

Tool Circulation: Circular Economy for Tools in Manufacturing

Tool circulation refers to the controlled cycle of tools and tooling withdrawals between use, reconditioning and re-provisioning in production. For technical buyers, it is a central lever for reducing tool costs, downtime and inventories simultaneously. A well-organised circulation makes consumption and wear data visible and lays the foundation for robust framework agreements and manufacturer loyalty.

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Key facts at a glance

- 01** Tool circulation describes the cycle of use, retrieval, reconditioning (e.g. regrinding, re-setting) and re-provisioning of tools.
- 02** In practice, circulation times typically range from a few hours (standard indexable inserts) to several days (special tools, regrinding).
- 03** Circulating tool pools frequently reduce the number of stored tools by 20 to 40 per cent compared with decentralised, uncoordinated inventories.
- 04** Measurable core metrics are circulation time, circulating inventory, regrinding rate and tool costs per machine hour.
- 05** A digital tool management system is now the de facto standard for controlling circulation.
- 06** Buyers can often reduce circulation costs by 10 to 25 per cent through framework agreements with reconditioning service providers.

Definition: tool circulation

Tool circulation is the organisational and logistical control of the cycle a tool goes through from provision at the machine via retrieval after use or end of tool life to reconditioning, inspection and renewed provision. It also covers the sorted-out tools that permanently leave the cycle. The aim is an economic balance between availability at the machine, inventory in circulation and reconditioning capacity.

Distinction from tool management

Tool management encompasses the entire strategy from standardisation, procurement and design through to data maintenance. Tool circulation is the operational core of this management and describes exclusively the physical and data-based movement of tools within the cycle. Both levels nevertheless interlock: only those who systematically evaluate circulation data can derive scrap rates and consumption KPIs, which later feed into procurement negotiations. In many operations, circulation is therefore the first step towards structured tool management.

Involved processes and roles

Typically involved in the circulation are tool issue, maintenance or the reconditioning service provider, machine operators, the cutting stock/warehouse area and procurement. Clearly defined responsibilities are a prerequisite: who decides on scrapping, who on regrinding, who on replacement procurement? Without unambiguous allocation, shadow inventories and duplicate purchases arise, which inflate the buffer warehouse and distort the calculation of actual tool costs.

Methods and approach in tool circulation

Building a functioning circulation follows a multi-stage approach: inventory analysis, process definition, system support and continuous control via KPIs. It is essential that production and procurement access the same data set.

Inventory analysis and standardisation

The starting point is a stocktake: which tools are in circulation, at the machine workstation, in cabinets and in the buffer warehouse? In practice, significant duplication and triplication of similar tools is often found. The resulting standardisation – reduction to standard types, agreed with the production process owners – immediately reduces the circulating inventory and simplifies subsequent procurement. At the same time, a market analysis of potential reconditioning service providers and suppliers is prepared.

Identification, marking and system support

Every circulating tool receives a unique identification, typically via barcode, RFID or data matrix code. A tool management system records incoming and outgoing items, tool lives, assessments of cutting material and reconditioning condition. Data quality determines the benefit: only clean master data – where a structured master data process pays off – allows robust evaluations. A periodic data quality report shows where recording gaps exist, for example with manually withdrawn tools.

Circulation control and provision concepts

Proven concepts are kanban-controlled rack replenishment at the issue point, defined minimum stock levels in the buffer warehouse and defined sequencing processes during reconditioning. For individual and special tools, a replenishment logic via call-off order or fixed purchase requisition applies. For consumables such as indexable inserts, automatic reordering when reorder points fall below thresholds has proven effective. Alignment with production planning and freeze fence periods is important: the

more stable the order pattern in the near term, the more precisely the circulating inventory can be dimensioned.

Key KPIs for controlling tool circulation

Without KPIs, the circulation remains a black box. The following selection has proven itself in practice as a control metric and should form part of regular supplier and internal reviews.

Circulation time and circulating inventory

Circulation time measures the average duration from withdrawal to re-provisioning. Typical benchmark values: a few hours for standard cutting stock, one to three working days for in-house regrinding, up to two weeks for external reconditioning or re-manufacture of special tools. The circulating inventory results from consumption multiplied by circulation time – if circulation time falls, the tied-up capital inventory falls for the same demand.

