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**TECHNOLOGICAL ADVANCEMENT OF PAKISTAN MACHINE
TOOL FACTORY (PMTF)**

DP/PAK/84/012

PAKISTAN

Terminal report

Prepared for the Government of Pakistan by the United Nations Industrial
Development Organization, acting as executing agency for
the United Nations Development Programme

Based on the work of the Project Management

Backstopping Officer: E. Kok
Engineering and Metallurgical Industries Branch

United Nations Industrial Development Organization
Vienna

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Explanatory notes

This terminal report has been prepared in accordance with the UNDP *Programme and Project Manual of UNDP*, chapter entitled "Project monitoring, reporting and evaluation", document 30605, February 1988. At the time this report was completed (November 1995), the final figures were not yet known, so estimates were made.

The following acronyms have been used:

CAD/CAM	Computer-aided design/computer-aided manufacturing
CNC	Computer-numerical-controlled
CTA	Chief Technical Advisor
ISO	International Organization for Standardization
MIS	Management information system
PMTF	Pakistan Machine Tool Factory
SEC	State Engineering Corporation (Pakistan)
TIC	Technical Information Centre
UCD	UNIDO Country Director

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EXECUTIVE SUMMARY

This report covers the experiences and results of the development project "Technological Advancement of Pakistan Machine Tool Factory (PMTF)", DP/PAK/84/012, financed by the United Nations Development Programme (UNDP) and executed by the United Nations Industrial Development Organization (UNIDO).

Technological and organizational capabilities

PMTF has achieved improved capabilities in various technological and organizational processes as intended. The main achievements are as follows:

- PMTF now contributes to the Government's policy of liberalization and privatization through improved capabilities, the flexibility and efficiency as well as PMTF's effectiveness have increased. For example, the computer-aided design and manufacturing (CAD/CAM) capabilities have cut down development time for complicated products, in some cases to 60 per cent, while product accuracy has increased.
- The project has changed the attitude of all PMTF staff towards issues of continuous improvement and information. This changed attitude is probably one of the best indicators for success of the project and for long-term sustainability. For example, the Technical Information Centre (TIC) has received far more internal requests for information than had been expected, and the trend is growing. Also, the tool design department, on its own, has developed special computer programs to improve its work. The quality and appropriateness of these programs were so high that foreign software companies have expressed an interest in them.

Development acceleration

This project has brought to Pakistan a number of first-time-in-the-country inputs. Without this project, not only PMTF but also the rest of the engineering industry in Pakistan would have lacked some critical technological improvements. For these, PMTF will function as a national point of reference. Two main examples can be cited:

- *ISO 9000 standards for quality assurance in the engineering manufacturing industry.* These standards are becoming increasingly essential not only for the international but also for the national market.
- *Machine tool rebuilding.* Through this operation, older and worn-out machine tools can be brought to the original specification for one third or less of the price of a new investment. This service will be extended at a later stage to the rest of the engineering industry in Pakistan, enabling the industry to improve product quality and finishing at moderate cost.

Sustainability and the multiplier effect

The project carries many indicators for assuring sustainability. Practically all outputs are in full operation and spreading. The need for the outputs over the duration of the project has become more apparent to all concerned. In many cases a multiplier effect is already visible:

- The CAD/CAM facilities originally employed 13 trained staff. After one year of operation, PMTF on its own increased this number to 30, and further training is ongoing.
- For the machine tool rebuilding, a special recruitment programme has started to allocate staff in order to increase capacity.
- Various services are being supplied to outside industries.

Project execution and re-orientation

At one point, the project was subjected to a UNDP-initiated in-depth evaluation. The success of the project shows that the evaluation instrument to adjust the project under changing conditions was properly used. Also, all partners in the project demonstrated flexibility by implementing all recommendations of the evaluation mission. Lessons have been learned on modalities of project implementation and management.

Main data on PMTF

Establishment:	Started in 1968 in collaboration with Orelikon Buhle and Company, Switzerland.
Ownership:	Fully owned by the Government of Pakistan, controlled through the State Engineering Corporation, Ministry of Industries and Production.
Location:	PMTF Road, off National Highway, Karachi-75030, Pakistan.
Factory area:	Total of 177 acres, of which 34 acres are covered.
Range of products:	Transmissions, die casting and machine tools.
Annual turnover:	PRs 500-600 million.
Total assets:	PRs 900 million.
Number of employees:	2,240, including 85 engineers who are university graduates.

Project main data

UNDP input:	US\$ 2,185,991.
Government input:	PRs 3 million.
Duration:	Project document signed on 15 May 1988, project completed on 31 December 1995.
UNIDO experts/consultants:	23, for 80.1 man-months.
Subcontractors:	3, with value of US\$ 645,800.
Training:	180 PMTF staff involved in on-the-job training, 13 fellowships for training and 7 study tours abroad and 1 local in-service training course.
Equipment:	US\$ 118,069.

Outputs

Of the 10 outputs described in the table, 8 were either envisaged at the outset of the project or added at the re-evaluation stage and 2 (outputs 9 and 10) were carried out at the request of PMTF.

Outputs

	No.1: Survey of computerized management information system (MIS)	No.2: Introduction of CAD technique for design of products and tools as well as CAM technique for CNC machining shop	No.3: Capability to develop CNC machine tools by conversion of existing ones with bought-out special components	No.4: Improvement in manufacturing technology	No. 5: Introduction of quality assurance system
Introductory information:	-	-	- A Market Study on Pakistan's Industry for requirements of CNC machine tools and Machining Centres was carried out by a UNIDO consultant and PMTF's concerned staff. It was completed by the end of 1992. The result had shown that the requirements are limited.	Due to the existing level of manufacturing technology, implementation of this output was only on particular request from UNDP.	Certification of a company quality management system facilitates international acceptance of company-held ISO 9000 certificates.
Services to be provided by the output:	- Proposal for computerized MIS - (In the original Project Document the additional establishment of a cost accounting subsystem was foreseen, but it was later agreed that it will be done by PMTF)	Use of CAD/CAM techniques in every day work.	Conversion of standard machine tools to CNC ones.	- Improvement in die-casting operations on the workshop floor level. - Operation of Computerized Measuring Machine. - Improvement in Manufacturing of Spiromatic gears. - Improvement in Heat Treatment Processes.	Assistance to PMTF in introduction of quality management/assurance system.
Activities to produce the output:	- Survey of the existing computerized MIS. - Recommendation for a new or up-dated MIS, its structure and working methods. - Proposal for set-up of hardware and software for new or up-dated MIS. - Implementation plan, complete with proposals and outlines for training programme.	- Preparing Terms of References (TOR). - Choice of sub-contractor. - Delivery of equipment, hardware and software, - 6 month intensive training course for 13 engineers. - Establishment of CAD Product Design Office, CAD Tool Design Office and CAM Machine Shop Office. - Training in CAD/CAM system management. - Gradual use of CAD/CAM techniques in every day work. - Maintenance of CAD/CAM system, hardware and software as well as updating the software.	- Design of conversion. - Procurement of special components. - Manufacture of components, assembly and testing of prototypes. - Two fellowships, with total duration of 12 months.	- On-the-job training - Study the problems - Experiments - Solving the problems - Proposal for further improvements	- Establishment of a permanent Quality Assurance Unit, under working name called "ISO 9000 Cell" - Quality awareness training of PMTF's employees, workers and all level managers - Review of the present quality system. - Selection of ISO 9002 as basic standard for PMTF at this stage. - Instruction, guidance and supervision for preparation of the Quality System Documentation (procedures). - Guidelines for implementation of the system and training of auditors. - Executive management training. - Three fellowships with total duration of 12 months.
Involvement in activities:	- Staff of UNIDO's subcontractor, P-E International Egham, UK - Staff of PMTF, Production Services, Finance and Management.	- UNIDO consultant, - Staff of UNIDO's subcontractor, Computer-Vision Corporation, Bedford, USA and SBS Computers, Karachi, Pakistan, - PMTF's 13 engineers as core staff for CAD/CAM. - PMTF's Deputy General Manager (Engg.) as CAD/CAM System Manager.	- UNIDO to supply special components. - PMTF to design the conversion, manufacture some required additional components, assembly and test the prototype.	- UNIDO consultant - PMTF staff involved, die casting, in computerized measuring, in manufacture of spiromatic gears and in heat treatment	- UNIDO expert (s) - Staff of "ISO 9000 Cell" - Corresponding staff and management from all department of PMTF - Authorized institution for calibration.
Problems encountered:	Nil	Nil	Due to the limited market demand, implementation of this output proceeded slowly and concentrated on milling machine only.	Nil: except in heat treatment where for improvement additional equipment had to be obtained.	Underestimation of time required for introduction of a quality management system ISO 9000.
Present status and result:	- The output has been completed in form of a very well elaborated document. - The management has all the necessary information for a new or up-dated MIS. - Practical results could be expected in the long-run only i.e. after gradual implementation by PMTF of the cost accounting subsystem and later gradually the new or up-dated MIS.	- All activities completed and output very satisfactorily fulfilled. - Expected results i.e. use of CAD/CAM techniques in every day work obtained. - The results are much better than expected. In each office other engineers who have not participated in organized training are being trained and expanding the use of CAD/CAM. For example: In the Tool design office already 70% of new drawings are made by using CAD technique.	- All required actions to produce a prototype of CNC milling machine have been completed, except the testing which is now in process. - Capability to develop converted CNC machine tools exists.	- Output completed - Involved staff trained - 6 fellows completed - Work is proceeding very satisfactorily	- PMTF is determined to introduce ISO 9000 and to obtain certification as an imperative for future existence. - A permanent quality assurance unit is established and successfully working - All foreseen activities of UNIDO project are successfully completed. - Works on quality system documentation are in progress as well as on implementation and auditing of the system. Finalization is expected in mid 1996. Preliminary contacts for calibration measuring equipment are in process.
Sustainability of results:	It will depend on PMTF's policy.	Yes, very much.	Yes, while the used system easily allows development of other engineering products.	Yes, very much.	Yes, very much.
Contribution towards the attainment of the immediate objective:	- At this stage: positive, but partial only in "...managerial advancement..." - In the long run it will depend on implementation by PMTF.	- For this stage and for the long-run: very positive in "... technical, technological and managerial advancement..." improving PMTF's capability to respond to market changes."	For this stage and for the long-run: positive in "... technical, technological advancement for improving PMTF capability to respond to market changes..."	Influence on immediate objective is very positive.	Very positive in all aspects

