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NATIONAL METROLOGY CENTRE

DP/ETH/84/006

PEOPLE'S DEMOCRATIC REPUBLIC OF ETHIOPIA

Report of the evaluation mission*

Prepared in co-operation with the Government of the
People's Democratic Republic of Ethiopia, the
United Nations Development Programme and the
United Nations Industrial Development Organization

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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SUMMARY OF IN-DEPTH PROJECT EVALUATION

PART A

Project No.: DP/ETH/84/006
Project Title: National Metrology Centre (NMC)

Executing Agency	UNDP budget ($)	Date proj. approved	Date of evaluation
UNIDO	1,200,000	18 September 1985	26 Feb-11 March 1988

Government Implementing Agency	Govt. budget (Eth. Birr)	Date operations started
Ethiopian Standards Institution	2,449,000	January 1986

I. Summary of project objective and outputs

The project focussed on (a) establishment of the National Metrology Centre (NMC), (b) preparation of legal documents, regulations, etc. as the basis for a metrology foundation in Ethiopia, and (c) organizing an operational metrology programme.

II. Purpose of the evaluation mission

To determine and assess: (a) how adequately the immediate objectives or purpose of the project have been attained and (b) how effective the services provided by the NMC have been, are and are likely to be, in helping the Government to achieve the relevant national and/or sectorial development objectives.

III. Findings and conclusions of the evaluation mission

A. Project design

. The description of the development objective is stated in such vague and high-level (macro) terms that attempting to trace a connection between the project and it is not feasible.

. Notwithstanding this condition and given the socio-economic and institutional context of the project, the original project proposal was justifiable in terms of Government objectives, priorities and strategies for industrialization.

. The purpose of the project and the expected results of the project activities were not clearly differentiated or specified making project management, i.e., workplanning, reporting, monitoring, review and evaluation difficult and subject to individual interpretation.

. Given the poor design, it is not possible to say with assurance if the project has been successfully completed or even when it has been completed other than when the inputs cease, as there are no explicit or implied end-of-project status (purpose) or performance (output) indicators.

. The consequences of these design deficiencies were overshadowed by input delivery problems but are becoming more evident as NMC capability becomes tested through service operations.

. The experience of "lessons learned" on similar projects, including DP/ETH/79/003, and the guidelines for planning and managing of institution-building projects provided by UNDP and UNIDO are not reflected in the design.

. The project document failed to explain the project concept or justification and explanation of a model for the planning of a national metrology system. The mission has supplied one which can be used to evaluate the EAS. The team finds such a retroactive comparison satisfactory.

. If the UNDP/UNIDO guidelines had been followed, the project would have limited itself to the first or "start-up" phase of institution building and have provided a more reasonable duration.

. The budget estimates for equipment, even allowing for the decline in the value of the U.S. dollar, were grossly unrealistic which seriously affected instrumentation acquisition and slightly curtailed training.

. Important measurement capability components (activity modules) for roughness and surface finish (smoothness), humidity and moisture, flow, and time distribution were omitted without explanation.

Assessment: poor to fair (1^+)

B. Implementation

. Because of the budget problem, 47 out of the 107 instruments included in the prodoc annex could not be delivered.

. All instruments were correctly installed and are operational.

. All training programmes were executed in a satisfactory manner but, in some cases, their short duration may have limited the benefits, i.e., skill level obtained.

. UNIDO backstopping, when required, was satisfactory but was primarily limited to input acquisition and delivery.

. The self-evaluation process (PPERs) helped make the one tripartite review held more effective and result or problem-oriented.

. Judging by the in-depth evaluation of the sister project for the NQCTC, this evaluation is also contributing to better decision-making but there may be an over-reliance on these processes to the dimunition of better planning in the first place and more result-oriented, routine project management by the responsible parties.

. The first CTA, who had been team leader for 006 and was nominated by the Government, experienced difficulty due, in part, to the vagueness of the project design and subsequent different interpretations of priorities, a position description which required a range of talents unlikely to be found in one man, and exacerbated by personality conflicts and individual frustrations.

. The second CTA has performed in an extremely conscientious and highly technically qualified way, displaying devotation to the NMC and his profession. He was also nominated by the Government.

. The mission overall assessment of implementation is satisfactory (3).

C. Results

Building

. The existing plant adequately serves the needs of the NMC. It is critical that the air conditioning be repaired soonest. A slight alteration may be necessary to install a water demineralization capacity.

. Within the next 5 to 10 years, additional space of roughly 400 m^2 will likely be required.

Laboratory Measurement Capability

. Overall achievement - "less than planned" primarily due to lack of equipment (the 47 missing instruments) but largely overcome by skill of NMC staff and CTA and, actually, somewhat remarkable in view of the short duration of the project. Assessment of units as included in the prodoc are:

Mechanical measurements	-	as planned	(3)
Electrical chemistry ms'ts.	-	less than planned	(2)
Physical chemistry ms'ts.	-	marginal	(1)
Time and frequency ms'ts.	-	less than planned	(2)
Temperature measurements	-	as planned	(3)

Organization

. This output is really a function of the Government and EAS, not the project.

. The approved but not yet fully implemented organization for the Metrology Department may result, if care is not taken, in over-organization and bureaucratizing of the laboratories which could impede rather than facilitate operations.

. The Textile Measurement Unit does not fit into a metrological scheme and might better be located in the Quality Control Department.

National Metrological Standards Component

Achievement: as planned (3)

. Nine SI units of measurement are reproduced in Ethiopia within a range and accuracy traceable to a low but well-established level of international standards.

. The results have been excellent considering the unusually short duration of the project.

. The metrological services are being carried out using correct procedures. Performance is effective if not always fully efficient due partly to missing supporting equipment and tools and inexperience.

. Because of raising industrial need for calibration and mandatory product standards awaiting official gazetting, as well as those being developed, the demand for services and subsequent workload in the NMC will expand.

Legal Documents

Achievement: more than planned (4)

. Fourty metrology written standards, i.e., legal documents, have been elaborated.

. Ninety-nine draft documents of lower order, e.g., guidelines and testing instructions, have also been developed.

. A draft proclamation has been prepared but found deficient by the mission in important aspects.

. It is not clear to EAS who in the Government should approve these documents.

. A new proclamation on metrology is needed.

Education Programme

Achievement: less than planned (2)

. Various useful efforts, employing the several media, workshops, etc., have been made but the programme is ad hoc in nature and without focus.

Quality Control

. NMC calibration of hundreds of instruments and providing calibration standards for inspectors of more than 50,000 measuring instruments throughout the country assures better quality control.

. All requests of the NQCTC to the NMC for calibration of mass, electrical, lengths and other instruments were provided in a timely and adequate fashion.

. At the moment, the NMC is only partially effective in fulfilling all possible NQCTC demands for calibration.

Overall assessment of results: somewhat less than planned (2.5)

D. Beneficiaries/impact

. It is arbitary and fruitless to isolate metrology from standards, quality control, etc., when either attempting to provide a project rationale/justification or measure its subsequent benefits.

. Given the political-social-economic and institutional context in Ethiopia and Government plans for moderate industrialization, the project rationale is unassailable, the only question being how centralized and mandatory the system should be.

. Benefits - which result from the determination of standards, quality control testing and certification, and an appropriate metrological foundation - are beginning to increase in type, frequency and significance.

Assessment of potential impact: excellent (4)

IV. Lessons learned

. The results of previous UNDP/UNIDO evaluations, translated into guidelines to planning industrial research and service institutions, were not applied.

. Despite time-consuming pre-approval reviews, revised manuals, preparation of a Programme Advisory Note (PAN), guidelines on preparatory assistance and institution-building, staff training, output-oriented reporting and evaluation systems, establishing Project Appraisal Staffs at headquarters, etc., there seems to be little or no improvement in project design, as judged by these two projects.

. Under these conditions, the value of attempting to capture development assistance experience and applying it to future projects is placed in question.

V. Summary recommendations of the evaluation mission

(1) Any proposal for a Phase II or new approach should apply, to the extent applicable, the guidelines included in the UNDP/PAN and UNIDO issuances (Res Rep, ESA).

(2) Similarly, the higher-level problems or constraints that the project intends to impact on should be clarified (Res Rep, ESA).

(3) The Government should consider action to support a service for the maintenance and repair of measuring instruments in the country by requiring same from the foreign suppliers of instruments (Government).

(4) The NMC and NQCTC should collaborate on drafting a new Government proclamation on metrology for review by the General Manager of ESA. Mission advice is provided (ESA).

(5) Metrology legal documents should be approved at the ESA General Manager level upon submission by the Metrology Department (ESA).

(6) An ESA public relations and information programme covering all operational elements including the Metrology Department should be developed as part of its annual planning and budgeting process (ESA).

(7) ESA should consider the advantages of adherence to the International Convention of Metre and its institutional bodies (ESA).

(8) UNDP should consider making project design which meets existing standards as a "mandatory" part of preparatory assistance by establishing project design teams which include design expertise. Other mission suggestions are also included (UNDP and UNIDO).

(9) The Government should give favourable consideration to the EAS proposal for a new salary structure which will assure the recruitment and retention of required professional and technical skill levels.

(10) The following options concerning follow-up assistance are provided in reverse order of mission preference and depending on fund availability, although all except the first are not mutually exclusive:

(a) terminate both 003 and 006 when present project activities cease; or

(b) extend current project only to add: absolutely necessary equipment to bring outputs (activity modules) to level planned or reconstructed:

(i) limited to areas of measurement already advanced. Ballpark estimate of cost - US$250,000 plus 10% for training and 5% for consultancy.

(ii) to all measurement areas listed in prodoc and slightly updated. Ballpark estimate of cost - US$200,000 plus 10% for training and 5% for consultancy; and

(c) additional instruments which at relatively small cost could significantly improve NMC effectiveness. Ballpark estimate of cost - US$130,000 plus 10% training and 5% for consultancies;

(d) Preparation of a new project proposal which aims at strengthening EAS in the management of a comprehensive or systems approach to standards, quality control and metrology. Emphasis would be on developing the necessary "software" to accomplish its mission covering capability components such as management and planning, training, consultancies, creating public awareness and education, computer support, etc. The prodoc should provide maximum flexibility for short-term technical assistance, perhaps using a high-level project advisory group.

VI. Evaluation team

Raymond E. Kitchell, UNDP Consultant and Team Leader

Ato Bekele Desta, Senior Export, Office for the State Committee for Economic Relations (OSCFER)

Professor Tomasz Plebanski, UNIDO Consultant

PART B
(to be completed by UNDP Resident Representative and to be sent to the UNDP Regional Bureau, UNIDO Headquarters and the Government, together with the report)

I. Report of the Evaluation Mission sent to:
(list names and affiliations of recipients and the date of trasmitted)
[to be supplied by Res Rep after receipt of report]

II. Comments of UNDP field office:
(Comments on effectiveness and relevance of evaluation, specifically the finding recommendations and required follows-up)
[to be supplied by Resident Representative after receipt of report]

PART C
(to be completed by UNIDO and sent to the UNDP Resident Representative and Regional Bureau concerned within one month after)

Summarize comments on technical and managerial aspects of findings, recommendations and lessons learned:

PART D
(to be completed by the UNDP Resident Representative 12 months after the completion of the evaluation)

Follow-up taken place:
(Record and comment and any actions that have taken place as a results of, or follow-up to the evaluation, including a subsequent UNDP/UNIDO Project Performance Evaluation Report and/or Tripartite Meeting. Comment specifically on all recommendations under the evaluation report.)

LIST OF ABBREVIATIONS USED

Birr	Ethiopian Currency (1 US$ = 2,05 Birr)
CTA	Chief Technical Adviser
DRR	Deputy Resident Representative
EAS	Ethiopian Authority for Standardization (formerly ESI)
ESI	Ethiopian Standards Institute
JPO	Junior Professional Officer
NMC	National Metrology Center (now the "Metrology Department" of EAS)
NPC	National Project Coordinator
NPO	National Project Officer
NQCTC	National Quality Control and Testing Centre (now the "Quantity Control and Certifications Department"of EAS)
SIDFA	Senior Industrial Development Field Adviser
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization

CONTENTS

	Page
SUMMARY OF IN-DEPTH PROJECT EVALUATION	2
LIST OF ABBREVIATIONS USED	9
TABLE OF CONTENTS	10
INTRODUCTION	11
CHAPTER I. PROJECT CONCEPT AND DESIGN	13
A. Socio-economic and institutional context of the project	13
B. Project document	15
C. Project concept for metrology	19
CHAPTER II. PROJECT IMPLEMENTATION	25
A. Delivery of inputs	25
B. Implementation activities	27
C. Project management	30
CHAPTER III. PROJECT RESULTS AND ACHIEVEMENT OF OBJECTIVES	33
A. Outputs produced (i.e. results)	33
B. Achievement of the immediate objective	48
C. Linkage between metrology and quality control laboratories of EAS	48
D. Contribution to the achievement of the development objective	48
CHAPTER IV. CONCLUSIONS	51
CHAPTER V. LESSONS LEARNED	55
CHAPTER VI. RECOMMENDATIONS	57

Annexes

I.	Terms of reference	60
II.	List of persons met and organizations visited	64
III.	Analysis of equipment requirements	65
IV.	EAS organization	74

INTRODUCTION

The Ethiopian Standards Institution (ESI), with the advice of UNIDO, was created in 1970. In 1979, under UNDP/UNIDO project DP/ETH/75/010, the Granfield Institute of Technology (UK) was given the task of assisting ESI in the establishment of a National Quality Control and Testing Centre (NQCTC) and preparing a preliminary study concerning a National Metrology Centre (NMC), as both centers were necessary to carry out the ESI mission.

Accordingly, UNDP/UNIDO project DP/ETH/79/003 was approved in March 1979 and became operational in October 1979. Its purpose was to provide facilities and capabilities for testing products covered by the 108 Ethiopians Standards issued in 1971/72. In May 1985, a tripartite in-depth evaluation found that the NQCTC was "... functioning in a satisfactory manner and achieving most of its objectives". It also recommended that a NMC be established because accurate/precise measurements are the sine qua non for the "proper and effective performance of industrial quality control. The analysis of NQCTC project achievements showed that its effectiveness was dependent on the calibration and verification of the measuring instruments available in its laboratories and upon helping the industrial sector in the calibration of equipment at the factory level. The Government requested UNDP's assistance and in September 1985, DP/ETH/79/003 was approved becoming operational the following year. Since that time, 003 has been extended from its original duration of three years and is still on-going.

