic and social development.	Periodic studies to identify impact of project activities on enterprise productivity and innovation for social applications	INEGI data Consultants' reports	Risk: factor exogenous to project (e.g., macro instability, effective functioning of financial sector) reduces private sector investment and social investment
Project Outputs			(Outputs to Development Objectives)
Support excellence in science and technological research, increase the availability of scientific and technological human capital, and institute an integrated strategy for development of fields of science of strategic importance to Mexico's economic and	Bibliometric indicators; output indicators (number and value of projects financed, students trained); mix of resources between established and emerging/ priority disciplines	Annual CONACYT reports; external studies	Assumption: Project incentives result in increased human resource formation and relevance of science for social and economic development

social development Facilitate linkages between private firms, universities and research institutions through financial support for joint activity and technical assistance to bridge institutions	Increased private investment in science and technology; increased joint activity between academia and industry	INEGI data, CONACYT reports; external studies	Assumption: Linkage activity will spur private investment in technology and reduce isolation of academic community
Support increased firm-level productivity through provision of decentralized, demand-driven technological services for small and medium enterprises and creation of a pilot private sector-led venture capital scheme.	Technological upgrading of participating firms, including application of MSTQ, to be determined by base-line and subsequent studies of project impact	Project-specific monitoring and evaluation program - indicators include: number of firms qualifying for ISO9000, small companies working through tech. networks on common problems and others TBD	Assumption: High quality advisory service will have significant impact on quantity and quality of firm investment in technological upgrading
Project Components Project management:			(Components to Outputs)
Creation of Project Advisory Council	Frequency, attendance, and duration of meetings, actions resulting from meetings	Council reports; special analyses commissioned by Council	Assumption: Council improves input of private sector into national Innovation policy
Science and Technology Research Component:			
Increased efficiency and effectiveness of science support program via (i) longer, larger grants to the highest quality researchers; (ii) consolidated peer review procedures, greater direct input of committees and scientific community into S&T policy; (iii) increased number of Ph.D.s and Master's students receiving training as part of projects; and (iv) decreased time for young researcher to become full, contributing members of their fields	CONACYT data, Survey of Graduate Scientist and Engineers, SNI applications, periodic external evaluations	Annual Committee Reports to Advisory Council	Assumption: reform of policy incentives will impact formation of scientific community
Increase in research and development capacity in fields of immediate social and economic priority	Field Development Area Director reports and independent evaluation	Annual Field Development Directors report to the Advisory Council	Risk: Selection process becomes captured by interest groups
Industry-University Linkage Component:			
Restructuring of SEP-CONACYT system of public S&T institutes to increase (i) self-financing and (ii) service	Financial statements of participating centers; annual monitoring/evaluation of progress in implementation of	Annual report of Technical Committee of Linkage Component	Risk: regulatory reform to enable flexibility and decentralized management of centers is not implemented.

to industry	business plans		
Industry-led joint projects with universities to increase firm investment in S&T and increase effectiveness of educational/research institutions	Firm investment in S&T; demand for participation in program; outputs (papers, patents, joint degree programs, students hired by firm) resulting from collaboration	Study of program impact on firm investment in S&T and human resource formation	Assumption: current wave of publicity and expressed interest in joint activity will result in commitment to results in subset of cases
Enterprise Technology Enhancement Component:			
Pilot Enterprise Technology Upgrading/ Extension Program to (i) catalyze development of market for external consulting services through demonstration effect; (ii) directly impact productivity of participating firms	Impact on firm use of external consultants (initiation, deepening of relationship); impact on firm productivity	External longitudinal studies of program impact	Risk: private sector agents prove ineffective at execution; lack of finance impedes firm participation in matching grant scheme
Regional/Sectoral Technology Centers to support creation of demand-led services, including MSTQ	Annual evaluation of centers to assess progress in meeting business plans (financial and operational indicators); annual evaluation of CONACYT management	Annual report of Technical Committee of Technology Component	Risk: demand from sectorally- and regionally-based groups of investors is less than expected due to joint action problems and conflicts of interest
Foresight for Innovation program to increase participation of private sector in S&T policy	Number of participants in sectoral Foresight panels	Foresight studies and follow-up reports.	Assumption: rolling sectoral approach to Foresight will reduce politicization of process and facilitate results
Seed Capital for Innovation to provide financing for start-up technology-based enterprises	Quantity and value of investments placed; compliance with fund investment guidelines	Annual report of private fund management group; external monitoring and evaluation	Risk: Insufficient deal flow reduces investment opportunities

Annex 2
Knowledge and Innovation Project
Project Description

Overall Project Management

The project would be executed by the National Science and Technology Council (CONACYT - *Consejo Nacional de Ciencia y Tecnología*). The Director General of CONACYT will be the principal counterpart responsible for overall project implementation and for interaction with the Bank on matters of policy. The responsibility for project administration will be shared by the Deputy Directors for Science and Technology Policy, for Scientific Investigation, for Directed Research, for Technology Development, and for the SEP-CONACYT system of centers. The project will be implemented according to the Project Implementation Plan, which forms part of the Loan Agreement. The Deputy Director for Science and Technology Policy will be the chief liaison with the Bank for implementation matters. The responsibilities of the other Deputy Directors are described in the sections for the corresponding components.

Project Advisory Council

A high level Advisory Council would provide external advice and feedback on the design and implementation of the project. The council would provide strategic input for CONACYT to assess the performance of the project and to adapt (within the limits specified by the PIP) project goals and procedures accordingly.

The Council would be comprised of approximately 10 highly distinguished individuals from academia and the private and public sectors . All members, including approximately 2 international representatives, should be eminent in their fields and have broad experience in science and technology. The Director General of CONACYT would select and chair the council, which would also advise CONACYT on non-project related activities.

The Council would meet on average once a year for 4-5 days (during 1998 the Council would be expected to meet twice due to project start-up). The agenda would be determined in advance by the chair and circulated substantially prior to the meetings.

Project Component 1 - US$ 285.00 million

The Science and Technology Research Component

The objective of this component is to improve the quality, efficiency, and relevance of S&T research in Mexico. Improvements with respect to quality will be achieved through the consolidation and expansion of the peer-review evaluation system. Improvements with respect to efficiency and quality will come through decentralization of decision-making and research, improved financial and procurement arrangements, and better incentives for human resource formation in research projects. Improvements with respect to relevance will come partially through the identification and promotion of new fields of investigation of high social and economic priority to Mexico. Stronger peer review and participatory planning are also expected to contribute improvements in relevance and quantity of S&T research. The

President's Science Advisory Council (CCC) and the Mexican Academy of Sciences would participate along with other representatives of the scientific community at various levels of the management of the component, including committees for monitoring and evaluation.

The component will have three subcomponents: (a) Support to Research Projects; (b) Field Development; and (c) Special Programs.

Support for Research Projects

This subcomponent will consist of competitive, peer-evaluated awards for science and technology research projects. This subcomponent will be a continuation of PACIME program, with some important modifications. The committee structure will be maintained, with approximately ten evaluation committees representing the traditional disciplines. The PACIME structure has been modified to include (a) larger, longer duration grants; (b) incentives to encourage intensive human resource training; (c) increased number and quality of ad hoc peer reviewers per proposal, including international peer reviewers; and (d) increased use and improved quality of peer monitoring and evaluation, including site visits. The evaluation committees will publish Requests-for-Proposals (RFP) that state the number and types of proposals they intend for a given year.

The individual RFPs will reserve a specified amount of the resources for full proposals from young researchers. Grants for full proposals would be the same and duration as the other Research Projects grants, and are intended to give the best young researchers a chance to delve immediately into investigation and human resources training. It is suggested this type of grant be provided to no less than 15 percent and no greater than 30 percent of the new researchers entering any given field. Researchers would be eligible to apply for these grants if: (a) they have not reached their 36th birthday by the time of application (38th for those outside Mexico City); (b) they have received Ph.D.s in the field; (c) they will be employed as full-time researchers at a research institutions by the time the grant becomes effective (within one year of award notification). The Young Researchers Program will also provide other, less selective instruments of support to new Ph.D.s in the process of establishing themselves as researchers. These are: (a) post-doctoral fellowships; (b) repatriation and retention grants; (c) scientific initiation grants (for basic equipment).

Field Development

The objective of this subcomponent is to support scientific and technological research in areas of high scientific, economic and/or social relevance to Mexico. The subcomponent will support those areas which have not been able to develop under the traditional research support structure. Generally, these have been areas that are multi-disciplinary and that have strong links with non-academic partners.

The goal will be to accelerate development of these areas through (a) the promotional activities of an "area director"; these will include stimulating the formation of new groups, new networks, and new academic programs; (b) direct support for research projects. The selection process for Field Development projects will be overseen by the area director, under the guidance of a technical advisory committee.

Fields to be funded will be selected through a two stage process. A selection committee, whose members represents the scientific community, the private sector and civil society, will issue a broad call for possible areas to receive funding. From this first round, the committee will select a small number (six to twelve) of Field Development proposals to be evaluated in detail by the subcommittees. Each

respective subcommittee, to be composed of a distinguished member of the scientific community, two SNI level two researchers, and one foreign expert, will investigate the area and may submit full proposals for consideration. The selection committee will then choose among these (one to three field per year) to receive funding. The terms of reference for the committees and the basic qualification criteria for potential fields are described in the Project Implementation Plan. As a pilot, CONACYT will begin in 1998 a new field in the area of Informatics and Computer Science. This field has been selected outside of the above-described process due to its broad applicability to sciences and private sector needs.

Special Programs

The project will support a series of special programs to improve (i) monitoring and evaluation and (ii) institutional capacity of CONACYT as executing agent for the component.

Monitoring and evaluation in this component will consist of three main parts: (a) routine project evaluation; (b) the annual evaluation of the discipline, led by the evaluation committee; (c) special studies which focus on the sector as a whole. As a basic principle, data collected will be used as a consequential input in future policy or funding decision. This contrasts with the current situation, in which the emphasis is on the collection of descriptive statistical data. Very little qualitative evaluation or use of the data for policy purposes takes place. With respect to project evaluation, use of peer evaluators (especially for the Young Research Program) and site visits will increase. Projects will be evaluated not only on the quality of the scientific or technological output but on its relevance, the nature and extent of human resources training, linkages of the researcher and the research to the final user community, and the administrative efficiency of the project. The final report will be condensed into a short summary that will become a mandatory part of all future grant applications. Committees will place increasing emphasis on past performance in consideration of grant selection. This more in-depth project evaluation will feed into an annual review of each discipline, to be undertaken by each evaluation committee. Each committee will submit a report to CONACYT including both quantitative descriptive statistics and qualitative evaluation by peers. The reports will also contain the committee judgments on the state of the discipline, the performance of the researchers within it (not limited to those receiving CONACYT support), and the future needs. This report will also contain the committee budget allocation request for the upcoming year. CONACYT may adjust allocation levels among the committees based on evidence of superior performance and/or need of a given discipline (as spelled out in the annual report). Finally, a series of periodic special studies will be undertaken to provide the timely data and information necessary for good policymaking. Some of these studies are specified in the PIP.

In addition, a series of special studies will be undertaken to provide the timely data and information necessary for good policymaking. Among these studies will be a regular, comprehensive, and longitudinal survey of graduate scientists and engineers. This survey would become a routine part of monitoring and evaluation for CONACYT. It would focus on, *inter alia*, (a) the time-to-completion of degree; (b) length of time from graduation to first job offer; (c) number of offers within field of specialty; (d) employment and salary history for two or more years after graduation. Technical assistance will be provided to CONACYT for the design and execution of this survey. Another required study will investigate, both qualitatively and quantitatively, the role of CONACYT within overall support to scientific and technological research in Mexico. A third study will investigate, again both qualitatively and quantitatively, the uses of Mexican research output. Other studies will be commissioned by the project advisory council as deemed necessary.

Finally, the project will support strengthening of CONACYT's Deputy Directorate for Science Research via training, design and installation of information systems, and consultants.

Project Component 2 - US$ 156.44 million

Industry-Academia Linkage component

This component aims to (i) increase enterprise investment in science and technology through strengthening of relationships with academic and research institutions; (ii) improve the impact of academic institutions on firm-level innovation and productivity through training of skilled human resources, service provision, and R&D; and (iii) promote the creation of public goods through spillover effect of increased investment in R&D. The component focuses on creation and strengthening of bridge institutions which facilitate the interaction of the academic and private sectors.