Tool costs and reconditioning rate

Proven KPIs are tool costs per machine hour or per component, the regrinding rate (proportion of reconditionable tools in the scrap-out volume) and the scrap-out rate per tool life. Here the loop closes to total cost of ownership: the lowest purchase price is not automatically the cheapest option if reconditioning capability or tool life is worse. Incoming inspections supplemented by measurement system analyses (SPC) make it possible to understand variations in tool lives and their causes.

Availability and cost of failure

The KPI tool availability at the machine (typically target values above 98 per cent) and the number of production-side tool stoppages show whether the circulation supports manufacturing. Missing tools cause set-up losses and in critical cases delivery delays – a risk that can feed directly into supplier evaluation if the supplier is responsible for consignment or circulating inventories.

Procurement-side design of tool circulation

Procurement shapes the circulation through contract models, supplier selection and pricing. With increasing data quality, classic procurement instruments can be deployed in a targeted manner.

Contract models: purchase, consignment, pool responsibility

Common models are classic purchase with a regrinding contract, consignment stock at the supplier, or the so-called tool pool model, in which the supplier is responsible for availability and reconditioning. Consignment and pool models transfer inventory risks to the supplier and reduce tied-up capital, but require clear billing rules, defined notification processes and a reliable PO order process. In tenders, circulation KPIs and reconditioning concepts should be considered as award criteria alongside the unit price.

Pricing and indexing

For carbide tools, raw material and cutting material costs account for a considerable share of the price. Price indexing on relevant raw material indices or manufacturer sales platforms creates transparency and avoids tough price negotiations. Framework agreements across multiple sites or damage groups increase volume and improve terms; supplemented by a structured commodity strategy for the machining sector, synergies between tool purchasing, reconditioning and special tool development can be bundled.

Supplier selection and dual sourcing

For critical special tools, dual source management makes sense in order to avoid failure risks with the sole regrinding or re-manufacturing partner. Supplier evaluation should assess reconditioning quality (residual tool life, dimensional accuracy) in addition to price and delivery reliability. Qualifications such as AEO status for international circulation should also be checked, as well as – for critical supply relationships – regular credit checks of the reconditioning partner, whose failure would immediately bring the circulation to a standstill.

Risks and controls in tool circulation

The circulation is prone to typical weak points: shadow inventories, poor data quality, dependence on individual reconditioners and unclear contractual arrangements. Targeted controls and reviews minimise these risks.

Shadow inventories and compliance

Factory and workshop staff frequently resort to privately procured or taken tools when the official circulation stalls. Such shadow inventories distort consumption data, violate internal procurement policies and make later supplier evaluation more difficult. Remedy is provided by low-threshold withdrawal processes, clear escalation routes and aligned anchoring of circulation rules in the procurement guidelines. Visible framework conditions also facilitate the factual invoice verification for reconditioning and repurchase offsets.

Dependencies and failure scenarios

If the sole regrinding partner fails or special tools can only be procured from the machine manufacturer, the circulation quickly becomes a bottleneck. Resilience activities – second source, defined emergency stocks, tool qualification for alternative manufacturers – are the most important levers here in terms of supply chain resilience. Force majeure clauses in tool contracts should be specifically reviewed for failure risks of the reconditioning partner, for example in the event of raw material shortages or supply disruptions.

Controls and continuous improvement

Proven measures are periodic circulation reviews with production, tool issue and procurement, spot checks of reconditioning quality, and an annual stock reconciliation between system data and physical

inventory. In tenders, bidder questions should be used to make service providers' actual processes transparent – transport logistics, grinding technology, scope of inspection. Agile procurement approaches, such as short framework contracts with option extensions, allow adjustments when the production programme or tool technology changes.

Current developments in tool circulation

Digitalisation, sustainability requirements and changed procurement logic are noticeably changing tool circulation. Buyers should be aware of these trends and factor them into their strategy.

Digitalisation and RFID-supported circulation

RFID tracking, automatic dispensing systems and system integration with ERP and machine data are now state of the art in medium-sized and large manufacturing operations. The benefit lies less in pure inventory recording than in the availability of tool life and wear data, which can also be used for negotiations. Buyers should check, when selecting suppliers, which interfaces the tool manufacturer or reconditioning service provider offers, and align system decisions closely with the IT strategy.

