

## **11 Physical Metrology – The National Metrology Laboratory (NML) of South Africa**

### **11.1 Overview of physical metrology**

The key activities of the National Measurement Laboratory (NML), as with all national measurement institutes, are the development, maintenance and dissemination of the national measurement standards. The NML's role provides essential vertical linkages and horizontal linkages for the South African economy.

The international framework for metrology is established by a treaty, the Metre Convention, under which the International System of Units (SI) embodies the internationally-accepted definitions of units of measurement. South Africa is a signatory to the Convention and, through the NML, participates in the forums that are established under the Convention to coordinate the global system of metrology. In so doing, the NML ensures that the South African measurement standards are comparable with those of other nations that participate in the Convention, and provides a scientifically valid starting point for the measurement system within South Africa. The NML calibrates reference standards for lower-level calibration laboratories which, in turn, provide calibrations of measuring instruments used in industry. This process provides a complete chain of measurement traceability<sup>8</sup> between the SI and the practical measurements used in industry and the community in South Africa. It also illustrates the crucial national significance of the NML, which is relied upon to provide a scientifically sound interface between the international measurement system and the South African measurement system. This vertical integration is essential for South African measurements to be accepted in international trade, and for South Africa to have a credible domestic measurement system for trade, commerce, manufacturing, services, and consumer and environmental protection.

Within the structure connecting international and domestic metrology, there is an intermediate layer of regional metrology that has assumed greater significance in the last decade. As the demands of developing economies have increased, it has become evident that international comparison programs that are coordinated by the International Bureau of Weights and Measures (BIPM) cannot reach all national metrology institutes directly. The level of accuracy at which a comparison is conducted cannot be achieved by all national metrology institutes, and there are simply too many national metrology institutes for all to participate in each international

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<sup>8</sup> Traceability : property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons having stated uncertainties.

comparison and still complete the comparison in a reasonable time. To address this situation separate regional comparisons are being conducted, linked to the BIPM coordinated comparisons through 'link' NMIs. At least two regional national metrology institutes that have participated in the BIPM coordinated comparisons are sought to subsequently act as 'link' laboratories for the regional comparison. The South African Development Community Metrology Traceability Co-operation (SADCMET) is the regional metrology entity for the southern African region, and South Africa's NML is the only member of SADCMET that has the capability to participate in both the BIPM and regional comparisons. Hence the NML provides a crucial linkage, not only for South Africa but also for the metrology systems of other nations in the SADC region.

The activities of the NML feed into the operation of all other elements of the technical infrastructure in South Africa. Its measurement expertise is required for writing of documentary standards, providing technical assessors for accreditation and certification activities and providing measurement traceability to underpin legal metrology. In addition, it is a repository of expertise for solving industrial measurement problems.

For the South African SQAM review, there were a number of specific Terms of Reference relevant to physical metrology in South Africa and the national body responsible, the NML. The Terms of Reference covered :

- The relationship between the NML and South African industry compared to the situation prevalent in South Africa's main trading partners and comparable economies.
- The positioning and legal identity of national metrology institutes internationally compared to the arrangements in South Africa, and the preferred positioning for the NML.
- The level of government funding for the NML compared with international counterparts.
- How the NML services the measurement traceability needs of the SQAM infrastructure and how it provides calibration and testing infrastructure.

### 11.1.1 The South African situation

The South African Metrology Landscape is depicted in Figure 13.