The component would be comprised of three subcomponents. (I) Public sector S&T institutes, which have the potential to serve as important bridge agents, would be subjected to an intensive restructuring program to increase service to industry. (II) At the university level, technical assistance will be provided for creation/strengthening of outreach centers. (III) A matching grant scheme would support industry-led joint projects with academic institutions.

Restructuring of Public S&T Institutes. A program to increase self-financing of the system of SEP-CONACYT research centers would be supported under the project. Approximately 19 out of a system-wide total of 27 public S&T centers (7 technology, 12 science, and 9 social science institutes) would be subjected to a comprehensive process to increase self-financing and industrial relevance. Under a phased, five-year implementation period, government direct subsidies in participating centers would be progressively reduced to 50 percent of current levels in real terms. In place of the direct subsidies, the centers would compete for CONACYT financing of pre-competitive research projects some of which will be in collaboration with private sector partners. In addition, regulatory reform would give the centers increased flexibility and accountability in management; new investments would be financed through a competitive, project-based fund; new management information systems would be installed; and technical assistance would support the conversion process.

A pilot restructuring program of four technology institutes, supported by a Japanese Grant, was initiated in November 1997. An intensive period of training, support consultancy, and business plan development ensued. Three top managers of each pilot center, plus the national coordinator of the SEP-CONACYT system participated in a study tour to similar centers in four European countries undergoing a similar restructuring process. The draft business plans for the pilot centers were delivered to the Bank in March 1998 outlining strategies in marketing, human resource management, financial management, expansion of knowledge base, information systems, and other management issues.

The project would support a business planning process for each of the 15 remaining centers (approximately) to be followed by implementation of the plans for restructuring. The activities would include (i) staff and management training; (ii) installation of management information systems; and (iii) a one-time contribution to a fund to support competitive projects cofinanced by the private sector.

Joint Industry-Academic Projects: In order to catalyze the creation of linkages between universities and private enterprises, the project would support joint activities in applied research; product and process design, development and improvement; and technology adaptation and diffusion. The projects would be supported by a matching grant managed by the participating enterprise to ensure leadership from the private sector and prioritization of private sector needs. Firms would contribute 50 percent of the direct costs of the projects (at least 10 percent of which must be in the form of cash deposited in a special trust

fund) with the CONACYT/World Bank financing the remaining half. A cap of US$300,000 in CONACYT support would apply to each project, although average projects are expected to be smaller. Universities would contribute staff salaries, student assistants, and use of facilities.

The selection process would consist of an Operational Committee including strong representation from the private sector, which would approve all projects with CONACYT support in excess of US$50,000. Projects under this amount would be approved by an internal CONACYT technical committee with support from external expert evaluations. A Consultative Committee would review implementation progress and overall policy of the overall Industry-Academia Linkage and Enterprise Technology Enhancement Components. Proposals from industry would be accepted year-round, with a target approval time of 1-3 months. Criteria for selection would be (i) the effect of project on creating or deepening a formal relationship between the participating firm and university(ies); (ii) expected impact on firm productivity and competitiveness. The aim is to avoid academically-driven, technology push projects which do not serve the needs of industry. A full financial and technical evaluation would be required for review.

Participating firms would provide interim progress reports to CONACYT, with random ex-post audits to be performed by CONACYT on an estimated 5% of projects. An external evaluation, including longitudinal surveys, would be conducted to assess economic impact.

Promotion of the scheme would be addressed via (i) advertising; (ii) private agents; (iii) linkage seminars and other mechanisms as needed.

Technical Assistance to Universities. Support would be given to create and strengthen university outreach units. This activity would be promoted via direct efforts of CONACYT staff, media, and a series of seminars and would be financed jointly by CONACYT and participating universities.

Project Component 3 - US$ 191.33 million

Enterprise Technology Enhancement Component

The component aims to directly impact the productivity and competitiveness of firms, particularly small and medium enterprises. Four activities would be supported: (i) firm-level technology modernization/extension program based on decentralized network of local agents supported by matching grant scheme; (ii) regional/sectoral technology centers, privately-owned and operated, supported by a credit scheme; (iii) special pilot studies to address emerging policy priorities identified during implementation of project; and (iv) a pilot venture capital fund with private management and majority ownership.

Technology Modernization Program. The scheme would aim to (i) support technology modernization among SMEs and (ii) create an active market in technology services. The economic rationale for the program is to address the information asymmetry impeding use of external advisory services to solve problems and facilitate growth. The program is demand-led: the matching grant would provide encouragement for firms to obtain specialist external support. Firms would benefit through direct participation and through the demonstration effect of successful participants.

The program would provide support for firms to make use of approved consultants for technology firm modernization projects. This support would primarily be in the form of a grant to cover 50 percent of the cost of the consultancy support, up to a maximum amount per firm of US$50,000 over

the duration of the Program. Firms would be required to undertake an initial diagnosis - the cost of which will also attract a 50 percent grant - in order to identify accurately priority areas for attention in subsequent consultancy projects. Where appropriate, firms would also receive assistance to prepare terms of reference for and expected outputs for the project, and to identify a suitable consultant. The grant would be paid, on a reimbursement basis, on satisfactory completion of the project (based on proof of payment of the consultant and of delivery of the defined outputs).

The Program will be administered by private sector Agents, acting on behalf of CONACYT, which will act as the main contact point with firms and consultants. Agents will be paid a fee based on the number and scale of projects arranged and grant disbursed.

All types of technology upgrading activities qualify under the program, including: diagnosis; productivity improvement; product design; quality systems; reduction of response times; cost reduction; introduction of new process and product technologies; design and introduction of management and financial information systems; technology implications of fashion trends; benchmarking and best practice; and technical training in any of the above areas.

Overall responsibility for management of the Program will rest with the Consultative Committee of the Technology and Industry-University Linkage Components. Other than during the initial period of operation (defined below) only this Committee will have the authority to change the operating rules or procedures of the Program, decide on appointment of Agents, revise Agents remuneration, and make decisions in the event of disputes between Agents, firms or consultants.

Start-up period. To ensure that the Program operates efficiently and effectively, a pilot period will be undertaken to enable CONACYT to recruit and train staff to work on the program, to develop management tools, and test implementation arrangements. Provisions will include financial and management information systems; model agreements between CONACYT and the Agents, Agents and firms, and firms and consultants; criteria for registration of consultants; and publicity and explanatory material for the Program. Completion of the pilot phase, including agreement on an Operation Manual, will be a condition for disbursement for the full-scale Program under the Bank loan.

In addition, during the first year of operation (including the pilot) a small Technical Group comprising two senior CONACYT managers and two people nominated by World Bank will meet at least quarterly to review the setting up and operation of the Program and to make such adjustments to the operating procedures as are necessary in the light of experience to ensure the efficient operation of the Program.

Designated staff in CONACYT, overseen by the Consultative Committee, will maintain close contact with the Agents, particularly during the pilot phase, to ensure they understand and correctly implement all aspects of the Program. Subsequent supervision arrangements are as described below.

Role of Agents. Agents must respond positively to all inquiries, and not restrict access to firms in specific sectors or locations, whatever the Agent's own focus. The main responsibilities of the Agents will be to:

- market the scheme
- participate in development of diagnostic tools in collaboration with CONACYT, consultants, other Agents and international advisers
- arrange a business diagnosis to identify support requirements
- support development and maintenance of a register of consultants by CONACYT

- provide assistance to firms to identify a suitable consultant, prepare terms of reference, specify required outputs from projects, and complete application procedures
- monitor progress on projects
- check satisfactory completion of projects, including review of defined outputs and proof of payment of consultant
- submit project completion details to CONACYT to trigger reimbursement of firms
- provide CONACYT with regular monitoring reports and access individual projects and project files as required.
- arrange delivery of training courses for consultants (see section on training for consultants) in consulting skills such as diagnostic techniques and project management, and to ensure consultants are fully aware of all CONACYT Programs and other relevant Government schemes.

Registration of consultants. Simple criteria for the registration of consultants will be developed by CONACYT before launch of the Program. Only individuals will be able to register, whether or not they are members of a consultancy firm (this is to avoid a registered firm assigning inexperienced staff to a project). Consultants may be registered to undertake one or more of the qualifying activities depending on their qualifications and experience. Actual registration will be undertaken by Agents, but subject to supervision by CONACYT to avoid unfair or restrictive practices. CONACYT will also develop a central computerized register of consultants, based on information supplied by Agents, which can be accessed by all Agents and firms. The register of consultants should include feedback from firms on their performance on specific projects.

For consultants wishing to undertake diagnosis there will be a requirement to undergo training in the use of diagnostic tool(s). People wishing to register as consultants with adequate qualifications but little or no previous consulting experience will be required to undergo consultancy training arranged by the Agent.

Training of consultants. Agents will arrange delivery of training courses for consultants to be provided by appropriately qualified trainers. Courses should cover consulting skills such as diagnostic techniques and project management, and information on CONACYT Programs and other Government schemes which may be relevant to firms.

Co-ordination with other Government schemes. The Agents will be encouraged to facilitate access to the full range of service providers and Government support Programs, including the CIMO Program and other support services offered by SECOFI, NAFIN and Bancomext.

Monitoring and Evaluation. Due to the innovative nature of this scheme, an extensive program of external monitoring and evaluation would be undertaken. The Operational Committee would monitor the performance of the agents through periodic reporting and unscheduled *in situ* visits. In addition, an external economic evaluation of the program experience would be undertaken.

Regional/Sector Technology Centers. This sub-component would aim to improve local access to technology services, primarily for SMEs, through selective support to private centers demonstrating clear evidence of demand. Support would be provided to establish new centers or expand and improve existing ones through the implementation of specific projects. Proposals for new centers would be received from consortia of at least three private firms/organizations (e.g., chambers of commerce, universities).

Critically, centers would respond to demand from firms - rather than being driven by government funding preferences. Therefore, the range of services provided by the centers could vary considerably and

include the following areas:

- technology diffusion and adaptation
- process development and improvement
- product design and improvement
- technology transfer
- testing and calibration services
- specialist technical information
- advanced technical training (including programs developed jointly with a university)

To ensure close attention to firm needs and avoid overinvestment in facilities and infrastructure, CONACYT investment would finance up to 50 percent of total project costs with a cap of US$750,000. Funds would be on-lent by CONACYT at a rate greater or equal to UDI[1] plus 100 basis points.

Projects would be selected through a competitive process managed by CONACYT involving a three-stage process including feasibility studies and review by the Technical Committee of the Industry-University Linkage component. Criteria for selection include the likelihood sustainability/self-financing in medium-term; realism of income and expenditure forecasts; strength of demand for services, potential impact on firm competitiveness, quality of management and leadership of center; and the proportion of total investment contributed by committed private funding.

CONACYT would monitor use of funds by the centers and overall implementation of the business plans through periodic reporting requirements and site visits by staff and consultants. CONACYT would conduct an annual evaluation of program performance for Bank review; a full external evaluation would be conducted during the third year of operation.

Special pilot studies. The project would support emerging policy priorities of CONACYT as identified during the implementation period. Two pilots were identified at the time of project appraisal, as discussed below:

(a) Foresight for Innovation. This sub-component would serve to increase public-private cooperation in formation of science and technology policy with the objective to:

· Build awareness of the need for restructuring and the development of linkages to the global innovation system among all relevant stakeholders -- private enterprises, government, and civil society at large
· Generate consensus and a shared understanding among private and public sectors of the role of technologies in relation to innovation, competitiveness and development.
· Facilitate networking and alliances between multinational firms and national firms, government, and academia which will produce substantive changes in policy and strategy

Due to the high degree of political sensitivity, and corresponding risks, CONACYT has opted for a phased approach which would initiate the foresight process in several selected sectors of the economy, as described below:

Pre-Foresight Phase. Private-public committee. Formation of an initial private-public committee which would catalyze a broader public-private discussion on the benefits and scope of the technology foresight

[1] *Unidad de Inversion* - unit of exchange indexed to inflation.

exercise in Mexico. The committee would prepare and endorse a set of options for the Mexican technology foresight

Workshops to raise awareness and choose options, convened by the private-public committee, which would serve three purposes:

- Increasing awareness of the private sector through sharing of international experiences of technology foresight exercises in the US, Japan, UK, Germany and elsewhere
- Identification of initial pilot areas
- Self-selection of champions -- highly committed individuals who would lead the process

Preparation of the pilots. At this stage one should note the critical role of highly committed "champions", the importance of involving relatively young people (30-40 years of age), the organizational structure of the process (e.g. formation of the steering committee), and selection of specific sectors.

