3DMC 3D METROLOGY CONFERENCE

A Hydraulic Levelling System for Machine Tool Alignment

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FIDIA

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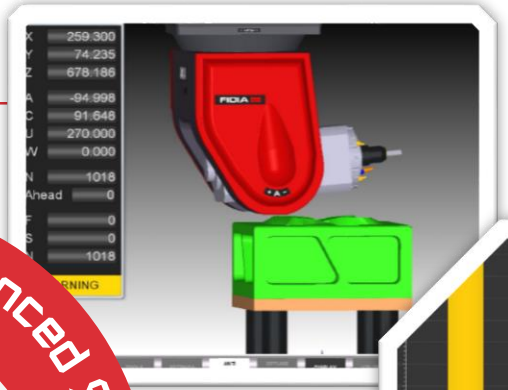
GIVING SHAPE TO DESIGN

FIDIA R&I DOMAINS

- HSM Machines
- Milling Heads
- Roto-tilting Tables

Mechanics

Advanced SW



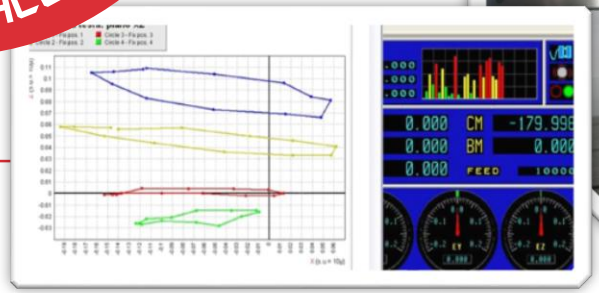
- ViMill®
- HiMonitor

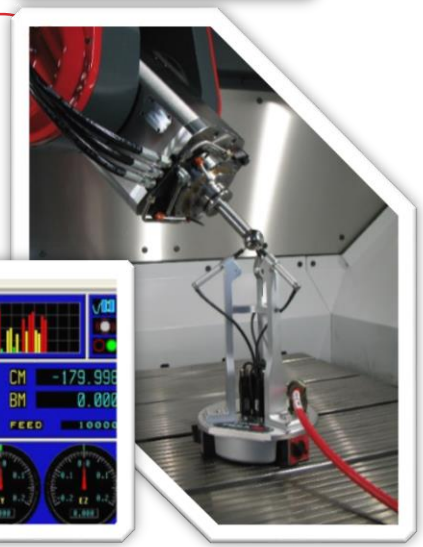
- Real Time CNC
- Xpower Digital Drives
- I/O Line™

Electronics

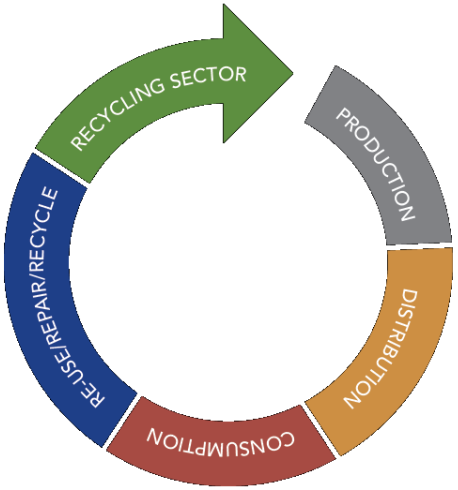
Accessories

- HMS™
- HPW
- TMS
- WMS

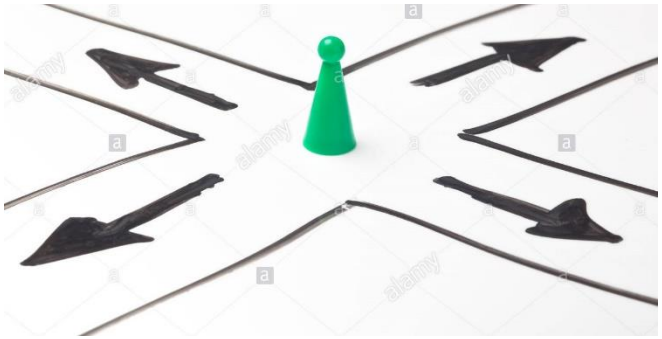




THE FIRST DILEMMA



Circular Economy is pushing toward sustainability that means try to extend the "commercial" life of products



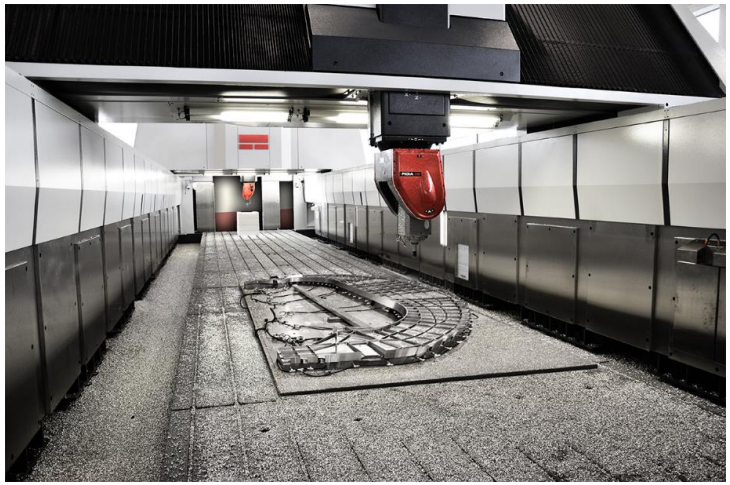
Global competition and implicit market rules requires to frequently launch new products with a high degree of personalisation

ONE ASPECT OF THE DILEMMA

This **dilemma** translate into producing machines of increasing size, very customized that we delivered in all countries.

