



Smart tooling decisions,
from strategy to shopfloor



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Welcome



Imagine starting the buying process of a new car by focusing only on the tires. It sounds absurd, doesn't it? Yet, this is exactly what happens when companies begin their machining projects with a misguided cutting tool selection strategy.

The cutting tool isn't just another component, it's the linchpin of the entire production process. If you get this wrong, everything else, from sustainable efficiency to cost-effectiveness, falls apart.

Rather than diving into less critical details, begin with the big picture. Choose the right cutting tool strategy from the start, and you'll set the foundation for success. Otherwise, you're just setting yourself up for failure before you've even begun.

Agenda

- Production excellence
- Some reflections
- Machining process model
- Machining economics
- Economic machining
- Tool selection, from strategy to shop floor
- Tool selection for management
- Tool cost versus production savings
- Tool selection for engineers
- Challenges & opportunities in tool selection
- Efficient tool utilisation for operators
- Closing the loop, tooling as a system
- Conclusions and summary





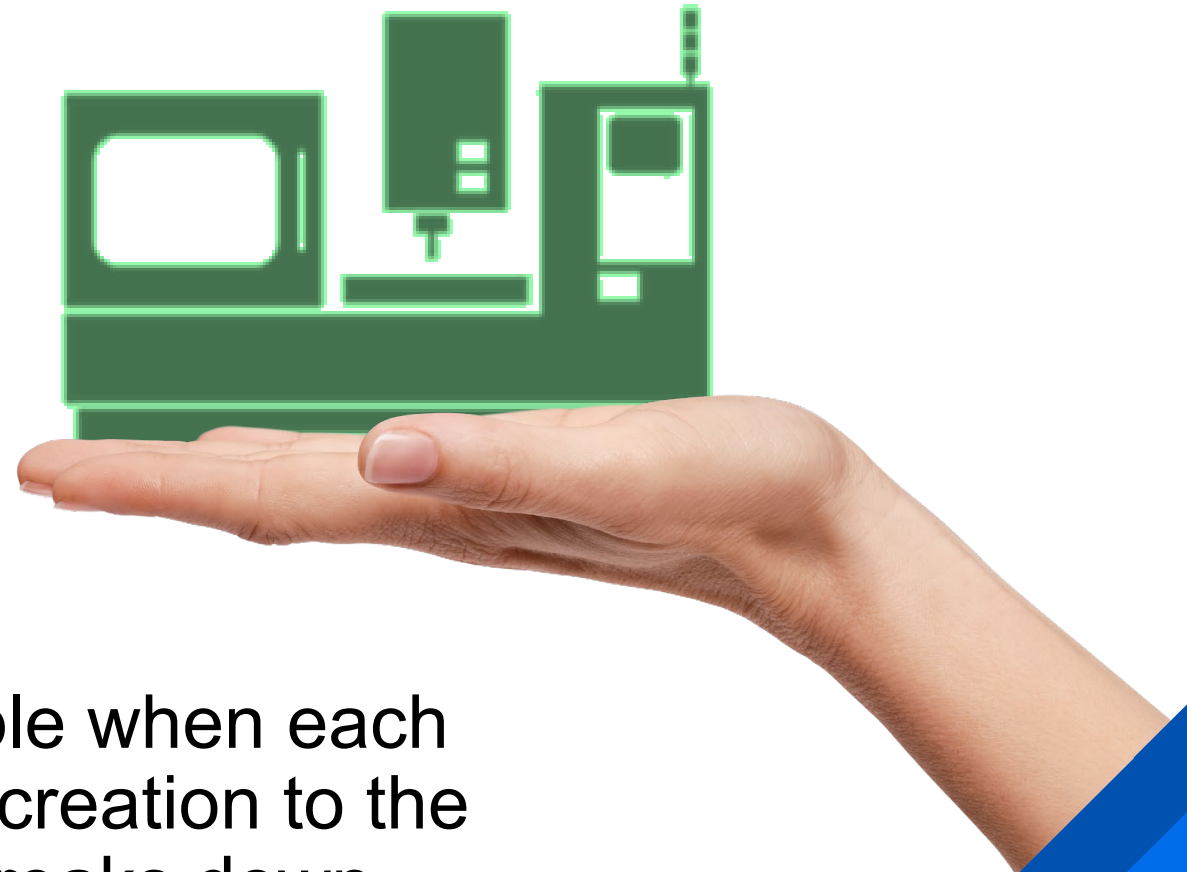
Production excellence

Production excellence

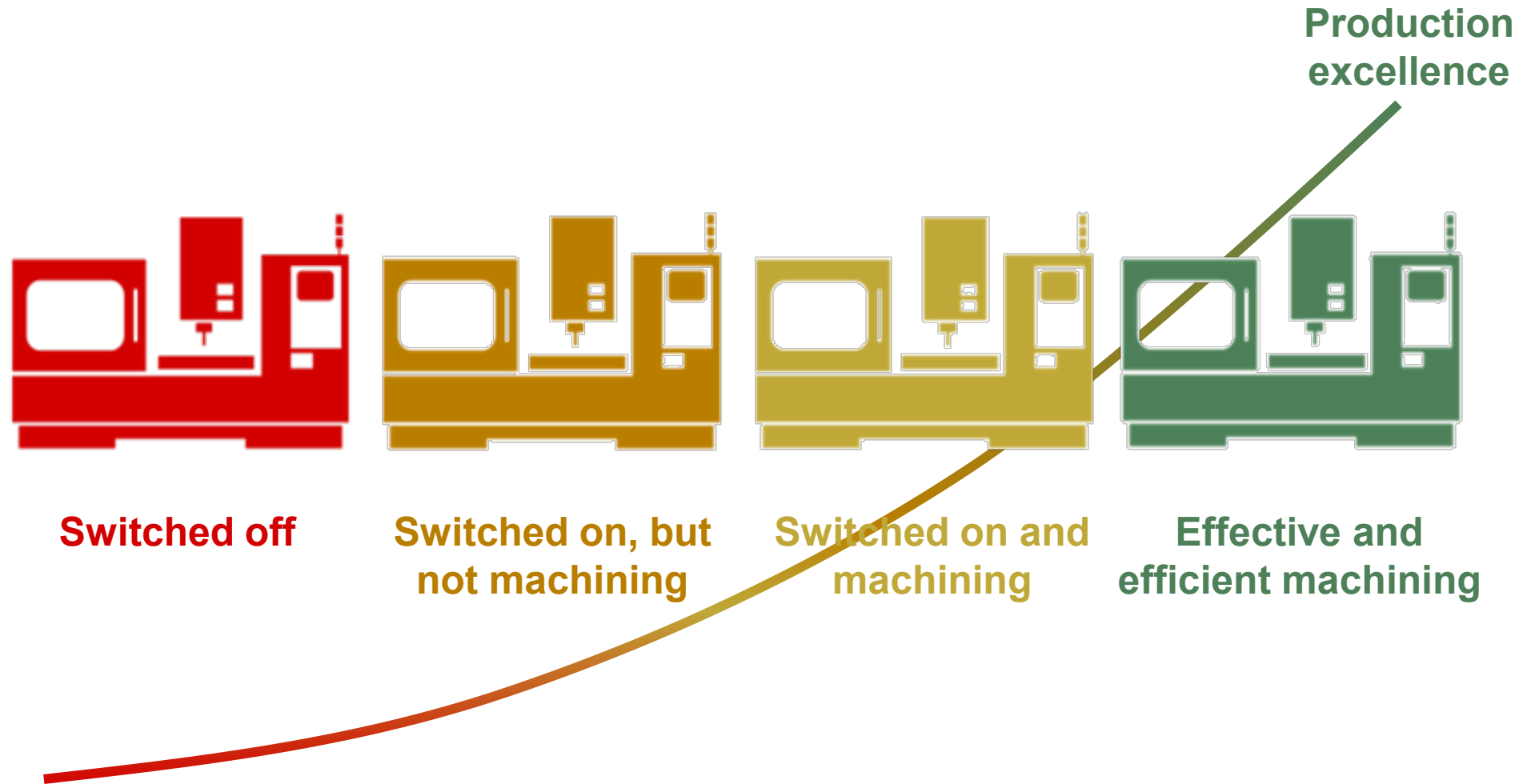
The sustainable, continuous improvement of operations and processes to gain competitive advantages like reduced costs, increased productivity, increased profits ...

Be better than the competition.

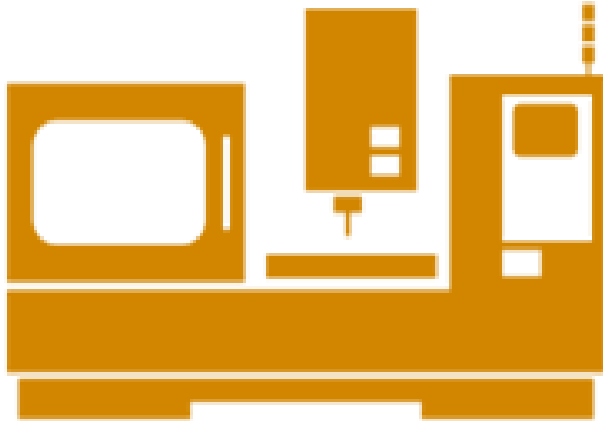
Production excellence is only possible when each employee can see the flow of value creation to the customer, and fix that flow when it breaks down.



Production excellence



Production excellence



Machine is powered but not machining

- Set-up
- Workpiece manipulation
- Tool indexing/presetting
- Problem handling

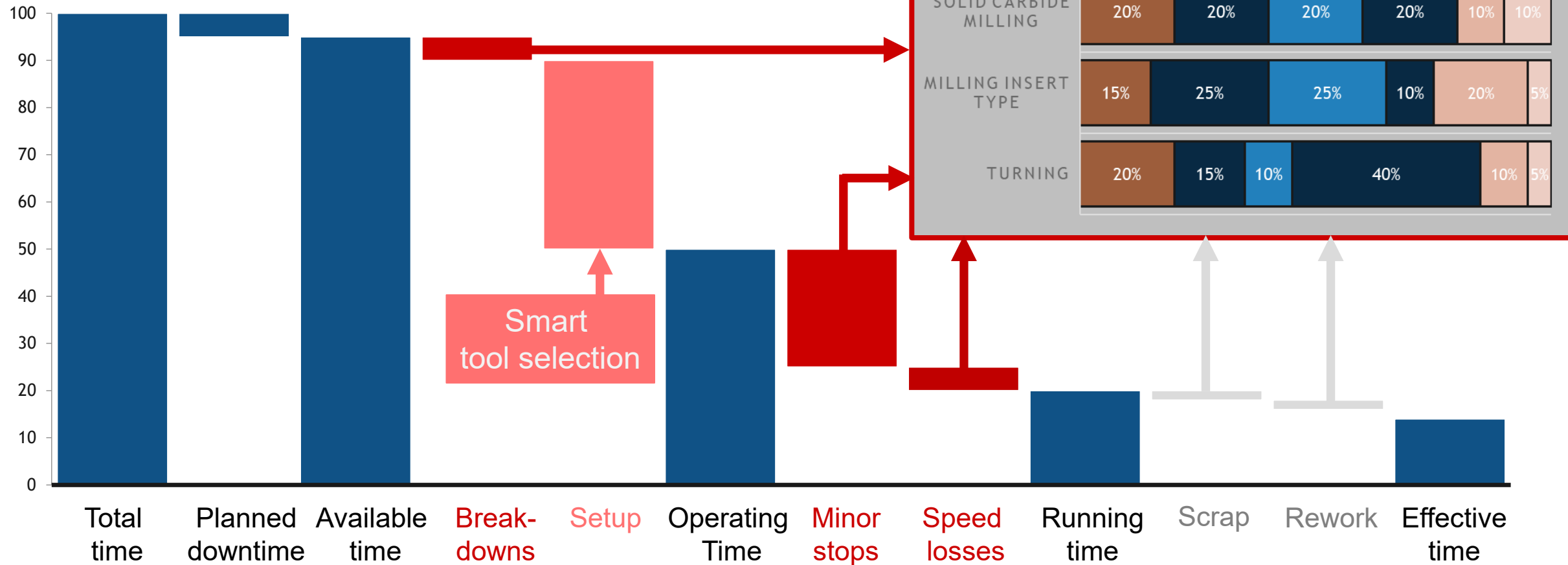


Machine is not optimized machining

- Not well selected tools
- Non-adapted or optimized strategies
- Unbalanced cutting data
- Out of scope cutting conditions

Production excellence

NEXT STEP defines a clear relation between machining technology and OEE.





Some reflections to start with



The elephant in the room

Who actually chooses your cutting tools?
You or your supplier's bonus plan?

- If your answer starts with a company logo instead of a person's name... we might have a small problem.
- Too many companies let their tool suppliers decide for them.
- Suppliers know their catalogues, not your workshop.
- It's time to take back control.

Tool selection



Why are you here?
What do you expect from this
workshop?



Production excellence

What do you think your biggest achievement is?

What do you think your people think their biggest achievement is?

What do you think your customers think your biggest achievement is?



Production excellence

What do you think your biggest problem is?

What do you think your people think the biggest problem is?

What do you think your customers think your biggest problem is?



Production excellence

Do you know how much time is lost
behind your CNC machines?
Do you know how much money is
wasted in your workshop?
Do you know how many workpieces
end up in the waste bin?



Production excellence

Do you know the impact of failing equipment on the mental health of your workshop people and the production engineers ?



Production excellence



Tool selection, from strategy to shop floor

Why tooling matters

- Tools cut metal. Without them, your machine is just an expensive sculpture of cast iron and servo motors. Yet the importance of tooling is often underestimated.
- Tooling represents just a few percentage points of production cost. Yet those few points influence everything else: machine utilisation, throughput, scrap rate, energy use, and ultimately competitiveness.
- Wrong tooling decisions multiply hidden costs: downtime, poor quality, missed deliveries, unhappy customers.
- Right tooling decisions create stability, accuracy, productivity, sustainability, and the breathing room to innovate.



The true role of tooling

- It is the interface between the machine and the material, the only point where all your investments in machines, CAM systems, training, and lean initiatives actually touch the workpiece.
- Yet too often, tooling is treated as a secondary purchase, measured by unit price rather than contribution. The result is predictable: underperforming processes, inconsistent quality, operator frustration, and missed opportunities for cost savings and sustainability improvements.

