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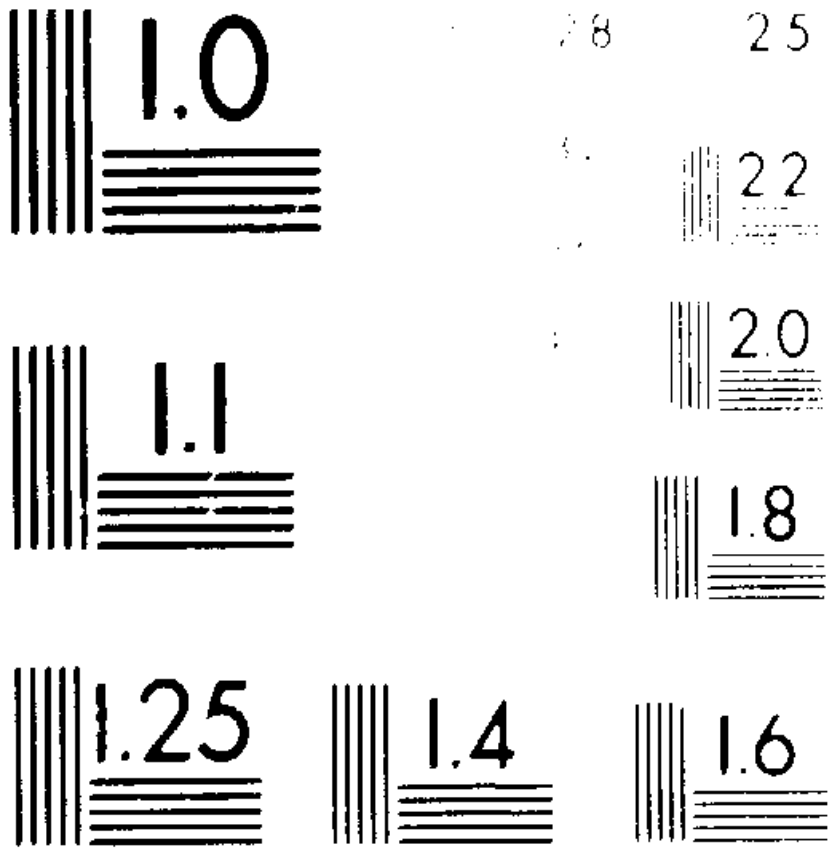
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November, 1983
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

METRIFICATION IN BRAZIL

DP/BRA/82/020
FEDERATIVE REPUBLIC OF BRAZIL

Final Report *

Prepared for the Federative Republic of Brazil
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Natarajan GANAPATHY,
Metrication Expert
(mission: 19 September 1983 - ? November 1983)

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from R. Schmied, IO/Intr

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ANNEXES

1. Introduction

The Metrification Project in Brazil (BRA/82/020/11-04/31.3.K) was to assist the government with respect to the adoption and use of the International System of Units, SI, in the overall context of the development of Metrology, Standardization and Industrial Quality. The 1.5 month long project, with Rio de Janeiro as the duty station and some travel to other important locations, started with my arrival in Rio de Janeiro on 20 September 1983. On the same day I met with the Chief Technical Adviser to get a briefing on the scope of the project, areas to be covered and specific tasks to be accomplished. In further discussions with the Chief Technical Adviser and my INMETRO contact, Engº Erasmo Flávio Moreno Martins and also through review of documentation provided to me, I familiarized myself with the organization and functions of CONMETRO/SINMETRO/INMETRO and ABNT and the situation of metrification responsibilities within this framework. I also gathered that the organization for metrification was in the embryonic stage and that a proposal had recently been drafted to redefine the structure and role of CNMET, the National Committee for Metrification.

During the first week, a series of interviews were organized with INMETRO officers responsible for standards activities in the various industry sectors and also an itinerary for travel/visits/lectures was drafted, in collaboration with the Chief Technical Adviser.

During the second week I accompanied the Chief Technical Adviser to Brasilia for discussions with INMETRO officials dealing with metrification and to review a draft plan detailing the structure and role for CNMET.

The subsequent four weeks were characterized by discussions on metrification status in different industry sectors, visits to factories and technical institutions in São Paulo, Feanco, São José dos Campos and Xerem and a series of eleven lectures to industry/government groups.

Over the six week period, dealing only with the working level of INMETRO officials, I did not have the opportunity to make a first-hand assessment of the degree of commitment to metrification at the higher, policy/executive levels of the government.

2. Terms of Reference

The Terms of Reference as provided for the Metrication Expert under Project BRA/82/020/11-04 are summarized below:

In cooperation with INMETRO personnel and under the leadership of the Chief Technical Adviser:

1. Assist in the development of a national plan for metrification in Brazil.
2. Assist in the development of the infrastructure and the setting-up of committees for metrification.
3. Assist in identefying priorities and procedures.
4. Give lectures to induce industry to cooperate in the metrification programme.
5. Prepare a final report on findings and recommendations to the Government for further actions.

Obviously, the very first step to precede the above tasks was to assess the current situation with respect to metrification in Brazil.

3. Assessment of current situation of SI usage

It should be noted at the outset that Brazil, being one of the first countries in the world to adopt the metric system of measurements, has been "metric" for well over a century. The concern of the government at present is that the universal and exclusive use of the International System of Units (SI) should become normal practice in all major industrial sectors, in concert with the broader programme for metrology, standardization and industrial quality (based on CONMETRO Resolution nº 04/80).

An overview of the current situation with respect to the use of SI units was obtained through interviews with a number of government and industry officials, review of some technical standards and specifications, perusal of trade journals and catalogues and a random scanning of labels on consumer products in the shops. Full details on my assessment are contained in my report on 'Assessment of current situation' and is attached as Annex III. A listing of interviews and visits is attached as Annex I.

In summary, Brazil has been using the metric system of measurements for over a century but due to rapid industrial development and technological influence from abroad, there has been an incursion of standards, technical reference documents, manufacturing machinery and test equipment using inch-pound measurements. Also, as in the case of other tradionally metric countries, there is extensive use of non-SI units and terminology. Metrification in Brazil is therefore a question of adopting correct SI units and terms to replace the non-SI (inch-pound as well as old metric) units, in such fields as education, research, healthcare, technical and commercial documentation, manufacturing operations, test facilities and product descriptions. This process of metrification is more of a concern to professionals and industry groups rather than to the general public.

4. Lectures to Industry/Government groups

A series of eleven lectures were delivered by me in Rio de Janeiro, São Paulo, Franca, São José dos Campos and Xerem to such audiences as INMETRO, ABNT standards committee, Electrical/Electronics Industry, Structural Steel and Construction Industry, Ship-Building Industry, Aerospace Industry, Leather and Shoe Industry and Wood Industry. The general content of the speeches, covering a global overview of the adoption of SI by the nations of the world, the implications of adopting SI, the metric conversion experience in Canada and the prospects for Brazil's metrification, is attached as Annex IV.

The purpose of these lectures was to sensitize the industry groups as well as INMETRO officers to the problems, approaches and benefits in moving to SI usage. A listing of the lecture locations and audiences is attached as Appendix II.

5. National Plan for Metrification

A draft proposal for the restructuring and redefining of CNMET, the National Committee for Metrification was reviewed by me in detail. Subsequently, taking into consideration my findings on the current situation on SI usage, the degree of interest shown by industry and the steps taken so far at the government level towards metrification, a report was prepared for a National Plan for Metrification in Brazil. This report, attached as Annex V, discusses the scope and essential features of a National Plan and provides a model for such a plan. This model should of course be reviewed and refined taking into account prevailing economic and political considerations.

6. Implementation: Infrastructure and Procedures

A report on steps to be taken for launching the national metrification programme and procedures for a planned and coordinated approach to metrification has been prepared. This report, attached as Annex VI,

contains twenty-one points for consideration by those who will be responsible for the metrification policy, rather than those who will implement it.

7. Recommendations for Priorities and Further Actions

1. The first priority obviously, is to agree on the shape and role of the body responsible for metrification in Brazil. A definitive proposal for the composition of CNMET, its secretariat and the infrastructure of committees has to be submitted to CONMETRO for approval. The recommendation in this regard is that a separate metrification division (or DISI for SI Division) be established in INMETRO. Metrification has a larger field to cover than standardization and if the metrification group is part of the standardization division, then such fields as education, health and agriculture, which are outside the usual standards activities, will be more difficult to cover.

2. The second priority is to staff the metrification division with competent officials and concurrently form CNMET, the National Coordinating Committee, in accordance with CONMETRO's approval. This is likely to be a time-consuming effort.

3. Next comes the finalization of the National Metrification Plan document, getting it approved and publicizing it. Copies of the Plan should be made available to all affected parties.

4. Immediately following the publication of the National Plan, the formation of the committees according to the agreed infrastructure should start. Initial efforts should be focussed on the priority sectors. It is recommended that the CNMET chairman should write to the heads of national industry associations, state and other major enterprises, universities and technical institutions, labour and consumer groups and major government departments, briefly explaining the National Metrification Programme and inviting them to nominate knowledgeable representatives for metrification committees.