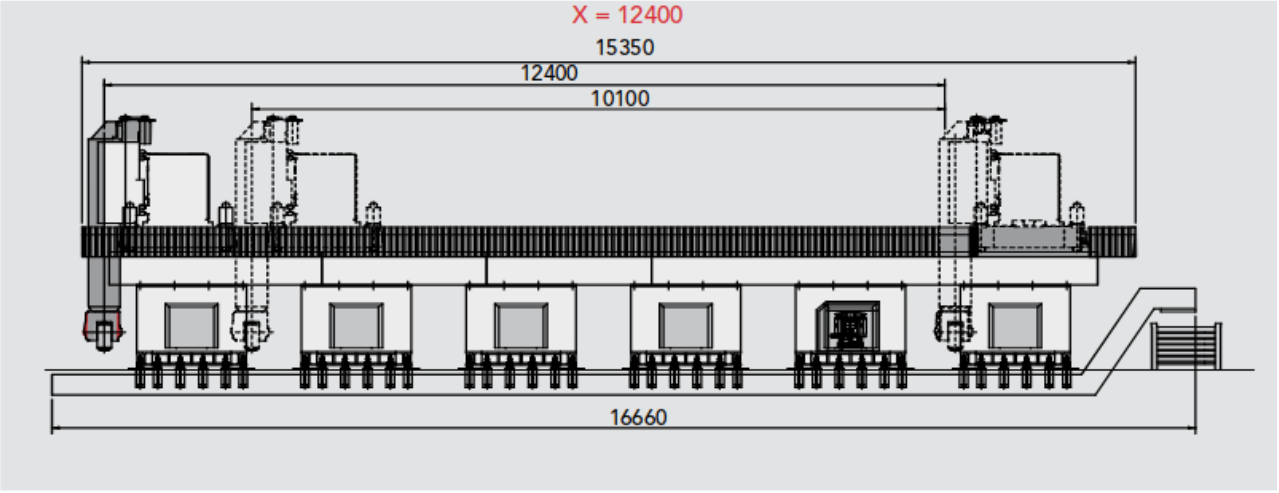
LARGE SIZE AND SPECIALIZED APPLICATION

HIGH COST MACHINES NEEDS TO BE MAINTAINED AT THEIR BEST, THEY CAN'T BECOME TECHNOLOGICALLY OBSOLETE



THE DILEMMA GENERATES ISSUES

Competitiveness towards large size and specialized machine means equipment needs to be maintained (among other things) geometrically at top.



X Strokes	starting from 2800 mm (110”), steps of 2400 each (5200, 7600, 10000, ...)
Y Strokes	from 2200 - 2800 - 3500 - 4000 mm (86” - 157”)
Z Strokes	Within the range 1000 mm - 2500 mm (39” - 98”)

For FIDIA that means periodically measure (and then compensate) at least the main static errors

ISSUES NEEDS TO BE DEALT WITH

Internal procedures foreseen around 30 different trials for assessing and correct the main machine static errors. This out of the production site is done manually and takes time.

TIME

ISSUES NEEDS TO BE DEALT WITH

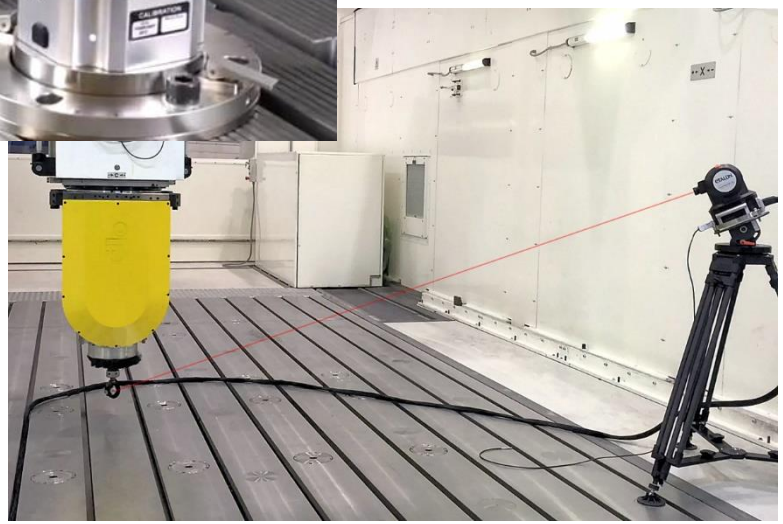
Not all customer have trained workforce. Moreover specific competence are required

TRAINED WORKFORCE

ISSUES NEEDS TO BE DEALT WITH

For the small volume machine, granite artefacts (bars, square…) are acceptable and allows quick check.

Large size machines are a different story…



RIGHT EQUPMENT

ISSUES NEEDS TO BE DEALT WITH

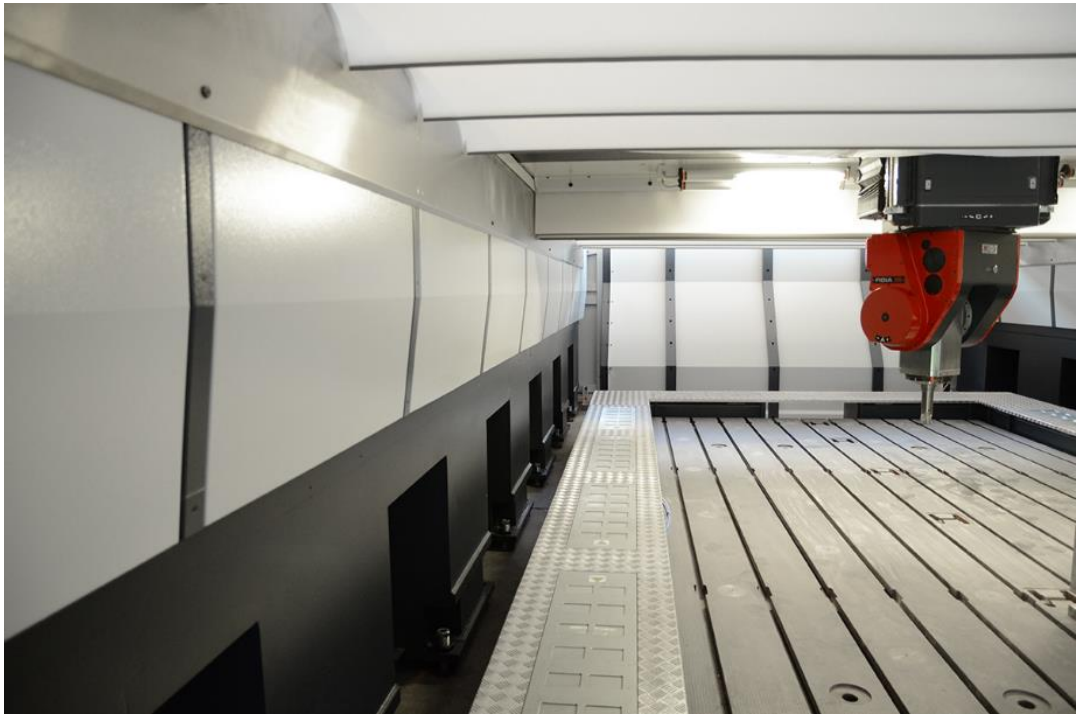
Costs limit the number of instruments that can be bought, therefore the number of parallel setup FIDIA can handle. Low number also increase the transportation and therefore the probability of damage.

