
XVIII IMEKO WORLD CONGRESS
Metrology for a Sustainable Development

**AN EDUCATIONAL PROGRAM FOR THE
QUALIFICATION OF TECHNICAL
PERSON INVOLVED WITH
COORDINATE METROLOGY IN BRAZIL.**

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1. Dissemination of Coordinate Metrology in Brazil

1983 – Mitutoyo Introduces first CMM in Brazil

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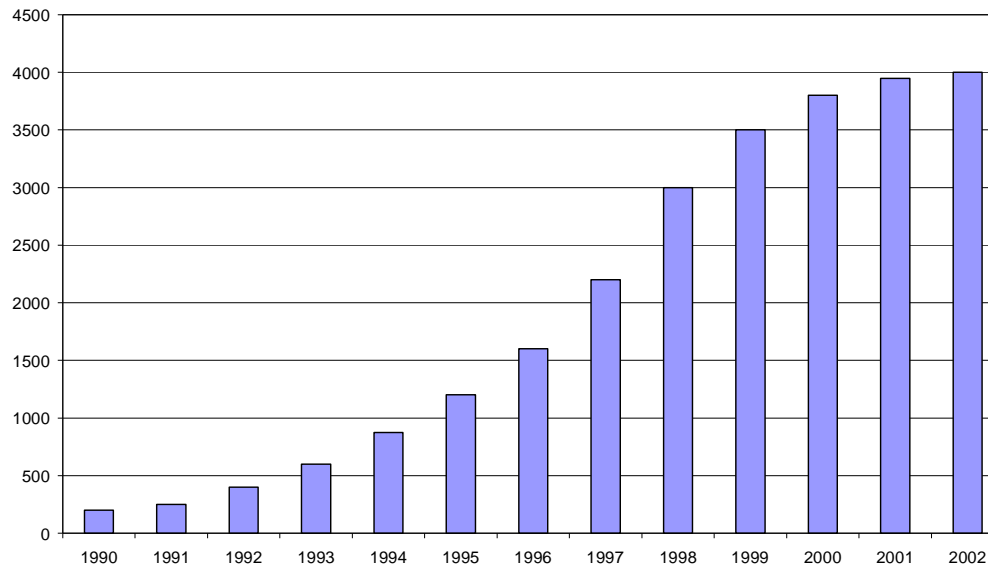
...

2006 – Around 4000 Coordinate Measuring Machines operating

1983



Máquinas



2006

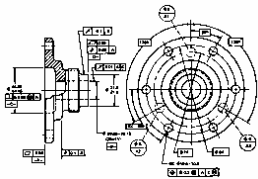


Small Companies

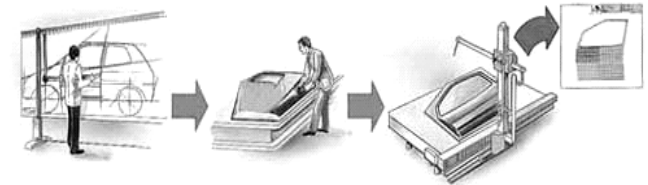


Big Companies

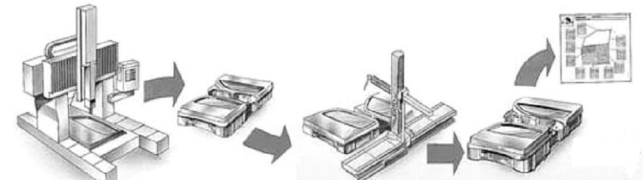
1. Dissemination of Coordinate Metrology in Brazil