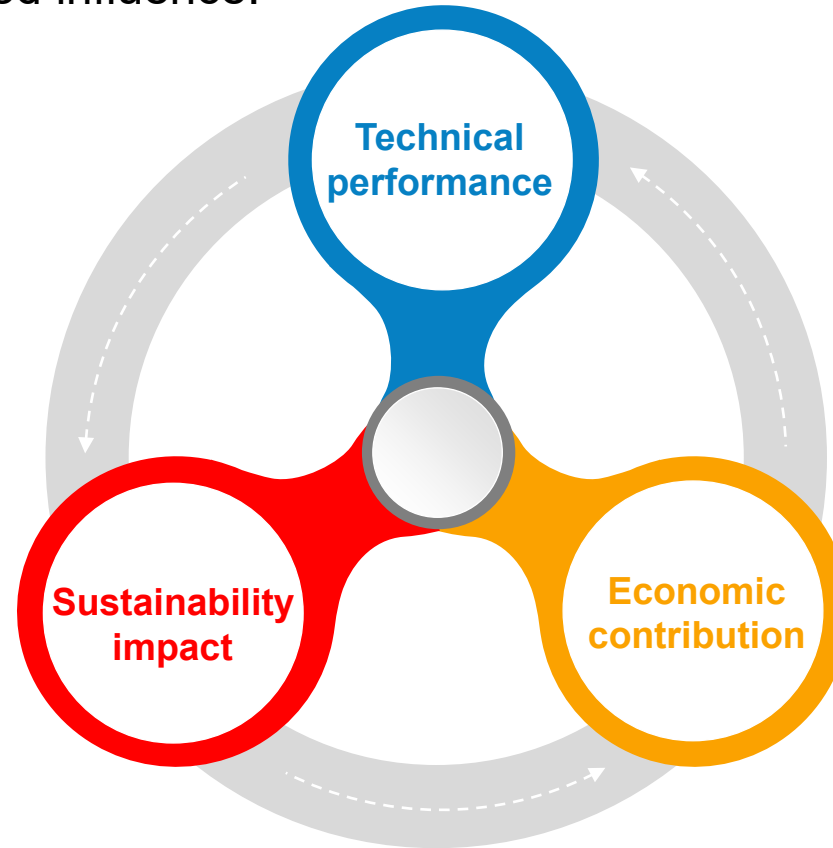


Common misconceptions

Misconception	Reality check
“Cheapest tool is best”	Purchase price is irrelevant without context. Cost performance – risk corrected – ratio is what matters.
“Operators decide everything”	Operators can make or break tool performance, but choices must be aligned with strategy and tactics.
“Suppliers know best”	Suppliers know their catalogue and price list. You must know your applications, production capabilities and capacity, and company targets.

The 3 dimensions of tooling

- The tooling multiplier effect.
 - The small cost with outsized influence.



- Cutting geometry, substrate, coating, and tool holding determine chip formation and evacuation, cutting forces, surface integrity, and tool life.
- A mismatched tool can transform a stable machining process into a chatter orchestra.
- Tools represent only 3–5% of production cost, but they influence the other 95%.
- A poorly chosen tool extends cycle time, drives up scrap rates, or demands extra finishing operations.
- A well-chosen tool unlocks faster machining strategies, longer unattended runs, and higher machine utilisation.

- Longer tool life means fewer resources consumed in tool production and less waste.
- Efficient cutting reduces energy per part.
- Stable processes reduce scrap, which is the single largest sustainability failure in machining.

The four perspectives

- **Management** has the thankless task of steering the ship while everyone else is rowing. Tooling might look like a small decision, but it has strategic consequences.
- The tactical view: **the engineers**. Where management sets the rules of the game, engineers decide how to play. They are the bridge between strategy and shopfloor reality.
- The practical view: **the operators**. Operators are where theory meets reality. They don't just press cycle start; they make or break tool performance.
- **Circular feedback** loop for continuous improvement. Tooling decisions are not isolated, they form a system: management → engineers → operators → feedback → management.



The stakes

- Wrong tool decisions → higher cost, missed delivery ...
- Right tool decisions → stable, profitable production ... happy customers
- Tooling as a competitive advantage



Economic ripple effect of tooling

The economic case is overwhelming: tool selection is not a technical curiosity; it's a profit driver.

Factor	Poor tool selection	Smart tool selection
Cycle time	15% longer	10% shorter
Scrap rate	8%	2%
Tool indexing	Frequent, unplanned	Predictable, scheduled
Downtime cost	€120,000/year (emergencies)	€40,000/year (scheduled changes)
Cost per part	+12% higher	-9% lower

Tool selection for management

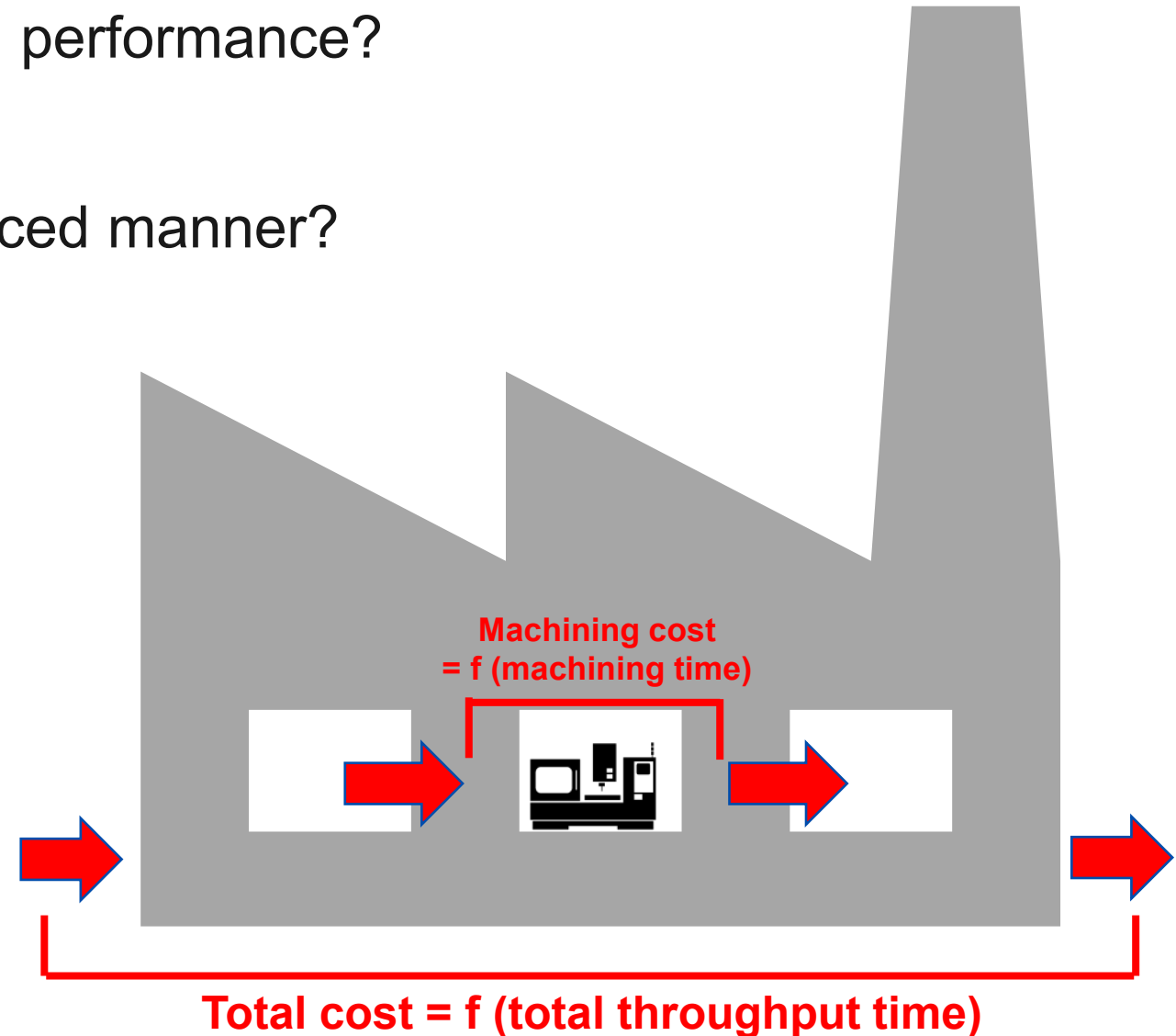


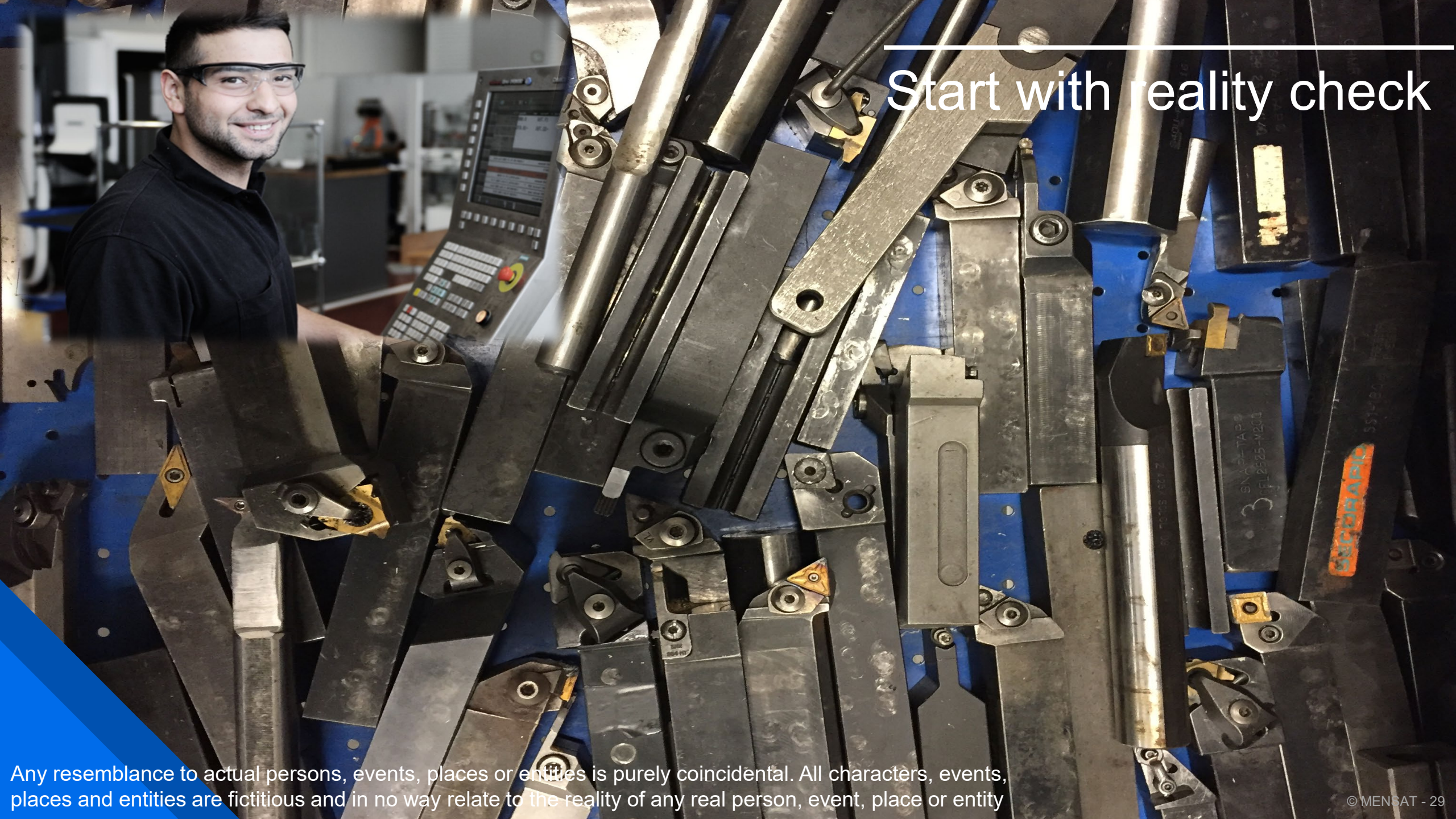
Defining the right tool selection policy is a strategic decision that begins and culminates at the highest levels of company management.



Management tasks

- How to improve the company's overall performance?
- What are the key factors?
- Is production capacity used in a balanced manner?
- What could release extra capacity?
- Is correct technology being used?
- Do people have correct knowledge, skills and mindset?