5. As the Sector Committees and Sector Coordinating Committees get organized, the information secretariat of INMETRO or preferrably the metrification division (DISI) should prepare simple publicity pamphlets to create awareness and to motivate industry groups regarding the metrification programme. A unique symbol or logo for metrification can considerably enhance public awareness.

6. The INMETRO standards division as well as the Metrification division officials should be fully sensitized to SI units and also rationalization. This is a very important step because these officials will be the "preachers" of SI to their respective committees.

7. The media (radio, television, newspapers, magazines and advertising) should be sensitized to metrification at an early stage. Although Brazil's metrification programme will not have a major impact on the general public (except for such terms as kilojoules instead of calories, kilopascals instead of kg/cm^2 for tire pressure, etc.) it is wise to feed positive information to the media instead of them reacting negatively to something they found out by accident. The recommendation is that a special information secretariat under INMETRO (or DISI) handles the public information matters.

8. Similarly, the state and city governments should also be kept informed and their cooperation enlisted for metrification, assuming that these levels of government will also have interactions with industrial and public welfare in their jurisdictions.

9. The current concerns on monetary inflation and economic recession may be cited as obstacles to launching metrification. However, it is strongly recommended that this is the time, when factories are not too busy, to do some "house cleaning" and plan for the future.

10. Once the infrastructure of committees is in place, at least for the important, priority sectors (such as education, iron and steel, structural metals), a metrification consultant can be brought in for a period of three months to advise on the development of planning, coordinating and approval procedures. It is estimated that it will take approximately one year before the time is ripe for a metrification expert to make useful contributions in the Brazilian scene.

11. Lastly, but most importantly, the government's commitment to metrification should be overtly displayed from the highest policy levels. Otherwise, the private sector groups who are called upon to implement the necessary changes will not be convinced.

8. Acknowledgement

The timely and effective execution of this UNIDO project relied heavily on the leadership and commitment of the Chief Technical Adviser. His personal efforts in organizing my programme and his valuable guidance in carrying out my tasks are gratefully acknowledged. I also thank all the INMETRO officials and industry people who provided me with valuable information and made a great effort to communicate with me in English and French. Last, but not least, my sincere thanks go to the UNIDO project office personnel in Rio de Janeiro for their valuable administrative support.

ANNEX I

VISITS AND DISCUSSION

Date	Subject	Place	Person(s) met	Nº of hours	Expert
20/09	Metrification Project Briefing	INMETRO-RIO	B.S. Krishnamachar Chief Technical Advisor	1.5	N. Ganapathy
21/09	SINMETRO/INMETRO	INMETRO-RIO	B.S. Krishnamachar Chief Technical Advisor	1.5	N. Ganapathy
21/09	Metrification - Metals/Mechanical	INMETRO-RIO	Engº Erasmo and B.S. Krishnamachar	1.0	N. Ganapathy
22/09	Metrification - Iron and Steel	INMETRO-RIO	Engª Regina Vimercati and Engª Heliane Fonseca	1.0	N. Ganapathy
22/09	Metrification - Electrical/Electronics	INMETRO-RIO	Engª Juçara Lopes da Silva	1.0	N. Ganapathy
22/09	Metrification - Agro-Industries	INMETRO-RIO	Sra. Angela Damasceno Sra. Suzana Oliveira Sr. Gerson Novaes	1.5	N. Ganapathy
23/09	Metrification - Naval Automotive	INMETRO-RIO	Engº Julio Sergio Mirelli, Engº Reinaldo Figueiredo	1.5	N. Ganapathy
23/09	Metrification - Civil Construction	INMETRO-RIO	Engº Leonardo da Silva	1.0	N. Ganapathy
23/09	Metrification - Chemicals/Petroleum	INMETRO-RIO	Engª Fatima Leone Martins, Engª Elizabeth Cavalcante, Engº Sergio Vianna	1.5	N. Ganapathy
26/09	Metrification - General	INMETRO - DF	Engº Rubens Galina Engª Mercia Cosac	1.0	N. Ganapathy
26/09	Metrification - Electrical/Electronics	INMETRO - DF	Engª Maria Aparecida	1.5	N. Ganapathy
26/09	Metrification - Wood	INMETRO - DF	Engª Maria Theresa Rodrigues Rezendi	1.0	N. Ganapathy
27/09	Metrification - National Plan	INMETRO - DF	Eng. Márcia Cosac, Engº Luiz de França Lima, B.S.Krishnamachar	2.0	N. Ganapathy

ANNEX I

VISITS AND DISCUSSION

Date	Subject	Place	Person(s) met	Nº of hours	Expert
27/09	Metrification - Project Scope	UNDP - DF	Various UNDP official	1.5	N. Ganapathy
30/09	Metrification - Leather, Agro industries	INMETRO-RIO	Sra. Márcia de Barros, Engº Adriano Braga de Melo, Sr. Suzana Oliveira	2.5	N. Ganapathy
03/10	Visit - IPT Wood/Pulp paper	IPT - SP.	Engª Silvia Bugajer Dra. Silávia Bergman, Engº Marcio Augusto Nahuz, Engº Reinaldo Herreto Ponce	2.5	N. Ganapathy
03/10	Visit Wood Panels factory	Duratex - Jundiai	Sr. J. B. Moura	1.0	N. Ganapathy
04/10	Visit - IPT Pulp/CRM laboratories	IPT - SP.	Dra. Silavia Bergman Dra.	2.0	N. Ganapathy
05/10	Visit IPT - Leather	IPT - Franca	Dr. Hélio Jorge Sra. Márcia de Barros	1.0	N. Ganapathy
05/10	Visit-Shoe factories	Franca	Sandalo, Terra, H.B. (officials)	6.0	N. Ganapathy
06/10	Visit IPT - Leather	IPT - Franca	Dr. Hélio Jorge Sra.	2.0	N. Ganapathy
07/10	Metrification - Steel/Construction	ABCEM - SP	Engº Roosevelt Carvalho	2.0	N. Ganapathy
13/10	Metrification - Electrical/Electronic	ABINEE - SP	Engª Maria Aparecida Martinelli Sr. Ernest Muhr	2.0	N. Ganapathy
13/10	Visit - Pirelli cable factory	Santo André	Dr. Carmine Toralli Engº Louiz Carlos Stracieri	3.0	N. Ganapathy

ANNEX I

VISITS AND DISCUSSION

Date	Subject	Place	Person(s) met	Nº of hours	Expert
17/10	Metrification - General	INMETRO - RIO	Dr. Joseph Brais B.S.Krishnamachar	1.0	N. Ganapathy
17/10	Visit - INMETRO	Xerem	Engº Ricardo Nóbrega	2.0	N. Ganapathy
19/10	Metrification - SI Units	São Paulo	Dr. Rodolfo Maluky	2.0	N. Ganapathy
19/10	Visit CTA	São José dos Campos	Engº Luiz de França Lima	2.0	N. Ganapathy
20/10	Visit EMBRAER	São José dos Campos	Engº Ozires Silva (Diretor-Presidente) Engº Shiroiyuko Kudo Engº Luiz de França Lima	1.0	N. Ganapathy

A N N E X II

LECTURE - INDUSTRY

Date	Subject	Place	Nº of Persons	Nº of Hours	Total p/h	Expert
04/10	Metrification (Wood/paper/pulp)	IPT - SP.	15	1:7	25.5	N. Ganapathy
06/10	Metrification (Leather/shoe ind)	Franca - SP.	23	1.3	29.9	N. Ganapathy
10/10	Metrification (Construction)	ABCEM - SP.	7	2.0	14.0	N. Ganapathy
13/10	Metrification (Electrical/ Electronics)	ABINEE - SP.	35	2.1	73.5	N. Ganapathy
18/10	Metrification (INMETRO)	INMETRO -RJ.	10	2.0	20.0	N. Ganapathy
19/10	Metrification (CEUMI)	São Paulo	12	1.8	21.6	N. Ganapathy
20/10	Metrification (Aerospace)	CTA - São Jose dos Campos	20	2.5	50.0	N. Ganapathy
20/10	Metrification (Aircraft)	EMBRAER -São José dos Campos	45	3.0	135.0	N. Ganapathy
24/10	Metrification (INMETRO)	INMETRO - RJ.	8	2.7	21.6	N. Ganapathy
27/10	Metrification (ship-building)	SOBENA - RJ.	12	1.6	19.2	N. Ganapathy
27/10	Metrification (International Seminar)	Xerem	18	2.2	29.6	N. Ganapaty
			TOTAL	22.9	449.9	

CLASSIFICATION OF DOCUMENTS

OF UNIDO PROJECT BRA/82/020

Expert Name: Mr. NATARAJAN GANAPATHY

Overall nº*	Expert post Nº	Serial nº given by Expert	Date	Subject Title
C-763	11-04	01	29/9/83	General notes for speaches to Industry Associations/ Sector Groups/Related Organizations in Brazil on Metrication - A global overview prospects for Brazil Canadian Experience.
R-774	11-04	02	Oct.83	Assessment of current situation.
R-776	11-04	03	Oct.83	National plan for metrication in Brazil.
R-778	11-04	04	Oct.83	Implementation - Infra-structure and procedures
R-779	11-04	05	1/11/83	Final report by N.Ganapathy

*Given by the Secretary

ANNEX III

ASSESSMENT OF CURRENT SITUATION

1. It is to be recognized at the outset that Brazil is one of the first 17 signatories to the Treaty of the Metre in 1875 and thus it has been a "metric country" for over a century. The concern of the goverment at present is for the universal and exclusive use of SI, the international System of Units, especially in the major industrial sectors.