The ESI was upgraded and reorganized into the Ethiopian Authority for Standards (EAS) in 1987 with a larger mission, more authority and reporting directly to the Council of Minsters, confirming the Government's intention to promote national industrial development by creating national systems of standardization, quality assurance and metrology compatible with the centrally planned economy of Ethiopia and appropriate for prevailing conditions and longer-range plans.

Also during the period since project inception, some 281 new mandatory Ethiopian Standards have been approved and are being prepared for publication resulting in new demands for quality control and meterological services as the product list expands.

At this stage, most Government and UNDP/UNIDO NMC project inputs have been delivered and project activities, except for some additional short-term training, are nearing completion. According to UNDP evaluation requirements and the need for an independent assessment of performance and results before decisions can be made on possible future assistance of UNDP/UNIDO to EAS, this evaluation exercise was originally scheduled to have taken place last November but was unavoidably delayed until February/March of this year (see annex I for the mission terms of reference). The evaluation mission consisted of three members:

Mr. Raymond E. Kitchell, Team Leader, UNDP Consultant with extensive background in design, management and evaluation of development projects in industry;

Ato Bekele Desta, Senior Expert in the Office of the State Committe for Economic Relations and Government representative; and

Professor Tomasz Plebanski, UNIDO Consultant, Director of Research and Development Centre for Standard Reference Materials in Warsaw and an internationally recognized expert on metrology.

Within its terms of reference, the mission focused on a detailed assessment of the capabilities established by this institution-building project, their adequacy and revelance to current and near term requirements, and a comparative analysis of these capabilities against the conditions envisioned at the time of project formulation and at project completion - now some three years later. Within this approach, most time was spent at the EAS although interviews with most concerned Government officials were held and visits made to several factories which have received project-related assistance. For a complete list of persons met and organizations visited see annex II.

Finally this background introduction would not be complete without acknowledging the excellent support received from EAS, and particularly its Metrology Department, the current CTA, and the Office of the UNDP Resident Representative, including the SIDFA and JPO.

CHAPTER I. PROJECT CONCEPT AND DESIGN

A. Socio-economic and institutional context of project

1. Basic data

Ethiopia has a land area of 1,223,800 km^2 inhabited by a population of 17 million growing at a comparatively rapid annual growyh rate of 2.9 percent. It had a GDP in 1987 of 4747 Birr (2316 US$) and per capita GDP of 107 Birr (52 US$). Recent statistic indicate the GDP share is: agriculture 50%; industry 10.6%; services 35%, and all other 4.4%. Agriculture make up 86% of the labour force with industry a distant second at 3%. Similar disparities exist in the share of export with agriculture providing 86% (mostly coffee, pulses, oilseed, hides and skins) and industry 10%. In brief, the industrial sector in Ethiopia is at a very low scale of development and its contribution to the country's economy and development is on the same scale, 10-11%.

2. Development priorities and strategies

It should not be surprising, then, that it is Government policy to expand the industrial base and expand industry's share of the GDP to 23.9 per cent in 1993/94 though the implementation of 216 new and expanded projects. The country's 10 year perspective plan (1984-94) based on an average annual growth rate of 12%, includes the following objectives for the manufacturing sector, among others:

- Increasing the quantity of basic consumer goods;
- Expanding and establishing new capital and intermediate goods industries to increase production of machinery, spare parts and other production means required particularly by the agriculture, construction and transport sectors;
- Strengthening and expanding small-scale industries and handicrafts;
- Contributing to improving the country's balance of payment position through export promotion and import substitution; and
- Laying the foundation for development of heavy industries.

To obtain these plan objectives in the industrial sector, the strategies adopted by the Government include: increasing production of consumer goods though light and cottage industries; expanding the construction industry by raising engineering and design capabilities; upgrading the skills of construction workers; expanding building materials industries, adopting labour-intensive production techniques to accelerate employment generation; and to expand producer service and consumer co-operatives, especially in the handicrafts and small-scale industries sector. The power sector is also to be expanded and the exploitations of the country's mineral resources will be developed.

3. Present status and major problems

The manufacturing sector is presently limited to the simple processing of agricultural produce and the production of a small range of consumer goods, mostly cotton textiles, clothing, tobacco, beer soft drinks, mineral water, cement and other construction materials. Most of the output is for the domestic market, but a growing proportion is also available for export, notably semi-processed hides and skins, sugar and oil seed products. Most industries have low value-added since they rely heavily on imported materials.

The industrial sector is charactinzed by insufficient production methods, obsolescent machinery and under skilled manpower at both managerial and technical levels resulting in low productivity and poor quality.

The performance of the industrial sector is also adversely affected by other internal and external factors, including:

- Poor maintenance
- Low investment levels
- Acute shortage of skilled manpower
- Limited management authority
- Imbalance between public and private sector
- Low capacity to generate foreign exchange
- Pricing policies
- Inadequate wage and remuneration system
- High dependence on imports of essential inputs
- Obsolence of machinery and lack of spare parts.

4. Institutional context

The Ethiopian Standard Institution (ESI) was established by Government Order No. 64 of 1970 accountable to the Ministry of Domestic Trade as an autonomous body of the Ethiopian Government. It was mandated to enforce and administer the "Weights and Measures Proclamation No.208 of 1963" and to establish and monitor acceptable standaids and quality control measures thoughout the country.

In order to promote and apply standardization, quality control, certificate marking and metrology for the improvement of national economic development and to further accelerate measures to be taken in this connection, the Government found it necessary to strengthen the Ethiopian Standard Institution by up-grading to the Ethiopian Authority for Standardization. It is an autonomous body of the Zthiopian Government as per the Proclamation No. 328 of 1987, and is now directly accountable to the Council of Ministers. It is the sole organ for standardization and metrology in the country.

The Authority has a National Standards Council composed of Representative from ministries of Agriculture, State Farms Development, Health, Industry, Foreign Trade, Domestic Trade, Construction, Science and Technology Commission, Office of the National Committee for Central Planning, Higher Education Commission and the General Manager of the Authority. The General Manager is the Chairman of the Council and also is the head of the EAS Secretariat which has under its aegis four operational departments besides Administration and Standards Translation. The total number of personnel in the EAS is 5,300 of which about 40 are qualified engineers and specialists.

The Authority, with its head office located in Addis Ababa, has about ten branch offices in various major towns. The activities of weights and measures are carried out by the Legal and Metrology Division in the head office, defferent branch offices and mobile inspections team.

The National Metrology Centre (NMC) is incorporated in the organizational structure of the EAS under a new Department of Metrology which consists of a Scientific Metrology Division, Industrial Metrology Division which is not yet operational, and Legal Metrology Division. The organizational chart of EAS is attached as annex IV.

It can been seen, therefore, from the foregoing, the increasing importance the Ethiopian Government gives to the role of standardization, quality control and metrology in the socio-economic development of the country. Although the development of the industrial sector is rendered a second priority to agriculture in the ten years perspective plan, the sector is much expected to play a significant role in the economic development in terms of increased contribution to GDP and employment. Agro-based industries are dominant, contributing 60% of output in the medium to large-scale industries and 80% in the small enterprises. The dominant products are consumer items, as activities in food processing account for 25% of total output and textiles 22%. Exports of manufactured goods (products) is low and is limited mainly to leather products.

Therefore, in order to achieve the objectives, inter alia, of the Government to produce the necessary manufactured goods required to meet the need of a growing part of the population for basic necessities, such as food, drinking water, shelter and clothing, and also to increase the country's foreign exchange savings and earnings, the services of the Ethiopian Authority for Standardization in rendering standards, quality control, and metrology and testing becomes of paramount importance to the industrial sector. The Government, in its efforts to expand industrial production, improve the quality of goods produced, increase productivity and reduce wastages, will certainly benefit from the services of EAS which will also assist industrial promotion and improvement in the balance of payments by increasing competitive capacity of the manufactured products on the domestic markets as well as in the world markets, thus resulting in the increase of general Government revenue which could be utilized for the socio-economic investment in order to improve the well-being of the people.

B. Project document

1. Description of the major design elements

The development objective is given as:

> "to assist [underscoring supplied] the Government in expanding its industrial production and in improving the quality of the goods produced".

Under 'Background and justification', this objective is slightly elaborated as follows:

> "This project will assist the government in introducing international standards of methology in both the primary and secondary sectors of the economy, with a view to guaranteeing the methological quality requirements of industry and ensuring that commodities sold or brought are of acceptable standards. The standardization of weights and measures will ensure the complementarity of the immediate products of different factories, facilitate trade and marketing, raise the quality of local products, and protect the interest of consumers".

The project's immediate objectives are formulated as follows:

"(a) The establishment of a Metrology Center with adquately equippped laboratories and with an appropriate organizational structure;

(b) The establishemnt of the necessary legal measures, the development of law, regulations, standards, instructions and guidelines for metrological institutions, industrial enterprises and traders; and the prevision of a legal basis for the adoption of the International System of the Units in all fields of economic life;

(c) The modernization of the traditonal measurement system now used in rural areas of the country by conversion to the International System of Units."

Further elaboration in the prodoc states that the NMC "... is needed to provide facilities for the calibration and verification of the measuring instruments now available in the laboratories of the NQCTC in order to enable it to function effectively..."[underscoring supplied]. Moreover, the NQCTC would provide assistance to the embryonic industrial sector in the calibration of its equipment. When the NQCTC is fully equipped and in operation, the foundation will have been laid for the production of quality products in the economy [underscoring supplied]. A link between these two projects was clearly intended.

There is no doubt that the logic of the project was flawed from the top down beginning with its description of the development objective, which unnecessarily complicates its justification. In the first instance, the development objective is that of the Government, not of UNDP, UNIDO or the project. If we leave out the words "to assist", we do have a brief statement of its objective in the industrial sector, but it is so macro is nature that it would be extremely different, if not impossible to predict the causal effect on the objective of improved quality control and surely impossible to trace the effect of metrology per se. What is needed for UNDP/UNIDO purposes is to break the relevant development objective(s) down into more micro elements and components thereof, e.g. the major impediments, constraints or problems involved in increasing: production, productivity, value-added, exports, etc.; and, to decreasing reliance on exports, and a relatively small range of economic goods, etc. (see section A above). When this is done, e.g. certainly poor quality goods are a major impediment for increasing exports, added-value, and foreign exchange earnings, it will be easy and more credible to hypothesize that completion of this project will have a significant impact on improving quality which, in turn, along with many other actions taken outside of the EAS, will help the Government achieve its goals in the industrial and associated sectors. In the case of metrology, it is a sine qua non that accurate measurement is necessary for improved quality productivity, etc., but there is no way to provide it objectively, i.e. quantifiably. In brief, responsible people must collectively accept the assumption that it is true. Based on the approach outlined above, the justification of the project can now be judged and compared with alternative methods in a more rational or logical manner. It is clear that, in this case, the development objective was not adequately presented or defined at an appropriate level of detail. While this situation has not adversely affected the project itself, once approved, it has led to some parties removed from the scene to express concern whether the project was an appropriate and cost-effective response to Ethiopia's needs. The team does not share this concern but points out that the information in the prodoc is so vague, it is difficult to argue one way or the other. Clarification would almost be a precondition for follow-on UNDP/UNIDO assistance.

While the causal relationship or expected impact of the project on a higher-level government objective, or set of objectives, is the basis for project raison d'être, a similar relationship between the project purpose or immediate objective and the expected project results (or outputs) to be produced by project activities and outputs, is the basis for judging the project design and concept in the project formulation, approved and appraisal stage. They are also the basis for subsequent monitoring and evaluation. Before proceeding further in this analysis, it is necessary to display how the outputs are described in the prodoc:

(a) Well equipped and operational metrological laboratories in the following areas:

- Mechanical measurements (length, mass volume, force, pressure);
- Electrical units measurements;
- Physical chemistry measurements (density, viscosity);
- Time and frequency measurements; and
- Temperature measurements.

(b) Fully trained personnel to ensure sustained operational efficiency of the laboratories;

(c) Legal documents (proclamations, laws, rules) to ensure the proper functioning of the Metrology Centre;

(d) A well designed organizational structure for the Centre including staffing requirements; and

(e) An educational programme designed to introduce the newly established measuring practices and standards to the public at large.

There is, upon analysis, an obvious overlap and confusion between the immediate objectives and the outputs which can be particularly troublesome in institution-building projects. For example, all the outputs taken together are a part of immediate objective (a), i.e. establishment of the NMC. Immediate objective (b) is identical with output (c) and it is difficult to see any output related to intermediate objective (c). Output (a) is not a capability but a service. The confusion between the two is confounded by the lack of specifity in the output statements. Meaningless generalizations have been underlined above, e.g. "well-equipped" and "operational". Unless set in a framework of discrete functions to be carried out, the quantity, quality and type of service to be rendered, and actual and/or expected level of effort (demand), the statements included in the prodoc are not useful for substantive work planning and subsequent implementation, as events in this and its mother project, i.e. ETH/79/003 (NQCTC), clearly demonstrated.

While the UNDP guidelines and definition of the "intermediate objective" are clear enough, including relating it to the "function" of the project, the term itself is misleading, particularly to those who neither have the time or inclination to look further. A better term would be project "purpose", i.e. what change is the project expected to bring about? It is at this level that we can more objectively evaluate whether the project was a success. On the other hand, performance measures at the output level are created by specifying the several outputs and, if necessary, breaking them down into sub-outputs or, in the case of institution-building projects, into "activity modules".

If the purpose is vague and the outputs lack specificity, what does implementation concentrate on, almost by definition? Obviously, the delivery of inputs. This is a necessary but not sufficient condition to ensure project

success. It is difficult under these conditions to relate inputs to work to output and assess their efficiency and completeness. Similarly, faced with such statements, how can an objective and in-depth evaluation be undertaken? It really cannot without first trying to reconstruct what was originally intended, or should have been intended by referring to position descriptions, equipment requisitions, training requests, and by bench-level interrogation, which is what the evaluation mission did in this case.

