SYSTEMATIC FOR EXPANDING THE COVERAGE OF THE LEGAL METROLOGY VERIFICATION IN BRAZIL

Alexandre Nixon Soratto [1], *Omer Pohlmann Filho* [2], *Marcio Ribeiro de Paiva* [3]

[1] Inmetro Office at Santa Catarina, Florianópolis, Brazil, ansoratto@imetro.sc.gov.br
[2] Inmetro/Cored, Rio de Janeiro, Brazil, opohlmann@inmetro.gov.br
[3] Inmetro/Cored, Rio de Janeiro, Brazil, mrpaiva@inmetro.gov.br

Abstract: This article presents the development of a systematic to identify the location, in the Brazilian market, of measuring instruments, subject to metrological control of the National Institute of Metrology, Standardization and Industrial Quality (Inmetro) and their Delegates bodies that comprise the Brazilian Network of Legal Metrology and Quality (RBMLQ). The aim of this systematic is to support the planning and execution of the RBMLQ services, and contribute to increase the amount of measuring instruments verified all over the country. Preliminary results show the effectiveness of systematic and suggest the existence of potential demands for metrological verification legal in Brazil. This systematic can be adapted for use in other countries.

Key Words: legal metrology, metrological verification, RBMLQ.

1. INTRODUCTION

The growing demand for legal metrological verification of measuring instruments in Brazil and in the world requires intelligent mechanisms to support planning and execution of these services.

However, it perceives that the total universe of establishments subject to the action of the Brazilian Network of Legal Metrology and Quality - Inmetro (RBMLQ-I) is unknown, and there are no standardized procedures for use of this information, in the planning of metrological verification of measuring instruments, regulated in the country.

Currently, planning the activities of Bodies that comprise the RBMLQ-I is based on the quantity of measuring instruments verified in prior periods, or in the number of establishments and instruments known and registered in the Integrated Management System (IMS) of RBMLQ-I. This plan does not use an estimate based on the actual number of establishments subject to the visit, or of measuring instruments subject to metrological verification.

More difficult to plan without knowing the universe of service to be performed is to perform the periodic verification services without knowing the exact location of new establishments to be visited.

Traditionally, metrological verification teams of RBMLQ Bodies roam street by street, of each municipality, in search of new establishments and measuring instruments subject to its operation. This way to meet new demands for metrological verification spends a lot of resources, which makes it extremely inefficient, besides being of questionable efficacy, because it depends exclusively on the proactively of the verification teams. Thus, the growth of periodic verification has not been sustainable in some Bodies of RBMLQ in Brazil. This type of search roam street by street is justified by the lack of mechanisms to assist the location of new establishments likely to visit.

However, initiatives such as the development of the "Index of Coverage Metrological Verification and Inspection" in Brazil, developed by the Indicators Working Group of RBMLQ-I created by the General Coordination of RBMLQ-I (Cored) serve as a starting point for development of mechanisms of this nature [1-3].

This article presents the development of a systematic that proposes to assist in the location of establishments subject to the performance of RBMLQ, with the object of increasing the quantity of measuring instruments verified in Brazil. The results are presents of its application to search for balances and sphygmomanometers, among other instruments, in two Inmetro's delegates Bodies: the Institute of Metrology of Santa Catarina (Imetro/SC) and the Institute of Weights and Measures of the Amazonas (IPEM/AM) . The article concludes with discussions of the potential of this Brazilian systematic to support management of RBMLQ-I and increase the coverage of metrological verification in Brazil.