COST, DISTANCE and FOREIGN COUNTRIES

NOW FOCUSING ON SPECIFIC TASKs

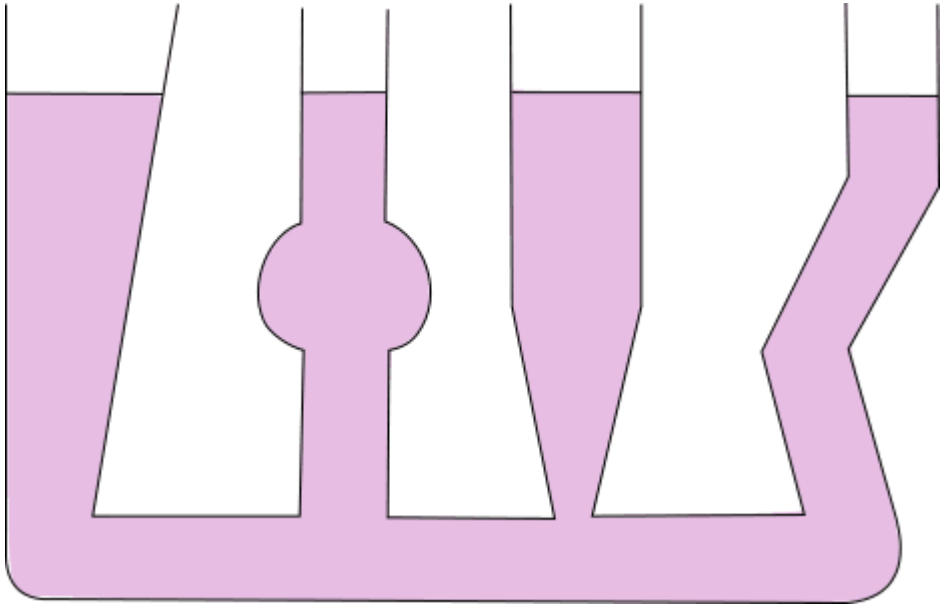
Considering a large gantry machine, just after the installation phase or during the periodic assessment we need to check that:

1) the tool tip really moves on XY plane really horizontal with respect the axis stroke
2) the working table is also parallel to the plane where the tool tip moves