2. Targeted beneficiaries

While the project document does not address directly who will be the beneficiaries and end-users of the capabilities established in the NMC by the project, they are clear enough and include:

- The NQCTC is a primary or direct beneficiary, as the NMC with calibrate its own instruments and help it in its efforts to improve quality control;

- Another primary beneficiary in the EAS will be the Research and Testing Laboratory Service which will need calibration services and the Standards Specification Department which will use metrology when processing new or revised standards;

- Secondary beneficiaries will be the end-users of NMC services, primarily factories, government ministries and industry corporations; and

- Ethiopian educational, scientific and technological institutions.

3. Prior obligations and prerequisites

It is interesting to note that the only such statement in the project document relates to structural alterations and facilities. No mention is made of any legal requirements, enabling legislation, approval of standards, etc.

4. Findings

The important findings or conditions, based on the above descriptions and analysis, can be stated as:

(a) The description of the development objective is confused with the project and stated in such macro terms that rational analysis of the expected causal relationship is not possible.

(b) Notwithstanding this condition, and given the socio-economic and institutional context of the project, the proposal was a justifiable one in terms of government objectives, priorities and strategies for industrialization. Clarification of the problems being addressed, however, will be necessary for justification of any further assistance to the NMC and/or EAS.

(c) The purpose of the project has not been clearly defined and is confused with the expected outputs which are correctly stated in terms of new capacity, but are so vague as to be almost useless for management purposes, i.e. work planning, reporting, monitoring and evaluation.

(d) Because of the poor design of the project, it is not possible to say with assurance if the project has been successfully completed or even when it has been completed other then when the inputs cease, i.e. there are no explicit or implied objectively verifiable, end-of-project status indicators at the purpose level or performance indicators at the output level.

(e) The consequence of these design deficiencies have been overshowdowed by input delivery problems but are becoming more evident as institutional capability becomes tested in service to its clients and end-users, either mandatory or voluntary, and gaps appears which were not anticipated or adequately planned for. Although the institution-building function is clear, the approach short timeframe and failure to specify laboratory functions does not reflect that "lessons learned" have been applied.

(f) There is no problem with identifying targeted beneficiaries. There are problems, however, in terms of current and projected demand and its effect on capabilities, establishing programme priorities, etc.

C. Project concept for metrology

1. Purpose of national metrology system

The fundamental task of metrology consists in providing a country with a system of uniform, accurate, and precise measurements, and to assure compatibility of the national system of measurements to the international system, thereby serving the total socio-economic life and development of the country, namely to:

- Industry, in promoting controlled technologies and processes;
- Commerce, in assuring accurate measures and avoid collision of interest on exchange of products;
- Agriculture, in helping to control productivity of soil and its auxiliary components, in controlling measurable bioprocesses and performance of food industry;
- Environment, health and labor protection, by establishing precisely defined measures and measurement methods for determining safety levels;
- Public, by protecting consumers and user interests against unjust weights and measures, and incorrect measurements;
- Science, in providing mutual understanding, intercomparison of results and discoveries; to this respect it should be stressed that metrology itself is an interdisciplinary science on measurements hence creating a basis for the development of all branches of human knowledge which need quantitative results;
- Defense, by providing accuracy and precision of measuring instruments which are applied in defense industry and units;
- Quality control, by providing well calibrated instruments and measurements methods where measurable properties of materials and products have to be determined with high accuracy and precision;
- Standardization, by implementing measurable demands of standard.

2. Relationship to quality control

Metrology and quality control have to be interpreted as mutually supporting systems, however, the first being an independent one. This means that metrology is a necessary but insuficient condition for an efficient quality control system.

The unique economic and technical efficiency of metrology considered as a uniform, accurate and tracable to international standards system of meaurements, consist in:

- Providing accuracy, i.e. an essential factor of quality of measuring instrumentation, which means a multiple quality effect because the instruments are further used for quality testing of commercial goods;
- Creating one single, pyramidal calibration scheme in the country for each physical quality, at the top of which is the highest order national standard and at the bottom-commercial instruments, hence avoiding duplication or unnecessary purchases of expensive standards and precise instrumentation by each industrial branch and each sector of national economy;
- The quality of industrial products depends highly on many factors other than measurements, e.g. on innovation, design, engineering, technology, operational reliability and appropriate quality inspection at each step of production, not only at the final one. Moreover, the quality of light industry products depends largely on non-measurable factors, like fashion, style, packaging, people habits and so on.

3. Part of a product system

A very popular but serious error in some quality assurance systems consists in concentrating directly on the end-product and considering the producer as a single addressee of quality requirements, whereas quality of a product should be reviewed throughout all steps of the process from:

- Design;
- Laboratory and experimental or pilot-scale production of prototype;
- Production (industry);
- Distribution (supply, marketing, storage); to
- Maintenance and service.

Moreover, quality involves essential issues such as accreditation, labeling, preshipment, etc.

4. Criteria for establishing a national system of metrology

In light of the above explanation, in designing a national center of metrology the following criteria and guidelines should be applied to assure success and viability:

(a) Select and specify the precise physical quantities to be included in a center's activity; of course, inclusion of the basic quantities of the SI system, or at least those such as length, mass, temperature, time and angel, are axiomatic since without them metrology makes no sense;

(b) For each physical quantity, state the required approximate range of measurements, i.e. the range of reproduction of the given unit of measurement has to be spelled out in quantitative terms;

(c) For each physical quantity, the accuracy level of measurements has to be at least roughly estimated. A common mistake is jumping immediately to high precision before assuring uniformity and minimum necessary accuracy. This can cause a waste of large amounts of money for advanced instrumentation that cannot provide meaningful, i.e. both accurate and precise measurements;

(d) For each physical quantity, expected calibration service of the respective laboratory should be roughly specified.

A design applying these criteria will define the required technical level of the laboratory according to national conditions and development objectives and permit the detailed planning of adequate measuring instrumentation, facilities, laboratory space and installation, and, most important, staffing and skill requirements, i.e. activity modules.

Such a model design process should, by definition, be preceded by a survey of actual and future country needs. However, the capability of a national metrology centre should strive to always to be ahead of the existing industrial measurements level and survey results have to be filtered through metrological knowledge of performance characteristics.

5. Framework for evaluation

The evaluation mission has used the above criteria along with reconstructed statements of project purpose (intermediate objectives) and outputs, to assess the degree of project success achieved to date.

6. Reconstructed project design

Development objective

As discussed above and in chapter III, section C, the statement of the "Development Objective" in the prodoc is too macro, vague and high-level in nature to be useful to assessing either the rationale for orginally approving the project or for subsequent evaluation of project impact. Rather a more specific and lower-level problem area or areas should be related, such as poor product quality impeding export of semi-finished or finished products, low quality of basic inputs constraining productivity in production of textiles, etc. Because of the almost infinite number of variables involved, the time span and cost required to make reasonable observations, and its low relevance to assessing project performance, the team is not attempting to reconstruct this statement. Such an exercise, involving the Government (particularly EAS), UNPD and UNIDO, would be profitable when and if additional assistance is being considered.

Project purpose

The inadequacy or absence of a description of the project propose has been noted. The incumbent CTA, recogninzing the need for such a statement, attempted to provide one in his final report, distributed in January 1989. He wrote:

> "The aim [underscoring supplied] of the project DP/ETH/84/006 - National Metrology Centre - is:
>
> (i) Achieve a valid metrological foundation for measurements, especially in those fields where measurements are required to be traceable to national standards, where uniformity of measurements must be assured, or where safety and health of people are dependent on the results of measurements. Such fields have been found to be:
>
> - measurements in industrial production
> - measurements in industrial research and development
> - measurements in scentific research institutes
> - measurements in connection with conformity tests and type approval
> - measurements in connection with technical/supervision, safety and environmental requirements; and
> - measurements in execution of the Weights and Measures Act (Legal Metrology).
>
> (ii) To assist the Government in expanding its industrial production and in improving the quality of the goods produced by means of the establishment of a metrology center with adequately equipped laboratories and with an appropriate organizational structure, the establishment of the necessary legal measures, laws, regulations, standards, etc. and the modernization of the traditional measurement system now used in rural areas of the country by conversion to the International System of Units."

It seems to the evaluation mission that these statmeents are moving in the right direction. A more succinct statement for our purposes might be:

> (To assist the Government in) Establishing a metrological capability within the Ethiopian Authority for Standards which will provide an appropriate metrological foundation for measurements - especially in those fields where measurements are related to mandatory national standards, required uniformity, safety, health and enviornmental protection - within the EAS systems approach to fullfilling its mission (Proclamation no. 328/1987) to promote and apply standardization, quality control, certification, marking and metrology for the enhancement of national development.

This statement, we believe, puts the project in proper perspective but still correctly reflects its institution-building function and indicates the change which is desired (as from the time of project conception), recognizing the important events which have taken place since 1985. Nevertheless, while the specification of the outputs will help, since the mission of the EAS is continuous it is necessary to provide some end-of-project status indicators which show when the "project" itself has been successfully completed, i.e. the purpose achieved. The EPS indicators must be structured in terms of client use

of the metrological services (e.g. measurements, calibrations, consultation, training) at the level which is appropriate for the stage of institution development expected at the end of the project duration. They may, for example, be in the form of a desired level of services specified as to type, quality and quanity and by targeted-users, e.g. the various departments in EAS, Ministry of Industry, particularly the Industrial Operations Sector and its Quality Control Service, the industry corporations, factories, etc.

This statement should explain when the Government, UNDP and UNIDO have selected the specified project results or outputs and how they expect them, collectively, to successfully achieve the project purpose as measured by the EOPS indicators (which, for credibility purpose, should have been established in the project formulation stage). In other words, establishing the several measurement labs or activity modules at specified levels, and getting the necessary organizational and legal support, will be sufficient to get NMC through the first phase of establishment and initial operations. We have provided specification in annex III.

Project outputs

Output No.1 - Mechanical measurements
(a) length
(b) mass
(c) volume
(d) force
(e) pressure

Output No.2 - Electrical units measurements

Output No.3 - Physical chemistry measurements
(a) density
(b) viscosity
(c) ph

Output No.4 - Time and frequency measurements

Output No.5 - Temperature measurements

Output No.6 - Legal Metrology Division capable of drafting legislation, regulations and legal documents to enable the NMC to carry out its mission

Output No.7 - Support services established for public information, training at plant and managerial levels, and consultation on problem-solving in applied metrology.

Activities/inputs

If the project had followed the design guidelines already provided by UNDP and UNIDO, it would be possible to trace the relationship between inputs to work or activities to outputs. For example, one finances a specific training program to obtain a needed skill level to carry out the function encompassed by the revelant activity module or organizational unit. Since project implementation is almost over, this would serve little purpose at this time. If a phase II or any type of follow on assistance to EAS is contemplated, this should be required as a non-binding annex to the project document.

Table No.1

Evaluation mission's assessment of clarity of major design elements
DP/ETH/84/006

	(0) Missing	(1) Poor	(2) Fair	(3) Satis-factory	(4) Very Good	(5) Excellent
1. Development objective		X				
2. Project objective/purpose			X			
3. Causal relationship between 1 and 3 or project justification			X			
4. Prerequisites		X				
5. Outputs		X				
6. Activities			X			
7. Inputs				X		
8. Critical assumptions	X					
9. End of project status indicators	X					
10. Workplan	X					
OVERALL ASSESSMENT OF PROJECT DESIGN		/X/ poor to fair				

CHAPTER II: PROJECT IMPLEMENTATION

A. Delivery of inputs

UNDP/UNIDO inputs

UNDP/UNIDO inputs are presented in Table No.2. Figures given in this table are commented as follows:

Provision for 1987 expenditures was made in the new IPF (1987-91) to recapture the $135,000 transferred to project ETH/79/003 in October 1983 and part of the $500,000 transfered to other projects in December 1983.

(2) Money allocated for the equipment $539,710 was underestimated, did not result from the real cost of equipment (annex III to prodoc does not include estimated cost). Because of this budget was unrealistic from the beginning, even the increase of budget for $135.000 and some transfer of money from other parts of budget to the equipment component (which in total meant an additional $ 172.934) did not help very much. Moreover, the fall of dollar value and general increase of prices for instruments between 1984-89 of about 30% meant that to purchase all missing instruments from the annex III, another $580,000 would be needed (as roughly estimated by the mission).

The transfer of some money in 1988 from the training to equipment component was fully justified when it was done but it may cause difficulties in fulfilling the fellowship programme in 1989 (fellowships may be cut from three to two months).

Table No. 2

Project Budget Covering UNDP Contribution
(in U.S. dollars)
Mandatory Revision

Country: ETHIOPIA
Project No.: DP/ETH/84/006/B/01/37
Project Title: National Metrology Centre

Code	Project Personnel	Total m/m	Total $	1985 m/m	1985 $	1986 m/m	1986 $	1987 m/m	1987 $	1988 m/m	1988 $	Increase in budget April 1987 $	Total $	Latest budget according to mandatory revision 17.10.88 $
11-01	Chief Technical Adviser	22	181,900	-	-	7	56,650	12	100.200	3	25,050	-	181,900	184,475
15-00	Project Travel	-	3,000	-	-	-	2,000	-	1,000	-	-	-	3,000	5,876
16-00	Other Personnel	-	17,200	-	-	-	2,200	-	15,000	-	-	-	17,200	15,000
19-00	Total Personnel	22	202,100	-	-	7	60,850	12	116,200	3	25,050	-	202,100	198,702
	Subcontracts													
21-00	Subcontracts	30	200,000	-	-	-	-	30	200,000	-	-	-	200,000	194,393
	Training													
31-00	Individual Fellowships	32	99,600	-	-	12	37,390	20	62,300	-	-	30,000	129,690	68,183
32-00	Study Tours	2	18,000	-	-	1	9,000	1	9,000	-	-	-	18,000	17,951
														365 -
39-99	Total Training Component	34	117,690	-	-	13	46,390	21	71,300	-	-	-	147,690	85,769
	Equipment													
41-00	Expendable Equipment	-	6,000	-	-	-	6,000	-	-	-	-	-	6,000	14,031
42-00	Non-expendable Equipment	-	533,710	-	-	-	381,460	-	152,250	-	-	105,000	638,710	698,730
														117 -
49-99	Total Equipment Component	-	539,710	-	-	-	387,460	-	152,250	-	-	105,000	644,710	712,644
	Miscellaneous													
51-00	Sundries	-	5,500	-	-	-	2,500	-	2,000	-	1,000	-	5,500	8,492
59-99	Total Misc.	-	5,500	-	-	-	2,500	-	2,000	-	1,000	-	5,500	8,492
99-99	PROJECT TOTAL	86	1,065,000	-	-	20	497,200	63	541,750	3	26,050	135,000	1,200,000	1,200,000

Government inputs

The Ethiopian Standards Authority assigned its most senior official, the General Manager, of EAS as National Project Coordinator (NPC) for the project as planned in the project document. Moreover, it assigned the requisite adequate number of national professional as counterparts to the CTA and sub-contract personnel employed under the project. The Government also provided physical plant, office furniture, laboratory and support facilities.

