

Manufacturing Ops

Every production decision is a capacity and margin decision.

See the full operating picture: schedule, material, people, machines, maintenance, quality and cost. Then act before a delay becomes margin loss.

Customer overview

Solution, value model, pilot approach and every feature by topic

Industries

Pharma and biotech, medical devices, chemicals, food and beverage, consumer goods, semiconductors, aerospace, automotive and general manufacturing

Works with your systems

Connects to any platform: Microsoft Dynamics 365, SAP, Oracle, NetSuite, MES, CMMS, HR, learning and data platforms

Contents

What's inside.

	Who this document is for	03
	At a glance	04
01	The case for manufacturing operations	10
02	What Zeak Manufacturing Ops does	17
03	How value is created and proven	39
04	How customers start	46
05	Features by topic	54
	How the numbers work	84
	Sources and definitions	86

Read this first if you have five minutes: At a glance (pages 4 to 9) answers whether Manufacturing Ops is a fit, what deciding on it involves, and how you stay in control. **Not every production problem needs AI**, and this document says where it does not.

Who this document is for

Written for everyone who has a say in a production decision.

Production decisions cross operations, planning, maintenance, materials, HR, quality, finance and IT, so this overview is written for all of them. Start with the pages that answer your question, then read on to see how the pieces connect.

If you lead	You will want to know	Start with
Executives and network leaders COO, VP Operations, VP Manufacturing	Where capacity and margin are at risk across plants, and which interventions create verified value	The case for manufacturing operations; Four ways to create value; How customers start
Plant and production managers Plant manager, production manager	What is stopping output today, and the least-cost recovery	A connected decision; Live schedule control; Bottlenecks, risk and recovery
Planners and schedulers Master scheduler, production planner	What should run where and when, whether the plan is feasible, and how to change it quickly	The scheduling board; Drag and drop with a guardrail; Features: planning and scheduling
Shift supervisors and operators Supervisor, team lead, operator	Who and what is available now, what moved, what is late	Available labor is not qualified labor; The plan where the work happens
Maintenance and reliability Maintenance manager, reliability engineer	Which assets are available, due, or economically critical, and when to take them down	Maintenance is a capacity constraint; Profiles for every resource
Materials and warehouse Materials manager, warehouse lead, buyer	Which items will block production, by order, plant, location and horizon	Material readiness; Features: material readiness
HR, training and workforce planning HR business partner, training coordinator	Which shifts, skills, training and certifications make the schedule feasible	Training records the schedule can use; Profiles for every resource
Quality VP Quality, QA manager, validation lead	Where yield, holds and release delay consume output, and that controls are never bypassed	Trust is part of the product; Features: quality, yield and traceability
Finance CFO, plant controller, cost accountant	How operating losses convert to cost, margin and cash, without double counting	How Zeak calculates value; A worked business case; How the numbers work
IT and administration CIO, enterprise architect, IT manager	What Zeak reads and writes, where it runs, who can act and how write-back is governed	What Zeak reads and writes; Trust is part of the product; Hard questions

At a glance

Most plants already have the data. What they lack is one view of every constraint, and the ability to act on it in time.

ERP records orders. MES records execution. Maintenance, HR, training and quality each keep their own calendar. Zeak Manufacturing Ops joins them into one schedule that knows what is actually possible, shows what a change will cost before you make it, and carries the decision through approval to measured value.

The problem

The factory rarely loses money in one place. It loses it **between plans, calendars and handoffs**: a machine scheduled while it is down for maintenance, an operator assigned whose certification expired, a batch started that stops for one missing component.

What Zeak does

Connects schedule, material, machines, maintenance, people, training and quality into **one governed scheduling board**, checks every move against every constraint, and puts cost and service impact next to each decision.

How you start

One line or plant, one decision owner, one baseline Finance agrees. **Prove the economics with your own data before any larger commitment.** Read-only first; nothing changes in your ERP or MES until you say so.

What you get

A schedule the floor can actually run, earlier warning of shortages, conflicts and late orders, and value reported in hours, capacity and dollars, with Finance-validated results kept separate from estimates.

Not every production problem needs AI. Most of the value comes from connected data, clear rules and a governed workflow: one calendar for maintenance and production, a certification check at the point of assignment, a shortage with an owner. Zeak uses AI where it improves investigation or recommendations, and every recommendation shows its evidence and is reviewed by a person before anything changes.

Is Manufacturing Ops a fit?

A quick, honest check before you spend time on an evaluation.

Manufacturing Ops works for any industry, standalone or connected to the systems you already run. It is a strong fit when the problem is visibility, feasibility or follow-through, and a poor fit when the real gap is somewhere else.

Signs it will help

Maintenance and production collide	Machines are scheduled while planned out of service, or maintenance is postponed because the plan is full.
The real schedule is a spreadsheet	Planners export from the ERP, rebuild the plan in Excel and re-key changes.
Starts stop after they start	Orders are released and then wait for a component, a tool, a qualified operator or a quality release.
Changeovers eat the bottleneck	Sequence decisions are made by habit; nobody measures changeover hours on the constraint.
Training lives in binders and HR files	Supervisors check qualifications from memory; audits find expired certifications on the floor.
Downtime is not measured	There is no telemetry, so stops and their causes are never quantified or prioritized.

Signs to wait, or start elsewhere

You need an ERP or MES first	Zeak works with those systems; it does not replace them. Start there, then connect Zeak.
There is no one to own the decision	A pilot needs a named owner and a few hours a week from planning and the plant.
The process works and nobody feels the cost	If there is no visible capacity, cost or service loss to fix, wait until there is one worth measuring.
You need machine control	Zeak plans, checks and records; it does not control equipment. That stays in your automation and MES layer.

Recognize three or more signs on the left? A one-hour walkthrough of how your plan is built today is usually enough to tell whether a pilot is worth it.

What deciding on Manufacturing Ops involves

Four small decisions instead of one big one, each made on evidence you can inspect.

	Step	What you decide	Evidence you will have	Your commitment
1	Walkthrough One to two hours	Whether Zeak addresses a real problem in how you plan and run production	Your team shows us how the plan is built today and what must not break	None
2	Discover Scoped to the project	Line or plant, decision owner, success and failure criteria	A pilot charter, a measured baseline and a one-page risk register	Your team's time only
3	Pilot Most take less than a few weeks	Whether to move each capability up the autonomy ladder	Results on your own data against the baseline, and a backtest on your history	Pilot terms agreed in your proposal
4	Roll out Your pace	Which lines, plants and capabilities come next	A readout, a value report and a rollout case Finance has reviewed	Only after the pilot result is accepted

What it takes from your team

Who	Time
Decision owner	A few hours a week through the pilot
Planning and plant team	A few hours a week for real decisions and feedback
Maintenance, HR or training contact	Calendar and records access; review of rules
Finance contact	Baseline agreement at the start; review at the readout
IT and platform owner	Read-only access, single sign-on, roles and a test environment

You can stop after any step and keep everything you have learned. **Nothing changes in your ERP, MES or maintenance system unless you decide it should.** Length depends on the project: the most complex pilots take weeks, most take less. Scope and timing are confirmed in Discover; pricing and pilot terms are set out in your proposal.

Three questions every decision has to answer

A production decision system earns its place only when it answers all three, for everyone who has a say.

A good decision needs more than a strong demo. It needs proof in your own data, a real improvement for the people doing the work, and a clear answer to what happens when something goes wrong. This overview is written to answer all three.

What is possible?

For leaders who want to modernize operations and need results they can show.

What Zeak gives you

- A pilot on your real plant data within weeks
- Capacity, cost and service impact measured in your own numbers, agreed with Finance
- A staged picture of what comes next, line by line and plant by plant

See results on your own plant before anyone commits to more.

Start with: The autonomy ladder; Four ways to create value; How customers start

Will this make the work easier?

For the planners, supervisors, maintenance planners and operators who run the plan every day.

What Zeak gives you

- One board for machines, people, maintenance and material
- Drag and drop that checks the rules for you and shows the cost before you commit
- Alerts that open the record; keep using Excel where it helps, through a governed round trip

The constraints are already on the board when you open the schedule.

Start with: The scheduling board; Calendars and scheduling, in one place; Profiles for every resource

What could go wrong, and who owns it?

For the people who protect your systems, your compliance, your workforce and your budget.

What Zeak gives you

- ERP, MES, maintenance and quality systems stay the systems of record
- Read-only until you say otherwise; a named approver for every stage
- Every action audited; your cloud; full export; a written risk register for the pilot

Read-only until you say otherwise. Nothing moves on the floor without a person.

Start with: What changes, what doesn't; Trust is part of the product; Hard questions

What changes, what doesn't, and how you stay in control

Works alongside the systems you already run. Read-only until you say otherwise. You decide when it acts.

If we were in your seat, we would worry about four things: disruption to a plan that works, changes reaching the floor without review, data leaving your environment, and being locked in. Here is how each is handled, before you have to ask.

What does not change

Your ERP, MES, maintenance, quality, HR and learning systems stay the systems of record. Production orders are still released where they are released today. Zeak is added alongside: **wrap first, replace later, if ever.**

How you roll back

Any stage can be stepped back or switched off by your approver without losing records. Write-back is enabled object by object, and disabled the same way.

What changes, stage by stage

Each capability moves up the autonomy ladder only when the criteria you set are met: Observe, then Advise, then Assist, then Act. Stopping at any stage is a legitimate outcome.

Where the data lives

In your own cloud or the Zeak cloud, your choice. Connected-system data stays in those systems; Zeak keeps live links and a snapshot at the time of each decision. Everything exports in open formats.

What we will not ask you to do

- Replace your ERP, MES or maintenance system
- Customize your ERP or fund a costly custom build
- Move your master data
- Sign a long commitment before the pilot result
- Accept a business case built on headcount reduction
- Let anything publish to the floor without a person

Who approves what

A named owner on your side approves every stage gate. People accept or reject every recommendation; AI never publishes a schedule, overrides a maintenance block or qualifies a person.

The autonomy ladder

Automation is a staircase you control, not a leap.

Every capability in Zeak that recommends, drafts, automates or writes to your systems has a stage, set by you. You set the criteria for moving up. Stopping at any stage is a legitimate outcome.

1

Observe

Read-only and in parallel. Zeak builds the connected schedule and constraint picture from your data and changes nothing.

Your plan runs exactly as today.

Conflicts, shortages and changeover loss become visible.

2

Advise

Zeak flags conflicts and late orders, recommends sequences and recoveries and shows the evidence. People accept or reject every recommendation.

Nothing is committed without a person.