EASY BUT NOT SO EASY…

If we just find a real good horizontal reference…



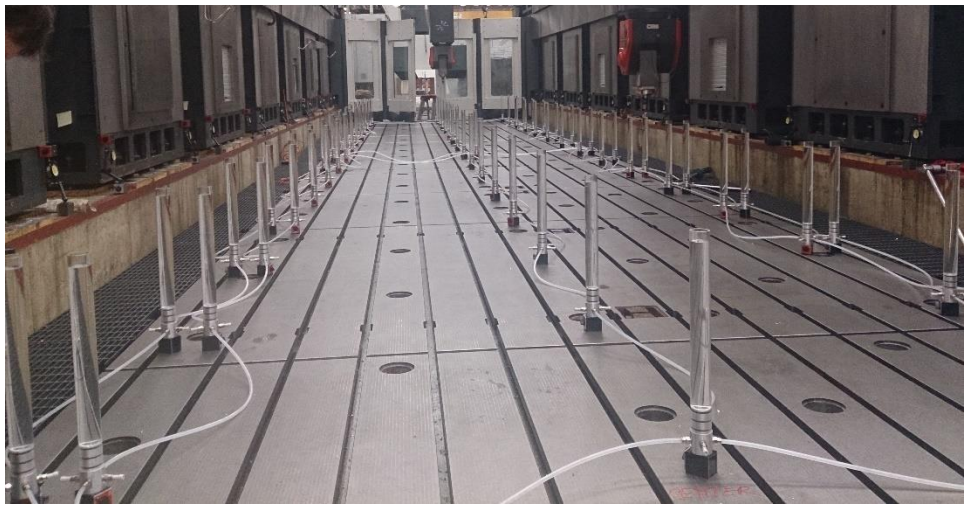
Communicating vessels

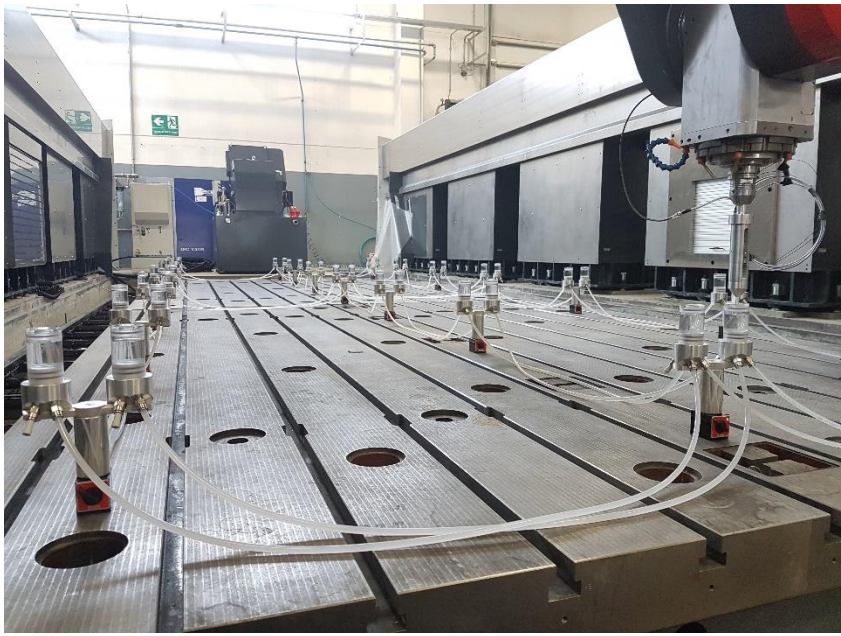
When the liquid settles, it balances out to the same level in all of the containers regardless of the shape and volume of the containers…

EASY BUT NOT SO EASY…

Are they really at the same level…

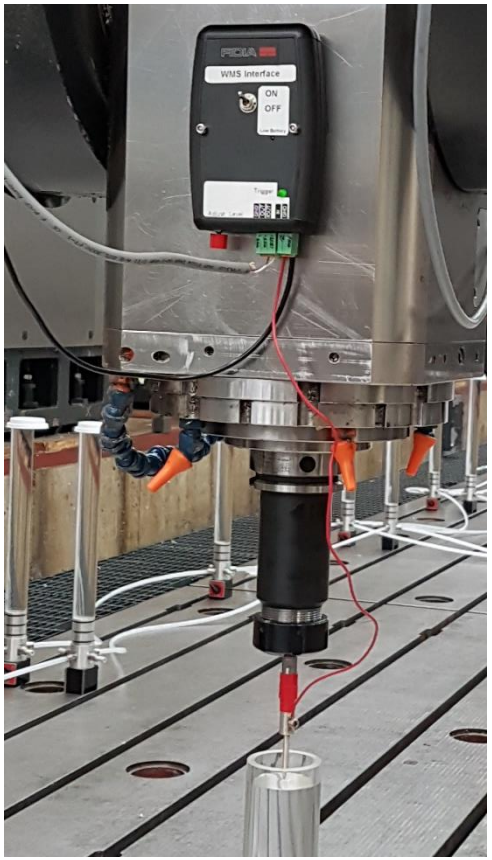
- Liquid need to settle
- Liquid homogeneous (density, bubbles)
- Temperature (density, evaporation)
- Atmospheric Pressure difference (maybe negligible)
- Gravity (negligible)
- Environment (air blowing, near machines, …)
- Pollution and object on the surface

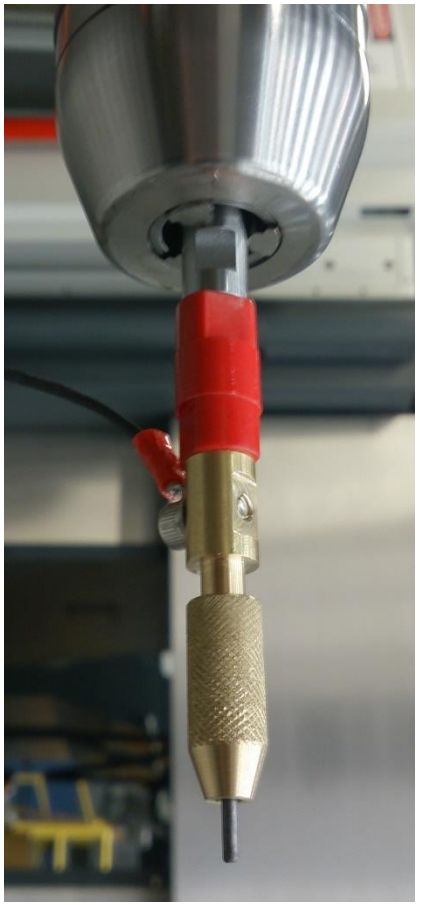




LIQUID LEVEL SENSOR - Electrochemical

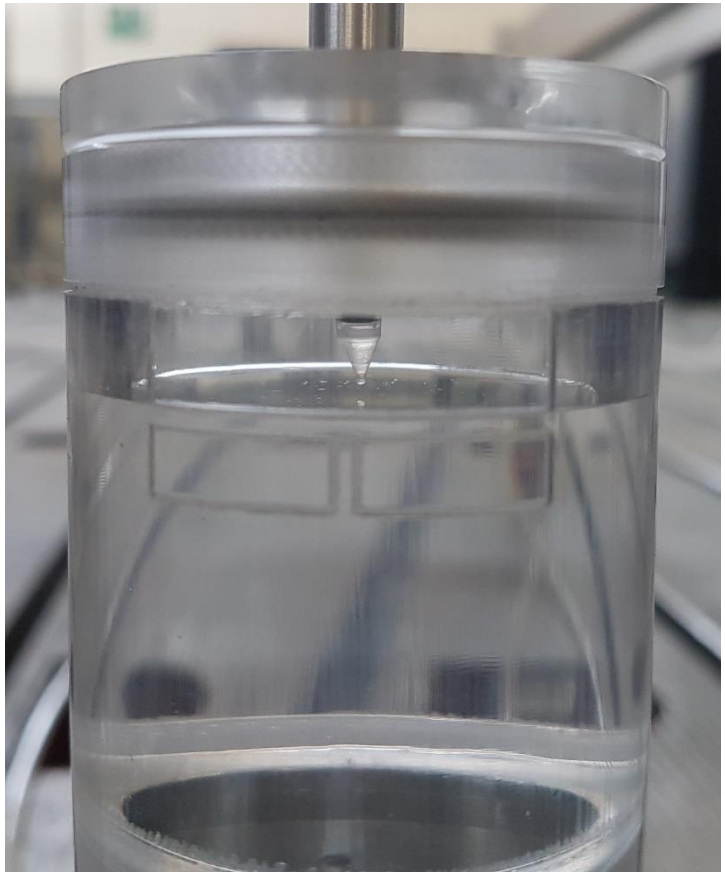
How can we detect the surface of the liquid with the Machine Tool Tip?