Actual government expenditures incurred for projects NQCTC-ETH/79/003 and NMC-ETH/84/006 are as follows:

		Birr
-	National project (26) professional personnel (NQCTC)	625,248
-	Office furniture and equipment (NQCTC)	42,000
-	Building design and construction	7,319,785
-	Metrology lab. building modification	69,804
-	NQCTC equipment purchase	237,247
-	NQCTC expenditure (chemicals for equipment cleaning, local and transport etc.)	154,000
-	National project personnel (40 techn.) metrolcgy	144,000
-	National project personnel (8 prof.) metrology	76,800
	Total	8,668,084

This amount exceeds the amount included in the original prodocs.

B. Implementation of activities

After the Governmental Proclamation No.328 of 1987, the ESI was upgraded to the Ethiopian Authority for Standardization (EAS) and the NMC became the Metrology Department of EAS. The project went operational, from UNIDO's viewpoint, in January 1986 with arrival of the CTA for the first part of his split mission and worked for the project until 3 April 1986. During that time most of the requisitions for the supply of equipment had been prepared and sent to UNIDO. During the second part of his mission (7.10.86.-30.11.87), the CTA started specifying the rest of equipment for purchasing, developing the terms of reference for the subcontractor's team, and modifying the laboratory rooms.

Equipment

All the incoming instruments were checked for physical damage and completness, and their delivery reported to General Manager, SIDFA, UNIDO, etc. The subcontractor's team and CTA installed the instruments and trained the counterparts in their use. All instruments were identified as correctly installed and operational expect one block gange comparator for which the vacuum pump has been sent to the manufacturer for replacement. The lack of many indispensable instruments is traced to the budget problem already explained.

Consultants

At the time of arrival of the subcontractor's team there were only three EAS staff members available for the seven consultants. However, EAS immediately made available nine counterparts including the Head to the National Metrology Centre.

The co-operation between international and national counterparts was very good and productive in terms of instruments installation, on-the-job training and elaborating guidelines and testing/instructions, although the lack of English-language ability for some consultants caused some problems.

Training programme

The project document specified eight international fellowship and two study tours. Three fellowships have already been carried out:

Area	Placement at	Duration	Time schedule
Electrical units	Institute for Ind. Resources and Stand's	8 months	22.6.87-14.8.87
Mass measurements Volume measurements	PBT	3 Months	14.9.87-18.12.87
Density measurements Volume and flow measurements Mass measurements	PBT	3 months	01.09.88-30.11.88

The training programme has been carried out adequately but the period of eight weeks for electrical units and three months for various but related fields is very short. During their stay they could learn to handle measuring instruments and to do calibration work in their respective fields, but it was not possible for them to go into detail. However, the results of training is that they are now in a position to give calibration service to the quality control laboratory of EAS, governmental institutions and industries.

The remaining fellowship programmes are:

Field of training	Placement at	Duration	Time schedule
Temperature and viscosity measurements	PBT	3 months	1.1.89-31.3.89
Length and angle measurements	PBT	3 months	1.1.89-31.3.89
Force and pressure measurements	PBT	3 months	1.1.89-31.3.89
Calibration, maintenance and servicing of time & frequency measuring instruments)	German Calibration Service FRG	3 months	1.6.89-31.8.89
Calibration, maintenance and servicing of electrical units measuring instruments)	German Calibration Service FGR	3 months	1.6.89-31.8.89

A study tour for General Manager to visit France, Switzerland, FRG, GDR, CSSR and Austria took place during May/June 1987. A study tour for the Head of the Technical Service Department of EAS to visit Canada and the United States of America was carried out during May/June 1988. A study tour to visit FRG, CSSR and USSR is planned for the Head of NMC to take place during the middle of 1989. CTA (A.V.) has not found any difficulty in finding the placement for them.

Initiating the operation of laboratories

A separate building in the EAS compound was constructed for laboratories of the NMC. There are six laboratories each having an area of 24 m^2 and one hall of 200 m^2 besides offices, store rooms, services, social facilities etc. The hall has been divided into various laboratory rooms where mainly calibration work can be carried out. All the delivered instruments have been installed and the counterparts trained in the use of them. Through these activities began the initiation of the operation of laboratories. The first services have been produced in the month of April 1988.

Servicing and maintenance

In some cases, project equipment was not supported with necessary accessories, spare parts, ordinary tools, special tools, etc. There is no trained staff in the maintenance of electrical and electronic instruments. The CTA has proposed procuring one test bench with all necessary instruments for the servicing and maintenance of these instruments. It is planned that two of the fellowship holders will be trained on servicing and maintenance in FRG during June/July 1989. While local NMC service is satisfactory and can solve the problems at laboratories, it is important that a general programme for servicing measuring instruments in the country be established by involving foreign producers in this service sector. Such a programme is essential for assuring the efficiency of metrology.

Backstopping

Project formulation - there is no evidence that UNIDO had much input, concern or problems with the project rationale or design. De facto, design was delegated to the CTA of the NQCTC project. UNIDO's principal concern was that the annexes to the prodoc, particularly the position descriptions and equipment specifications, were adequate for subsequent input delivery. UNDP/New York expressed concern with the cost-effectiveness of project rationale and total cost, but not its design.

International staffing - both the CTA's were selected by the Government with UNIDO's role limited to certification.

Contracting - there have been complaints that the bidding for the contract on consultancy services was restricted or otherwise constrained so that some qualified bidders could not adequately compete. The mission could not confirm this but notes that the requirement for English language capability was not meet by the contractor, causing subsequent implementation problems which were only overcome by a team effort.

Purchasing - the normal errors usually associated with preparing specifications and cost estimates for complicated equipment, compounded by a fall in the value of the U.S. dollar, caused some confusion. Communication problems seem to clear up with the arrival of a new CTA, caused partly by the impact of budget reductions.

Training - the training programmes were design by the CTA's and most placements were arranged by them leaving UNIDO's role primarily one of processing, which was done in an efficient manner.

Management - the UNIDO backstopping officer has never visited the project, despite invitations to attend tripartite reviews financed from project funds, due to work pressure. His comments on the latest PPER indicates that his in-depth knowledge of the project concerning the capability to be produced and its use and effect may be limited. On the other hand, he has done a conscientious and effective job, insofar as conditions permitted, to insure the timely delivery of required inputs. No action was taken, however, by any of the concerned parties on ODG/EVAL suggestions in 1986 and 1987 that the project design, particularly the outputs, needed clarification.

C. Management

Inadequate framework

The deficiencies in the project design, particularly in clarifying the purpose or immediate objective of the project and in specifying the outputs in terms of measurable capability, have already been noted. Unfortunately, these deficiencies (i.e. vagueness, generalities, confusion, etc.) affect the whole management process. For example, the so-called "work plan" is simply a bar-chart which schedules the delivery of inputs and related activities. It does not result in a work plan to produce the outputs, i.e. on how the inputs (resources) will be used to finance activities (e.g. on-the-job training) to reach the desired skill level of capability. Because the outputs are stated in generalities, no progress (milestones) or performance (specifications) indicators are provided for monitioring and reporting purpose. Similarly, when all the real outputs, i.e. the various measurement categories, are collapsed into one output statement, as was done in the prodoc and in the PPERs, statements of baseline, targets and progress are so generalized as to defeat the whole purpose of using activity modules in institution-building projects. In brief, a poor design does not promote an adequate framework for planning, monitoring, reporting and reviewing progress towards achieving the porject purpose. By default, management concentrates on inputs and the activity involved in their delivery.

Reporting and monitoring

As noted just above, meaningful reporting and monitoring, especially by UNIDO Headquarters, has been constrained by (i) the absence of output-oriented milestones and progress indicators; and (ii) no project visits by the backstopping officer.

Review and evaluation

If the history of this project reflects little progress in improving project design with a focus on the development use of the project results, the picture regarding review and evaluation is much more encouraging. A review of the minutes of the 1987 tripartite review and an interview with its chairman clearly demonstrates that it focused on substantive problems and was held in a "business-like manner". Preparation of the PPER beforehand obviously contributed to this result. A perusal of the in-depth evaluation of 003 (and hopefully of this report) will also indicate that they are being integrated into the management and decision-making process. In fact, if any criticism can be made, it is that the parties may be relying too much on independent

evaluation rather than on the use of routine project management tools (e.g. milestone-oriented work plans, progress indicators, annual reviews, etc.) by the responsible managers.

Overall assessment

The evaluation mission's overall assessment of implementation activities is very good. See Table No.3 for detailed assessements.

Table No.3

Evaluation mission's assessment of implementation activities
DP/ETH/84/006

	(0) Nothing	(1) Poor	(2) Fair	(3) Satis-factory	(4) Very Good	(5) Excellent
1. Technical advice						
CTA # 1			X			
CTA # 2						X
2. Training programme/placement					X	
3. Requisition and purchase of equipment				X		
4. Installation and certification of instruments				X		
5. Building construction/ adaptation					X	
6. Management				X		
OVERALL ASSESSMENT OF IMPLEMENTATION					/X/ Very good	

CHAPTER III. PROJECT RESULTS AND ACHIEVEMENT OF OBJECTIVES

A. Outputs

The evaluation has been carried out in reference to the planned outputs by investigating, stepwise, respective laboratory units, equipment at place, facilities, documents and discussing the relevant technical problems with CTA, Chief of Metrology Department and metrology personnel.

The mission adopted the following procedure, recognizing the existance of technical gaps in the project document: first, due to the lack of a complete survey of country's needs for metrological services and lack of information about planned range and accuracy of measurements for each physical quantity included in the project (such as length, mass, etc.), the reference planned level of measurements was estimated as that indispensable in almost all less developed countries. Some reference data was also estimated from the known or assumed accuracy of the instruments listed in annex III to the project document. By filtering all these assumptions through the general metrological knowledge which, fortunately, well defines what has to be done at the beginning and what areas of measurements are of highest importance independently of a country's economy and geographic location, the mission was able to find out what most probably was meant in part II.D of the project document under the term "well equipped and operational metrology laboratories ..." and to assess the actual state-of-the-art along a favour-to-disfavour scale of achievements, as follows:

5 extraordinary
4 more than planned
3 as planned
2 less than planned
1 marginal
0 no capability

Considering that this is an institution-building project planned for only 2 1/4 years, the team has tempered its statements keeping in mind the unusually short time provided for achieving the immediate objective and outputs. First, attention is drawn to the laboratory capability to (i) provide metrological services; then (ii) to assure traceability of its metrological standards to the lowest international level or at least to the level of reputable organizations in advanced countries. Measurements of each physical quantity were investigated separately along the full chain of expected outputs, but findings and conclusions were collected in the following components to avoid duplication of some statements:

(1) Building component
(2) Laboratory measurements capability component
(3) Organization component
(4) National metrological standards component
(5) Metrological services component
(6) Equipment component
(7) Documents component
(8) Personnel component
(9) Educational programme component

1. Building component

Assessment: as planned

The physical plant reflects the actual needs of the National Metrology Centre and is well designed and constructed. Facilities are appropriate and the location avoids danger of outside distrurbing influences. The air conditioning system does not work properly whereas it is vitaly needed. A supply of demineralized water from a small installation is needed to avoid high energy loss on distillation; the distilled water is now brought in containers from the quality testing laboratory is not adequate for instrument transformers.

With development of services and increased demand, the laboratory space will become insufficient in the perspective plans of 1985-2000. The needed additional laboratory space is estimated roughly at 400 m^2 current space.

2. Laboratory measurements capability component

Overall assessment: less than planned

The 21 measurement areas listed below (physical quantities) were defined and investigated. Those four which the mission considers of highest importance (i.e. measurements of mass, length, time and temperature), 13 of high importance (measurements of angle, volume, force, pressure, DC and AC voltage, DC and AC current, energy, power, resistance, density and frequency), and four being important (measurements of inductance, capacitance, instrument transformers, viscosity). No measurements that could be neglected in terms of country needs were identified. The overall characteristics of the actual state-of-the-art of the NMC is presented in Table No.4 and may be commented as follows:

Table No.4

Actual state-of-the-art of the NMC compared to outputs included in the project document

Lab. capability vs. standards level and services		Number of measurement areas			
			Subtotals of		
Value	Assessment	Total	Highest Importance	High Importance	Importance
5	Extraordinary	-	-	-	-
4	More than planned	1	1	-	-
3	As planned	8	1	7	0
2	Less than planned	5	1	4	-
1	Marginal	2	1	1	-
0	None	5	-	1	4
	Overall	21	4	13	4

Nothing was done in 24% of the measurement areas which are relatively less important than the others.

Considering value categories 2-4 as reflecting the requirements of the project document, 66% of the laboratory component output is assessed as correct. It incorporates most of the measurement areas of highest and high importance.

Disturbing figures concerning instruments supply were presented above in anticipation of discussing the equipment component to justify, whenever applicable, lower results than planned, and to avoid duplication of statements in the below presented detailed description of measurement areas.

