Project ROKOST

Can an optimized case hardening process improve productivity in Hard Part Turning by 50 percent?

Anna Ganea


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Hard Part Turning

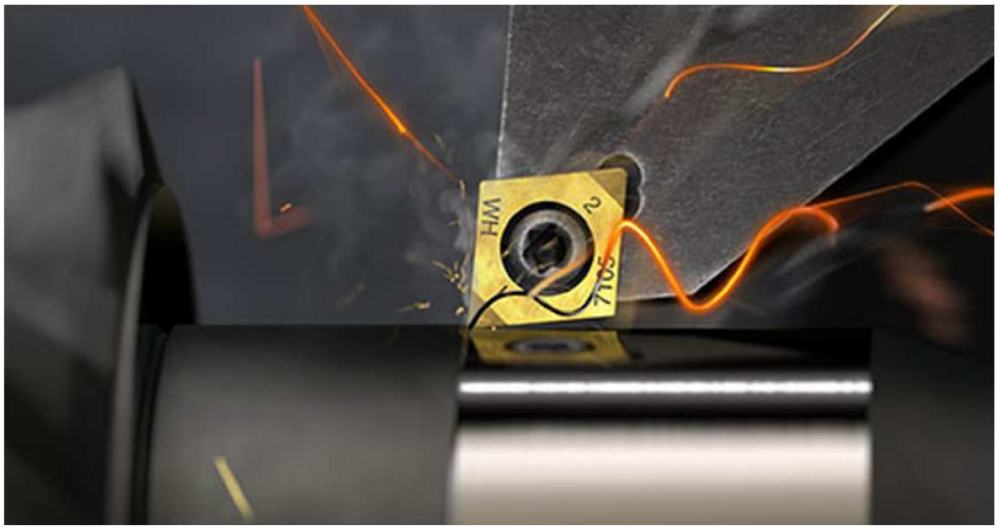
HPT – finish machining for achieving the right shape, dimensions and surface quality

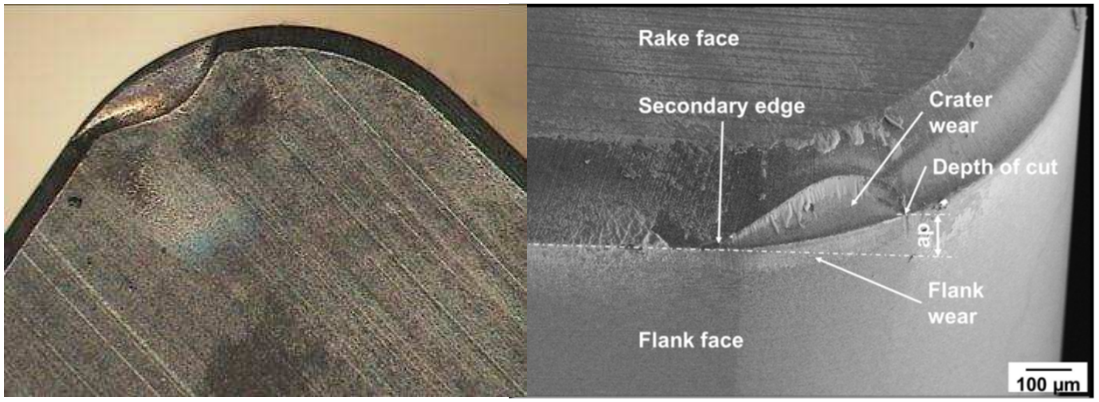
Typically transmission components for automotive applications