Main Foresight Phase. Implementation of the pilots. The main foresight stage involves intensive communication process between private sector, academic and government stakeholders. It may take a variety of organizational forms: surveys, panels of experts, workshops and conferences. Organization and administration of this phase may need to be subcontracted to ensure logistical efficiency.

Post-Foresight Phase. During the post-foresight stage the results and lessons from the pilot will be diffused among participants and relevant groups.

(b) Strategic Technology Information System. Given the identified inefficiencies in the flow of information (including markets, technologies, suppliers) to SMEs in Mexico and the potential economic benefits from increased diffusion, a study to assess the options for spurring the development of the market for private information services.

Pilot Venture Capital fund. The fund aims to fill a distinct gap in the financial sector in Mexico: equity investment in start-up, technology based enterprises. The fund would be managed by experienced private venture capitalists, with majority ownership and control by private investors. The fund would finance technology-based start-up enterprises identified through CONACYT's technology development activities and from external sources. The full legal and operational analysis for the fund has been completed by CONACYT's advisers; however, the private fund managers and investors had not yet been identified at the time of pre-appraisal. When planning is complete, the Bank would provide a "no objection" prior to support of the fund under the Project.

Annex 3
Knowledge and Innovation Project
Estimated Project Costs

Millions of US$

	Local	Foreign	Total
Science and Technology Research			
Research	132.85	110.00	242.85
Field Development	17.15	15.00	32.15
Policy/Project Management	4.00	6.00	10.00
Total	154.00	131.00	285.00
Industry-University Linkage			
Centros SEP-CONACYT	40.00	26.00	66.00
Joint Projects	39.74	31.50	71.24
Institutional Strengthening of Universities	14.20	5.00	19.20
Total	93.94	62.50	156.44
Enterprise Technology Enhancement			
Technology Modernization	37.49	30.00	67.49
Regional/Sectoral Technology Centers	35.84	35.00	70.84
Special Pilot Programs	0.50	2.50	3.00
Venture Capital	45.00	5.00	50.00
Total	118.83	72.50	191.33
Total Allocated Cost	366.77	266.00	632.77
Unallocated	-	30.00	30.00
Total Project Cost	366.77	296.00	662.77

Project Financing by Component

Component	Government	Bank	Private Sector	Total
Science and Technology Research	150.00	135.00	-	285.00
Industry-University Linkage	48.70	62.50	45.24	156.44
Enterprise Technology Enhancement	10.57	72.50	108.26	191.33
Total Allocated	209.27	270.00	153.50	632.77
Unallocated		30.00	-	30.00
Total	209.27	300.00	153.50	662.77

Annex 4

Mexico Knowledge and Innovation Project
Economic Analysis

Scientific and Technological Research Component

Cost Benefit Discussion

The arguments have been made that CONACYT subsidies (and World Bank lending) are justified by a number of factors, such as:

- the public good nature of research outputs such as certain kinds of knowledge and human resources (including the long term wait for benefits from fundamental research, the high risk of individual research investments, the lack of clear causal linkages between the research and the benefits);
- the underinvestment in research by the private sector due to institutional failures and the need to subsidize research while strengthening the institutions;
- non-linearities in the system, which in some cases result in low returns for initial research investments, and require governmental pump priming to reach rates of return that will justify private investment;
- the role of the government as consumer of research products in many areas such as health and environment.

In fact, the difficulty of quantifying benefits is an underlying root of the argument for government subsidies of research. It is therefore extremely difficult to do a normal cost-benefit study for the S&T Research Component of the Project (or indeed for the project as a whole.)

However, it is argued that the S&T research component funds only projects which independent peer reviewers feel expected benefits exceed expected costs. Moreover, area Advisory Committees seek to balance the portfolios so that synergies occur from the portfolio, and the expected benefits from the portfolio of projects exceeds the sum of the benefits from the individual projects while the costs are just the sum of the individual project costs. Similarly, CONACYT in the KIP project is seeking to achieve indirect benefits in building scientific capacity and reforming the sector that will be external to the benefits seen in evaluating individual proposals. Thus if the benefits of the portfolio exceed the sum of the benefits of the individual research projects, and each of the projects is judged cost-beneficial in itself, the portfolio should pass the cost-benefit test.

The key to this argument lies in the peer review process. In general all proposals received are graded by the Advisory Committee, taking into account the reviews of ad hoc peer reviewers selected for the individual proposals. Only proposals judged good or excellent are funded, and increasingly "good" proposals can not be funded due to funding limitations. In the early years of the PACIME project, available funds were not used as committees decided that none of the unfunded proposals had sufficient expected benefits to justify their budgets. Discussion with the committees suggest that while they follow in general the published proposal evaluation criteria, they consciously take into account such factors as the likelihood that the project will achieve its stated objectives, the likelihood that its actual achievements will be socially or economically important to Mexico, as well as to the scientific and technological community in general, the degree to which educational and training benefits are to be expected from the project. Committees make such judgments based on broad scientific and technological expertise of the panelists, including understanding of the dynamics of the specific disciplines in

which the investigators are proposing to work. The successful introduction of open peer review processes for these decisions was one of the major accomplishments of the PACIME project, and Mexico now is among the countries funding the large majority of government supported science which feel that peer review is the appropriate way to make cost-benefits judgments on individual research proposals.

The KIP program is seeking to improve the effectiveness of the qualitative cost-benefit analysis which is intrinsic to the research grants project. It is doing so by increasing the responsibility of the Advisory Committees and of science managers in making portfolio composition decisions, in the Field Development program making them more proactive in seeking network solutions which expand research synergies, and making allocation of resources among Committee programs competitive based on the cost-benefit estimates of the alternative committee uses of the funds.

Cost-Effectiveness Assessment

Introduction

Cost-Effectiveness analysis seeks to illuminate the economic advantages and disadvantages of alternatives available to a project without seeking to fully quantify project benefits. Most frequently cost-effectiveness analysis focuses on least cost alternatives to accomplish a specified purpose. Less frequently, but equally validly, cost effectiveness analysis may focus on maximizing the impact available with a given level of resources. This latter approach is used in the following assessment.

In Mexico, central funding for scientific and technological research administered by CONACYT is defined through the national science and technology plan, and the annual budget process. The Gross Investment in R&D is not defined by quantifying the need for knowledge and budgeting to meet that need, but by a complex professional and political process which establishes budget levels. Of course all nations budget their national governmental support for research in this way, not just Mexico. Thus the most substantive issue is how to maximize the value to Mexico of the resources allocated to CONACYT for support of scientific and technological research.

In the following assessment two alternatives are considered:

- the PACIME grants program approach developed and used successfully in the prior World Bank project, and
- the KIP grants program approach, which represents a modification of the system in use for the past eight years, with modifications based on lessons learned from the PACIME project.

It should be noted that there has been no attempt to apply cost-effectiveness analysis to select the most effective set of possible alternative sets of lessons learned from PACIME. This would not have been possible given the heuristic nature of the reform planning.

It is important to be clear as to what is being assessed. In Mexico, the scientific and technological research system faces considerable instability, due to changing economic, social and political factors. In so far as the conditions faced by the research system are different in the period 1998 to 2002 than they were from 1991 to 1997, the impact of the projects may be quite different. This cost-effectiveness assessment does not attempt to deal with changes in impact due to such factors. Similarly, there is a worldwide increase in the productivity of scientific and technological research due to the accretion of knowledge and the improvement of scientific instruments and information technology. While this trend should improve the impact of KIP versus PACIME, it is not considered in this assessment.

The assessment focuses only on the incremental impact that is to be expected by the substitution of improved project procedures as compared with the impact if the PACIME procedures were used in KIP. Note that the assessment focuses primarily on the direct output of the S&T Research component of the KIP, emphasizing the value to the country of research services. The subcomponent can also be considered as having indirect objectives in building research capacity and reforming the research system. To the extent that the project seeks to improve institutions as the participants in the system "learn by doing", the following comments would apply to either construct.

A multiplicative function is used for the impact of the project, of the form:

$$I = R * P (E,Q) * S$$

Where:

I is the overall impact of the component;
S is the size of the program;
P is the productivity of the researchers in use of program resources, which is a function of the efficiency of use of resources, and the quality of the work done; and
R is what the CONACYT staff term *pertinencia* or relevance.

This last term is worthy of some explanation. Take a business enterprise as an example. Suppose that a company has the same production budget in 1998 and 1999. In each year it produces the same products. In 1999, the capital and labor cost per unit production in each product is lower than in 1998, and in each case the quality of the goods produced is better in 1999 than in 1998. Is the business necessarily more successful in 1999 than 1998? Clearly not, if the product mix is less relevant to the market faced by the company in 1999 than it was in 1998. (The Pan American Health Organization has used a factor terms "transcendencia" in health planning, to deal with these issues of importance that go beyond efficiency and quality.)

Efficiency:

Room for Improvement: There appears to be considerable room to improve efficiency of researchers funded by CONACYT. It has been suggested that as much as one-third of their working time may be spent in the proposal process and in administrative reporting on grants. Time taken from research for procurement of equipment and project management also exceed requirements imposed by funding organizations in other countries. Research is delayed to late arrival of instruments funded by CONACYT grants, due in part to procedural requirements which lengthen the acquisition process. Researchers in some cases complain that their research efficiency is compromised by "red tape" imposed by the CONACYT grants which requires them to be less than optimal equipment for their needs. Lack of fungibility of research funds from different sources causes inefficiency in the ways research teams are configured and the configuration modified to meet changing research circumstances.

Young researchers in Mexico frequently face a period of very low scientific productivity lasting for several years after they receive their Ph.D.s before they receive their first research grants. Lacking resources to buy facilities and pay operating costs of their research, they will normally be in something of a holding pattern after their CONACYT scholarship grant/loans end until their first research grants are signed.

Graduate students typically require 4 to 5 years to get a Masters degree, and six to seven years to get a Ph.D., again far longer than their peers in other countries, presumably in part because they spend less time productively advancing their education, and more time waiting and doing administrative and other work due to the problems identified above.

Effect of reform of PACIME Procedures on Efficiency: (The changes and their rationale are described in more detail in the PIP.) CONACYT will make immediate changes in its procedures to increase the efficiency of grantees, and the simplified processes will be in effect for the first set of KIP grants which will be made in 1998. A study will be conducted early in the project to identify additional changes (and provide the basis for requests for changes in law and/or regulation needed for such changes). Grants will be extended to three years (from about 2 years in PACIME) to reduce the administrative burdens of the competitive process on scientists. CONACYT will move toward disciplinary windows which will receive all funding requests for support, and away from instrument specific windows, thereby simplifying the administrative tasks of principal investigators in managing their labs.

Some of the innovations of KIP will tend to have short term impacts on average efficiency of researchers funded in the portfolio which will be negative. KIP includes a variety of new instruments for young investigators, which should greatly increase their career productivity. But one must expect that the per year productivity of young researchers building their labs and starting their research careers will be lower than that of more experienced researchers. Similarly, the Field Development Subcomponent of the project will seek out fields where production is not equal to social and economic needs; to the degree that these Field Development projects fund new or weaker labs to build their research capacity, it is to be expected that short term productive efficiency in these grants will be relatively lower than in funding the already strong and productive fields and laboratories.

The project includes incentives for graduate education in research grants, and especially it includes incentives for timely completion of research degrees. These changes should improve the efficiency of funded laboratories in training Masters and Ph.D. students.

Reasonable Expectation for Overall Efficiency Impact: It is extremely difficult to increase the efficiency of scientific laboratories, and the program will in some areas accept relatively lower annual productivity to increase long term benefits. However, given the room available for improvement, and the emphasis of the program on such improvements, it seems likely that it should be possible in five years to increase the amount of time researchers actually spend on their research and students actually spend fruitfully learning how to do research each year by four (4) to seven (7) percent.

Quality:

Room for Improvement: It is of course difficult to judge quality of research from self reporting, and the monitoring and evaluation process used in PACIME did not provide an overview of the quality of CONACYT funded research. Citation indicators must be interpreted with great care for a country like Mexico, but they suggest that there should be a marked increase in Mexican papers that meet the quality standards for mainstream journals, and one must assume that this low level of publication represents not only a low level of production of results, but also problems with the quality of those results.