	No.6 Machine tool rebuilding workshop	No.7: Market analysis unit	No.8: Technical information centre	No. 9: Strategic management and planning	No.10: Human resources development
Introductory information:	Machine tool rebuilding is a new technology introduced in Pakistan.	---	---	The purpose of request was to render assistance in the formulation of a strategy for future development of PMTF.	---
Services to be provided by the output:	To transfer and implement the machine tool rebuilding technology.	In-house capability to undertake market analysis.	Technical information for PMTF concerned staff.	- To assess PMTF's strategic base and analyses the practical consequences of the existing strategy. To hold a seminar/workshop on strategic management and planning. - To elaborate a clear plan of action for the immediate future of PMTF and indicate the organizational consequences.	Original request of PMTF was to design an appropriate training scheme.
Activities to produce the output:	- PMTF - Establishment of a workshop within required facilities. - UNIDO/PMTF - Phase I of technology transfer through on-the-job training on the 1st four selected machine tools. -PMTF - Replacement of parts and components found defective with new ones. - UNIDO/PMTF - Phase II of technology transfer through on-the-job training for the 1st four selected machine tools to be completed and tested. - UNIDO - Studytour for acquaintance with practice of rebuilding technology under different environmental conditions.	- An introductory survey with proposal for PMTF's actions in this field. - Establishment of Market Analysis Unit; and - "On-the-job-training" of PMTF's concerned staff.	- Survey of the existing facilities and their use as well as survey of PMTF's requirements. - Elaboration of up-to-date, partially computerized technical information system and definition of requirements. - Building new premises, installing all necessary facilities and supply of completely new furniture/fixtures. - Procurement of books, periodicals and other information materials. - Procurement and installation of computer hardware and corresponding software - On-the-job-training of TIC staff. - Awareness training courses for PMTF staff. - Establishment of working contacts with other similar institutions in Pakistan and abroad. - Follow-up and corrective measures for effective use of established system.	- Assessment of PMTF's strategic base. - Seminar on strategic management and planning. - To prepare an overview of the integrated objectives of PMTF and its long term goals and prepare a short-term action plan and longer term time-table.	- Study of training needs. - Study of staff development. - Study of management development.
Involvement in activities:	- Team of UNIDO consultants - Team of PMTF staff (engineers and qualified workers) has been reassigned for development of these activities.	- UNIDO consultants - PMTF staff from Sales & Marketing Department	- UNIDO Consultant with total duration of 6.5 months in four split missions. - TIC permanent staff. - PMTF concerned staff and management.	- 2 UNIDO consultants - PMTF management	- UNIDO consultant - Staff of Personnel Division - Top management of PMTF
Problems encountered:	Nil	The implementation of this output started normally but, with progress of work it became clear that positive results hardly could be reached during the life of the project.	- There was no problem with establishment of TIC.	Nil	Nil
Present status and result:	- The Machine Tool Rebuilding Workshop is established, staffed and equipped. - PMTF's actions for extension of the targeted yearly outputs are already in progress. - The first four selected machine tools have been rebuilt and tested with very satisfactory results. - The Workshop's staff are trained and can proceed with work without further assistance. - The study tour is arranged, but will be realized in January 1996.	- The first UNIDO Consultant assigned for two months in split mission had in collaboration with PMTF management completed the introductory survey and proposal for establishment of Market Analysis Unit; - The second UNIDO Consultant was working for one month only for "On-the-job-training" of concerned staff; - The third UNIDO Consultant had one and half months mission and besides the "On-the-job-training," had elaborated a proposal for operating procedure of the Unit. - A "Market study for diversification of PMTF's product-mix" was prepared under UNIDO subcontract with National Management Consultant, Karachi Pakistan. - Due to the problems encountered the system has been elaborated, existing staff basically trained, but the organized permanent activities have not yet started.	- TIC has been completed. The basics of an information system are in place. Fine-tuning will depend on time, practice and pressure from clients. - The use of TIC by PMTF staff is gradually increasing. In spite of that, it is considered important that the top level management be fully involved in continuous effort on development of information culture, because that is the base for technical, technological and managerial advancement of PMTF. - The result is very satisfactory.	Formulation of a strategy for future development of PMTF has been elaborated with the following main topics: - Current strategy - New strategy development - Organizational consequences of the revised business strategy. The assistance has been completed. All further actions are responsibilities of PMTF, SEC and the Government	Conclusion of study was that PMTF's real need is not a training scheme, but an institutionalized human resources development function (which includes, but goes far beyond training). Establishment of institutional human resources development needs: The UNIDO consultant had underlined the needs and proposed advance actions required for introduction of human resources development function. This project had arranged participation on specialized Seminar in Human Resources Development for two executives from PMTF and SEC.
Sustainability of results:	Yes, very much.	Depends on future.	Yes, very much. On the long-run, it is expected even more influence on overall advancement of PMTF.	Depends on PMTF, SEC and Government.	Depends on PMTF, SEC and Government.
Contribution towards the attainment of the immediate objective:	Contribution towards the attainment of the immediate objective: very positive, in all aspects.	Marginal one.	Very positive in all aspects.	Positive	Positive

I. THE PROJECT

A. History of the Pakistan Machine Tool Factory

The Pakistan Machine Tool Factory (PMTF) was established in 1968, in collaboration with Oerlikon Bührle and Company of Switzerland, in order to lay a base for the indigenous manufacture of machine tools and other precision engineering products, thereby supporting the development of the industrial sector. Regular production started in 1971. Under the collaboration agreement, a number of things were accomplished:

- PMTF was equipped with first-rate production and quality assurance facilities, all know-how documentation and a computerized management information system (MIS).
- Thirty-five engineers and professionals of PMTF were trained abroad.
- Fifty Swiss experts worked in the factory for nearly three years, providing assistance and training for management and technical staff.

PMTF is a State enterprise and a subsidiary of the State Engineering Corporation (SEC) of the Ministry of Industries and Production. Located near Landhi Industrial Estate, about 35 km from Karachi, it employs about 280 executives, 1,710 professionals and 250 casual workers, for a total of 2,240 persons. Its annual sales during the past decade are shown in annex I and its major customers are listed in annex II. Employee turnover was rather high in the beginning, particularly among those who were trained and considered to be potential managers. Presently, the turnover is normal, that is, about 5 per cent.

With the passage of time, the market situation changed radically and PMTF could not remain with its original product line. On the one hand, lower quality machine tools, either domestic or imported, were successfully competing with PMTF's high quality, relatively expensive ones, and on the other hand, the growing automotive industry was demanding sophisticated engineering products like gears and axles. These factors have led to the present product mix: machine tools, gears and axles, non-ferrous die-castings and other products (see annex III).

PMTF

When PMTF was established it had – for that time – a comprehensive product mix and very up-to-date facilities and systems. Unfortunately, for various reasons, not enough attention was paid to changing demand patterns or to improved production techniques and technological developments, so progress came to a halt. The problems were in three main areas:

- The relatively large turnover among trained personnel necessitated organizing new training.
- The changing demand pattern required changes in the product mix and the ability to respond quickly.
- Technological progress had made obsolete the production techniques and even the facilities.

Aware of these problems and realizing they needed to be solved, PMTF asked UNDP and UNIDO for technical assistance. The request was accepted and the project (DP/PAK/84/012) was approved. Its explicit aim was "the technical, technological and managerial advancement of PMTF with particular emphasis on improving PMTF's capability to respond to market changes".

B. History of the project

1. Chronology

Some of the project milestones were as follows:

- The project was initiated in 1984.
- The project document was signed on 15 May 1988.
- Implementation started in 1989 with a visit of the National Project Director to UNIDO Headquarters and the arrival of three experts in 1990.
- Owing to the poor performance of the project through mid-1991 (less than 7 per cent of the funds had been disbursed), UNDP ordered its in-depth evaluation.
- The evaluation was performed by International Science and Technology Institute, Inc., of Washington, D.C. Ludwig Rudel (UNDP) was the Team Leader and Stevan Buranj (UNIDO) was the Technical Advisor. The recommendations contained in the evaluation report were accepted by the Government of Pakistan, SEC, PMTF, UNDP and UNIDO, and it was agreed that the project should continue to be implemented.
- The project was restarted in February 1992.
- Official completion date of the project was 31 December 1995.

2. Funding

The UNDP contribution set forth in the original project document was US\$ 1,557,173. On 30 June 1991, in project revision M, the budget was increased by UNDP to cover the cost escalation due to inflation, and the final figure is US\$ 2,185,991.

The Government of Pakistan has contributed PRs 3 million and PMTF is financing all permanent operations.

3. Management

The management roster, past and present, is as follows (annex IV for organigram):

National Project Director

Masood Ahmad Khan
Managing Director, PMTF
(since 29 June 1993)

Fazlur Rahman
Managing Director, PMTF
(September 1991-28 June 1993)

T. A. Khan
General Manager of Engineering, PMTF
(May 1988-August 1991)

Project Coordinator	Qazi Muhammad Aslam Deputy General Manager of Engineering (since September 1991)
Chief Technical Advisor (CTA) (part-time)	Stevan Buranj retired UNIDO CTA/Principal Advisor (since February 1992)

4. Site and premises

The project is situated in PMTF, Landhi, Karachi. In addition to using existing PMTF premises and facilities for its operations, the project required the creation of some new facilities and the adaptation of others:

- The Technical Information Centre (TIC), a completely new building, with new furniture and all related facilities.
- Computer-aided design (CAD) for products, adapted premises with new furniture and facilities.
- CAD tool design, adapted premises with new furniture and facilities.
- Computer-aided manufacturing (CAM) machining shop, adapted premises with facilities.
- CAD/CAM training course, temporarily adapted premises with all the necessary facilities.
- ISO 9000 cell, adapted premises with facilities.
- ISO 9000 training room, adapted premises with all facilities for training.
- Machine tool rebuilding workshop, a closed area in the main workshop hall, completely adapted for this type of work, with an overhead crane, tooling, stores, machine tools and other required infrastructure.

C. Project implementation

The project was implemented in a macroeconomic and political situation that was considerably different from the situation that prevailed when the project was originally defined. Flexibility was therefore necessary if the project was to proceed successfully and achieve its objective. All three parties (PMTF, UNIDO and UNDP) cooperated closely, particularly in substantive matters. UNDP allowed the project to shift allocations between budget lines (but within a budget component) without prior permission from UNDP, whenever the project activities required. This greatly facilitated implementation.

Implementation of the project after the restart was based on a number of prerequisites:

- Well-defined job descriptions.
- Carefully elaborated terms of reference.
- The choice of very competent experts and consultants (annex V).

- Counterparts who were available full-time, as well as support from and involvement of other PMTF staff.
- An adequate work plan with elaborated plans of action.
- Strict follow-up.

The internationally recruited professionals were responsible for planning, advice, guidance and supervision of the activity. They also gave lectures and training courses or prepared the counterparts to do so.

PMTF staff and counterparts were fully involved in activities through an on-the-job training system and/or lectures and training courses. A limited number of counterparts were given specialized training abroad. In the few cases in which UNIDO consultants were called in to conduct studies and submit proposals, the counterparts were responsible for obtaining the necessary information.

1. Professional project personnel

Three international professional personnel were recruited through UNIDO from the beginning of the project until August 1991. After the restart of the project, in February 1992, the number of such personnel was 20. Of these 7 had more than one mission to the project. The return missions were carefully planned according to the activity (TIC, CAD/CAM, ISO 9000, machine tool rebuilding). They proved to be very successful and the cost savings were substantial. All except one of the UNIDO experts and consultants recruited after the restart of the project were highly qualified professionals and adequate for the task. The total input for international project personnel recruited through UNIDO is estimated to be US\$ 996,425 for 79.5 man-months of service.

The subcontractors engaged 3 international professionals for the MIS survey and 12 for CAD/CAM training. They also employed 6 national professionals for CAD/CAM training and maintenance. All the professionals from the subcontractors were highly qualified and adequate for the task.