Generally case hardened (carburized) steels, ~58-63 HRC

Cutting material: cBN

Hard Part Turning



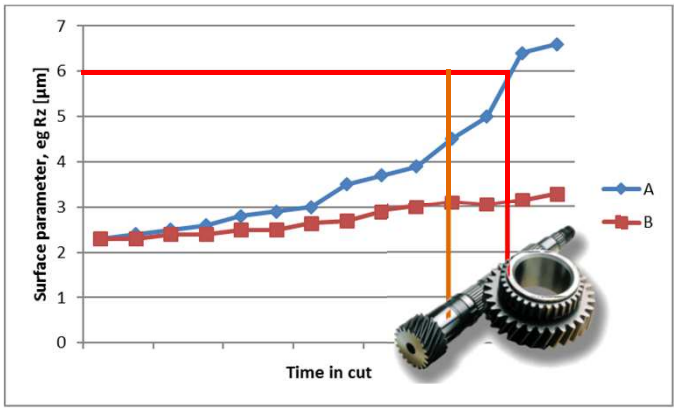


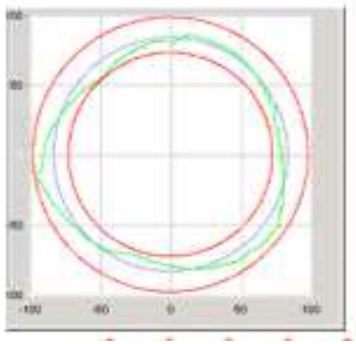
Finish machining

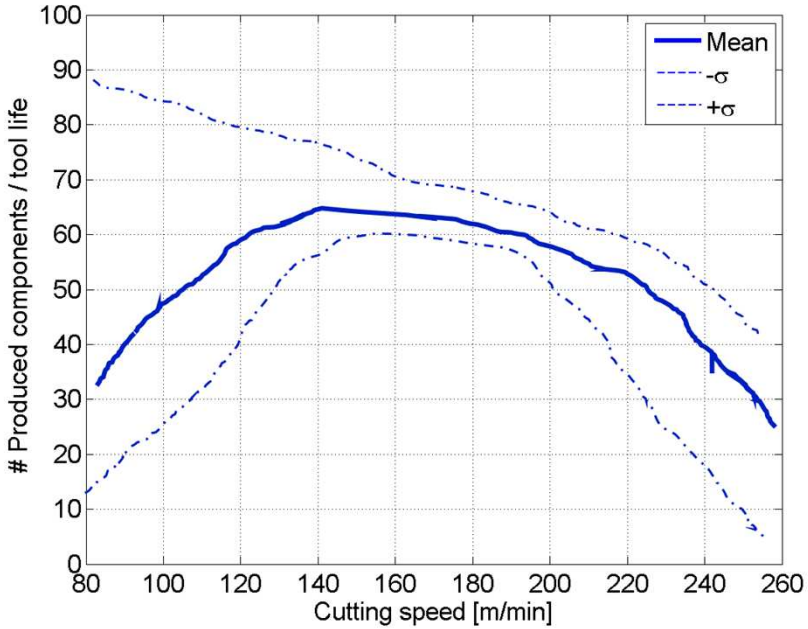
Wear

Tool life

Hard Part Turning







Tool life through component quality

Safe tool life

Cutting speed influence – optimum

Variations

Project motivation

Variations in carburizing have strong impact on HPT performance

- Experience from earlier research projects and test work – and at end users
- Sub-optimal productivity in manufacturing
- Variations: both process selection and variability
- Relations not well understood

A need to increase understanding about underlying mechanisms

to enable tailoring the carburizing process

not only for component properties and cost effectiveness

but also for a more robust Hard Part Turning process

Project ROKOST

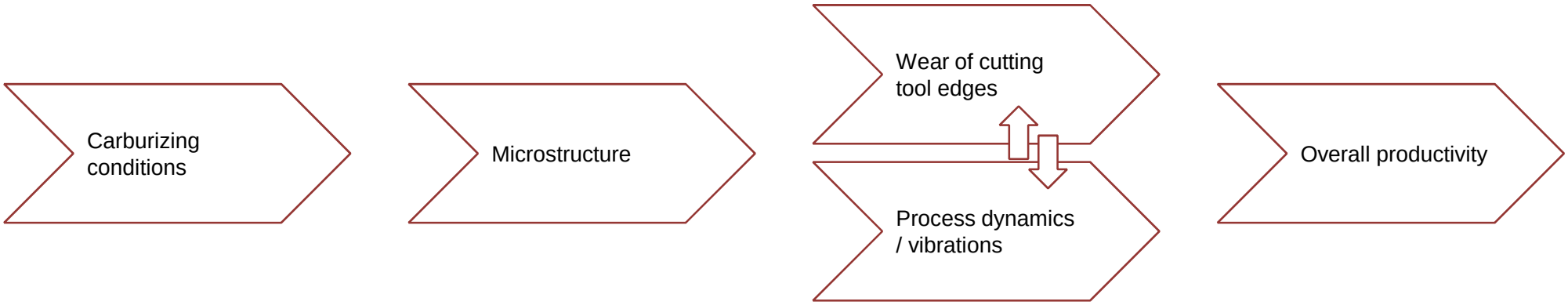
Project partners including full value chain -

automotive manufacturers together with suppliers of steels, heat treatments and machining solutions