With Observe, this is where most plants find most of the value.

3

Assist

Planners use the scheduling board to draft and publish plans in Zeak, with approval before anything reaches the floor or your systems.

You approve before anything is saved or written back.

The re-keying disappears; the decision stays with your team.

4

Act

Automation for routine, well-proven cases only, such as re-sequencing within the firm window or reserving recertification time. Exceptions route to people.

Only what you have switched on.

Many plants never need Act, and that is fine.

1. Your criteria are met

The pilot charter sets what must be true before a capability moves up a stage.

2. Your named approver signs off

Nobody moves a stage without them, and they can step back or switch off at any time without losing records.

3. Every change is audited

Each stage change, recommendation, acceptance, rejection and override is logged.

01

The case for manufacturing operations

Capacity is the scarcest asset in most plants, and most of it is lost between systems, not inside them. The research is consistent: plants that see constraints earlier and act with evidence recover capacity without new equipment or headcount.

What the research says
Where value leaks
The cost of seeing late

Why ERP and MES feel hard to use
Why most factory AI stalls
What the research says, by industry



What the research says

Scheduling, maintenance and labor decisions are margin decisions, and the gap between leaders and laggards is large.

Plan faster**>50%**

lower planning-related scheduling labor after eight weeks of advanced scheduling BCG [R1]

Recover capacity**~30 min/day**

additional production time, a >3% OEE uplift, in the same BCG client work BCG [R1]

Reduce downtime**30-50%**

lower machine downtime reported across digital manufacturing programs McKinsey [R2]

Raise productivity**15-30%**

higher labor productivity in the same McKinsey value ranges McKinsey [R2]

Cost of downtime**~11%**

of revenue lost to unplanned downtime at the world's 500 largest companies, about \$1.4 trillion a year Siemens [R13]

Smart manufacturing**10-20%**

improvement in production output reported by adopters, with 10-15% capacity unlocked Deloitte [R14]

Supervisor time**1-2 h/shift**

of assignment effort removed by dynamic scheduling; on-time delivery rose from 50% to 90% McKinsey [R3]

Labor scarcity**1.9M**

US manufacturing jobs could go unfilled through 2033 Deloitte and The Manufacturing Institute [R20]

The management question is not whether one benchmark applies everywhere. It is whether your organization can measure where hours, capacity, material, labor and margin are being lost, and prove what changed after an intervention. Benchmarks size a hypothesis; your plant baseline replaces them.

Benchmarks are directional evidence from external research, not Manufacturing Ops performance guarantees. Sources are listed at the end of this document.

Where value leaks

The factory rarely loses money in one place. It loses it between plans, calendars and handoffs.

Each leak below is measurable when hours, quantities and schedule decisions connect to finance. Manufacturing Ops exposes the formula, the baseline and the source behind every opportunity rather than promising generic savings.

Where value leaks	What Manufacturing Ops exposes	How value is measured
Scheduling churn	Late orders, changeovers, idle bottlenecks, moves inside the frozen window, resource conflicts	Lost bottleneck hours; planner hours; overtime; expedite cost; margin at risk
Maintenance conflict	Machines scheduled while on planned maintenance; late prerequisites; unplanned downtime	Downtime hours; maintenance delay; MTTR; schedule compliance; \$ per downtime hour
Labor readiness	Shift gaps, absence, skill mismatch, expired certifications, untrained on the new procedure version	Uncovered labor hours; overtime; invalid assignment attempts; FTE-equivalent capacity
Material readiness	Shortages, quality holds, stock in the wrong place, expiring lots, kits not staged, late inbound	Short quantity; days of cover; orders blocked; stops after start; recovery cost
Yield and quality	Scrap, rework, retest, release delay and poor yield	Cost of poor quality; good output; scrap and rework hours; cost per good unit; release lead time
Changeover and sequence	Habitual sequences, campaign breaks, allergen or potency changeovers on the constraint	Changeover hours on the bottleneck; contribution per constraint hour
Handoffs and status	Shift handover by memory, status chasing, meeting packs rebuilt by hand	Supervisor and planner hours; repeat issues; time from event to action

External evidence. BCG reports that spreadsheet-heavy production scheduling can be replaced by optimization that treats maintenance, operator absence, raw-material availability and machine-product compatibility as constraints; the cited client work achieved a >3% OEE uplift and >50% lower planning labor. [R1]

The cost of seeing late

Disruption is a recurring cost of running a plant. Response time decides how much of it you pay.

Every event below already happens in your plant. The difference between a small cost and a large one is usually the hours between the event and the decision.

Downtime cost \$1.4T a year in unplanned downtime across the world's 500 largest companies Siemens [R13]	Line-stop cost \$2.3M/h reported cost of an idle line in automotive, the highest of the sectors studied Siemens [R13]	Warning time 1-2 h per shift spent assigning workers by hand before dynamic scheduling McKinsey [R3]	Recovery TTR vs TTS time to recover versus time the operation can survive: the gap is the exposure MIT [R10]
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Event	Schedule response	Economic question
Machine breakdown	Block the resource; identify affected operations; recalculate earliest finish and alternates	What is the downtime value at risk, and what is the cheapest recovery?
Maintenance window moves	Re-evaluate all production assigned to the asset	Does moving maintenance reduce or increase total cost and risk?
Worker absence	Recalculate qualified labor coverage by shift	Is overtime, reassignment or resequencing cheaper?
Certification expires	Flag affected assignments; show qualified alternates and the recertification path	Which orders lose their qualified operator, and when?
Material shortage	Flag orders that cannot start or stay supplied; open an owned material action	Which orders, customers and margin are at risk?
Quality hold	Remove held material or equipment from feasible supply and capacity	How much output is delayed, and what is the release path?
Urgent demand	Re-optimize within frozen-window rules and show what is displaced	Is the customer gain worth the schedule disruption?

Why ERP and MES feel hard to use

They are excellent systems of record. They were never designed to be the place where production decisions are made.

This is not a criticism of your systems. It is why Zeak sits alongside them rather than replacing them: the system of record keeps doing what it does well, and the decision layer does the rest.

What people experience	Why it happens	What Zeak does instead
Every change takes a transaction	ERP and MES are built to record transactions accurately and controllably, not to explore options. A simple move can mean several forms and codes.	A scheduling board where a move is a drag, checked against every rule before it is saved
Constraints live in different systems	Maintenance in the CMMS, shifts in HR, training in the learning system, holds in the QMS, so no screen shows whether a job can really run.	One connected picture of material, machines, maintenance, people, training and quality
The real plan is a spreadsheet	Planners export, rebuild and re-key because the system will not show the trade-offs they need. [R1]	A governed spreadsheet round trip, then a board good enough that the spreadsheet is optional
Dates look feasible and are not	Infinite-capacity dates ignore labor, tools, maintenance and changeovers.	Finite-capacity dates and a health score for every schedule version
Customizing is slow and brittle	Every change to the ERP or MES is a project, and every upgrade puts it at risk.	Configuration in Zeak, alongside the system of record: no ERP customization, no costly custom build
Screens are built for experts	New supervisors and operators need weeks to navigate; turnover makes this worse. [R20]	Role-based views, profiles and plain-language questions on every record

No need to customize your ERP or fund a costly custom build. Manufacturing Ops is a configurable solution that fits the processes that are strategic to your plants, and runs alongside the systems you already have.

Why most factory AI stalls, and how to avoid it

The technology is rarely the problem. Sequence, data and ownership are.

Two findings from MIT are worth knowing before any production AI decision, because they explain why so many programs disappoint and what the successful ones do differently.

Productivity often dips before it rises

MIT and US Census research on manufacturing plants found that adopting AI is frequently followed by a short-term productivity decline before gains appear, and that plants with stronger data and management practices recover faster. [R19]

Implication: measure a baseline, start where data is reliable, and move up the autonomy ladder only when your criteria are met.

Most pilots never reach the P&L

MIT NANDA reported that most enterprise generative-AI pilots it studied produced no measurable P&L impact, and that deployments delivered with an external partner succeeded markedly more often than internal builds. [R18]

Implication: begin with a decision, an owner and a number Finance agrees, and buy the outcome rather than a toolkit.

What that means for Manufacturing Ops

Rules before models

Maintenance blocks, certification gates and changeover matrices are rules. They deliver value on day one without any AI.

Baseline before claims

Planner hours, changeover hours, downtime and late orders are measured before the pilot, so improvement is evidence, not opinion.

Workflow before automation

Every finding gets an owner, an approver and a due date. Automation comes later, only for proven cases.

People decide

AI investigates and recommends with evidence; planners, supervisors and approvers decide.

What the research says, by industry

Different industries, the same pattern: the constraint that decides output is rarely the one the system plans for.

Industry	Constraints that decide the schedule	Measures that move
Pharma and biotech	Batch readiness, trained-operator gates, material release, calibration, quality holds, hold-time limits	Release lead time, right-first-time, qualified coverage
Medical devices	Lot and device trace, validated equipment, certified resources, line clearance	Release cycle, qualification coverage, schedule attainment
Chemicals and process	Campaigns, shared reactors and tanks, cleanout, batch yield, turnarounds	Cost per ton, yield, campaign length, changeover
Food and beverage	Allergen sequencing, sanitation windows, shelf life, traceability rules	Sanitation hours, OTIF, waste, trace time
Cosmetics and consumer goods	Packaging-line changeovers, SKU and promotion variants, fill and pack balance	Changeover hours, promotion on-time, line utilization
Semiconductors	Tool and recipe compatibility, queue time, WIP, qualified operators, maintenance windows	Cycle time, WIP, tool availability, yield
Aerospace and defense	Work-package readiness, certified technicians, tooling, long-lead parts, rated orders	Wrench time, turnaround, readiness, cert coverage
Automotive and discrete	Takt and line balance, component shortages, tools and dies, mixed-model sequence	Takt adherence, OTD, line-stop minutes
Industrial and electrical	Engineered-to-order routings, test capacity, long-lead components	On-time delivery, test utilization, shortage impact
General manufacturing	Machine and operator capacity, changeovers, maintenance, shortages	Attainment, OEE where measured, overtime

02

What Zeak Manufacturing Ops does

One governed schedule that knows every constraint, a board where a change is a drag with a guardrail, and a complete profile for every person, machine and material behind it.

The right tool for each problem
What is in the product today
What Zeak reads and writes
A connected decision
The scheduling board

Maintenance, labor and training
Profiles for every resource
Calendars and scheduling
Highest-impact features
Industry applications



The right tool for each problem

Not every production problem needs AI. Most of the capacity is found before AI is switched on.