2. An overview of the current situation with respect to the use of SI units was obtained through interviews with a number of government and industry officials, review of some technical standards and specifications, perusal of trade journals and catalogues and a random scanning of consumer product labels in the shops. Discussions on industry practices were guided within the framework of the following questions:

   a) Are there Brazilian National or industry standards applicable to your industry?

   b) Do these standards relate to international or other standards of foreign origin, such as ISO, IEC, ASTM, BSI?

   c) Are the measurement units in the standards specified in SI?

   d) Are the dimensions and measurements values in round, rationalized numbers or are they arithmetrical conversions of inch-pound values?

   e) Are the standards being applied and practiced widely in your industry?

   f) Who is the motivating force for your industry to practice SI? INMETRO, major company or external bodies?

g) Does the industry foresee any problems with machinery and test equipment to be SI only?

h) Is the industry constrained by export, import and domestic market implications for using only SI units and standards?

i) Are there fears of costs for changing to SI?

j) Are the government's projects and purchase orders in SI units and dimensions?

k) Are there any verification, inspection procedures by government or other bodies to ensure compliance with SI specifications?

l) If inch-pound measuring equipment are used in your manufacturing/testing operations, how were they acquired?

3. Highlights of SI-related information, pertaining to a variety of industry groupings are presented below:

a) Metals, Mechanical (Engº Erasmo Flávio Moreno Martins-INMETRO)

ABNT, the technical standards writing body in Brazil has a number of primary standards in SI. Industry is generally fearful of cost of changing to SI products and modifying existing inch-pound equipment, especially of a time of economic recession in Brazil.

b) Iron & Steel (Engª Regina Alves Vimercati and Engª Heliane Fonseca, INMETRO)

Considerable work done by ABNT technical committee on standards, but there is widespread use of ASTM standards within the industry. Technical documents and reference material are mostly in English units and designers prefer to work in those units. Many items of machinery and test equipment are in English units. Mills fear cost of changing to metric sizes. Government has set deadline of January 1984 for equal angle steel to be in metric sizes.

c) Structural metals (Sr. Roosevel Carvalho - ABCEM, Dr. Fernando Souto - Falcão Bauer)

Technical problems in standardizing structural shapes; many standard designs exist in inches; transition from present inch sizes to new metric sizes will take a long time; problem of double inventory; major producers COSIPA, AÇOMINAS, USIMINAS, CSN and COFAVI do not have a coordinated approach. Plate thickness is in millimetres.

d) Naval & Automotive (Engº Júlio Sérgio Mirilli, Engº Reinaldo Balbino Figueiredo - INMETRO; Thércio de Almeida - GM of Brazil)

In ship-building there are eight major companies, all private enterprises and EMAQ has shown leadership in promoting metric standards. Some ABNT standards are adaptations of US standards, with inch-pound values converted to metric values. Many hydraulic and plumbing equipment and parts are only described in English units in catalogues.

The automotive industry is alleged to be metric, but standards (especially fasteners) may vary from company to company. General Motors designs and production operations are entirely metric.

e) Civil construction (Engº W.Leonardo da Silva, INMETRO)

Civil construction and building materials are generally in metric dimensions, 100mm module is used, tiles are 400 x 400mm; concrete blocks are 600mm. There seems to be no metrication issues or problems, except perhaps wood/panel sizes.

f) Electrical/Electronics/Wire & Cable (Engª Juçara Lopes da Silva Engª Maria Aparecida Martinelli - INMETRO; Sr.Ernest Muhr - ABINEE; Sr. Roberto Gonçalves - ABINEE/COBEI; Dr. Carmine Taralli, Engº Louiz Carlos Stracieri - PIRELLI)

Big lead was taken by Pirelli in preparing ABNT standards for electrical wire, based on IEC series. Designs and tenders for electrical projects may be metric, but manufacture is often in inch-pound units, converted back to metric descriptions. Most reference

data (US origin) in English units. Fasteners pose a big confusion: companies of European origin may use metric fasteners, while others, GE for example, may use US sizes. ABINEE (the electrical industry association) is very supportive of metrication, but at the company level, people are not convinced of the need to go SI and are also fearful of costs. ELETROBRAS, the national electrical utility company, has a "metric" policy for all procurement but the engineers are content with conversion of inch-pound values to metric values, rather than a true metric standard. New catalogues & sales literature in SI only, represent significant costs.

g) Wood and Wood products (Engª Maria Theresa Rodrigues Rezende, Angela Maria Guerra Damasceno - INMETRO; Sr. Márcio Augusto Rabelo Nahuz; Engº Reinaldo Herrero Ponce - IPT Woods Division; Sr. J. B. Moura - DURATEX Jundiaí)

Wood industry is large in Brazil, with significant export of lumber and panels, but relatively undeveloped with respect to standards, processes and quality control. Panel sizes are in a mixture of units; thickness in fractions of inches, length and width may be inches or metres or millimetres. A lot of machinery in the wood industry is old, in English units, but generally un-sophisticated. Once standardization activity is in place, for example product standards, rationalized sizes, uniform test methods etc., metrication per se will not be a serious problem. A metrication plan drafted in 1980 is dorment.

h) Pulp and Paper (Dra. Silávia Bergman; Engª Sílvia Bugajer - IPT)

Industry is generally metric - but non-SI metric units are common. In laboratory tests, conversion tables are used for comparison of results with English units. Going SI is a matter of concern at the technical level rather than at the user level.

i) Leather and related industries (Sra. Márcia de Barros - INMETRO; Engº Hélio Augusto Ferreira Jorge - IPT; Sr. Moisés Magalhães - Terra Shoe Company)

Leather and leather products, particularly shoes, from a prosperous industry with considerable exports, but there is little by way of standardization and quality assurance. Metrication per se is not a significant concern. Machinery in factories is generally not metric-measurement sensitive, except for some pressure guages marked in $lbs/inch^2$ and kg/cm^2.

j) Food, Soft-drinks (Sr. Adriano Braga de Melo, Sr. Gerson de Andrade Novaes; Sra. Suzana Saboia de Moura Oliveira - INMETRO)

Consumer packages and product descriptions are in metric - SI is not a major concern. Many laboratory tests and equipment are in English units (for comparability with US or British source reference documents). For soft drinks, all filling equipments are in English units (US source) and content declarations on bottles are rounded values. Maintenance and spare parts in English units have to be imported, depriving local industry of the opportunity to grow in this field.

Metrication is not a great problem, except perhaps at the internal processing level.

k) Chemical industries (Engª Fátima Leone Martins, Engª Elizabeth dos Santos Cavalcanti, Engº Sérgio de Gouveia Vianna - INMETRO)

The perto-chemical industry has developed with US technology and chemicals through US and European multinationals. Many manufacturing, processing, testing equipment imported or given as aid, in English units. Companies use their own internal standards, which may or may not be metric, depending on origin; the American Petroleum Institute Standards and Specifications are the controlling factors in the petroleum industry; oil is sold in barrels, not cubic metres. PETROBRAS is taking a

lead in standards activity, but NBRs have soft-converted values. The National Petroleum Council (CNP) can impose decrees relating to oil, gas and alcohol.

l) Aerospace industry (Col. Luiz de França Lima and other officials of CTA; Engº Ozires Silva - Diretor-Presidente EMBRAER; Engº Shiroiyuki Kubo and other engineers of EMBRAER)

The aerospace industry is dependant on an international market and is highly influenced by US technology, materials and standards; Brazil can not take unilateral action for metric standards and materials; in EMBRAER one aircraft is a metric design while another is entirely in English units; metric sizes for metals, tubes, fasteners are not readily available and some cost three times the price of non-metric; long cycle for product design and manufacture; conversions between non-metric and metric design parameters pose problems; tools are mixed.

m) ABNT - Standards Writing Organization - (Dr. Rodolfo Maluhy, Chairman CEUMI)

All Brazilian National Standards are required to use only SI units; CEUMI the special committee on SI units is preparing a series of documents on units applicable to different industries; work is time-consuming and a long process. A Brazilian sub-contractor for a project may use all metric units and designs but then has to translate everything into English units for review and approval by the U.S. main contractor.