Start with reality check

Any resemblance to actual persons, events, places or entities is purely coincidental. All characters, events, places and entities are fictitious and in no way relate to the reality of any real person, event, place or entity

Tools as management supposes they are



Tools as they are mostly observed in the workshop

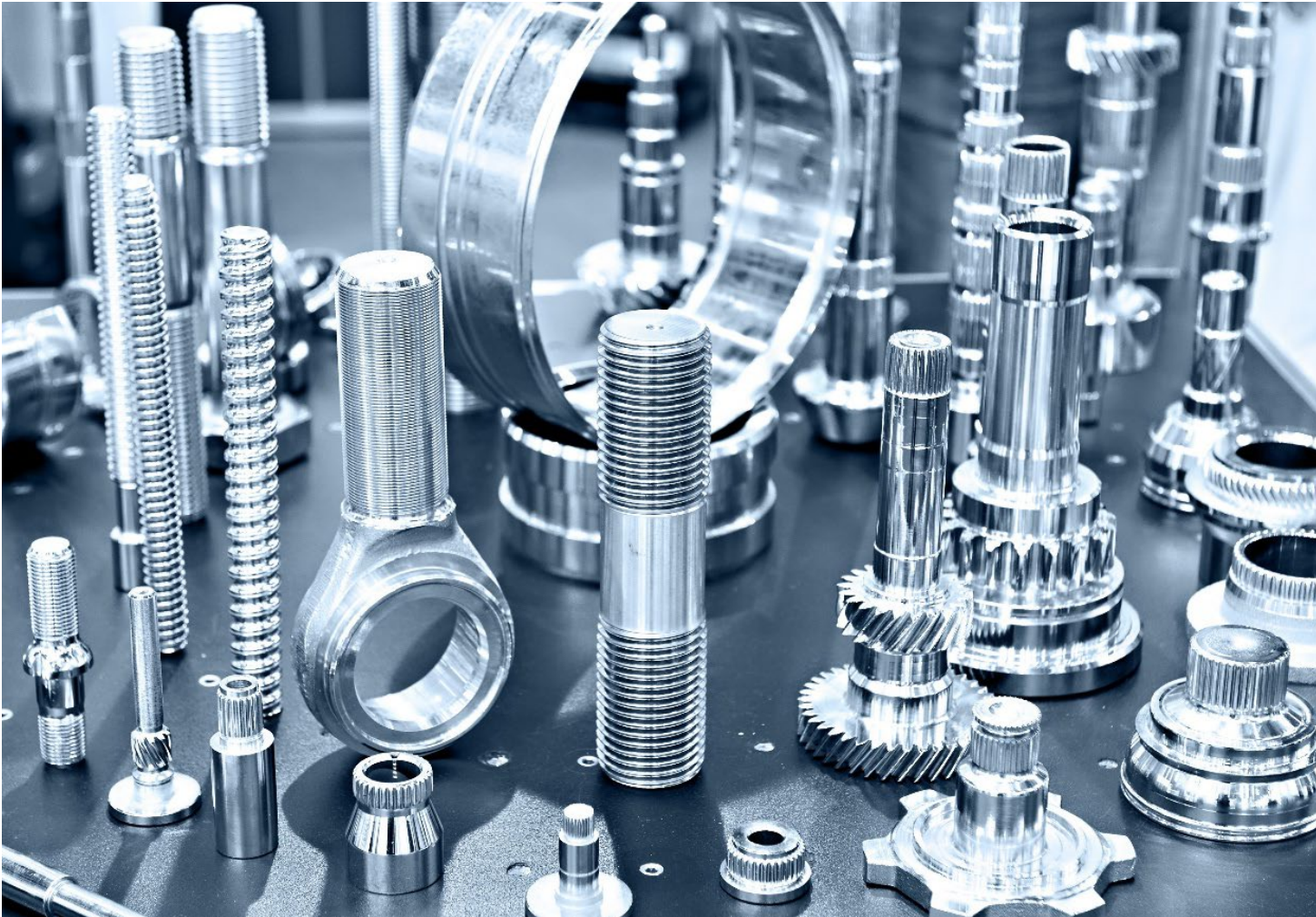


Management's role

- Translate company KPI's in a general tooling policy
- Define specific tooling policies
 - Disposable vs reconditioning
 - Standard vs modular
 - Short-term vs lifecycle cost
 - ...
- Allocate operational budgets and set investment priorities
- Select and negotiate with strategic partners and key suppliers



Global company KPIs



Production economy
(cost, time ...)

Time Efficiency
(productivity)

Quality
(product - process)

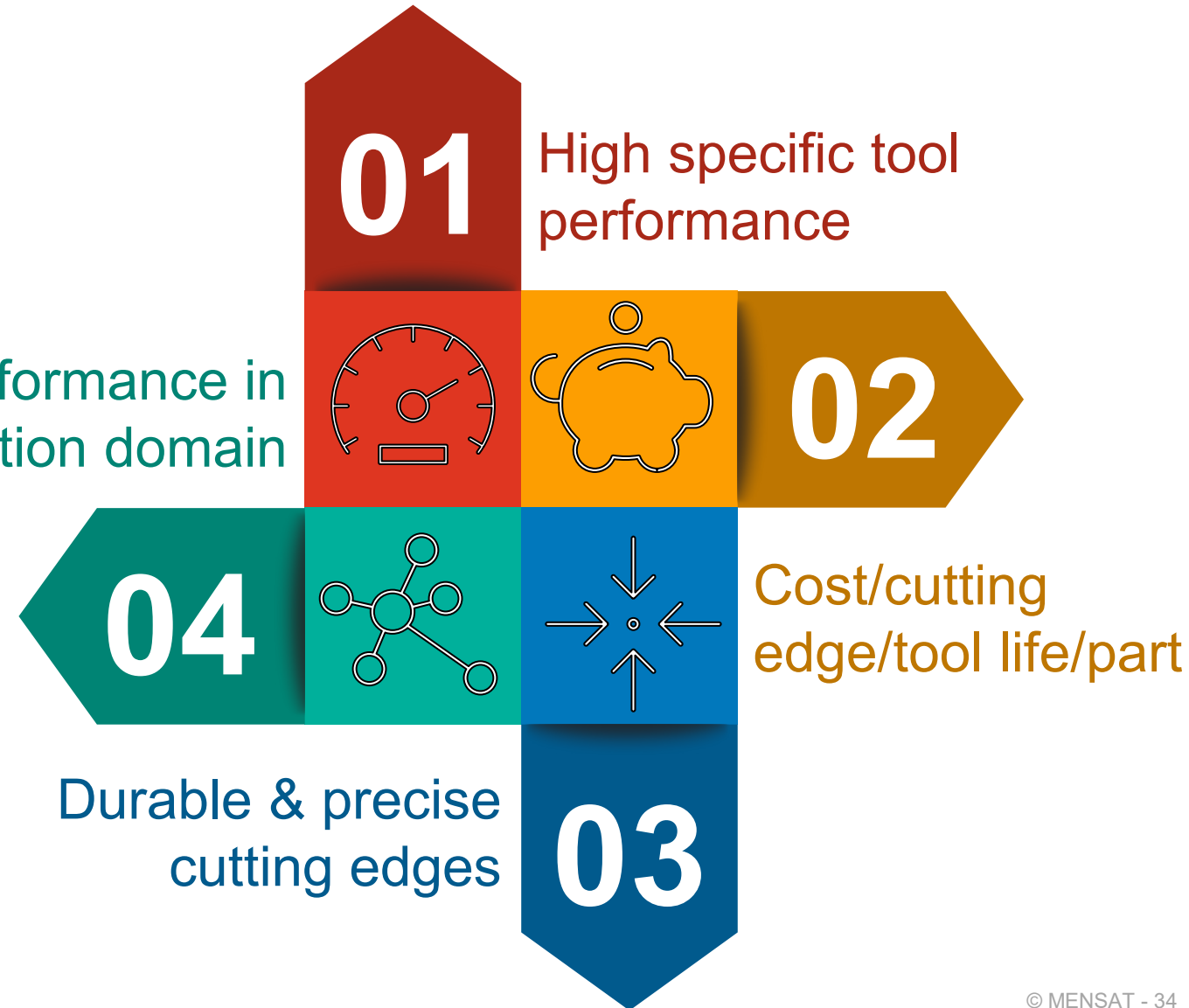
Total output/turnover
(First Time Yield)

Global sustainability

Tool selection in sync with company KPI

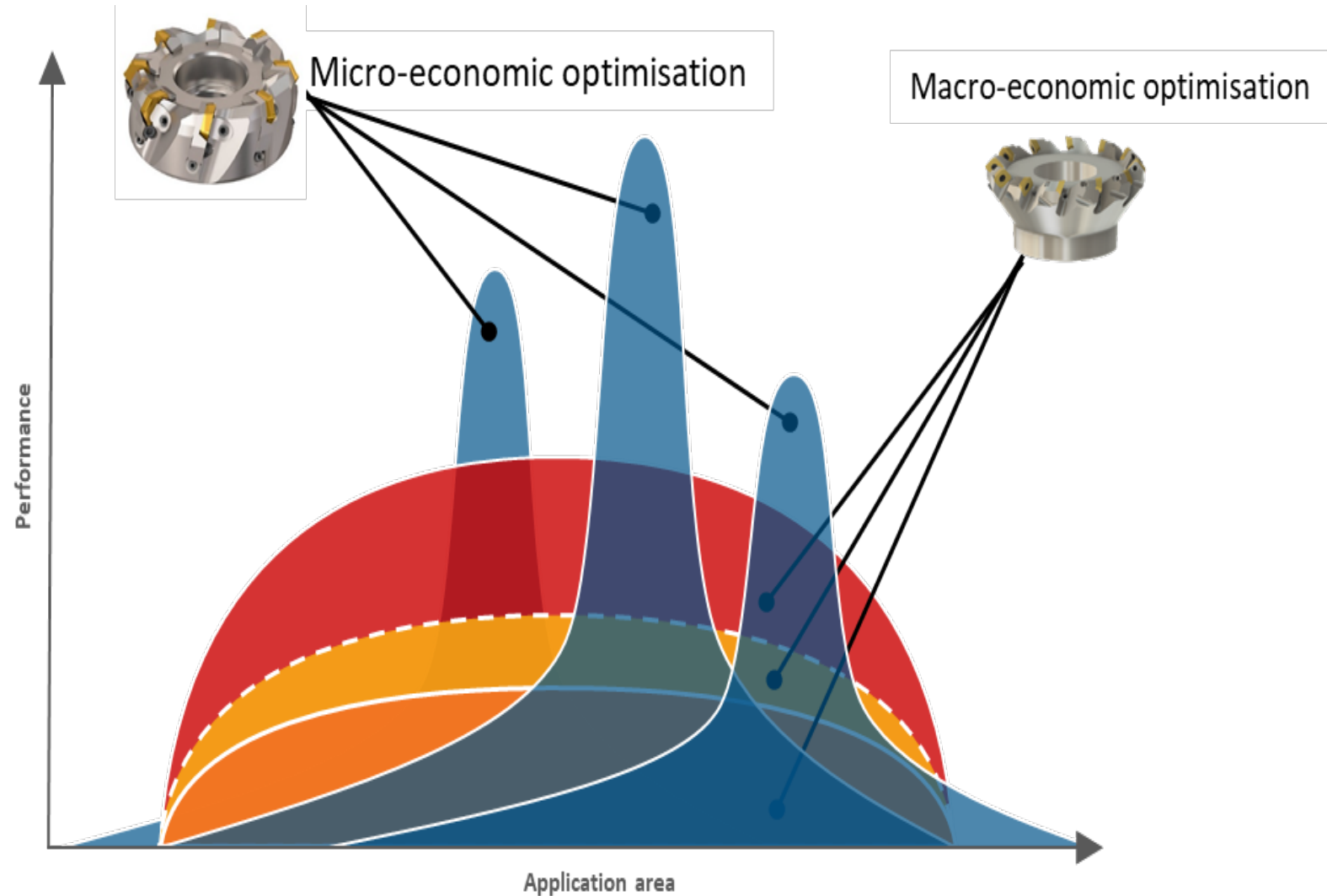
1. Productivity (time efficient)
2. Economy (cost efficiency, profit)
3. Quality of output
4. Flexibility & versatility
5. Sustainability & circularity

Tool performance in
broad application domain



Tool selection as function of company KPI

Productivity & economy versus flexibility & versatility



Strategic risks

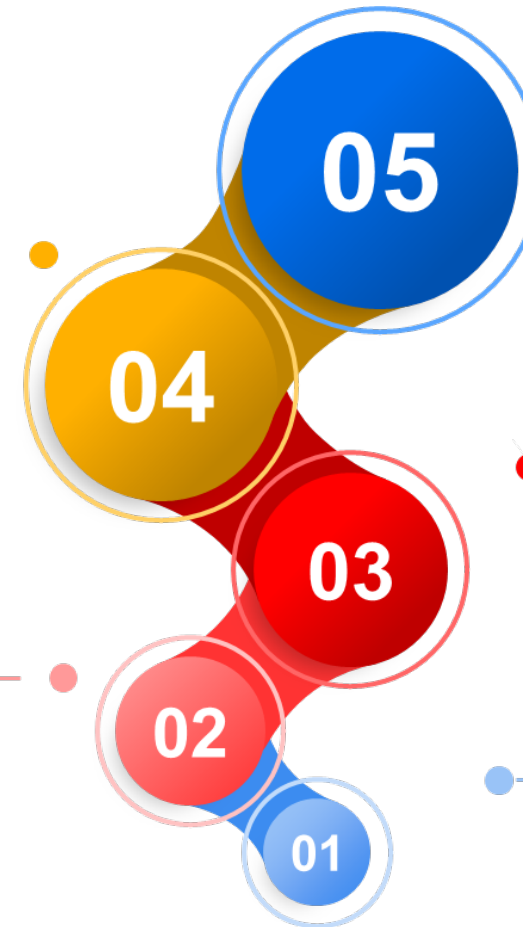
- Supply chain dependence
- Supplier & tool obsolescence
- Hidden costs of “cheap” tools

Competitive

Customer and market drivers.

Reputational

Industry and customer perception and employee engagement.



Governance

Planning, control and monitoring.

Financial

Revenue generation and cost control.

Operational

Inefficiency and waste identification.

Supplier relationships

- Vendor vs partner vs strategic ally
 - Vendor: transactional, price-focused.
 - Partner: shares knowledge, provides training, aligns with your needs.
 - Strategic ally: joint projects, long-term planning.
- Knowledge transfer and joint projects
- Long-term value creation for all parties



Procurement pitfalls

- Focusing only on price
- Ignoring delivery time, on-time-delivery (OTD), delivery of content quality
- Ignoring or neglecting engineering input
- No plan B
- Short-term savings, long-term losses



The CFO's view

- Tooling as asset vs expense
- Procurement savings versus operational efficiency
- Balance sheet impact of smarter policies



Strategic questions

- Are we buying the cheapest or the smartest?
- How resilient is our tooling supply chain?
- Are we tracking total lifecycle cost?

- Collect tool performance feedback
- Use feedback for better sourcing and negotiation
- Education or training needed?



Takeaway for management

- Tools = strategic levers, not consumables
- Policies shape competitiveness
- Strategy is set, now engineers must make it real.





Tool selection for engineers

Engineers' role

- If management sets the rules of the game, engineers decide how to play. They are the bridge between strategy and shopfloor reality.
- Select tooling for specific applications
- Define machining strategies & conditions
- Define machining data windows
- Productivity & cost & quality
- Sustainability & circularity
- Variability and versatility



The framework for tool selection



1

Technological factors: machine, workpiece, clamping, material ...

2

Quality factors: dimensions, geometry, surface finish and integrity ...

3

Economic factors: costs, productivity, reliability, sustainability ...