Most production value isn't lost for lack of AI. It's lost in the gaps: the maintenance window the planner never saw, the operator whose certificate lapsed last week, the component that was on hand but on hold.

1

Connect the data

Put records side by side that have never been compared.

- **Maintenance vs production.** The CMMS window and the production order on the same machine, same hours.
- **Training vs assignment.** The certification expiry date next to the operation it qualifies.
- **Stock vs usable stock.** On-hand minus held, expiring and unstaged lots.

2

Apply clear rules

Set a rule once and let it check every move, every day.

- **Maintenance hard block.** Approved maintenance removes the asset from capacity.
- **Certification gate.** No valid certificate, no assignment.
- **Changeover matrix.** Allergen or potency changes cost what they really cost.

3

Govern the workflow

Give every finding an owner, an approver, a due date and the evidence.

- **Shortage with an owner.** A Q4 stockout becomes a PO request with aging.
- **Frozen-window change.** Routed for approval with the cost attached.
- **Shift handover.** Open issues carried forward, not forgotten.

4

Use AI where it helps

Investigate and recommend at a scale no team can match.

- **Why is this late?** A plain answer traced to the operations behind it.
- **Best sequence.** Options compared on service, changeover and cost.
- **Early warning.** Orders likely to miss in the next 14 days, with the reason.

What is in the product today

This is not a slideware roadmap. The core decision workspace is built and connects to the systems you already run.

Built capabilities 26 in the current build across 10 functional areas	Partly built 2 machine performance baseline and formula lineage	Roadmap 201 capabilities, including the scheduling board, maintenance and certification gates	Calculation layer 1 so a measure reads the same on every screen
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Group	In the current build	What it is for
Intelligence	Command Center, AI Manufacturing Assistant, AI insights and recommended actions, dashboard and metric builders, saved views	Your daily starting point and self-service analysis
Plan	Production plan queue, production order register, demand-to-production lineage	What should run next, and why it cannot
Capacity	Resource schedule Gantt, capacity load table, move-operation what-if	Load by machine and resource, tested before a change
Material	Material readiness funnel, shortage root cause by BOM or formula line, warehouse demand view	Which orders can start and which lines block them
Execute	In-flight operations, started operations register, production lifecycle status flow	Actual versus plan, and where orders are stuck
People and quality	Workforce load view, operator rebalance signal, quality impact dashboard, yield and scrap view	Labor balance and yield loss next to the schedule
Risk and operate	Bottleneck exposure, production risk register, recommended action workflow, connection health and freshness	The constraint, the risks, and how current the data is

Figures describe the current application build as of October 2026. Production readiness in your environment is confirmed during the pilot. The scheduling board, maintenance blocks, certification gates and training records described on the following pages are roadmap capabilities.

What Zeak reads and writes

Zeak reads what your systems already know, and writes back only what you have approved.

Use Zeak on its own, or connected to the systems you already run. Start read-only; turn on write-back object by object when you are ready.

Reads

- Production and batch orders, routes, operations, BOMs and formulas
- Resources, work centers, calendars, capacities
- Inventory, lots, holds, inbound and transfers
- Maintenance plans, work orders, calibration
- Shifts, absence (availability only), time records
- Training, certifications and skills
- Quality events, yield, scrap, release status
- Machine signals where available

Writes, only when you enable it

- Published schedule dates and resource assignments
- Maintenance requests
- Material, transfer, PR or PO requests
- Production reporting from the floor
- Training assignments

Each object is enabled separately, validated, approved and audited, and can be switched off the same way.

Standalone, connected or both

Standalone: Zeak holds orders, resources, calendars and training records for a pilot or a site without an MES or CMMS.

Connected: live links to your systems of record, refreshed on a schedule you set, with freshness shown on every screen.

Both: start standalone where a system is missing, connect the rest, and switch later without rework.

Your systems stay the system of record. Zeak never controls equipment and never publishes to the floor or writes to your ERP without an enabled object, a validated change and a person's approval.

What Zeak understands from your systems

If your system holds it and you authorize it, Zeak can use it.

Zeak can work with any record, field or transaction your systems expose, including custom fields. The examples are common starting points, not limits. New or custom data is added by configuring the connector, not by changing Zeak.

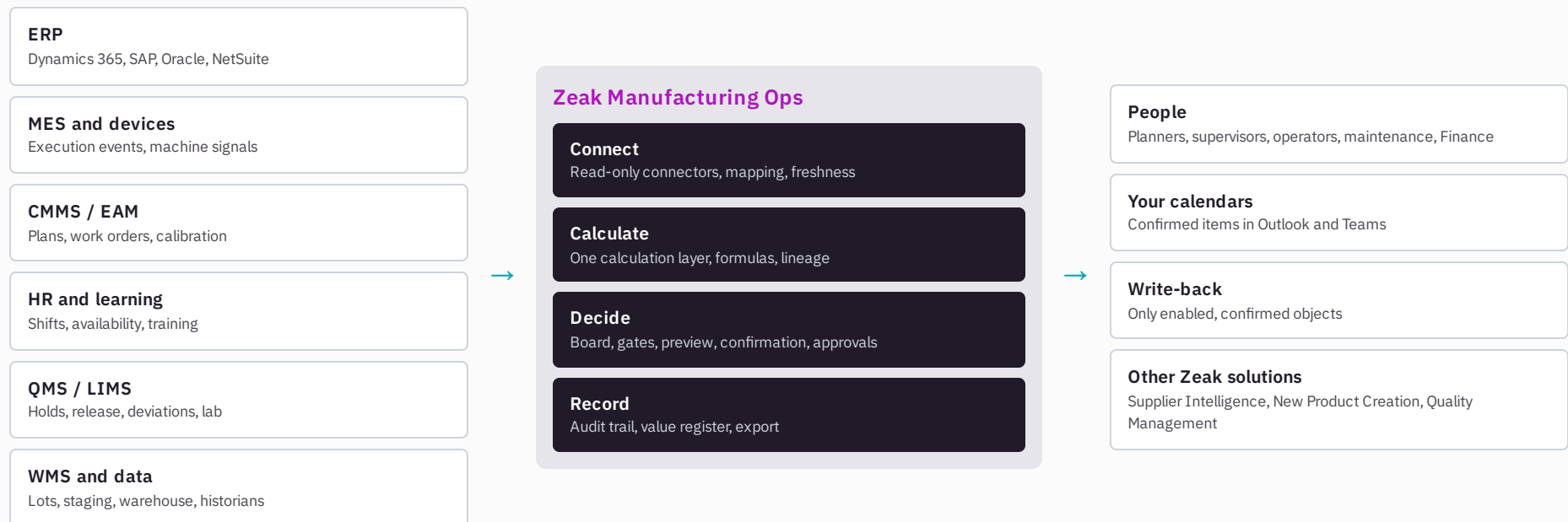
The question context answers	For example	In your system	Records such as
What should we make?	Production and batch orders, demand, due dates, priorities	Dynamics 365	production orders, batch orders, planned orders, sales orders, and more
How is it made?	Routes, operations, BOMs and formulas, changeover families	SAP S/4HANA	production and process orders, routings, master recipes, work centers, PM orders, and more
Where can it run?	Machines, lines, tools, calendars, maintenance windows, calibration	Oracle Cloud	work orders, work definitions, resources, maintenance work orders, and more
Who can run it?	Shifts, availability, skills, training and certifications	NetSuite	work orders, assembly builds, routings, work centers, and more
Is the material usable?	On-hand, lots, holds, expiry, staging, inbound	MES, CMMS, HR, learning and quality systems	execution events, work orders, shifts, course completions, deviations, through the same connector approach
What did it cost?	Labor, overtime, scrap, downtime, expedite, standard and actual cost	Data platforms and machine signals	historians, data warehouses and device feeds where available

Zeak reads and writes through each system's own interfaces, within the access you grant. Record names are examples of each vendor's terminology. Microsoft Dynamics 365 is the first connector in this product; others use the same approach.

How it fits together

Your systems stay the system of record. Zeak reads, decides with your people, and writes back only what is enabled and confirmed.

Deployed in your cloud or Zeak's, with your identity provider. Data flows left to right; write-back is the only path back, and it is off until you turn it on.



Connected to the rest of Zeak. New products set up through Zeak New Product Creation arrive with their routings, approved resources and training requirements. Supplier risk from Supplier Intelligence and quality events from Zeak Quality Management appear next to the orders they affect.

The operating model

One schedule, many constraints.

Manufacturing Ops treats production as one connected decision across demand, material, assets, people, maintenance, quality and cost.

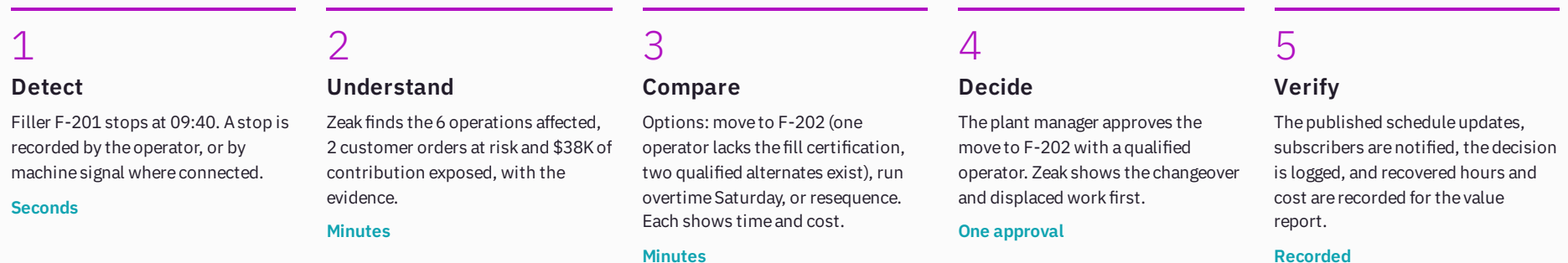
Decision layer	What is connected	Decision it enables
Demand and orders	Production orders, batches, product family, due dates, customer and demand context	What should run, and why
Materials	BOM and formula demand, on-hand, reservations, holds, expiry, inbound, transfers, alternates, staging	Can it start, and will it stay supplied?
Resources	Machines, lines, tools, shared assets, capacity, compatibility, plant and location	Where can it run?
Maintenance	Planned and unplanned maintenance, calibration, inspection, turnaround windows, spares	Is the asset truly available?
Workforce and training	Shifts, availability, skills, training, certifications, crew standards, work rules	Are the right people available and qualified?
Quality	Holds, release status, in-process results, line clearance, deviations	Is the material, equipment or batch released?
Execution	Actual start, progress, output, stops, delays, holds and finish	What changed, and what needs replanning?
Economics	Labor, material, downtime, quality, expedite, energy, WIP and contribution margin	Which recovery protects the most value?

