Life Cycle Management of Abrasive Tools and its Effect on Sustainable Grinding

**Motivation**

- Machining with geometrically undefined cutting edges represents a key technology capable of
- High process performance
- High process stability
- High quality tolerances
- However, sustainability is a growing concern.
- Abrasive tools are main enablers for capable processes and are the focus of the following analyses.

**Sources**

- After Dahms, Gunter, Hino, Dornfeld, Pictures from Tyrolit, Vemasonic, H2L, EARTH, acetate.

**Use Phase: Grinding Process, Process Chain, Leveraging**

- **Enhance the grinding process**
  - Coolant reduction
  - Reduced energy consumption
  - Higher productivity

- **Shorten the process chain**
  - Avoid tool change and add value by combination of hard cutting, grinding and hard roller burnishing
  - Avoid the hardening process by grind-hardening

- **Leverage grinding for enhanced product life cycle**
  - Speed stroke grinding to induce compressive stress
  - Decreased product wear by tribolayers
  - Shorter wear-intensive run-in phases of seal systems

**Use Phase: Tool Design**

- **Design parameters**
  - Grit type
  - Grit size and size distribution
  - Bond type
  - Tool hardness
  - Pore volume and shape

- **Design impacts**
  - Process productivity
  - Process forces
  - Process heat generation and convection
  - Tool wear

**Future Work**

- Evaluating abrasive tool production
- Energy consumption in the production of abrasives related to tool productivity
- Bonding, including pore builders
- Body design (material and shape)
- Evaluating grinding process sustainability
- Machine power measurements
- Grinding swarf, emissions to air or cooling lubricant
- Leveraging tool conditioning
- Generating a toolbox for the selection of abrasive grits
- Evaluating end of life
- Including supply chain and packaging aspects