Vinnova funded, program Hållbar produktion - FFI

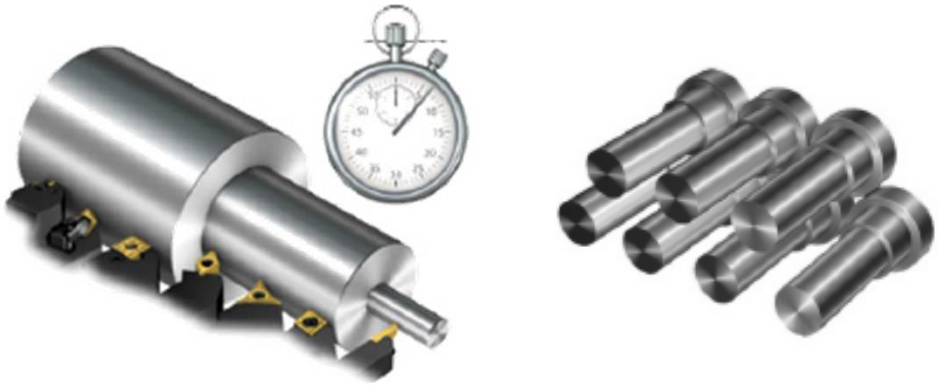
Project duration 2018-2021

Understanding the link



Overall productivity

“Productivity = the value of output produced divided by the value of input or resources”



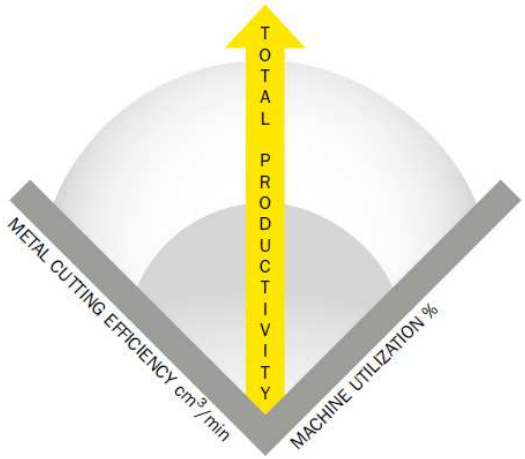
Overall productivity

Controlled wear of cutting tools

- Increased cutting speed and feed /
- Increased tool life

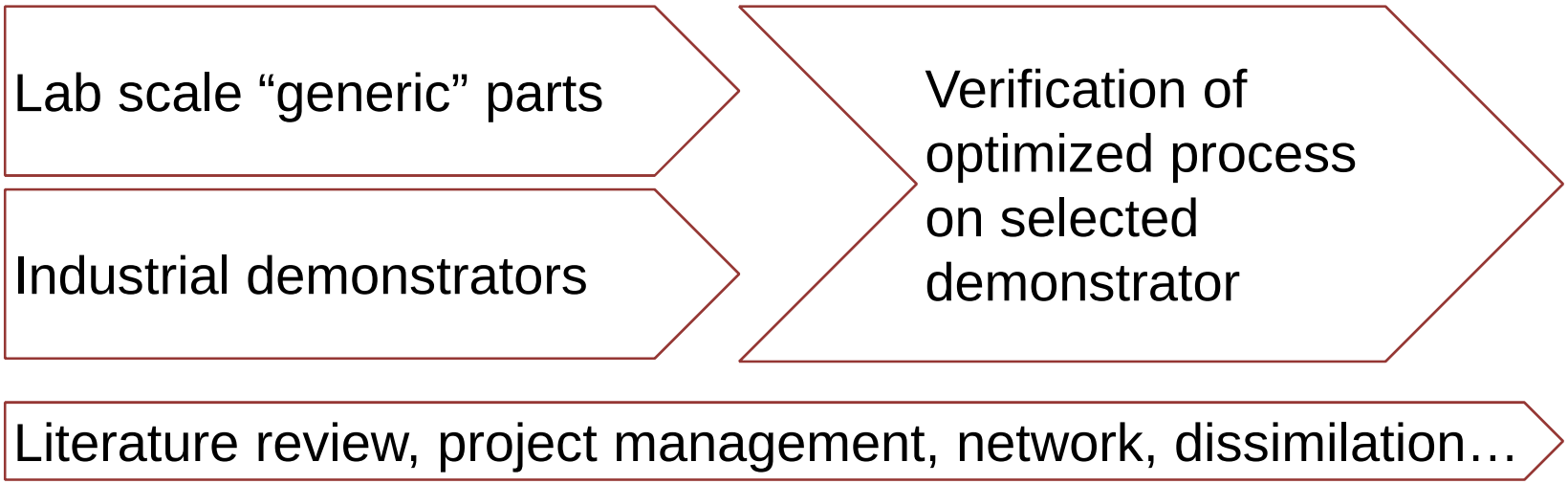
Improved consistency - robustness

- Better utilization of cutting material
- Fewer unexpected stops
- Less scrapped material
- Less time for quality verification
- Less time for tool change