2. SYSTEMATIC FOR EXPANDING THE COVERAGE OF THE LEGAL METROLOGY VERIFICATION IN BRAZIL

The systematic proposal was developed through meetings with experts in legal metrology, in information systems and analysis of statistical databases. It is based on a structured approach consisting of six steps, as according in Figure 1. The object this point is encourage the identification of the universe of establishments subject to the performance of RBMLQ and, especially, to assist the location of instruments measuring regulated and liable of metrological verification in Brazilian market.
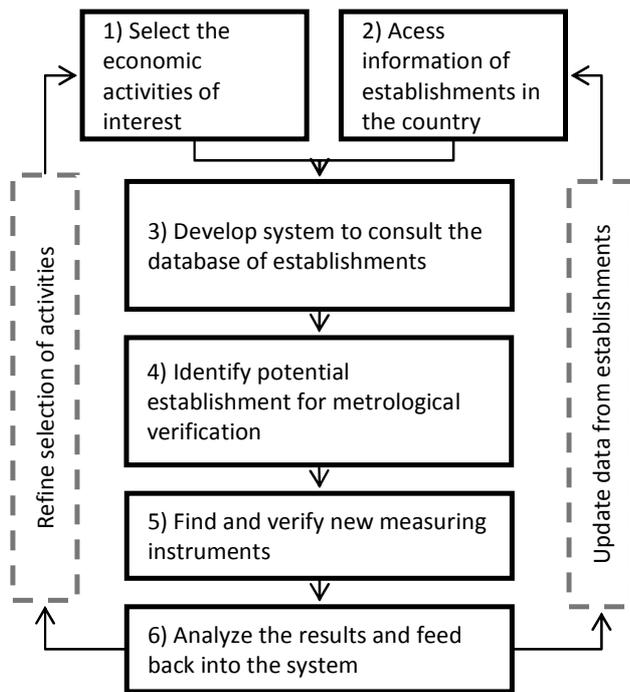
Fig. 1. Systematic for expanding the coverage of metrological verification

2.1. Step 1: Select economic activities of the interest

This step is very critical because it has direct influence on the results of systematic and involves a comprehensive study should be conducted with the support of professionals with experience in the practice of metrological verification of measuring instruments.

The study is basically the selection of economic activities associated with the use of measuring instruments regulated by Inmetro. It was used the National Classification of Economic Activities (CNAE), being the official codification of the National Statistical System, adopted by the Public Administration in Brazil, to identify the economic activity of juridical persons [1-4]. CNAE groups the economic activities by the similarity of their productive functions (inputs, technologies and processes). It has five hierarchical levels of economic activity, comprising: 21 sections, 87 divisions, 285 groups, 672 classes and 1.301 subclasses. The study and selection of economic activities of interest RBMLQ-I was done at the level of subclasses, with emphasis on the sections of the retail and wholesale trade, industry, service providers and healthcare establishments.

As result of this selection, were obtained groups of activities that interest RBMLQ-I. For example, the group: *"trade retail establishments that potentially use balances class III and IV small"* (up to 350kg) grouped codes CNAE of supermarkets, mini markets, grocery stores, bakeries, butchers, fishmongers, fresh produce, farming, trade in building materials and liquefied petroleum gas, among others.

Another example was the group of *"establishments in the health area that potentially use scales and sphygmomanometers"*. This group included the CNAE codes of hospitals, clinics, doctors' offices, health posts and pharmacies, among others.

These groups of economics activities codes allow to be filtered the establishments of interest in any database that uses the CNAE as parameter for identification of the economic activity.

It is important to note that economic activities were selected with the intention of to trace the establishments that using measuring instruments regulated by Inmetro. However, these same economic activities include many establishments that do not use measuring instruments, and which could not be excluded otherwise. Therefore, it is important to understand that this problem causes margins of error in surveys, whose results should be considered estimates and not exact values.

2.2. Step 2: Access information of establishments in the country

The second stage is independent the first and to consist to find and obtain access to a database of active establishments in the country. This database must have national coverage, periodic updating, availability of access, and provide for each establishment: the name, the complete address, CNPJ (National Register of Legal Entities) and CNAE.

In this search, were held research and meetings with experts from entities, such as: the state Boards of Trade of the Santa Catarina (JUCESC) and Rio de Janeiro (JUCERJA), the State Revenue Department of Santa Catarina, the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Labor and Employment (MTE).

For answering the prerequisites for this systematic and, in addition, offer the number of employees at each establishment (which helps in estimating its size), was adopted the database from The Annual Social Information (RAIS) of the MTE, whose access is given through the signing of Term of Commitment between Inmetro and the MTE.

However, it should be understood that this database of establishments, as well as any other of its kind, presents inconsistencies in some information, due to the high mobility of establishments, mainly of micro and small businesses, that open, close and change of address in short time.

2.3. Step 3: Develop system to consult the database of establishments

With groups of CNAE codes of interest (Step 1) and the database of establishments in the country (Step 2), continued to develop a system that allow access this information in an organized and directed form.