2. Counterparts and participating personnel at Pakistan Machine Tool Factory

As explained above, the activities of the project were carried out by teams of internationally recruited professionals and PMTF staff. Every international professional (UNIDO expert/consultant or subcontractor consultant) had at least one counterpart. The counterparts, of whom there were 30, were either executives or high-level professionals in their field.

Additional professionals were involved in the work, some directly, others indirectly. PMTF management participated actively in implementing the project by offering introductory courses, holding meetings and suggesting improvements in areas involving PMTF as a whole. More than 180 PMTF staff participated in some way in the project.

3. Subcontracts

The project had four subcontracts:

- Survey for computerized MIS. The subcontractor was P-E International PLC, Egham, United Kingdom of Great Britain and Northern Ireland.

- CAD/CAM techniques for design and manufacture. The subcontractor was Computer-Vision Corporation, Bedford, Massachusetts, United States of America.
- Supply of consultancy services, hardware and software maintenance and delivery of uninterruptible power systems (UPS) and extra manuals for CAD/CAM activities. The subcontractor was SBS Computers, Karachi, the local representative of Computer-Vision Corporation.
- Market study for diversification of the PMTF product mix. The subcontractor was National Management Consultants, Karachi.

All subcontracts except one have been completed. The exception is the CAD/CAM hardware and software maintenance subcontract, which will not be completed until 31 May 1997. The total cost of the subcontracts is estimated to be US\$ 645,802.

4. Fellowships and study tours

The original project document called for 23 persons to be trained on individual fellowships for a total of 138 man-months. After the restart of the project, this scheme was completely revised, with preference being given to on-the-job training by experts/consultants and to short, specialized fellowships. Accordingly, 13 persons were given fellowships for training for a total 44.9 man-months (annex VI). The total cost of individual fellowships is estimated to be US\$ 219,752.

Before the project was restarted in February 1992, there had been two study tours for three people. After that, three study tours for six people were completed. One study tour for three people is expected to have been completed in January 1996. The study tours are listed in annex VII. The total cost of study tours is expected to be US\$ 94,773.

5. Equipment

The project is not equipment-oriented, but for the following outputs equipment had to be provided (see annex VIII).

- TIC
- Machine tool rebuilding project
- Computer-numerical-controlled (CNC) milling machine prototype
- CAD/CAM techniques for design and manufacture.

The equipment for the first three items was supplied by UNIDO and for the last item by the subcontractors. The value of the equipment supplied by the subcontractors is included in the total value of the subcontracts. The value of equipment supplied by UNIDO is expected to be as follows:

- Expendable equipment, estimated at US\$ 39,418
- Non-expendable equipment, estimated at US\$ 88,352.

6. Reports

All UNIDO experts and consultants have prepared their interim and/or final reports. Four UNIDO consultants and two subcontractors were involved in surveys and studies. All these reports, surveys and studies are in the hands of UNIDO Headquarters and PMTF. The most important reports, surveys and studies are listed in annex IX.

D. Monitoring

A detailed work plan was prepared for the restart of the project. It was updated yearly after every mandatory revision, even the simple ones. The work plan was practical and relevant. In addition, action plans were prepared about three times per year. Both kinds of plan were closely followed.

Working visits to the project were made by the following persons:

- UNDP resident representative
- UNDP deputy resident representative
- Chairman of SEC
- Responsible staff of SEC
- Responsible staff from the Ministry of Industries and Production
- UNIDO Country Directors (UCDs)
- Programme Officers from the UNIDO office at Islamabad
- Backstopping Officer from UNIDO Headquarters.

All the working visits were useful: they helped a lot in understanding the problems faced as well as in solving them. The experience shows that a project such as this, implemented in a large and sophisticated engineering factory, should have more working visits from UNIDO Backstopping Officers and Programme Officers.

A project performance and evaluation report was prepared every year in September, and a tripartite review meeting was held regularly every year, as required by UNDP, except in 1994, by which time the project was nearly completed.

II. DEVELOPMENT PROBLEMS AND IMMEDIATE PROBLEMS

A. Development problems

At the outset of the project, Pakistan's Sixth Five-Year Plan (1983-1988) was under way. That Plan placed emphasis, for the manufacturing sector, on improvement in management skills and absorption of technology. High priority was given to the steel-based engineering industry, so as to achieve savings on imported machinery, equipment and expertise and promote the export of manufactured (i.e. engineering) goods.

UNDP supported these aims. Its Fourth Country Programme for Pakistan (1988-1991) targeted UNDP assistance to "... improve the effectiveness of the utilization of development resources ..." and focused the programme in four areas. One of these areas was "strengthening development institutions which provide the essential infrastructure for large development programmes". PMTF was a good example of such an institution.

In the course of the project, the development problems of the engineering industry, of which PMTF was a part, not only did not let up but became even more serious and more difficult. This was due to the changed macroeconomic environment brought about by the Government's decision to liberalize and deregulate. Private competition had been growing, and the market was liberalized and even opened to international competition. It should be noted that in its Fifth Country Programme for Pakistan (1993-1998), UNDP assistance is focused mostly in the social sector.

B. Immediate problems

The immediate objective of the project, stipulated in the original project document, was as follows: "the technical, technological and managerial advancement of PMTF with particular emphasis on improving PMTF's capability to respond to market changes." This was a correct objective and a realistic one, and it remained unchanged throughout the project.

A number of problems were faced at the start of implementation. These fell into four categories:

- Because PMTF was so large in comparison with the limited scope and financial resources of the project, some of the outputs and activities originally selected turned out to be unrealistic or not measurable.
- Project management had a less-than-adequate approach to implementation: the job descriptions were imprecise, there was no operational work plan and the procedure for clearing experts/consultants took a long time.
- A project such as this, where the recipient institution's technical sophistication is greater than is normally found in developing countries, requires highly specialized experts, and adequate funds must be reserved to pay the going rates for these specialists. Such, however, was not the case.
- There should have been, as well, flexibility to cope with changes in the environment. Again, this was not the case at first.

Owing to the problems referred to above, implementation of the project had been marginal for the first three years, when only 7 per cent of the project budget was disbursed or committed. In mid-1991, therefore, UNDP ordered an in-depth evaluation, which resulted in the following changes:

- Redesign of activity areas/outputs, keeping the same objectives.
- New managerial approach for implementation of the project.
- Permission to engage highly qualified (and correspondingly well-paid) experts and consultants as well as to contract high-level subcontractors.
- Introduction of limited but sufficient flexibility in implementation.

This UNDP intervention led to the successful completion of the project in December 1995.

During the lifetime of the project, several changes in technology, in government economic policy and in market conditions occurred. These changes, which can be summarized as follows, all influenced implementation of the project:

- Rapid development of technology in the engineering industry all over the world, particularly with respect to the use of computer techniques, flexibility of production, use of standards and standardized elements, use of new materials and new processes, high quality operations and reduced production costs.
- The worldwide trend to greater productivity and better utilization of capacities in the engineering industry by means of automated processes using sophisticated CNC machines and machining centres and by introducing technology for machine tools rebuilding.
- The introduction everywhere in the world of ISO 9000 standards for engineering products.
- The introduction of a free market economy in Pakistan.
- A growing number of private engineering firms in Pakistan with more up-to-date technology, leading to severe competition in the local market.
- Frequent changes in government financial policy for the mechanization of agriculture, indirectly influencing PMTF's production of gears and axles.
- The Government's declared privatization policy, which has meant long-standing uncertainty for PMTF.
- The increase in the project budget in June 1991 to US\$ 2,185,991 to account for cost escalation, which thereafter, however, remained unchanged in spite of further cost escalation.

C. Effects of the changed environment

Before describing the effects it should be noted that, given these changing conditions, it was essential to have a reasonable degree of flexibility for implementing the project. It became necessary to introduce a more sophisticated than originally planned CAD technique for the design of products and tools, a CAM technique for the CNC machining shop and a comprehensive training scheme for the core engineering staff. The project had to introduce these improvements to obtain better and longer lasting results.

A properly functioning technical information centre was a key factor in the technical and technological advancement of PMTF. Staff needed to be able to obtain all the information they

required and to keep informed about technical and technological developments. The project had to provide all the facilities, and owing to long years of neglect, PMTF management had before it the difficult task of properly managing the centre. This output was introduced at the re-evaluation stage.

Quality assurance through ISO 9000 standards and consequent certification is becoming an unavoidable requirement for the sale of products. The project had to take that fact into consideration and to arrange long-term technical assistance. However, owing to volume and complexity, the quality control work will not be completed during the life of the project, and PMTF has to arrange for it to be carried on until it can be completed, which may be expected during 1996 or early 1997. This is also a new output.

PMTF had to re-consider the idea of developing a sophisticated CNC machine tool. There were two main reasons for this:

- The technique has been already highly developed, the gap in technology is too wide and it is a very costly process.
- The present demand for it by Pakistan industry is very limited.

One possibility would be to convert a conventional machine tool from PMTF regular production to a simple CNC machine tool using bought-in special hydraulic and electronic devices. It is not known, however, if the market will need and accept such a converted CNC machine. Anything beyond the conversion of conventional machine tools could be done in financial and technical collaboration with a reputable foreign firm. This possibility is being explored.

PMTF had to abandon the idea of establishing a maintenance workshop for the hydraulic and electronic devices of CNC machine tools as it was not necessary. Only a small maintenance shop for operating CNC machines is needed. An electronic laboratory is being established in collaboration with the local electronic institute.

It was technically and economically imperative for PMTF to introduce a machine rebuilding workshop. Machine rebuilding technology has developed rapidly and become widespread in the last decade. The main features of this technology are as follows:

- A rebuilt machine is guaranteed to perform like a new one.
- The cost of rebuilding is at most only about one third of the cost of a new machine.

This technology has not yet been introduced in Pakistan. PMTF has over 900 machines, more than 70 per cent of which are over 20 years old. It will be the first organization to bring this technology into the country. This is a new output.

The immediate objective is to ensure that PMTF will be able to respond to the market demand, but just what the demand is is not obvious. PMTF needs in-house capability to do market analysis so it can determine its optimum product mix and define a strategy for increasing market share. The project had to provide assistance to enhance this capability.

It was considered important for PMTF to have in place an effective MIS, and as first step a more precise cost accounting system. The existing MIS, introduced in early 1971, was outdated, so the project envisaged a modest amount of financial assistance for a survey of a computerized MIS and, in connection with this, the establishment of a cost accounting system. The survey, which was

completed in November 1992, absorbed nearly all the budgeted funds. Since the actual establishment of a cost accounting system would have cost approximately US\$ 400,000, which was far beyond what the project could afford, it was decided at the tripartite review meeting in November 1993 that PMTF would proceed on its own with that activity in due time.

In view of the overall changes from the outset of the project, particularly the free economy, the need for a strategy for market share expansion and the Government's declared policy of privatization, the project, at the request of PMTF management, rendered limited assistance in strategic management and planning and in human resources development.

Owing to the existing level of manufacturing technology on the workshop floor as well as to the limited project budget, it was decided that technical assistance for improvement in manufacturing technology would be rendered only at the special request of PMTF.