Project goal $\sum$ = + 50 %

Project layout



Industrial demonstrators

Mapping current state

- Variations
  - Between produced batches
  - Between in-house / sub-contracted process
- In terms of
  - Material properties of hardened components
    - Hardness, microstructure, residual austenite
  - “Productivity” in HPT
    - Wear of cutting tools, tool life, produced component quality

Lab scale “generic” parts

Test parts designed for project

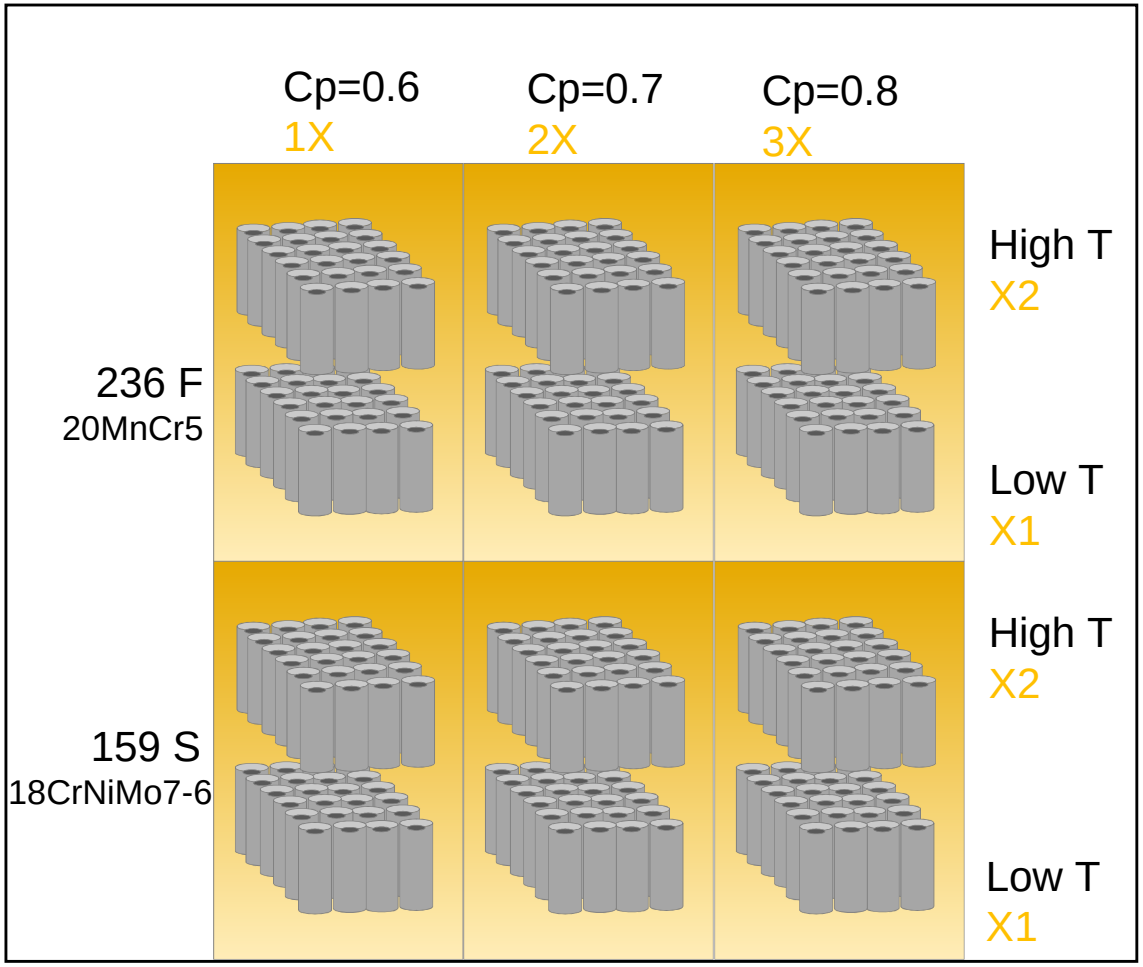
- Supplied by Ovako
- Cas carburizing Bodycote Angered