Effects if Changes from PACIME to KIP on Quality: The KIP program is making several changes that should improve quality of results from the projects funded. It seeks to increase concentration of resources on the best proposals. The monitoring and evaluation system will be strengthened, and more feedback provided to investigators on the substance of their research. Meetings of funded researchers will be organized at which their work will be subject to constructive peer comment. Advisory committees will increase the use of evaluation of the quality of past CONACYT research grants in considering new proposals, and thereby will create incentives for grantees to improve quality. The program will also strengthen Mexican scientific and technological journals which play an important role in providing incentives for research quality.

On the other hand, it seems likely that the average quality of work by young investigators and in new fields will be lower than that in the traditional research grants areas, and again seeking long term improvements in Mexican S&T research capabilities may tend to reduce the quality attained on the average in the portfolio of projects.

Reasonable Expectation for Overall Quality Impact: The rate of change of quality in a portfolio of hundreds or thousands of research grants will be slow, and some changes from PACIME to KIP will actually tend to decrease the average quality of research funded in the portfolio (see discussion of Young Researcher program, above). It seems likely that the net impact will be perhaps a one (1) to five (5) percent increase in average quality of the research supported by the program.

"Pertinencia"

Room for Improvement: The assessment is predicated on the assumption that the Mexican economy is in a process of rapid growth, and as part of that growth. It is known that in general countries become more research intensive as per capita GDP increases, and that the growth of the research capacity is in part due to the greater needs for research of more productive industrial sectors and subsectors that become increasingly important in the economy. As a result one expects increased need for changes in the composition of the research capacity of Mexico, and of the portfolio of CONACYT's funded research grants. If Mexico is to sustain moderate levels of GDP growth and a rapid increase in the percentage of GDP allocated to research and development, then it is going to need to restructure its research capacity to meet the changing needs of the country.

"Pertinencia" also implies that the research results in social and economic benefits to the country. There appears to be considerable criticism that research in the universities and government laboratories supported by CONACYT is too "ivory tower". Thus there seems to be considerable potential to improve the utility of CONACYT funded R&D projects in Mexico's social and economic development.

Effects of Changes from PACIME to KIP on "Pertinencia": In the PACIME program, CONACYT was relatively passive in terms of directing funding so as to maximize the "pertinencia" of the research in its funded portfolio, essentially supporting capacity that had been developed as a result of decisions made in the academic sector or in the governmentally owned and operated laboratories. While CONACYT will not seek to replace markets, the autonomous universities, state governments, state universities and other policy makers in defining R&D priorities, it will take a more proactive stance in this regard. Indeed, emphasis on increased publications in Mexican and international journals may tend to make the research portfolio more sensitive to the priorities of the scientific societies as reflected in the editorial policies of those journals, and as effected through incentives to do research which is published in high prestige journals.

As part of the KIP, the Field Development Subcomponent will engage CONACYT in identifying R&D areas where existing capacity is low compared to social and economic importance, and will be proactive in building capacity in those fields and funding research. Advisory committees in the traditional CONACYT areas will be more proactive in reviewing the portfolios of funded projects and comparing the balance of the funding with the desired evolution of their disciplines in Mexico. Competitive processes will be introduced which allow marginal changes in the allocation of resources among disciplinary programs in response to both the productivity and quality of those programs and changing national needs.

The linkage and technology components of the KIP should also result in institutional changes which influence the directions of R&D in the universities and government research labs, making them more responsive to market pressures and the demands of industry.

While the Linkage and Technology components are specifically designed to build institutions to improve the relevance of R&D to social and economic development, actions within the S&T Research Component to improve the dissemination of research results will also tend to have that impact, as will efforts to involve users of research results more in CONACYT's processes.

Reasonable Expectation for Overall "Pertinencia" Impact: The portfolio of projects funded by CONACYT will evolve over the next decade, as it continues to support large areas of existing S&T capacity that remain or increase in relevance to Mexico's needs, and as it identifies new areas or niches that need to be strengthened. The "pertinencia" of the overall portfolio will be the result of complex decision processes in which CONACYT is only one actor, and perhaps not the most important actor in many individual decisions. Still there is likely to be a modest increase in "pertinencia" as a result of the changes from the PACIME to the KIP procedures. Perhaps a one (1) to three (3) percent increment in "pertinencia" might be reasonably expected.

Combined Effect of Improvements in Productivity and "Pertinencia"

It has been suggested in the equation above that "productivity" is a function of the quality and the efficiency of research, and in the discussion above it has been suggested that the KIP procedures, based on the lessons learned from PACIME should increase efficiency by three (3) to seven (7) percent and should increase quality by one (1) to five (5) percent. It seems likely that the overall benefits from improvements in efficiency and quality should be additive (rather than the average of the two as increase in productivity). Thus productivity should increase by four (4) to twelve (12) percent.

It is suggested that "pertinencia" and productivity are multiplicative, and that "pertinencia" will increase by one (1) to three (3) percent using KIP rather than PACIME procedures. Thus it is suggested that the value of the CONACYT program will increase by five (5) to fifteen (15) percent as a result of the switch from PACIME to KIP procedures.

Comments on Financial Values

For the Scientific and Technological Research Component, we assume that the ratio of matching funds to World Bank funds are 1 to 1.

We estimate:

- a ratio, r(1), of non-matching Government contributions to World Bank contributions;
- a ratio, r(2), of funds provided by universities and others to the funds provided by CONACYT in the grants made by CONACYT.

Thus, for every dollar of World Bank funding there would be (1+r(1)) dollars of government funding (matching and non-matching contributions), and (2+r(1))* r(2) dollars of university and other institutional funding. Thus, in total, for every dollar of World Bank funding there would be 1+r(1)+2*r(2)+r(1)*r(2) in funds from Mexico.

Since the KIP procedures will be used for the entire portfolio, and will influence the productivity of the complementary and matching funds, we can conclude that switch to KIP from PACIME rules will increase the productivity of research funding of 1+r(1)+2*r(2)+r(1)*r(2) in Mexican funding for every dollar of World Bank loan by five to fifteen percent at the end of five years.

Indicators Related to Potential Benefits of the Science and Technology Research Component

Scientific and Technological Research funded within that component of the KIP project produces knowledge which is used in different ways. Total benefits from the research would appear to be the aggregate of those benefits from the different uses.

As an example, take a project conducted in a civil engineering faculty on methods to prevent rusting of metal used in civil construction. The results of such research might be directly used to improve civil works, as where government incorporates such knowledge in standards for metal reinforcement of civil works, and such value could in theory be measured in terms of savings on construction and maintenance. Graduate students working on the project will receive benefits in learning how to do research, absorbing tacit knowledge of research methods which can only be acquired through experience; in theory such value could be measured in terms of the value of such education to students and the social value external to those benefits which the students are able to appropriate in future earnings. Those involved in the research would normally be expected to bring knowledge acquired during the research into the classroom for undergraduate and continuing education of engineers. Thus, in the example, the department might upgrade the theoretical material on corrosion taught in its courses, and acquaint students with state of the art instrumentation for corrosion studies. One might in theory measure the value of such information to the students in terms of willingness to pay for professional training in research intensive schools, and one might measure social value of the knowledge in terms of the engineering firms evaluation of the education and training provided by the university. There is a consumer value for the information produced as well; thus if the information is published in journal articles a part of the value of the journal is attributable to the project that produced the knowledge published, and if a newspaper article is published on corrosion in bridges as a result of the project, a part of the value of that newspaper is attributable to value the public places on that knowledge as a consumer service.

The following categories are suggested for benefits from research projects funded under the KIP:

- Training in how to do research for students seeking research degrees (Masters and Ph.D.)
- Feedback into curricula of undergraduate and continuing professional education of new knowledge, methodologies, instrumentation, etc.
- Consumer benefits from professionals and the general public who take interest in scientific and technological knowledge;
- Specific application of research results:
- Generalized feedback into government and industry of new knowledge, methodologies, instrumentation, etc. by consulting and other participation of researchers involved;

To estimate the potential benefits from the research, we reviewed the research grants made in 1997. According to the grants data base, CONACYT approved 804 grants with a total value of 336,007,290 pesos. All of these seem to have potential to involve graduate students at the MS or Ph.D. level, and thus to have potential benefits in the training of researchers.

Of the grants, 545 were to researchers in institutions which appeared to offer undergraduate education, with a total value of 209,997,605 pesos. These projects would presumably be those with potential benefits in undergraduate education.

The grants were further classified as to various types of potential direct applications of research results, as follows:

- Resources: Increase of available resource base, as when geological researchers identify previously

unknown ore deposits, or when hydrologists identify ways to better manage an aquifer to increase the water that can be drawn, or maintain environmental amenities, as when ecological research leads to better management techniques to protect nature reserves.

- Construction: Improved technologies for construction of civil works, buildings, etc., or for protection of such works or structures from damage caused by environmental factors.
- Extraction: Improved technologies for extractive industries, such as agriculture, logging, fishing, etc.
- Goods: Improved technology for manufacturing goods, as when the research results are used to develop new products or new process for the production of goods, or to improve existing goods. Software products are considered to be "goods".
- Services: Improved technology for producing services, as when research results are used to develop new services or new processes for the production of services or to improve existing services. Specifically, health and educational services are included in this category, as are communications services.
- Institutions: Improved institutions as when, for example, economic research leads to ways to improve markets or other economic institutions, sociological research identifies problems in current social institutions and suggests ways those institutions can be improved, or research in management science illuminates ways in which enterprises can be better organized.
- Policies: Improved policies, as when epidemiological research illuminates the pattern of diseases and leads to improved articulation of public health programs to health conditions, or when ecological research illuminates the processes in an ecosystem leading to better policies for the sustainable use of the ecosystem.

Projects were identified as Basic Research when direct applications were not apparent.

A number of projects were classified as having Incomplete Information. (Inc. Inf.) in the data base to determine potential impact.

There was of course no way to ascertain what benefits actually will accrue in Mexico from any project. Indeed, with only very limited information available to judge potential benefits and with more than 800 funded projects over the entire range of science and technology estimates of potential benefits were very inexact. Still, the information suggests at least a classification of kinds of benefits to be expected, and proportion of projects that potentially may lead to direct applications. It is expected that some such classification will be incorporated in the project review and the monitoring and evaluation processes of the new project.

The following table shows the numbers of projects and their, tabulated by the class of benefit. (Note that this classification was exclusive. Thus a project could be classified as having benefits in the production of goods or in the production of services, but not both. Projects could of course simultaneously have potential educational benefits and potential benefits in the production of goods or services.)

Type of Benefits	Number of Grants	Percent of Grants	Value of Grants (Pesos)	Percentage of Value	Average Grant (Pesos)
Basic	210	26.12%	107,743,031	32.07%	513,062
Inc. Inf.	208	25.87%	24,819,270	7.39%	119,323
Resources	22	2.74%	9,843,353	2.93%	447,425
Extraction	72	8.96%	39,571,574	11.78%	549,605
Construction	7	0.87%	2,700,450	0.80%	385,779
Goods	127	15.80%	68,332,981	20.34%	538,055
Services	69	8.58%	39,521,207	11.76%	572,771
Institutions	14	1.74%	3,999,935	1.19%	285,710
Policies	75	9.33%	39,475,489	11.75%	526,340
Total	804	100.00%	336,007,290	100.00%	417,920

The grants under the Incomplete Information (Inc. Inf.) category were primarily research initiation grants (which were not described in the data base by substantive content.) If these were distributed into applied and basic research as the rest of the projects, it would seem that about two-thirds of the CONACYT grants and funds were allocated to applied research and technology development, and the rest to basic research.

An aside might be made on the term "technology". The 127 grants related to the production of goods were technological in nature, and indeed many of the 72 grants related to extractive industries were also technological in nature. However, the large number of polity and institutional research grants were applied but not technological as one usually defines technology. Similarly, many of the resource related grants were not "technology" as that word is usually used but would have socio-economic benefits.

The Basic research might be worth a comment as well. CONACYT seems to be required to fund much of this research, such as research on Mexico's history and cultural diversity. Basic research in areas such as optimization theory, molecular biology and materials science is also important for Mexico, both in the sense that it may turn out to have applications in the medium and long term, and in that it informs technology and education. Only a relatively small portion of the research was in areas such as astrophysics in which Mexican applications of the research seemed remote and unlikely, and CONACYT would seem to have responsibility to keep a small amount of such research funded in that the higher education community depending on such funding.

In general the CONACYT portfolio appeared to be relevant to Mexico's socio-economic development in terms of the substantive content of the grants funded. The reforms in the KIP project should help to move the portfolio from one-third to one-fourth or one-fifth devoted to fundamental research.