LIQUID LEVEL SENSOR - OPTICAL

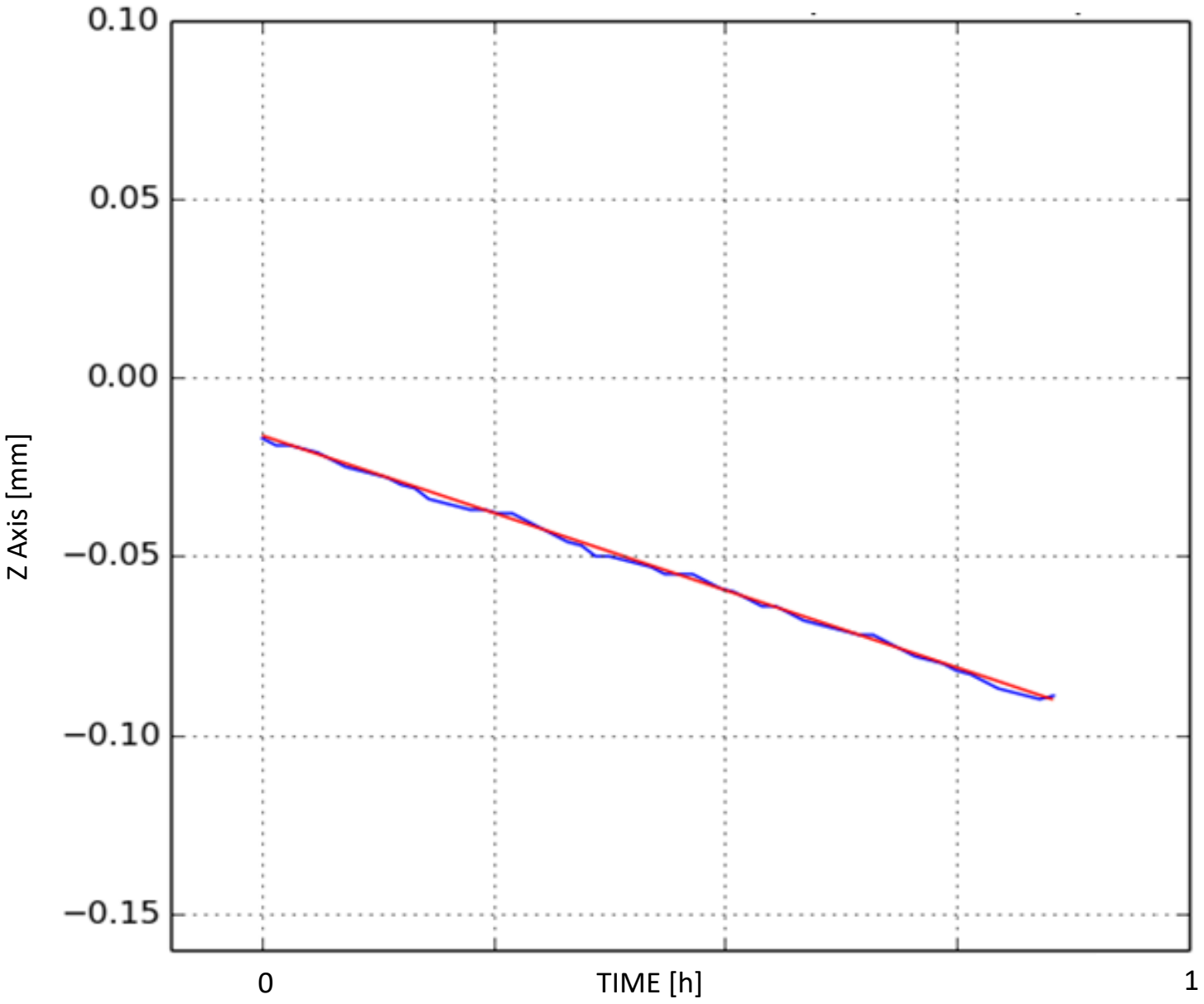
How can we detect the surface of the liquid with the Machine Tool Tip?