When an input is missing, Zeak shows the gap rather than manufacturing a number. Without machine signals, OEE reads unavailable, not estimated. Without a shift calendar, labor coverage is marked incomplete. Every figure shows its source and when it was last refreshed.

A connected decision

From a machine stop to an approved recovery, with every step on the record.

An illustrative example. Names and figures are invented.

**Without a connected view**

The supervisor phones maintenance, the planner opens three systems and a spreadsheet, someone checks the training binder, and the overtime decision is made at 15:00 when the customer order is already late.

With Manufacturing Ops

The options, their constraints and their cost are on one screen within minutes. The decision is made by the person who owns it, before the delay propagates, and its value is measured afterwards.

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

The scheduling board

A production schedule you can view by time, plant, product, order, person and machine, and change with a drag.

Machines, people, crews, tools and maintenance on one board, so one move shows its effect on everything the job needs.

Capability	What it means in practice	Business value
Day to year, one schedule	Zoom the same governed schedule from shift detail to annual capacity windows	Less reconciliation between schedules and capacity plans
Slice by any dimension	Legal entity, plant, line, product family, order, machine, person, crew or shift	Every function answers its own question without rebuilding the plan
Draft, Reviewed, Frozen, Published	One controlled schedule with revision history, comparison and subscriptions	No more 'which version is current?'

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Drag and drop, with a guardrail on every move

Move an order, operation or maintenance window, and see what it does to material, maintenance, labor, changeover, lateness and cost before you save it.

What the preview shows before you confirm

Measure	What changes
Lateness	Orders that become late or recover, with new expected finish
Changeover	Setup and cleaning hours added or saved on each resource
Material	Whether material is usable, unexpired, staged and not on hold at the new time
Maintenance and calibration	Conflicts with approved maintenance windows or calibration due dates
Labor and certification	Qualified people on shift, gaps and qualified alternates
Displaced work	Other orders that move as a result, and whether they stay on time
Overtime and cost	Overtime, expedite, changeover and displacement cost

Every drop is checked

- Capability and routing: can this resource run this product?
- Maintenance and calibration: is the asset blocked or overdue?
- People: enough qualified, certified operators on shift?
- Material: usable, unexpired, staged, not on hold?
- Tools and shared assets: free at that time?
- Timing: hold times, minimum and maximum waits, frozen window
- Cost: changeover, overtime, expedite and displaced work

Nothing is final until it is confirmed

Every change, whether dragged, typed, imported, recommended or triggered by an event, is staged as pending. It reaches the published schedule, the floor and your systems only after a person confirms it, and after a second sign-off where your settings require one.

Planner tools

- Change basket: batch several moves, review together, undo and redo, confirm once
- Ripple rules move dependent steps; locked orders never move
- Ranked alternatives when a drop is invalid
- Split, merge and resequence by drag
- Type a change in plain language for the same preview
- Keyboard and touch support for tablets on the floor

What top performers measure. BCG's advanced-scheduling work emphasizes changeover minimization, OTIF and backlog balance, while treating maintenance, operator absence and raw-material availability as hard constraints. [R1]

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Calendars and scheduling, in one place

Production, maintenance, people and training each get a calendar, and they all share one set of constraints.

A drag on any calendar is checked against all the others: a maintenance move shows the production it displaces, a training session shows the coverage it removes.

Calendar or scheduling capability	What your team can do	Status
Production scheduling board	Machines, people, crews, tools and maintenance as lanes; day to year; drag, drop, split, merge, lock	In the current build: resource Gantt and move-operation what-if. Roadmap: the full board
Pending changes and confirmation	Every change is staged and becomes final only when a person confirms it	Roadmap
Secondary sign-off	A second person approves where your settings require it: frozen window, cost, late orders, gate overrides, write-back	Roadmap
Schedule versions	Draft, Reviewed, Frozen, Published; comparison; frozen, firm and open windows	Roadmap
Maintenance calendar	Day, week and month views; drag windows with production-impact preview; best-window finder; hard block	Roadmap
Workforce calendar	Drag people and crews onto shifts and operations with certification and work-rule checks; shift swaps and overtime requests	Roadmap
Training calendar	Drag training sessions onto the calendar; book attendees; see coverage and production impact	Roadmap
Plant calendars	Holidays, shutdowns, turnarounds and reduced-capacity days used by every schedule	Roadmap
Templates and recurrence	Standard weekly patterns and campaign cycles applied as drafts	Roadmap
Your own calendar	Confirmed assignments, maintenance and training in Outlook and Teams	Roadmap

One rule everywhere: nothing on any calendar is final until a person confirms it, and until a second person signs off where your settings require it. Confirmed changes are recorded with who, when and why, and only confirmed items reach the floor, your systems and people's own calendars.

Confirmation and sign-off, set your way

Every change is confirmed by the person who makes it. Some also need a second person, and you decide which.

Routine moves should stay fast. Risky ones deserve a second look. Your administrators set the rules in settings, so the product fits how your plants already govern change.

What you configure	How it works
Which changes need a second sign-off	Set in settings by plant, line, horizon and change type: production schedule, maintenance, workforce, training, order release and write-back to your systems
When it is triggered	Inside the frozen window; cost or overtime above an amount; orders made late; priority customers affected; locked work moved; maintenance, calibration, certification or release gates overridden
Who signs off	By role, plant or named person; one of a group or all of them; in sequence or in parallel; delegates for absence and an escalation path
Four eyes, for real	Nobody can sign off their own change, on any screen, phone or channel
What approvers see	The same impact preview and evidence the requester saw; approve, reject or send back with a reason; electronic signature where your quality system requires it
While it waits	Shown as pending on every calendar and never sent to the floor or your systems; time limits, reminders and escalation you choose
When it cannot wait	An urgent path for breakdowns, safety and quality holds, with sign-off required afterwards within a set time
Keeping rules honest	Policies are versioned and approved themselves; test a draft policy on past changes; see where approvals add delay without reducing risk

Nothing reaches the floor, your systems or any personal calendar until it is confirmed and, where your settings require it, signed off by someone else.

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Live schedule control

Track what is running, what moved, what is late, and what the delay will hit next.

The schedule updates from source events rather than waiting for the next planning cycle, and never implies real time when the data is stale.

Order or batch progress
62%
actual quantity or completed-step progress
from reported production

Delay
+18 min
current deviation from plan, propagated downstream
with affected orders listed

Resource state
Available
or blocked by maintenance, absence, qualification or hold
on every lane

Data freshness
2 min
source timestamp on every screen
stale data is marked stale

Capability	What it does	Why it matters
Predicted finish from actual rates	Expected finish updates from the rate the line is actually running	Earlier, more honest warning of late orders
Delay propagation	Downstream operations and orders at risk, and the earliest recoverable finish	Recovery effort goes where the delay spreads most
Early warning, 1 to 14 days out	Orders likely to miss, with the reason	Days of warning to recover or reset expectations
Stop and downtime capture	Operators record stops and reasons when machines are not connected	A downtime baseline in weeks without a hardware project
Event-driven replanning	Breakdowns, absence, shortages, holds and urgent demand trigger re-evaluation	A revised proposal in minutes, never auto-published

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Maintenance is a capacity constraint

Production capacity should already know when the machine is unavailable.

Maintenance is not an overlay added after planning. It is a first-class constraint, and the cheapest window is a production decision as much as a maintenance one.

Capability	What it does	Measures
Unified maintenance calendar	Preventive, corrective, predictive, calibration, inspection and turnaround work on the production board	Planned maintenance hours; conflicts; schedule compliance
Hard block on allocation	Approved maintenance makes the asset unavailable unless an authorized override is recorded	Blocked assignments; overrides; conflict hours
Best window finder	Proposes the windows that lose the least production value and still meet the due date	Production value displaced per maintenance hour
Usage-based forecast	Projects meter- and run-hour-based maintenance from the planned schedule	Due-maintenance collisions avoided
Readiness gate	Technician certification, parts, tools, permits and access confirmed before work starts	Wrench time; ready-on-start rate; delayed restarts
Criticality, spares and calibration	Assets ranked by impact; critical spares coverage; overdue calibration blocks use	MTTR; MTBF; spares coverage; calibration compliance
Click-to-add maintenance	Request maintenance from the board with asset, crew, parts and capacity impact	Time to create work; planning lead time

Why maintenance belongs in the schedule. McKinsey reports that maintenance technicians at many organizations spend less than half their time on tools, often because skills, parts, tools, access and work packages are not ready; its connected-maintenance work cites 10-15% lower maintenance spend and 2-3 OEE points. Deloitte reports predictive maintenance can raise uptime 10-20% and cut maintenance planning time 20-50%. [R4, R15]

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Available labor is not qualified labor

The schedule should know who is on shift, who is qualified, and who will not be by the time the job runs.

Manufacturing Ops combines HR shifts and availability with skills, training and the certification rules of the work, at the point of assignment.

Capability	Example	What happens at assignment
Shift and availability calendar	Worker A: Shift 2; unavailable 14-16 Oct	Unavailable outside shift and during leave. Leave reasons are never shown
Requirement mapping	Operation X needs certification Y; product family Z needs authorization A	The requirement travels with the work
Certification gate	The selected operator's certificate expired last week	Warning or hard block, with qualified alternates shown
Crew size and skill mix	Line 3 needs four operators, two at independent level	Labor-ready only when crew standards are met
Expiry and recertification	A certification expires before a job scheduled next month	Recertification action created; training time reserved
Labor shortage heatmap	Plant 2, Shift 3: 16 required hours, 10 qualified hours available	6-hour gap exposed before the shift starts
Overtime, fatigue and work rules	Third consecutive double shift; minimum rest not met	Flagged before save; override recorded

External evidence. In a McKinsey manufacturing case, supervisors lost 1-2 hours every shift assigning workers; dynamic scheduling removed that loss and raised on-time delivery from 50% to 90%. BCG's aerospace work emphasizes confirming workforce capacity, certifications and authorization before work begins. [R3, R12]

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Training records the schedule can use

Training evidence that lives where work is assigned, not in a binder or a separate system nobody checks.

Your learning and HR systems can stay the source. Zeak reads completions and certifications, holds them where no system exists, and uses them in every assignment.