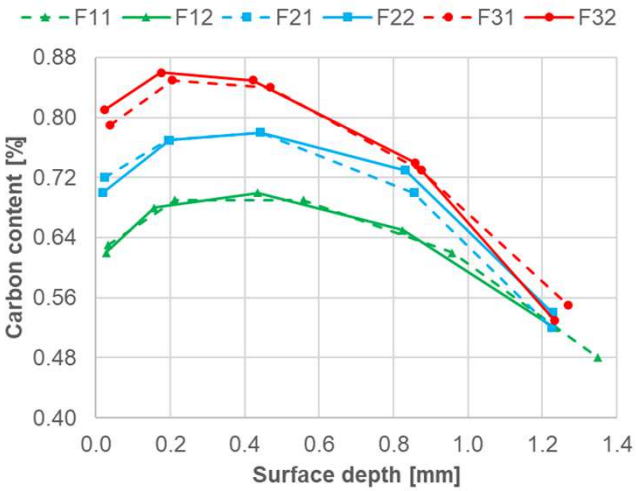
Test matrix

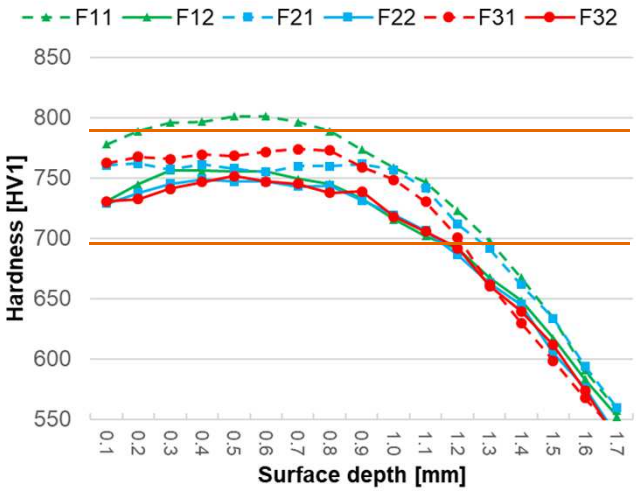
- Steel grades
- Carbon potential
- Tempering temperature

