

PHM for machine capability

Jaydeep Karandikar R&D Staff Oak Ridge National Lab Manufacturing Demonstration Facility karandikarjm@ornl.gov

ORNL is managed by UT-Battelle, LLC for the US Department of Energy



CAK RIDGE Machining and Machine Tool Research and Development

Making better use of the existing installed machine tool base

• Move from a geometry focus to a performance focus



• The complete system: tool, tool holder, spindle, machine, ... matters



• Make it easy to access the data





Creating new machines for new needs

Hybrid systems



• Small machines, big parts





• Machines for freeform optics





Workforce development

Complete spectrum: operators to thought leaders













2



Are all my machines equally capable?

CAK RIDGE MANUFACTURING National Laboratory

3

https://images.app.goo.gl/LhebZ5DGRNnm5HoM9

Machining dynamics





Identical machines? Different dynamics





Stable cutting conditions for one machine – unstable for other

CAK RIDGE National Laboratory

5

Identical machines? Different dynamics

- Machine spindle dynamics depend on:
 - drawbar force
 - retention knob
 - spindle bearing pre-load

• Identical machines may start with different dynamics and they change over time.

• Process parameters converge towards the worst machine.



Machine capability

If a good program stops working:

- excessive tool wear/tool breakages
- machining chatter
- recuts and rework
- part quality

Something is wrong – it is a maintenance issue and not a normal condition.



PHM needs for machine capability

- Monitor machine health for process capability:
 - spindle dynamics
 - machine axis errors
- Model machine health in terms of process capability and part quality:
 - recommend corrective actions
 - optimized and defect-free machining process



Thank you!

Acknowledgements:

Scott Smith (ORNL)

Tony Schmitz (ORNL/UTK)

