SOMMACT Self Optimising Measuring MAChine Tools
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Partners:

ALESAMONTI S.r.l. (IT) - Project Coordinator
API VARESE (IT)
FIDIA S.p.A. (IT)
HAWLAT GmbH (DE)
IBS PE BV (NL)
INRIM (IT)
ISM-3D SL (SP)
KOVOSVIT MAS AS (CZ)
SUPSI (CH)
TTS S.r.l. (IT)
University of Huddersfield (UoH) (UK)
WEISS GmbH (DE)

Deliverable D0.1a

SOMMACT Periodic Report – First Progress Report

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Lead Task beneficiary:	**ALESAMONTI S.r.l.**
Author:	**Gianfranco MALAGOLA**
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1) **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

2) **PU** = Public, **PP** = Restricted to other programme participants, **RE** = Restricted to a group specified by the consortium, **CO** = Confidential, only for members of the consortium

1 Publishable summary

SOMMACT develops and validates an innovative production hardware and control system founded on understanding, evaluating and controlling large machine tools production performances.

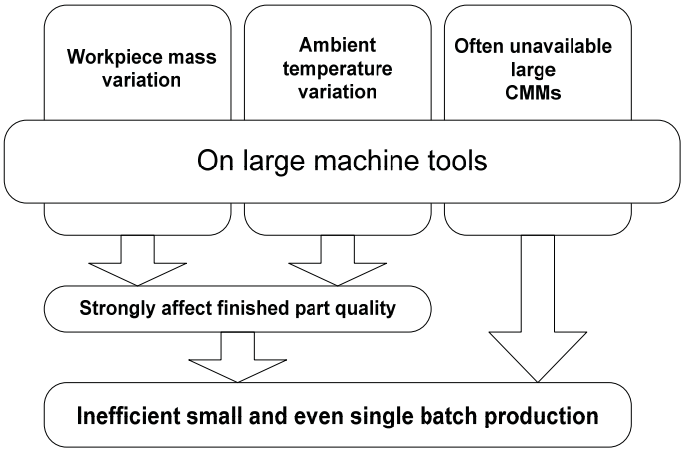


Figure 1 – The problems to be solved

Small and single batch production, particularly for large (some cubic metres), heavy (several tons), and complex workpieces, is still a challenge for machine tools users (see Figure 1).

To achieve high product quality, timely QC (Quality Control)-production loops are required, which are inefficient and expensive.

The organisation and sequencing is also difficult because the process performance practical knowledge is almost unavailable.

As a consequence, this type of production is still affected by inefficiencies and waste (energy, raw material and time).

SOMMACT approaches these issues by the detection (in-process embedded traceable measurements) and compensation (adaptive control and self-learning) of geometrical effects of varying external and internal quantities, such as temperature gradients and workpiece mass (see Figure 2).

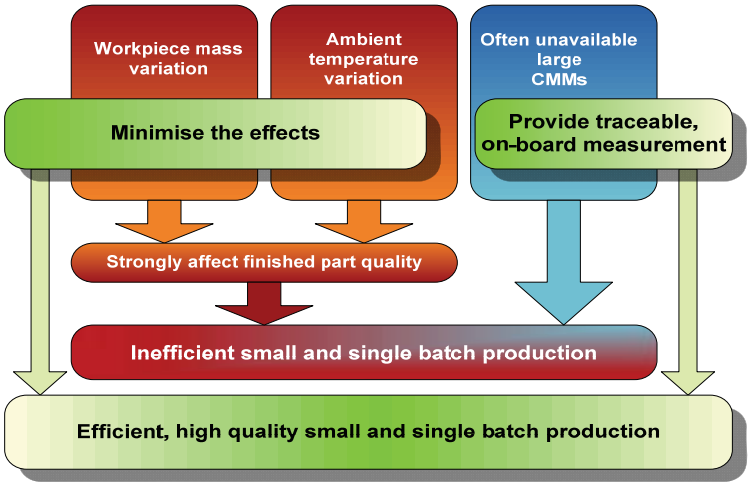


Figure 2 – SOMMACT approach

The SOMMACT vision is based on three pillars:

1. A new metrological concept to enhance the measuring capabilities of machine tools, to monitor machine geometrical deformations reliably and to inspect machined parts characteristics traceably.
2. Enhanced sensor systems, measuring the 6 degrees of freedom (dof) of each machine component, and a control system integrating machine and workpiece data with environment and load conditions, and adapting machining accordingly.
3. A self-learning model of the system performance, accumulating knowledge on the machine behaviour, based on calibration and real-time measurement data, and on their relationship with workpiece characteristics (e.g. mass).