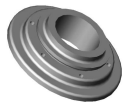
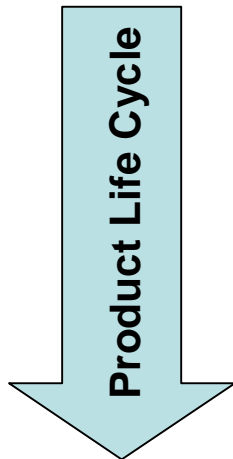
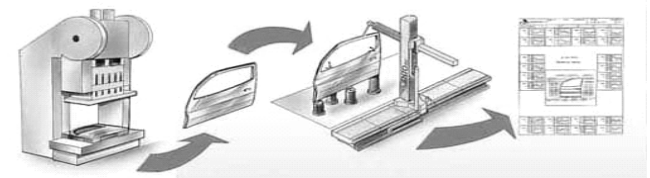
Product Development



Process Development



Process/Product Control

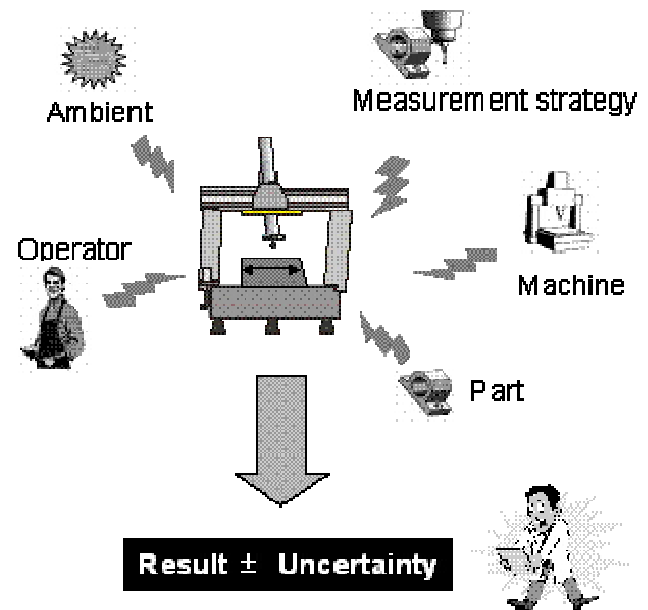


~ 5.000 Persons involved with coordinate metrology in Brazil

2. The Necessity of Metrologic Qualification

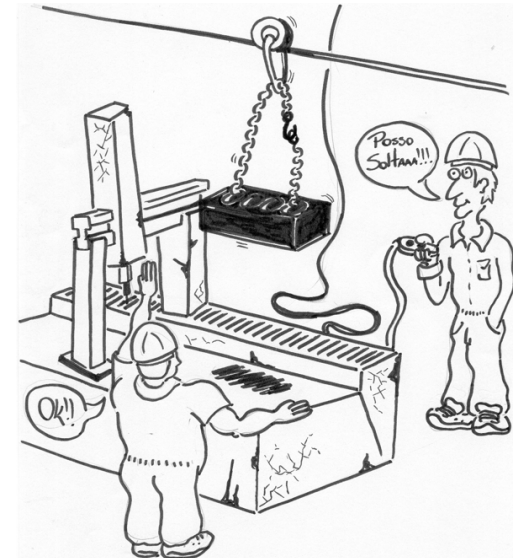
Some False Statements about Coordinate Metrology in Brazil

- The measurement uncertainty is always very small and appropriate for any piece;
- The operator doesn't have any influence on the results, as the measurement is automated;
- The acquisition of the machine is the only investment necessary to use the technology;
- The operational qualification is the only training necessary.



2. The Necessity of Metrologic Qualification

It is often the existence of operators that are expert in the machine and measurement software, but ignore basic criteria to avoid measurement errors, or how to estimate the measurement uncertainty of the results.



From the operator of is required not only in the operation of the machine but also ...

2. The Necessity of Metrologic Qualification

but also ...

- To participate of the development of the products and of its geometric specification;
- To understand the drawing and the product geometric specification;
- To establish correct measurement strategies;
- To operate the machine and the measurement software efficiently, exploring their full potentialities;
- To apply careful procedures to preserve the reliability of the measurements and the measuring machine;
- To evaluate the reliability of the measurements and to verify the correction of its uncertainty compared to the tolerances of the product;
- To analyze the results and extract useful information for the correction and optimization of processes and products;
- To interact with teams of quality assurance to indicate dimensional non conformities and propose solutions.