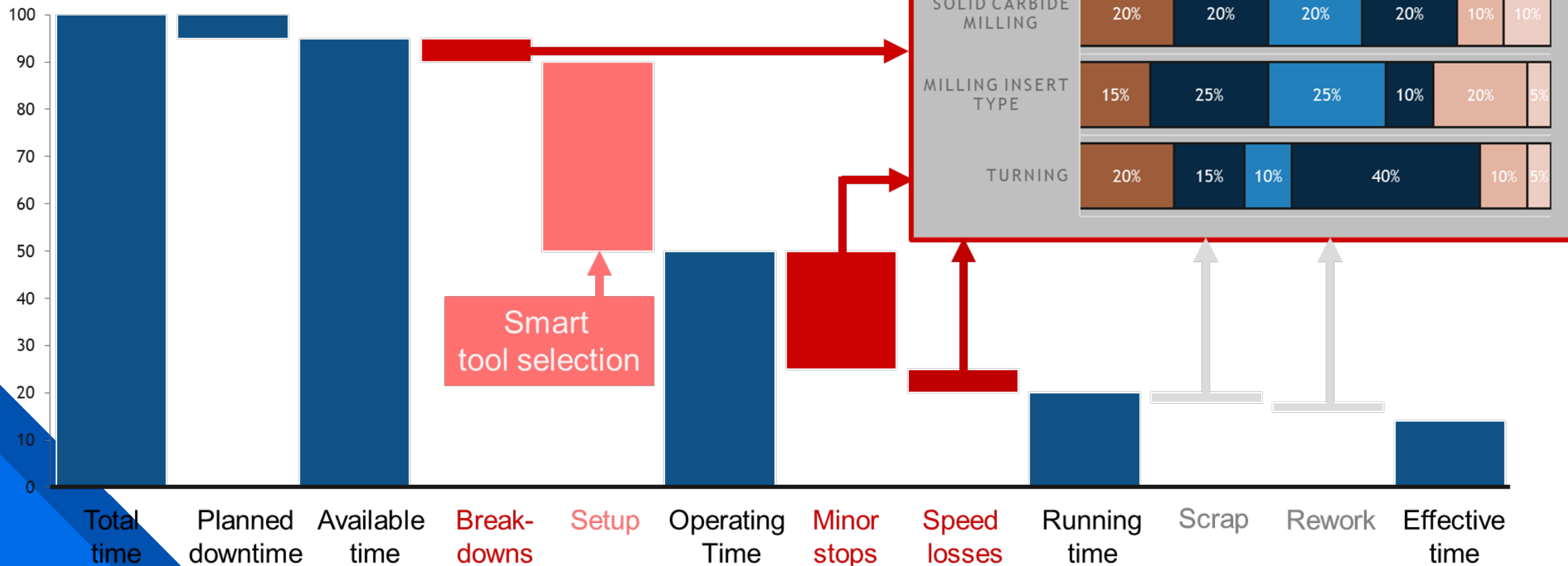
The elements in tool selection

- The machine spindle connection: type and dimensions
- The toolholding system
 - Front end type
 - Modular or monoblock (quickchange)
- The tool holder type
 - Solid system
 - Insert system
- Cutting edge features
- Operation
- Cutting conditions and environment
- Machining strategy
- Cutting data
- Overall targets

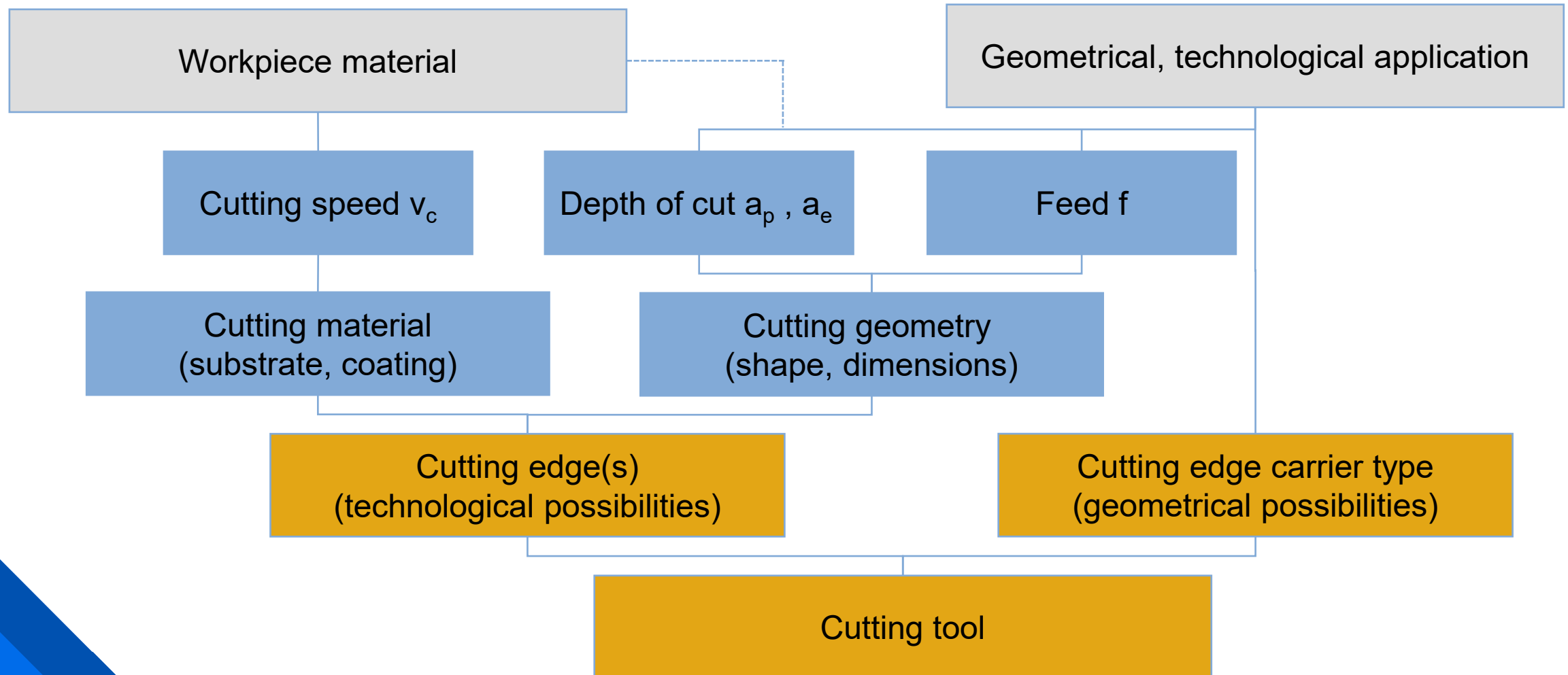


Tool selection for production excellence

The sustainable, continuous improvement of operations and processes to gain competitive advantages like reduced costs, increased productivity, increased profits ...



Cutting tool elements and features



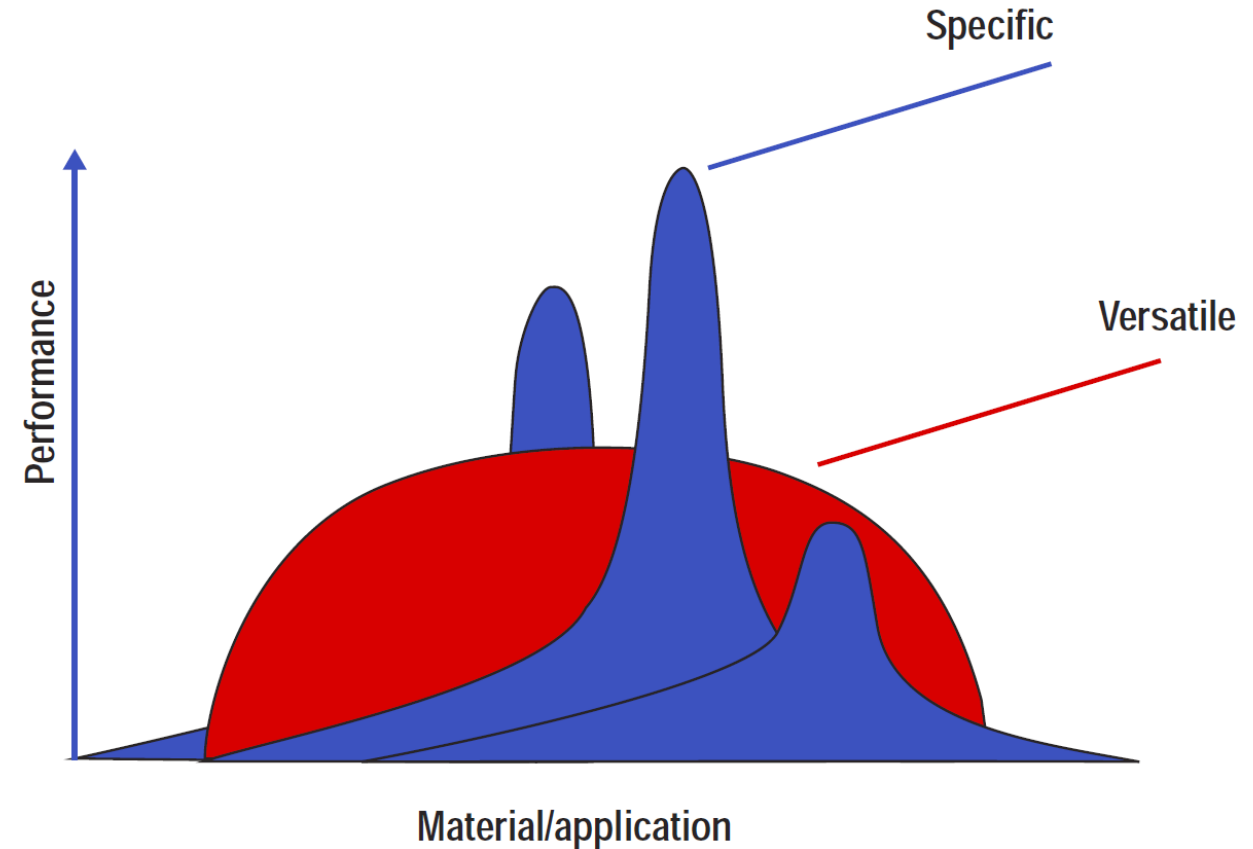
Cutting tool selection questions

- Which cutting edge carrier?
 - Shank dimensions.
 - Solid cutting edge or which insert clamping method.
 - Basic shape and dimensions of insert.
 - Macro cutting geometry.
- Which cutting edge (insert system)?
 - Basic shape and geometry.
 - Cutting point geometry.
 - Cutting edge geometry and chip-breaking geometry.
 - Dimensions.
 - Cutting material
- Cutting tool = carrier + cutting edge
- How to use it? (cutting conditions)
 - Cutting data, other factors (coolant, ...).



Cutting tool selection, best choice

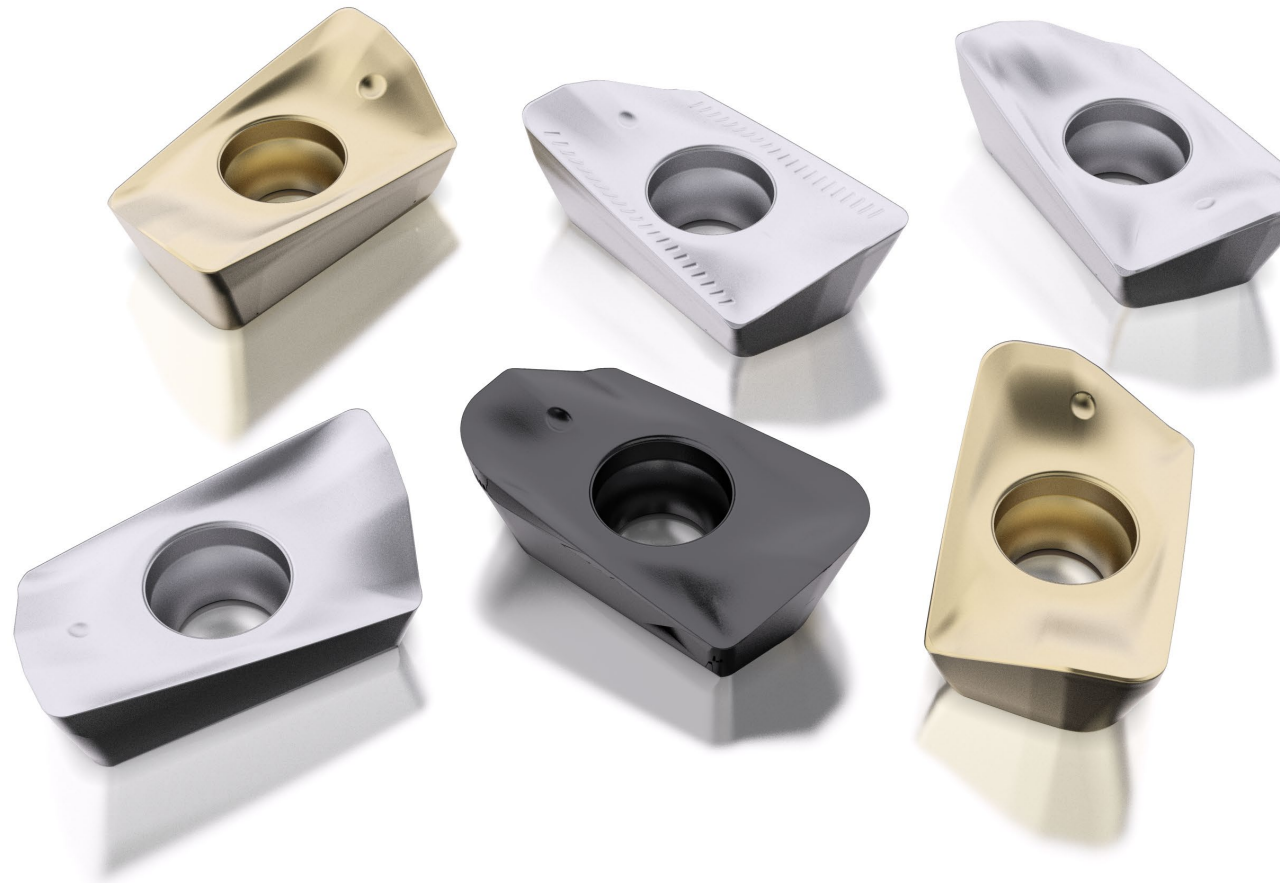
- Cutting edge carrier, best choice
 - As universal as possible.
 - Reliable and sustainable.
 - As small an cutting edge (insert) as possible.
 - Application suitability.
- Correct cutting edge
 - As universal as possible.
 - Reliable and sustainable.
 - As small as possible (cost effective).
 - Application optimised.
- Best tool is correct edge carrier together with a correct edge, used in a correct manner.