What a training record holds

Field	Detail
Course or certificate	Name, version, issuer, internal or external
Dates	Start, completion, expiry, refresher interval
Result	Grade or rank, assessment result, observed performance
Evidence	Certificate attachment or reference; trainer and trainee signatures
Link to work	Roles, operations, equipment, products and sites it qualifies
Procedure version	The SOP or work instruction version trained on
Source	Learning system, HR, Zeak, with import time

From record to qualified assignment

- **Requirements by role:** each role carries its required courses and refresher intervals
- **Skills matrix:** trainee, supervised, independent, trainer, by operation and machine
- **Procedure-change training:** a new SOP version assigns read-and-understand training automatically
- **On-the-job sign-off:** trainer and trainee sign; edits need a reason
- **Effectiveness checks:** qualification only after the check is passed
- **Compliance dashboard:** overdue, expiring and missing training by line, shift and role
- **Cross-training planner:** who to train next to protect the bottleneck

Built for audits, without a blanket compliance claim. Quality standards such as ISO 9001, ISO 13485, IATF 16949 and AS9100 require evidence of competence; FDA 21 CFR Part 11 and EU GMP Annex 11 govern electronic records and signatures. Zeak provides records, signatures and audit trail; validation remains your decision. [R16]

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Profiles for every resource

A complete profile for every person, machine, line, tool, material, order and plant, one click from the schedule.

Each profile shows its sources and freshness, an activity timeline, current documents and comments, and a completeness score so data owners know what to fix first.

Profile	What it shows	The question it answers
People	Role, shifts, supervisor, skills and proficiency, certifications and expiry, training history, assignments, hours and overtime, qualified operations	Who can run this, and when?
Machines and assets	Capabilities, products it can run, schedule, maintenance history and calendar, calibration, performance, downtime, spares, cost rate, criticality, documents	Can this asset run this job, and what does it cost when it cannot?
Lines and work centers	Resources, crew standards, rates, changeover matrix, schedule, attainment, bottleneck history	What can this line really do?
Tools, molds, dies and fixtures	Life and usage counts, location, condition, calibration, compatible products, bookings	Is the tool available and fit for use?
Materials and lots	Specification, status, expiry and retest, holds, location, where used, supplier, coverage	Is this lot usable for this order?
Orders and batches	Timeline, genealogy, materials, people and resources used, quality events, cost	What happened to this batch?
Products	Routing or formula versions, approved resources, changeover family, yield, cost and margin	How does this product really run?
Plants, crews and shifts	Calendars, capacity by resource and skill, headcount by qualification, handover notes, measures	How do our plants and shifts compare?

Profiles respect your access rules: people see only the fields their role permits, and health or absence reasons are never displayed. Includes roadmap capabilities.

Material readiness

Run a shortage test for an item, product, plant, location or horizon, then turn the gap into an owned action.

The goal is to find the future shortage before the production order becomes late.

Question	View or measure	Action
What is short now?	Required versus available, reserved and usable quantity by BOM or formula line	Transfer, expedite, substitute or request supply
What becomes short in Q4?	Projected stockout and days or weeks of cover by item, product, site and horizon	Open a material request or purchase requisition
Which orders are affected?	Shortage, order or batch, product, promised date, economic exposure	Prioritize supply by production and service impact
Is stock really usable?	Quality-held, expiring, allocated, picked, staged and available inventory kept separate	Avoid releasing an order that will stop after it starts
Is the kit on the line?	Kit-complete and line-side status for each upcoming order	Stage before the shift, not during it
Is there an approved substitute?	Approved alternates and formula versions with qualification state	Recover without bypassing change control
Who owns recovery?	Request, PO, transfer or substitute action with owner and aging	No shortage remains only an alert

Connected to Zeak Supplier Intelligence. Where both are in use, supplier risk, inbound status and qualified alternates appear next to the shortage they affect, so the material decision and the supplier decision use the same facts.

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

The plan where the work happens

Operators and supervisors see the same plan as the planner, on the floor, in the form they need.

Leading plants put digital tools in the hands of frontline teams, not just planners. Manufacturing Ops brings the plan, its instructions and its exceptions to the line.

Operator task list

What to run next on this machine, with staged materials, current instructions and checks, on a tablet or kiosk.

Structured shift handover

Safety, quality, equipment, material and open issues handed over, acknowledged and searchable.

Andon and help requests

Help raised from the line routes to maintenance, quality or materials, with response time measured.

Tiered daily meetings

Tier 1 to 3 boards from live measures, with actions owned and escalated.

Digital work instructions

The current, approved version only, with images and video, opened from the task.

Stop and reason capture

A downtime baseline without sensors, labeled as manual so it is never confused with machine data.

Badge clock-on

Actual labor by order for cost and standards, reconciled to time and attendance.

Works offline

Short network loss on the floor does not stop work; entries sync safely.

External evidence. The World Economic Forum's Global Lighthouse Network, run with McKinsey, repeatedly highlights digital tools for frontline workers, from digital work instructions to tiered performance management, among the use cases that scale. [R17]

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

Highest-impact features

16 capabilities where plants typically find the most value first.

Ranked by the size and speed of the value they unlock and how little they ask of your systems to start. Your discovery confirms which matter most in your plants.

Feature	What changes on the floor	Measure to watch
Drag and drop with preview, confirmation and configurable sign-off	Replans in minutes; every move checked, priced and confirmed, with a second sign-off where your settings require it	Time per change; rejected conflicts; unconfirmed changes
Finite-capacity schedule engine	Dates the floor can actually hit	Feasible schedule rate; late orders
Maintenance calendar, drag and drop, hard block	No production on assets planned out of service; windows agreed on one calendar	Production-maintenance conflicts; overrides
Training record, requirement mapping, certification gate	No unqualified assignments; alternates offered instantly	Invalid assignment attempts; qualified coverage
Changeover and setup matrix	Hours recovered on the constraint every week	Changeover hours on the bottleneck
Readiness-gated order release	Orders released only when ready	Stops after start; release overrides
Horizon shortage test to owned action	Q4 shortages found now and owned until resolved	Projected shortages; shortages without owner
Early warning for late orders	One to fourteen days of warning, with the reason	Late orders; prediction accuracy
Stop and downtime capture	A downtime baseline without a sensor project	Downtime hours by reason
Skills matrix, compliance and workforce calendar	Crew plans checked against skills and training	Percent compliant; single-person skills
Person and machine profiles	Assignment and asset questions answered from one page	Time to answer; profile completeness
Spreadsheet round trip	Planners keep Excel where it helps, through the same validation	Ungoverned copies retired
Structured shift handover	Fewer repeated problems between shifts	Repeat issues; handover completion
Schedule and downtime leakage calculators	Firefighting and downtime measured in hours, then dollars	Leakage hours by lever
Value register and pilot baseline	Estimated, implemented and validated value kept apart	Validated value; time to value
Dynamics 365 connector first	Connected in days to weeks, not a separate project	Time to connect; reconciliation exceptions

Includes roadmap capabilities. **Features by topic** shows what is in the current build; availability for your scope is confirmed in your proposal and pilot.

What each role sees and decides

One fact base. Ten roles, each with a decision to make and a measure to own.

Role	Sees	Decides
COO / VP Operations	Network capacity, service risk, margin exposure, validated value	Approves capacity and recovery trade-offs; sponsors the rollout
Plant manager	Constraint, throughput, late orders, recovery options with cost	Chooses the recovery; approves frozen-window changes
Planner / scheduler	Feasible sequence, conflicts, health score, versions	Builds, compares and publishes the schedule
Shift supervisor	Live progress, delays, crew coverage, handover	Rebalances labor; raises maintenance and quality requests
Maintenance planner	Calendar, readiness, backlog, criticality, cost of downtime	Places maintenance in the least costly window
Materials / warehouse	Shortage horizon, usable inventory, staging	Owns recovery actions; stages kits
Training / HR	Compliance, expiries, skills coverage, cross-training needs	Schedules training that protects output
Quality	Holds, release status, deviations, line clearance	Releases or holds; approves substitutes
Finance	Leakage by lever, value states, cost per good unit	Agrees baselines; validates realized value
IT	Connection health, access, write-back controls, audit	Enables connectors and write-back objects

What each industry needs

Every functional area serves every industry. Some carry industry-specific capabilities on top.

Functional area	Pharma & biotech	Medical devices	Chemicals & process	Food & beverage	Cosmetics & CPG	Semiconductors	Aerospace & defense	Automotive & discrete	Industrial & electrical	General mfg
Intelligence & Command Center	●	●	●	●	●	●	●	●	●	●
Production Planning & Scheduling	●	●	●	●	●	●	●	●	●	●
Scheduling Board, Capacity & What-if	●	●	●	●	●	●	●	●	●	●
Material Readiness & Procurement Handoff	●	●	●	●	●	●	●	●	●	●
Shop Floor & Live Progress	●	●	●	●	●	●	●	●	●	●
Maintenance & Asset Availability	●	●	●	●	●	●	●	●	●	●
Workforce, Shifts, Training & Certifications	●	●	●	●	●	●	●	●	●	●
Quality, Yield & Traceability	●	●	●	●	●	●	●	●	●	●
Bottlenecks, Risk & Recovery	●	●	●	●	●	●	●	●	●	●
Cost, Margin, Energy & Value	●	●	●	●	●	●	●	●	●	●
External Supply & Outsourced Production	●	●	●	●	●	●	●	●	●	●
Workflow, Collaboration & AI Agents	●	●	●	●	●	●	●	●	●	●
Self-Service, Reporting & Automation	●	●	●	●	●	●	●	●	●	●
Industry Configuration & Starter Packs	●	●	●	●	●	●	●	●	●	●
Integrations, Governance & Deployment	●	●	●	●	●	●	●	●	●	●
Resource Profiles	●	●	●	●	●	●	●	●	●	●
Frontline Operations	●	●	●	●	●	●	●	●	●	●

● core capabilities apply ● plus one industry-specific capability ● plus two or more industry-specific capabilities. Starter packs configure default rules, measures and gates for each industry; the core product stays the same.

03

How value is created and proven

Value is measured in operational units first, then translated into dollars only where your Finance team agrees the formula. Estimated, implemented and validated value are never added together.

Four ways to create value
An illustrative value model
A worked business case

How Zeak calculates value
A value case for everyone
Why the approach is different



Four ways to create value

Four levers, measured in operational units first.

Illustrative examples on a mid-size plant. Dollars come only from your own rates, agreed with Finance; the value model and worked case on the next pages show the method.

Recover capacity**125 h**

a year on the constraint line from sequencing, maintenance windows and fewer stops

Valued at your contribution per constraint hour, and only where demand exists to use it.