With the technical expertise of the Metrology Institute of Santa Catarina (Imetro/SC), was developed the Establishments Consultation System (ECS) which made it possible the storage and filter of database of establishments, whose economic activity (CNAE) has been contemplated in, at least, one of the groups of interest of RBMLQ, formed in the Step 1 of this systematic.

The ECS allows generating a variety of strategic and useful information for planning of the RBMLQ-I, for example, the total quantities of establishments that operate

in activities that potentially use some kind of measuring instrument regulated. Potentially because, as commented at the end of Step 1, there are uncertainties in the grouping of economic activities, which allow the presence of establishments that do not use measuring instruments, making this quantity greater than its real value.

However, knowing the estimates of total quantity of establishments that use a specific type of measuring instrument, even though increased, it is important to Inmetro during the development of new metrological technical regulations. In these activities it is interesting some studies about viability and impact analysis.

For the RBMLQ, these estimates can help in adjusting their capacity to demand, because it provides information useful for the dimensioning of teams who will work in the verification of recently regulated measuring instruments, or instruments already regulated for some time, but locate in areas less explored by the teams of metrological verification.

In respect to these less explored areas, the ECS provides information that enables the location of establishments that need the services of metrological verification of the RBMLQ. Showing a way to find these establishments is the purpose of the next steps of this systematic.

2.4. Step 4: Identify potential establishment for metrological verification

This step is relatively simple and constitutes a extract the unknown establishments by RBMLQ and their respective addresses, from the universe of establishments that have potentially use measuring instruments, stored in the ECS.

This filtering was performed by crossing numbers of the CNPJ (National Register of Legal Entities) of the establishments known and registered in the IMS of the RBMLQ-I, with the CNPJ of establishments that potentially use measuring instruments contained in the ECS (MTE database). The difference between these two quantitative of establishments represents the establishments said unknown, because are not part of the IMS of Bodies that comprises the RBMLQ.

The percentage of establishments registered (known) in the IMS of the RBMLQ-I on the total establishments in ECS (unknown) has been called "Index of the Coverage Metrological Verification" [1-3]. This index is an estimated that serves as a diagnostic of the less covered areas by the verification and that, therefore, might need attention and investment. It can be calculated by the ECS, for each group of economic activity of interest to the RBMLQ generated in 1st Stage. Important remembering that the uncertainties and inconsistencies in the data mentioned earlier makes the value of this index less than reality.

Cored/Inmetro, as well as many Bodies of RBMLQ have been using this index as a diagnostic approximate of a coverage of metrological verification offered for various types of measuring instruments, measuring pumps of fuels, trade scales, medical scales, sphygmomanometers and tachograph, among others.

This way, for each type of measuring instruments, its possible to generate a list of establishments not registered with the IMS, among which could be possible to find establishments using measuring instruments subject to

metrological verification. For each establishment, ECS provides the name, full address, number of employees and CNAE, among other information.

2.5. Step 5: Find and verify new measuring instruments

This stage is to visit the addresses provided by the ECS to confirm the existence of establishments, their economic activities and the use of measuring instruments regulated, that need metrological verification.

The planning and execution of such visits are made by the Bodies of RBMLQ considering criteria that include:

- type of measuring instruments to be investigated;
- municipalities to be visited, prioritizing those with the lowest Index of the Coverage Metrological Verification;
- sample of the establishments to be visited;
- verification teams;
- period of the visits.

Is desirable that the verification teams are formed by persons different those who perform periodic verification on measuring instruments at the selected municipalities. However, the costs of these visits will be less if they are harmonizing with the routine visits planned by the Bodies of RBMLQ.

Thus, when visiting a particular municipality to carry out verifications of instruments registered in the IMS, verification teams will take advantage of this displacement to carry out the visits to establishments suggested by ECS.

With the purpose of validating the information about the establishments of the ECS and create opportunities to refine the selection of codes of economic activity of interest (CNAE), it is important that during the visits, some information is recorded, such as:

- "new" measuring instruments verified;
- measuring instruments that were already verified;
- establishment does not use measuring instruments;
- establishment uses a not approved model of measuring instrument;
- establishment not found at the address provided;
- establishment finished its activities (disable);
- notifications requiring acquisition of measuring instruments with approved models.