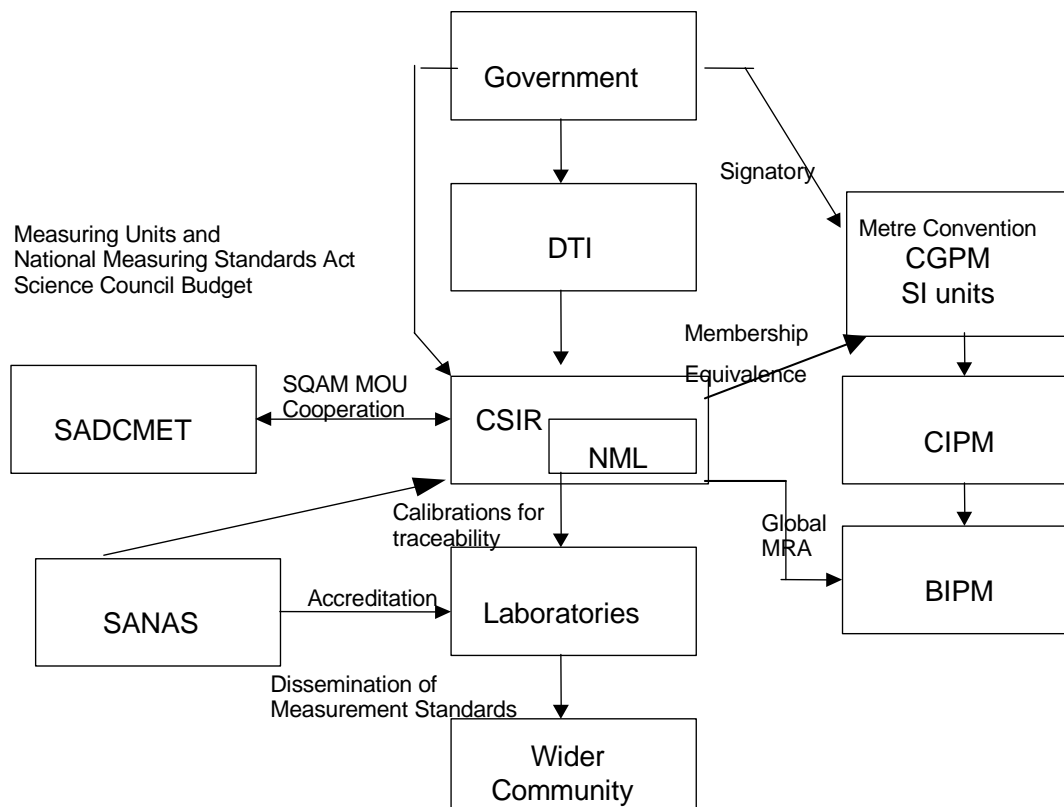
The widespread involvement of metrology is evident in all aspects of trade and commerce. Accurate measurements are required in all sectors of the economy, including agriculture, communications, transport, surveying, fisheries, defence, manufacturing, medicine, etc.

The technical areas of work of the NML are as follows:

- *Regional and international metrology:* participation in the global Mutual Recognition Arrangement on the mutual recognition of national measurement standards and of measurement certificates issued by national metrology institutes, assurance of regional traceability, metrology training, and consultancy.
- *Electromagnetic metrology:* photometry and radiometry, ionising radiation, time and frequency, acoustics, ultrasound vibration, DC and low frequency, radio frequency.
- *Mechanical metrology:* mass, volume and density, pressure and vacuum, dimensional, temperature and humidity, flow, force, hardness and torque.
- *Chemical metrology:* surface and micro-analysis, chemical traceability, gaseous reference materials, other primary reference materials (solids, liquids).

To disseminate the values of the national measurement standards, the NML calibrates the standards and high accuracy instruments of second-level calibration laboratories, such as those accredited by the South African National Accreditation System (SANAS) or those involved in type testing and the provision of measurement traceability for trade metrology. The second-level laboratories in turn provide the majority of calibrations of measuring instruments used in industry and the community. Where there is an absence of appropriate services in this second-level tier, the NML may calibrate instruments of suitable accuracy directly for industry.

**Figure 13: The South African Metrology landscape**



### 11.1.2 The regional situation

The NML is a key member of SADC MET and has associate membership of two adjacent regional metrology organisations, namely: the Asia Pacific Metrology Programme (APMP) and the Middle East and North Africa Metrology Cooperation (MENAMET). MOUs and MRAs also exist between the NML and its counterparts in economies that are agreed between the NML and DTI to be of strategic significance for South Africa.

The NML currently holds the secretariat for the SADC MET and provides representation for the region on the Joint Committee of Regional Bodies convened by the BIPM. The NML is actively pursuing the establishment of mutual recognition of measurement standards within the SADC region, with an ultimate objective of obtaining international recognition for SADC MET and enabling SADC countries to participate in the global MRA between national metrology institutes. NML's role as the key reference laboratory for SADC MET in international comparisons has been referred to previously.

The NML is actively pursuing alliances with counterpart laboratories, such as PTB (Germany), and international organisations, such as UNIDO (United Nations Industrial Development Organisation), to support development and training initiatives within the region. The NML also played a leading role in the establishment of the SADC Resource Centre for Metrology Education (SECME).

The DTI provides funding for the majority of expenses incurred by the NML's participation in regional activities relating to physical metrology. SANAS also supports NML members to attend regional meetings related to accreditation functions e.g. expert meetings of the European cooperation for Accreditation.