Sustainability and circular economy

Reconditioning instead of new purchase is a classic contribution to the circular economy: regrinding, recoating and conversion significantly extend the service life and reduce resource consumption. Increasingly, customers are also asking suppliers for conceptual evidence of resource efficiency. Tool circulation can be well integrated here into reporting and internal sustainability targets – for example via the documented reconditioning rate.

Consolidation of procurement

The trend is towards fewer, larger suppliers in the tool sector with integrated circulation and reconditioning services – supplemented by electronic catalogue integration. A clean catalogue structure for tools reduces duplicate orders and facilitates analysis. However, consolidation also brings dependency risks; the balance between consolidation and dual sourcing must be defined individually per tool class. Packaging management also plays a role when reconditioning returns are transported in standardised reusable systems.

Typical metrics

Metric	Typical value
Tool availability at the machine	> 98 % <i>typical target value for standard tools; evaluate critical special tools separately</i>
Circulation time (internal regrinding)	1–3 working days <i>external 1–2 weeks, standard cutting stock in hours</i>

Regrinding rate	> 80 % <i>proportion of reconditionable tools in the scrap-out volume; strongly tool-dependent</i>
Circulating inventory reduction after standardisation	20–40 % <i>typical order of magnitude for initial consolidation</i>

Practical example

A mid-sized mechanical engineering company with around 40 CNC machining centres had decentralised tool cabinets at every workstation and no overview of the actual inventory. Following an inventory analysis, more than 30 per cent of such duplicate orders were identified. The company introduced RFID identification and a tool management system, defined a central buffer warehouse with kanban control and commissioned a reconditioning service provider under a framework agreement with defined circulation times and reconditioning rates.

- Standardisation of indexable insert types from over 60 to fewer than 25 active types
- Definition of reorder points and automatic reordering via PO Order
- Monthly circulation review with production and procurement based on tool life and circulation time data
- Inclusion of reconditioning quality in the annual supplier evaluation

Conclusion

Tool circulation is more than a logistical side issue: it connects production organisation, inventory management and procurement. Those who systematically measure circulation time, circulating inventory and reconditioning rate can reduce tool costs, increase availability and build robust negotiating positions. Procurement should actively shape the circulation – through contract models, standardisation and supplier selection. The prerequisite is a clean data basis and clear responsibilities along the cycle. Those who approach this systematically quickly achieve measurable savings in practice while simultaneously improving supply security.

Frequently asked questions

? What does tool circulation mean?

Tool circulation refers to the controlled cycle of tools from provision at the machine through retrieval to reconditioning and re-provisioning. It covers identification, transport, reconditioning, inspection and stock management. The aim is high availability with minimal capital tie-up.

? How long does the tool circulation take?

This depends heavily on the tool type and reconditioning route. Standard cutting stock such as indexable inserts typically cycles within hours to days, while external regrinding or recoating

services often take one to two weeks. Special tools requiring re-manufacture can take considerably longer.

? **How can procurement reduce tool costs?**

Key levers are standardisation of tool types, regrinding and reconditioning contracts with defined quality requirements, and framework agreements covering multiple sites. In addition, total cost of ownership should be considered rather than the purchase price alone. Price indexing on raw material indices creates transparency for carbide products.

? **What is a tool pool model?**

Under the tool pool model, the supplier takes responsibility for the availability, stockholding and reconditioning of tools at the customer's premises. Billing is typically based on actual usage, for example per machine hour or per component. The advantage for procurement lies in lower capital tie-up and clear responsibility, but it requires a robust data and billing infrastructure.

? **Which KPIs are important in tool circulation?**

Core KPIs are circulation time, circulating inventory, tool costs per machine hour, regrinding or reconditioning rate and tool availability at the machine. In addition, tool life analyses and scrap-out rates provide indications of quality and process stability. These figures also serve as a negotiating basis and for supplier evaluation.

? **Is tool reconditioning still worthwhile?**

For high-value tools such as milling cutters, drills and solid carbide cutting tools, regrinding is generally economical, often with a reconditioning capability of several cycles. It is important to have a verifiable quality requirement for the reconditioning service provider, as poorly reconditioned tools can wipe out savings through lost tool life. The economics should be assessed using total cost of ownership per tool class.

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