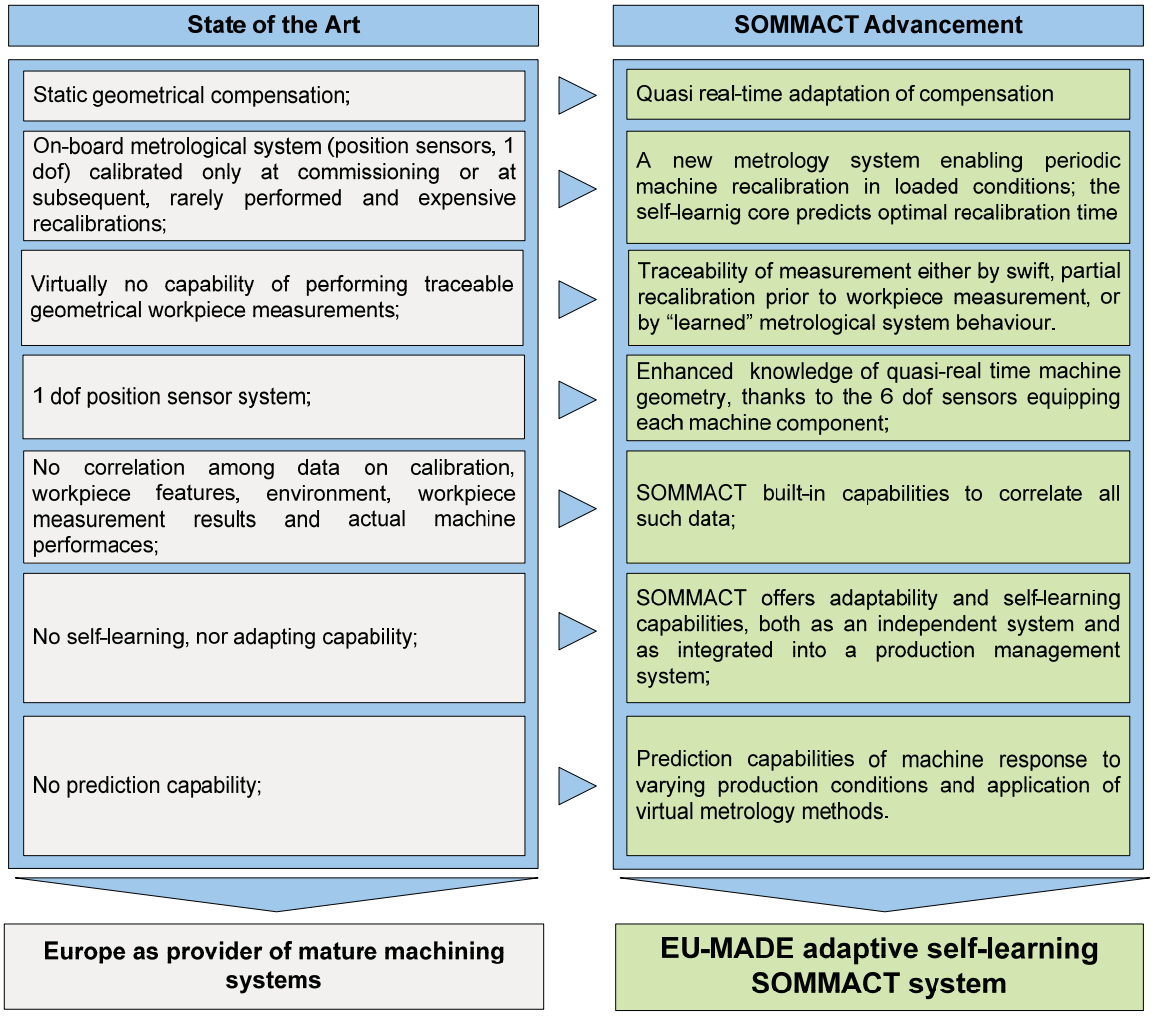
The advantages are an improved product quality at competitive costs, and a prediction capability of the system performances based on increasingly reliable model.