### **11.1.3 The international situation.**

The Metre Convention was founded in 1875 and South Africa acceded to it in 1964. The CGPM (General Conference on Weights and Measures) is the governing body of the Convention and presently comprises representatives from 48 member countries. The CIPM (International Committee of Weights and Measures) consists of 18 members elected by the CGPM and is effectively the management committee of the BIPM (International Bureau of Weights and Measures), the international centre for metrology. CIPM also appoints Consultative Committees, of which there are currently ten, one for each of the quantities (e.g. mass, length, temperature etc) relating to the base units of the SI.

Participation in the activities under the Metre Convention is part of the process of establishing credibility for a national metrology institute. South Africa is represented at CGPM as are all signatory nations. However participation in CIPM and Consultative Committees requires the capability to make -significant scientific contributions in the relevant metrological areas. At present, there is no South African member elected to CIPM but the NML is a member of three Consultative Committees and an observer on one. To increase participation in these latter activities, the NML will need to add to its R&D capability. Given the recent or impending retirement of a significant number of its senior and experienced staff, NML will need to investigate ways to rapidly replace and develop its R&D capability. CSIR has indicated that its arrangements with the University of Pretoria could provide additional research studentships for the NML.

A second and essential mechanism for establishing international recognition of the capability of an NMI is participation in the global Mutual Recognition Arrangement between national metrology institutes which has been instituted by the CIPM. The Arrangement introduces consistent criteria for stating the uncertainty of national measurement standards and for

evaluating calibration capabilities at a national level. Moreover the availability of these data via Internet will create a transparent and internationally accessible resource.

South Africa, through the NML, has signed the global MRA and has therefore committed the NML (i) to participate in the world-wide programs for comparison of national standards and (ii) in relation to its calibration services, to maintain a quality system complying with the requirements of ISO/IEC 17025 or equivalent. In addition to establishing credibility for South Africa's measurement system, the participation by the NML in the global MRA is essential for capacity building within the SADC region. Since this activity is of national interest, it should be financed by Government.

The implication of the global MRA is that measurement certificates issued by a participating NMI will become acceptable in all participating countries (provided that the certificates reflect the capabilities stated for the NMI in the MRA database). This will, to some extent, open up the opportunity for NMI's to provide cross-border services, although the physical limitations of transporting standards reliably will provide a natural cap on the scope of this opportunity. Some NMIs may pursue opportunities to provide traceability services outside their traditional domestic borders in order to generate revenue and also to maintain facilities on a cost-effective footing and to maintain staff experience. The NML is selectively pursuing such opportunities with consideration to obvious national sensitivities, especially in the SADC region.

## 11.2 Positioning, recognition and governance of NMLs

### 11.2.1 The South African situation

The Measuring Units and National Measuring Standards Act was created as Act 76 of 1973, and was amended in 1998. In essence the Act requires the Council for Scientific and Industrial Research (CSIR) to maintain national measurement standards and to compare these on an international basis. The Act also prescribes the official measuring units in South Africa and provides for a Schedule of National Measuring Standards to be published from time to time in the Government Gazette. In the event of a legal dispute, the Act provides that data produced by the NML are deemed to be correct unless proven otherwise.

The Scientific Research Council Act (Act 46 of 1988) also charges CSIR with the responsibility to keep and maintain the National Measuring Standards.

In addition to these Acts, a Memorandum of Agreement (MOA) between the CSIR and the DTI declares *inter alia* the following:

- The activities associated with statutory maintenance of the National Measuring Standards are to be carried out by a separate identifiable entity within CSIR known as the NML.
- CSIR may decide on the best organisational model for the NML but requires DTI agreement.
- The NML may provide calibration services to the private sector when the market is unable to do so or fails to provide the required levels of accuracy, provided that NML endeavours where possible to promote the development of such capabilities in the private sector.
- CSIR must apply the financial support provided by DTI under the agreement to the infrastructure for maintaining national measurement standards and must acquit the expenditure in an annual report to DTI.

Currently the NML is one of nine business units within the Division for Manufacturing and Materials Technology (M&MTEK) at the CSIR. The Director of M&MTEK represents the NML in the CSIR senior management team that is led by the President of CSIR and comprises Division Directors and a number of Vice-Presidents. The CSIR senior management reports to the CSIR Board.