2. The Necessity of Metrologic Qualification

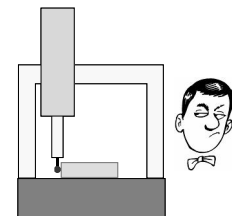
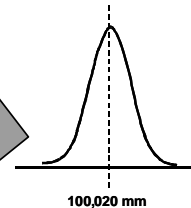
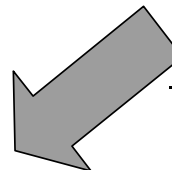
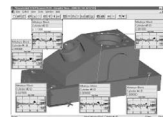
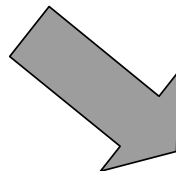
OPERATIONAL
QUALIFICATION

+

METROLOGIC
QUALIFICATION

Machine and software
operation expertise

Knowledge, abilities
and attitudes to assure
metrological reliability



3D METROLOGIST



3. The Motivations for the Program FORMA3D

- ➔ The need of metrological background to the technical persons involved with coordinate metrology in Brazil,
- ➔ The lack of a qualification program dedicated for the function of 3D Metrologist, in spite of the great presence of that activity and its great importance inside many productive chains

FORMA3D



Programa de Formação de Metrologistas 3D

3. The Motivations for the Program FORMA3D

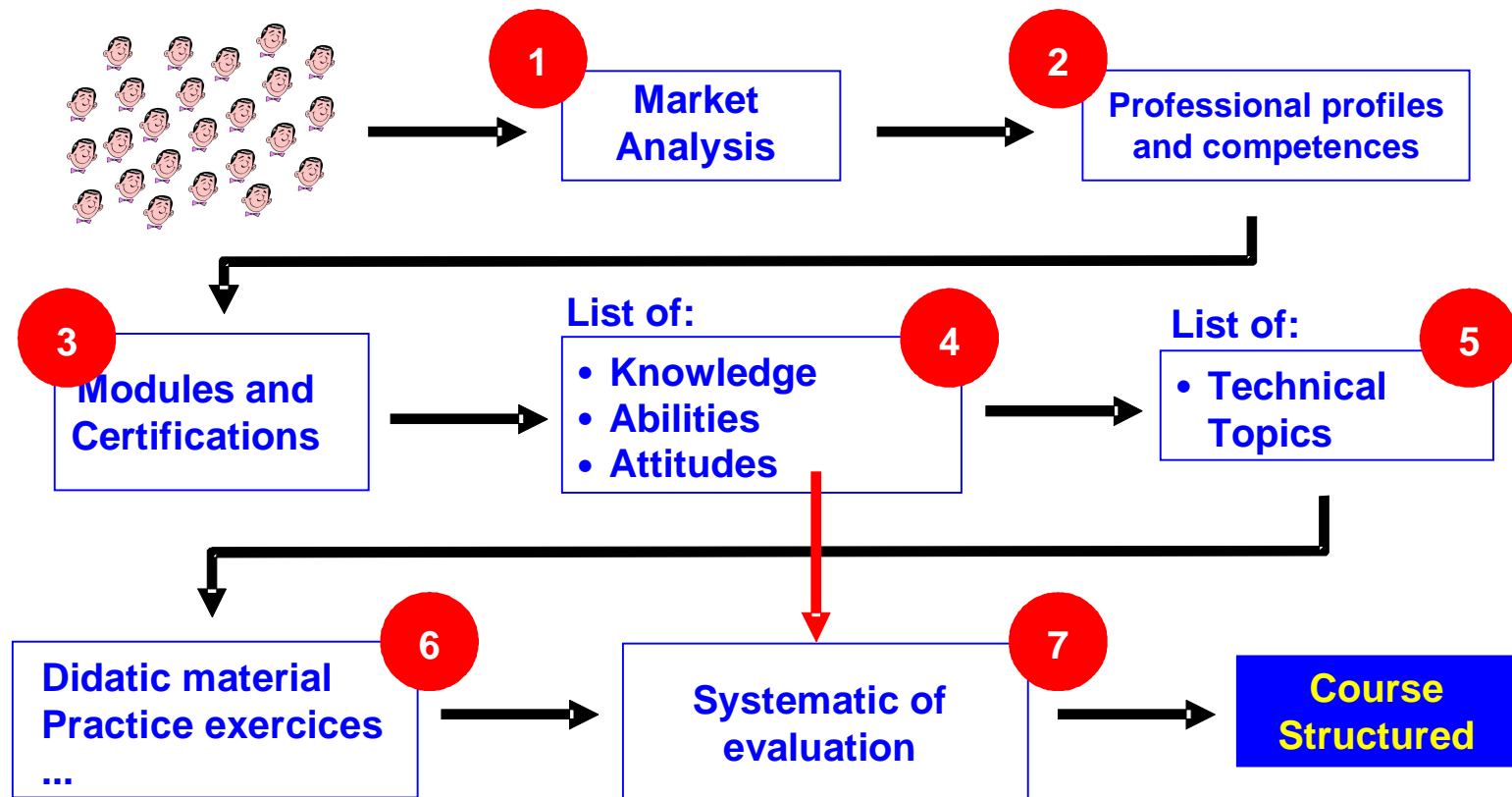
FORMA3D is a training program focused on the knowledge and abilities necessary to the technical personnel involved with coordinate metrology to carry out, with efficiency and reliability, their activities.