4. The following conclusions are drawn from the above findings:

a) Brazilian industries have grown rapidly using technological assistance as well as equipment from foreign sources, especially U.S.A. As a natural consequence, there has been an incursion of standards, technical reference material, manufacturing machinery and test equipment using inch-pound values.

b) As in the case of traditionally metric countries, non-SI metric units, especially in the mechanical and chemical engineering fields, continue to be used in manufacturing and test processes and product descriptions.

c) At the higher education and research levels, there is considerable use of technical material, reference handbooks and tables of US origin, in inch-pound values. The traditional textbooks and other material of European origin are not necessarily in SI.

d) Under the SINMETRO system for preparing Brazilian National Standards, there is a policy of using SI units only; however it is possible that dimensions and measurement values are merely arithmetrical conversions of inch-pound values.

e) The government's objective for the universal and exclusive use of SI does not appear to have filtered down to the individual enterprise level. It is alleged that at the working level in industry, people are unconvinced or indifferent to SI. Also, the fear of the unknown translates into a fear of high costs.

f) At the consumer level, SI per se is not a serious concern, except for some catalogues and descriptions of mechanical equipment in English units. It is gratifying to note that at least one brand of mineral water bottler quotes conductivity correctly in microsiemens!

g) To sum up, metrification in Brazil is more appropriately "SI-fication", meaning that the practice of non-SI (inch-pound as well as old metric) units and terminology should be replaced by correct SI practice in such fields as education, research, technical documentation, manufacturing operations, test facilities and product descriptions. Motivation and sensitization to SI should be directed not so much to the general public in their every-day life but to certain specific publics in defined areas.

5. An important area where the transition to strict adherence to SI units is likely to pose difficulties is health and medical sciences. Due to the fact that these are outside the jurisdiction of INMETRO and the Ministry of Industry & Commerce, no discussions have taken place to explore the SI practice and potential problems. However, it is safe to assume that, based on the worldwide situation, considerable effort and education will be required to adopt SI units and terminology in clinical laboratories, radiology and nutritional sciences. Established traditions, implications of personal safety and cost of re-calibration of laboratory equipment and redesign of charts will be some of the major obstacles for changing to kilopascal for blood pressure, kilojoule for dietetic energy, mol for concentration of solutions, sievert for radiation dose equivalent, and so on.

6. The degree of interaction between State government and the Federal government with respect to national policies such as metrification, has not been assessed; this will deserve some attention.

ANNEX IV

GENERAL NOTES FOR SPEECHES

TO

INDUSTRY ASSOCIATIONS/SECTOR GROUPS/RELATED ORGANIZATIONS

IN BRAZIL

on

METRICATION - A GLOBAL OVERVIEW

PROSPECTS FOR BRAZIL

CANADIAN EXPERIENCE

WELCOME AND INTRODUCTION

1. THE METRIC WORLD

Brazil is one of the original 17 signatories to the "Treaty of the Metre" in 1875, adopting the metre and the kilogram as the foundation of weights and measures. By the year 1900, a total of 35 countries in Europe and North and South America officially accepted the metric system of measurement as their legal measures. However, in countries under British influence the new metric system was confined to the scientific field while the traditional foot-pound system flourished in general use.

Even within the metric countries, different adaptations of the metric system evolved for specialized purposes; CGS units, electrostatic units, electromagnetic units, MKS units - are examples.

Over the last few decades, with the advancement of technology and expansion of worldwide trade the need to use a common, international measurement system became increasingly important to industrial countries.

In 1960, at the 11th CGPM, the most modern evolution of the metric system was established with the name SI, for Système International d'Unités. The major features of SI was that it was a rational and coherent system, linking all fields of science and engineering without awkward conversion factors.

Also in the 1960's, Britain, the major Commonwealth countries and also the U.S.A. began preparations for the eventual adoption of SI to replace their traditional foot-pound units. In the far east, Japan was well on its way to completing its change to SI and China declared its policy on SI.

Today you can see that all industrialized countries of the world have either changed to SI or are in the process of completing the change-over. South Africa, UK., Australia, New Zealand, Singapore, Japan are all essentially SI; Canada is almost there and the USA is well on its way. Even the European Common Market countries are obliged to standardize their weight and measures based on SI by 1986.

So, the World is moving to SI and it is important that Brazil too keeps abreast with this trend.

2. WHY SI?

Why is this big move to SI taking place? Obviously there is an economic advantage. SI is simple: one unit for one quantity. It is claimed that considerable teaching time is saved in schools. It is universal, because of the common, international use of the same terminology and symbols; there are no misunderstandings in trade and commerce. (Compare with US gallons, Imperial gallons, short tons, long tons, etc.) It is rational meaning there are no conversion factors between different quantities. It is coherent, linking all fields of science and engineering; the derived units for various quantities in mechanics,

electricity, magnetism, heat, light, chemistry, nuclear physics have simple, continuous relationships. A stardard, international system of measurement has enormous benefits for world trade and technology transfer. Consider for instance the move to "world product"; automobile and computer parts manufactured in different countries can be easily integrated. Another example: in grain handling, Canada used different measurements at different levels and required many conversions of units (from bushels to pounds to short tons to metric tonnes). Now there is a single system: kilogram and tonnes, resulting in enormous cost savings to the industry.

3. WHAT DOES MOVING TO SI MEAN?

It means the adoption of a universal language of measurements, symbols and standards in our everyday life: in education, in technical specifications, in product descriptions, in trade documentation, in laws and regulations, in the measuring equipment, in the manufacturing processes and in our consumer and domestic areas. It affects people in all walks of life. The change involves education; standardization; internationalization. It is not merely a case of mathematical conversion of numbers, it has to be a case of "Think SI". Considering the national involvement, there will be short term costs but these have to be viewed with long term benefits. Therefore this is the time to do some house-cleaning. Think about modernizing standards; think about rationalizing product sizes and packages; think about improving production processes; think about modern approaches to designs and drawings. These are all well known elements of industrial

standardization, rationalization and quality assurance. It is a slow process which pays-off in the long run. It is a one-time opportunity to change and we may as well do it right.

4. HOW CAN THE CHANGE BE ACCOMPLISHED?

a. It should be a joint effort between government, industries, educational institutions and consumers. It should be a coordinated effort involving the whole economy. The consciousness, dedication and participation of all people is the key to successful implementation.

b. A national policy should be established in the common interest. A climate of receptivity to the change should be created through informing all the affected people. The problems and opportunities should be explained to the industries. Areas of change should be planned by the respective industries in consultation with their suppliers and customers. Priorities should be established for leading sectors, which others can follow.

c. Education should emphasize the benefits of a single, universal system of measurement. Adequate information should be provided to management as well as labour in the industries. Training should be provided where necessary.

d. Standardization and rationalization should be attempted concurrently, to establish the foundation for reaping economic benefits. This

is also the opportunity for improving quality of production and product certification.

e. Planning for the change should lead to cost avoidance. Investigate if equipment can be modified or adapted rather than replaced. Plan the timing of replacements to coincide with obsolescence or design changes. Remember that changes can be evolutionary and not revolutionary. The investment versus benefit should always be studied to avoid unnecessary costs.

f. Participation in the planning process is an absolute necessity. If you do not study the problems and opportunities, somebody else will decide the changes for you. The move to SI is sometimes like pushing a rock up the hill - you have to maintain a momentum.

5. WHAT ABOUT COST? WHO PAYS?

In many cases, there is a short term cost aimed at a long term benefit. The important thing is to plan for cost-avoidance.

a. Plan the timing of the change. Example: In Canada, the plan for changing food weighing scales from pounds to kilograms took into account the introduction and modernization of digital scales in many stores. By scheduling the change over a common period, large quantities of digital scales were produced and could be bought at competitive prices.

b. The management of the transition needs smart thinking. Minimize dual inventories by setting

cut-off dates.

c. Think of rationalization and simplifying inventory control. Cost savings on wires and fasteners by the automobile industry.

d. Instead of asking "What will it cost to change?" ask yourself "What will it cost me later, if I don't change now?" Future costs are always higher. Example, conversion kits for scales, pressure gauges can be obtained cheaper when whole industry is changing than at a later date when you are alone.

e. Individual companies, which plan the changes for future benefits, should bear their costs. If you rely on the govt. to pay you then "intelligent thinking and cost management" will not take place. There will be a high social cost; the 'good' and the 'bad' will attempt to get the same money. For example, UK, Australia, NZ, Canada and USA all have concluded that costs should be borne by industry as part of their normal business development.

f. Initial estimates of costs are always higher than what is actually needed. Difficult to separate "metrication costs" from normal business improvements or modernization costs. Companies which have converted in Canada and in USA (example GM, Stelco, Alcan) claim that their costs were less than 1% of annual sales; ("less than accounting errors").

6. CANADIAN EXPERIENCE

a. Government policy through White Paper on Metric Conversion in 1970 - Metric Commission was established - Steering Committees and Sector Committees organized to plan a coordinated conversion - four-phase program of Investigation, Planning, Scheduling and Implementation covering a ten-year period was launched.

b. The Standards Council of Canada was formed to initiate and coordinate national standards activities to facilitate metric conversion.

c. Sector committees prepared plans, recommended by Steering Committees and approved by Metric Commission .

d. Many industries produced Metric Practice Guides for their special areas. They participated in revising and upgrading industry standards.

e. Metric Commission launched a massive information campaign to educate the public.

f. Conversion progressed through a series of major events: temperature in 1975; road sign in 1977; car odometer and speedometer in 1978; gasoline from 1978 to 1979; and so on.

g. Problems mainly related to interdependency with USA; therefore close coordination with US industries was necessary.

h. Initial diffuculties with Iron & Steel; fasteners; Machinery; wire & cable; paper sizes; panel products (plywood); retail scales; clinical laboratories; nuclear medicine. Each resolved through industry/government joint efforts.