The major direct stakeholders in the NML are the funding bodies (discussed in detail later). DTI is the major funding source, providing around 60% of operating costs and a contribution to capital costs, and CSIR provides around 12% of operating costs from its Parliamentary grant (STEP) funding. Other direct stakeholders are the clients of the NML and the partner SQAM institutions. Indirect stakeholders are industry and the community at large, both of which receive benefits from NML's activities in supporting trade and providing measurement traceability.

### **11.2.2 The international situation and practices**

The following table summarises the information received regarding the positioning and legal identities of national measurement institutes for the nine countries surveyed. (Where a country's NMI functions are spread over more than one institution, only the major institution is listed.)

The information indicates that, in regard to the positioning and legal identity of NMI's, at least three models are in use throughout the world. These include the following, with the percentage of NMI's surveyed that fall into a specific category shown in brackets.

- Operating as part of a standards and conformance organisation (40%).
- Operating as part of an R&D institution (30%).
- Operating as a separate entity, accountable directly to Government (30%).

The governance structures vary according to the types of institutions. Entities of a corporatised or similar nature (e.g. in the Netherlands) are governed by Boards that function in the same capacity as the Board of a private sector organisation. Hence, while the government may have the right to appoint some Board members, these members act to promote the interests of the governed entity, not to represent government. Statutory authorities may be governed by a Board (e.g. in Australia) or may report directly to government (e.g. in Brazil). Institutions that are part of a government department (e.g. in the USA) have direct governmental governance.

In regard to formal recognition of the NMI's role, each country surveyed had legislation of some type that assigned responsibility for maintaining national standards of measurement. In some countries (e.g. Australia), the legislation was augmented by Memoranda of Understanding between government and the NMI or its parent institution in order to more fully specify the roles that the NMI should fulfil in the national interest.

Since the NMIs in the surveyed countries all operate with some degree of success, it is clear that there is no single preferred model for positioning, governance, and legal identity of an NMI. It is more important to assess the operation of an NMI in context, and inquire whether the positioning, governance, and legal identity aid or hinder the achievement of the NMI's mission.

**Table 18: Positioning and Legal Identities of NMIs**

Country	NMI	Positioning and Legal Identity
Australia	NML	NML is positioned within the Division of Telecommunications and Industrial Physics of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). CSIRO is a statutory authority under the Science and Industry Research Act 1949. The national metrology system is authorised by the National Measurement Act 1960.
Brazil	LNM	The Directorate of Scientific and Industrial Metrology (DIMCI) coordinates scientific and industrial metrology through its operation of the National Laboratory of Metrology (LNM). DIMCI is a directorate of the National Institute of Metrology, Standardisation and Industrial Quality (INMETRO). INMETRO is a Federal Autarchy established by Law No 5966 in 1973. It is responsible to the Ministry of Development, Industry and Foreign Trade. The national metrology system is authorised by Law No 9933 (1999).
Malaysia	NMC	The National Measurement Centre (NMC) is maintained by SIRIM Bhd, a wholly-owned company of the Malaysian Government. SIRIM was corporatised in September 1996. Drafting of a National Measurement Act is in progress.
United Kingdom	NPL	The National Physical Laboratory is a government-owned, contractor-operated facility (GOCO). It is currently operated on behalf of the Department of Trade and Industry by NPL Management Ltd, a wholly owned subsidiary of SERCO Group plc. No explicit reference to NPL is made in legislation relating to metrology, but the existence of national measurement standards is assumed by many items of legislation.
New Zealand	MSL	The Measurement Standards Laboratory (MSL) operates within Industrial Research Limited (IRL). IRL was created as a company incorporated under the Companies Act 1955 and a Crown Research Unit under the Crown Research Institutes Act, 1992. The national metrology system is authorised by the Weights and Measures Act 1991.
Sweden	SP	SP was established as a Government office in 1920, and metrology functions were added to its role in the 1970's. In 1993 SP was converted to a privatised structure, but with all shares held by government. The authorisation of the national metrology system is provided in the Measuring Units, and Measuring Devices Act
USA	NIST	NIST is an agency of the Technology Administration of the US Department of Commerce. It operates under the authority of the National Institute of Standards and Technology Act (15 U.S.C. 271)
Iceland	Longgildi ngirstofa	Longgildingirstofa is an independent government institution operating under the Ministry of Trade and Industry, and was established in 1997. Authorisation of the national metrology system is provided in Law Number 100/1992.
Netherlands	NMi VSL	NMi VSL is part of the Holland Metrology N.V. (HM) holding. HM is a company wholly owned by the Dutch State. The legal authority for maintaining measurement standards arises from a Dutch law, namely the IJkwet. NMi VSL was appointed by Royal decision as the Dutch national measurement standards institute

### 11.2.3 Conclusions

The mission of the NML is to “support South Africa’s competitiveness through the provision of internationally recognised measuring standards and measurements.” Its positioning, governance and legal identity should contribute to achievement of that mission.