Economic Anlaysis of Industry-University Linkage and Enterprise Technology Enhancement Components

Introduction

The economic analysis of this type of project presents special difficulties. This is due essentially to the indirect relationship between actions taken under the project and the stream of benefits that result from them. Despite these difficulties, an attempt is made here to present a quantified measure of some of the benefits that are expected to result from this project.

Background

Developing countries are very diverse in terms of their R&D capabilities , their technology contracting capabilities, their Intellectual Property Rights (IPR) systems, and their capacities to administer and adjudicate such systems.

Mexican technological development, particularly in industry, suggests that a great deal of investment in technological development is required to achieve levels comparable to Newly Industrialized Countries' (NIC) economies. As the record of NICs (and, before them , of Japan) reveals, Mexico can grow faster than the advanced countries. Being able to use modern technology without having to expend resources creating it from scratch, more Less-Developed Countries (LDCs) may be able to catch up to the industrialized nation in level of economic development. But convergence through catch-up growth cannot happen in the absence of substantial investment in technological development. For Mexico, the dominant objective of firm-level R&D is to facilitate technology purchase, either in direct (licensing) form or indirect form where new production technology must be incorporated into plants and where quality control is required for exports of products.

In terms of invention, Mexico has the same level of patents granted to domestic firms and inventors as Argentina, Egypt, Hungary, India, Malaysia, Philippines and Turkey that have comparatively minor invention capabilities in relation to Poland, Brazil and China. Comparative patent data by industry of manufacture and sector of use for Mexico indicates a concentration of patents in the chemicals sector.
Mexico shows an expansion in domestic invention (especially in chemicals) from 1981 to 1985 but a decline since 1985, possibly due to crowding-out by American inventors, whose inflows almost tripled between 1985 and 1992. The next few years may show whether Mexican invention can react to an influx of American invention as successfully as seen in Korea. So far, chemical and drug industry and manufacturing continue to dominate domestic invention patterns, while foreign inventors dominate the electronics and metals industries.

2. Cost Benefit/Cost Effectiveness of the Technology Component in Mexico

This annex summarizes the available information on benefits and costs of the technology and linkage components and gives a preliminary assessment of the problems of carrying out a reliable benefit/cost analysis, including estimating rates of return to R&D and technology support programs. In principle, one should be able to estimate productivity benefits and costs, to assess the economic growth consequences of technology investments. Based upon this preliminary assessment, proposals are made for data collection and analysis that should be built into the project monitoring and evaluation so as to improve assessment of the development impact of the project.

Indicators of technological development

In analyzing technological development, it will be ideally good to know how much has been invested in what kinds of capital with what rates of return. Unfortunately, such information is not generally available and is exceedingly difficult to obtain on an aggregate basis for some important forms of capability acquisition, like those which occur in connection with initial efforts to attain increased mastery over newly acquainted industrial technology. Available instead are data for various indicators related to distinct aspects of technological capability. These indicators offer a limited, but meaningful comparison of technological development across countries.

Research and Development Indicators, 1995

Country	R&D/GDP	% Gov R&D funding	% Private R&D funding	% Others R&D funding	R&D private sector spending/GDP
Germany	2.27	37.1	60.8	2.1	1.50
Canada	1.60	37.9	46.7	15.4	0.96
USA	2.58	36.1	59.9	4.0	1.85
Spain	0.82	53.9	38.9	7.2	0.37
France	2.34	41.6	48.7	9.6	1.44
Italy	1.14	47.4	48.7	3.9	0.65
Japan	2.64	21.5	68.2	10.3	1.87
Mexico	0.31	66.2	17.6	16.2	0.06
United Kingdom	2.19	32.3	50.3	17.4	1.43
Sweden	3.04	31.4	62.9	5.7	2.31

Source: INEGI-CONACYT, R&D Survey, 1996
OECD, Main Science and Technology Indicators
Mexico Science and Technology Indicators, 1996, CONACYT

The figures in the table illuminate several aspects of technological development with the caveat, regarding the comparability of such indicators across countries. Private sector R&D investment as a percentage of GDP is very low in Mexico compare to OECD countries. However, data on industrial R&D do not capture many related kinds of technological effort that are important at lower levels of technological development. For example many important innovations come from sources other than what is formally classified as R&D such at the system of "just-in-time" production process. Significant increases in productivity, come initially from technological efforts related to raw material control, product and process quality controls, production scheduling, changes in product mix. Formal R&D activities typically commence only after a substantial degree of capability has been acquired production and in at least some aspects of investment.

The modernization component will support innovations that come from technological effort that are more focus in increasing productivity and efficiency at the firm level than R&D activities per se.

Returns of industrial R&D

Studies of various forms of investment in technology are important for policy purposes because of the need to understand the factors that stimulate such investment. Unfortunately, there is little evidence from LDCs about the determinants of investment activities by private firms (Evenson 1995).

Surveys of returns to private R&D in developed countries show that investments in R&D, when evaluated ex-post, yield private returns that are at least as high as returns to other investments (Mohnen 1990). Mansfield (1977) reports on 17 case studies of innovation for which the median private rate of return was 25 percent. Griliches (1980) reports rates of returns for large U.S. industrial firms ranging from 30 to 50 percent. Mairesse and Sassenoun (1991), on reviewing a number of studies giving statistical estimates of the impact of research expenditures on firm-level productivity covering several advanced countries (France, Japan, and the U.S.) found that all implied positive and highly significant elasticities, with approximate rates of return ranging from 14 to 24 percent.

Social rates of return should exceed the private rates owing to the individual firm's inability to appropriate the

full benefits from conducting R&D. Mansfield (1977) found that social rates of return (median, 56 percent) were in most cases more than double the private rates. Griliches (1991) and Nadiri (1993) have reviewed a number of empirical studies and conclude that R&D spillovers are of substantial importance, which provided additional evidence that social returns are considerably in excess of private returns.

Very few studies have estimated returns to industrial R&D in LDCs. Basant and Fikkert (1993) have done of the few studies for developing countries. Their estimates of the private returns to R&D in India are no less than comparable estimates obtained for developed countries. They also find evidence that social returns exceed private returns.

There are no estimates on the returns to industrial R&D for Mexico. During project implementation econometric calculations will be required to obtain a preliminary estimation on the rates of return. CONACYT can perform this task based on the data available from its National Innovation Survey 1996.

Technical Efficiency of SMEs

The evidence is mixed about how efficient SMEs are relatively to larger firms. The relative importance of limited technological capabilities as a constrain to SME growth needs to be analyzed in Mexico. Batra and Tan (1995) estimated firm level efficiency for Mexico. They use data of 5,072 manufacturing firms in 1992. They used R&D investments and know-how licensing as measures of technological capabilities. They found that the correlation between efficiency and R&D was positive and significant. Mexico has a better developed R&D capacity that can increase firm efficiency. In other countries, such as Colombia and Indonesia the correlation was negative. The study suggests that the project could generate a positive impact on firm efficiency. We will need to assess this impact for the project.

Benefit/Cost Evaluation

Despite the difficulties in calculating the stream of benefits, the analysis below suggests the following:

Modernization Component

A positive Net Present Value of US$ 4.2 million (internal rate of return of 10 percent) can be anticipated for the quantifiable components of this sub-component. The NPV calculation uses a discount rate of 10 percent, and the estimate incorporates all the benefits of the project that can be quantify. It excludes any value for intangible benefits, and on that basis might be considered as a lower bound estimate of the actual return to be generated.

Linkage Component

Joint project sub-component. A positive Net Present Value of US$2.6 million (internal rate of return of 16 percent) can be anticipated for this sub-component. The NPV calculation uses a discount rate of 10 percent

Quantifying Benefits

Ideally, the effect of each of the project intervention the costs of firms should be the starting point for an examination of the potential increase in profits. However, such data are not generally available, and sometimes not even known by the owners/managers of firms. Despite this, most firms have notional estimates of the potential increases in output that could result from specific actions. This information, together with some simple assumptions, provide us a basis for estimating the potential increases in profit (benefits) that are expected from the modernization sub-component.

Modernization Sub-component

We have used for the calculations as a benefit measure, the profits generated by the commercial projects which are the ultimate destination of assistance under this project. However, we have not considered economic

externalities from research and development in the formal and inform a way and demonstration effects to other firms. In the absence of precise information on these types of considerations, it seems most practical to assume financial and economic values are coterminous.

The valuation of benefits uses a two stage calculation which firstly estimates the extra output created by assisted firms, and secondly the profit, or benefit, associated with that output. Additional output is defined as the difference between the level of output achieved by firms assisted by the project and the level of output these same firms would have achieved in the absence of the project. These parameters will be monitored during the life of the project using baseline and annual surveys of assisted firms.

For this sub-components, we have assumed that for every US$1 of consultancy assistance, assisted firm will increase their output (sales) according to: US$0 for 1 day diagnostic, US$1.5 for 3 day diagnostic, US$ 3.2 for firm project and US$ 3.5 for a group project, each year over a five year period. This is a very conservative assumption compared to the performance reported in an export project in Kenya, in which export earnings increased by about US$20 for every US$1 dollar of consultancy input. In the second stage an approximate measure of the profit, or benefit generated from this output value (Cr.2197-KE, Project Completion Report). In the second stage an approximate measure of the profit, or benefit generated from this output value can be made using a working estimate that, at the margin, the ratio of gross profits to output is 25 percent. We verified this assumption during appraisal in Mexico.

Private Regional/Sectoral Technology Support Centers

The primary benefit is the economic return generated by the centers which received grants from the project. The proposed centers or the strengthening of them which are assumed would not have proceeded without the availability of the new source of grants. CONACYT has reported , at least 6 potential regional centers are in the pipeline. During project appraisal, we could not evaluate the potential of the proposed projects. We suggest that CONACYT require a financial and economic analysis of each proposed center as part of the appraisal process prior to extending support, to ensure that proposed projects generate a positive rate of return.

The objective is to choose among alternatives to identify the most profitable opportunities for investment in both the existing and new regional technical centers. Furthermore, the objective is also to maximize the economic impact of investments on the concerned sector. Some features of this methodology, which relate specifically to the types of activities that would be provided by the regional technical centers, are summarized below:

For the financial analysis: a) a market study to determine what services are needed by private industries that are not being offered by the private sectors, as well as the demand for the proposed service/services at different prices; b) a technical study to determine what investments are necessary to offer a given service; and c) financial rate of return analysis, including the full cost of the investment and of operating expenses, to verify that it is financially viable for the institution to provide the service at an acceptable price. The proposal should include all the financial and economic analysis.

For the economic analysis: a) a market study to estimate actual and potential demand by industrial enterprises for services provided by regional technical centers; b) Economic benefits of investment, estimate the revenue of regional technical center investment for the period 1998-2003 (at border prices for services that are currently provided overseas, or at prices offered by local suppliers when such suppliers exist) and estimate the benefits of investments for the sector (for example, increase in exports, savings in resource utilization, productivity improvements; c) estimate investment costs (at market prices) and direct and indirect operations costs, but also when possible estimate at opportunity cost; d) calculate the internal rate of return.

Linkages Component

Joint Projects. The purpose of this type of expenditure is to help attract new investment from the private sector and increase collaboration between firms and universities. We will assume that this sub-component should generate an additional US$5 of output (sales) to the firm for every $1 spent on this sub-component. The additional output is then translated into additional profit using a ratio of gross profits to output of 25 percent.. However, assigning a value to the benefit of this subcomponent is difficult. Given the complexities of the issues on this type of projects, including those regarding R&D spillovers to other sectors in the economy and the lags on the results of the investment.

Sensitivity Analysis
The impact of the main risk on each project benefit is summarized bellow:

Modernization Component. A primary source of sensitivity is in meeting the performance target for the positive impact of consultancy assistance on firms' output. Should this performance be lower than estimated, the NPV of this sub-component will be reduced. An alternative way of viewing this risk is that, may be the number of firms proposed will be served but they may not generate extra profit from the assistance provided as expected.

Linkages Component
Joint Projects. The benefits are dependent of the performance target for the positive impact of the collaboration. If the collaboration created only US$ 4 of extra output per US$1 of investment, the NPV of the component becomes negative.