LIQUID LEVEL SENSOR - OPTICAL

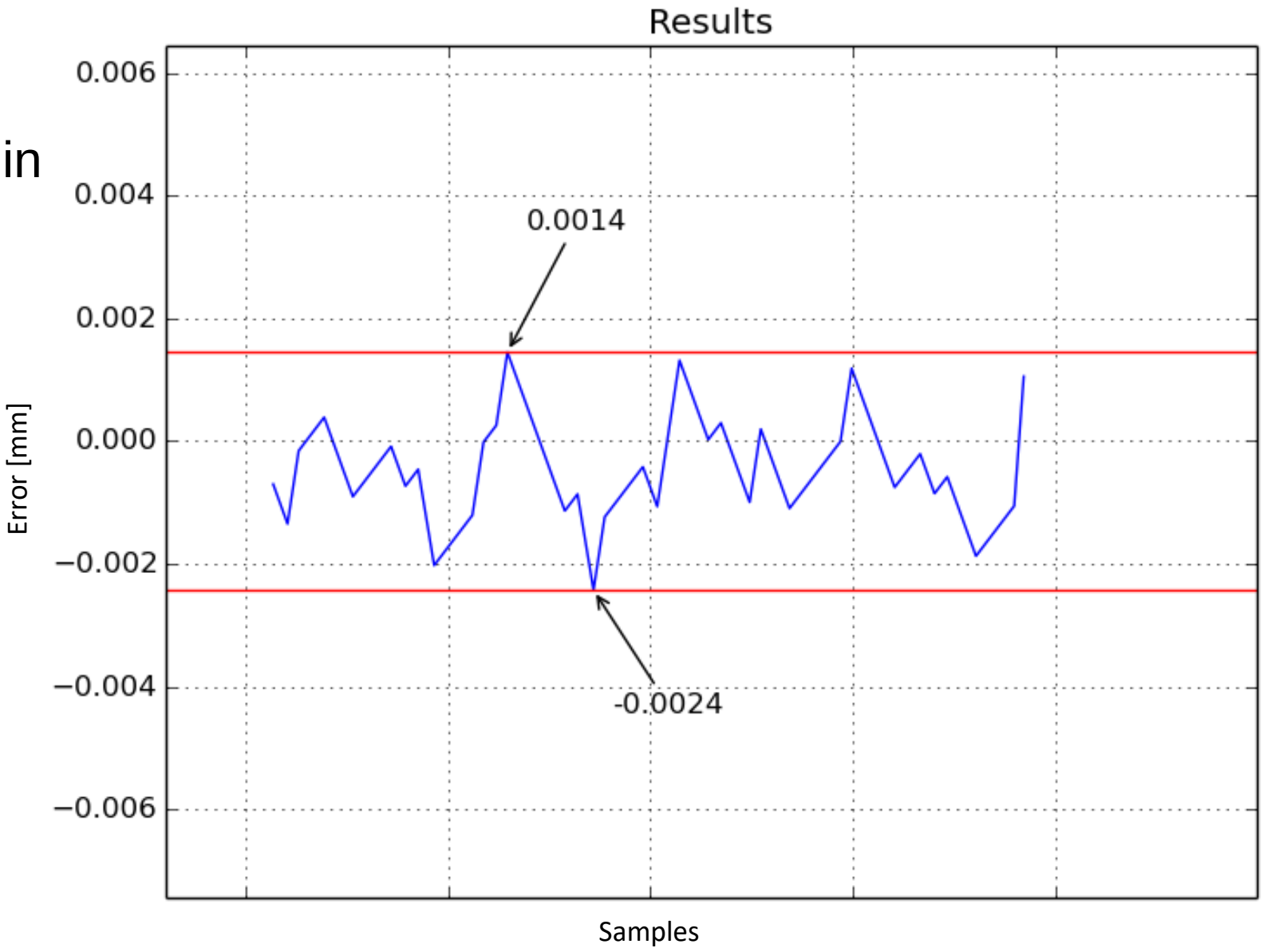
Cycles N. = 100
Feed = 20mm/min

Total time
~53minutes



LIQUID LEVEL SENSOR - OPTICAL

Cycles N. = 100
Feed = 20mm/min



WMS – Water Measuring System

Make everything automatic with the CNC…

A Hydraulic Levelling System for Machine Tool Alignment

WMS is a new system for measuring, correcting and compensating static errors on a gantry machine tool using water as a planarity reference

WMS drastically reduces time and cost for aligning structural parts of the machine tool

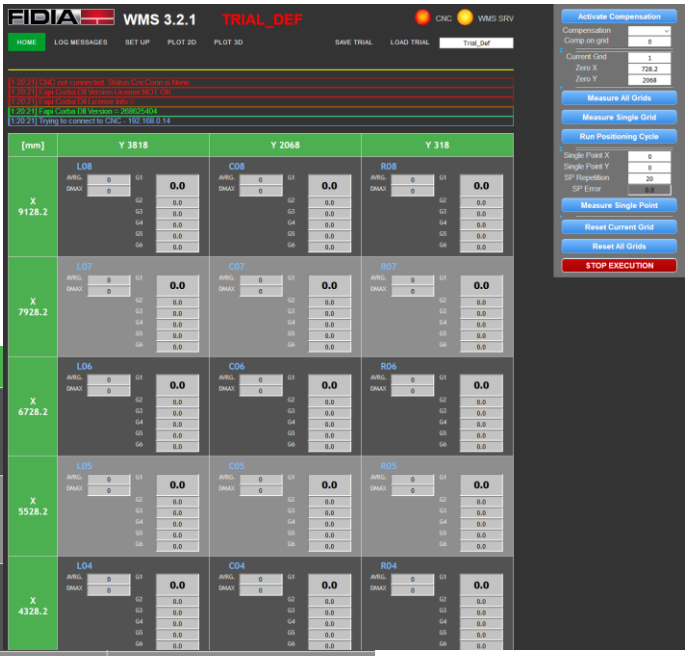
WMS – Water Measuring System

WMS consists in a matrix of interconnected tubes acting as communicating vessels and positioned on the machine tool table

WMS – Water Measuring System

WMS GUI gives a immediate feedback of the errors committed by the machine.