The NML is positioned currently within CSIR, an R&D institution with a much broader remit. CSIR claims that there are distinct benefits to NML of being part of this larger organisation, including shared facilities and access to a large pool of expertise. However, these benefits appear to be mainly of an infrastructural nature for which the NML pays in the form of an overhead levy from the DTI grant. Additional potential advantages to the NML are: increased stability and security as part of a larger organisation; potential access to post-graduate students through an agreement between CSIR and the University of Pretoria; rapid entry into new fields by drawing on expertise extant in CSIR; and increased career opportunities for the NML’s staff.

There are clear advantages to CSIR of retaining the NML in its structure: the DTI grant is counted as external earnings by M&MTEK and CSIR; there is potential to use the NML resource to complement other M&MTEK resources in the pursuit of external commercial activities; potential to redirect resource for divisional interest; a contribution to divisional overheads; a gain in marketing credibility by being the holder of national standards; and a closer relationship with government (DTI).

The positioning of the NML within CSIR has both positive and negative consequences for recognition of the NML. On the one hand, the high profile of CSIR adds to the credibility of its constituent units. On the other hand, the NML may remain invisible within the larger entity, particularly to its indirect stakeholders that are less familiar with its role and location. This dilemma is explored in the later section dealing with interactions with industry.

Given the international models, the review team considered the possible options and benefits of positioning the NML outside CSIR. One option would be to position it in one of the other standards and conformance institutions. Another option would be to establish NML as a separate entity reporting directly to government. The former option would require an alliance with other SQAM institutions, an alternative which would seem impossible in view of the mixed private and public sector nature of the SQAM infrastructure, and which would require massive re-alignment of organisational culture for all parties. The second option would deliver a relatively small institution with the benefits of autonomy but the vulnerability of being a small entity at a time when government policy appears to favour the efficiencies gained by operating larger organisational units. Pragmatically, therefore, in the current situation, it is concluded that

the NML's positioning within the CSIR is the best available option, and that the governance process must be optimised within that framework.

Direct governance of the NML is exercised within the CSIR structure, with NML being located in the M&MTek Division. However the NML's national interest responsibilities have only a small representation within the much broader range of CSIR's activities. At present the CSIR, and therefore the M&MTek Division, has a strong focus on becoming less dependent on Government funding and more commercially orientated. There is evidence that the NML is being influenced by this commercial focus, and various stakeholders have expressed concern that the NML is, and will increasingly be, competing with industry. Although the NML denies that it is competing in any way, and has an explicit policy not to compete with industry, the concern remains that its national interest activities could be compromised if it is bound to this aspect of the strategic direction of the CSIR.

NML has reported that its placement within M&MTek offers the following advantages : (i) administrative and business services are provided through M&Mtek (with these overheads being charged to NML's budget); (ii) M&Mtek has experience in managing a number of centres for transferring skills and technologies to various industry sectors and this experience, together with a range of industry contacts, would be valuable to NML in providing metrology education to industry; (iii) M&MTek was one of the main sources of skills being transferred to the NML to address new areas of standards development. While the current arrangements may facilitate NML's access to services and information in M&MTek, CSIR could direct these arrangements to continue even if NML were a separate entity from M&MTek.

It is difficult to see a substantial alignment in future between the targets for the M&MTek Division and the NML. Hence the only reasons for maintaining the current situation of locating NML within M&MTek appear to be matters of convenience in size of units reporting to CSIR senior management and perceived convenience in accessing administrative services and information in M&Mtek.

The significance of the NML for South Africa's long-term position in domestic and international trade is too great to risk gradual, even if inadvertent, attrition of its mission. Therefore it is desirable that NML be a separate entity within CSIR. This positioning will allow CSIR to demonstrate a clear separation of NML's function from undue influence of CSIR's commercial strategies and will free NML to pursue its mission with a clear and consistent charter. This arrangement will also increase the visibility to the CSIR Board of the legislative responsibilities assigned to CSIR for maintaining national measurement standards and will provide an

opportunity for direct overview of that process. The pathway for reporting to the CSIR Board should be established after taking into account the other governance issues discussed below.