Reduce cost**10%**

less addressable maintenance spend, plus less overtime and expedite

Counted only when Finance sees the avoided spend in actuals or budget.

Protect service**3**

fewer late orders a month from early warning and costed recovery

Valued as contribution margin protected, never as revenue and margin both.

Release cash**3 days**

shorter release lead time, less WIP and excess stock

One-time cash, kept separate from recurring P&L.

Headcount language. Labor savings are reported as hours released, loaded labor dollars and FTE-equivalent capacity. Any actual change in headcount or hiring is an enterprise staffing decision, never an automatic software outcome.

An illustrative value model

Dollars saved, hours saved, capacity recovered and FTE-equivalent capacity on the same page.

These are arithmetic illustrations using external benchmark ranges. They are not product forecasts and must not be added together without removing overlap.

Value lever	Illustrative formula	Hours or capacity	FTE-equivalent	Illustrative \$	Evidence and caveat
Planning labor released	12 planners and supervisors × 1.25 h/day × 250 days × 50%	1,875 h/yr	0.90	~\$131K at \$70/h	BCG scheduling benchmark [R1]. Capacity release, not an assumed layoff
Shift assignment effort	2 plants × 2 shifts × 1.5 h/shift × 250 days	1,500 h/yr	0.72	~\$98K at \$65/h	McKinsey: 1-2 h/shift removed [R3]. Do not add to planning labor where tasks overlap
Bottleneck capacity recovered	0.5 production h/day × 250 days	125 h/line/yr	Resource capacity	~\$375K at \$3,000/h contribution	BCG 30-min/day example [R1]; depends entirely on local contribution and demand
Changeover hours recovered	300 changeovers/yr × 0.5 h saved on the constraint	150 h/yr	Resource capacity	~\$225K at \$1,500/h contribution	Illustrative; uses your changeover matrix and contribution rate
Maintenance cost opportunity	\$4.0M annual addressable maintenance cost × 10%	-	Maintenance resources	~\$400K/yr	Bain 10% maintenance-cost example [R5]; needs maintenance workflow and data in scope
Cost of poor quality	\$2.0M annual COPQ × 10-20%	-	Material, labor, capacity	~\$200K-\$400K/yr	Directional, consistent with McKinsey quality-cost ranges [R2]
Unplanned downtime	1,000 downtime h/yr × 20-40% × \$2,000/h	200-400 h	Machine capacity	~\$400K-\$800K/yr	Accenture range [R9]; needs stop capture or machine signals
Release lead time (cash)	\$40M annual batch cost × 3 days ÷ 365	-	-	~\$330K one-time cash	Illustrative; carrying-cost benefit (~\$33K/yr at 10%) is the recurring P&L effect

FTE-equivalent uses 2,080 productive hours per FTE, an assumption to be replaced with your own standard. Cash release is shown separately from recurring P&L effect.

A worked business case

One plant, three lines, two shifts: improvement measured in units first, then in dollars.

Illustrative. The structure is what matters: every line has a baseline, an after, a unit, a formula and a validation state.

Lever	Baseline	After	In operational units	In dollars	State
Changeover sequencing on the filler (constraint)	11.2 h/week changeover	8.8 h/week	125 h/yr recovered	\$312K capacity opportunity at \$2,500/h	Estimated until output is sold
Maintenance hard block and best window	5 production-maintenance conflicts/month	1/month	36 h/yr of disruption avoided	\$54K overtime and expedite avoided	Finance validates against actuals
Certification gate and skills matrix	9 invalid assignments/quarter found in audit	0 saved invalid	Rework and deviation hours avoided	Not monetized; compliance risk reduced	Reported as risk, not savings
Early warning and costed recovery	6 late orders/month	3/month	36 late orders avoided per year	\$110K contribution protected	Margin, not revenue, counted
Planner and supervisor effort	26 h/week rebuilding and chasing	12 h/week	700 h/yr released	0.34 FTE-equivalent · \$47K at \$67/h	Capacity release, no headcount assumed

Capacity opportunity

\$312K

counts only when recovered hours meet real demand

Cost avoided and margin protected

\$164K

\$54K cost avoided plus \$110K margin protected, validated by Finance

Capacity released

700 h

0.34 FTE-equivalent, redeployed to improvement work

Totals are deliberately not summed into one number: capacity opportunity, cost avoided, margin protected and released effort are different kinds of value with different validation rules.

How Zeak calculates value

Every number has a published formula, a source in your data, and a validation state.

Measure	Formula or interpretation	Required caveat
Hours saved	Baseline manual effort minus post-adoption manual effort	Use system logs or time study; exclude work shifted elsewhere
FTE-equivalent capacity	Hours released ÷ annual productive hours per FTE	Capacity released, not headcount eliminated
\$ labor capacity	Hours released × approved loaded labor rate	Not P&L savings unless labor cost or hiring actually changes
Machine hours recovered	Baseline lost time minus post-adoption lost time	Valued only against constrained, usable demand
\$ capacity opportunity	Recovered bottleneck hours × approved contribution per hour	Opportunity, not revenue, until output is sold
\$ cost avoided	Avoided overtime, expedite, maintenance, scrap, rework or contractor spend	Finance validates avoided transaction or budget impact
\$ margin protected	Contribution margin on orders protected by implemented recovery	Never count both revenue and margin for the same event
Cash released	Inventory or WIP reduction at cost; days removed × daily cost	One-time cash kept separate from recurring P&L
Resources conserved	Material scrap avoided, energy per unit reduced, spare effort avoided	State the physical unit and approved unit cost separately

Three value states, never mixed: estimated (identified, not acted on), implemented (action taken, effect not yet confirmed) and validated (confirmed by Finance against the agreed baseline).

A value case for everyone who has a say

The same numbers answer four different questions.

For the CFO

Will it reach the P&L? Baselines agreed before the pilot, published formulas, three value states kept separate, overlap removed, and Finance validating realized value.

For the COO and plant manager

Will it get more out of the plant? Recovered constraint hours, fewer late orders, fewer stops after start and faster recovery, in your own measures.

For planners and supervisors

Will it give me time back? Hours of rebuilding, re-keying and chasing released, measured from system logs, not surveys.

For IT, Quality and HR

Will it stay in control? Read-only start, approvals, audit trail, qualification gates enforced, no headcount case, your cloud, full export.

You see the value in your own numbers **before** you commit to more. If the pilot does not show it, you stop and keep everything you learned.

Why the approach is different

ERP tells you what happened. Point tools see one dimension. Manufacturing Ops connects them into a decision you can act on and prove.

Today's tool	What it does well	What Manufacturing Ops adds
ERP	Records orders, inventory and cost; plans at infinite capacity	Decision layer on top: finite capacity, every constraint, cost of each change
MES	Executes and records production on the floor, often site by site	Network-wide plan, readiness and value; reads MES events, never controls machines
Scheduling tools (APS)	Optimize sequences, often without maintenance, training or cost context	Optimization plus maintenance, certification, quality and cost in one board, with approvals
CMMS / EAM	Plans and records maintenance work	Maintenance as a production capacity decision, priced in lost production value
Learning and HR systems	Hold training and shifts, disconnected from assignments	Qualification enforced at the point of assignment
Spreadsheets	Flexible and familiar, ungoverned and person-dependent	Governed round trip, then a board planners prefer

Keep what works. The aim is not to displace systems your teams depend on, but to remove the gaps between them that cost capacity and margin, without customizing your ERP or funding a costly custom build.

04

How customers start

Every engagement is shaped around your problem. We prove the economics with your own data before asking for a larger commitment.

How customers start
A controlled path to production
Trust is part of the product

Who delivers Zeak
Questions buyers ask
Hard questions, answered plainly

How customers start

Every engagement starts with your problem, and is shaped around your plant.

There is no fixed pilot package. We agree the problem, the people, the data and how success will be measured with you, and the timing follows from that: the most complex take weeks, most take less.

Your problem first

Ascheduling, maintenance, staffing or material problem your team already feels, with a named owner on your side.

Your data, your systems

Read-only connection to the systems you already run; where a source is missing, Zeak runs that part standalone or shows the gap.

Economics before commitment

A baseline your Finance team agrees, so the value is measured in your own numbers before any larger commitment.

In your environment

Solutions are delivered into your own environment for hands-on evaluation; you decide when anything moves to production.

We are willing to co-invest in qualified pilots, so you can see the value on your own data before a larger commitment.

A controlled path to production

Each phase ends with evidence you can inspect, not a date on a plan.

	Phase	What happens	Exit evidence	Your team
1	Discover	Choose one decision journey, owner, line or plant and measurable baseline. Confirm data and rules (maintenance, certification, changeover).	Signed pilot charter: owner, baseline, success measures	Decision owner, Finance, IT
2	Connect	Read approved orders, resources, calendars, maintenance, training and quality data. Reconcile totals, definitions and freshness.	Reconciliation report: totals match source within tolerance	IT and data owners
3	Configure	Set roles, views, rules, gates, thresholds, approval routes and write-back boundaries.	Configured board, rules and approval routes	Planning and plant team
4	Validate	Test decisions with planning, maintenance, HR, quality and Finance. Review security, access and audit evidence. Regulated scope follows your validation approach.	User acceptance; security and audit evidence pack	Business users, security, quality
5	Deploy and expand	Move the approved scope to production at your pace, monitor adoption and value, then extend by line, plant and capability.	Value report; next line or plant case approved	Sponsor, Finance

Zeak delivers production-ready solutions into a test or recent production-copy environment for hands-on evaluation; you move to production when you are satisfied. Exit criteria are proposed defaults agreed during Discover.

Delivery and support

One team, one method, from the first workshop to long-term use.

The people who build Manufacturing Ops implement and support it.

What	How it works
Delivery	One team of senior practitioners from Discover through rollout; configuration, connectors, rules and value baseline are ours to deliver
User training	Role-based sessions for planners, supervisors, maintenance and administrators; a sandbox on a copy of your data; in-app guidance
Go-live support	Hands-on support on site or remote through the first weeks of production use, with daily check-ins at the start
Ongoing support	Defined response times by severity, a named contact, release notes and a tested upgrade path for each release
Adoption and value reviews	Usage by site and role alongside validated value, reviewed with your sponsor on a regular cadence
Validation support	For regulated scope: traceability matrix, risk assessment and test scripts aligned to your validation approach

Support terms and response times are set out in your proposal.

Trust is part of the product

Six controls that let a COO, a CISO, a quality head and a works council say yes.