D. Final outputs of the project

The projects had 10 outputs, the last 2 of which were requested by PMTF:

<i>Output</i>	<i>Description</i>
1	Survey for a computerized management information system (MIS)
2	Introduction of CAD techniques for the design of products and tools as well as CAM techniques for CNC machining shop
3	Capability for developing CNC machine tools by converting existing machine tools using bought-in special components
4	Improvements in manufacturing technology
5	Introduction of a quality assurance system
6	Machine tool rebuilding workshop
7	Market analysis unit
8	Technical Information Centre
9	Strategic management and planning
10	Human resources development

All of these outputs are described in detail in chapter III.

III. OUTPUTS AND ASSOCIATED PROBLEMS

A. Output 1. Survey for a computerized management information system

The output had two components. The first was a proposal for a computerized MIS. The second was the establishment of a cost accounting subsystem; it was later agreed that this would be done by PMTF. The activities to produce the output were as follows:

- Survey of the existing computerized MIS.
- Recommended structure and working methods for a new or updated MIS.
- Proposal for setting up hardware and software for the new MIS.
- Implementation plan, complete with an outline for a training programme.

The staff of the UNIDO subcontractor P-E International and the staff of PMTF (production services, finance and management) were involved in these activities. No problems were encountered. The present status and results are as follows:

- The output has been completed and exists in the form of a well-elaborated document.
- The management has all the information it needs to set up a new MIS or to update the existing one.
- Practical results may be expected in the long run only, that is, after gradual implementation by PMTF of the cost accounting subsystem and, later, the new or updated MIS.

Whether or not the results are sustainable will depend on PMTF policy. The contribution towards the attainment of the immediate objective has so far been positive, although the "managerial advancement" portion of the objective has been only partially attained. In the long run, the contribution will depend on implementation by PMTF.

B. Output 2. Introduction of computer-aided design techniques for the design of products and tools as well as computer-aided manufacturing techniques for the computer-numerical-control machining shop

The output was the use of CAD/CAM techniques in everyday work. The activities to produce the output were as follows:

- Preparing terms of references.
- Choice of subcontractor.
- Delivery of equipment, hardware and software.
- A six-month intensive training course for 13 engineers.
- Establishment of a CAD product design office, a CAD tool design office and a CAM machine shop office.

- Training in CAD/CAM system management.
- Gradual use of CAD/CAM techniques in everyday work.
- Maintenance of the CAD/CAM hardware and software as well as updating of the software.

A number of people were involved in the activities: the UNIDO consultant; staff of the UNIDO subcontractors Computer-Vision Corporation and SBS Computers; 13 PMTF engineers, who served as core staff for CAD/CAM; and the PMTF Deputy General Manager of Engineering, who served as CAD/CAM System Manager. No problems were encountered. The present status and results are as follows:

- All activities were completed and the output was very satisfactory.
- The expected result, i.e. the use of CAD/CAM techniques in everyday work, was achieved.
- The result is much better than expected. In each office engineers who did not participate in organized training are being trained and the use of CAD/CAM is expanding. For example, in the tool design office, 70 per cent of new drawings are made using CAD techniques.

The result is expected to be very sustainable. At this stage (and in long run) the contribution to the achievement of the goal "technical, technological and managerial advancement [for] improving PMTF's capability to respond to market changes" has been very positive, and it is expected to continue to be positive.

C. Output 3. Capability for developing computer-numerical-controlled machine tools by converting existing ones using bought-in special components

A study of industrial demand in Pakistan for CNC machine tools and machining centres carried out by a UNIDO consultant and PMTF staff was completed by the end of 1992. It showed that such demand was limited. The output involved the conversion of standard machine tools to CNC ones. The activities to produce the output were as follows:

- Design of the conversion.
- Procurement of special components.
- Manufacture of components and assembly and testing of prototypes.
- Two fellowships, with a total duration of 12 months.

UNIDO supplied the special components and PMTF designed the conversion, manufactured some additional components and assembled and tested the prototype. Because of limited market demand, implementation of this output proceeded slowly and concentrated on milling machinery. The present status and results are as follows:

- All actions needed to produce a prototype of a CNC milling machine have been completed except the testing, which is now in progress.
- The capability to develop converted CNC machine tools exists.

The results of the output are sustainable and the system easily allows development of other engineering products. At this stage, the contribution to the objective "technical, technological advancement [for] improving PMTF's capability to respond to market changes" is positive and is expected to continue so.

D. Output 4. Improvement in manufacturing technology

Because the existing level of manufacturing technology was generally high, this output was implemented only in particular areas, at the request of PMTF. Overall, the output was completed and staff were trained. The results were satisfactory and lasting, except for improvements to heat treatment, which would have required new investment. Six fellowships, with a total duration of 14.9 months, have been completed. The influence on the immediate objective "technological advancement" was very positive. The exercise was very cost-effective and in the long run will be even more so.

1. Improvement in die-casting operations on the workshop floor

There were problems in several areas: the composition of alloys, the high percentage of scrap, the variable quality of the products, the quality of dies, the breakdown of die-casting machines and the handling of cast parts. All these problems were tackled and either have been solved or solutions have been proposed. All PMTF personnel involved in die-casting, from die designers to shop floor workers, were instructed and practically trained. The result has been very satisfactory and is expected to be even better in the long run.

2. Operation of the computerized measuring machine

This output was introduced to bring the engineers up to date on the correct use of the machine as well as to instruct them in the use of the additional accessories and instruments that would eventually be required. On-the-job training was performed and instructions were given. The result has been very satisfactory and is expected to be lasting.

3. Improvement in the manufacturing of Spiromatic gears

Owing to a manufacturing error, over 2,000 Spiromatic gears were not accepted by a customer. The cause of the error, which was not known at the time, has now been determined and eliminated. Instructions were given for proper maintenance as well as for the repair of the 2,000 gears. The result was very satisfactory and lasting and has resulted in a big cost saving.

4. Improvement in the heat treatment processes

The output was introduced to study the possibility of increasing productivity and introducing more up-to-date processes. Studies were made and experiments successfully completed, but no measurable improvements could be obtained without further investment. The work discipline in following the prescribed heat treatment process was improved. A comprehensive report has been prepared.

E. Output 5. Introduction of a quality assurance system

1. Background

The ISO 9000 series of quality management standards provides criteria and guidelines for establishing systems that will ensure consistent quality in both manufacturing and service activities. To demonstrate compliance with the standards, a company's quality management system must be assessed and certified (or registered) by an independent certification body, either domestic or international. Such certification (or registration) facilitates the international acceptance of company-held ISO 9000 certificates and promotes international links. Over 90 developed countries have now accepted the ISO 9000 series as the model for their own national standards for quality management, and this trend is spreading.

There are six steps in the establishment of a company quality management system:

- Awareness, understanding and training
- Review of present system
- Selection of standard
- Quality system documentation (instructions, preparation and development of procedures)
- Implementation of the system
- Certification.

The project was not involved in certification. That was left for a later stage, when PMTF would apply to an internationally authorized institution or company. It was partially involved in implementation of the system (guidelines and training of auditors). The main tasks of implementation and auditing were the duty of PMTF staff and management. Implementation also covered control of inspection, measuring and test equipment, which included the obligatory calibration of measuring tools by an authorized institution. The project was also partially involved in quality system documentation but only to the extent of providing instructions, guidance and supervision. The quality system documentation itself had to be prepared by PMTF staff and management.

2. The project

The output entailed assistance to PMTF in introducing a quality management/assurance system. The activities to produce this output were as follows:

- Establishment of a permanent quality assurance unit, to be called the ISO 9000 cell.
- Quality awareness training for PMTF employees, workers and managers.
- Review of the present quality system.
- Selection of ISO 9002 as basic standard for PMTF at this stage.
- Instruction, guidance and supervision in preparing the quality system documentation (procedures).

- Guidelines for implementing the system and training auditors.
- Executive management training.
- Three fellowships with a total duration of 12 months.

Three additional activities were to be carried out by PMTF:

- Preparation and development of procedures, i.e. the quality system documentation.
- Implementation and auditing of the system.
- Calibration of measuring tools and measuring equipment.

Those involved in the activities included: UNIDO experts, the staff of the ISO 9000 cell, relevant staff and management from all departments of PMTF, and an authorized institution for calibration.

A few problems were encountered, two of which had been envisaged:

- It took considerable time to gain a clear understanding of quality assurance system ISO 9000 and, particularly, the volume of work involved.
- The UNIDO expert had to be replaced, owing to illness. The time gap between the two UNIDO experts was 11 months, which delayed the project.
- There is no authorized institution for calibration in Pakistan. A foreign institution needs to be contacted by PMTF.

The present status and results of this output are as follows:

- PMTF is determined to introduce a quality management system and to obtain certification (or registration), which is essential for future success.
- A permanent quality assurance unit, with the working name ISO 9000 cell, has been established and is operating successfully.
- All the foreseen activities of the project have been successfully completed.
- Work on quality system documentation (procedures) as well as on implementation and auditing of the system is in progress. The work is expected to finish in mid-1996.
- Preliminary contacts for calibration measuring tools and measuring equipment have been made.

The result is considered to be very sustainable, and the output is expected to contribute to the attainment of the immediate objective.

3. Remarks

The time required for introducing a quality management system is commonly underestimated, even in developed countries, so some delay should be tolerated, as long as the work is proceeding. Moreover, certification can be requested only once implementation has been completed.

F. Output 6. Machine tool rebuilding workshop

1. Background

Machine tool rebuilding is a comparatively new technology in the industrially developed world, but it is already widespread. It should not be confused with machine tool maintenance, repair or overhaul. The main characteristics of machine tool rebuilding are as follows:

- The rebuilt machine has the same performance and accuracy as a new one.
- The warranty period is the same as for a new one.
- The cost of rebuilding is no more than one third the cost of an equivalent new machine.

Beyond doubt, machine tool rebuilding is an excellent and cost-saving new technology for PMTF and Pakistan.

2. The project

To transfer and implement this technology, a study was initiated in October 1993 and completed in January 1994. A decision was made to establish a machine tool rebuilding workshop under the following conditions:

- Transfer of technology would be in form of on-the job training, i.e. rebuilding four selected machine tools representing the major machine groups.
- The project would provide a team of UNIDO consultants for 30 weeks in split missions.
- PMTF would provide all the facilities for an independent specialized workshop.
- The time-frame for rebuilding the first four machine tools would be between 18 and 24 months.
- The starting target output would be 10-12 machines per year, with a gradual increase foreseen.

Several activities were involved in this output:

- PMTF established a workshop with the required facilities.
- UNIDO/PMTF jointly conducted phase I of the technology transfer through on-the-job training for the first four machine tools and supervision only for the second batch of four tools.
- PMTF replaced defective parts and components with new ones, bought-in or produced at PMTF, and supplied equipment for the workshop (an ongoing activity until the workshop is approximately 80 per cent equipped).

- UNIDO/PMTF jointly conducted phase II of the technology transfer through on-the-job training for the first four machine tools to be completed and tested.
- UNIDO sponsored a study tour to acquaint a trainee with rebuilding practices under different environmental conditions.

The present status of the output and its results are as follows:

- The machine tool rebuilding workshop has been established, staffed and equipped.
- PMTF is acting to increase the yearly output.
- The first four machine tools have been rebuilt and tested, with very satisfactory results.
- The workshop staff have been trained and can work without further assistance.
- The study tour is expected to have taken place in January 1996.