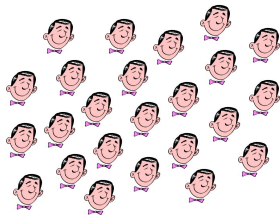
Its main objective consists of offering a wide and independent training program for the professionals involved with the 3D Measurement in the Brazilian Industry

FORMA3D

Knowledge**Abilities****Attitudes**

4. Pedagogic and Technical Structuring





13) Analise as tolerâncias abaixo e indique a máquina (ou as máquinas) que pode produzir. Observe o exemplo da primeira tolerância.

Pega	MÁQUINA A Máquina com 40 µm	MÁQUINA B Máquina com 10 µm
Tolerância ±1,0 mm	OK	OK
Tolerância ±0,1 mm	OK	OK
Tolerância ±0,01 mm	NÃO	OK
Tolerância ±0,001 mm	NÃO	NÃO

14) Observe como o bloco é montado na carimbeteira. Baseado nessa montagem, responda:

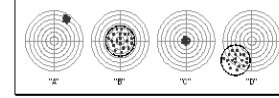


a) Indique as dimensões do bloco que representa o bloco montado na carimbeteira para definir o sistema de coordenadas local T.

b) Desenhe o bloco montado na carimbeteira, assando as referências de coordenadas locais dentro das referências para a medição.



4) Um fabricante de armas testou 4 modelos e contra um alvo e obteve os resultados mostrados abaixo.



Baseado nos resultados classifique as armas, da melhor para a pior.