Benefit Cost Analysis

Modernization Sub-component

Rate of Discount	NPV (US$ millions)	IRR
10%	4.27	
12%	3.50	
24%	0.70	30%

Joint Projects

Rate of Discount	NPV (US$ millions)	IRR
10%	2.66	
12%	1.55	
24%	-2.24	16%

Annex 5
Knowledge and Innovation Project
Financial Summary

Thousands of US$
Years ending December 31

	1998	1999	2000	2001	2002	2003	Total
Project Expenditures							
S&T Research	15.00	60.00	60.00	60.00	60.00	30.00	285.00
Ind-Univ Linkage	8.44	30.00	38.00	35.00	30.00	15.00	156.44
Tech Enhancement	11.33	30.00	45.00	45.00	40.00	20.00	191.33
Total Allocated	34.77	120.00	143.00	140.00	130.00	65.00	632.77
Unallocated							30.00
Total Expenditures							662.77
Project as percent of:							
Gen. gov't consumption		0.1%					
Gross dom. inv.		0.1%					

Annex 6

MEXICO: Knowledge and Innovation Project
Project Implementation Arrangements

A. Institutional Arrangements

The executing agency for the project will be CONACYT. CONACYT has five years of experience as executor of the Mexico Science and Technology Infrastructure Project (Loan 3475-ME) which supported similar activities to the proposed loan. A number of improvements to project design are proposed under the new loan to increase operational efficiency and effectiveness.

CONACYT, with Bank approval, will hire individual consultants with strong experience in procurement under science and technology projects to manage the procurement under the project. Regarding the selection of consultants for the different components, *ad hoc* evaluation committees will be convened as required.

The Science & Technology Research Component will consist of competitive, peer-evaluated grants awarded for the purpose of science and technology research. The majority of the research grants will be awarded to individuals and will average US$150,000 (to be spent over a three-year period); however, some research grants will be awarded to group projects averaging US$1 million. The research grants would cover the financing of equipment and laboratory materials. CONACYT's Deputy Directorate of Science Research will implement this component.

The Industry-University Linkages Component will consist of the following three subcomponents: (a) restructuring of SEP-CONACYT centers, (b) joint university-industry projects, and (c) university linkages capabilities. The first subcomponent will be implemented by the Deputy Director of Coordination of the SEP- CONACYT Centers; the other two subcomponents will be implemented by the Deputy Directorate of Technology Modernization.

Finally, the Enterprise Technology Enhancement Component will consist of the following four subcomponents: (a) Technology Modernization, (b) Regional/Sectional Technology Centers, (c) Special Pilot Programs and (d) Venture Capital Fund. The Deputy Directorate of Technology Modernization will implement this component.

B. Procurement of Goods

Procurement of all goods will be carried out in accordance with the Bank's Procurement Guidelines (*Guidelines: Procurement Under IBRD Loans and IDA Credits,* version dated January 1995, revised January and August 1996, and September 1997). For contracts for goods to be awarded on the basis of ICB, the Borrower may grant a margin of domestic preference in the bid evaluation up to 15 percent or the amount applicable to customs duties, whichever is lower, to qualified domestic manufactures.

The following procurement procedures will be utilized under the Project:

1. *International Competitive Bidding* (ICB) – This procedure will be used for all contracts above US$350,000 equivalent. This will represent about 85 percent of total goods procured directly under the project. This procedure will require the use of Bank Standard Bidding documents.

2. *National Competitive Bidding* (NCB) - Contracts costing less than US$350,000 equivalent but more than US$100,000 equivalent will be procured following NCB procedures. Goods under these contracts will be locally available and will be unlikely to attract foreign competition. This procedure will require the use of standard bidding documents as agreed by the Bank and the Mexican authorities.

3. *International/National Shopping* (IS/NS) – IS procedures will be used for goods valued less than US$200,000 equivalent, up to an aggregate amount of about US$3.4 million equivalent. NS procedures will be used for goods costing less than US$50,000 equivalent, up to an aggregate amount of about US$4 million equivalent. (IS and NS would represent approximately 5 percent of total goods.

4. *Direct Contracting* (DC) – Goods that are obtainable only from one supplier will be procured under DC procedures. This procedure will be subject to prior Bank approval. The aggregate amount of goods to procured under DC is US$0.5 million equivalent, that represents about 1 percent of total goods.

C. Procurement of Consulting Services

Consultants will be hired on terms and conditions, (including review of their qualifications), in accordance with the principles and procedures set in the *Guidelines for the Use of Consultants by the World Bank Borrowers and the World Bank as Executing Agency* dated January 1997 and revised September 1997.

D. Grant and Credit Schemes

The project will include five credit and grant subcomponents that due to their nature will operate under different procurement rules.

Science and Technology Research Projects (Research Grant Scheme) – The purpose of this subcomponent is to improve the system for science research and human resources training in Mexico. This subcomponent will support 4000-5000 research projects approved through CONACYT's competitive review process (800-1000 per year) to be implemented by individual investigators from roughly 250 universities and research centers spread throughout the country. Procurement would be carried out by the grantee's university or research center. Each grant agreement between CONACYT and the Investigator will stipulate that all procurement must be performed in accordance with the Bank's Procurement Guidelines (*Guidelines: Procurement Under IBRD Loans and IDA Credits,* version dated January 1995, revised January and August 1996, and September 1997).

The research grants will average US$150,000 over three years to be used to purchase a diverse array of specialized scientific equipment (approximately 45 percent), materials, reagents and consumables (approximately 25 percent) and the remaining funds (roughly 30 percent) will be spent on project-specific materials and services (i.e. field work expenses, printing, external commercial services, maintenance, documents and information services, lab animals, etc.).

The average purchase amount is expected to be approximately US$5,000. Estimates of total purchase amounts by method of procurement are as follows: 25 percent ICB, 15 percent NCB, 45 percent IS/NS (*Licitación Restringida*), and 15 percent Direct Purchase (1 supplier).

Procurement training and support for participating universities will be provided under the Project. Random ex-post auditing will be undertaken by CONACYT and external auditors to ensure compliance with Bank guidelines. In addition, aggregate reports of procurement data will be reviewed to signal irregular activity for further review.

Joint University - Industry R&D Projects (Matching Grant Scheme) – This activity would support projects through a competitive matching grant scheme executed jointly by members of academia and industry. Project proposals will be subject to technical, commercial, and financial evaluations. Firms that have their projects approved will then sign a contract with the higher education institution or research center with which they will carry out the project.

The participating firms will execute procurement in accordance to the financially evaluated proposal. The matching grant scheme will operate on a reimbursement basis against proof of expenses incurred and achievement of corresponding objectives under execution plan.

Enterprise Technology Modernization Program (Matching Grant Scheme) – The program will support procurement of consultant services by SMEs in the form of a grant to cover 50 percent of the cost of consultancy support up to US$50,000 per firm. The qualifying activities will consist of technology upgrading services. All consultants will be required to register for the program as individuals.

Grants will be paid on a reimbursement basis, based on satisfactory completion of the project, proof of payment to the consultant, and delivery of the defined outputs.

Regional/Sectoral Technology Centers (Credit Scheme) – This subcomponent plans to provide support to privately owned and operated Technology Centers via matching credits based on technically evaluated business plans. Credits will match private sector contributions to Centers, but will be limited to US$750,000 per center.

Approved projects will have funds transferred in tranches. Each successive payment will be subject to satisfactory progress with a staged implementation program set out in the business plan.

Venture Capital Fund – The Bank would contribute US$ 5 million (approximately 10 percent of total equity) to a privately managed technology-based venture capital fund.

Project Cost by Procurement Arrangements (in US$million equivalent)

Expenditure Category	Procurement Method				Total Cost (including contingencies)
	ICB	NCB	Other	N.B.F.	
Goods (Computers, Equipment and materials)					
1D. DAIC Institutional Strengthening	0.80	0.80	0.40		2.00
	(0.80)	(0.80)	(0.40)		(2.00)
2A. Centros SEP-Conacyt	36.00	4.00	1.00		41.00
	(2.00)	(2.00)	(1.00)		(5.00)
2C. Strenthening Linkages Capabilities in Academy		2.00			2.00
		(1.00)			(1.00)
Total Goods	36.80	6.80	1.40		45.00
	(2.80)	(3.80)	(1.40)		(8.00)
Services b/ (Consultants, training, promotion)					
1C. DAIC Institutional Strengthening			8.00		8.00
			(8.00)		(8.00)
2A. Centros SEP-Conacyt			25.00		25.00
			(21.00)		(21.00)
2C. Strenthening Linkages Capabilities in Academy			17.20		17.20
			(4.00)		(4.00)
3C. Special Pilot Programs			3.00		3.00
			(2.50)		(2.50)
Total Procurement	36.80	6.80	54.60		98.20
	(2.80)	(3.80)	(36.90)		(43.50)
Grant & Credit Schemes					
1A+B. Science & Tech. Research Projects a/			275.00		275.00
			(125.00)		(125.00)
2B. Joint R&D Projects - Matching Grant c/			71.24		71.24
			(31.50)		(31.50)
3A. Enterprise Technology Modernization Matching Grant Scheme d/			67.49		67.49
			(30.00)		(30.00)
3B. Regional/Sectoral Technology Centers - Credit Scheme e/			70.84		70.84
			(35.00)		(35.00)
3D. Venture Capital Fund f/			50.00		50.00
			(5.00)		(5.00)
Other					
4. Unallocated			30.00		30.00
			(30.00)		(30.00)
TOTAL PROJECT	**36.80**	**6.80**	**619.17**		**662.77**
	(2.80)	**(3.80)**	**(293.40)**		**(300.00)**

Note: N.B.F. = Not Bank-financed

Figures in parenthesis are the amounts to be financed by the Bank loan/IDA credit

a/ The Science Research Subprojects (Competitive Grants System) may incur procurement of goods through ICB, NCB, LIB, shopping and direct contracting by investigator as indicated in grant agreement.

b/ Services procured in accordance with World Bank, Guidelines: Selection and Employment of consultants World Bank Borrowers (Washington, DC, January 1997).

c/ Joint R & D Project selection in accordance with the criteria and procedures agreed with the Bank.

d/ Modernization Program Matching Grant selection in accordance with the criteria and procedures agreed with the Bank.

e/ Technology Development Credit Scheme selection in accordance with the criteria and procedures agreed with the Bank.

f/ Innovation Venture Capital selection in accordance with the criteria and procedures agreed with the Bank.

Table B

Thresholds for Procurement Methods and Prior Review

Expenditure Category	Contract Value (Threshold)	Procurement Method	Prior Review
Works			
	< US$350,000	Three quotations	none1
	≥US$350,000	NCB	none1(not contemplated)
Goods			
	<US$100,000	National or International Shopping	none1
	US$100,000-US$350,000	NCB or LIB	none1
	≥US$350,000	ICB or LIB	All
Services			
(a) Individuals	<US$50,000	Qualification-based	none1
	≥US$50,000	Qualification-based	TOR, CV, draft contract
(b) Firms	<US$100,000	Qualification-based	none1
	>US$100,000	QCBS or QBS	All

Note:

QCBS = Quality- and Cost-Based Selection
QBS = Quality-based Selection
SFB = Selection under a Fixed Budget
LCS = Least-Cost Selection
CQ = Selection Based on Consultants' Qualifications

ICB = International Competitive Bidding
LIB = Limited International Bidding
NCB = National Compeititive Bidding
IS/NS = International/ National Shopping

1 Subject to random ex-post review

Table C

Allocation of Loan Proceeds (in US$million equivalent)

Expenditure Category	Amount in US$million	Financing Percentage
1. Science Research Projects		
A. Research Projects - Grants	110.00	50% of grant expenditures
B. Field Development - Grants	15.00	50% of grant expenditures
C. Institutional Strengthening - consulting services	8.00	100% of expenditures
D. Institutional Strengthening - goods	2.00	100% of foreign; 85% of local expenditures
2. Industry-University Linkage		
A. Centros SEP-Conacyt		
i. consultants and training	21.00	100% of expenditures
ii. goods	5.00	100% of foreign; 85% of local expenditures
B. Joint R&D Projects - Matching Grants	31.50	100% of amounts disbursed
C. Strenthening Linkages Capabilities in Academy - Consultants, training and promotion	4.00	100% of expenditures
D. Strenthening Linkages Capabilities in Academy - Goods	1.00	100% of foreign; 85% of local expenditures
3. Enterprise Technology Enhancement		
A. Enterprise Technology Modernization - Matching Grants		
i. Phase I - Pilot	5.00	100% of amounts disbursed
ii. Phase II - Implementation	25.00	100% of amounts disbursed
B. Regional/Sectoral Technology Centers - Credit Scheme	35.00	100% of amounts disbursed
C. Special Pilot Programs	2.50	100% of expenditures
D. Venture Capital Fund	5.00	10% of fund equity
Unallocated	30.00	
TOTAL	**300.00**	

Annex 7

Knowledge and Innovation Project
Project Processing Budget and Schedule

A. Project Budget (US$000)	Planned (At final PCD stage)	Actual
	US$150	US$160

B. Project Schedule	Planned (At final PCD stage)	Actual
Time taken to prepare the project (months)	13	
First Bank mission (identification)	N/A	2/24/97
Appraisal mission departure	3/98	4/14/98
Negotiations	4/98	4/21/98
Planned Date of Effectiveness	7/98	7/98

Prepared by: CONACYT

Preparation assistance: Japanese Grant of US$735,000

Bank staff who worked on the project included:

Name	Specialty
Daniel Crisafulli	Task Team Leader, Economist
Michael Crawford	Science and Technology Specialist
Sonia Plaza	Economist
Roberto Matus	Operations Analyst
Yevgeny Kuznetsov	Economist
Lea Braslavsky	Procurement Specialist
Livio Pino (during appraisal)	Financial Management Specialist

Annex 8

Knowledge and Innovation Project
Documents in the Project File*

Selected Documents Available in the Project file

A. Basic Documents for Project Implementation
- Knowledge & Innovation Project, Implementation Plan, May 1998
- Operational Manual, Science and Technology Research Compenent, May 1998.