- Compromises will often be necessary.
Cutting conditions are balancing elements?
What's important in the application?

Indexable inserts, best choice

- Basic shape and dimensions
 - Tolerances
 - Number of cutting edges
 - Cutting edge geometry
 - Cutting edge length
 - Point geometry
 - Point dimensions
 - Chip breaking geometry
 - Cutting material
-
- Cutting edge: strength or sharpness
 - Application: specific or multipurpose





Solid tools, reconditioning

- Significant savings on tooling costs by reusing the solid carbide tool. At the same time reducing impact on our environment.
- From used to “new” in one easy process.
- Solid tools reconditioned, best is using the original equipment, CNC grinding programs, treatments and coatings.
- Guaranteed high & process secure performance.
- When the quality of the workpiece surface decreases.
- When workpiece accuracy is not achieved.
- When large burrs appear on the edge of the workpiece.
- When unusual noise and smoke appear.
- When cutting power level increases.

Consequences of wrong decisions

- Downtime, scrap, missed delivery
- Frustrated operators
- Disappointed management
- Disappointed customers
- Reputation damage



Feedback from operators

- Engineers must capture shopfloor data and information
- Motivate operators to give feedback
- Listen to feedback and suggestions of the operators
- Translate and send to management
- Reward feedback
- Use to refine tactics



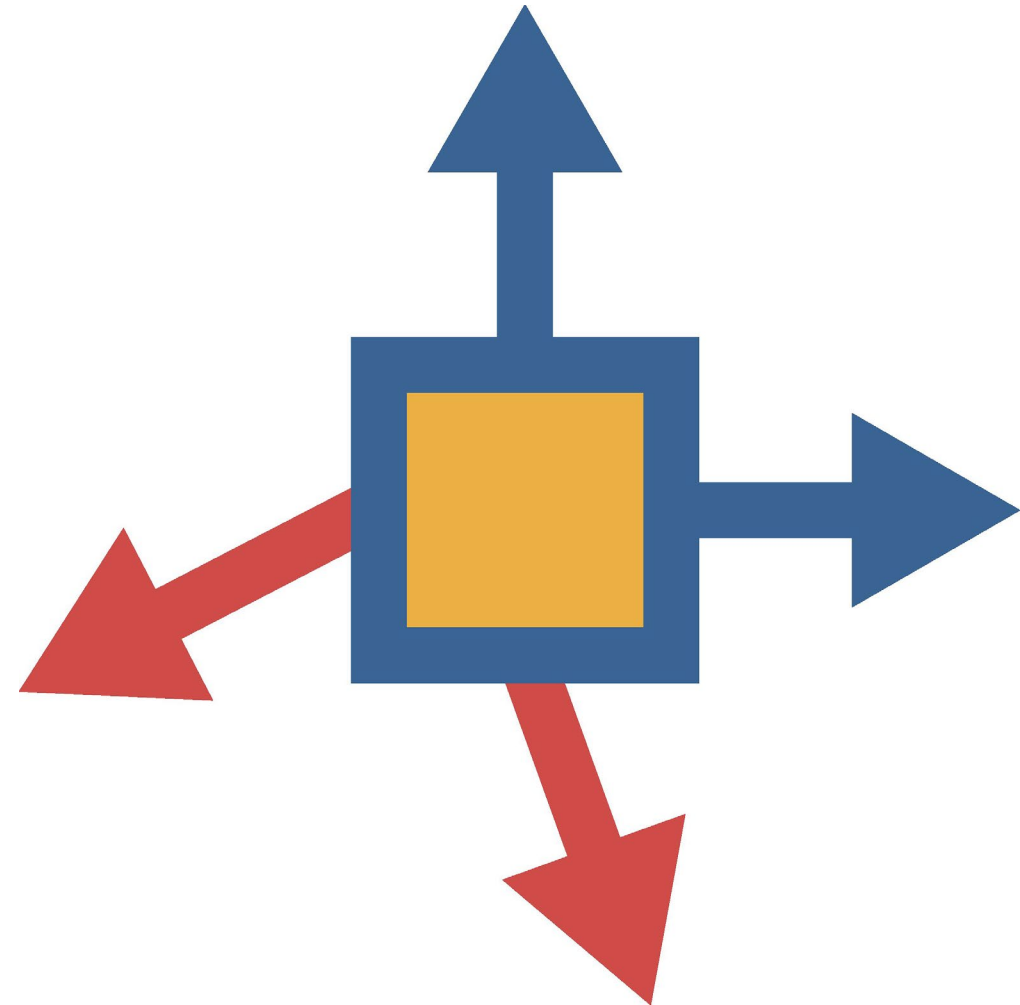
Engineers' pitfalls

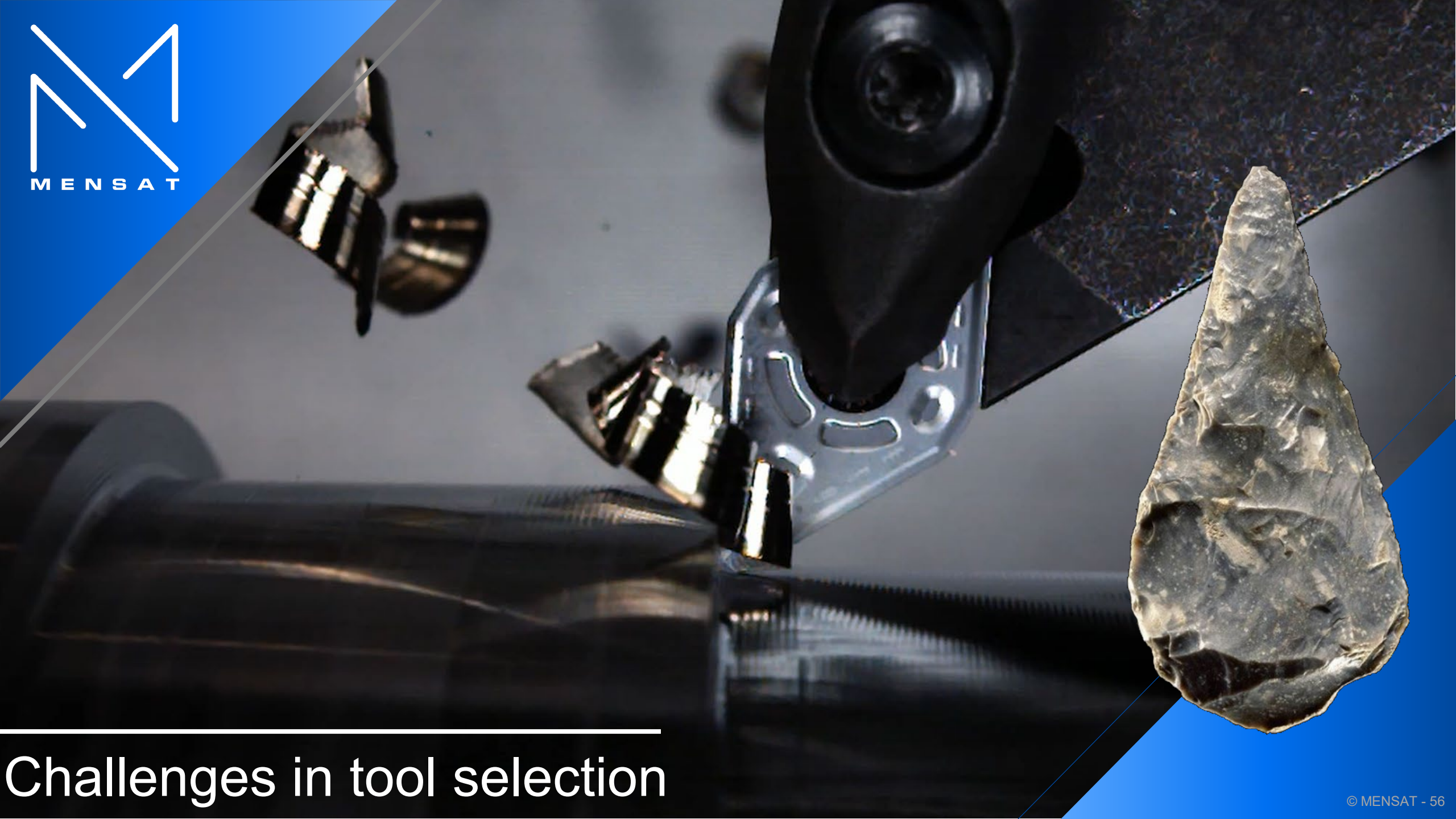
- Overengineering (just to prove it can be done)
- Ignoring operators' input
- Chasing the wrong KPI's



Takeaways for engineers

- The best tool is not the fastest or the cheapest, but the one that creates the most stable, sustainable, and profitable process.
- Engineering choices decide tactical success.

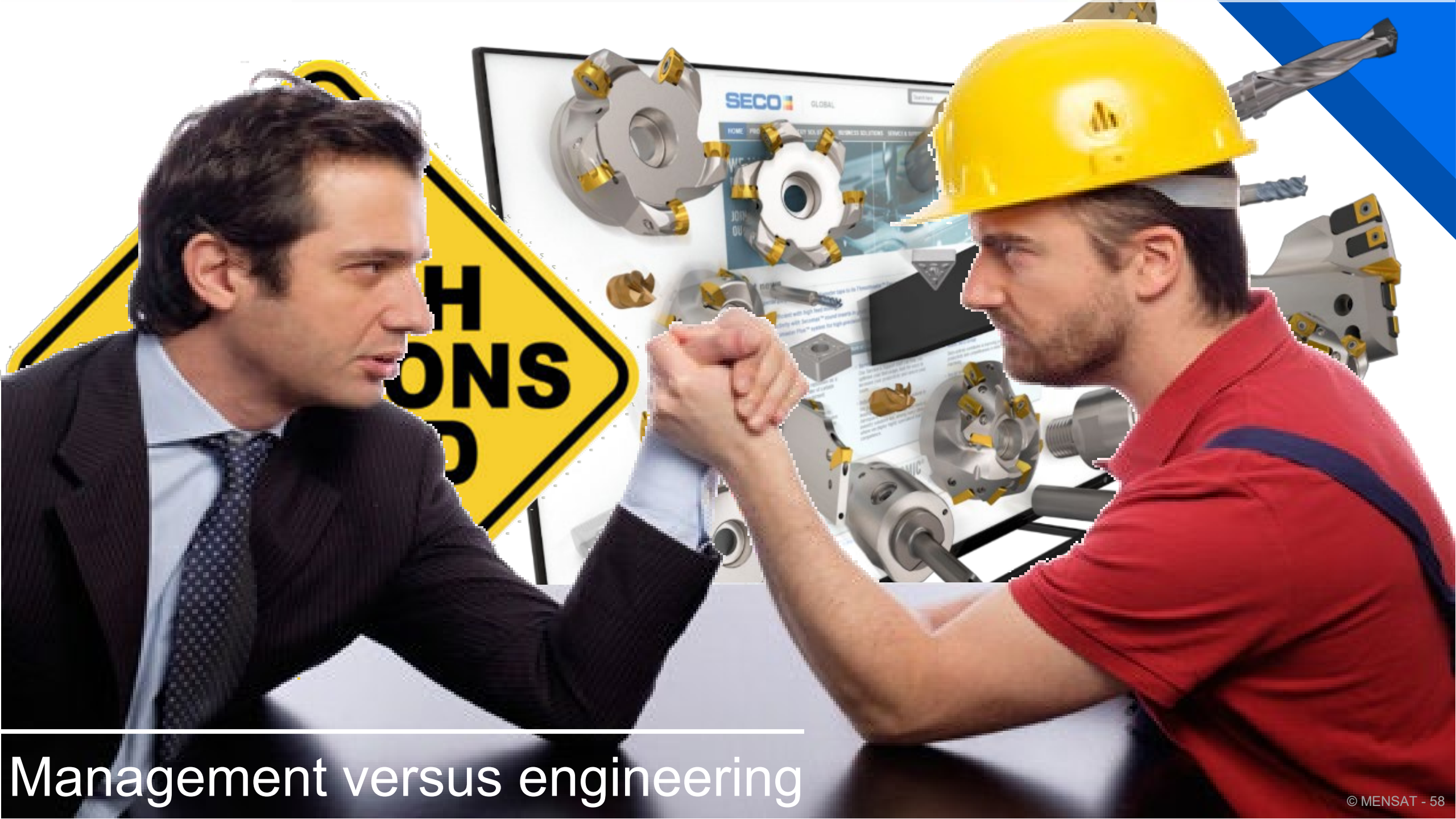




Challenges in tool selection



The challenges in tool selection



Management versus engineering

Selecting a cutting tool is not just a technical decision but one that impacts cost-efficiency and sustainability. A modern machinist must navigate these challenges carefully to ensure optimal production outcomes while minimizing environmental impact and maintaining economic viability.



The challenges in tool selection

- Material compatibility
- Tool life, length and stability
- Cutting conditions and machining parameters
- Cost versus performance trade-offs
- Availability and supply chain considerations



The challenges in tool selection



Different workpiece materials require specific cutting tools with appropriate features. The machinist must consider the hardness, toughness, and thermal properties of both the tool and the material being cut.

Technical challenge



Using a tool not optimised for the material can lead to faster wear, tool breakage, and higher costs due to frequent tool changes or poor surface finishes, impacting production efficiency.

Economic impact



Incorrect tool selection may result in excessive material waste, increased energy consumption due to inefficient cutting, and a higher carbon footprint from the need for additional resources and energy.

Sustainability aspect

Material compatibility



Predicting tool wear and managing tool life is crucial for maintaining consistent quality and avoiding unexpected downtime. Factors like cutting speed, feed, and depth of cut influence how long a tool can be used effectively.

Technical challenge



Short tool life increases costs due to frequent tool indexing and machine downtime. Investing in tools with longer tool life may have a higher upfront cost but could reduce overall operational costs.

Economic impact



Longer-lasting tools reduce the frequency of indexing, leading to less waste and lower resource consumption, contributing positively to environmental sustainability.