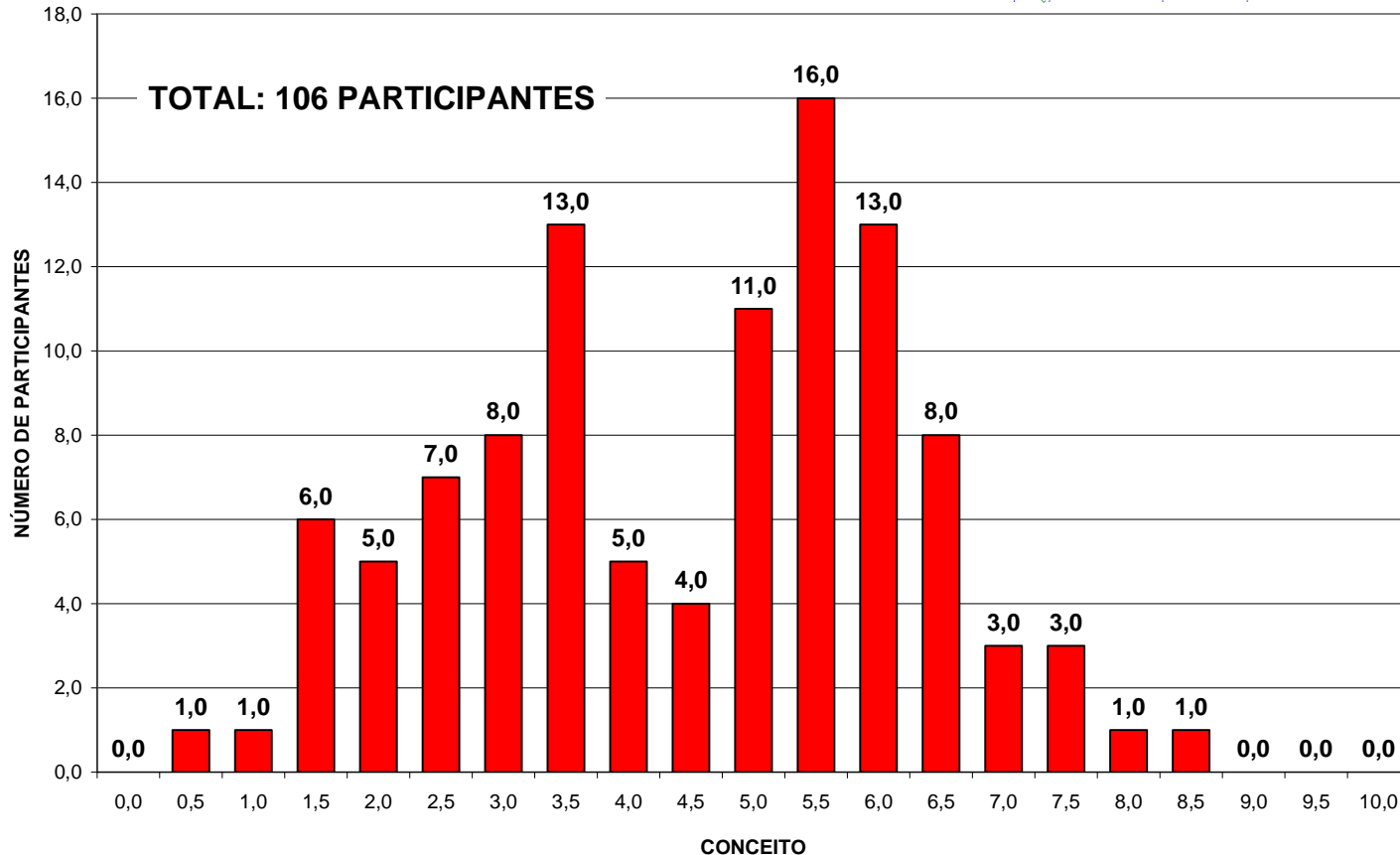
- Modelo: **Arma C**
- 2º Melhor: **Arma A**
- 3º Melhor: **Arma B**
- Pior: **Arma D**

5) Observe o seguinte conjunto de dados. Eles foram obtidos com 2 parâmetros digitais diferentes medindo várias vezes um bloco-padrão calibrado com 100,000 mm de comprimento.


Parâmetro	Parâmetro 1 mm	Parâmetro 2 mm
1	100,004	100,005
2	100,005	100,006
3	100,006	100,007
4	100,007	100,008
5	100,008	100,009

a) Ordene as posições no menor e no maior comprimento.

Parâmetro 1, pois a média dos resultados é bem próxima do valor do bloco-padrão.