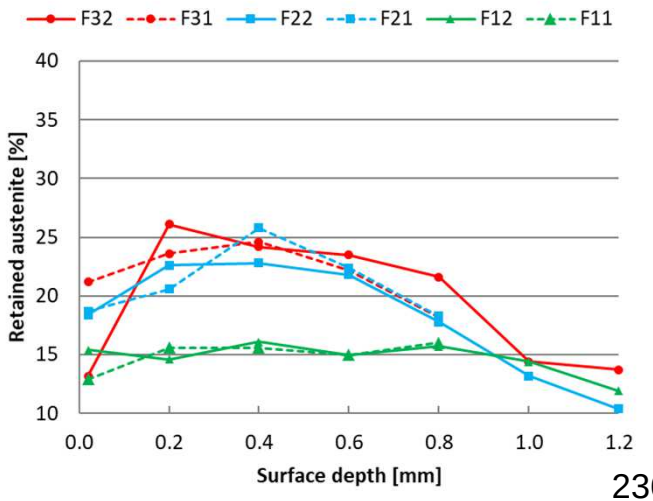
12 variants

Denomination, eg S12

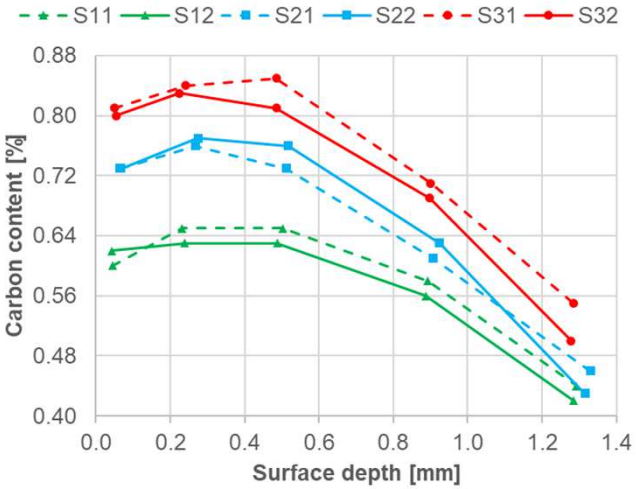


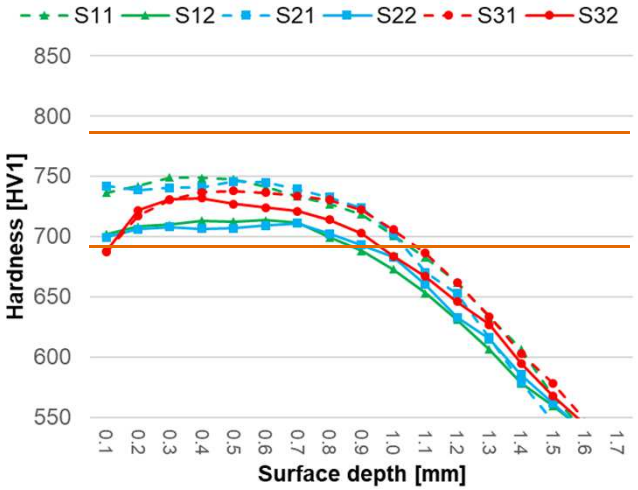


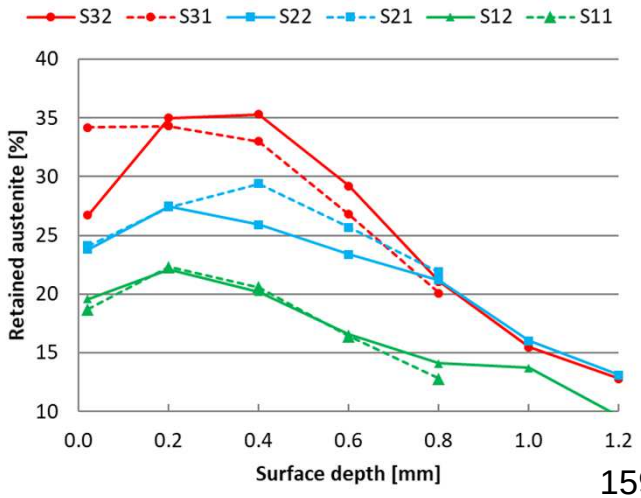




236 F
20MnCr5







159 S
18CrNiMo7-6

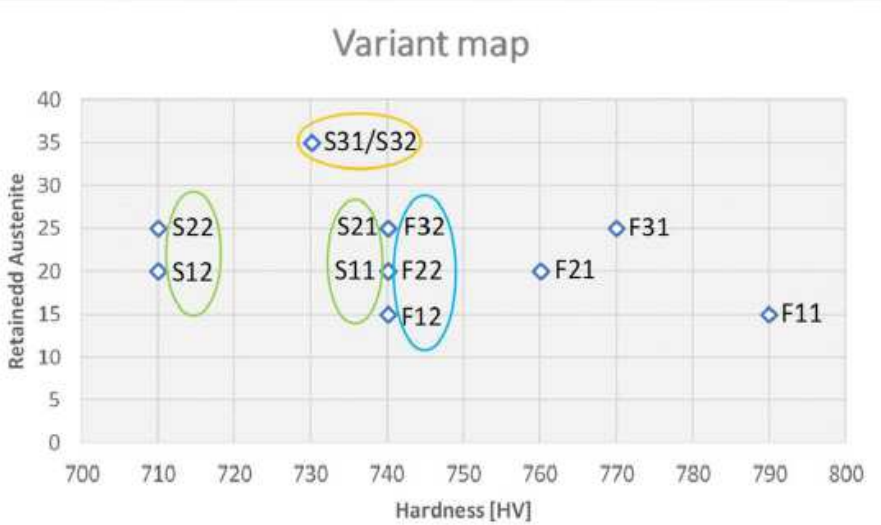
Lab scale “generic” parts

Machining tests – tool wear studies

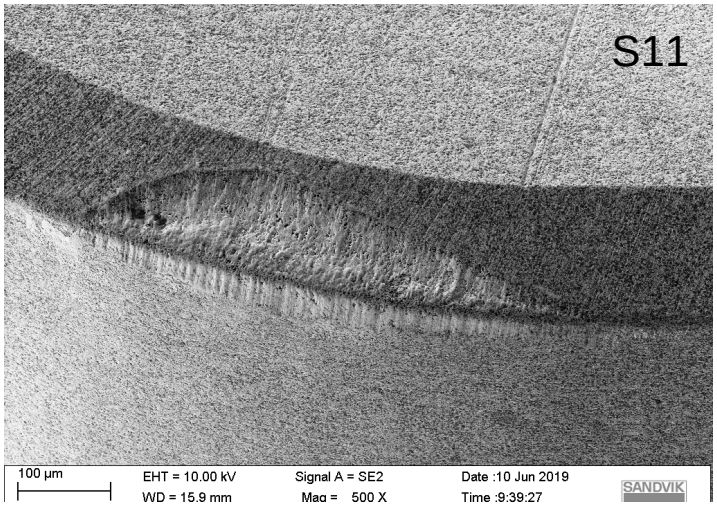
- Initial wear (3-5 minutes)
  - Qualitative and quantitative wear studies
- Progressed wear / tool life