7. WHAT CAN BRAZIL DO?

Brazil is very fortunate in that it is essentially a metric country for over a hundred years. All people are brought up with the metric system of measurements. You have made tremendous progress over the last few decades in your industrial production. You have developed most of your industries under Brazilian control. Industrial growth means exports and imports. This has meant that you have dealings also with inch-pound countries such as UK, USA, Canada etc. You have a variety of manufacturing equipment and machinery using inch-pound units. They may have been brought here through some aid program of by some of your foreign-owned big companies.

In my brief talks with people here, I have heard frequent references to the inch-pound equipment in your manufacturing operations and testing laboratories. Brazilian standards activities are receiving serious attention and I believe that under the SINMETRO system, a full range of standards using SI units only will be developed. Your government is committed to the SI system. You do not have the major problem faced by Canada in educating the public about metric units. To become a fully SI nation, only your industries and testing laboratories have a major role to play.

In broad terms, to move to SI, first investigate the present situation and decide on what metrication means; then,

a. Define the policy, goals and strategy.

b. Establish the infrastructure for planning and implementation, with industry involvement.

c. Give priority to standardization and rationalization.

d. Involve the educational, training and research institutions.

e. Each industry to plan the change taking into account the constraints from suppliers, customers and markets.

f. Get the consensus and cooperation of all parties for the timing of the changes.

g. Implement.

8. SOME COMMON CONCERNS

a. "I cannot change because of my customers."
Remember that the entire world is adopting SI; sooner than you think, your customer may not want non-SI products.

b. "I cannot be fully SI because my suppliers cannot meet my requests."
This is why a coordinated change by all sectors of industry should be planned. Suppliers, manufacturers and marketers have to work together.

c. "When there is an economic recession, I do not want to change."
This may be a short-sighted view. At a time of recession, you have more time to think; no pressure to make an urgent production. Use this time of plan ahead and do house-cleaning. The change may be made later, but think now.

d. "We buy and sell to the USA; we should keep the inch-pound system."
The USA is changing in many industries. Automobiles, construction and agricultural equipment, machine tools, computers and parts, paper and pulp, liquor, soft drinks, gasoline pumps. Sooner than you think they will be metric and you will be caught with obsolete production.

e. "It will cost me too much to change my equipment."
Not necessarily; planning will avoid excessive costs. Make the change gradually, at appropriate times; everything does not have to be replaced at once.

f. "I do not want to keep inventory in two systems."
Quite true; manage the transition effectively; set cut-off dates without too long a period for dual inventories.

g. "I have machinery calibrated in inches and pounds; I do not want to buy new SI machines."
Think of the "cost of not changing" and the long term effects. You can modify most equipment to SI readings.

9. WHAT CAN YOU DO AS LEADERS OF YOUR INDUSTRY?

Promote the awareness.
Motivate the change.
Explain the reasons.
Participate in the planning.
Implement with a common time table.
Reap the benefits as they accrue.
Be proud to be a leader.

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ANNEX V

NATIONAL PLAN FOR METRIFICATION IN BRAZIL

1. CONMETRO, The National Council for Metrology, Standardization and Industrial Quality, through its Resolution nº 08/78, established CNMET, the National Committee for Metrification, under the aegis of INMETRO. Resolution nº 04/80 further defined the structure and role of CNMET for coordinating and harmonizing the sector metrification plans, developing and submitting to CONMETRO a general program for metrification and advising CONMETRO on matters relating to metrification. During 1983, a proposal was drafted for the re-structuring of a metrification division under INMETRO, including an SI Coordination Committee and an infrastructure of Sector Sub-Committees, Implementation Commissions and Working Groups. Taking into consideration these actions taken at the government level and also the assessment of the current status of SI usage at the private sector/industry level, recommendations are made below for the scope and content of a National Plan for Metrification.

2. It is recognized that the main impetus for the universal and exclusive use of SI in all sectors of the economy has been provided through the government's intentions in this regard. The involvement of all affected parties, from the government as well as the private industry groups, for a coordinated implementation of metrification through a consensus process, is the intended approach. In other words, metrification is to be a voluntary cooperative effort, with government leadership to support the necessary activities.

3. The assessemnt of the present situation indicates that metrification in Brazil is mostly a question of adopting correct SI units and terminology to replace certain non-SI practices (inch-pound as well as old metric), especially in the educational, industrial and medical sectors. A change of this nature should be pre-conditioned by public awareness and information and should be implemented in a planned and coordinated manner.

4. The National Plan should not only be an explicit record of the government's intentions but also be a tool for informing all affected parties and for guiding their metrification activities. Therefore, such a plan should address, as a minimum, the questions of what is to be accomplished, why, by whom, when and how. However, it should only be a concise policy/ strategy document, leaving the details of implementation to be developed by individual sector committees, guided by their own particular problems and opportunities.

5. The National Plan should establish an infra-structure to investigate, plan and monitor metrification issues in all relevant sectors of the economy, provide guidance for a common approach and methodology for sector plans and also outline priorities and procedures for coordination, approval and implementation of sector plans.

6. The coordinating body for metrification at the national level is quite appropriately CNMET, as decreed by CONMETRO. Metrification is quite different from Standardization; yet the two must go hand-in-hand, just as Standardization is closely related to Industrial Quality. Therefore, the executive organ for metrification should be a distinct division within INMETRO and not a sub-division under the standards activities.

7. CNMET, to be an effective national coordinating body for metrification, should have ready access to and two-way activity flow with ALL government departments and agencies. Whereas CONMETRO has high-level representation from all government departments, a working level inter-departmental committee under the guidance of CNMET can deal with the implementation of metrification in harmony with private sector plans. This will also ensure that areas outside MIC jurisdiction, such as health, education, customs, revenue and labour are directly involved in the metrification programme.

8. Costs - to the government, to the industry and to the consumer - will be a general concern shadowing the metrification programme. Therefore, the National Plan should preferrably have an explicit statement addressing the question of costs (e.g., plan for minimum costs; companies should bear their costs; no price increases with metrification; short term costs for long term benefits; etc).

9. National metrification will be a relatively long project, measured in years rather than in months, and will involve a variety of industry and government organizations. Therefore, sound project managament techniques should be applied in implementing and measuring the progress of metrification. The National Plan should establish a mechanism for monitoring and taking corrective actions, through the infrastructure for metrification.

10. With these factors in mind, a model for a National Plan is presented herewith as Exhibit A. This is of course, subject to further refinements and elaborations by CNMET and CONMETRO to suit national economic and political considerations.

A MODEL FOR NATIONAL METRIFICATION PLAN

Preamble*

The rapid growth of international commerce and technology exchange has prompted the countries of the world to use a single, universal system of weights and measures. The International System of Units, called SI, which is the modern evolution of the metric system making it rational and coherent, has been accepted by almost all countries of the world. In line with this world trend, the national policy of Brazil is to promote the universal and exclusive use of SI in all sectors of the economy. In order to accomplish this task CNMET has been established to motivate public and private sector organizations to adopt SI and to coordinate their activities in this regard.

Goal

The national goal is that SI units and terminology should become normal practice for all commercial and legal measurement purposes, gradually replacing non-SI units in the form of obsolete metric units and English measurement units which are now prevalent in many technical, scientific and commercial fields.

Policy

- The process of accomplishing the exclusive and universal use of SI as normal practice for Brazil, called the National Metrification Programme, will be a joint effort involving government departments, industries, business, educational institutions, labour and consumers.

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* Use a suitable summary of CONMETRO Resolution 04/80.

Metrification should be planned by those who will be affected by the process, taking into account their specific problems and opportunities for change.

- The plans should be coordinated at the national level to minimize unnecessary disruptions and costs and to maximize the net benefit to the national economy.
- Standardization and rationalization of product sizes, being complementary to metrification, should be attempted concurrently in order to reap the long term benefits of metrification.

Strategy

- National metrification relies on the active participation and cooperation of all sectors of the economy.
- Planning for metrification will be initiated at each sector level, and the sector plan will serve as a guide to individual enterprises and organizations which will be implementing the necessary changes to achieve the national goal.
- Each sector or industry group, through a committee of representatives knowledgeable about that sector, will prepare the Sector Metrification Plan, which will be harmonized with the plans of related sectors by a Sector Coordinating Committee.
- Metrification will be a four-phase project. First is the Investigation Phase, during which each sector or industry group will determine what metrification means in terms of problems and opportunities in its area of activity, including products, markets, equipment and documentation and will define the policy and strategy for accomplishing the changes. The Planning Phase is to determine the time sequence of actions to be taken and to estimate the time required to accomplish the changes. The Scheduling Phase is for harmonizing the

timing of changes in collaboration with related sectors and target dates. The Implementation Phase is when metrification can proceed in a broad front accross the whole economy on a coordinated time scale.

- Monitoring of sector activities and providing information to all interested parties are important elements stretching over all the phases. Periodical feed-back reports from Sector Committees will enable revisions to plans and corrective actions when necessary.

- Proper investigation and planning by industry groups and a coordinated implementation by individual enterprises will minimize disruptions to normal operations and avoid unnecessary costs. Taking advantage of standardization and rationalization of product sizes will lead to benefits.