5. Curricular Structure

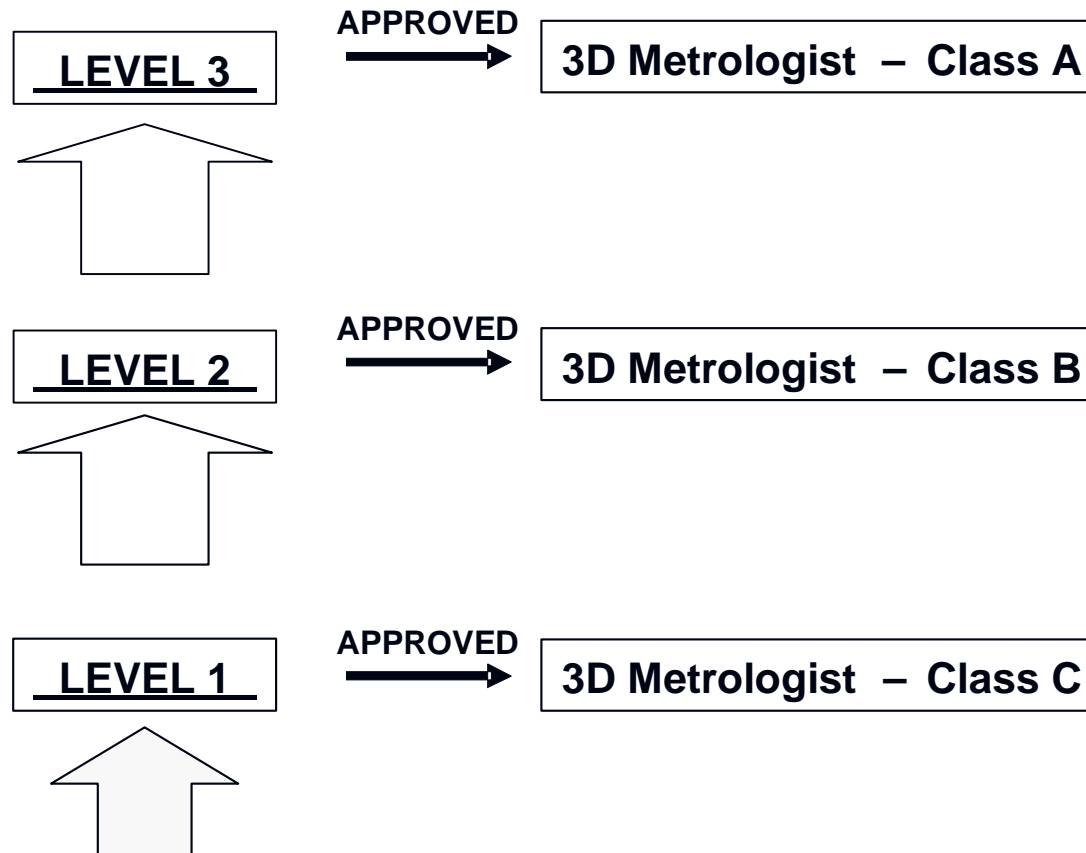


Module 1: 3D Metrologist – Class C: Professional with competence to understand the functional principles and sources of errors of coordinate metrology and execute a measurement efficiently.

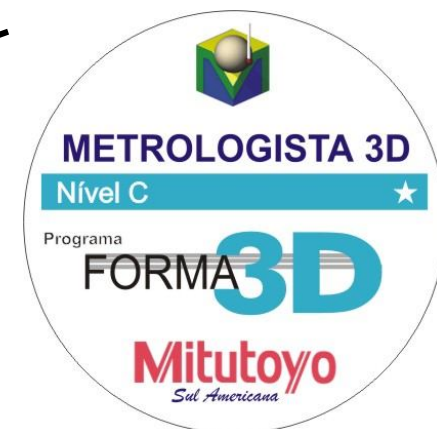
Module 2: 3D Metrologist – Class B: Professional with competence to understand fully the product geometric specification, define solid measurement strategies, elaborate programs CNC, evaluate the uncertainty of the measurement and to verify its reliability.