Sustainability aspect

Tool life, length and stability



The machinist must optimise cutting conditions based on the selected tool, material, and desired outcome (e.g., surface finish, dimensional accuracy). This requires balancing performance and tool life.

Technical challenge



Incorrect data can lead to suboptimal tool performance, resulting in increased cycle times, higher energy consumption, and greater wear, all of which increase costs.

Economic impact



Optimised cutting conditions reduce energy consumption and extend tool life, which helps minimize waste and improve the overall efficiency of the machining process.

Sustainability aspect

Cutting conditions and machining parameters



High-performance tools often come with a higher price tag, but they can deliver better results in terms of speed, quality, and tool life. The machinist must assess whether the performance benefits justify the cost.

Technical challenge



Investing in high-performance tools can reduce overall production costs by decreasing cycle times and improving efficiency, but the initial investment must be weighed against the expected return.

Economic impact



Choosing the right balance between cost and performance can lead to more efficient use of resources, reducing waste and the environmental impact of machining operations.

Sustainability aspect

Cost versus performance trade-offs



The tool crib engineer must ensure that the selected tool is readily available when needed. Delays in the supply chain can halt production, particularly when using specialised or custom made tools.

Technical challenge



Supply chain disruptions can lead to costly downtime, rush orders, and potential quality issues if substitutes are used without proper testing.

Economic impact



Local sourcing and efficient logistics reduce the carbon footprint associated with transporting tools, and predictable supply chains reduce the need for excess inventory, which can lead to waste.

Sustainability aspect

Availability and supply chain considerations



Effective tool utilisation for operators

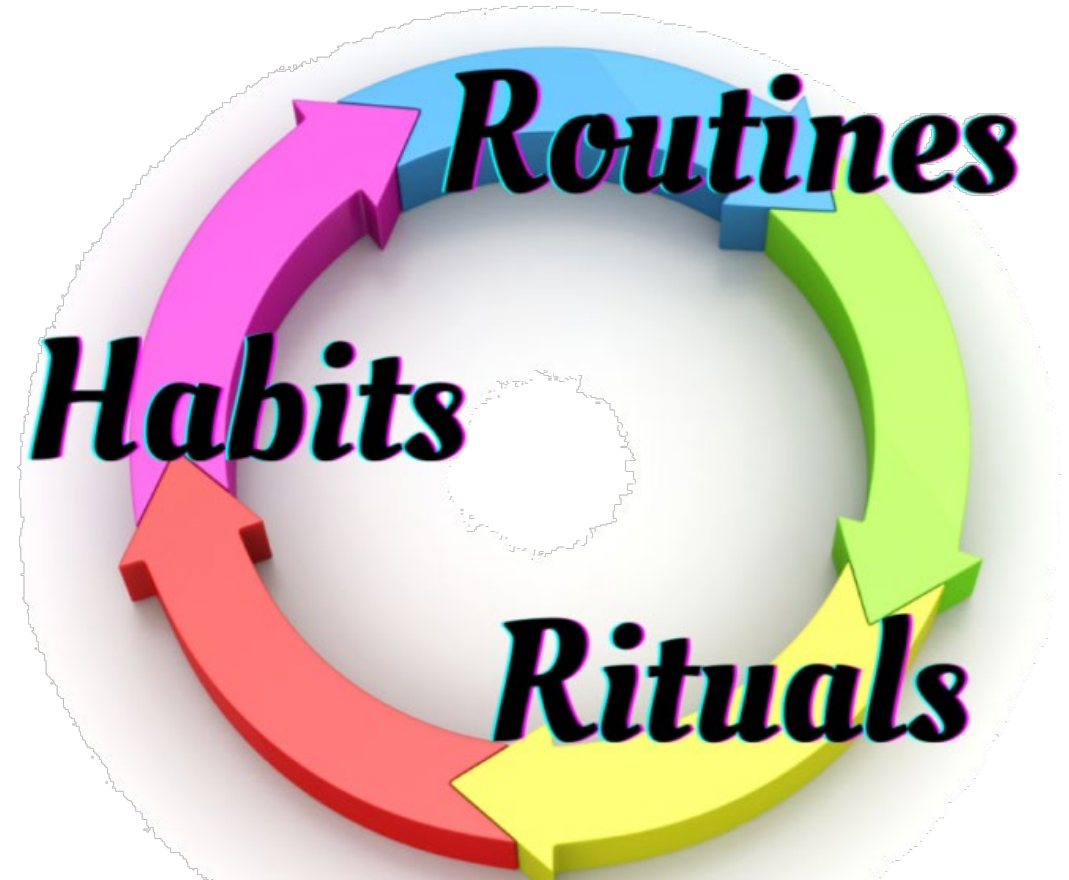
Operators' key roles

- Operators are where theory meets reality. They don't just press cycle start; they make or break process & tool performance.
- Operator's role
 - Correct tool setup and handling.
 - Monitoring tool wear and process stability.
 - Giving feedback to engineers and management.



Daily habits that matter

- Correct tool mounting and handling
- Tool indexing and manipulation
- Cleaning and local storage
- Correct error handling
 - Dropped tools = microfractures
 - Dirty holders = runout
 - Wrong clamping = breakage & premature wear



Process monitoring

- Observe the process closely
 - Listen: cutting sounds reveal tool health.
 - Look: chip colour and shape show heat and wear.
 - Feel: vibration signals instability.
- Spot equipment issues: coolant, chip conveyor ...
- Operators influence on tool life
 - 10–20% tool life variance = operator handling
 - Training and care pay off



Feedback loop

- Report wear patterns, chip problems, breakages
- Helps engineers optimise tactics
- Energy awareness
 - Avoid idle spindle running
 - Shut down unnecessary systems



Operator pitfalls

- “It’s not my problem” mindset
 - Ignoring small tool issues until failure
 - Misusing cutting data
-
- No feedback
 - No team attitude
 - No pro-active attitude to junior colleagues



Takeaway for operators

- Tools work best when cared for and monitored
- Operators are the frontline of tool performance

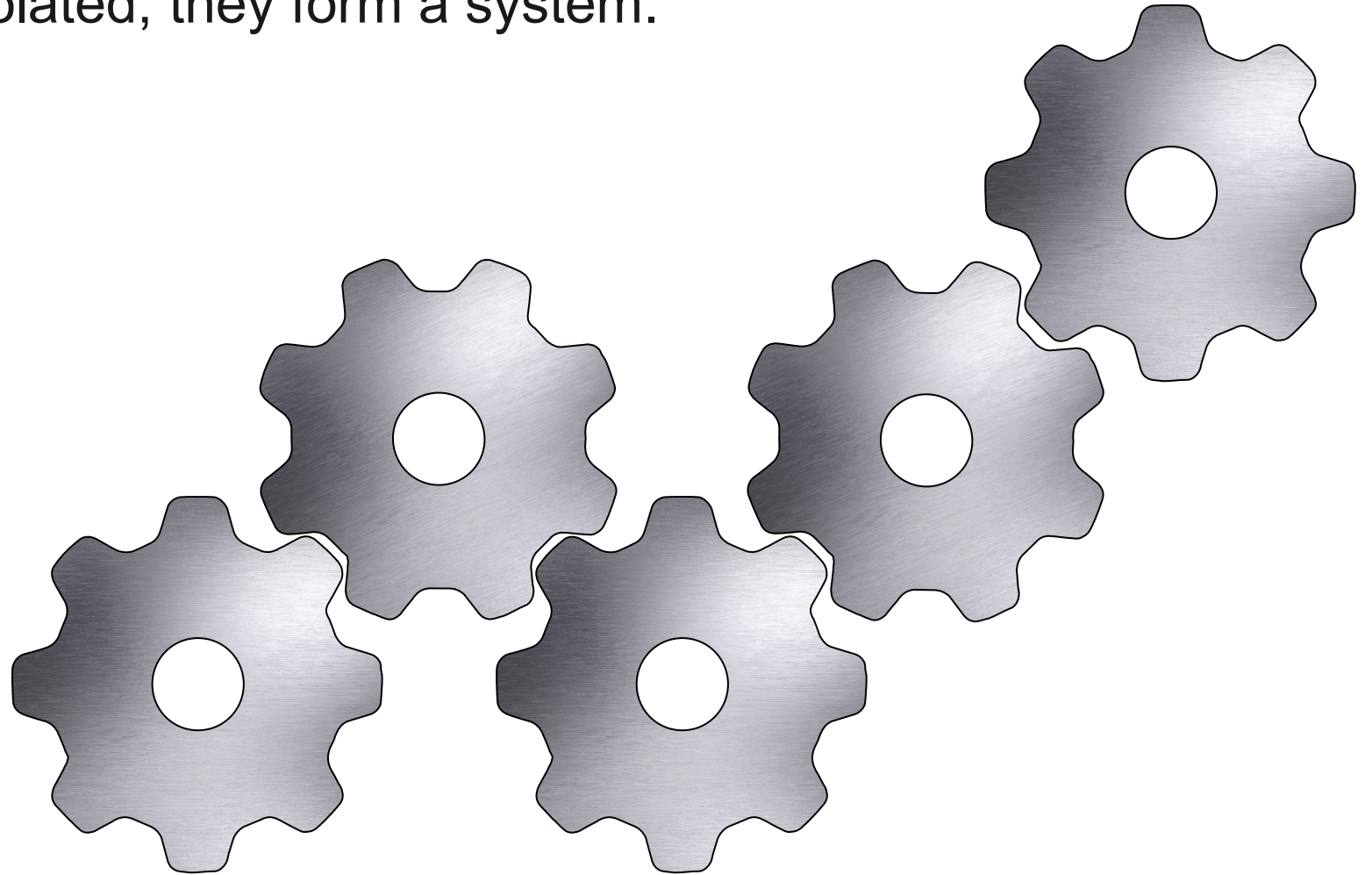




Closing the loop, tooling as a system

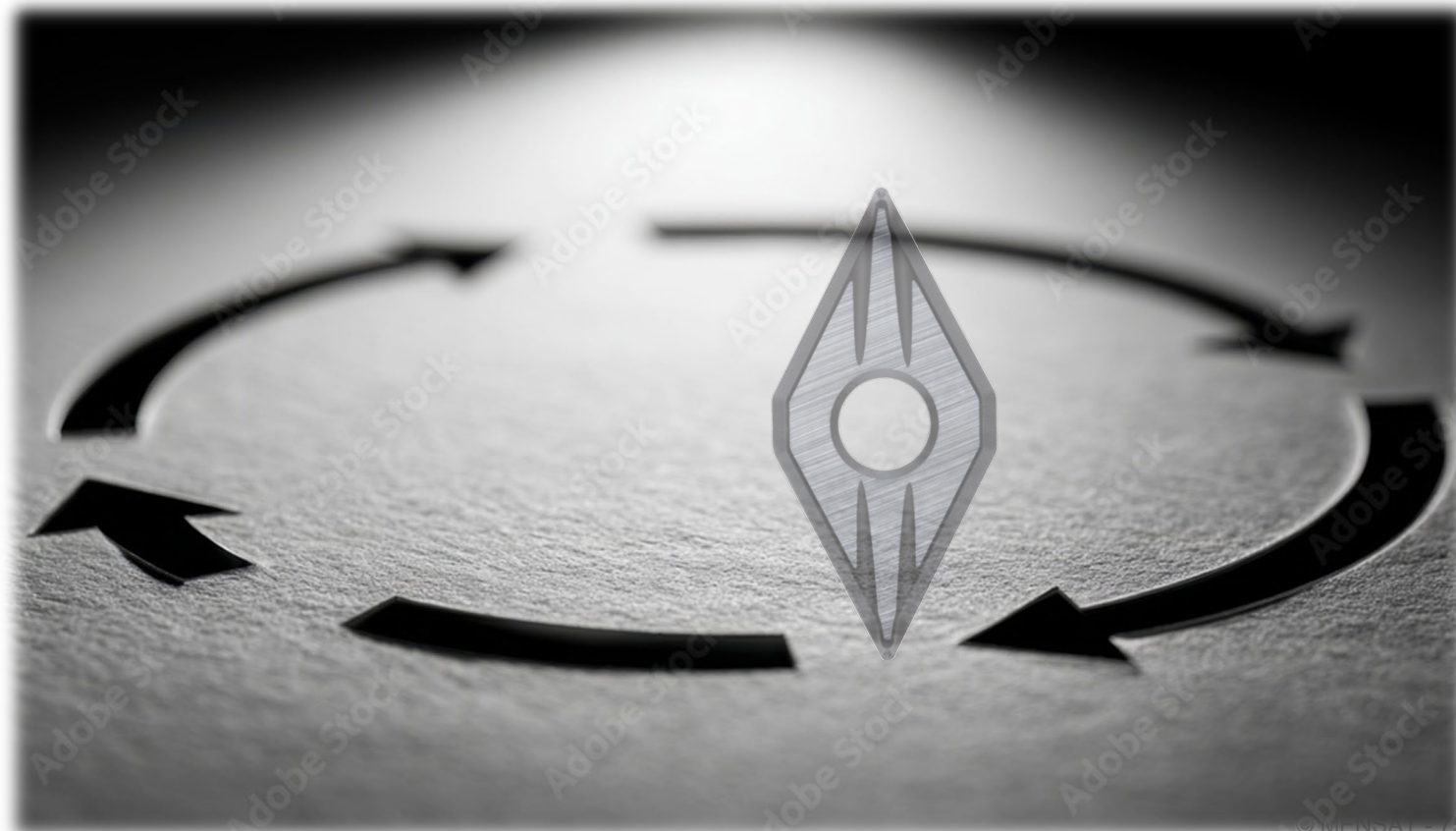
The system view

- Tooling decisions are not isolated, they form a system.
- Management sets policy
- Engineers design tactics
- Operators execute
- Feedback closes the loop



Building the loop

- Communication across all roles
- Shared KPI's, metrics and goals
- Blame-free culture that values input
- Why the loop breaks
 - Management ignores feedback
 - Engineers ignore operators
 - Operators feel ignored, so they stop reporting
- Channels
 - Regular tool performance reviews
 - Simple reporting formats



Cultural & human aspects

- Remember: tools don't run themselves. People matter. Respecting the role of each player is the fastest route to stable, competitive machining.
- Blame-free communication
- Recognising operator input
- People make or break tooling success
- Engagement = better performance



Takeaway

Tooling success is a team sport.