Timing

Considering that all the trading nations of the world are adopting the SI units of measurement, Brazil also should initiate the move now. Based on the experience of other countries making the change, it is estimated that Brazil's metrification programme can be accomplished over a five year period. As targets to guide the sectors, the Investigation Phase should be essentially completed by (—)*, Planning phase by (—) and Scheduling Phase by (—); Implementation in some areas may start by (—) and be essentially completed by (—).

Roles and Responsibilities

CNMET, the National Committee for Metrification has the responsibility to organize an infrastructure of committees to plan and implement metrification in their respective sectors. Public and private sector organizations, including industry and trade associations, educational and research institutions, health services,

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* Insert appropriate calendar month, year, depending on when the Programme is announced and launched.

Sector Coordinating Committee	11.0	Food and Agriculture
Sector Committee	11.01	Agriculture and horticulture
	11.02	Livestock
	11.03	Dairy products
	11.04	Poultry
	11.05	Fishing and fish products
	11.06	Consumer food products
	11.07	Beverages and bottling
	11.08	Alcoholic beverages
	11.09	Packaging
Sector Coordinating Committee	12.0	Health Services
Sector Committee	12.01	Hospitals and medical services
	12.02	Clinical laboratories
	12.03	Public health/sanitation/pollution
	12.04	Radiology and nuclear medicine
Sector Coordinating Committee	13.0	Consumer and other Services
Sector Committee	13.01	Home economics
	13.02	Sports and recreation
	13.03	Accommodation and food services
	13.04	Retail trades
	13.05	Personal services
	13.06	Communication services (media)
	13.07	Labour syndicates
Government Sector Coordinating Committee	14.0	Government Departments and Agencies

NOTE: Individual Sector Committees and their groupings depend on the industrial structure and input/output interactions in the Brazilian scene. The above list should be treated only as a checklist for covering the various sectors where metrification is expected to have an impact. Depending on the nature and degree of impact, this list should be modified.

Government's leadership will facilitate metrification through ensuring that laws, decrees, regulations and policies on purchasing goods and services are supportive of industry plans.

Priorities

Higher education and technical institutions will recevie priorty attention to propagate and promote adherence to correct SI units. Similarly, Brazil's primary industries and resource industries, where metrification can proceed without under external constraints will be the focal points for launching the National Metrification Programme.

Infrastructure

The concept of the infrastructure of Committees for the National Metrification Program is shown in Figure 1. Tentative list of Sector Committees and their grouping under Sector Coordinating Committees are shown on Table 1.

Public Information

The Information Secretariat of INMETRO/DISI* will publish leaflets and information material as the needs arise and will respond to general enquiries on the National Metrification Programme.

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* Appropriate designation of the information or public relations group to be used.

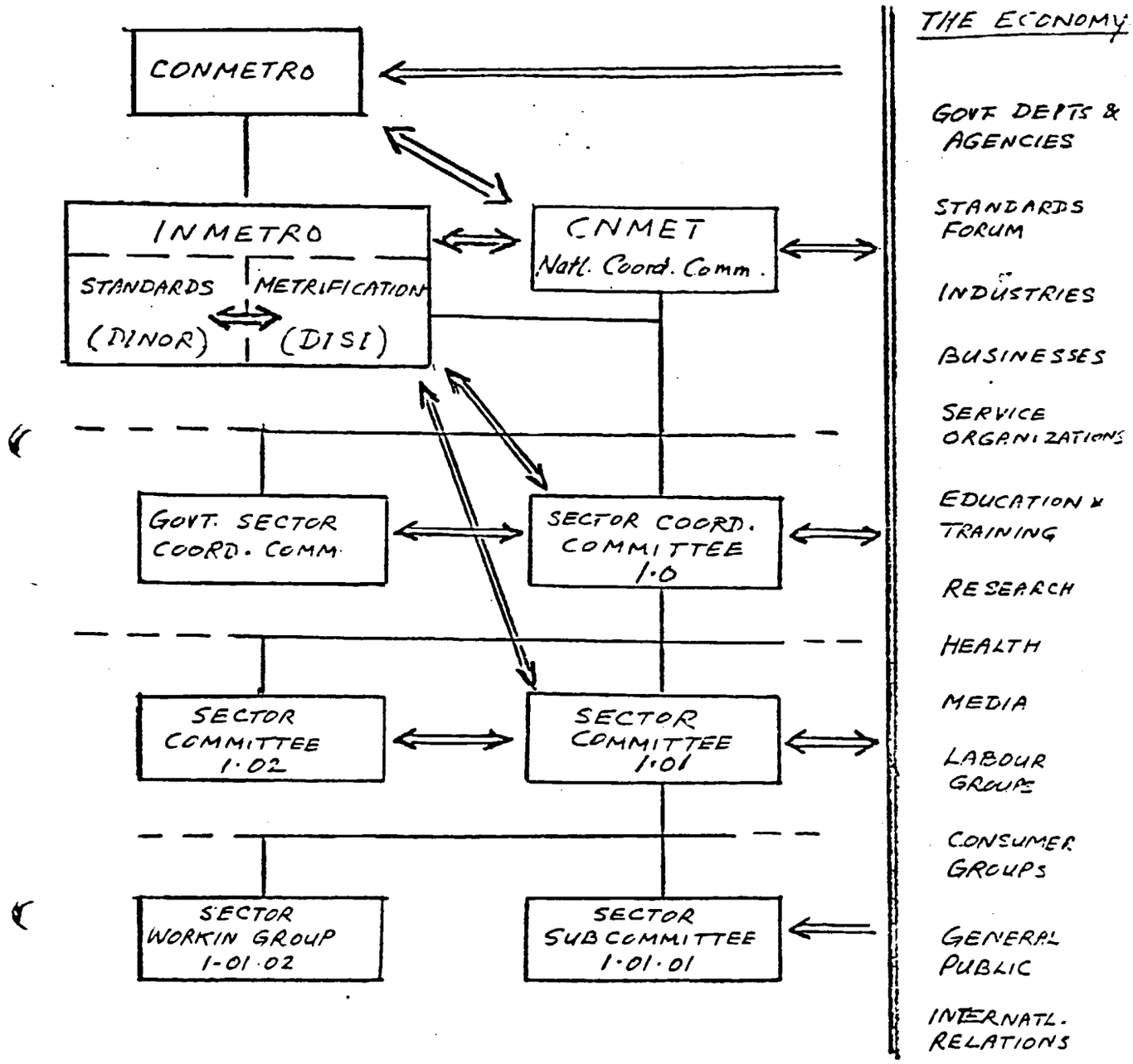

FIG. 1 - INFRASTRUCTURE & INTERACTIONS (⟺)

FOR METRIFICATION.

TABLE I

TENTATIVE GROUPING OF SECTOR COMMITTEES

AND SECTOR COORDINATING COMMITTEES

Sector Coordinating Committee	1.0	Education
Sector Committee	1.01	Universities and colleges
	1.02	Technical training institutions
	1.03	Research/Technology institutions
Sector Coordinating Committee	2.0	Metals and Metal Products
Sector Committee	2.01	Iron and steel mills, foundiries
	2.02	Structural steel
	2.03	Fasteners
	2.04	Wire and wire products (non-electric)
	2.05	Metallic pipes and fittings
	2.06	Sheet metal fabrication
	2.07	Metallic containers
	2.08	Hardware manufacturers
	2.09	Cookwares and housewares, metallic
	2.10	Non-ferrous metals
Sector Coordinating Committee	3.0	Machines and Tools
Sector Committee	3.01	Metalworking machinery
	3.02	Other manufacturing machinery
	3.03	Machine shops
	3.04	Tool and die makers
	3.05	Hand tools
	3.06	Instruments and measuring devices (non-electric)
	3.07	Heating, ventilaring and airconditioning equipment

Sector Coordinating Committee	4.0	Mechanical Manufacturing
Sector Committee	4.01	Automobiles and parts
	4.02	Shipbuilding and ship-repairing
	4.03	Railroad equipment
	4.04	Bus, trailer and truck body
	4.05	Aerospace equipment
	4.06	Construction and agricultural equipment
	4.07	Off-road transportation equipment
Sector Coordinating Committee	5.0	Electrical Manufacturing
Sector Committee	5.01	Electrical appliances and parts
	5.02	Lighting and light fixtures
	5.03	Generation, transmission, distribution
	5.04	Wire and cable (electrical and telecommunication)
	5.05	Major electronic equipment and parts
	5.06	Consumer electronic products
	5.07	Computers and office equipment
Sector Coordinating Committee	6.0	Construction
Sector Committee	6.01	Builders and contractors
	6.02	Architects and designers
	6.03	Real estate developers and marketers
	6.04	Road construction
	6.05	Building materials manufacturers and distributors
	6.06	Wood and panel product manufacturers
	6.07	Water works