With the introduction of this new technology several problems arose (choice of staff and qualifications of the workers, the selection and purchase of additional equipment, the procurement of new inventory and tools, the replacement of defective parts etc.) but PMTF management was determined to proceed, and it succeeded. The project helped wherever possible.

The result was thought to be highly sustainable. PMTF has a large number of its own machine tools for rebuilding, as well as outside requests for this. Moreover, the activity is very cost-effective and could easily become an attractive part of the future product mix. It is considered to have contributed to the attainment of the immediate objective.

G. Output 7. Market analysis unit

The output was intended to provide an in-house capability for market analysis. The activities needed to produce the output were as follows:

- An introductory survey with a proposal for PMTF actions.
- Establishment of a market analysis unit.
- On-the-job training for participating PMTF staff. UNIDO consultants and staff from the PMTF sales and marketing department were involved.

The following activities were carried out:

- The first UNIDO consultant, who was assigned for two months in a split mission, completed, in collaboration with PMTF management, the introductory survey and proposal for a market analysis unit.
- The second UNIDO consultant worked for one month only, conducting on-the-job training.
- The third UNIDO consultant had a 1.5-month mission and, besides on-the-job training, elaborated a proposed operating procedure for the unit.

- A market study for the diversification of the PMTF product mix was prepared under a UNIDO subcontract with National Management Consultants.

The implementation of this output started normally, but as work progressed it became clear that no positive results could be achieved during the life of the project, for a number of reasons:

- PMTF is a State enterprise, and it has to fulfil several obligations, among them development and social obligations.
- PMTF needs a strategy for future development policy, including a resolution of the long-standing question of privatization.
- It is not certain whether PMTF products can be sold in the free market.
- PMTF enjoys a high quality of engineering, but does not have enough economists employed in the unit.

As a result of all these problems, this output became a marginal one. The system has been elaborated and the staff employed at that time were basically trained. Organized activity has yet to start. The contribution to the attainment of the immediate objective was only marginal.

H. Output 8. Technical Information Centre

The output involved providing access to technical information for participating PMTF staff. A number of activities were carried out:

- Survey of the existing facilities and their use, as well as a survey of PMTF requirements.
- Elaboration of an up-to-date, partially computerized technical information system and definition of requirements.
- Building new premises, installing the necessary facilities and supplying new furniture and fixtures.
- Procurement of books, periodicals and other information materials.
- Procurement and installation of computer hardware and software for it.
- On-the-job training for TIC staff.
- Awareness training for PMTF staff.
- Establishment of working contacts with similar institutions in Pakistan and abroad.
- Follow-up and corrective measures to make TIC more effective.

The people involved in the activities included a UNIDO consultant (total duration of 6.5 months, in four split missions), permanent staff of the centre and participating PMTF staff and management.

There was no problem with the establishment of TIC. It had been expected that PMTF staff might not use the services, but they quickly realized the importance of this facility and 1,048 queries were dealt with during the first 18 months (see annex X for data over a two-year period).

TIC has been completed and the basics of an information system are in place. Fine-tuning will depend on time, practice and pressure from clients. Despite the fact that the use of TIC by PMTF staff is gradually increasing, it is considered important for top management to be fully involved in a continuous effort to promote an information culture, because that is the base for the technical, technological and managerial advancement of PMTF. All in all, results have been very satisfactory and are expected not only to be sustainable but also to have, in the long run, even more influence on the advancement of PMTF. The output has contributed positively to the attainment of the immediate objective.

I. Output 9. Strategic management and planning (requested by Pakistan Machine Tool Factory)

The request was for assistance in formulating a development strategy for PMTF markets, products, manpower and equipment using information available from PMTF and/or gathered by the project, especially the reports on MIS.

The main terms of reference for this assistance were as follows:

- To assess the strategic base of PMTF and analyse the practical consequences of the existing strategy.
- To hold a seminar/workshop on strategic management and planning for high-level management tailored to meet the needs of PMTF.
- To elaborate a clear plan of action for the immediate future of PMTF, giving due consideration to the elements of strengths-weaknesses-opportunities-threats (SWOT).
- To indicate the organizational consequences of the plan and propose alternative solutions.
- To prepare an overview of the integrated objectives of PMTF and its long-term goals and prepare a short-term action plan and a longer term timetable.

The two UNIDO consultants were M. El-Namaki, who was active at the start of the output, and B. Cox, who rendered this assistance in full.

With the collaboration of PMTF top management, a strategy for the future development of PMTF was elaborated. The main topics were as follows:

- Current strategy
- New strategy development
- Organizational consequences of the revised business strategy.

The assistance has been completed. All further action is the responsibility of PMTF, SEC and the Government. The contribution to the attainment of the immediate objective "managerial advancement" was considered to be positive.

J. Output 10. Human resources development (requested by the Pakistan Machine Tool Factory)

During implementation of the project, there was a need for assessing and identifying the training needs of PMTF personnel and designing an appropriate training scheme, and a request was made to help meet this need. James Dee was the UNIDO consultant for this assignment, which was completed by the end of May 1993. It was concluded that the real need was not a training scheme but an institutionalized human resources development function, which includes, but goes far beyond, training.

The conclusion was not a surprise. It is not, however, implementable partly because the regulations for an institutionalized human resources function should be common for all public sector engineering industries so they would have to be arranged and supervised by SEC. The UNIDO consultant nonetheless proposed some actions in advance of introducing a human resources development function:

- Specialized seminars for executive managers.
- Specialized training courses for future managers in human resources development.
- Setting up a small specialized unit under the Managing Director.
- Development of the unit into a division that would cover all functions of human resources development.

The project arranged for two executives from PMTF and SEC to participate in a seminar on human resources development. All further action is the responsibility of PMTF and SEC. The assignment contributed to attainment of the immediate objective "managerial advancement".

IV. PROJECT RESULTS

A. Outputs

The outputs contained in the latest version of the project document were listed in chapter II. D and elaborated in chapter III. The activities to produce the outputs were completed, except for the output involving the introduction of a quality assurance system, which will be completed by PMTF by mid-1996. All outputs have achieved their targets (the output on quality assurance is expected to achieve it) except one, the output involving a market analysis unit.

B. Immediate objective

The immediate objective of the project remained as stated in the original project document:

"Immediate objective of the project is technical, technological and managerial advancement of the PMTF with particular emphasis on improving PMTF's capability to respond to market changes."

Chapter III described the components of the outputs and the results obtained as well as the sustainability of those results and the contribution of the output towards attainment of the immediate objective. As all outputs except one contributed towards attaining the immediate objective, although the degree of that contribution varied, it should be concluded that the project as a whole achieved its immediate objective.

C. Development objectives

According to the original project document, the development objectives were as follows:

- To realize savings on imported machinery, equipment and expertise.
- To promote the export of manufactured goods in general and of engineering goods in particular.
- To promote domestic manufacture of vehicles and vehicle parts.

The development objectives continue to be valid, despite government policy having shifted towards reliance on private sector and market forces, which caused changes to be introduced during the life of the project.

As mentioned above, the project fulfilled its immediate objective by achieving positive results in most of the outputs. Since some of those outputs are directly connected with the achievement of the development objective and the others are indirectly connected, it can be said that the project has made an important contribution to the achievement of the development objective.

D. Sustainability

All outputs of the project were produced with the full involvement of the participating staff at PMTF. Moreover, two new activities were arranged and organized as permanent activities of PMTF. For example, for staff that received training under the project, special contractual arrangements were made to keep them in the factory. Other indicators of the sustainability are elaborated in chapter V.C, "Achievements".

E. Beneficiaries of results

PMTF is the direct beneficiary of the project results. Industries producing tractors, motorcycles, vehicles, gas meters, machine tools, capital equipment, textile machinery etc. are the indirect beneficiaries of the project, which could benefit them in different ways. The most common would be the regular supply of products with a reliable level of quality. Also, PMTF would be enabled to respond quickly to changing market demand.

PMTF management is convinced that some of the experience and results of the project should be shared with other engineering industries, which face the same or similar problems. For this purpose, PMTF and the project will produce a video film on project activities and results. The film is for information purposes, and if another engineering industry finds in it something of interest, it can approach PMTF management for detailed information or even collaboration. In the areas of technical information and quality assurance/ISO 9000, contacts have already been established with some partners in Pakistan.

F. Follow-up

The project is responsible until 31 May 1997 for maintaining the CAD/CAM system hardware and software and for upgrading software. All arrangements for this have been finalized, with PMTF being responsible for supervising the implementation. No other follow-up actions are envisaged.

G. Summary

The following outputs were completed with very positive results and an immediate impact on PMTF:

- Output 2. Introduction of CAD techniques for the design of products and tools as well as CAM techniques for the CNC machining shop
- Output 4. Improvement in manufacturing technology
- Output 6. Machine tool rebuilding workshop
- Output 8. Technical Information Centre.

The following output was completed and the result was expected to be positive (this output is imperative for PMTF's future):

- Output 5. Introduction of a quality assurance system.

The following output was completed and the technical result was positive. The financial impact will depend on market acceptance of the improved product:

- Output 3. Capability for producing CNC machine tools by converting existing ones with bought-in special components.

The following outputs were completed and had positive results and clear recommendations, but the impact will depend on the policies of PMTF, SEC and the Government:

- Output 1. Survey for a computerized MIS

- Output 9. Strategic management and planning
- Output 10. Human resources development.

For information purposes only, it should be mentioned that the total input for this output was US\$ 286,528, or 13.1 per cent of the project budget.

The following output has not yet been implemented owing to circumstances that were explained above, and the impact is only marginal:

- Output 7. Market analysis unit.

For information purposes only, it should be mentioned that the total input for this output was US\$ 100,690, or 4.6 per cent of the project budget.

This summary shows that PMTF has been improved technologically, the financial contribution of UNDP was in general very well spent, the overall results are very satisfactory and the project can be said to have been successful.

V. FINDINGS AND LESSONS LEARNED

A. Findings

During its first three years, the project utilized only 7 per cent of the project budget. None of the project's target outputs were achieved, although the basic conditions for continuation of the project (redesign of outputs, new training scheme, restudy of equipment and introduction of a new managerial approach) had been fulfilled by PMTF and UNIDO. Then, an in-depth evaluation ordered by UNDP recommended changes in implementation policy and approach. These recommendations were accepted by all the parties, and the project restarted in February 1992 and was completed in December 1995. It should be emphasized that the in-depth evaluation exercise, including the recommendations and subsequent actions, had a decisive impact on the successful implementation and completion of the project.

Following the recommendations of the in-depth evaluation, the management of the project was changed. Until then, the National Project Director had been the General Manager of the Engineering Division. After the change and until the project's completion, the management of the project comprised the PMTF Managing Director as National Project Director and Coordinator, assisted by an internationally recruited part-time Chief Technical Advisor. This change resulted in effective implementation of the project as well as excellent collaboration among all parties concerned.

Only three UNIDO experts/consultants were working on the project during the first three years. After the restart, until completion, UNIDO introduced a flexible recruitment and (to some extent) payment policy, which allowed the assignment of 20 highly experienced specialists. Fifteen consultants from the subcontractors were also assigned to the project. All these experts/consultants contributed significantly to the success of the project.

The project helped PMTF to accept the idea that continuous improvement was imperative for the company's future. In addition to these qualitative changes, there have been technical changes as well: CAD/CAM techniques, introduction of ISO 9000 standards and improvements in the manufacturing field. Moreover, a very cost-effective machine tool rebuilding technology has been transferred and installed.