2.1 Mechanical measurements - general assessment: as planned

Length - assessment: less than planned

A capability was achieved to calibrate a part of industrial and commercial instruments, to provide working standards used by inspectors to calibrate all length measuring instruments in the country, to calibrate micrometers and dial guages for the NQCTC of EAS, and to provide consultations to over 25 factories. The following fields of operation are missing due to the lack of instruments:

- Calibration of line gauges (measures)
- Calibration of tapes
- Profile measurements

Unfortunately, roughness and surface (smoothness) were omitted which are of major importance to industry.

Angle - general assessment: less than planned

[Note: Angle has not been spelled out under part II.D.1, but planned through instruments no.12-15 in annex III to project document.]

Adequate capability was achieved to reproduce the unit of angle but due to the lack of equipment, no calibration services can be provided.

Volume - assessment: as planned within the range 0.1-1000 dm^3

However, tank load measurements are not ready to become operational. Missed are accessories to calibrate big reservoirs from dimensional measurements (ref. No.54, annex III to project document). Unfortunately, dynamic volume measurements, i.e. flow measurements, were missed in the project document. They are of major importance for industry and commerce, e.g. water flow meters.

Mass - assessment: more than planned in the range 1 mg ton 10 kg

The laboratory will achieve full capability if it receives two missing balances of 50 and 500 Kg and respective sets of weights.

Force - assessment: as planned in the range 1 KN - 500 KN accuracy 0.1%

Load cells were replaced by proving rings resulting in reduction of calibration capability. Compression and tension dynameters were identified in proper use.

Pressure - assessment: as planned up to 60 MPa

However, needs were identified to increase the upper range of measurements to 120 MPa and lower range to 100-700 KPa. Noticed were calibrations done for the NQCTC.

Electrical units measurements - general assessment: less than planned

[Note: these units were not named in the project document, but could be indirectly defined by the mission from the equipment list.]

DC voltage - assessment:
as planned in standards level
less than planned in calibration capability

AC voltage - assessment:
marginal in standards level
marginal in calibration capability

DC current - assessment:
as planned in standards level
as planned in calibration capability

AC current - assessment:
as planned in standards level
as planned in calibration capability
However, a current supply instrument is needed.

Inductance - general assessment: no capability

Capacitance - general assessment: no capability

Power - general assessment: no capability

Instrument transformers - general assessemnt: no capability

Nothing could be achieved under several measurements since about 10 essential instruments were missing (79-81, 84-90 in annex III of the project document). Project management should be aware that the power and instrument transformer test sets are very expensive and their installation may require additional space.

Energy - assessment: less than planned both in standards level and calibration capability

Resistance - assessment:
as planned in standards level
none in calibration capability

2.3 Physical chemistry measurements - general assessment: marginal

Viscosity - assessment: no capability
Though viscosity is included in the expected outputs, no instrument for its measurements was planned in the original project document which was a mistake. However, it is noted that one metrologist has been trained abroad and in the local laboratory in viscosity measurements. This can be explained only in view of future assistance to the Quality Testing Laboratory.

Density - assessment:
as planned in standards
marginal in calibration capability

Actual standards have a limited application because of the lack of basic and auxiliary equipment: hydrostatic balance, thermostats, calibration liquids, and S.O. However, successful calibration was performed by using borrowed facilities.

2.4 Time and frequency measurements - general assessment: less than planned

Frequency - assessment:
as planned for standards level
less than planned in calibration capability
Despite general lack of equipment, some calibration possibilities resulted from additional supply of a quartz oscillator.

Time - assessment: less than planned
Atomic time scale - assessment: less than planned
This is due to the lack of essential instrument no. 91 from annex III to the project document. For the time being, however, the rabidium clock may substitute for it provided facilities for receiving universal time signals become available.

Distribution of time - assessment: more than planned
because nothing was mentioned in the project document. Distribution of time signals throughout the country is of extreme importance, much higher than creation of a time scale. In this respect, much has been accomplished due to CTA (A.V.) initiative to build up a system which consists of a transmitter and a receiver of time signals with a preliminary accuracy of one ms. The work is almost completed but needs some additional equipment.

2.5. Temperature measurements - general assessment:
as planned within range -15°C to 1100°C, both in standards level and calibration capability
less than planned within the range up to 2300°C both in standards level and calibration capability
Because only one optical pyrometer is available, whereas lacking are eight instruments listed in annex III to the project document. It is stressed that the upper range of temperature measurements (up to 2300°C) could not been proved (even by assumptions) as needed in Ethiopia.

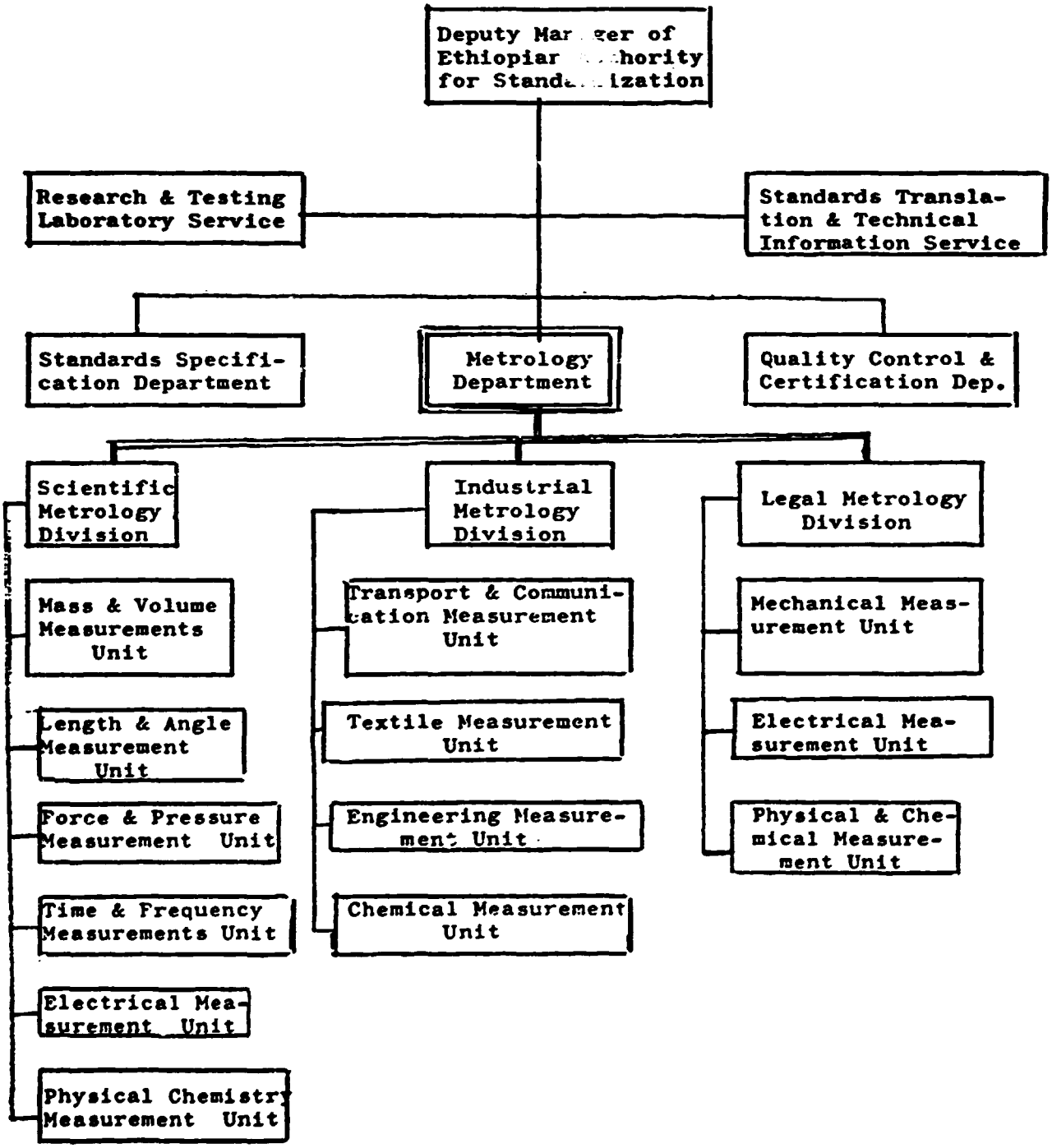
3. Organization of NMC (see Table No.5)

General assessment: as planned
This output is cited in the project document. Whether the National Metrology Centre, which recently became the Metrology Department of EAS, was well organized or not will be seen in the near future when it will be possible to assess the usefulness of each unit. This, of course, is up to EAS but any changes in the organization should consider the following comments:

- Distribution of activities between many units which are or will be staffed by only one or two metrologists, respectively, hardly reflects operational demands. People of the same technical profession should co-operate with each other as close as possible. Therefore, horizontal linkage of units may be identified as advantageous in the future.

Table No.5

Actual Organization of National Metrology Centre Which Became Metrology Department



- The physical chemistry measurements unit consists only of density measurements (viscosity simply does not exist). Since the density is closely related to mass and volume, the physical chemistry measurements unit could be cancelled with density transferred to the "Mass and Volume Measurements Unit". The same advice applies to Chemical Measurements Unit and Physical and Chemical Measurements Unit within Industrial Metrology and Legal Metrology, respectively.

- The Textile Measurement Unit does not fit into a metrology scheme. Being, as it seems to be considered, important to EAS it might be transferred to - and combined with - a respective section of the Quality Control Department.

4. National Metrological Standards Component

General assessment: as planned

Under the term "National metrological standard" an entire module, including instrument, reference standard, facilities and a man capable of operating it, is understood. It is able to reproduce the given unit of measurements and transfer it to the industry, commerce and other sectors at a defined level of accuracy, and provide traceability to international standards.

The actual level of National Meterological Standards is presented in Table No.6 with the following comments:

- Four basic and five derived SI units of measurements are reproduced in Ethiopia within a range and accuracy of measurements traceable at a low but well established level to international standards;

- Achieving this result within two years of project implementation has to be interpreted as an excellent;

- The investigations and all possible technical efforts, considered as a continuous work on National Meterological Standards, should be carried out parallel with conservation and improvement of those already established standards and on developing new ones within the area of NMC operation, keeping in mind gradation of units given;

- In some countries, National Metrological Standards are granted a special document issued in one copy only, which is called "Passport of National Meterological Standard", signed by the Head of Standards Authority. The EAS may wish to consider this form of justification of National Metrology Standards;

- In part B of Table No.6 recommendations are made concerning frequency and accuracy of recalibration of National Meterological Standards. Almost all of them should be recalibrated abroad in four year intervals.

Table No.6

Characteristics of actual national metrological standards

A. Actual level of national standards

Physical Quantity	Unit	Standard	Nominal value or range	Accuracy (Uncertainty)	Last International Calibration Institution	Date	Contact Person(s) for the Specific area
Length	m	Block gauges	0.5 μm 500mm	$\pm$ 0.05-$\pm$0.4 μm	Johansson	1987	
"	"	Universal Measuring Machine	1016mm	$\pm$ 0.7 μm	SIP	1988	
Length	"	Steel Tape	20m		PTB	1988	
Angle	rad	12 Face Polygon	30°	1"	Rank	1987	
Mass	kg	1 kg	1 kg	$\pm$ 73 μg	NBS	1988	
Temperature	Kelvin	L.G.Thermometer	-6 upto 360°C	$\pm$ 0.02°C	Thermo-Schenider	1986	
		Platinum resistance	-180°C up to 627°C	$\pm$ 0.001°C	NPL	1986	
		P-Rh Thermocouple(Pt-10%Rh-Pt)	10°C upto 1100°C	$\pm$ 0.3°C	NPL	1980	
Pressure	Pa	dead-weight Tester PR Tester	60MPa	$\pm$ 0.03%	NPL	1987	
Atm.Pressure	Pa	Control Barometer	Upto 0.1MPa	$\pm$ 0.05%	GERMANY		
Force	N	Proving rings (Set)	1 to 500 kN	0.1%	DKD/FRG	1987	
DC Volt	V	Transvolt	1.0181177	$\pm$ 0.7 V	Guildline	1986	
		Standard Resistor	0.001 ohm upto				
DC Resistance	ohm		1 M ohm	$\pm$ 0.005%	Tinsley	1986	
Frequency	Hz	Rubidium F.S.	5 MHz	$\pm$ 8×10^{-12}	Rohde & Schwartz	1987	

B. National metrological standards which should be calibrated abroad

Physical Quantity	Standard	Nominal Value or Range	Accuracy (Uncertainty)	Recalibration Interval
Mass	1 kg	1 kg	± 73 μg	4 years
Resistance	Standard resistor	1.0 ohm	± 0.005%	4 years
Force	Proving rings	500 kN	± 0.1%	4 years
Tempera-ture	a) PRT	upto 627°C	± 0.001°C	3 years
	b) P-Rh thermocouple (type S)	10°C upto 1100°C	± 0.3°C	4 years
Volt	Weston cells	1.018110 V	± 1 μV	depending on the drift
Length	Block gauges	upto 100 mm	± 0.05 μm	4 years

5. Metrological Services

General assessment: as planned

Metrological services are presented in Table No.7 and shall be commented as follows:

In 1988 the NMC was not only capable to perform some calibration services, but it actually calibrated 233 instruments at the demand of various industrial sectors. This means that in some areas more has been achieved than expected in the prodoc. However, in other areas, laboratories were not ready to perform services. This implies an average assessment that the output in servicing clients was found "as planned". Calibration of standards by NMC for inspectors who provide numerous metrological services in the country, listed in part B of Table No.7, means an even more important result than that coming from direct calibration. The services done by NMC were carried out along correct procedures. Performance was effective, but yet not fully efficient. To become fully efficient, much more of auxiliary equipment and tools are needed. The efficiency also depends highly on the experience of the metrologists which comes with years of practice. Because industrial needs for calibration are raising, new mandatory product standards are being developed. It is expected that the volume of metrological services provided by the project laboratories will expand. It was found, too, that the metrological services treated as a whole provide almost enough money from fees collection to become self-sufficient. This is an unexpected important factor when making judgements regarding the sustainability of the NMC. It was also found that besides metrological calibration services, NMC provided some voluntary maintenance services for industry, e.g. by repairing and adjusting balances.