The machine tool measuring capabilities are enhanced to the point that it can be used as a Coordinate Measuring Machine (CMM). This (i) avoids or reduces QC-production loops, (ii) provides workpiece traceable measurement results and (iii) inputs valuable data into the self-learning core.

SOMMACT will measure the effects of process disturbances on geometric errors of individual machine components, store the corresponding data and associate them with corresponding known disturbances (e.g. ambient temperature and workpiece mass) and apply quasi real-time adaptation of geometric compensation tables under the supervision of the self-learning core.

Self-optimisation methods will be applied to steadily improve the product quality. Individual stored geometric errors will be combined with (i) on-board workpiece measurement results, (ii) independent CMM measurement results, (iii) timely, swift re-tuning data and (iv) possible full recalibration data.

SOMMACT advancement over the State of the Art are summarised in the following scheme.



Main expected results

- 100% of improvement of product quality;
- 20-30% reduction of total manufacturing time for small and single batch production;
- 15-20% increase of machine availability;
- Strong drive toward "zero defects" target;
- 70% reduction of workpiece moving phases;
- 15-20% increase in acceptable operating temperature conditions.

Socio-economic impact

SOMMACT will support the transformation of the machine tool industry to strengthen Europe's ability to compete in terms of high added value for the end users as cost-based competition is not compatible with the goal of maintaining the Communities social and sustainability standards.

European machine tool builders will increase the knowledge-based content of their products and the service-related content of their revenues will increase.

European end users – that are mainly SME – will produce significantly better quality parts with an increased productivity thus increasing their competitive advantages and protecting jobs.

Environmental impact

SOMMACT units will significantly reduce energy consumption by (i) reducing manufacturing time (20-30% for small and single batch production) and (ii) reducing workpiece displacement phases (70%). Energy consumption for rework will also be greatly reduced.

Overall reduction of waste and energy consumption will derive from improved product quality that will spread benefits through the whole subsequent production chain: machine tools are sometimes called "the machines that produce machines".

Work performed and results achieved so far

All work planned for the first six months of SOMMACT project execution have been performed according to schedule and the following results have been achieved:

- The **project website** private area was developed at an early stage, with the main purpose to serve as a valuable tool for R&D partners. The public area will soon be improved to inform on the results achieved so far, including a publishable summary of project deliverables.
- **Extensive State of the Art investigation** – Deliverable D1.1 – A set of 117 very valuable documents is currently made available to the R&D partners on the project private website area. This knowledge base will be updated throughout the project execution.
- **Analysis of error sources** – Deliverable D2.1 – The characteristics of the machine tool errors are considered to determine their significance for the SOMMACT project. Additional errors, possibly not identified by normal calibration strategies, are also discussed and considered as contributors to uncertainty during self-calibration and on-board measurements.
- **Identification of preferred application scope** – Deliverable D1.2 – Measurements performed on machined installed in real production environment confirmed the baseline data on workpiece mass and ambient temperature variations sensitivity. Production processes analysis highlighted further possible project goals.
- **Standardisation** – Deliverable D6.5 – The IMS MATECS-MTP initiative outline has been published on the Intelligent Manufacturing System (IMS) website and will be promoted during next scheduled meeting. A preliminary presentation for a New Work Item Proposal (NWIP) has been performed within ISO TC39/SC2.
- **Dissemination** – A fully operational machine tool, equipped with an anthropomorphic robot, was presented at EMO 2009 world machine tool exhibition in Milan, Italy, performing a demonstration cycle including simulated machining, on board measurement and self-calibration with a self-centring probe measuring a reference artefact.

Contact information

Gianfranco MALAGOLA +39 0332 731060 g.malagola@alesamonti.com

Renato OTTONE +39 348 4106508 r.ottone@alesamonti.com

Website www.sommact.eu