Sector Coordinating Committee	7.0	Resource Industries
Sector Committee	7.01	Mining
	7.02	Petroleum exploration
	7.03	Coal and coal gas
	7.04	Fuel refining
	7.05	Fuel distribution and retail service stations
Sector Coordinating Committee	8.0	Processing Industries
Sector Committee	8.01	Chemicals
	8.02	Consumer chemical products
	8.03	Pharmaceuticals
	8.04	Compressed gases
	8.05	Plastics and plastic products
	8.06	Rubber and rubber products
Sector Coordinating Committee	9.0	Transportation Industries
Sector Committee	9.01	Road transport
	9.02	Rail transport
	9.03	Water transport
	9.04	Air transport
	9.05	Postal and parcel services
	9.06	Tariffs and customs
Sector Coordinating Committee	10.0	Agro-industries
Sector Committee	10.01	Wood and wood products
	10.02	Leather and leather products
	10.03	Paper and pulp
	10.04	Textiles and clothing
	10.05	Home furnishings

Sector Coordinating Committee	11.0	Food and Agriculture
Sector Committee	11.01	Agriculture and horticulture
	11.02	Livestock
	11.03	Dairy products
	11.04	Poultry
	11.05	Fishing and fish products
	11.06	Consumer food products
	11.07	Beverages and bottling
	11.08	Alcoholic beverages
	11.09	Packaging
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	12.02	Clinical laboratories
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Sector Coordinating Committee	13.0	Consumer and other Services
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Government Sector Coordinating Committee	14.0	Government Departments and Agencies

NOTE: Individual Sector Committees and their groupings depend on the industrial structure and input/output interactions in the Brazilian scene. The above list should be treated only as a checklist for covering the various sectors where metrification is expected to have an impact. Depending on the nature and degree of impact, this list should be modified.

ANNEX VI

IMPLEMENTATION - INFRASTRUCTURE AND PROCEDURES

1. Implementation of the national programme for metrification starts with the announcement - preferrably from the Ministerial level - of the national policy goal of the universal and exclusive use of SI units and terminology as normal practice in all sectors of the economy. Such an announcement is to be supported by general public awareness pamphlets to inform and motivate the education, industry and business sectors. The INMETRO chart on SI units and symbols "Unidades Legais no Brasil" is an example and other pamphlets may deal with the scope, timing and benefits of moving to SI and explain the role of CONMETRO/INMETRO/CNMET in the metrification process. Other government departments should also be informed.

2. Concurrently, the Metrification Division within INMETRO (called DISI for convenience) is to be built up and staffed with "Sector Coordination Officers" or "Sector Program Managers" with industry experience, such as in mechanical/production/industrial engineering, marketing or standardization. This group will be the secretariat for the national metrification programme, providing technical as well as administrative support to CNMET and the numerous committees which will plan and implement metrification.

3. CNMET is the national coordinating body for metrification, as defined by CONMETRO Resolution nº 04/80, and is therefore responsible for policy/strategy formulation and approval of metrification plans. Its composition should

include influencial people from industry, export/import business and education/research; important government departments/agencies like customs and revenue, consumer protection and industrial development/assistance; standards writing forum such as ABNT; and the INMETRO/DISI/ secretariat.

4. The next major task is to build up the infra-structure of committees. This is best achieved through a letter from the chairman of CNMET to heads of industry associations, major companies, educational and research institutions, labour groups and consumer organizations, inviting them to nominate their representatives to participate in the metrification committee structure. Relevant government departments should also be invited.

5. The foundation of the infrastructure is made up of Sector Committees, each representing an industry or related interests: e.g. Iron & Steel; electrical/electronics; universities/technical schools; and so on. These Sector Committees should have between 10 and 20 members to be effective and should have appropriate representatives of the industry, the related government departments, standards writing body and also interested consumer and labour groups. The chairman of the Sector Committee should be an industry member, preferrably from a major company, which can provide support to committee activities. The secretary of the committee is the officer from DISI.

6. To coordinate the metrification activities of related sectors and to harmonize their plans, Sector Coordinating Committees should be formed with the chairmen of a group of related Sector Committees: e.g. Construction Coordinating Committee, covering Architects and Designers; Building Contractors; Structural Steel; Brick and Concrete; Wood

Products, Real Estate. The chairman of the Coordinating Committee should be one of the CNMET members, neutral to any potential conflicts between industry groups.

7. There should be one Sector Coordinating Committee with representatives of the government departments and agencies to harmonize government actions such as legislation, regulations and purchasing in line with industry plans.

8. The Sector Committees may, as the need arises, establish sub-committees or working groups to address specific subjects or issues of concern to the sector: e.g. a group of 3 or 4 members may study the need for re-writing standards and introducing rationalization of product sizes.

9. The infrastructure and information flow concept are shown in Figure 1. Possible grouping of Sector Committees under Sector Coordinating Committees is shown in Appendix I.

10. Terms of Reference for Sector Committees and Sector Coordinating Committees should be developed by DISI with the approval of CNMET and be presented to the individual committees for acceptance. An example of the Terms of Reference for Sector Committees is given in Appendix II.

11. Metrification should be launched as a four phase programme of Investigation, Planning, Scheduling and Implementation. Monotoring sector activities and providing information to interested parties should spread over all the phases. The Investigation phase is to determine what metrification means to each industry in terms of changes to hardware, software, purchasing and marketing and to define the policy/strategy for such changes. Planning is to determine

the time sequence of actions to be taken and estimate the duration to accomplish the change. Scheduling is an important phase to harmonize the timing of changes in collaboration with related sectors and to establish a time-table or target dates. Implementation can then proceed on a common, coordinated time scale to minimize disruptions to business operations.

12. CNMET should promote a common methodology for sector planning and guide the committees. Modern project management techniques using activity breakdowns, simple precedence diagram and a barchart with key events will be most appropriate for metrification, which will be a relatively long project measured in years rather than weeks. A common format for reporting sector activity progress should also be established. A model for a Sector Plan can be based on Canadian Sector Plans already provided.

13. The Sector Coordinating Officers of DISI should organize periodic meetings of Sector Committees and Sector Coordinating Committees in consultation with the respective chairmen in order to maintain momentum in investigation, planning, implementation and monitoring of progress in the various sectors.

14. Each Sector Committee will prepare its plan for metrification in consultation with related sectors, suppliers and customers and present it to the responsible Sector Coordinating Committee. The Sector Coordinating Committee will review the plan to avoid and/or to resolve potential conflicts with other related sectors. The plan will then be submitted to CNMET for approval. CNMET may decide to send an important plan to CONMETRO for further review and approval. Approved plans and time-tables will be publicized by the CNMET secretariat, namely DISI.

15. Industry Associations and major companies should be encouraged to publicize through their trade magazines, bulletins and newsletters, information on metric standards, product availability, supplies requirements, target dates, etc., in order to create awareness and motivate smaller companies.

16. Sector Committees, through their chairmen, should be made responsible for responding to enquiries on metrification in their respective sectors and also to provide periodic feed-backs to CNMET through the established progress-reporting channel.

17. Major enterprises, if not all companies, should be encouraged to appoint Metrification Coordinators within their company. This will be important for multi-division, multi-product, multi-branch companies to ensure uniform actions.

18. The CNMET secretariat (DISI) should publish simple information pamphlets periodically, to maintain awareness of the national metrification programme at the national and international level. A special secretariat for information can play a useful role in this regard.

19. CNMET should identify priority sectors which can have a "multiplier effect" on other sectors; should focus on sectors where INMETRO and the industry can take decisions and show quick progress (e.g. iron & steel) rather than on specialized areas governed by foreign influence (e.g. petroleum; aerospace).

20. The Education Sector at the university and technical school level should get immediate attention. Professors can be motivated to up-date and promote technical books and reference documents written strictly in SI Units; this could also be treated as graduate student projects. Since many foreign documents are regularly translated into Portuguese for Brazilian use, correct SI units and terminology can be introduced at the same time.

21. Government actions can facilitate metrification in many ways. Government departments and state enterprises should announce firm commitment to specifying and procuring products and services in SI units only. Some cost concessions can be made for Brazilian SI products as against imported, non-SI products. The import licensing agencies and the customs department can practice a policy of permitting products and documentation in SI units only. Government departments and agencies granting aids and incentives to industry and businesses can use a leverage to promote SI. In some circumstances weights and measures regulations (legal metrology) can prohibit the use of non-SI instruments and measuring devices after a cut-off period. In general, government departments and agencies should review and revise laws, decrees and regulations to facilitate or remove inhibiting factors for strict adherence to SI units. The cooperation of other levels of government, state and city, should also be enlisted. To induce active and regular participation at metrification committee meetings, the government may consider providing some financial assistance to committee members for travel from distant places to attend meetings.