Table No.7

Metrological services performed by National Metrology Centre and by Legal Metrology

A. Industrial Metrology Division
6 months statistics April-October 1988

Balance and weight sets	25
Pressure measuring instruments	40
Thermometers	51
Length measuring instruments	33
Electrical multimeters	9
Saccharometers, picnometers ect.	68
Force measuring instruments	7

B. Weights and Measures (Legal Metrology Division)
Half year Statistics 1988*

Balances	17,838
Weight pieces	21,764
Length measures	1,646
Volumeters	850
Fuel pumps	718
Lorry Tanks	192

* Done by field inspectors by using standards calibrated through the project's labs.

6. Equipment Component

General assessment: less than planned

Only 60 from 107 planned instruments have been provided. Those, which are indispensable to make the project successful, in an up-dated form, are listed in annex III and collected in three categories:

(a) Fulfilling prodoc demands
    1) partially in its most important area
    2) as a whole (but without set-ups for transformers)

(b) Bringing NMC to a more productive function by adding some important but inexpensive measurements belonging to mechanics, physical chemistry, etc. Estimated needs are A1 - US$ 250,000, A2 - US$ 200,000, B - US$ 130,000, plus training at 10% and consultants at 5%.

7. Legal Documents

General assessment: more than planned

First, the adjective "legal" means "official" in science and technology. Otherwise all scientific and technical literature would become illegal in the sense of lawless or false issues. This means that each document approved by an authorized office becomes legal. Consequently, all written standards are doubtless legal documents within the country. If so, the output of project can be characterized as follows:

- 40 metrological standards, i.e. legal documents, what means in the mission adopted scale: more than planned;

- 99 draft documents of lower order, like guidelines and testing instructions which until checked for applicability and approved by EAS have to be interpretted as technical reference literature; in the mission scale, this means an extraordinary result.

What is really lacking is the establishment of a national law on measurements and measuring instruments, called hereinafter "Governmental Proclamation on Metrology", or simply Proclamation, in consequence of which some few basic regulations concerning e.g. list of instruments under mandatory testing, calibration fees, instruments handling, could have been issued by EAS.

The difficulty consists in that the Governmental Proclamation involves immediately authority, political and even sovereignity implications which should not interfere with the project. From the other side the problem consists in that good examples for a less developed country are hardly available, if any. Advanced countries focused their attention on the production of instruments, while those less developed which have a small production should first of all care of the imported instruments.

What project people and EAS staff should and could elaborate working toegther are three variants of a general design of the proclamation, organized in technical, financial and organizational terms. The variants should differ with each other in areas and depth of state supervision but all should adopt following structure:

- Be as short and flexible as possible, do not go into unnecessary details;

- Beyond the governmental part, give full power to the EAS;

- Do not overestimate NMC capability in testing;

- Bring all those instruments and material standards which serve to calibrate the others under mandatory EAS control;

- Focus the attention on imported instruments;

- Distinguish legalization from approval of prototypes;

- Under no condition permit inflow into the country of instruments calibrated in illegal units of measurements;

- Permit experienced well-equipped organizations to act on behalf of EAS in calibration services under EAS supervision.

Drafts of Proclamation which were reviewed by the mission do not correspond with the above listed requirements.

8. Personnel Component

General assessment: as planned

Staffing of labs is presented in Table No.8, supplemented by the following comments:

- Staffing of NMC laboratories is actually adequate to the demands of prodoc. However, it is both risky and inconvenient to have only one specialist for one broad area of measurements. In case of his absence no services can be done. In case he leaves, all investment in training is lost and the whole area of given measurements becomes discontinued (sometimes for years). Therefore, it is recommended to hire stepwise additional metrologists and technicians, especially if volume of services is expanding;

- Staffing of inspectors has achieved much higher level than planned;

- From direct observations and talks, mission concluded that all four metrologists were well-trained and carefully performing calibration services.

Table No.8

Staffing of labs

		Present		Future (5 years)	
		Professional	Technician	Professional	Technician
1.	Scientific Metrology Division				
1.	Length and angle	1	-	2	1
2.	Mass and volume	1	-	2	1
3.	Physical chemistry	1	-	2	1
4.	Time and frequency	1	-	2	-
5.	Force and pressure	1	-	2	1
6.	Electrical	1	-	2	-
2.	Industrial Metrology Division				
1.	Transport and communication	-	-	1	1
2.	Engineering	-	-	2	2
3.	Chemical	-	-	1	1
3.	Legal Metrology				
1.	Mechanical measurement	1	40	2	50
2.	Electrical	-	-	1	5
3.	Physical chemistry	-	-	1	5

Note: Classification of professionals into divisions is not rigid.

9. Educational Programme Component

General assessment: less than planned

(this is described in chapter II)

Various significant efforts and issues were noticed, however, the programme itself is lacking and needs to be developed as soon as possible.

10. Assessment of Outputs

The overall assessment of outputs is somewhat less than planned. See Table No.9 for details.

Table No.9

Evaluation mission's assessment of results (outputs in prodoc) capacity
DP/ETH/84/006

	(0) None	(1) Marginal	(2) Less than Planned	(3) As Planned	(4) More than Good	(5) Extraordinary
Output No. 1 - Laboratories						
(i) mechanical ms'ts				X		
(ii) electrical units ms'ts			X			
(iii) physical chemistry ms'ts		X				
(iv) time and sequence ms'ts				X		
(v) temperature ms'ts				X		
Summary assessment			X			
Output No. 2 - Skills acquisition						
(i) mechanical ms'ts				X		
(ii) electrical units ms'ts				X		
(iii) physical chemistry ms'ts				X		
(iv) time and sequence ms'ts				X		
(v) temperature ms'ts				X		
Summary assessment				X		
Output No. 3 - Legal documents						
(i) standards					X	
(ii) guidelines and instructions						X
(iii) Gov't proclamations		X				
Summary assessment					X	
Output No. 4 - Organization				X		
Output No. 5 - Education			X			

OVERALL ASSESSMENT OF RESULTS /X/ Somewhat less than planned

B. Achievement of the immediate objective

Using the purpose statement reconstructed in chapter I, the evaluation mission assessed the achievement of the project purpose, i.e. effectiveness, as satisfactory and even quite remarkable given the limited duration of the project and the short time the NMC has been operational. Among the criteria used to make this judgement in this institution-building project are the following:

- Since standards are mandatory, particularly for weights and measures, establishing relationships with clients is almost automatic. It is worth noting that even where standards are still voluntary, the NMC has been responding to industry clients for calibration services and even providing some voluntary repair of measuring instruments;

- Certainly, as a part of the EAS, the Metrology Department is integrated into the national structure and, closer to home, is working very closely with the Quality Control Department. There have been several joint endeavours, including workshops and on-site problem-solving to improve quality content;

- Workload statistics (see Table No.7) show an impressive output of the NMC for the first six operational months of its existance;

- Since fees are changed for calibration services and metrology is now an integral part of the total national standards programme, the usual problems of sustainability facing many young industrial research and services organizations do not appear to be major factors for the NAM. It remains to be seen, however, what happens to staff retentions, given the current low-paying civil service salary structure and the increasing opportunities for outside employment as the Ethiopian industrial base expands.

C. Linkage between metrology and quality control laboratories of EAS

After the installation of equipment in the metrology laboratories, Quality Control Laboratories of EAS, industries and governmental institutions were informed about the calibration facilities of Metrology Department and importance of calibration. Among others, the Quality Control Laboratories of EAS took advantage of it. So far, the Quality Control Department has submitted 10 requests for calibration of instruments in the fields of mass, electricity and length. Metrology Department was able to carry out these calibrations.

D. Contribution to the achievement of the development of objective

The necessity to clarify the development objective by making it more micro or lower-level and constraint-oriented has been explained in chapter I. It is also rather arbitrary and pointless to isolate metrology from standards, quality control, etc., when either attempting to justify a project rationale or measuring its benefits. This section is being presented within a total or systems approach to improving the quality of industrial and consumer products, the only way the team believes that its contribution to the economy can be reasonably judged.

Rationale

To a significant extent the need for an appropriate meterological foundation for measurements, traceable to national standards, to provide uniformity, and assure safety and health, is self-evident and is also a prerequisite to industrial development. What can be questioned, is the approach to take, e.g., should standards be mandatory or primarily determined by market forces, should they be developed and enforced by industry itself, by government or largely shaped by market forces, etc.?

This project was formulated after Ethiopia adopted a socialistic political and economic system but many institutions were still operating under pervious mandates such as the Ethiopian Standards Institute. Since 1985, two very important events have taken place. First, Proclamation No. 328/1987, transformed ESI into an authority reporting to the Council of Ministers (see chapter I) and assigned the mission to (a) promote standardization, quality control, certification and metrology activities; and (b) ensure the quality and safety of products. Among the power and duties given EAS were:

- Prepare, improve or change compulsory Ethiopian Standards relating to goods, practices and processes in this economic sector and follow up the implementation of same;

- Affix the standard marks to goods which conform to Ethiopian standards;

- Inspect and certify the conformity of measuring instruments to Ethiopian Standards, and seize those which do not confirm; and

- Devise ways and means of gradually abolishing the use of traditional units of measurements.

The second major event was the formal approval in 1988 of 281 new standards, making a total of 389 standards to be enforced covering 120 products with a large backlog of more new standards. Given the political-economic-institutional context and government plans to establish the basis for moderate industrialization, the rationale seems unassailible, the only question being whether quality control and calibration should be centralized, as it is in Proclamation No. 328, or decentralized at this stage of industrial development. The team believes the Government made the correct choice although great care must be given as to the scope, depth and detail to which mandatory procedures, regulations, instructions and similar guidance are eventually required (refer to "legal problems").

Benefits

In chapter III, the services provided by the fledgeling NMC since it became operational have been provided. Herein are some examples of more tangible benefits traceable to the capabilities created and strengthened in projects 003 and 006 as reported to the mission by Ethiopian Government officials outside of EAS.

- The General Manager for General Goods of the Ethiopian Import/Export Corporation cited ample evidence that although only recently established, standards are showing a beneficial impact. He cited several examples where NQCTC testing help them determine that external suppliers, e.g. of razor blades, were not meeting the specifications in the call for bids. This gives the corporation the option of refusing the bid and a great deal of leverage in price negotiation.

- In another example, it was discovered that an aerosol insecticide sold for home use did not meet WHO and Ministry of Health specifications and was unfit for human use.

- Another official, formerly involved in Price Polices and Studies Department of the ONCCP, explained the cost plus approach used to determine prices. When appraising the cost components, the quality levels promoted in the standards, e.g. for galvanized steel sheets, now allow the government to set price differentials based on quality thereby giving the consumer more choice at equitable prices, particularly where there is a seller's market, i.e., only one domestic source of supply.

- This official also cited hides and skins as an example of how standards ensure the quality and increase the price and market for agricultural products. Hides and skins are the second most important export commodity in Ethiopia. Because of poor preparation and grading, price quotations were based on low average values. Improved procession and grading and the introduction of standardization resulted in price increases which, in turn, fostered further improvements in processing and preparation resulting in greater productivity.

- The Head of Export Department in the Ministry of Foreign Trade explained how they require, before a contract with a foreign buyers is approved, that the Ethiopian Standard be met. He cited an example where the EAS served as a mediator. There was a problem of quality on green beans which were supplied by the Oilseeds and Pulses Export Corporation. He asked for the intervention of the ESA who determined that the problem was in the poor selection make from the farmers rather than in storage and transportation.

- The Akaki Spare Parts and Small Tools Factory, only recently inaugurated and representative of the new type of industrial base being built up, has already used the services of the NMC to calibrate and certify its measuring instruments. With emphasis on the design of replacement parts, quality control is essential, including, for example, in establishing standards for tools, measuring instruments must be reliable and a closely collaboration with EAS is envisioned.

- Other factories visited, including a private engineering firm and the Ethiopian Airlines, cited the savings that are achieved when they can use the NMC for reference standards rather than sending their instruments abroad.

Assessment

Based on the framework and the illustrative but representatives benefits described just above, the team believes the project rationale is, if anything, stronger than when the project was formulated and approved. Although the EAS, and particularly the NMC and NQCTC, is relatively new, benefits are appearing in increasing numbers, range and importance. Therefore, the teams overall assessment of the potential/actual importance and significance of the EAS, and its two major components which have received UNDP/UNIDO assistance, is "excellent".

CHAPTER IV. CONCLUSIONS

1. Project formulation

The design of this project, essentially done by the CTA of the National Quality Control and Testing Centre project, was deficient in several important aspects and partially caused by the rush to execute a project document which focussed on the determination of input requirements (31 pages) and gave brief attention (less than five pages) to the design framework. These deficiencies included:

. A development objective of such high-level vagueness that it was impossible to hypothesize a reasonable causal relationship between the project purpose and a high-level objective causing the project rationale or justification to be subject to unnecessary and uninformed review and needless delays.

. A confusion between the purpose of the project and the outputs or results required to sucessfully complete the project (although the institution-building function was clear from the beginning), which was combined with the lack of specificity (i.e., type, quantity and quality) in the outputs, the absence of explicit or implied end-of-project and performance indicators, resulted in an input rather than output-oriented system for project management subject to considerable interpretation/misinterpretation.

. The "lessons learned" from the evaluation of similar projects, including DP/ETH/79/003, and the guidelines for planning and managing of institution-building projects provided by UNDP and UNIDO, are not reflected in the design causing, inter alia, absence of an explanation of the project "concept" for metrology, failure to recognize the time-period necessary for the start-up or initial phase in institution-building, no recognition of the usefulness of describing laboratory units as activety modules, and similar experience which might have improved project effectiveness and efficiency, e.g., the determination of the accurancy range appropriate for each measurement category.

. The prodoc did not include very important measurement components (activity modules) for roughness and surface finish (smoothness), humidity and moisture, flow, and time distribution. Whether this was an unintended omission or in reaction to decreased funding availability is unknown.

. Budget estimates for equipment, which were not related to activity modules or measurement units, were unrealistically low and it was impossible to analyze how funding reductions would affect intended institution capability.

The above just described conditions, if typical of the design of other large-scale projects executed by UNIDO and other executing agencies, and in spite of multiple and serious efforts made on the part of UNDP to improve project design in the past few years, indicate that this may still remain a critical problem requiring high-level attention.