B. Bank Staff Assessments
- Appraisal Mission Aide Memoire (April 24, 1998)
- Project Concept Document (September 19, 1997)
- Project Information Document (December 10, 1997)

C. Related Projects
- Mexico - Staff Appraisal Report (SAR): Science & Technology Infrastructure Project (Ln. 3475-ME). Report No. 10468. April 30, 1992.
- Brazil - SAR: Science and Technology Reform Support Project. Report No. 17178-BR. November 26, 1997.
- Brazil - Project Completion Report (PCR): Science and Technology Project. Report No. 13144-BR. June 14, 1994.
- Indonesia - SAR: Higher Education Support Project. Report No. 15498. May 22, 1996.
- China - SAR: Technology Development Project. Report No. 12814. January 18, 1995.
- Ghana - SAR: Private Sector Development Project. Report No. T6320. November 2, 1994.
- Republic of Mauritius - Technical Annex: Technical Assistance to Enhance Competitiveness Project. Report No. 12693-MAS. May 2, 1994.
- Republic of Tunisia - SAR: Industry Support Institutions Upgrading Project. Report No. 15579-TUN. May 23, 1996.
- Russia Federation - SAR: Education Innovation Project. Report No. 16267-RU. May 6, 1997.

D. Others
- Bonilla, Marcial, R. Herrera Becerra, F. Gonzalez Ayerdi, and M. Jose Yacaman. Ciencia y Desarrollo, "Proyectos de Investigacion Cientifica: Analyis de los apoyos Otorgados." Septiembre/Octubre 1995, V. 21, #124, p.9.
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*Including electronic files.

Annex 9
Status of Bank Group Operations in Mexico
IBRD Loans and IDA Credits in the Operations Portfolio

Project ID	Loan or Credit No.	Fiscal Year	Borrower	Purpose	Original Amount in US$ Millions				Difference Between expected and actual disbursements a/		Last ARPP Supervision Rating b/	
					IBRD	IDA	Cancellations	Undisbursed	Orig	Frm Rev'd	Dev Obj	Imp Prog
Number of Closed Loans/credits: 200												
Active Loans												
MX-PE-7615	IBRD 28240	1987	BANOBRAS	URBN TRNSPRT I	125.00	0.00	34.02	2.49	41.46	1.41	S	S
MX-PE-7672	IBRD 3359A	1991	NAFIN	MINING SCTR	41.51	0.00	0.00	41.05	41.06	0.00	S	S
MX-PE-7704	IBRD 3358A	1991	NAFIN	VOC TRNG SCTR	18.99	0.00	0.00	17.01	32.03	17.03	S	S
MX-PE-7676	IBRD 3475A	1992	NAFIN	SCIENCE/TECH	6.50	0.00	0.00	3.36	1.36	2.03	S	S
MX-PE-7667	IBRD 3419A	1992	NAFIN	IRRIG SCTR	100.63	0.00	0.00	100.63	150.60	.40	S	S
MX-PE-7723	IBRD 36280	1993	BANOBRAS	HWY RHB & SAFETY	480.00	0.00	0.00	203.07	11.08	0.00	S	HS
MX-PE-7648	IBRD 35590	1993	BANOBRAS	MEDIUM CITIES TRANSP	200.00	0.00	0.00	160.85	121.13	0.00	S	U
MX-PE-7694	IBRD 3543A	1993	NAFIN	TRNSPRT AIR POLL CON	79.96	0.00	0.00	79.96	123.08	20.00	S	S
MX-PE-7724	IBRD 3542A	1993	NAFIN	LABOR MARKET & PROD.	11.25	0.00	0.00	3.93	1.94	0.00	S	HS
MX-PE-7612	IBRD 37520	1994	BANOBRAS	SOLID WASTE II	200.00	0.00	193.06	1.71	-4.23	0.00	S	S
MX-PE-7707	IBRD 37510	1994	BANOBRAS	WATER/SANIT II	350.00	0.00	0.00	187.68	167.66	0.00	S	S
MX-PE-7710	IBRD 37500	1994	BANOBRAS	N. BORDER I ENVIRONM	368.00	0.00	273.40	65.36	255.10	21.72	U	S
MX-PE-7725	IBRD 3722A	1994	NAFIN	PRIM.EDUC.II	254.36	0.00	0.00	238.54	201.91	19.29	S	S
MX-PE-7701	IBRD 3704A	1994	NAFIN	ON-FARM & MINOR IRRI	119.36	0.00	0.00	117.90	89.54	7.88	S	S
MX-PE-40462	IBRD 39120	1995	NAFIN	ESSENTIAL SOCIAL SER	500.00	0.00	0.00	18.29	18.30	-5.06	S	S
MX-PE-34161	IBRD 3838B	1995	NAFIN	FINANCIAL SEC T.A.	13.80	0.00	0.00	13.80	2.64	12.90	S	S
MX-PE-34161	IBRD 3838A	1995	NAFIN	FINANCIAL SEC T.A.	5.32	0.00	0.00	4.50	2.64	12.90	S	S
MX-PE-34490	IBRD 3805A	1995	NAFIN	TECH EDU/TRAING	187.49	0.00	0.00	182.84	120.03	59.83	S	S
MX-PE-7702	IBRD 3790A	1995	SEDESOL	SECOND DECENTRALZTN	303.39	0.00	0.00	243.00	126.37	45.61	S	U
MX-PE-7607	IBRD 3778A	1995	GOVERNMENT	RAINFED AREAS DEVELO	41.96	0.00	0.00	34.18	14.82	.88	S	S
MX-PE-7713	IBRD 40500	1996	GOM	WATER RESOURCES MANA	186.50	0.00	0.00	178.84	5.08	0.00	S	S
MX-PE-7689	IBRD 39430	1996	NAFIN	BASIC HLTH II	310.00	0.00	0.00	249.20	25.86	20.27	S	S
MX-PE-40685	IBRD 39370	1996	NAFIN	INFRA. PRIVATZTN TA	30.00	0.00	0.00	22.25	19.59	0.00	S	S
MX-PE-43163	IBRD 42060	1997	BANOBRAS	FEDERAL ROADS MODZTN	475.00	0.00	0.00	475.00	0.00	0.00		
MX-PE-7726	IBRD 41520	1997	GOVERNMENT	AQUACULTURE	40.00	0.00	0.00	40.00	2.08	0.00	S	U
MX-PE-7700	IBRD 41370	1997	GOVT OF MEXICO	COMMUNITY FORESTRY	15.00	0.00	0.00	14.50	1.50	0.00	HS	S
MX-PE-7732	IBRD 41010	1997	GOVERNMENT	RURAL FIN. MKTS T.A.	30.00	0.00	0.00	29.50	14.04	0.00	S	S
MX-PE-7711	IBRD 42760	1998	NAFIN	RURAL DEV. MARG.AREA	47.00	0.00	0.00	47.00	2.34	0.00	HS	S
Total					4,541.02	0.00	500.48	2,776.44	1,589.01	237.09		

	Active Loans	Closed Loans	Total
Total Disbursed (IBRD and IDA):	1,264.09	20,986.46	22,250.55
of which has been repaid:	60.24	10,778.70	10,838.94
Total now held by IBRD and IDA:	3,980.29	10,213.34	14,193.63
Amount sold :	0.00	92.34	92.34
Of which repaid :	0.00	92.34	92.34
Total Undisbursed :	2,776.44	5.61	2,782.05

a. Intended disbursements to date minus actual disbursements to date as projected at appraisal.
b. Following the FY94 Annual Review of Portfolio performance (ARPP), a letter based system was introduced (HS = highly Satisfactory, S = satisfactory, U = unsatisfactory, HU = highly unsatisfactory): see proposed Improvements in Project and Portfolio Performance Rating Methodology (SecM94-901), August 23, 1994.

Note:
Disbursement data is updated at the end of the first week of the month.

Status of Bank Group Operations in Mexico
IFC Committed and Disbursed Portfolio
As of 31-Mar-98
(In US Dollar Millions)

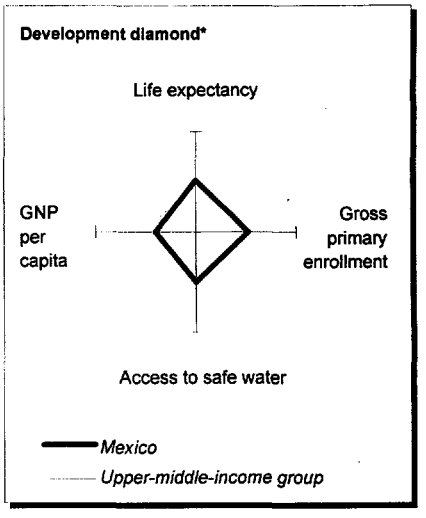
		Committed				Disbursed			
		IFC				IFC			
FY Approval	Company	Loan	Equity	Quasi	Partic	Loan	Equity	Quasi	Partic
1984/87/94/96	Metalsa	0.00	0.00	6.00	0.00	0.00	0.00	6.00	0.00
1987	VULICA	7.50	0.00	0.00	0.00	7.50	0.00	0.00	0.00
1987/91	CALICA	4.79	0.00	0.00	0.00	4.79	0.00	0.00	0.00
1988/91/92/93/95	Apasco	22.20	0.00	0.00	102.80	22.20	0.00	0.00	102.80
1988/94/95	Sigma	0.00	5.00	0.00	0.00	0.00	5.00	0.00	0.00
1989	Cemex	1.86	0.00	0.00	1.00	1.86	0.00	0.00	1.00
1989	Grupo FEMSA	0.00	9.43	0.00	0.00	0.00	9.43	0.00	0.00
1989/90	Banca Serfin	16.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00
1990	Petrocel	6.50	0.00	3.00	3.50	6.50	0.00	3.00	3.50
1990/91	Condumex	7.76	0.00	0.00	3.18	7.76	0.00	0.00	3.18
1990/92/96	BANAMEX	62.61	0.00	0.00	98.07	60.21	0.00	0.00	98.07
1991	CEDETEL	3.13	.77	0.00	6.09	.63	.77	0.00	6.09
1991	Vitro Flotado	13.22	0.00	0.00	5.53	13.22	0.00	0.00	5.53
1991/96	GIBSA	27.05	0.00	10.00	90.95	27.05	0.00	10.00	90.95
1992	Banorte-Arancia	4.17	0.00	0.00	0.00	4.17	0.00	0.00	0.00
1992	Banorte-SABROZA	3.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00
1992	Toluca Toll Road	8.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00
1992/91	Vitro	0.00	10.17	0.00	0.00	0.00	10.17	0.00	0.00
1992/93/95/96	Grupo Posadas	25.66	5.00	5.00	46.57	25.66	5.00	5.00	46.57
1992/96/97/98	Grupo Probursa	0.00	10.16	.21	0.00	0.00	10.11	.21	0.00
1993	Derivados	7.70	0.00	0.00	15.05	7.70	0.00	0.00	15.05
1993	GIDESA	12.50	8.00	0.00	25.50	12.50	8.00	0.00	25.50
1993	GOTM	1.40	0.00	0.00	1.32	1.40	0.00	0.00	1.32
1993	Masterpak	8.40	0.00	0.00	16.20	8.40	0.00	0.00	16.20
1994	CTAPV	4.67	0.00	2.53	0.00	4.67	0.00	2.53	0.00
1994	Interceramic	13.00	0.00	6.00	12.25	13.00	0.00	6.00	12.25
1994/96/98	Aurum-Heller	0.00	2.80	0.00	0.00	0.00	2.80	0.00	0.00
1995	Baring Venture	0.00	9.09	0.00	0.00	0.00	5.00	0.00	0.00
1995	Mexplus Puertos	0.00	3.04	0.00	0.00	0.00	3.04	0.00	0.00
1995/96	Baring Mex. FMC	0.00	.18	0.00	0.00	0.00	.17	0.00	0.00
1996	GIRSA	30.00	0.00	10.00	115.00	7.50	0.00	2.50	85.00
1996	NEMAK	0.00	0.00	6.00	0.00	0.00	0.00	6.00	0.00
1997	Banco Bilbao MXC	80.00	0.00	30.00	0.00	0.00	0.00	30.00	0.00
1997	Comercializadora	6.00	0.00	0.00	7.50	0.00	0.00	0.00	0.00
1997	Gen. Hipotecaria	0.00	1.43	0.00	0.00	0.00	1.43	0.00	0.00
1997	Grupo Minsa	20.00	10.00	0.00	30.00	20.00	10.00	0.00	30.00
1997	TMA	5.10	0.00	0.00	10.40	5.10	0.00	0.00	10.40
1998	Grupo Calidra	12.00	6.00	0.00	10.00	0.00	6.00	0.00	0.00
Total Portfolio:		414.22	81.07	78.74	600.91	288.82	76.92	71.24	553.41