APPENDIX I

TENTATIVE GROUPING OF SECTOR COMMITTEES

AND SECTOR COORDINATING COMMITTEES

Sector Coordinating Committee	1.0	Education
Sector Committee	1.01	Universities and colleges
	1.02	Technical training institutions
	1.03	Research/Technology institutions
Sector Coordinating Committee	2.0	Metals and Metal Products
Sector Committee	2.01	Iron and steel mills, foundiries
	2.02	Structural steel
	2.03	Fasteners
	2.04	Wire and wire products (non-electric)
	2.05	Metallic pipes and fittings
	2.06	Sheet metal fabrication
	2.07	Metallic containers
	2.08	Hardware manufacturers
	2.09	Cookwares and housewares, metallic
	2.10	Non-ferrous metals
Sector Coordinating Committee	3.0	Machines and Tools
Sector Committee	3.01	Metalworking machinery
	3.02	Other manufacturing machinery
	3.03	Machine shops
	3.04	Tool and die makers
	3.05	Hand tools
	3.06	Instruments and measuring devices (non-electric)
	3.07	Heating, ventilaring and airconditioning equipment

Sector Coordinating Committee	4.0	Mechanical Manufacturing
Sector Committee	4.01	Automobiles and parts
	4.02	Shipbuilding and ship-repairing
	4.03	Railroad equipment
	4.04	Bus, trailer and truck body
	4.05	Aerospace equipment
	4.06	Construction and agricultural equipment
	4.07	Off-road transportation equipment
Sector Coordinating Committee	5.0	Electrical Manufacturing
Sector Committee	5.01	Electrical appliances and parts
	5.02	Lighting and light fixtures
	5.03	Generation, transmission, distribution
	5.04	Wire and cable (electrical and telecommunication)
	5.05	Major electronic equipment and parts
	5.06	Consumer electronic products
	5.07	Computers and office equipment
Sector Coordinating Committee	6.0	Construction
Sector Committee	6.01	Builders and contractors
	6.02	Architects and designers
	6.03	Real estate developers and marketers
	6.04	Road construction
	6.05	Building materials manufacturers and distributors
	6.06	Wood and panel product manufacturers
	6.07	Water works

Sector Coordinating Committee	7.0	Resource Industries
Sector Committee	7.01	Mining
	7.02	Petroleum exploration
	7.03	Coal and coal gas
	7.04	Fuel refining
	7.05	Fuel distribution and retail service stations
Sector Coordinating Committee	8.0	Processing Industries
Sector Committee	8.01	Chemicals
	8.02	Consumer chemical products
	8.03	Pharmaceuticals
	8.04	Compressed gases
	8.05	Plastics and plastic products
	8.06	Rubber and rubber products
Sector Coordinating Committee	9.0	Transportation Industries
Sector Committee	9.01	Road transport
	9.02	Rail transport
	9.03	Water transport
	9.04	Air transport
	9.05	Postal and parcel services
	9.06	Tariffs and customs
Sector Coordinating Committee	10.0	Agro-industries
Sector Committee	10.01	Wood and wood products
	10.02	Leather and leather products
	10.03	Paper and pulp
	10.04	Textiles and clothing
	10.05	Home furnishings

Sector Coordinating Committee	11.0	Food and Agriculture
Sector Committee	11.01	Agriculture and horticulture
	11.02	Livestock
	11.03	Dairy products
	11.04	Poultry
	11.05	Fishing and fish products
	11.06	Consumer food products
	11.07	Beverages and bottling
	11.08	Alcoholic beverages
	11.09	Packaging
Sector Coordinating Committee	12.0	Health Services
Sector Committee	12.01	Hospitals and medical services
	12.02	Clinical laboratories
	12.03	Public health/sanitation/pollution
	12.04	Radiology and nuclear medicine
Sector Coordinating Committee	13.0	Consumer and other Services
Sector Committee	13.01	Home economics
	13.02	Sports and recreation
	13.03	Accommodation and food services
	13.04	Retail trades
	13.05	Personal services
	13.06	Communication services (media)
	13.07	Labour syndicates
Government Sector Coordinating Committee	14.0	Government Departments and Agencies

NOTE: Individual Sector Committees and their groupings depend on the industrial structure and input/output interactions in the Brazilian scene. The above list should be treated only as a checklist for covering the various sectors where metrification is expected to have an impact. Depending on the nature and degree of impact, this list should be modified.

APPENDIX II

EXAMPLE OF TERMS OF REFERENCE

FOR SECTOR COMMITTEES

1. Sector Committee (XX) reports through its chairman to Sector Coordinating Committee (AA).

2. It will hold regular meetings in appropriate locations accross the country to deal with the national metrification programme.

3. It will identify areas where non-SI units are prevalent within the industry(ies) forming the sector and will agree on correct SI units and terminology to be used.

4. It will review and coordinate the requirements within the industry(ies) for new or revised standards in SI units only and will recommend to the Sector Coordinating Committee priorities for the guidance of standards writing organizations. Concurrent with the standards review, rationalization of product sizes and reduction of proliferation of sizes will also be considered.

5. It will examine the need for new or revised legislation and regulations to facilitate or to remove inhibiting factors for strict adherence to SI units and where necessary, it will make recommendations for desirable government actions.

6. It will identify the required activities to accomplish normal SI practice within the sector, estimate the time required to complete such activities and prepare a sector plan and time table for achieving metrification, specifying any assumptions and constraints with respect to availability of supplies, changes to equipment and readiness of customers.

7. It will review assumptions and constraints noted in sector plans of related sectors and where necessary, make appropriate revisions to its own sector plan for a coordinated metrification programme.

8. It will monitor the progress of metrification activities within its sector and provide reports to the Sector Coordinating Committee.

9. It will act as an information source and respond to enquiries concerning metrification within its sector.

10. It may establish sub-committees and/or working groups with knowledgeable people from the industry(ies) to deal with specific tasks of interest to the sector.

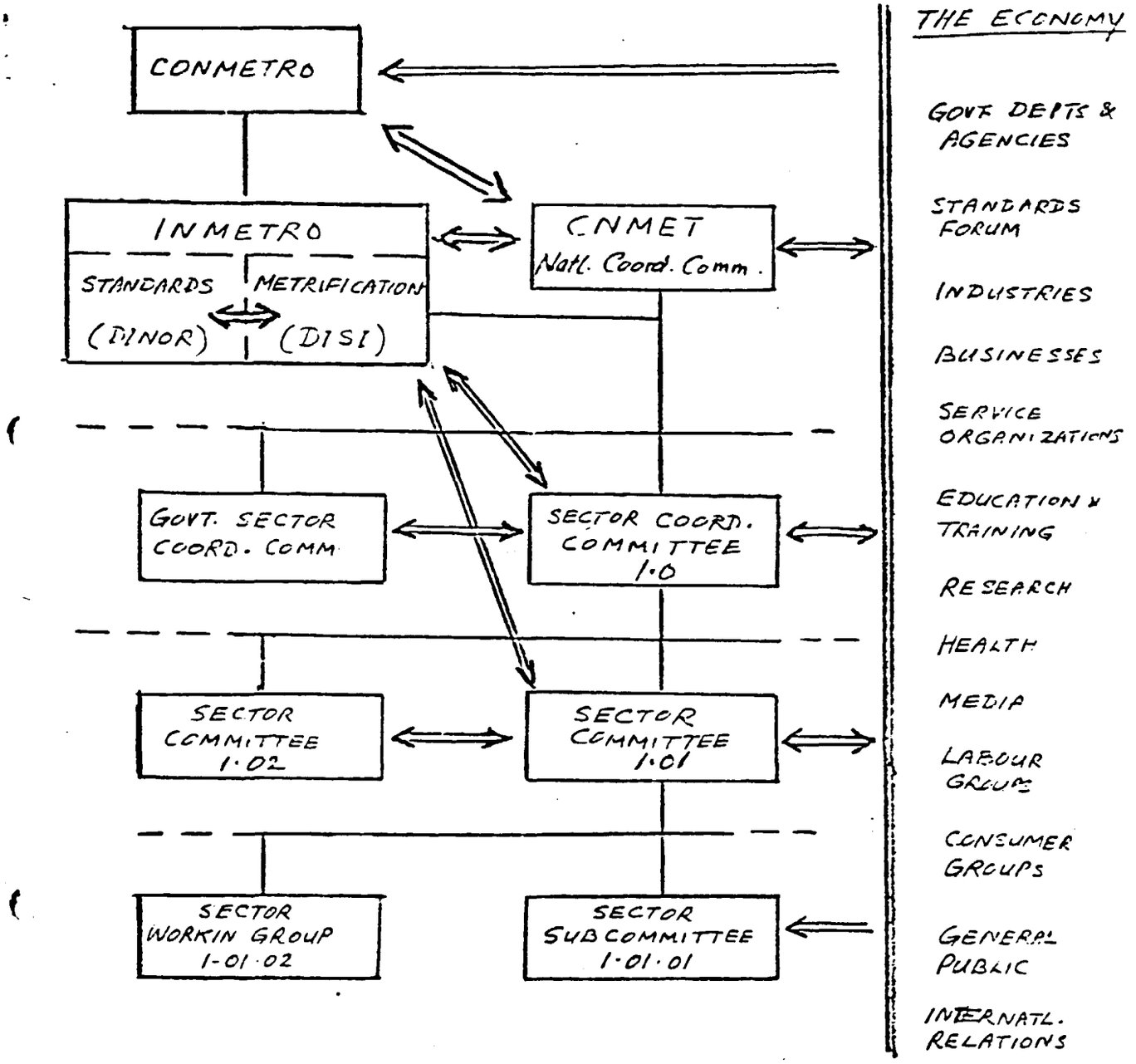

FIG. 1 - INFRASTRUCTURE & INTERACTIONS (⟺)

FOR METRIFICATION.