2.6. Step 6: Analyze the results and feed back into the system

In this step, the results of visits are analyzed to validate the information generated by the ECS and to verify the percentage of the new instruments found and the need for adjustments in some step of the systematic.

If the visits conclude that a large amount of establishments, from the same economic activity, did not use measuring instruments and, at the same time, this economic activity did not lead to establishments with measuring instruments, then it is important that the code CNAE of this economic activity is remove from the groups of interest.

Another important analysis is about the consistency of the establishment's information, collected from the database RAIS (MTE). A very large amount of inactive

establishments found suggests the need to update data, while finding many mistakes at the addresses suggests need to search for other external databases.

3. RESULTS OF THE APPLICATION OF SYSTEMATIC

Under the instruction of Cored, this systematic is in the process of application in several Bodies Delegates of Inmetro in Brazil. This section presents the results of visits on samples of establishments in municipalities in the Santa Catarina State (southern Brazil) and the capital of Amazonas State (northern Brazil).

The Metrology Institute of Santa Catarina (Imetro / SC) has selected ten municipalities to search for retail businesses that potentially use small scales class III and IV (up to 350kg). It was also selected a municipality to search for healthcare establishments that use potentially clinical scales and sphygmomanometers subject to metrological control.

In order to minimize the costs of searches, were prioritized the municipalities where the Imetro/SC had, during the visits, teams carrying out periodic verifications on the establishments of their annual registration (IMS).

Table 1 shows the results of visits to establishments whose information was obtained in the ECS with the database of RAIS MTE 2010.

In the search for trade scales, 321 establishments were visited, of which 45 (13.44%) used this measuring instrument. It should be noted that besides the 39 "new" scales that have been verified and registered in the IMS, were found 35 rigid meters and a wire measurer. In the case of instruments without approved model by Inmetro, the establishments were notified for the acquisition of instruments with the approved model.

Results of visits in samples of retail establishments that have potentially scales (III and IV small) or rigid meters (Santa Catarina)				
Municipalities	Visits	Establishments subject to metrological control	Scales	Rigid meters
Blumenau	54	4 (7,41%)	4	15
Itajaí	39	5 (12,82%)	4	3
Baln. Camboriú	23	2 (8,70%)	2	0
Joaçaba	23	1 (4,35%)	0	1
Concórdia	14	1 (7,14%)	0	2
São Bento Sul	42	5 (11,90%)	7	1
Garuva	10	3 (30,00%)	4	1
Criciúma	12	1 (8,33%)	1	1
São José	38	8 (21,05%)	7	1
Florianópolis	66	15 (22,73%)	10	10
Totais	321	45 (13,44%)	39	35
Results of visits in samples of healthcare establishments that potentially have clinical scales and / or sphygmomanometers (Santa Catarina)				
Municipalities	Visits	Establishments subject to metrological control	Clinical scales	Sphygmo manome-ters
Tubrarão	36	25 (69,44)	72	137

Tabela 1: Results of Santa Catarina State

In the health sector, there were 36 visits to establishments such as hospitals, clinics, doctors' offices, health posts and pharmacies, in search of medical scales and sphygmomanometers. Were identified 25 (69.44%) establishments with instruments subject to metrological control, totaling 72 clinical scales and 137 sphygmomanometers.

These better results in health sector show that, in terms of metrological verification, the less explored is the area in investigation, the greater the probability to be found new measuring instruments subject to verification.

This correlation can also be found when analyzing the results in the Amazonas State. Even using a database not updated (2008), the Institute of Weights and Measures of the State of Amazonas (IPEM/AM) visited 57 establishments in its capital, Manaus, seeking trade scales, and found 17 (29,82%) establishments using scales subject to metrological control. This result is higher than the 13.44% obtained by Imetro/SC using 2010 database.

However, using a very outdated database presents two drawbacks. The first is lack of information on new establishments, which began operations recently. And the second is to find a significantly higher amount of disabled establishments or that have changed address. With 2008 database, the IPEM/AM found 42,11% of disabled establishments, whereas with 2010 database, Imetro/SC found only 15,26% of establishments inactive or that has changed address.