Approvals Pending Commitment

		Loan	Equity	Quasi	Partic
1997	ALTAMIRA	17.80	0.00	1.00	38.00
1997	CHIAPAS FMC	0.00	.02	0.00	0.00
1997	FONDO CHIAPAS	0.00	5.00	0.00	0.00
1998	FORJA QUIMMCO	13.00	3.00	0.00	13.00
1998	HIPOTECARIA EQ	0.00	1.20	0.00	0.00
1998	MERIDA III	30.00	0.00	0.00	90.00
1998	ZN MEX FMC	0.00	.05	0.00	0.00
1998	ZN MXC EQTY FUND	0.00	20.00	0.00	0.00
Total Pending Commitment:		60.80	29.27	1.00	141.00

Annex 10: Mexico at a glance

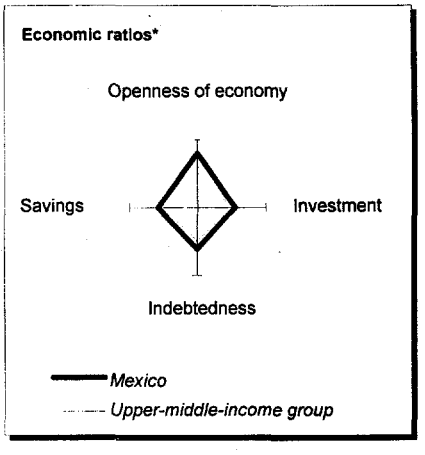
POVERTY and SOCIAL	Mexico	Latin America & Carib.	Upper-middle-income
Population mid-1996 *(millions)*	93.5	485	479
GNP per capita 1996 *(US$)*	3,640	3,710	4,540
GNP 1996 *(billions US$)*	340.2	1,799	2,173
Average annual growth, 1990-96			
Population *(%)*	1.9	1.7	1.5
Labor force *(%)*	2.7	2.3	1.8
Most recent estimate *(latest year available since 1989)*			
Poverty: headcount index *(% of population)*	..	..	..
Urban population *(% of total population)*	75	74	73
Life expectancy at birth *(years)*	72	69	69
Infant mortality *(per 1,000 live births)*	33	37	35
Child malnutrition *(% of children under 5)*	..	..	..
Access to safe water *(% of population)*	87	80	86
Illiteracy *(% of population age 15+)*	10	13	13
Gross primary enrollment *(% of school-age population)*	112	110	107
Male	114	..	..
Female	110	..	..



KEY ECONOMIC RATIOS and LONG-TERM TRENDS

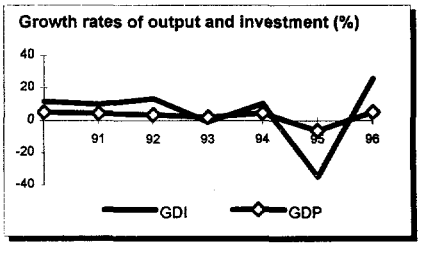
	1975	1985	1995	1996
GDP *(billions US$)*	94.4	183.6	286.3	329.5
Gross domestic investment/GDP	22.3	20.8	19.8	23.3
Exports of goods and services/GDP	5.7	15.5	30.4	32.5
Gross domestic savings/GDP	19.0	25.9	22.5	25.4
Gross national savings/GDP	17.2	22.1	19.2	22.7
Current account balance/GDP	-4.4	0.4	-0.6	-0.6
Interest payments/GDP	1.2	5.1	2.8	2.5
Total debt/GDP	19.3	52.8	58.0	47.7
Total debt service/exports	41.1	47.5	28.1	36.8
Present value of debt/GDP	..	..	55.6	..
Present value of debt/exports	..	..	166.2	..

	1975-85	1986-96	1995	1996	1997-05
(average annual growth)					
GDP	4.6	2.8	-6.2	5.2	5.1
GNP per capita	1.7	0.6	-9.3	3.9	3.2
Exports of goods and services	11.7	9.7	30.2	18.2	7.1

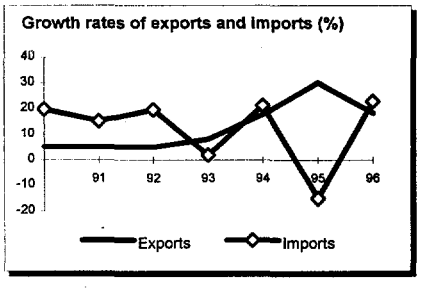


STRUCTURE of the ECONOMY

	1975	1985	1995	1996
(% of GDP)				
Agriculture	10.8	8.7	5.0	5.6
Industry	29.9	33.5	25.5	26.1
Manufacturing	21.9	23.5	19.1	19.8
Services	59.4	57.8	60.9	60.1
Private consumption	71.6	64.8	67.1	64.9
General government consumption	9.3	9.3	10.5	9.7
Imports of goods and services	9.0	10.4	27.8	30.3



	1975-85	1986-96	1995	1996
(average annual growth)				
Agriculture	3.1	1.3	1.8	3.8
Industry	4.7	3.2	-7.8	10.2
Manufacturing	4.1	3.5	-4.9	10.9
Services	4.8	2.9	-6.2	3.3
Private consumption	3.7	3.0	-9.5	2.2
General government consumption	6.3	2.0	-1.3	-0.7
Gross domestic investment	1.7	4.3	-34.8	25.7
Imports of goods and services	2.0	14.4	-15.0	22.8
Gross national product	4.2	2.7	-7.6	5.8

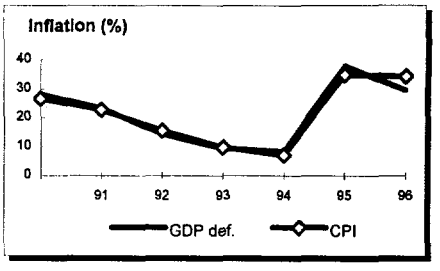


Note: 1996 data are preliminary estimates.

* The diamonds show four key indicators in the country (in bold) compared with its income-group average. If data are missing, the diamond will be incomplete.

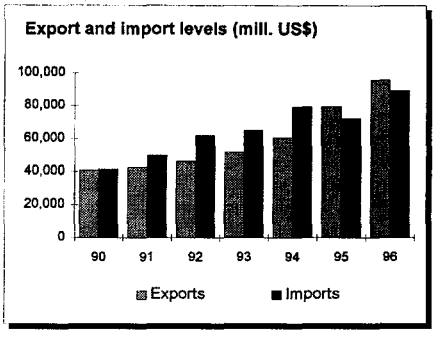
PRICES and GOVERNMENT FINANCE

	1975	1985	1995	1996
Domestic prices				
(% change)				
Consumer prices (period average)	..	57.7	34.9	34.4
Implicit GDP deflator (period average)	15.5	56.5	37.9	29.6
Government finance				
(% of GDP)				
Current revenue	..	32.5	22.8	23.2
Current budget balance	..	-3.7	3.2	3.7
Overall surplus/deficit	..	-8.3	0.0	0.0



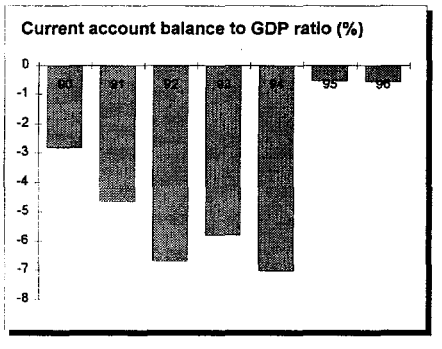
TRADE

	1975	1985	1995	1996
(millions US$)				
Total exports (fob)	..	22,931	79,542	96,000
Fuel	..	14,767	8,423	11,654
Agriculture	..	1,409	4,016	3,592
Manufactures	..	6,245	66,558	80,305
Total imports (cif)	..	14,533	72,453	89,469
Consumer goods	..	1,082	5,335	6,657
Intermediate Manufactures	..	10,287	58,421	71,890
Capital goods	..	3,165	8,697	10,922
Export price index *(1987=100)*	..	115	..	..
Import price index *(1987=100)*	..	99	..	..
Terms of trade *(1987=100)*	..	116	..	..



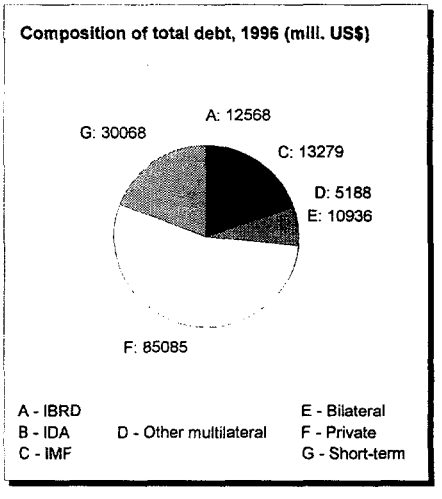
BALANCE of PAYMENTS

	1975	1985	1995	1996
(millions US$)				
Exports of goods and services	6,066	27,726	89,207	106,779
Imports of goods and services	8,466	19,915	81,454	99,700
Resource balance	-2,400	7,810	7,753	7,079
Net factor income	-1,783	-8,998	-13,290	-13,532
Net current transfers	141	1,986	3,960	4,531
Current account balance, before official capital transfers	-4,124	800	-1,577	-1,922
Financing items (net)	4,327	-3,223	11,167	3,690
Changes in net reserves	-204	2,423	-9,591	-1,768
Memo:				
Reserves including gold *(mill. US$)*	0	4,997	16,870	19,456
Conversion rate *(local/US$)*	0.0	0.3	6.4	7.6



EXTERNAL DEBT and RESOURCE FLOWS

	1975	1985	1995	1996
(millions US$)				
Total debt outstanding and disbursed	18,230	96,867	166,104	157,125
IBRD	1,123	4,034	13,823	12,568
IDA	0	0	0	0
Total debt service	2,613	15,293	26,887	40,786
IBRD	116	597	2,372	2,372
IDA	0	0	0	0
Composition of net resource flows				
Official grants	8	78	31	0
Official creditors	381	809	10,334	-7,793
Private creditors	3,365	-831	5,995	12,107
Foreign direct investment	609	491	9,526	8,169
Portfolio equity	0	0	520	2,995
World Bank program				
Commitments	310	928	1,877	617
Disbursements	188	840	1,732	1,051
Principal repayments	39	335	1,411	1,409
Net flows	150	505	321	-359
Interest payments	78	262	964	965
Net transfers	72	243	-643	-1,324



MAP SECTION

This map has been prepared by The World Bank's staff exclusively for the convenience of readers and is exclusively for the internal use of The World Bank Group. The denominations used and the boundaries shown on this map do not imply, on the part of The World Bank Group, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

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