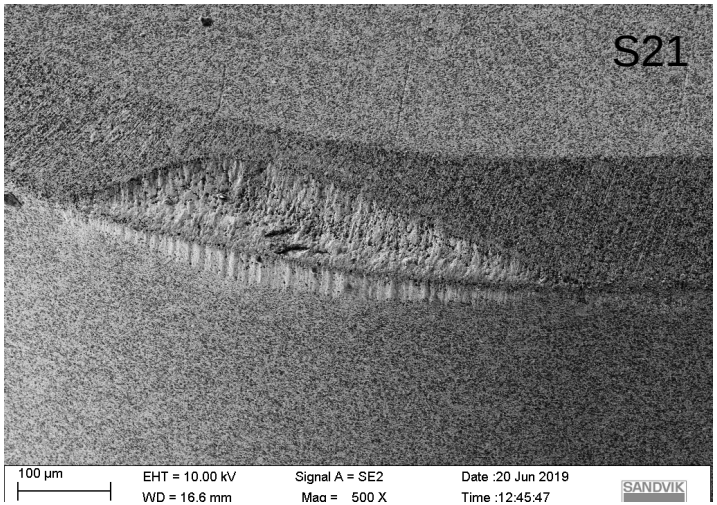
12 steel/hardening combinations

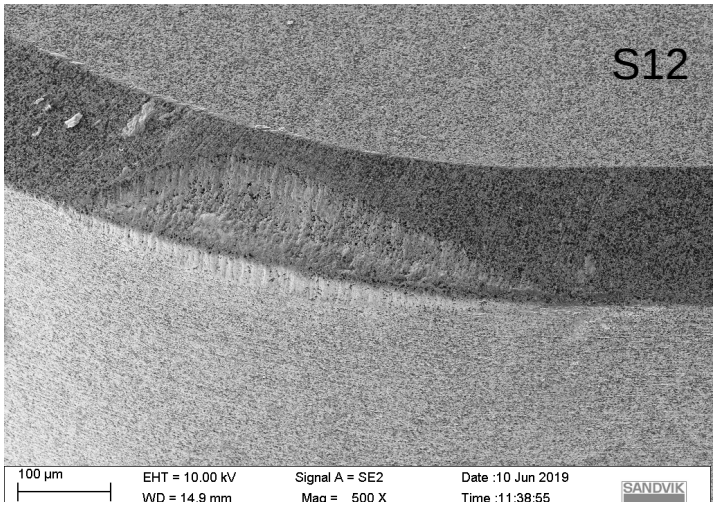
3 cutting speeds

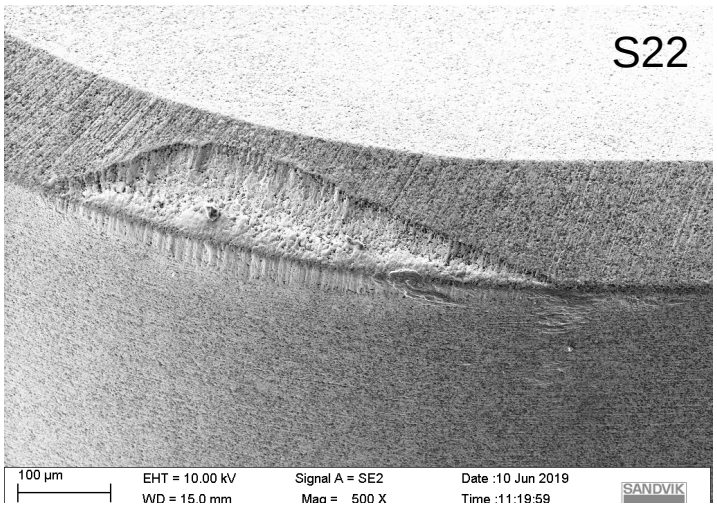


HV









Residual austenite

Vc 210 m/min
Ap = 0.1 mm
Fn = 0.15 mm/rev
4 minutes in cut

Verification and application

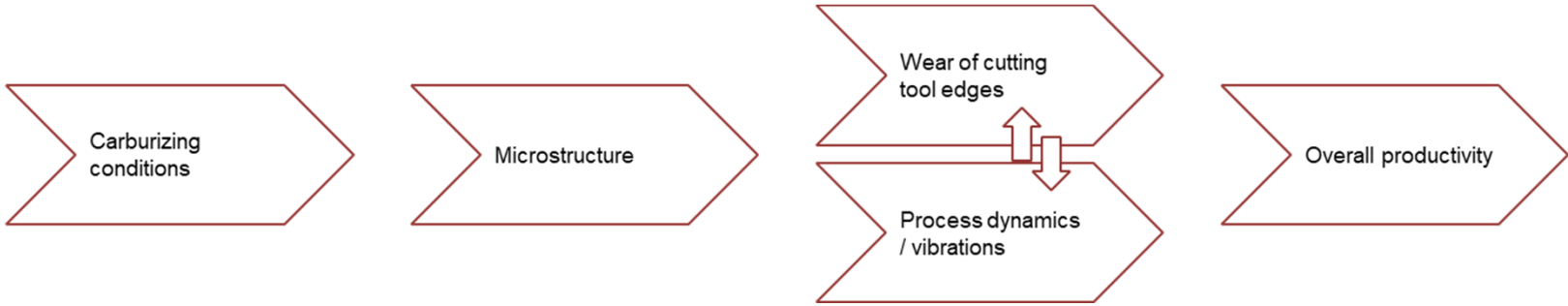
Results from generic components

- Wear and tool life at different cutting speeds
- Characterized material from different carburizing variants

Results from demonstrator components

- Variability of carburized material
- Understand critical variations related to mapped insert performance

Guidelines - how case hardening can be specified for predictable machinability

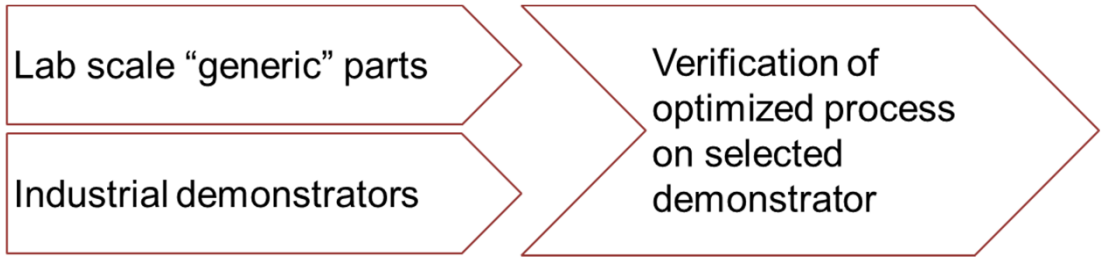


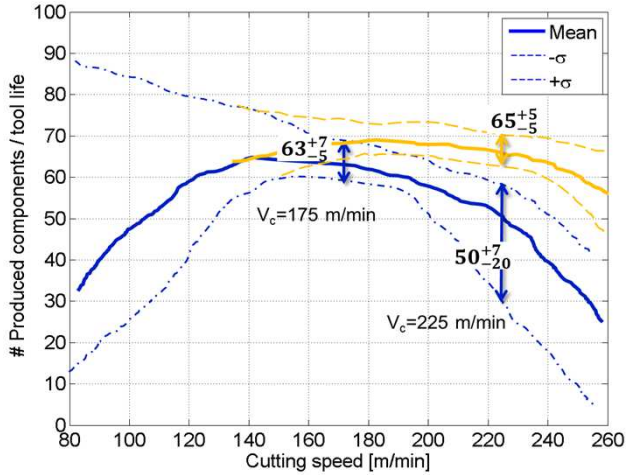
Verification and application

For a selected demonstrator, application of tailored carburizing process

Machining at adapted conditions

To validate productivity increase





Project goal

Based on improved machinability and consistency of the process, optimize the case hardening processes for a more efficient machining operation and less processing time, targeting 50% increased productivity, compared with today.

Make guidelines for how the case hardening can be specified for a predictable machinability.

Increase the understanding for the correlation between properties in the case hardened component and tool life in hard part turning.

Impact goal

To shorten lead times and increase flexibility in production

by identifying how the material parameters in the hardened surface of the components affect the machining.

To increase productivity, decrease rejection rate and maintain component quality

by decreased tool wear and optimized cutting parameters

To prepare for digitalized production process

by connecting processes affected by microstructure along the production chain and analyze collected data.


SANDVIK
Coromant