Module 3: 3D Metrologist - Class A: Professional with competence to coordinate measurement rooms, to participate of teams for definition of dimensions in the development of products, and interacting with project and process specialists to correct dimensional non conformities in the products.

5. Curricular Structure



6. Certifications



7. Results along the first three years

2004: Only in company

Level 1



DAIMLERCHRYSLER



Mercedes-Benz



VOLKSWAGEN

2005: Also at Mitutoyo Metrology Institute

Level 1



7. Results along the first three years

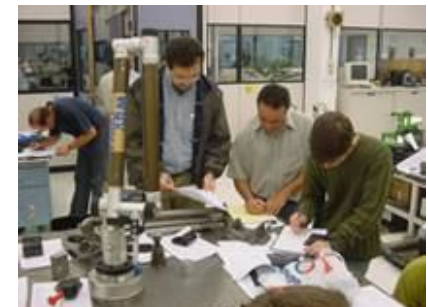
2006: In company and at Mitutoyo Metrology Institute



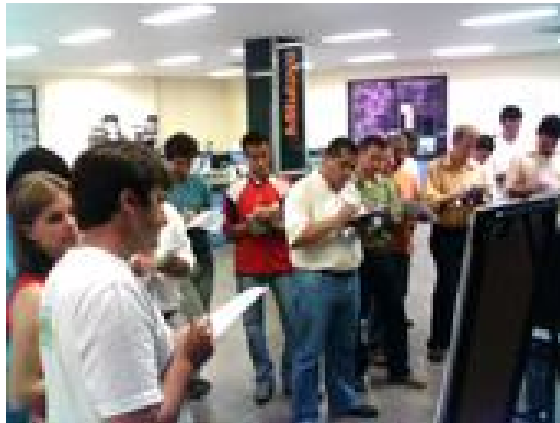
Level 1



Level 2



•Profile of Participants

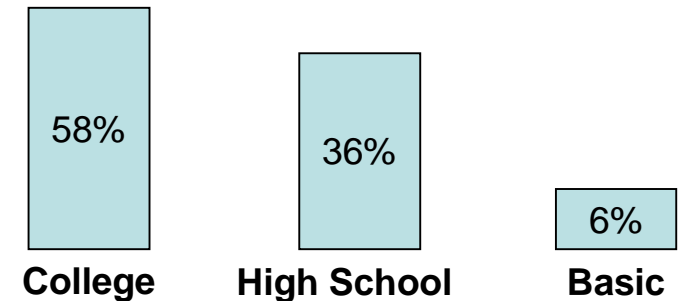


**3D Metrologists
Graduated**

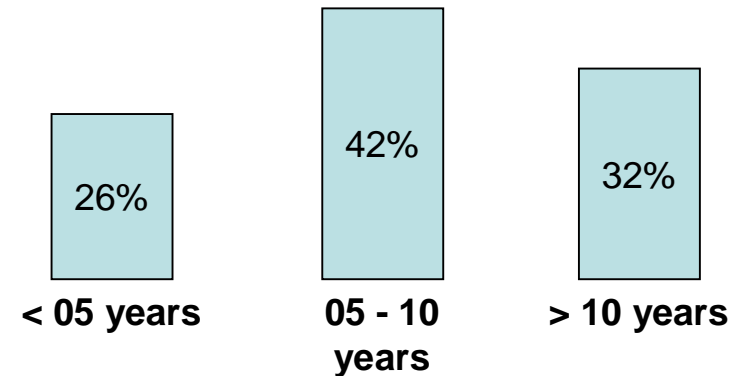
151 Class C

068 Class B

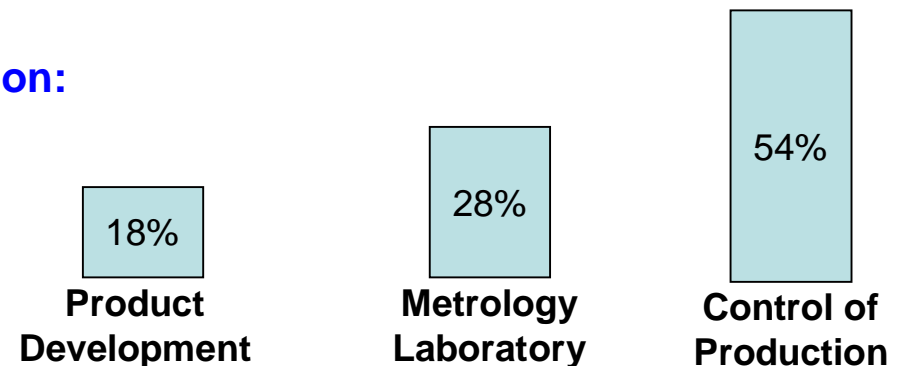
Education:



Experience:



Function:



Companies with 3D Metrologists Graduated:

Actaris
Altona
Arim
Arvin Meritor
Axe
Bitzer
Black and Decker
Confab
Cummins
DaimlerChrysler
Dana
Embraer

Estil
FE Fundação
FIAT Powertrain
Honda
IVECO-FIAT
Knorr-Bremse
Kostal
Luk