2. Implementation

Either because of the budget problem and/or a poor initial job in determining instrumentation requirements, 47 out of 107 instruments included in the prodoc could not be delivered causing cnsiderable concern throughout the project life to the NMC, CTA and UNIDO, both in the field and at headquarters.

Otherwise, backstopping of the project was satisfactory and there was better communication when the second CTA was recruited. No serious problems existed inthe training programmes, except some may have been too short in duration and, except for deficiencies in English language capabilities, the consultancies supplied were also satisfactory.

Management of the project, at least in the latter portion, has been satisfactory. However, both in 1986 and 1987, in its review of the annual self-evaluation reports the UNIDO Evaluation Staff pointed out the urgent need for a project redesign/specification, and no action was taken by any of the parties concerned in Vienna or Addis Ababa. On the otherhsnd, the only Tripartite Review held in 1987 and based on the most recent PPER was conducted in a very "business-like manner" concentratng on matters of considerable substance and importance. While much remains to improve the effectiveness of project design, the self-evaluation, tripartite review, and external in-depth evaluations are clearly contributing to focussing more attention on the expected results and their use by targeted clients/end-users in the intended manner.

3. Results

Because of the design deficiencies mentioned above, it was necessary to reconstruct the original statements of intermediate objectives and outputs by referring to position descriptions, training programmes, equipment supplied, and bench-level interrogations before a reasonable objective and meaningful assessment of results could be made within the framework of creating NMC capability to carry out its mission.

While the Evaluation Mission's assessment of results is somewhat less than planned, there are mitigating circumstances, e.g., the 47 missing instruments and the very short period the NMC has been operating (less than one year), which leads it to concludse that results have been, in reality, quite satisfactcry due, in no small part, to the professional competence and dedication of both national staff and the current CTA.

The conversion of ESI into EAS certainly strengthens the need for a metrological foundation in Ethiopia and the approval of 281 new standards increases the potential workload of the NMC considerably. This will increase the pressure both to fill in the gaps in existing measurement categories and to add new ones.

The problem regarding legal documents has been partially one of communication and more concerned with the level of legality required for testing instructions, frequency requirements, and the correct approval level - decisions which are not a direct responsibility of the project itself but which need resolution before the outputs can be effectively used.

The evaluation mission agrees with the de facto action taken to eliminate intermediate objective no. 3, i.e., "the modernization of the traditional measurement system now used in the rural areas of the country by conversion to the International System of Units". While this should remain a Government goal, it is not a timely or appropriate result to be included in this project.

In a similar view, conducting an education programme is not an appropriate output for an institution-building project although some starts in that direction were made.

The reorganization which followed the creation of the ESA, in effect, overtook any project plans for organization. While the current organization is adequate, the Mission has some concern that organizational plans for the Metrological Department may be over-elaborate and too compartmentalized.

4. Significance/impact/sustainability

When, as already suggested, national development plans for industry are brought down from the macro-level to the actual problems and constraints which are impeding progress, it is then possible to trace benefits from standards, particularly when viewed as a system including the establishment and updating of standards, certification of quality, calibration of instruments, etc. Viewing metrology within this concept, and recognizing the short time that project-generated capability in quality control, testing and instrument calibration has been in being, benefits are beginning to increase in type, frequency and significance.

The EAS, and its constituent parts, is self-sufficient in the sense that inspection and similar fees cover all local currency expenses, removing a common problem which plagues similar institution in the developing world. The need for new instruments, however, will continue to require Government subsidy and the use of scare foreign currency. While staff qualifications and turnover is not yet a problem, they may become so in the future if the new salary structure presented to the Government by the EAS or some similar plan is not adopted.

At this point, there is no evidence to indicate that the project results are not signficant or sustainable and the Evaluation Mission assesses the potential impact as very good.

5. Overall project assessment

The evaluation mission concludes that this has been a reasonably successful project with a very good potential impact. See Table No.10 for assessment by function.

Table No.10

Overall evaluation mission assessment
DP/ETH/84/006

	(0) Cannot Determine	(1) Poor	(2) Fair	(3) Success-full	(4) Very Good	(5) Outstanding Extra-ordinary
1. Efficiency						
Delivery and conversion of inputs into outputs				X		
2. Effectiveness						
Achievement of project purpose				X		
3. Impact/Significance						
Effect on development objective, problem or constraint (actual/ potential)					X	
Overall Project Assessment						
A reasonably successful project with very good actual and potential benefits				X		

CHAPTER V. RECOMMENDATIONS

1. Any proposal for a Phase II, or a new approach as recommended below, should identify sectorial problems and constraints upon which the project is expected to impact/ameliorate, thereby establishing a sound rationale for justification and expected benefits (Res Rep, ESA).

2. Similarly, any such proposal should apply, to the extent applicable in Ethiopia, the development lessons learned in such projects as expressed in the UNDP Programme Advisory Note on industrial research and service institutions and UNIDO guidelines on designing institution-building projects (Res Rep, ESA, UNIDO).

3. The Government should consider actions it can take to support a service for the maintenance and repair of measuring instruments in Ethiopia by, for example, requiring foreign suppliers to maintain such a service (Government).

4. The Departments of Metrology and Quality Control and Certification should collaborate on drafting and proposing a new Government Proclamation on metrology for review by the General Manager of ESA. (ESA)

5. Metrology legal documents, including regulations, instructions, guidelines, etc., prepared and proposed by the Metrology Department in collaboration with interested parties, should be approved at the level of the General Manager of ESA. (Government, ESA)

6. An ESA public relations and information exchange programme, covering all operational elements including the Metrology and Quality Control and Certification Departments, should be developed as part of its annual planning and budgeting process. (ESA)

7. Every measuring instrument purchased abroad for calibration should itself be provided with a calibration certificate issued, at the minimum, by a reputable measuring laboratory company/organization of a developed country. (ESA)

8. Each metrological standard or measuring instrument which may play the role of an Ethiopian National Metrological Standard and imported from abroad, should be ordered with a calibration certificate issued by a national metrological organization (e.g., PTB-FRG, NIST-USA, NPL or BCS-UK, BNM-France, DAMW-GDR). If this is not possible, the "standard" should be provided with such a certificate by a reputable traceability of certified accuracy to the international standard. (ESA)

9. When the Metrology Department is well-established, EAS should consider adherence of Ethiopia to the International Convention of Metre and its institutional bodies, primarily the General Conference on Weights and Measures and benefiting from the no-charge calibration services for national standard provided by the International Bureau of Weights and Measures. (ESA)

10. UBDP headquarters should consider making project design which meets "existing" standards as a "mandatory" part of the preparatory assistance for large-scale projects. Design teams should include at least one member with proven design expertise. (UNDP)

11. UNIDO should review its mechanisms and capabilities for making in-house experience available to design teams, including the application of lessons learned from evaluations, both at headquarters and field levels. (UNIDO)

12. The Government should give favorable consideration to the EAS proposal for a new salary structure which will assure the recruitment and retention of the required professional and technical skills levels.

13. The following options, in reverse order of Evaluation Mission "preference" (but recognizing that they are not mutually exclusive) are identified:

(a) terminate both projects 003 (NQCTC) and 006 (NMC) when presently funded project activity ceases; or

(b) Extend 006 (NMC) to add minimum instrumentation and supporting equipment to bring capacity up to the level of output as originally planned or reconstructed by the Evaluation Mission. Depending upon funding availability, three levels and their "estimated" cost are:

(i) limited to those areas of measurement already advanced:

Instrumentation	US$	250,000
Training		25,000
Consultancies		12,500
		287,500

(ii) to all areas listed in prodoc, or reconstructed, updated as necessary:

Instrumentation	US$	200,000
Training		20,000
Consultancies		10,000
		230,000

(iii) additional instrumentation which, at comparatively small cost, could significantly improve NMC effectivenes:

Instrumentation	US$	130,000
Training		13,000
Consultancies		6,500
		149,500

Total (ballpark) estimate	US$	667,000

(c) While it may be necessary to postpone funding until the next UNDP programme period, at least praparatory assistance should be provided to plan a new approach which: (1) is aimed at the EAS level rather than selected departments, (ii) involves a system or comprehensive approach to standards, quality control and metrology (rather than a piecemeal one); and concentrates on "software". The components of a flexible, advice and on-the-job training oriented EAS project, should include:

. Management - including long-range and strategic planning, continuous assessment of industry needs for standards, quality control, testing and calibration, projection of staffing needs, preparation of mission and work-related annual budgets, annual review and evaluation, etc.;

. Training - establishing a capability for both the training of new staff and upgrading of existing staff and training of industry counterparts;

. Information- strengthening the capability to create awareness and provide information and education to the public, particularly those subject to mandatory and pending standards, and provide feedback to EAS;

. Outreach - establishing a capability for co-ordinating EAS services for the public including appropriate ministries, government corporations and factories, particularly of a problem-solving nature (e.g., overcoming quality control problems at the factory or corporation level);

. Decision Support - providing computer programming capacity for programme, management and administrative support; and

. Direct Service - a flexible provision to supply ad hoc assistance on unforeseen but important problems.

CHAPTER VI. LESSONS LEARNED

In th instance, this chapter is being placed before "conclusions" because the experience with the two subject projects in project design is so disturbing that it may be symptomatic of a problem deserving the high-level and prompt attention of both UNDP and UNIDO headquarters and an appropriate recommendation to this effect has been prepared.

In the early 80's, UNDP and UNIDO jointly conducted a thematic evaluation of the experience gained in providing technical assistance to establish and/or strengthen industrial research and service institutions (IRSI) in order to determine their impact on the industrialization process in developing countries and to increase the effectiveness and relevance of the technical cooperation provided to such institutions. Both the NQCTC and the NMC fit the definition of an IRSI. The exercise, which took over two years and cost upwards of $200,000, involved a UNDP and UNIDO coordinator, twenty consultants throughout the world, and visits to IRSIs in Asia, Africa and Latin America. The results were reviewed by a high level group of professionals, representing sponsoring governments, industry clients and established IRSIs from both developing and developed countries, to discuss and analyze the major issues arising from the evaluation and a workshop for UNIDO staff was also conducted. The resultant guidelines were synthesized by UNDP and UNIDO into a Programme Advisory Note (UNDP/PPM/TL/29) issued in November 1982.

One important outcome of this evaluation was the development of the concept of "activity modules" (i.e., a unit which will perform a special task or group of tasks within the service institution) for planning, monitoring and evaluation purposes. The PAN recommended that the concept be used in institution-building projects and reflected in the project documentation. Subsequently, UNIDO adopted the concept in the design of its project self-evaluation system and, more recently, UNDP has adopted the concept for use in its Project Performance Evaluation Reports (refer to part III of the report - Evaluation of Project Performance - Outputs for Institution-building).

Projects and tripartite reviews

UNDP and UNIDO have revised their guidelines for project design to reflect the lessons learned from this and similar evaluations (see UNIDO/P.C.31/Add.4, which provides a checklist for the design and evaluation of institution-building projects). Training programmes in project design and evaluation are being sponsored by both UNDP and UNIDO and are given to host government and local staff whenever possible. In August, 1988, UNIDO issued guidelines for project design and drafting of project documents which are excellent and guides one through the entire process. In the reorganization which took place when UNIDO was transformed into a specialized agency, a Project Review and Appraisal Office was established to assure, inter alia, that project design met UNIDO, UNDP and other donor standards and reflects the development experience gained in the house over the years.

Why, then, is both the NQCTC(003) and NMC (006) projects, which have experienced serious design, justification and implementation problems, have these guidelines, i.e. lessons, been seemingly totally ignored? The examination which is permitted in the team's TOR and length of stay suggests some reasons. To begin with, there is almost always a rush by all parties to get the prodoc drafted, approved and executed. Preparatory assistance usually has this object as its main or sole preoccupation, not project design. In the NMC, an English professor with no experience in project design, the lessons learned, etc., drafted the prodoc with 90% of the pages devoted to position descriptions and equipment specifications.

At that time, the SIDFA was very new to UNIDO and there was the usual turnover in the Resident Representatives' office. The training provided by UNIDO helps a SIDFA or JPO recognize a good or bad design but it does not necessarily make him an expert, either in design or the technical field. The existence of the PAN and UNIDO guidelines were not even known to current field staff. As was discussed in the joint UN/UNDP/UNIDO evaluation of manufactures projects, it is difficult in the tripartite system to pin-point the responsibility for the quality of the outputs to be produced and their continuing developmental significance and impact.

There is general agreement in this Resident Representative's Office, and elsewhere the team assumes, with our conclusion that despite all the pre-approval reviews which take place (creating their own delays), the revised manuals, new guidelines, preparatory assistance and output-oriented reporting and evaluation, nothing much seems to have changed since the early efforts in 1980 to improve the quality of project design, both as a basis for more rational project approval and as a framework for subsequent project management/ implementation.

What can be done? Obviously, current efforts to improve the situation by providing awareness workshops, training and translating the lesson of experience into design and management guidelines, etc., needs to be continued. But just as it is equally obviously, this is a necessary but not sufficient condition. Some mandatory UNIDO requirements needed to be introduced, applying specific cost-effectiveness criteria, perhaps first on a pilot or experimental basis. While it should probably be conducted in collaboration with UNIDO, if successful the purpose would be to apply the results throughout the UN system or at least on those projects which are funded by the UNDP. It is suggested that, where the project size, complexity and duration justify the cost, especially in institution-building, and where the project purpose is not clear or the type, magnitude and quality of the outputs required to successfully achieve the project purpose of objective need definition, that preparatory assistance include the provision of a project design team consisting at the minimum of a responsible UNDP headquarters representative from the appropriate regional bureau or technical office, an expert in the technical field involved experienced in the transfer of technology to developing countries, and a responsible representative from the UNIDO Project Review Staff and/or Industrial Operations. At least one of the above should be experienced in the methodology of project design with a record of successful application. Where such skill is not available to a team, it should be added by borrowing from somewhere else, e.g., the evaluation staff, or by use of an experienced consultant. Only after an acceptable project design has been created should work commence on drafting the prodoc and its many attachments.