Every number is traceable

Every measure comes from one calculation layer with published formulas, its source and its freshness. Missing inputs read unavailable, never zero.

Access follows your rules

Roles, legal entities, plants, sites and sensitive fields are enforced in screens, exports, APIs and AI answers alike.

People approve what matters

Every change is confirmed by a person. Changes your settings flag, such as overriding a maintenance block or certification gate or writing to your systems, also need a sign-off from someone else, never the requester.

Everything is recorded

Moves, overrides, approvals, write-backs and value validations are attributable and time-stamped; retention and testing align with your requirements.

Your cloud, your controls

Deployed in your cloud or Zeak's, with your identity provider, under SOC 2 and ISO 27001 controls and GDPR-aligned data handling. Hosting responsibilities are defined up front.

AI within limits

Each capability runs at the autonomy stage you set. AI never publishes a schedule, qualifies a person or overrides a block.

People data is handled with care. Zeak uses availability, qualifications and hours for scheduling. It never displays health or absence reasons, and works-council or union requirements are configured as rules, not workarounds. Regulated workflows, including electronic records and signatures, require use-case-specific design and validation; no blanket compliance claim is made here.

Who delivers Zeak

Built and delivered by people who have run enterprise systems in manufacturing and regulated industries for decades.

Zeak is built and delivered by XcelPros. Each of our co-founders brings more than 25 years of experience leading SAP, Oracle and Microsoft Dynamics ERP, CRM and systems integration programs, including prior work at Accenture and Oracle.

25+ years each

ERP, CRM and systems integration across SAP, Oracle and Microsoft Dynamics, from strategy and design through go-live and support.

Manufacturing depth

Production, supply chain and quality processes in pharmaceuticals, life sciences, chemicals, food and beverage, consumer goods and other industries.

Shipped, not slideware

Complex software products designed, built and released for highly regulated industries.

One accountable team

The people who build Zeak implement and support it, so decisions are made by those who know the product best.

You work with senior practitioners who have done this before: in your industry, on your platforms, under the controls your auditors expect.

Design partners. Manufacturing Ops is new. We are inviting a small number of manufacturers to shape it as design partners, with Zeak willing to co-invest in qualified pilots.

Questions buyers ask

The questions we hear first, answered plainly.

Will Zeak replace our ERP, MES or scheduling tool?

No. It connects the systems you have and improves the decisions that cross them. They stay the systems of record.

Can we start with Microsoft Dynamics 365?

Yes. Dynamics 365 production, resources, calendars and asset management are the first connector. Your mapping and readiness are verified during Connect.

Does it work with SAP, Oracle, NetSuite or our MES?

Yes. Zeak connects to any platform through its integration layer. The connections for your environment are confirmed during Connect.

Do we need machine sensors?

No. Start with ERP, maintenance and labor data and operator stop capture. OEE reads unavailable until machine signals are connected, rather than being estimated.

Can our planners keep using Excel?

Yes. A governed round trip lets them export, edit agreed fields and import through the same validation as the board.

Does drag and drop change our ERP?

Not until write-back is enabled for that object and approved. Until then, the published schedule lives in Zeak.

How soon will we see something real?

It depends on the project. The most complex pilots take weeks; most take less. A live board and constraint view comes early in the pilot.

Can a change go live by accident?

No. Every change is pending until a person confirms it. Changes your settings flag, such as moves inside the frozen window or overrides of a maintenance block, also need a sign-off from someone else, and nobody can sign off their own change.

How do we know it paid for itself?

Finance agrees the baseline up front, actions are tracked, overlap is removed and Finance validates realized value.

Hard questions, answered plainly

The questions a careful buyer should ask us, with the limitations stated up front.

Is every feature in this document available today?

No. This overview describes the full capability set. Features by topic marks what is in the current build and what is on the roadmap; availability for your scope is confirmed in your proposal and verified in your pilot.

What happens when Zeak is wrong?

Rules, predictions and recommendations can be wrong. That is why Zeak advises before it acts, shows its evidence, logs every accept and reject, and lets you step back a stage at any time.

Will this be used to cut jobs?

Zeak reports hours released and FTE-equivalent capacity. What you do with that capacity is your decision; most plants redeploy it to improvement work and growth.

Does Zeak make us compliant?

No software does. Compliance comes from a validated system used under your procedures. Zeak provides records, signatures, approvals and audit trail.

What will this cost our team?

Time: a decision owner, a Finance contact, a few hours a week from planning and the plant, and IT for access. A pilot is never free to the people running it.

Is Zeak an MES?

No. Zeak plans, checks, records and measures. It does not control equipment or replace your execution system.

Will it work with our version of our ERP?

Connectors are versioned and tested per system and release. We confirm your system, version and customizations in Discover, and start read-only.

Can we stop?

Yes, at any stage, and keep every record. Everything exports in open formats at any time.

05

Features by topic

Every Manufacturing Ops feature, grouped by the job it does for your team: 229 features across 17 topics, each marked as in the current build or on the roadmap.

- | | |
|---|---|
| 1. Intelligence & Command Center | 10. Cost, Margin, Energy & Value |
| 2. Production Planning & Scheduling | 11. External Supply & Outsourced Production |
| 3. Scheduling Board, Capacity & What-if | 12. Workflow, Collaboration & AI Agents |
| 4. Material Readiness & Procurement Handoff | 13. Self-Service, Reporting & Automation |
| 5. Shop Floor & Live Progress | 14. Industry Configuration & Starter Packs |
| 6. Maintenance & Asset Availability | 15. Integrations, Governance & Deployment |
| 7. Workforce, Shifts, Training & Certifications | 16. Resource Profiles |
| 8. Quality, Yield & Traceability | 17. Frontline Operations |
| 9. Bottlenecks, Risk & Recovery | |



Topic 1 of 17

Intelligence & Command Center

Start every shift with what needs a decision, not a report to read.

8 features in this topic, 3 in the current build. Each is described below.

Operational Command Center Current build

Your team can see orders, schedule, material, operations, resources, value at risk and prioritized action signals in one landing view.

What you get: One daily operating picture that directs attention to the constraints with the largest service or financial effect.

[All industries](#)

AI Manufacturing Assistant Current build

Your team can ask natural-language questions across orders, BOMs and formulas, materials, operations, resources and risks, and every answer links to its source records.

What you get: Faster investigation without hiding the source records behind the answer.

[All industries](#)

AI insights and recommended actions Current build

Your team gets operational findings ranked by severity, urgency and value at stake, each linked to an evidence-backed next action.

What you get: Scarce management capacity goes to the disruption, margin loss or service risk that matters most.

[All industries](#)

Universal search and trace Roadmap

Your team can search orders, products, items, batches, resources, people, maintenance events, quality records and cost facts, within their role and site scope.

What you get: Find the record and its connected context in seconds.

[All industries](#)

Role-based home views Roadmap

Each role (plant manager, planner, supervisor, maintenance, quality, materials, finance) starts on a default view of the measures and queues it owns, and can rearrange it.

What you get: Each person reaches their decision faster while the plant keeps one set of numbers.

[All industries](#)

Highlights

- Operational Command Center
- AI Manufacturing Assistant
- AI insights and recommended actions
- Universal search and trace
- Role-based home views

Network command view Roadmap

Network and operations leaders can compare plants on attainment, capacity, OEE where available, labor coverage, shortages and value at risk.

What you get: Load and investment decisions made across the network on comparable facts.

[All industries](#)

Ask about this record Roadmap

On any order, batch, machine, person or shortage, your team can ask 'why is this late?', 'what if I move it?' or 'who can run it?' and get an answer grounded in that record.

What you get: Investigation starts from the problem in front of you, not a blank prompt.

[All industries](#)

Personal exception inbox Roadmap

Each user has one queue of exceptions they own (late orders, shortages, conflicts, expiring certifications) with due dates and aging.

What you get: Nothing important waits because nobody knew it was theirs.

[All industries](#)

Topic 2 of 17

Production Planning & Scheduling

One governed schedule from today's shift to next year's capacity.

22 features in this topic, 3 in the current build. Each is described below.

Production plan queue Current build

Planners can prioritize open orders using schedule date, status, material readiness, machine readiness, labor readiness and demand context.

What you get: Planners see the next feasible work and the reason a job cannot start.

[All industries](#)

Production order register Current build

Your team can search, filter and export production orders with product, site, status, quantity, operation and material progress.

What you get: One auditable register for order status and exceptions.

[All industries](#)

Demand-to-production lineage Current build

Planners can trace a production order back to the demand signal that created it and forward to the customer demand it affects, where data exists.

What you get: Schedule decisions can reflect service and economic priority.

[All industries](#)

Constraint-aware sequencing Roadmap

Planners get a recommended feasible sequence that respects material, machine, labor, maintenance, setup and changeover, quality and due-date constraints.

What you get: A more feasible schedule with fewer avoidable changes, waits and expedite decisions.

[All industries](#)

Multi-horizon master schedule Roadmap

Your team can view the same schedule by day, week, month, quarter and year, with time-bucket rollups and zoom.

What you get: One schedule from today through annual capacity planning.

[All industries](#)

Highlights

- Production plan queue
- Production order register
- Demand-to-production lineage
- Constraint-aware sequencing
- Multi-horizon master schedule

Slice-and-dice schedule dimensions Roadmap

Your team can filter and group the schedule by legal entity, plant, site or location, product, product line or family, order or batch, operation, machine or resource, worker or crew, and shift.

What you get: Every function can answer its own question without rebuilding the plan.

[All industries](#)

Publish and share production schedule Roadmap

Planners can move a schedule through Draft, Reviewed, Frozen and Published versions with an effective timestamp, owner, change log, comments and subscriptions.

What you get: One published schedule and a visible record of what changed.

[All industries](#)

Schedule comparison and variance Roadmap

Your team can compare any two versions and see moved orders, changed resources, changed start and finish, quantity, and expected service and cost impact.

What you get: Teams can separate necessary replanning from avoidable instability.

[All industries](#)

Real-time schedule progress overlay Roadmap

The schedule shows actual progress, percent complete, actual start, expected finish, delay and the latest source timestamp.

What you get: The schedule becomes a live execution view rather than a once-a-day artifact.

[All industries](#)

Event-driven replanning Roadmap

When a machine goes down, a worker is absent, a material becomes short, quality places a hold, maintenance changes or urgent demand arrives, affected work is re-evaluated automatically.

What you get: Faster response with lower recovery cost and fewer cascading delays.

[All industries](#)

Topic 2 of 17: feature detail (continued)

Production Planning & Scheduling

Finite-capacity schedule engine Roadmap

Zeak calculates start and finish times against real capacity across machines, labor, tools and calendars, forward or backward from due dates.