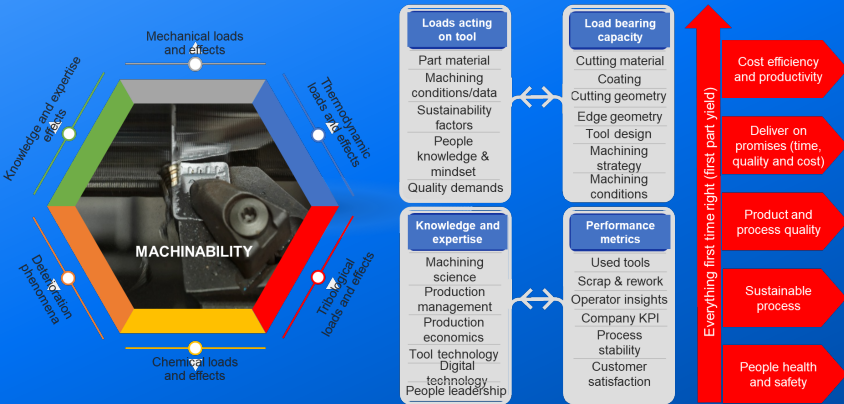
Conclusions and summary



Neglecting tool performance after purchase is like obsessing over fuel efficiency when buying a car, only to floor the gas pedal once you drive off the lot — both waste resources, money, and ultimately, efficiency.



Recap of key elements



Machining process model

1

2

Tool selection in sync with company KPI's

Tool performance in broad application domain

01

High specific tool performance



02

Cost/cutting edge/tool life/part

04



Sustainable/precise cutting edges

03



Selection challenges

4

3

Technical features



Four pillars & perspectives

Management
= strategy

Engineers
= tactics

Operators
= execution

Closed-loop =
improvement

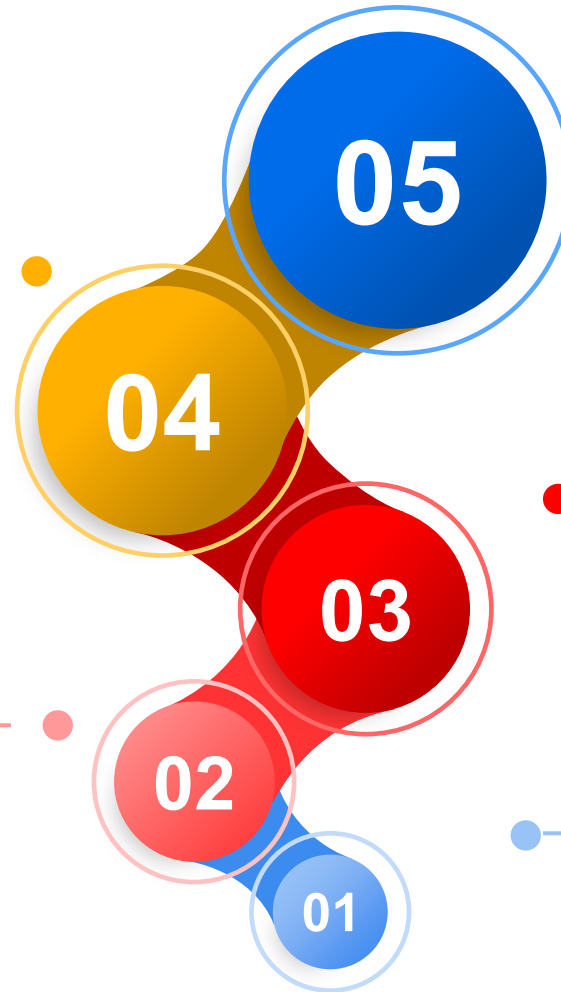


Tool features.

Fill in the technical details for the tools.

Prioritize company KPI's.

What is most important? Mission and vision? Role of tooling?



Cutting data

Cutting conditions must tie everything up in the best possible manner.

Technical KPI's of the tools.

Define so they are in sync with the prioritized company KPI's.

What are the company KPI's?

How do we expect tooling to contribute?

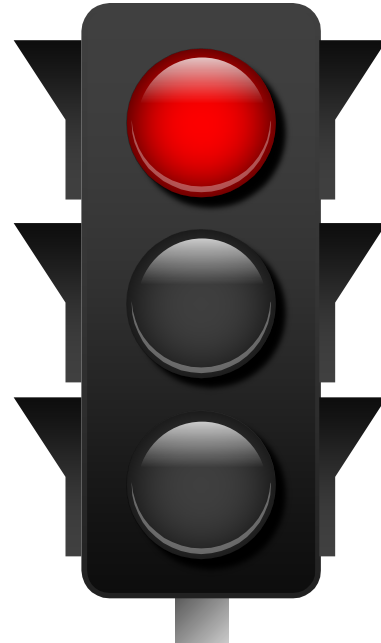
Tool selection, the 5 steps

Key messages

- Tools are not consumables; they are strategic assets
- Wrong choices → high hidden costs
- Correct choices → process stability and competitiveness



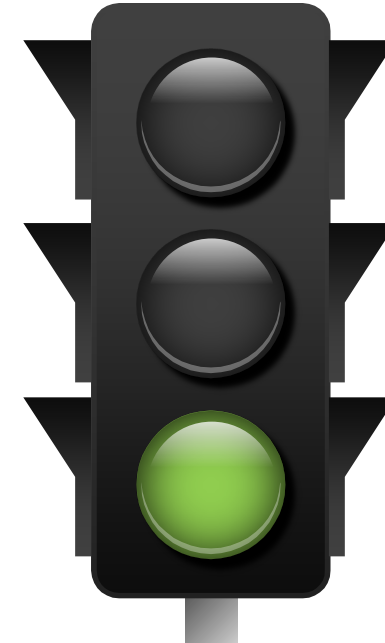
Strategic alignment - what to do tomorrow



Risky practice and consequence

Buying on lowest price → higher total cost,
unstable process.

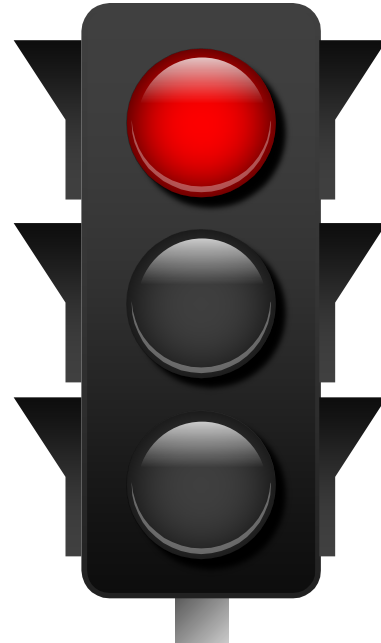
Random tool choices → conflicting results.
'Looks good on paper' → disappointment in
production.



Good practice

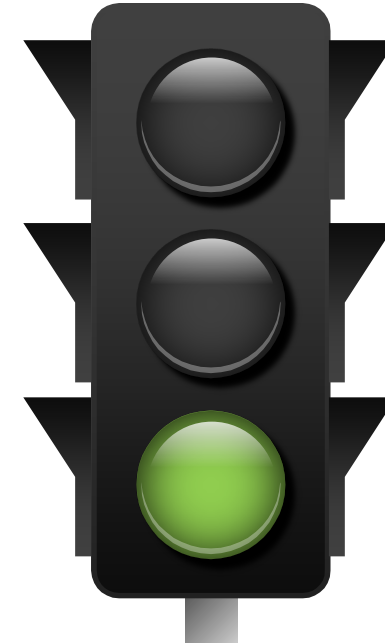
Select tools based on total cost per part, not price.
Align tooling strategy with company objectives.
Use data to validate performance, not opinions.

Management, leadership focus - what to do tomorrow



Risky practice and consequence

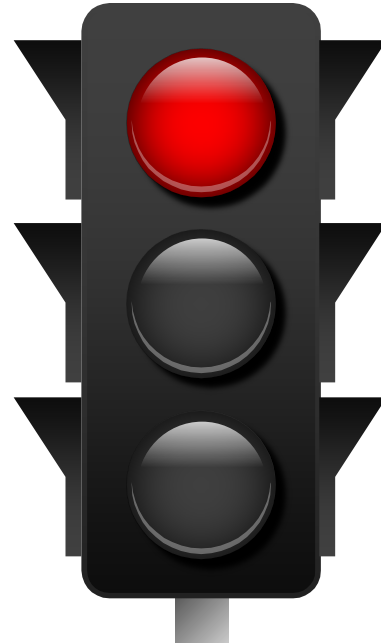
Conflicting KPIs → internal friction.
Reacting emotionally → firefighting.
Ignoring achievements → staff disengagement.



Good practice

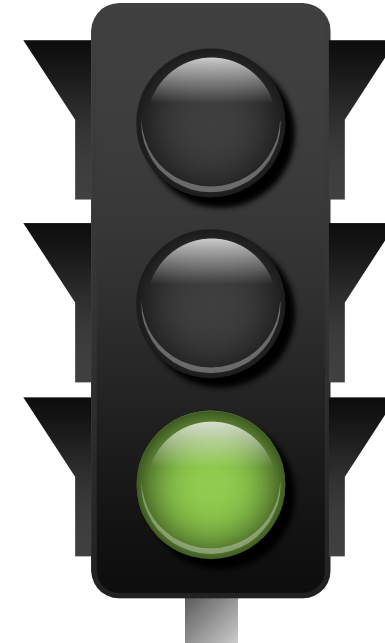
Communicate clear, balanced targets.
Support structured problem-solving.
Reward improvement and learning.

Engineers, technical precision - what to do tomorrow



Risky practice and consequence

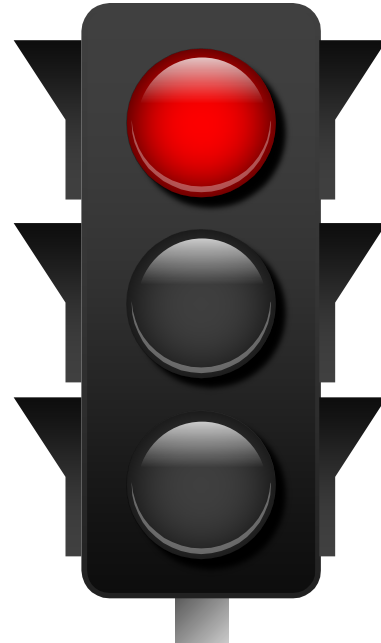
Catalogue copying → poor results.
No documentation → confusion later.
Ignoring chip control → tool breakages.



Good practice

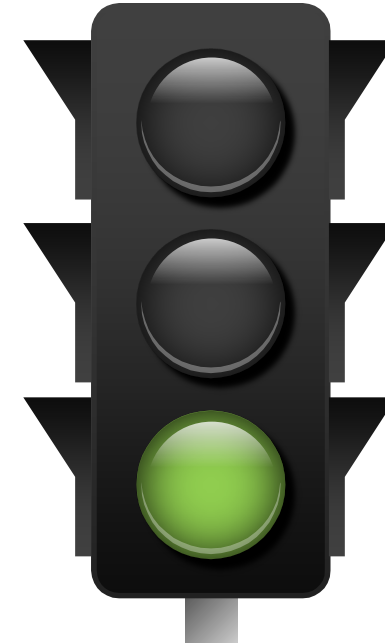
Select tools based on machining physics.
Validate data and document every change.
Optimise paths for chip evacuation and tool life.

Operators, process discipline - what to do tomorrow



Risky practice and consequence

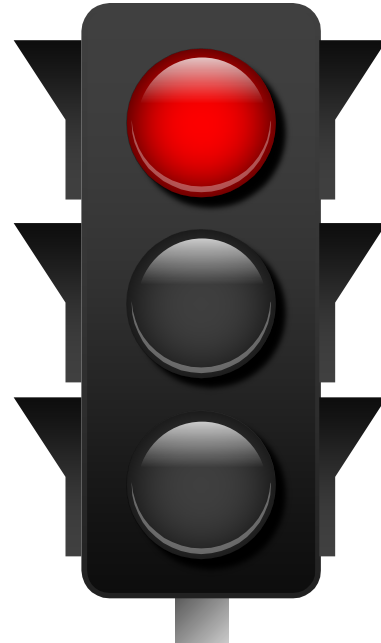
Improvising → unstable process.
Ignoring wear → sudden failures.
Staying silent → hidden damage.



Good practice

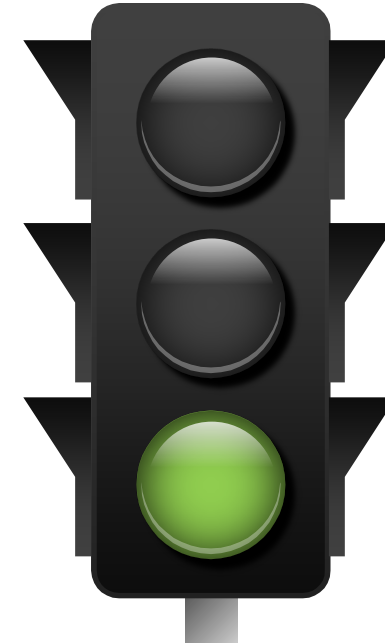
Follow documented setups and clamping specs.
Inspect tools and holders regularly.
Communicate issues early.

Closed-loop feedback for structured learning - what to do tomorrow



Risky practice and consequence

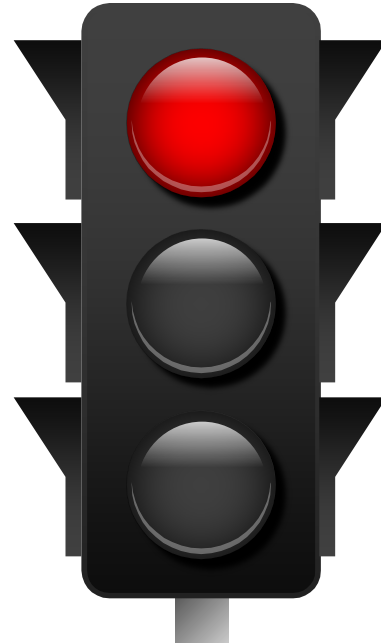
No data → guesswork decisions.
Inconsistent reporting → confusion.
Isolated learning → repeated errors.