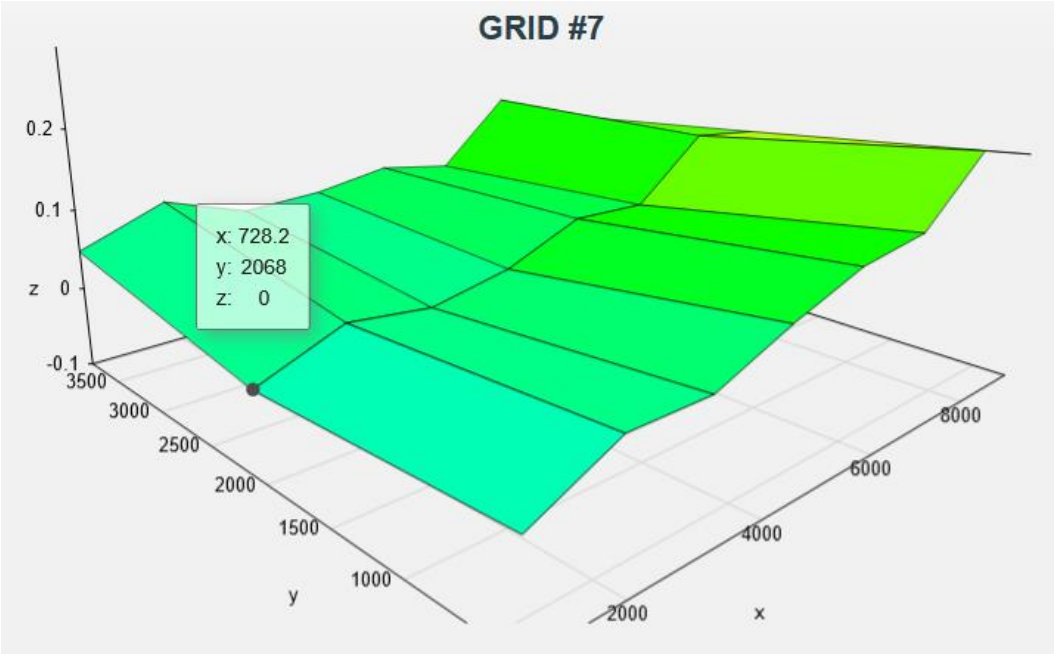
3D visualization is also available



[]	Y 3818		Y 2068		
X 9128.2	L08 AVRG. 0.1020 DMAX 0.0000 G7	0.102	C08 AVRG. 0.1390 DMAX 0.0000 G7		
X 7928.2	L07 AVRG. 0.1410 DMAX 0.0000 G7	0.141	C07 AVRG. 0.1510 DMAX 0.0000 G7		
X 6728.2	L06 AVRG. 0.0550 DMAX 0.0000 G7	0.055	C06 AVRG. 0.0780 DMAX 0.0000 G7		
X 5528.2	L05 AVRG. 0.0720 DMAX 0.0000 G7	0.072	C05 AVRG. 0.0830 DMAX 0.0000 G7	0.083	R05 AVRG. 0.1220 DMAX 0.0000 G7 0.122
X 4328.2	L04 AVRG. 0.0570 DMAX 0.0000 G7	0.057	C04 AVRG. 0.0450 DMAX 0.0000 G7	0.045	R04 AVRG. 0.0930 DMAX 0.0000 G7 0.093
X 3128.2	L03 AVRG. 0.0530 DMAX 0.0000 G7	0.053	C03 AVRG. 0.0270 DMAX 0.0000 G7	0.027	R03 AVRG. 0.0580 DMAX 0.0000 G7 0.058
X 1928.2	L02 AVRG. 0.0880 DMAX 0.0000 G7	0.088	C02 AVRG. 0.0400 DMAX 0.0000 G7	0.04	R02 AVRG. 0.0600 DMAX 0.0000 G7 0.06
X 728.2	L01 AVRG. 0.0482 DMAX 0.0000 G7	0.0482	C01 AVRG. 0.0000 DMAX 0.0000 G7	0.00	R01 AVRG. 0.0148 DMAX 0.0000 G7 0.0148

WMS – PRACTICAL USE

Adjusting mechanically a machine because after some years the ground has settled means move step by step columns and structure of some fraction of millimeters. Moreover at each changes it is necessary to check the effect that the movement have on the entire structure and if necessary correct it.

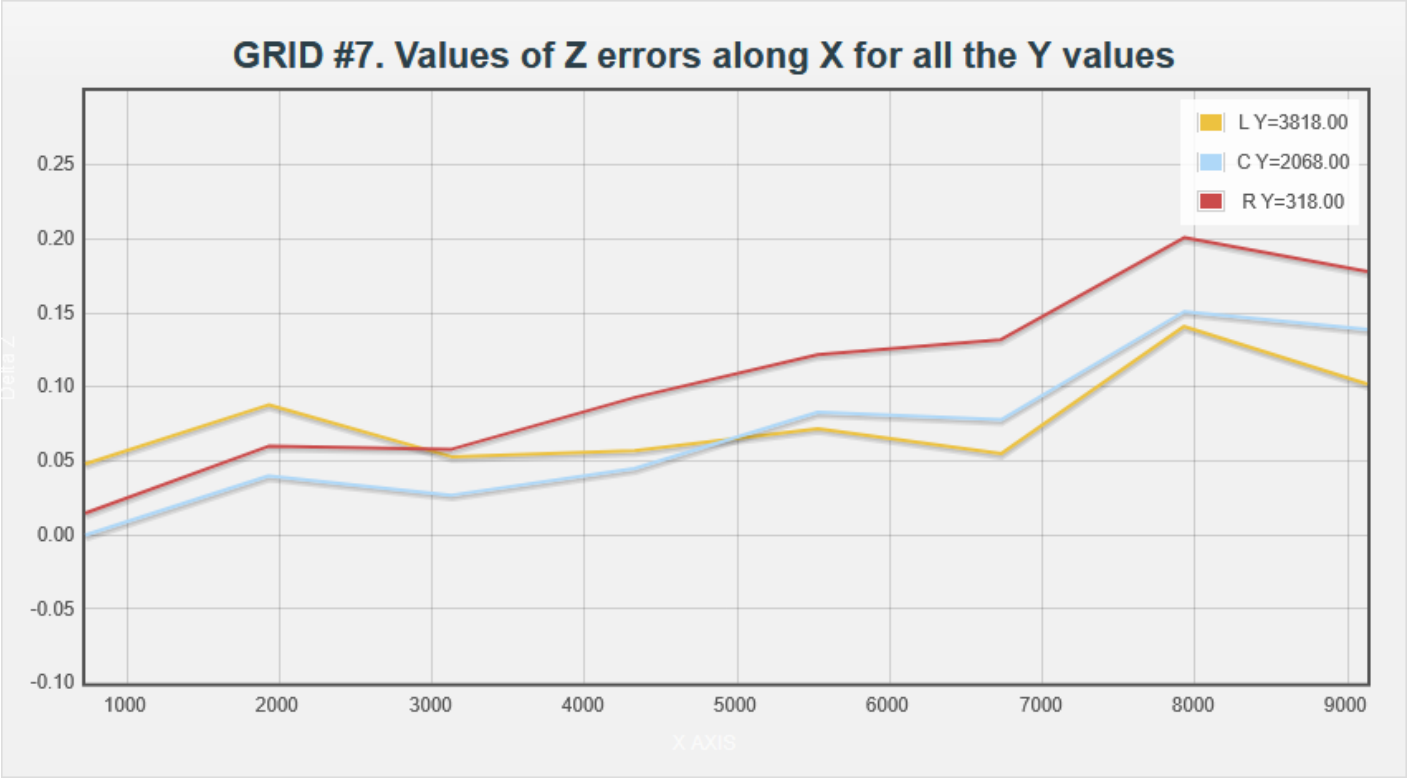


Therefore, the measure method must be suitable and enough fast.