The project results are comprehensive and they have already led to better design, an improved process, quality awareness etc. It is a long-term effort that will have a lasting impact. The economic benefits of the project cannot be measured properly at this stage, but they will come with time, through higher productivity, reliable quality, improved processes, more effective organization and the introduction of new or converted products. An exception is the machine tool rebuilding activity, where the economic benefit can be immediately measured.

The activities of all outputs have been incorporated into the regular organizational structure of PMTF, which means that the activities are now used in normal daily work. The future role will involve fine tuning and dissemination.

Since the main customers of PMTF are private companies, that sector has generally been an indirect beneficiary of the project. However, in some areas, such as machine tool rebuilding, technical information, quality assurance, it is also a direct beneficiary.

The eventual privatization of PMTF will have no effect on the project results, as long as the factory continues to operate. Technical advancement is equally important for both sectors, public and private.

PMTF needs to improve its marketing strategy to increase profitability, determine its optimum product mix and define a strategy for market share expansion, all of which are, however, connected with PMTF, SEC and government policies. In this area the project would either assist the management with information or technically participate in implementation of the same.

B. Lessons learned

Projects such as this one, where the recipient institution's level of technical sophistication is higher than normally found in developing countries, requires highly specialized experts. In such a case, it is imperative that adequate budgetary resources and authority to make exceptions be provided so as to be able to pay for the services of such specialists. The management of such projects is more labour-intensive for the implementing agency, and resources must be provided to meet the direct management costs.

Greater care must be exercised in the preparation of project implementing documents, to avoid misunderstandings between the recipient institution and the implementing agency. The work plan must contain detailed information, the job descriptions for recruitment of experts must be realistic and precise, and when conditions are changing, the implementing documents should be changed to reflect this.

In today's changing economic and social environment and given the rapidity of technical developments, flexibility should be an integral part of the project design for projects of longer duration.

C. Achievements

Technological and organizational capabilities

PMTF has achieved improved capabilities in various technological and organizational processes, as intended. It now contributes to the Government's policy of liberalization and privatization through these improved capabilities, with flexibility, efficiency and effectiveness all having increased. The CAD and CAM capabilities have cut down the time needed to develop complicated products, in some cases to 60 per cent, while increasing product precision and reliability.

The project has changed the attitude of PMTF staff towards issues of continuous improvement and information. This changed attitude is probably one of the best indicators for the success of the project and for long-term sustainability. The TIC, for example, has received a far greater number of internal requests for information than had been expected, and this number is growing. Also, the tool design department has developed, on its own, computer programs that improve its work. The quality and appropriateness of these programs were so great that foreign software companies have expressed an interest in them.

Development acceleration

This project has introduced into Pakistan a number of inputs. Without this project, PMTF as well as the rest of the country's engineering industry would have been without some critical technological improvements. For these, PMTF will function as a national point of reference. Two main examples can be cited:

- ISO 9000 standards for quality assurance in the engineering manufacturing industry. These standards are becoming increasingly essential not only for the international but also for the national market.

- Through machine tool rebuilding older and worn-out machine tools can be brought back to original specifications for one third or less of the price of a new investment. This service will be extended at a later stage to the rest of the engineering industry in Pakistan, enabling the industry to improve product quality and finishing at moderate cost.

Sustainability and multiplier effect

There are many signs that the project is sustainable. Practically all outputs are in full operation and spreading. In the course of the project, the need for the outputs became even more apparent for all concerned. In many cases a multiplier effect is already noticeable:

- The CAD/CAM facilities started with 13 trained staff. After one year of operation, PMTF increased this number to 30, and further training is ongoing.
- For the machine tool rebuilding, a recruitment programme is under way so that capacity can be increased.
- Various services to outside industries are currently supplied.

Project execution and re-orientation

At one point, the project was subjected to a UNDP-initiated in-depth evaluation. The success of the project shows that this instrument for adjusting a project under changing conditions has been properly used. Also, all the partners in the project demonstrated flexibility by implementing all the recommendations of the evaluation mission. Lessons have been learned on the modalities of project implementation and management.

VI. RECOMMENDATIONS

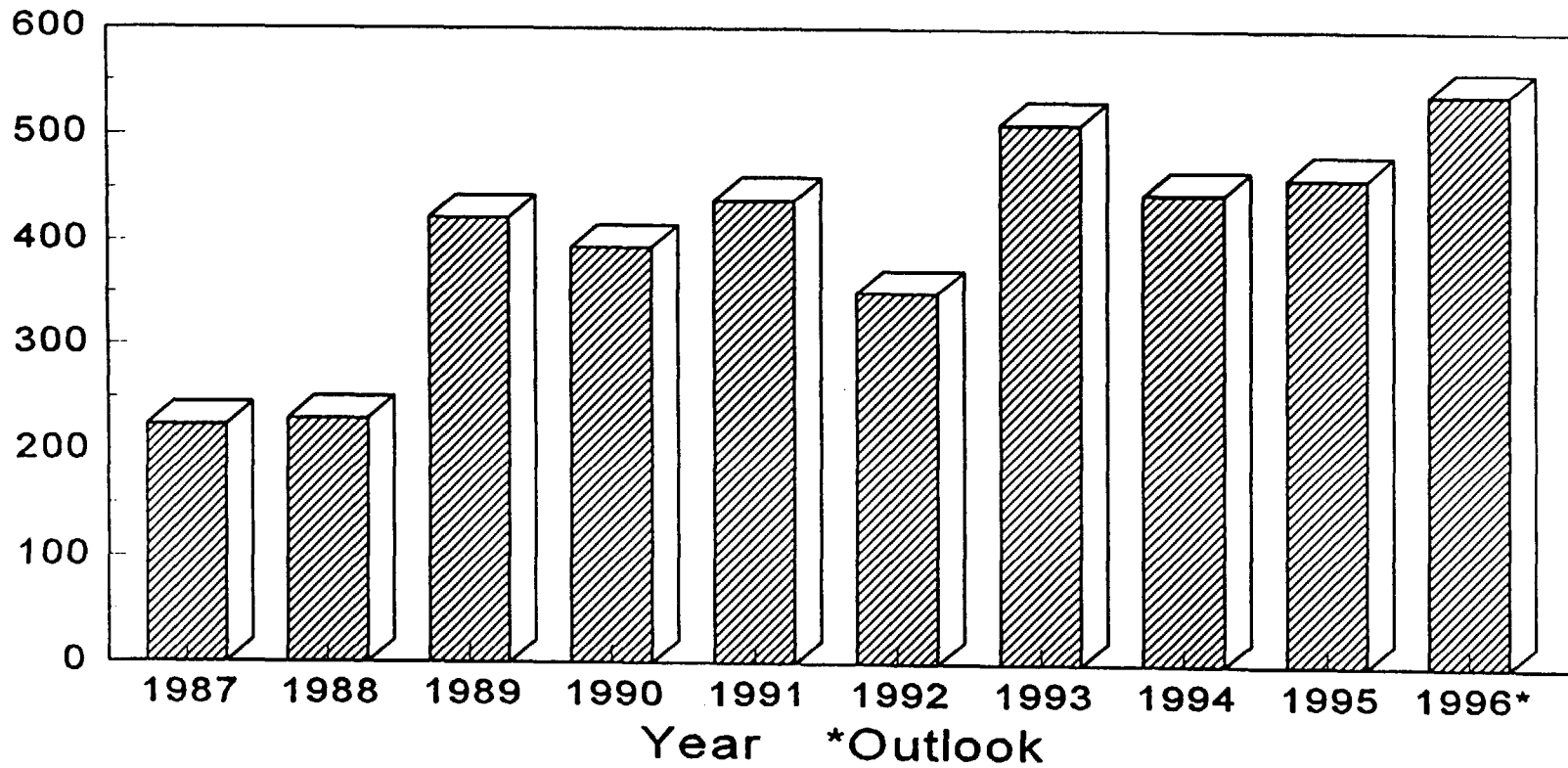
1. It is recommended that the management of PMTF should closely follow the results of activities introduced by the project.
2. The introduction of a quality assurance system is imperative for the future of PMTF. Therefore, it is recommended that the management of PMTF:
 - Closely follow up the completion of all remaining works, including internal auditing and calibration
 - Take advance actions in connection with the choice of an internationally recognized certification body.
3. It is recommended that PMTF should introduce, as soon as possible, an improved cost accounting system as a first step towards the new computerized MIS.
4. PMTF should overcome barriers in personnel policy, imposed by Governmental rules. It should first recruit some university graduates in economics and finance. Then it should introduce a human resources development function as soon as possible. This would lead to better management and would upgrade the workforce.
5. It is recommended that PMTF should exploit the advantages of CAD tool design by establishing a unit for the design and manufacture of dies, mainly for casting.
6. It is recommended that PMTF should, after two years or so, make a new investment in CAD software and hardware so as to keep up with global developments in this field.
7. During the life of the project, there were several attempts to define the development strategy of PMTF and, in that connection, to increase market share by improving the product mix. This was not an output of the project, but it is a real need of PMTF. During the project, the PMTF mission statement became clearer: to manufacture and supply high-quality engineering products and provide related services. In spite of overall conditions, explained in detail in this report, PMTF should continue its efforts to gradually improve its product mix.
8. It is recommended that for the management of any complicated, large scale project like this, UNIDO and UNDP should recruit an international part-time Chief Technical Advisor to assist the National Project Director. Moreover, the National Project Director should be the Chief Executive Officer of the recipient institution.
9. For long-lasting projects, UNIDO and UNDP should adopt an implementation policy that allows flexibility (the modalities for achieving this flexibility could be different, but the possibility should exist). An unusual but effective agreement for flexibility was reached between UNIDO and UNDP (see chapter I. C).
10. UNIDO should introduce a standardized form for the work plan, like it has for defining and implementing the project. The work plan should be very practical and must be in tabular form. A sample work plan, which proved very successful for this project, is shown in annex XI.
11. UNIDO should incorporate in every project document a realistic amount of funding for working visits to the project by the Backstopping Officer from UNIDO Headquarters and the Country Programme Officer. Every working visit should result in a short, but precise, report and a clearly specified plan of action for the forthcoming period.