**Recommendation 27: The NML continue to be positioned within the CSIR, but with the status of a separate division (or equivalent) to reflect its national role in the standards and conformance infrastructure.**

In spite of the fact that DTI contributes approximately 60% of the funding for NML it has no direct input to its management. There is provision in the MOA (Clause 1.4.10) for DTI to play a greater role in overseeing the expenditure of its annual grant to CSIR for delivery of the NML function, but these options have not been exercised.

Neither the other direct stakeholders (clients of the NML and SQAM institutions) nor the indirect stakeholders (industry and the community) have any direct representation in the governing or advisory structures of the NML. One such mechanism is already envisaged by the MOA (Clause 1.3) which provides the option for the Minister for Trade to appoint a Metrology Advisory Board to oversee the strategic direction of NML, however this option has not been taken up. The Review Team believes that there are clear advantages in establishing a structure that operates successfully to provide governance, stakeholder involvement and operational management.

A model that addresses the issues of governance and stakeholder involvement has been adopted for governance of the Australia Telescope National Facility within CSIRO in Australia. The ATNF Steering Committee is appointed by the Minister for Science and reports both to Minister and to the CSIRO Board. Committee membership includes CSIRO representatives, users, industry and, interestingly, three international peers. While it would be an expensive exercise to include peers from other national metrology institutes in an advisory board, there is no doubt that it would deliver benefits in keeping the CSIR Board and DTI informed of international trends. Moreover, the national metrology institutes surveyed within this study affirmed that the major drivers in setting their strategic priorities were international directions in metrology, and that these drivers usually anticipated trends that had not yet been recognised within industry.

Another management structure is already in use in CSIR for the Automotive Industry Development Centre and the National Laser Centre. For each Centre, a Management Board provides operational management and an Advisory Board provides strategic guidance. It would be possible to translate these familiar structures to the governance of the NML but the importance of independent oversight of the national interest role of the NML must not be lost in such an arrangement.

In consideration of the principles and the models described above, the recommended structure for management of the NML comprises a Management Board and an Advisory Board constituted as follows :

**a) NML Management Board**

An NML Management Board should be constituted with an independent Chair appointed by the Minister of Trade and Industry. The membership of the Board should be comprised the following :

- Two senior representatives from each of the two major funding agencies, DTI and CSIR, with the senior executive officer of NML being one of the CSIR representatives.
- The Chair of the Advisory Board (*ex officio*).
- A maximum of two members elected by and from the members of the Advisory Board as representative of their composition
- Representatives from the Government recognised SQAM institutions (SANAS, the SABS).

The Terms of Reference of the NML Management Board should be :

- To receive and implement strategic direction from the NML Advisory Board (see below)
- To oversee program planning and budget preparation for the NML.
- To monitor the performance of the NML against milestones and funding targets.
- To report to the CSIR Board.
- To present an Annual Report to the Minister for Trade and Industry on the performance of the NML including its performance against milestones and financial targets, and the extent to which it has addressed strategic objectives for the reporting period.

The NML Management Board should meet at least quarterly.

## **b) Advisory Board**

An Advisory Board should be constituted with an independent Chair elected by the Board members. The membership of the Board should be established by DTI inviting stakeholder groups to nominate representatives. The stakeholder groups should include SQAM institutions, regulatory agencies, industry, labour, community interests, and ideally at least one peer from the international metrology community. A maximum membership of approximately 18 would be appropriate.

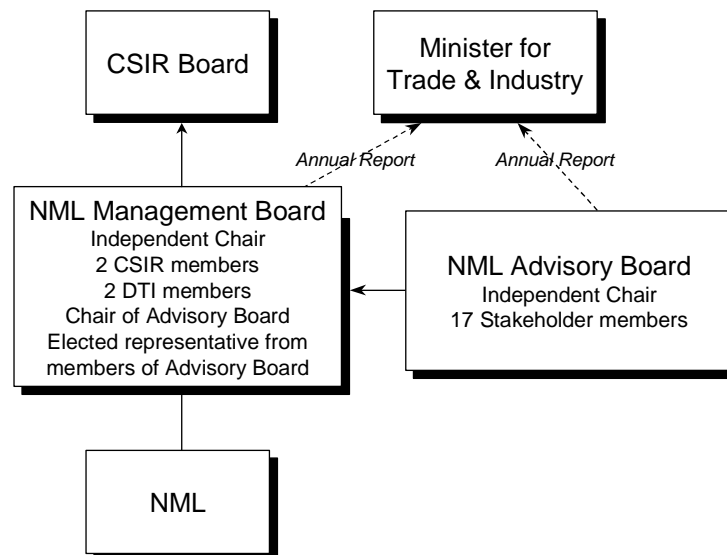
The Terms of Reference of the Advisory Board should be :