Good practice

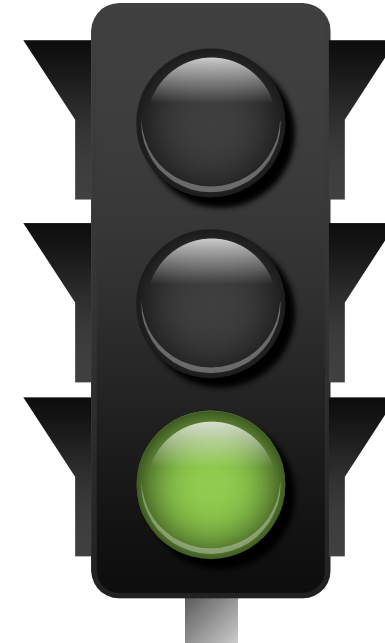
Record tool performance, wear and tool life consistently.
Use standard templates for reporting.
Share lessons across shifts.

The essence - what to do tomorrow



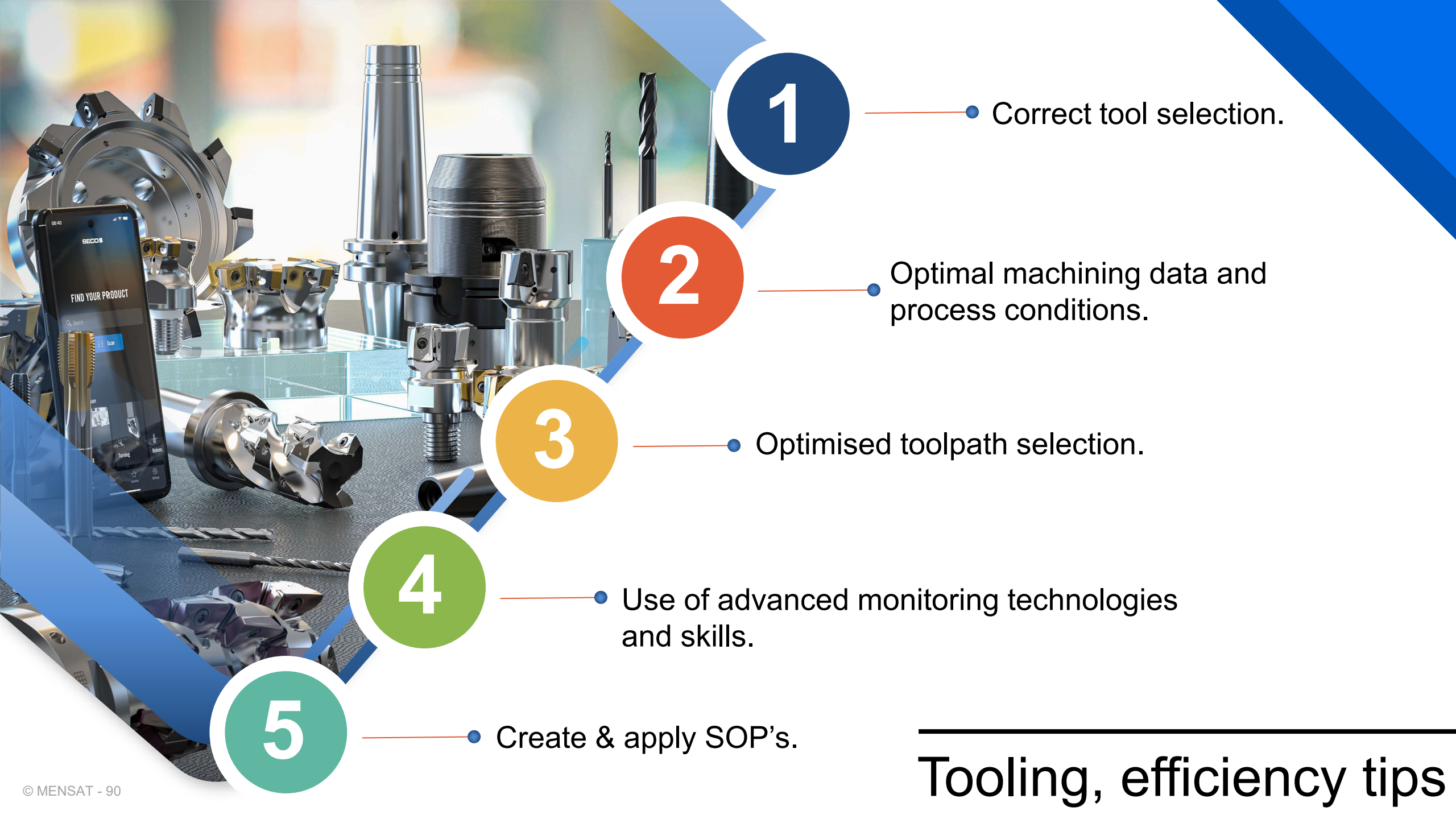
Risky practice and consequence

Guesswork + Silence + Shortcuts =
Instability, Waste, and Frustration.



Good practice

Data + Dialogue + Discipline =
Predictable, Profitable, Sustainable
Machining.



1

- Correct tool selection.

2

- Optimal machining data and process conditions.

3

- Optimised toolpath selection.

4

- Use of advanced monitoring technologies and skills.

5

- Create & apply SOP's.

Tooling, efficiency tips



6

• Regular tool inspection and maintenance.

7

• Correct tool storage and handling.

8

• Replace, recondition and regrind.

9

• Employee knowledge & skills training, motivation building.

10

• Consider total cost of ownership.

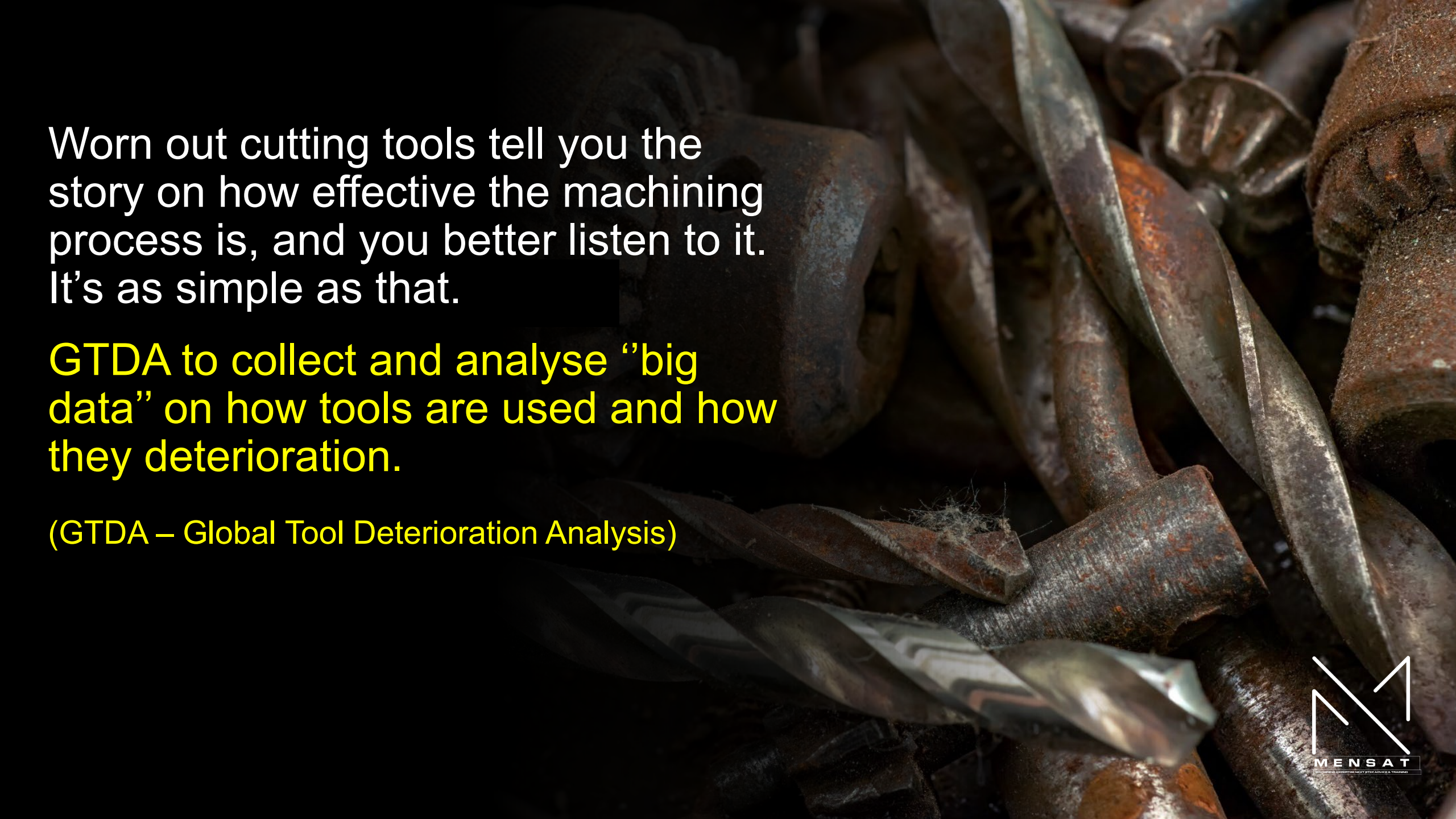
Tooling, efficiency tips

Gemba walks foster collaboration, which improves communication at all levels within the organization. Making an effort to go see your staff on the floor shows them that you care about their well-being and improves employee morale. It helps detect both disruptive and positive innovations.

RMPP to read and analyse machining processes and discover opportunities for production efficiency improvements.

(RPMM – Read Machining Process & People)





Worn out cutting tools tell you the story on how effective the machining process is, and you better listen to it. It's as simple as that.

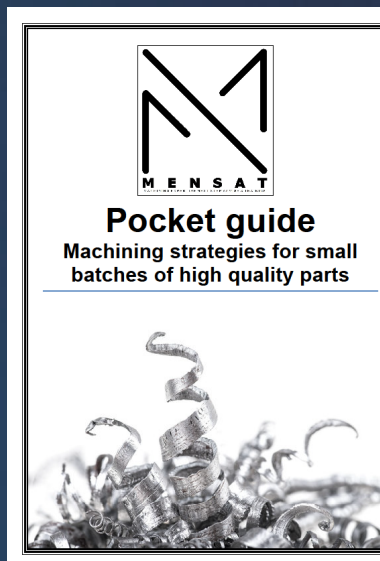
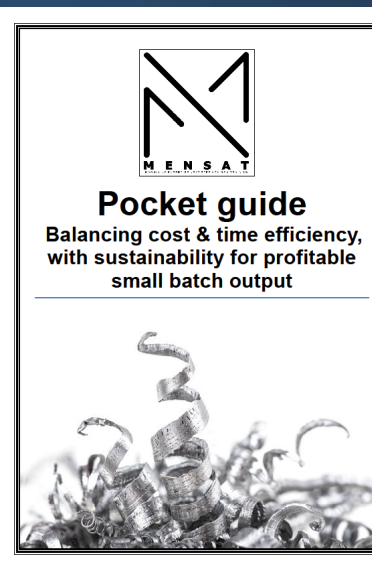
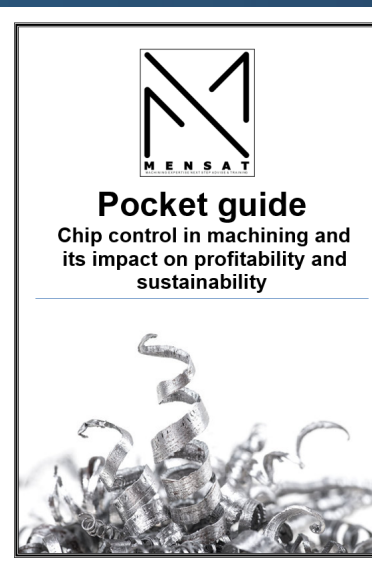
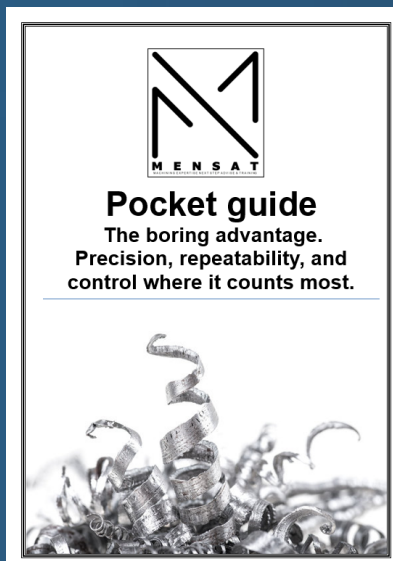
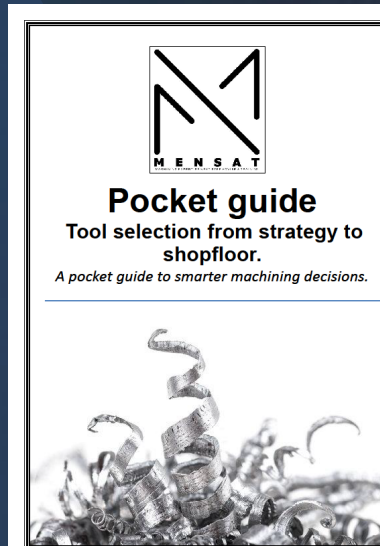
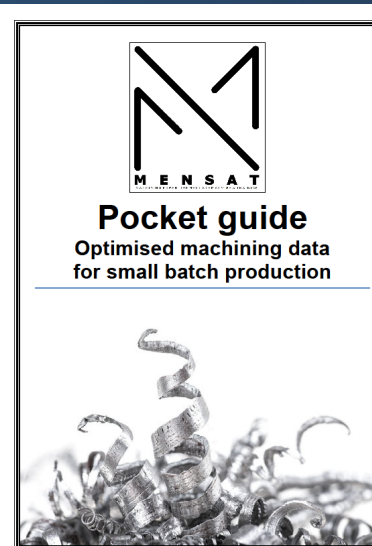
GTDA to collect and analyse “big data” on how tools are used and how they deterioration.

(GTDA – Global Tool Deterioration Analysis)

The solution to the problem lies in finding, training and retaining good people.

A MENSAT Masterclass is a management development programme for executives and professionals managing small batch machining production plants.

Available literature







If you want to improve machining performance, don't just look at the machine. Look at the tiny tool in its spindle. That's where the magic (or the misery) begins.

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Thank you!