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Annex I

PMTF SALES 1987-96

Rs in million



Annex II

MAJOR CUSTOMERS

Transmissions

1. Millat Tractors Limited
2. Al-Ghazi Tractors Limited
3. Pakistan Railways

Die Casting Parts

1. Sui Southern Gas Company
2. Atlas Honda Limited
3. Suzuki Motor Cycle Company
4. Phillips Electric Company

Machine Tools

1. Private and Government Manufacturing Organizations
2. Vocational Training Institutes

PRESENT RANGE OF PMTF PRODUCTS

TRANSMISSIONS

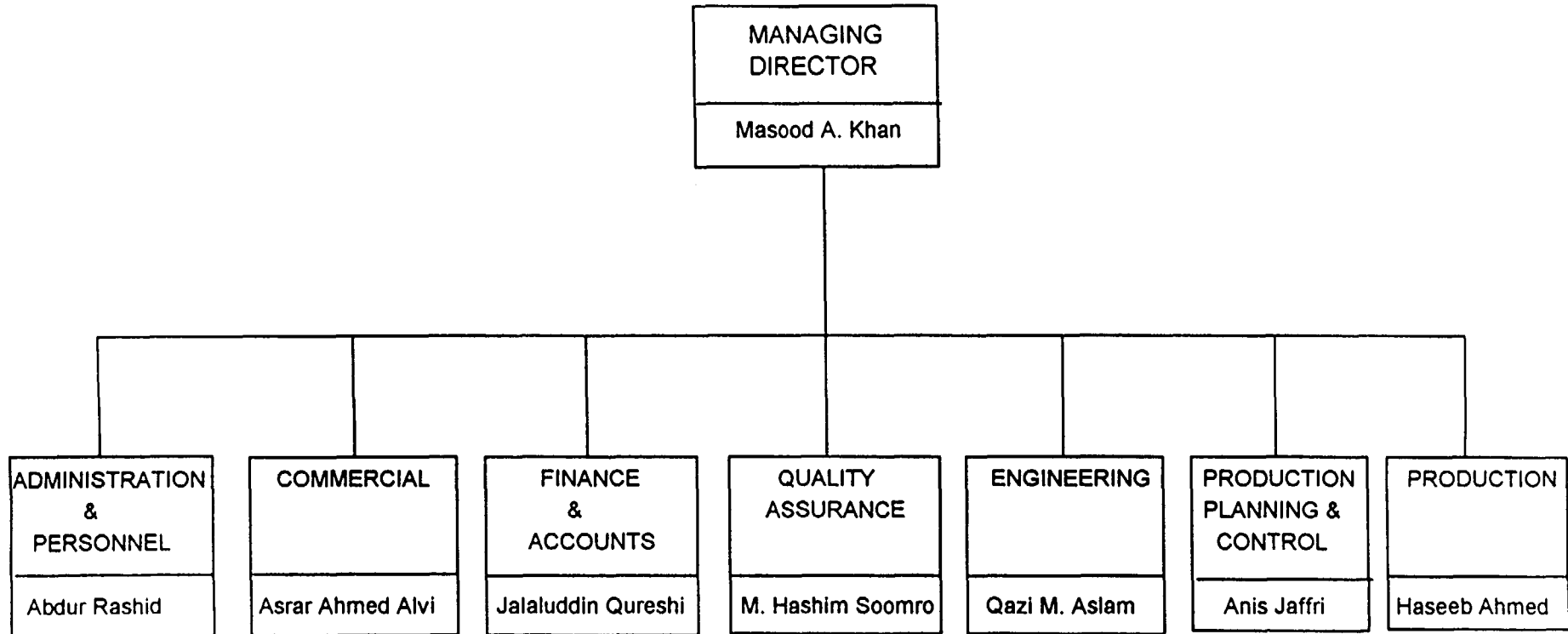
- Components for tractors
- Gears for locomotive
- Gears for various industries
- Components for truck

DIE CASTINGS

- Components for motorcycles
- Components for gas meters
- Components for domestic appliances

MACHINE TOOLS

- Milling machines
- Precision centre lathe
- Universal drilling machine
- Copy milling and boring machine
- Engraving machine
- Modular boring machine
- Fuel dispensing units

*Annex IV***ORGANIGRAM OF PMTF**

Annex V

UNIDO EXPERTS AND CONSULTANTS

No	Post No.	Expertise	Name/Country	Assignment(s)			
				No	m/m	Period	
1	11-02	CAD Product Design	Wadsworth, D./UK	1	2.5	04.94	06.94
2	11-03	CAD Tools & Dies Design	Yoshida, K./Jap	1	6.0	11.90	04.91
3	11-04	Tools, Jigs & Fixtures Design	Yoshida, K./Jap	1	4.0	05.91	08.91
4	11-07	Heat Treatment Technology	Liscic, G./Yug	1	3.0	04.90	06.90
5	11-08	Quality Assurance for Gears	Munro, J./UK	1	0.9	11.90	11.90
6	11-12/1	Quality Assurance	Mazza, J./Ita	4	5.8	08.92	12.93
7	11-12/2	Quality Assurance	Schytt, A./DK	1	5.2	12.94	05.95
8	11-13/1	Market Analysis	Mansson, P./Swe	2	1.8	05.92	11.92
9	11-13/2	Market Analysis	Ahonen, A./Fin	1	1.0	04.93	05.93
10	11-13/3	Market Analysis	Hostettler, P./CH	1	1.5	11.94	12.94
11	11-14	Technical Information	Clemente, W. /Phi	4	6.5	07.92	01.94
12	11-15	CTA/Principal Adviser (part-time)	Buranj, S.	11	14.0	02.92	12.95
13	11-55	Spiromatic Gears	Frei, A./CH	1	0.4	07.92	07.92
14	11-56	TOR for introduction of CAD/CAM	Jacques, T./UK	1	1.5	06.92	07.92
15	11-59	Strategic Management and Planning	El Namaki, M./NL	1	0.5	05.92	05.92
16	11-60	Market Survey for CNC Machine & Machining Centres	Ceccutti, G./Ita	1	1.5	07.92	08.92
17	11-63	Introduction of CAD/CAM Techn.	Wadsworth, D./UK	3	7.0	11.92	12.93
18	11-64	Strategic Management & Planning	Cox, B./UK	1	1.5	05.93	06.93
19	11-65	General Training and HRD	Dec, J./USA	1	1.4	04.93	05.93
20	11-66	Die Casting Technology	Beckley, W./UK	1	4.0	06.94	09.94
21	11-67	Machine Tool Rebuilding Technology	Cooper, R./UK	5	6.5	10.93	10.95
22	11-68	Computerized Measuring Technology	Dascalu, D./Rom	1	1.0	03.95	03.95
23	11-69	Heat Treatment Technology	Haeberli, E./CH	1	1.0	11.93	12.93
24	11-70	Machine Tool Rebuilding Technology	Clark, T./UK	1	0.7	09.94	09.94
25	11-71	Machine Tool Rebuilding Technology	Kean, G./UK	2	2.2	09.94	07.95

PMTF STAFF NOMINATED FOR INDIVIDUAL FELLOWSHIPS

No.	Name of Trainee	Workplace before Training	Duration in m/m	Subject of Training	Place and Country of Training	Workplace after Training
1	Asif Hasan	Shopfloor	3.0	Gear and Gearbox Manufacturing	East Kilbride Engineering Group Training Association/UK	Shopfloor
2	Anwer Rashid	Sales & Marketing	3.0	Repair & Maintenance of Hydraulic Components	East Kilbride Engineering Group Training Association/UK	Sales & Marketing
3	Shoukat Ali	Design Office	3.0	Gear and Gearbox Manufacturing	David Brown Radicon Ltd., Park Gear Works, Huddersfield/UK	Design Office
4	G.H. Siddiqui	Forging Shop	2.0	Heat Treatment of parts of Machine Tools	Leybold Dufferrit GmbH, Germany	Forging Shop
5	V. Haq Qazi	Heat Treatment Shop	3.0	Heat Treatment of parts of Machine Tools	Senior Heat Treatment West Bromwich, Kelvin, West Midland/UK	Material Testing
6	Shoaib Soulat	Pressure Die Casting	1.0	Pressure Die Casting Technology	Buehrle Brothers, Uzwil, Switzerland	Pressure Die Casting
7	Nasir M. Khan	Product Design	6.0	Design of NC/CNC Machine Tools	BSA Tools Ltd., Kitts Green, Birmingham/UK	Left PMTF
8	Moiz Alvi	Product Design	6.0	Design of NC/CNC Machine Tools	BSA Tools Ltd., Kitts Green, Birmingham/UK	Product Design

No.	Name of Trainee	Workplace before Training	Duration in m/m	Subject of Training	Place and Country of Training	Workplace after Training
9	Ahmad	Training Institute	6.0	Quality Assurance	Klingelberg & Soehne, 5609 Hockeswagen/Ger	Quality Assurance
10	Bashir Memon	Quality Assurance	3.0	Non-destructive Testing of Material	The Welding Institute, Abington Hall, Abington Cambridge/UK	Quality Assurance
11	Shahbaz Ahmed	Heat Treatment	3.0	Spectrography of Material	Material Testing Laboratories, Dudley	Heat Treatment
12	Aftab Iqbal	Tool Design	4.0	Design of Die Casting Dies and Ancillary Equipment	Capedome Ltd., No. 5 Lewisham Estate, Lewshab Rd. Smethwich Warly West Midland/UK	Tool Design
13	Azhar Mahmood	Maintenance	3.0	Repair of Electronic Components	East Kilbride Engineering Group Training Association/UK	Maintenance

Annex VII

PMTF STAFF PARTICIPATING IN STUDY TOURS

No	Aim, place & time of studytour	Duration in weeks	No	Name of Person	Post	
					Previous	Present
1	Recruitment of international professionals European Factories & UNIDO HQ vienna May 1989	2.0	1	Siddiqui, A.W.	M.D.	Transferred
			2	Khan, T.A.	GM/NPD	Retired
2	Exhibition of Gears Manufacturing with visit to UNIDO HQ Vienna USA and UNIDO HQ Vienna October 1991	2.0	1	Rehman, F.	M.D.	Transferred
3	Evaluation of suppliers for CAD/CAM subcontract UK, Germany, Austria & UNIDO HQ Vienna November 1992	2.0	1	Aslam, Q.M.	Dy. G.M.	Dy. G.M.
			2	Farooq, M.	Designer	Designer
			3	Shah, S.H.	Designer	Designer
4	CAD/CAM system management training HongKong 7 Singapore Computer Vision Training Institute and Factories with CAD/CAM System May and June 1994	7.0	1	Aslam, Q.M.	Dy. G.M.	Dy. G.M.
5	Seminar on Human Resources Development Visit to UNIDO HQ Vienna October 1994	2.0	1	Khan, M.A.	M.D.	M.D.
			2	Hasan, N.	SEC/G.M.	SEC/G.M.

