Lot size optimisation: economically defining demand-based quantities

Lot size optimisation refers to the systematic determination of those procurement and production quantities at which the sum of set-up, ordering and storage costs is minimised. It combines demand determination, warehousing and supplier management into a robust quantity planning process. In practice, a consistently implemented lot size optimisation reduces capital tie-up, storage space requirements and obsolescence risks – while simultaneously securing the ability to deliver.

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Key facts at a glance

01 The objective is to minimise total costs from procurement, changeover, storage and capital tie-up.

02 The classic optimal lot size follows the square root formula: it increases with demand and fixed costs and decreases with holding costs.

03 In practice, purely calculated values are often adjusted for circumstances such as price breaks, MRP time buckets or vehicle capacities.

04 Typical metrics are coverage, turnover ratio, service level and cost per lot change.

05 Lot size optimisation is an ongoing process: demand, prices and lead times change and require regular re-evaluation.

06 Digital demand forecasting such as demand sensing increases data quality and thus the reliability of optimised lot sizes.

Definition: lot size optimisation

Lot size optimisation is the quantitative planning of procurement and production lots with the aim of minimising total logistics-related costs per time unit. It answers the question of how much a buyer procures per order or a manufacturer produces per job.

Distinction from the classic lot size formula

The classic lot size formula ("optimal order quantity", Economic Order Quantity) considers only two cost blocks: fixed costs per order or set-up and variable holding costs. It provides a good starting value but does not map price breaks, volume discounts, delivery restrictions or capacity limits. In practice, it therefore serves as a reference point, not as an automatic decision.

- Fixed cost component: order processing, set-up, changeover, quality inspection per lot
- Storage cost component: interest, storage space, insurance, shrinkage, obsolescence
- Result: a calculated lot size which is then checked for feasibility

Relevance for technical procurement

For technical buyers, the lot size directly influences material availability, shop floor workload and working capital. Lot sizes that are too small generate unnecessary ordering and set-up costs as well as increased process risks in quality releases; lot sizes that are too large tie up capital, occupy warehouse space and increase the risk of residual quantities when specifications change. Lot size optimisation thus forms the bridge between demand determination, inventory policy and supplier agreements.

Methods and approach for determining the optimal lot size

Determination takes place in several steps: analyse demand, capture cost parameters, calculate the formula value, apply practical constraints and review the size periodically.

Data basis and demand analysis

The basis is historical consumption data, bill of materials breakdowns and reliable forecasts. The more volatile the demand, the more dynamic methods are preferable to a static value. Methods such as demand sensing shorten response times by including short-term sales signals in demand planning. Clean data quality is essential: outliers caused by special orders or misbookings would otherwise significantly distort the calculated lot size.

Calculation methods at a glance

In addition to the classic square root formula, methods exist for discontinuous demand. The part-period method and the sliding throughput method sample demand periods into lot units until storage and ordering costs balance out. Methods according to Wagner/Whitin optimise dynamically over a planning horizon but are more computationally intensive. In ERP systems, heuristics with period, cap value or days of coverage are frequently used.

- EOQ/square root formula: constant demand, good as a starting value
- Part-period method: for fluctuating demand in the MRP environment
- Dynamic optimisation: for multi-period planning with strong demand fluctuations

Adjustment to practical constraints

The calculated value is subsequently aligned with real-world conditions: price breaks and volume

discounts, minimum order quantities, packaging units, pallet or truck capacities, shelf-life restrictions as well as shop floor restrictions such as set-up matrices. Framework contracts with fixed call-off intervals or a kanban system with defined card loops also alter the effective lot size. The objective is a practical, rounded size that is close to the cost optimum and works operationally.

Key KPIs for steering lot size optimisation

Without metrics, the impact of optimised lot sizes cannot be demonstrated. Typically, companies combine inventory, service and process metrics into a set of assessment criteria.

Inventory and cost metrics

Key metrics are inventory turnover ratio, average coverage in days and capital tie-up in stock. In addition, the cost per ordering or set-up process and the share of lot changeover costs in total material costs are considered. In practice, the number of orders per item and year is also frequently tracked in order to detect over-fragmentation of procurement.

Service and process metrics

The lot size must not jeopardise delivery capability. Therefore, the service level (delivery reliability or availability) is monitored per material class. Schedule adherence by suppliers shows whether agreed call-off patterns are being met. Shortages frequently lead to sorting actions and returns – both indicators that a lot size is too tight or that the quality release is unstable.

Risks and controls in lot size optimisation

Optimised lot sizes can quickly become outdated. Effective steering combines regular data maintenance, clear responsibilities and contractual safeguards.