Mahle
Mitutoyo
Musashi

MWM
Pecval
PETROBRÁS
Peugeot-Citröen
Rempel
Renishaw
Romi
PUC-Rio
Saintgobain
Sandvik
Senai
Sew

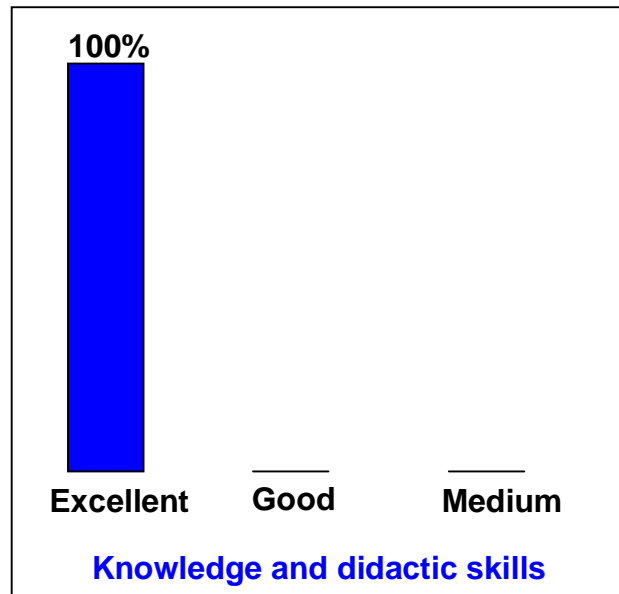
Shaeffler
SLN
Soma
Soriani
Teksid
Trans Tech
TRW
Turbomeca
Unicamp
Unipac
Vibracoustic
Volkswagen
Wayne
Wibra

Evaluation by the participants:

- About FORMA3D:



- About Instructors:



8. Conclusion

The program FORMA3D has been successfully in the objective to offer to the Brazilian Industry an independent and standardized training program.

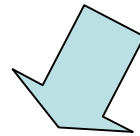
To consolidate the program nationally as a standardized and recognized training program, FORMA3D stays in constant articulation with companies, scientific societies and institutions.

The program FORMA3D welcomes any support of institutions and Societies involved with the promotion of Metrology and Quality in Brazil.



Programa de Formação de Metrologistas 3D

8. Conclusion



Expanding to be a Latin America training program.

Formación de Metrólogos 3D



FORMA

México

3D

04 a 08 de Diciembre de 2006

Centro de Capacitación del Instituto de Metrología Mitutoyo
Naucalpan, México.

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