Annex VIII

EQUIPMENT FOR THE PROJECT

No	Users in the Project	Description of the Items	Qty.	Exp.	Non-Exp.	Import	Local	Sub-contract	Remarks		
1.0	Computer Aided Design (CAD) and Computer Aided Manufacture (CAM) Product Design	1.0 Hardware									
		1.1 Sun Sparc Station RAM 32MB Speed 40 MHz HDD 500 x 2 MB Disk Drive 3.5"(2.8MB) Optical Mouse CD ROM	1		+				+		
		1.2 PC 486 (Daewoo) RAM 8MB Speed 33 MHz HDD 240 MB Disk Drive 3.5" (2.8MB) and 5.25"(1.2MB) Monitor 22" color VGA Mouse (A4 Tech)	4		+					+	
		1.3 Printer HP Laserjet-4	1		+					+	
		1.4 Plotter HP draft Pro (A2 size)	1		+					+	
		2.0 Software									
		2.1 DOS5	4	+						+	
		2.2 Novell Netware	1	+						+	
		2.3 Windows 3.1	3	+						+	
		2.4 CADD5 - 3D solid moulding	1	+						+	
		2.5 Personal Designer 3D wireframe	1	+						+	
		2.6 Personal Designer & Microdraft	3	+						+	
		2.7 Personal Designer UPL	2	+						+	
		2.8 Personal Designer Data Extract	3	+						+	
		2.9 Design View	4	+						+	

1.2	Tool Design	1.0	Hardware						
		1.1	Sun Sparc Station RAM 32MB Speed 40 MHz HDD 500 x 2MB Disk Drive 3.5"(2.8MB) Optical Mouse CD ROM	1		+			+
		1.2	PC 486 (Daewoo) RAM 8MB Speed 33MHz HDD 240MB Disk Drive 3.5"(2.8MB) and 5.25"(1.2MB) Monitor 22" color VGA Mouse (A4 Tech)	4		+			+
		1.3	Printer Laserjet-4	1		+			+
		1.4	Plotter HP draftPro (A2 size)	1		+			+
		2.0	Software						
		2.1	DOS 5	4	+				+
		2.2	Novell Netware	1	+				+
		2.3	Windows 3.1	3	+				+
		2.4	CADDS - 3D solid moulding	1	+				+
		2.5	Personal Designer 3D wireframe	1	+				+
		2.6	Personal Designer & Microdraft	3	+				+
		2.7	Personal Designer UPL	2	+				+
		2.8	Personal Designer Data Extract	3	+				+
		2.9	Design View	4	+				+
		2.10	Aldus Page Maker	1	+				+

1.3	CNC Shop	1.0	Hardware								
		1.1	PC 486 (Dacwoo) RAM 8MB Speed 33Mhz HDD 240MB Disk Driver 3.5"(2.8MB) and 5.25"(1.2MB) Monitor 22" color VGA Mouse (A4 Tech)	1		+			+		
		1.2	Printer HP Laserjet - 4	1		+			+		
		1.3	GN Telematic (Paper Tape Punch)	1		+			+		
		2.0	Software								
		2.1	DOS 5	1	+				+		
		2.2	Windows 3.1	1	+				+		
		2.3	Personal Designer and Microdraft	1	+				+		
		2.4	Personal Machinist NC programming	1	+				+		
		2.0	Technical Information Centre	1.	Technical Books	69	+			+	
						21	+		+		
2.	Periodicals 1993			16	+		+				
	1994			13	+		+				
3.	CD ROM of standard (12 issue)			1	+		+				
4.	Database manager (software)			1	+		+				
5.0	Equipment										
5.1	Computer CPU talent 386DX, 40MHz, 4MB RAM			1		+	+				
5.2	Computer CPU talent 386SX, 33MHz, 2MB RAM			2		+	+				
5.3	HDD 120 MB			2		+	+				
5.4	HDD 212 MB			1		+	+				
5.5	Monitor color VGA	3		+	+						
5.6	Printer HSP - 500 (citizen)	2		+	+						
5.7	Printer Laserjet (HP)	1		+	+						
5.8	CD ROM drive (ext)	1									
5.9	Amplifire (public address system)	1		+			+				

		5.10	Stand of Mike	1		+		+		
		5.11	Collar Mike	1		+		+		
		5.12	Speaker	2		+		+		
		5.13	Stand of Mike for table	1		+		+		
		5.14	Dymo Letter Punch	1		+		+		
		5.15	Calculator (scientific)	2		+		+		
		5.16	Calculator (non-scient.)	2		+		+		
		5.17	Emergency light	1		+		+		
		5.18	Tape Recorder	1		+		+		
		5.19	Steel Cabinet	1		+		+		
		5.20	Calculator	1		+		+		
		5.21	VGA card f. computer	1		+		+		
		5.22	Memory card (2MB)	1		+		+		
		5.23	Digital dayri peripheral	1		+		+		
		5.24	Paper tape punch for CAM station	1		+		+		
		5.25	Magiboard	1		+		+		
		5.26	Calculator (Casio)	2		+		+		
		5.27	Calculator (Citizen)	1		+		+		
		5.28	Sharpener (Pencil)	1		+		+		
		5.29	Camera (Canon)	1		+		+		
		5.30	Photocopy Machine (Canon)	1		+	+			
		5.31	Graph-in-the-box (software)	1	+		+			
3.0	Various Dept.									
3.1	Product & tool design	1	Design V 1.0 gear design software	1	+		+			
		2	PC Intel 386 SX Monitor VGA color Mouse Digitizing table A3 MS DOS V 5	1		+	+			
		3	PC Roland A3 (DXY 1300) plotter, 2 PCS 17" color monitor one PC RAM up-grade to 2MB, one PC, Vega graphic card, one PC A3 Sumeskeths, Software	1		+	+			
3.2	Sales and Marketing	1	Software package "Graph in the Box"							
3.3	Machine Tool Development	1	Set of special electronic and hydraulic components and parts for conversion of PMTF's standard milling machine to CNC (Glenyork)	1		+	+			

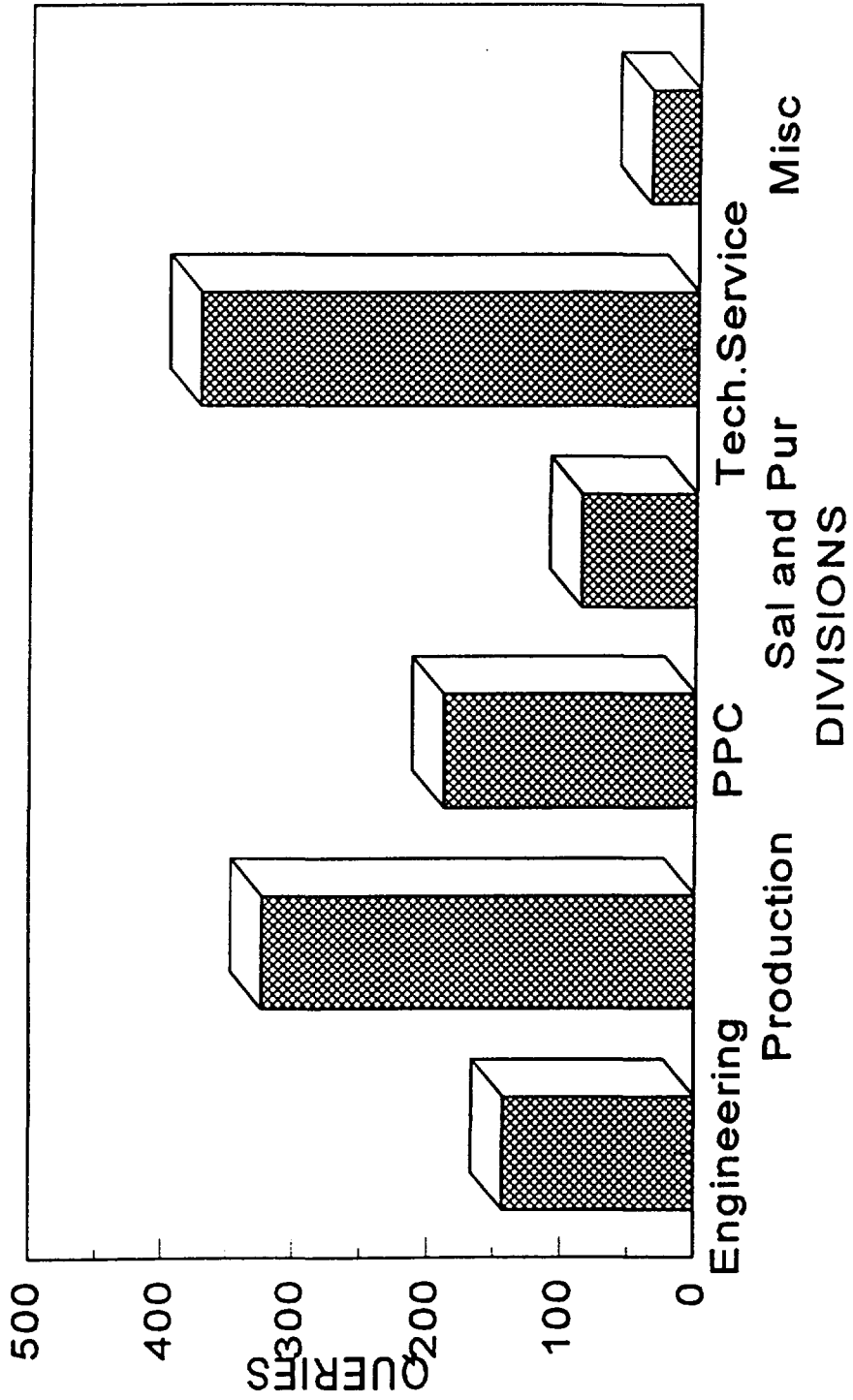
Annex IX

IMPORTANT REPORTS PREPARED DURING THE PROJECT

No.	Subject / Topic of Report	Date	Prepared by:
1	Improvement of heat treatment process at PMTF	June 1990	UNIDO Expert
2	Market analysis unit concept and programme	July + Nov 1992	UNIDO Consultant
3	Market analysis for diversification / mix of PMTF products	Sep 1992	Sub-contractor
4	Market study on Pakistan industry demand for CNC machine tools and machining centres	Sep 1992	PMTF + UNIDO Consultant
5	Survey for computerized management information system (MIS)	Nov 1992	Sub-contractor
6	MIS and establishment of cost accounting system	April 1993	Sub-contractor
7	Programme of technical information centre (TIC)	May 1993	UNIDO Expert
8	Report and recommendations for human resources development programme at the PMTF	May 1993	UNIDO Consultant
9	Report and recommendations for strategic management and planning	Nov 1993	UNIDO Consultant + PMTF Management
10	Transfer of technology for machine rebuilding activities	Jan 1994	UNIDO Consultant
11	Expert's final report on activities for introduction of CAD/CAM techniques in design and manufacture	June 1994	UNIDO Consultant
12	Expert's final report on activities for introduction of Quality Assurance System as per ISO 9000 standards	April 1995	UNIDO Expert

Annex X

QUERIES STATUS AUGUST 1993-AUGUST 1995



Annex XI

SAMPLE WORK PLAN

PROJECT : DP/PAX/84/012 - Technological Advancement of PHIT, Karachi
 WORKPLAN : PART NO. 2 - Related to Output No. 2

UPDATED - 30.08.1994 PART 2/ PAGE 1

S.NO	OUTPUT DESCRIPTION	ACTIVITIES	TIMING																		
			1992			1993									1994						
			10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	
2.	Revised and Improved description: Introduced CAD technique for design of products and tools as well CAM technique for CNC machining shop.	<p>1. Preparatory stage.</p> <p>11-86 Consultant for preparation of TOR on sub-contract for introduction of CAD/CAM techniques, 2.0 months - field work - final report and TOR. Complete in 06.1992 Submitted in 08.1992</p> <p>PHIT's acceptance of TOR and decision on implementation policy. Completed in 08.1992</p> <p>Call for tender and preliminary evaluation (started 09.1992) ***</p> <p>PHIT appointment of CAD/CAM system manager. ***</p> <p>Suppliers and systems evaluation through study tour of CAD/CAM system manager with 2 engineers and UNIDO consultant. **</p> <p>11-83 UNIDO Consultant/CAD Adviser **</p> <p>Final evaluation of tenders *</p> <p>Award of Contract ***</p> <p>Implementation is through sub-contract awarded to COMPUTER-VISION CORPORATION, Bedford MA 01730 USA Implementation starts from 04.1993</p> <p>2. Implementation stage (See page 2)</p>																			