Typical risks

The main risks are outdated cost rates, ignored demand changes and bottleneck situations with suppliers. If delivery capability declines, for example due to material shortages, an increased safety lot size may make sense – the formula alone is then not sufficient. Price volatility (e.g. metal surcharges or alloy surcharge) can also make larger lots economical in the short term, but shifts capital tie-up and obsolescence risk onto the buyer.

Controls and governance

A periodic review has proven effective, for example within the framework of the Quarterly Business Review (QBR) with strategic suppliers. There, call-off patterns, residual quantities and forecast-relevant changes are discussed and recorded in the minutes – a negotiation protocol or framework contract annex secures adjustments contractually. Before quantity changes, a sample delivery is recommended for new processes, and for excess inventory the returns process should be contractually stipulated. Data quality KPIs show whether the master data is reliable enough for the optimisation in the first

place.

Current developments: digitalisation and sustainability

Lot size optimisation is increasingly data-driven and integrated into overarching planning processes.

Automation and system support

Modern ERP and advanced planning systems calculate lot sizes automatically, take capacities into account and run what-if analyses. Artificial intelligence helps to detect demand peaks earlier and to adjust lot sizes dynamically. The prerequisite is reliable master data maintenance; that is why many companies link lot size reviews with data quality KPIs in master data management.

Sustainability and supply chain

Larger lots reduce transports and thus transport costs and Scope 3 emissions – at the same time, inventory and the risk of unused residual quantities increase. The trade-off becomes a sustainability topic: in practice, transport consolidation, packaging sizes and residual material quotas are included in the lot size decision. Buyers increasingly document this trade-off in order to make it traceable for customers and auditors.

Typical metrics

Metric	Typical value
Inventory turnover ratio	typically 6–12 per year *Benchmark for standard parts; special materials significantly lower*
Service level	>= 98 % *Target level per ABC class, do not jeopardise through lot size*
Ordering cost per order	determine regularly *Basis of the lot size formula, update annually*
Coverage (days of supply)	often 10–60 days per class *depends on lead time and item value*

Practical example

A mid-sized mechanical engineering company procures standard components (standard parts, motors, sheet metal parts) predominantly in fixed monthly quantities. An analysis showed typical symptoms: high inventory levels for A-parts, frequent rush orders for C-parts and a disproportionately high number of small orders. The company introduced lot size optimisation and, within one year, achieved a noticeable reduction in capital tie-up while maintaining a stable service level.

- ABC/XYZ analysis of all items and assignment to lot sizing methods (EOQ for A-parts, kanban for C-parts)
- Adjustment of calculated values to price breaks, pallet quantities and framework contract call-offs
- Introduction of quarterly lot size reviews including alignment with top suppliers
- KPI monitoring based on turnover, service level and ordering cost per item

Conclusion

Lot size optimisation is not a one-off calculation project but an ongoing steering process between demand, costs and delivery capability. The classic lot size formula provides the starting point; practical usability is decided by price breaks, capacities and supplier agreements. Those who keep cost rates, demand data and framework contracts up to date can sustainably reduce capital tie-up and process costs. At the same time, service level monitoring and regular reviews protect against delivery failures. Technical buyers are well advised to treat the lot size as a strategic lever rather than a mere ERP setting.

Frequently asked questions

? How do you calculate the optimal lot size?

The classic formula is: optimal quantity = square root of (2 × annual demand × fixed cost per order ÷ carrying cost rate × unit price). It balances ordering and holding costs against each other. In practice, the calculated value is then adjusted to price breaks, packaging units and capacities.

? Which costs are included in lot size optimisation?

Factors include fixed costs per order or set-up (processing, set-up, inspection) as well as variable holding costs such as interest, storage space, insurance and shrinkage. Not directly in the formula, but decisive, are capital tie-up, obsolescence risk and transport costs per additional delivery.

? What is the difference between lot size and order quantity?

The order quantity describes the quantity purchased per ordering process, whereas the lot size may also cover the production quantity per set-up. Both follow the same cost optimum: fixed costs per process versus holding costs. In procurement and production, the terms order quantity and production lot are therefore often used interchangeably.

? How often should lot sizes be reviewed?

Lot sizes are often re-evaluated annually or upon significant changes – for example, demand jumps, price changes or new delivery terms. For fast-moving items, many companies review quarterly, ideally embedded in governance routines such as the Quarterly Business Review with strategic suppliers.

? What happens with lot sizes that are too large?

Oversized lots tie up capital, occupy warehouse space and increase the risk of obsolete residual quantities when changes occur. In addition, flexibility decreases when it comes to short-term demand adjustments. In practice, this shows up in declining inventory turnover, shelf-life risks and increased tender residual quantities.

? How does lot size optimisation fit with kanban?

A kanban system limits inventory via card loops and thereby effectively defines the lot size per container or card. The kanban size is likewise calculated based on demand, replenishment lead time and buffer strategy. Both approaches pursue the same goal: minimal total costs while ensuring availability.

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