- To review strategic drivers of South Africa's needs for metrology.
- To review trends in international and regional metrology.
- To formulate a strategic vision for programs to be delivered by NML.
- To advise the NML Management Board (see above) on strategic directions for NML.
- To advise the NML Management Board on strategies for establishing relationships between NML and other organisations in order to facilitate full dissemination of metrology capabilities through the measurement chain in South Africa.
- To make an Annual Report to the Minister for Trade and Industry on the strategic directions in metrology in South Africa, the institutions that must be engaged to realise the strategic directions, and the resources that may be required to implement these directions.

The Advisory Board should meet at least once per year.

The proposed structure is shown in Figure 14 on the following page.

**Figure 14 : Proposed structure for the governance of the NML**



To give effect to the creation of an NML Management Board and an NML Advisory Board, as proposed above, it would be necessary to amend the existing Memorandum of Agreement between the Government and CSIR regarding the NML.

**Recommendation 28:** The Memorandum of Agreement dated 28 August 1998 between the Government and the CSIR in regard to responsibilities for national measuring standards be revised to include, inter alia, the establishment, composition and terms of reference of an NML Management Board to oversee the operation of the NML and an NML Advisory Board to provide strategic direction and advice to NML.

The manner of establishing the legal identity of the keeper of the South African standards is adequate. The practice in South Africa of establishing the role in legislation and augmenting this with a Memorandum of Agreement between government and the delivery organisation, CSIR, is consistent with arrangements in other surveyed countries. Adoption of the recommendations made above on positioning and governance would not affect the current legislation or MOA. However the current legislation recognises, for legal purposes, the traceability of measurement only to the South African national standards. Given the probable impact of the global MRA between national metrology institutes and the global MRA between accreditation bodies, it will be necessary at some time in the future to amend the legislation to recognise acceptance of traceability to foreign measurement standards. Since NML and SANAS are South Africa’s representatives in the respective areas, it would be prudent for the legislation

to admit recognition of overseas traceability as a general principle, but subject to the advice of the NML and SANAS in specific instances.

**Recommendation 29:** The Measuring Units and National Measuring Standards Act (Act 76 of 1973) be amended to accept legal traceability to foreign measurement standards in instances where the foreign measurement system can be demonstrated to meet the criteria of the relevant international MRAs. The legislation provide for NML and SANAS to offer specialist advice on whether the international criteria are met.

## 11.3 Funding

### 11.3.1 The South African situation

The activities required for maintenance of measuring standards in the NML are funded by the DTI (68% of total, based on 2000/01 budget) as well as STEP funds (12%). Most of NML's major assets are purchased with DTI capital funding, which is additional to the DTI contract funds. Income from commercial services rendered contributes approximately 16% of income, and services provided to SANAS 4 %.

The NML's funding history is given in the table below:

Financial Year	DTI for maintenance of the NMS	DTI for Facilities	Capital	Parliamentary grant (STEP)	External	Turnover (excl capex)
1995/1996	R 5.7 m	R 2.5 m		R 0.27 m	R 3.33 m	R 9.3 m
1996/1997	R 8 m	R 10 m		R 0,85 m	R 2.55 m	R 11.4 m
1997/1998	R9 m	R 10 m		R 1.1 m	R 3.9 m	R 14 m
1998/1999	R 10 m	R 18 m		R 1.4 m	R 4.4 m	R 15.8 m
1999/2000	R 12 m	R 0		R 2.85 m	R 5.95 m	R 20.8 m
2000/2001	R 15 m	R 0		R 3 m	R 5.1 m	R 23.1 m

The DTI has expressed concern over the high level of overhead cost of the CSIR in the NML budget and its impact on the DTI funding vote. NML overhead payments to CSIR amount to more than R 4 million per annum (17% of turnover) and this amount excludes overheads such as accommodation and security.