Another important analysis to be made concerns the consistency of the codes CNAE selected in Step 1. It was noted in research done in Santa Catarina State that the code "4744005 - retail trade of building materials not previously specified" brought to consult a considerable amount of establishments that did not use measuring instruments. This finding suggests the removal of this code for future search.

The investigations until the moment are sufficient to initiate discussions on the potential of the systematic proposed to leverage the legal metrological verification in Brazil.

4. DISCUSSION

The preliminary results presented in the previous section revealed that the systematic proposed can be applied in various areas of legal metrology, and the Establishments Consultation System (ECS) arises as an important tool to support the planning and execution of services provided by RBMLQ-I.

The analysis of the results for small commercial scales, which is the most verified instrument in the country, the systematic led to good results, even when investigated only the retail trade, which is further explored by RBMLQ in Brazil. These results tend to improve when it's investigated less explored markets, such as wholesale trade, industry and service providers, like the achievements in the health area in Santa Catarina.

The ECS offers advantages to all bodies that comprise the RBMLQ, whatever your level of structure in place and the capacity to meet the demands of society. For better structured Bodies, which have a good capacity to cover the metrological verification, the SCE has two main advantages. The first is to contribute to localize new establishments, activated recently or who had changed address. The second contribution of SCE is to assist the

tracking of establishments that use of measuring instruments regulated recently.

These advantages also apply to Bodies in the process of structuring and expansion of its capacity. For these bodies, the ECS can be used in the investigation of any type of instrument into new regions or in regions less explored. In such cases, the system helps to identify the universe of establishments to be visited, and the dimensioning of the workforce, vehicles and equipment.

It is important to understand that, the effectiveness of the ECS to identify new instruments for metrological verification is associated with three factors that deserve constant monitoring:

- quality selection of CNAE codes of interest (Step 1);
- update the information in the external database (Step 2);
- level of exploitation of the area to be investigated (the less explored area, the greater the effectiveness of the ECS).

The information generated by the ESA, it is important to highlights that the "Index of Coverage Metrological Verification and Inspection" (Step 4) provides information for strategic planning of the RBMLQ Bodies, example:

- reveals the geographic areas less covered by the metrological verification;
- provides references to establish indicators and goals consistent with the demand for each location;
- generates a fair performance comparison between the Bodies of RBMLQ;
- reveals the "benchmarks" of RBMLQ for futures benchmarking programs.

The systematic presented can be adapted for use by metrological control agencies in other countries. In addition, its flexibility also allows it to be applied for finding establishments that sell any type of regulated products such as, for example, pre-measured products and products of compulsory certification.

Considering the amount of ECS's potential advantages, it is desirable that should continue to be developed so that it can be incorporated into the Integrated Management System (IMS) of RBMLQ-I.

It should be noted that IMS holds an innovative technology developed by Inmetro exclusively to support the services of legal metrology and conformity verification in Brazil. By incorporating the functionality of the ECS, the IMS will allow that the metrological verification teams of RBMLQ upload their collectors of data with information from non-registered establishments, which potentially use measuring instrument in their activities.

Therefore, it automating and consolidates the implementation of this systematic in all Bodies of RBMLQ. This is a Cored´s strategic initiative with forecast for conclusion in late 2012, and whose developments will be subject to future publications.

5. CONCLUSION

This paper presented a systematic that has been developed by Cored/Inmetro and by Bodies that comprise the RBMLQ, with the objective of providing support for finding measuring instruments, subject to metrological control in Brazil.

There are six steps necessary for the development and implementation of the Establishments Consultation System (ECS) subject to the action of RBMLQ-I. The ECS provides important information for the planning of metrological verification in Brazil, in particular to find new establishments subject to metrological control, and to adjust the capacity of the RBMLQ to the existing demand for their services.

The first results of application of ECS, in the Santa Catarina and Amazonas states, demonstrate its effectiveness, and reveal opportunities for growth of the metrological verification, not only in the less explored areas (clinical scales and sphygmomanometers), but also in the traditional periodic verification of small trade scales.

The systematic continues to be applied and improved, to consolidate itself as a tool to support the management of the RBMLQ-I, and to increase the coverage of metrological verification in Brazil.

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