Tripartite Indepth Evaluation of DP/ETH/84/006

National Metrology Centre

Terms of Reference

Background

The Ethiopian Standards Institution(ESI)on the advice of UNIDO, was created under Government Order No 64 of 1970. Its duties and responsibilities were defined under proclamation No. 300 of 1972. It was empowered to enforce and administer the "Weights and Measures Proclamation "Nr. 208 of 1963 and to establish and monitor acceptable standards and quality control measures throughout the country. As per the proclamation No. 328 of 1987 the Ethiopian Standards Institute has been promoted to Ethiopian Authority for Standardization (EAS). EAS in Addis Ababa and its branches located in Asmara, Dire Dava, Jimma, Awassa, Dessie, Baher Dar, Assab, Nazareth, Assela and Massawa are responsible for verification, calibration and inspection of measuring instruments of the whole country.

The economy of Ethiopia is primarily agricultural. The manufacturing sector is in its initial stage of development and so far has not made a significant impact on Ethiopia's development.

In 1979, under the UNDP/UNIDO project DP/BTH/75/010, the Grandfield Institute of Technology (UK) was entrusted with the task of assisting the EAS in the establishment of a National Quality Control and Testing Centre and a preliminary study about a National Metrology Centre, as both centres form an integral part of the activities of EAS. Accordingly, a UNDP/UNIDO Project, DP/ETH/79/003, was approved in March 1979. This project has made a valuable oontribution to Ethiopia's development. It assisted in the development of the National Quality Control and Testing Centre (NQCTC), and provided equipment for the centre's laboratories to test building materials, textiles, leather, electrical, chemical and food and agricultural products etc.

The analysis of achievements of the NOCTC project showed, that the effectiveness of the centre could only be realized by the establishment of a National Metrology Centre, which could provide facilities for calibration and verification of the measuring instruments available in the laboratories of the NOCTC and help the industrial sector in the calibration of its equipment.

The Government of Ethiopia, in pursuance of UNIDO's other main recommendation that a national metrology centre be established, has requested UNDP's assistance. The building for the National Metrology Centre (NMC) was constructed in the compound of EAS and in September 1985 the project document DP/ETH/84/006 - National Metrology Centre was approved. The project budget of 1065000 US dollars to cover the costs of equipment, international staff, fellowhips etc was made available. The original budget assigned for the equipment was 539710 US$. Due to the fall of dollar value, this amount could not cover increased costs of equipment and the project budget was increased by 105000US$ for equipment and 30000 US$ for fellowships. The revised total UNDP input is now 1200000 US$.

The aim of the project DP/ETH/84/006 - National Metrology Centre is to assist the Government in expanding its industrial production and in improving the quality of the goods produced by means of the establishment of a Metrology Centre with adequately equipped laboratories and with an appropriate organisational structure, the establishment of the necessary legal measures, laws, regulations, standards etc. and modernization of the traditional measurement system now used in the rural areas of the country by conversion to the international system of units.

The duration of the project as in the project document is 2½ years and the local implementing agency is Ethiopian Authority for Standardization (EAS).

The outputs of the project will be to have well equipped and operational metrology laboratories in the areas of length, mass, volume, force, pressure, electrical units, density, viscosity, time & frequency, temperature etc, fully trained personnel, legal documents to ensure the proper functioning of the metrology centre etc.

The project became operational on January 1986 with the fielding of the CTA.

Scope and Purpose of the Evaluation

The primary purposes of the evaluation of the project are:

- to determine how adequately its immediate objectives given under Part II, B of the project document have been attained and how effectively they have been or are likely to be in helping the Government to achieve the relevant sectoral and/or national development objectives.

- to identify the factors which may have facilitated or deterred the achievement of the project's immediate objectives; and
- to make recommendations for future action.

The mission should feel free to review all steps taken in the implementation of the project and make recommendations as to its future. In carrying out these purposes the mission will in particular:

- assess to what extent the centre has been established in connection with the initial plans.
- assess the realization of the initially planned staffing requirements for the centre.
- analyse any internal and external factors that might have led to a less than satisfactory implementation of the project.
- assess to what extent EAS has been able, since the centre was established, to carry out its mandate.
- assess to what extent project budget revisions have hampered the project in achieving the results originally planned
- make recommendations regarding possible future assistance of UNDP/UNIDO to EAS.

Given the relationship between the project under evaluation and DP/ETH/79/003 "Quality Control Centre", the evaluation mission should consider common issues related to both projects.

Composition of the Mission

The mission will be composed of the following participants:

- a representative of UNDP
- a representative of UNIDO
- a representative of the Government

Consultations in the field

The mission will maintain close liaison with the UNDP Resident Representative in Ethiopia, the concerned agencies of the Government, the project manager(CTA) and other national personnel assigned to the project, as well as UNIDO field staff in the country.

Although the mission should feel free to discuss with the authorities concerned anything relevant to its assignment, it is not authorized to make any commitments on behalf of the UNDP or UNIDO.

Time table and report of the mission

The representative of UNDP and UNIDO will receive briefing at their reppective headquarters. Upon arrival in Addis Ababa, the mission will be briefed by the UNDP Resident Representative, who will provide the necessary substative and administrative support. The mission will complete its field work within two and a half weeks, starting mid-February 1989, Upon completion of its work, it will be debriefed by the UNDP Resident Representative and by the Institutional Infrastructure Branch at UNIDO headquarters, Vienna.

.... The mission will prepare a report in accordance with the attached guidelines. The report should be completed as far as possible in the field, so that there is an opportunity for additional consultations as may be necessary. It should be submitted in its final form simultaneously to the UNDP and UNIDO. The UNDP and UNIDO, by agreement, will submit the report to the Government of Ethiopia.

Annex II

List of Persons Met and Organizations Visited

UNDP/UNIDO

Ravi Rajan, Deputy Resident Representative
Kadress Vencatachellum, SIDFA
Daphne Cassey, Assistant Resident Representative for Programme
Giorgio Dossi, JPO
V.I. Kozlov, IO/INFR, UNIDO

EAS

Akberom Tedla, General Manager
Yohannes Afework, Head, Technical Services Dep't.
Tafesse Muluneh, Head, Metrology Dep't.
Ezra Tereffe, Acting Head, Quality Control Dep't.
Amurugam Vellingiri, CTA
Bezabih Makonnen, Head, Legal Metrology Division
Berhanu Worede, Metrologist for electrical units measurements
Eshatu Giffas, Chemistry testing officer
Challa Bekele, Metrologist for mass, volume and density measurements
Gabregziabher Testa-Giorgis, Metrologist for time and frequency measurements

Government

A. Schendki, Acting Head, Export Promotion Dep't., Ministry of Foreign Affairs
Tesfai Gashu, Manager, General Goods Import Enterprise, Ethiopian Import-Export Corp.
Leme Arity, Head, UN Department, Office of State Committee for Economic Relations
Worku Megra, Head, Production Sales and Technic Department, Ministry of Industry
Mulu-Work Gabre-Hiewt, Head, Quality Control Office, Ministry of Industry
Makonnen Abraham, Head, Development Projects Appraisal Dep't, Office of National Committee for Central Planning

Industry

Gubre-Kiros Haptu, General Manager, Akaki, Spare Parts and Hand Tools Factory
Terreffe Mengesha, Technical Manager, Ries Engineering S.C.
Fickru Robi, Manager, Kaliti No. 1 Power Distribution Station
Shiferaw Biru, Director Production, Ethiopian Airlines

ANNEX III

ANALYSIS OF EQUIPMENT REQUIREMENTS

Following documents were evaluated and serve as references to the analysis:

Ref. 1. Mission Report of June 1988 prepared for the Government of Ethiopia by UNIDC, based on the work of Mr. A. Vellingiri, CTA.

Ref. 2. Report of Subcontractors Team(contract No. 87/44) of July 1988 "Provision of consultancy services on the establishment and operation of Metrological Laboratories for the National Metrology Centre in Ethiopia.

Ref. 3. Annex III to project document DP/ETH/84/006/A/01/37 of September 1985.

Ref. 4. Final Report of January 1989 prepared for the Government of Ethiopia by UNIDO, based on the work of Mr. A. Vellingiri, CTA

All experts who elaborated the above listed documents made an excellent work. However, the evaluation mission decided to base its recommendations only on Ref. 1, which in general remains in conformity with Ref. 2, and on its own findings.

Ref. 3 was found outdated, for the purpose of Annex III, but serves as perfect illustration how many instrument have never been delivered from those originally planned, namely those listed under No. 3,4,7,8,10,11,12,14,22,26,34,37,39,40, 41,42,43,46,54,56,57,61,64,65,68,70,71,72,74,75,76,79,80,81, 82,84,85,86,87,88,89,90,91,92,94,95,107,of Annex 3 to project Document.

Ref. 4 is descriptive and illustrates well the actual state of NMC.

The purpose of evaluation consists in creating priorities in equipment which is recommended for purchasing:

First Priority, Marked A1, means indispensable equipment to permit the already existing measurement units of NMC i.e. about 75% of those listed in Project Document, to provide basic services for industry and other sectors.

Second Priority, Marked A2, means adding to A1 indispensable equipment to bring the entire NMC Measurement area to a level of satisfactory effectiveness and efficiency in terms of services and measurement standards. Hence A1 + A2 = A means fulfilling of pro-duc. demands for the measurement capability of NMC.

Third Priority, Marked B, means "high benefit for small money" from improving area A and completing within NMC important measurements which fit in its field of operation under outputs listed in part II, D. 1. by being, however, missed in spelling them clearly out.

Please note: Current and voltage instruments and calibration set-ups(to 6000A) to calibrate transformers will be deleted from the project because they are very expensive and need additional laboratory space.

No.	Priority	Measurements	Equipment to be Purchased		Approximate Value US$
			From Ref. 1	Additionally Recommended by the Evaluation Mission	
1	2	3	4	5	6
1	A1	Mass	Annex 20, No.1,2,3		45000
2	A1	"		500 kg balance, 500kg weight of stainless steel Class F1/F2,500kg standard weight made of Cast iron, Class M1	10000
3	A1	Length and Angle	Annex 19, No. 1,2, 3,4,5,6 without hard granite comparator stand, precision measuring stand, Puppitron probe, electronic display unit analogue,probes (2 different),square block, x-y recorder, laser	If more money available, purchase 1m gauge line blocks listed in Ref.2 chapter 6.2.1a. page 45 and an interferometer altogether for 72000US$ and build a mechanical set-up for calibration	22500

1	2	3	4	5	6
4	A1	Length & Angle	Please Note: Instead purchasing No.17 a selfmade device (attachement) shall be constructed	Microscope for comparator.	3500
5	A1			Accessories to SIP Universal Machine	4000
6	A1	Volume	Annex 21, No. 9	-	300
7	A1	"	-	Accessories for dimentional measurement of volume tanks	3000
8	A1	pressure	Annex 23, No.8	-	1000
9	A1	Electrical Units	Annex 24,No.1,4, 5,13,11,12	-	56000
10	A1	"	-	2 Power meters for DC Class 0.1	3000
11	A1			2 Powermeters for AC	3000
12	A1	Density	Annex 25, No.1,2, 3,4,5,6,7,8	-	13500
13	A1	"	-	Anton-Paar automatic high precision density meter	5000
14	A1	Time & Frequency	Annex 27,No 1,4,5, 6,7,8,9,10,11,12, 14,15,16,17,18,19, 21,22,23,24,25,26	-	43800

1	2	3	4	5	6
15	A1	Temperature	Annex 28,No.2,18,19, 20,21,22,26,27	-	19500
16	A1	Accessories and Auxiliary Equipment	Annex 6, No.1-27(all) for electronic maintenance and service)	-	14400
	A1	Total			247500
17	A2	Length & Angle	Annex 19, from No. 6: Puppitron probe, electronic display unit millitron(analogue),2 digital probes, square block, x-y recorder, laser 1mv, and No.15,16	-	4500
18	A2	"	-	Profile Projector	4500
19	A2	Volume	Annex 21,No.2,3,4,5,6	-	15000
20	A2	Force	Annex 22, No.1-46	-	43200
21	A2	"	-	Hydraulic Press	16700
22	A2	Pressure	Annex 23,No.1,2,3,4,5, 6,7	-	9000

1	2	3	4	5	6
23	A2	Electrical Units	Annex 24,No.2,3, 6,7,8,9,10,14,18, 19	-	70500
24	A2	Viscosity	Annex 26,No.1-33		22200
25	A2	"	-	Set of long(400mm) capillary Ubbelohde type viscometers	3000
26	A2	"	-	Hoeppler falling ball viscometer	2000
27	A2	"	-	Visco-balance	6000
28	A2	Time & Frequency	Annex 27,No.13, 20		4250
	A2	Total			200850
29	B	Length and Angle Roughness Surface Finishing	Annex 19, No. 7, 8,9	-	22000
30	B	Volume Flow measurements(i.e. dynamic volume)	Annex 21,No.7,8	This will need some construction effort done by ESA under guidance of CTA	10000

1	2	3	4	5	6
31	B	Pressure Vacuum Measurements	Annex 23, No.9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21	-	12000
32	B	Electrical Units Capacitance and Inductance Measurements Resistance transfer standards	Annex 24, No.15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31		36000
33	B	Density Density of Cereals Measurements	Annex 20, No.4, 5	-	1000

1	2	3	4	5	6
34	B	Temperature High temperatures measurements (and improvement of others)	Annex 28,No.1,3,4,5,6,8,9,10,11,12,13,14,15,23	Please Note: Automatic resistance bridge Ref. 1, Annex 28,No.7 seems to duplicate another one and therefore has been deleted	35600
35	B	Physical Chemistry	-	Dew point hygrometer of a medium but reliable accuracy	5000
36	B	Humidity and Moisture Measurements	-	Electric psychrometer with temp. sensors Pt 100, range of relative humidity 15-95%	3000
37	B		-	Automatic set-up for moisture measurements of solid materials by using a drying-weighing method	4000

1	2	3	4	5	6
38	B		Annex 20,No 6,7	e.g.CM infratronic moisture balance from Anselma industry-Vienna Moisture of cereals measuring instrument	1000
	B	Total			
	A1 + A2 + B	Total	-	-	577950

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