Currently with granite artifacts a 15m machine could require up to three weeks of works to be adjusted just to get the horizontal plane in tolerance.

WMS – Water Measuring System

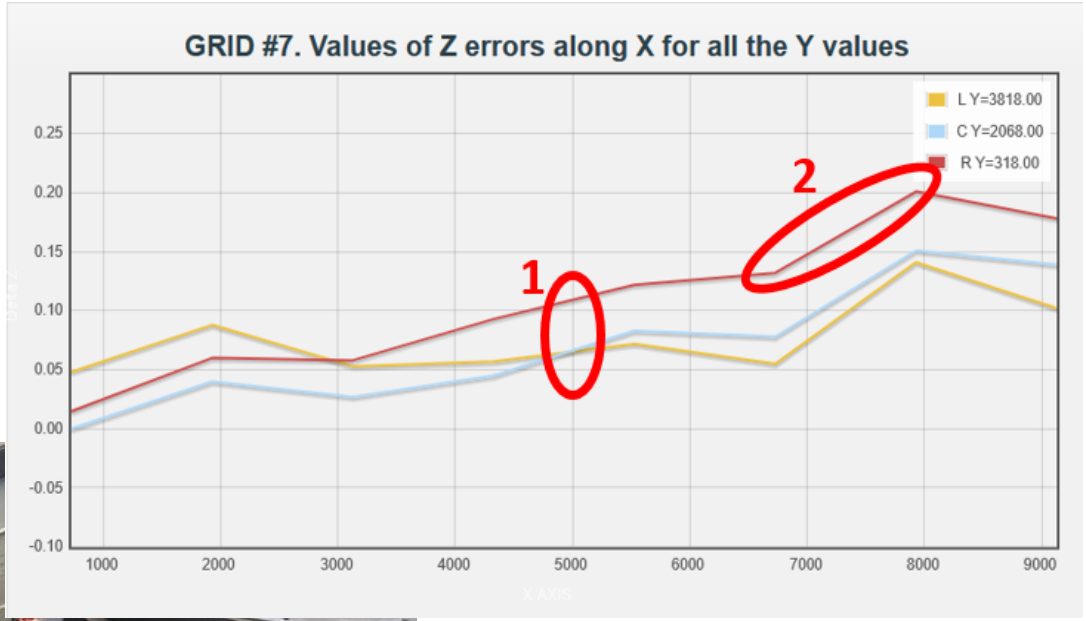
Exploiting the CNC functionalities and some ad-hoc SW the WMS system measure in roughly 25min a 8x4m plane and gives to the technician all the information necessary for moving and adjust the mechanical structure. Moreover is able to calculate the compensation in order to avoid the mechanical adjustment and introduce a SW compensation on the CNC.

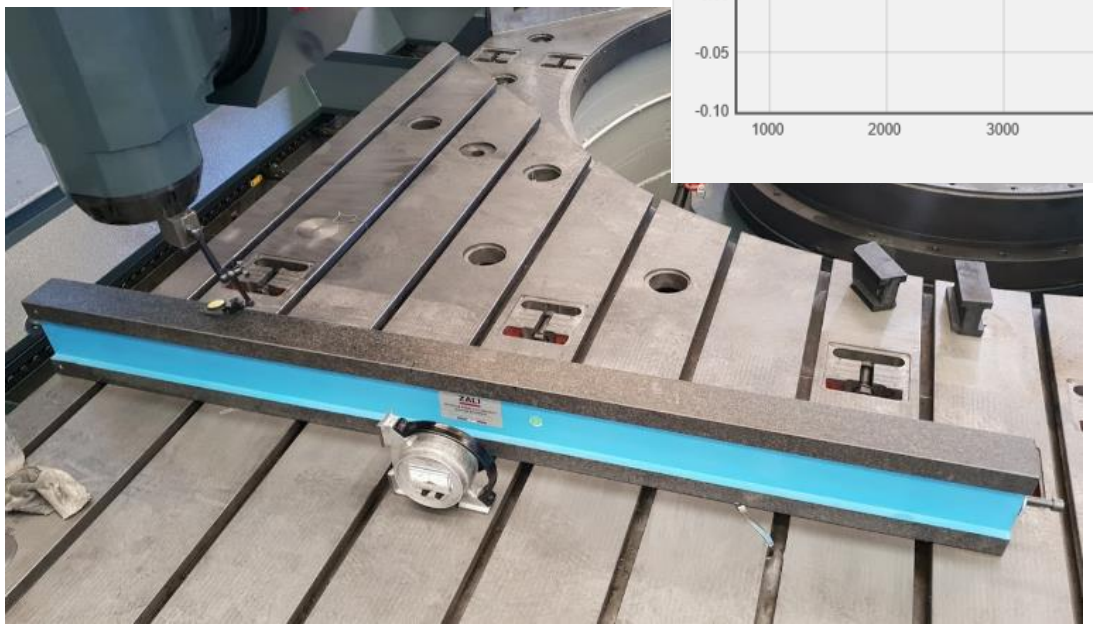


WMS – Water Measuring System

Tested against the real phenomenas.

Last step: Align the table.





THANK YOU

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