What you get: Dates the floor can actually hit, and earlier warning when they cannot.

[All industries](#)

Scenario workspace Roadmap

Planners can copy the live plan into a private scenario, change demand, capacity or rules, and compare scenarios side by side on service, cost, utilization and changeovers.

What you get: Better options compared on the same numbers before anything changes.

[All industries](#)

Changeover and setup matrix Roadmap

Your team can maintain sequence-dependent setup and cleaning times (product family, allergen, color, size, potency, grade) and use them in sequencing and impact preview.

What you get: Sequences that recover hours every week without new equipment.

[Chemicals & process, Food & beverage, Pharma & biotech, Cosmetics & CPG, Automotive & discrete](#)

Time fences and freeze rules Roadmap

Planners can set frozen, firm and open windows per plant or line, and define who may change work inside each window.

What you get: A stable near-term plan with flexibility where it is cheap.

[All industries](#)

Rough-cut capacity and S&OP handoff Roadmap

Your team can compare monthly and quarterly demand with capacity by plant, line and skill, and hand the result to sales and operations planning.

What you get: Capacity conversations happen months before the shortage, not during it.

[All industries](#)

Capable-to-promise date Roadmap

For a new or urgent order, your team can see the earliest feasible date given current capacity, material and the frozen window, and which orders it would displace.

What you get: Promises the plant can keep, with the trade-off visible.

[All industries](#)

Schedule health score Roadmap

Each schedule version shows feasibility, hard conflicts, late orders, changeover hours, utilization balance and stability on one scorecard.

What you get: A shared, objective view of plan quality before it is published.

[All industries](#)

Multi-level pegging Roadmap

Your team can see dependencies across intermediates, sub-assemblies and batches so a delay upstream shows its effect on every downstream order.

What you get: Recovery effort goes to the upstream order that unblocks the most output.

[Chemicals & process, Pharma & biotech, Automotive & discrete, Aerospace & defense, Industrial & electrical](#)

Plant calendars and exceptions Roadmap

Your team can maintain plant holidays, shutdowns, turnarounds, reduced-capacity days and local exceptions that every schedule uses.

What you get: One source of working time for planning, maintenance and labor.

[All industries](#)

Recurring schedule templates Roadmap

Planners can save standard weekly patterns, campaign cycles and shift-based templates and apply them to a horizon as a draft.

What you get: Routine plans built in minutes, with the same guardrails.

[All industries](#)

Readiness-gated order release Roadmap

Orders are released to the floor only when material, people, equipment, maintenance and quality gates are all met, or an authorized person releases with a recorded reason.

What you get: Fewer stops after start, and release becomes a control point rather than a habit.

[All industries](#)

Standards drift detection Roadmap

Zeak compares actual run and setup times with routing standards and proposes corrections where they consistently differ.

What you get: More accurate dates and capacity, and standards maintained from evidence.

[All industries](#)

Topic 3 of 17

Scheduling Board, Capacity & What-if

Drag, drop and see the consequence before you commit.

19 features in this topic, 3 in the current build. Each is described below.

Resource schedule Gantt Current build

Your team can see scheduled operations and reserved capacity by resource over time.

What you get: A visible load picture by machine and resource.

[All industries](#)

Capacity load table Current build

Your team can compare scheduled hours, registered hours, operations and order load by resource.

What you get: Capacity can be rebalanced before overtime or lateness occurs.

[All industries](#)

Move-operation what-if Current build

Your team can simulate moving an operation to another resource before committing.

What you get: Test a move before disrupting the live schedule.

[All industries](#)

Capability-aware routing Roadmap

Work is matched only to resources that meet capability, tooling, location, maintenance and workforce constraints.

What you get: Higher schedule feasibility and fewer reassignments.

[All industries](#)

Drag-and-drop rescheduling Roadmap

Authorized users can drag production orders, operations and maintenance windows across time and resources with immediate constraint validation.

What you get: Fast, visual replanning with guardrails.

[All industries](#)

Pre-commit impact preview Roadmap

Before a move is saved, your team sees the change in lateness, material readiness, maintenance conflict, labor and certification fit, changeover, overtime and cost.

What you get: Users see the trade-off before they commit it.

[All industries](#)

Highlights

- Resource schedule Gantt
- Capacity load table
- Move-operation what-if
- Capability-aware routing
- Drag-and-drop rescheduling

Plant and location capacity heatmap Roadmap

Your team can see capacity, utilization, maintenance blocks, labor shortages and material constraints rolled up by plant and location.

What you get: Work can be shifted to the plant or location with the best feasible capacity.

[All industries](#)

Multi-lane scheduling board Roadmap

Planners can show machines, people, crews and tools as lanes on one board, pin the lanes they care about, and see how one move affects each lane.

What you get: One board where every resource the job needs is visible together.

[All industries](#)

Change basket with undo and redo Roadmap

Planners can make several moves, review their combined impact, undo or redo any step, and commit them together.

What you get: Complex replans done in minutes, reviewed as one decision.

[All industries](#)

Ripple and snap rules Roadmap

When an operation moves, dependent operations follow according to rules (minimum and maximum wait, hold times, transfer times, same-resource sequencing).

What you get: Faster edits that keep process timing valid, including hold-time limits.

[Pharma & biotech](#), [Chemicals & process](#), [Food & beverage](#), [Semiconductors](#)

Split, merge and resequence Roadmap

Planners can split an order across resources or shifts, merge compatible orders or batches, and resequence by drag.

What you get: More options to protect due dates without re-keying.

[All industries](#)

Topic 3 of 17: feature detail (continued)

Scheduling Board, Capacity & What-if

Visual conflict layer Roadmap

The board marks maintenance blocks, certification gaps, material shortages, quality holds, overloads and frozen-window violations with distinct, accessible markers.

What you get: The planner sees what is wrong with the plan at a glance.

[All industries](#)

Ranked alternatives on drop Roadmap

When a move is invalid or costly, Zeak offers ranked alternative resources or times that are qualified and feasible.

What you get: The best feasible option is one click away.

[All industries](#)

Secondary resources: tools, molds, dies and fixtures Roadmap

Your team can plan tools, molds, dies, fixtures and test equipment as constrained resources alongside machines and people.

What you get: Fewer starts that stop for a missing tool.

[Automotive & discrete](#), [Industrial & electrical](#), [Aerospace & defense](#), [Semiconductors](#), [Medical devices](#)

Shared assets and utilities Roadmap

Your team can model shared constraints such as clean-in-place stations, tanks, cleanrooms, test chambers and utilities.

What you get: Plans that respect the constraints process engineers know about.

[Chemicals & process](#), [Food & beverage](#), [Pharma & biotech](#), [Semiconductors](#)

Board accessibility and touch Roadmap

The scheduling board supports keyboard-only operation, screen readers and touch on tablets.

What you get: The plan can be used where the work happens.

[All industries](#)

Pin and lock work Roadmap

Planners can lock an order, batch or slot (customer commitment, validation batch, audit run) so optimizers and other users cannot move it.

What you get: Commitments stay where they were promised.

[All industries](#)

Pending changes and confirmation Roadmap

Every schedule change (drag and drop, typed, imported, recommended or event-driven) is staged as pending, visible to the planner and affected owners, and becomes final only when a person confirms it. Changes above configured thresholds also need approval.

What you get: Fast editing with no accidental changes: nothing is final until someone confirms it.

[All industries](#)

Drag-and-drop workforce calendar Roadmap

Supervisors can assign people and crews to shifts, lines and operations by drag on a workforce calendar, with certification, work-rule and availability checks before confirmation.

What you get: Labor and production plans that stay in step.

[All industries](#)

Topic 4 of 17

Material Readiness & Procurement Handoff

Find tomorrow's shortage today, and give it an owner.

13 features in this topic, 3 in the current build. Each is described below.

Material readiness funnel Current build

Planners can convert BOM and formula demand into open lines, covered lines, ready orders and items short.

What you get: Planners know which orders can run and which materials block them.

[All industries](#)

Shortage root cause by BOM or formula line Current build

Your team can see required, available, reserved and short quantity by item, warehouse and production order.

What you get: A direct path from order risk to the material causing it.

[All industries](#)

Warehouse demand view Current build

Warehouse teams can see open material demand grouped by consumption warehouse or location.

What you get: Earlier staging and transfer decisions.

[All industries](#)

Usable inventory state Roadmap

Your team can separate on-hand, reserved, quality-held, allocated, picked, staged, in-transfer and available-to-promise inventory where source systems provide it.

What you get: Material readiness reflects usable stock, not just quantity on hand.

[All industries](#)

Horizon shortage report Roadmap

Your team can run a shortage test by item, product, product line, order, plant or location and horizon, such as Q4 or the next 90 days.

What you get: Materials teams can intervene before the start date is at risk.

[All industries](#)

Highlights

- Material readiness funnel
- Shortage root cause by BOM or formula line
- Warehouse demand view
- Usable inventory state
- Horizon shortage report

Shortage-to-action handoff Roadmap

From a shortage, your team can create or route a material request, purchase requisition or PO request, expedite, transfer or approved substitute.

What you get: Shorter time from detection to an owned recovery action.

[All industries](#)

Projected material coverage Roadmap

Your team can see projected coverage in days and weeks using on-hand, firm inbound, transfers, reservations and scheduled consumption.

What you get: Shortage risk is visible in time, not only in quantity.

[All industries](#)

Staging and kitting readiness Roadmap

Your team can see whether kits and line-side materials are picked, staged and complete for each upcoming order.

What you get: Fewer stoppages after start and less supervisor chasing.

[Automotive & discrete](#), [Aerospace & defense](#), [Industrial & electrical](#), [Medical devices](#)

Expiry- and lot-aware readiness Roadmap

Readiness accounts for shelf life at time of use, retest dates, lot status and first-expiry-first-out rules.

What you get: Less scrap and fewer batches started with material that cannot be used.

[Pharma & biotech](#), [Food & beverage](#), [Chemicals & process](#), [Cosmetics & CPG](#), [Medical devices](#)

Approved substitutes and alternate formulas Roadmap

Your team can see approved substitute materials and alternate BOM or formula versions, with their qualification state, when a shortage opens.

What you get: Faster recovery without bypassing change control.

[Pharma & biotech](#), [Chemicals & process](#), [Food & beverage](#), [Cosmetics & CPG](#), [Medical devices](#)

Topic 4 of 17: feature detail (continued)

Material Readiness & Procurement Handoff

Excess and slow-moving stock tied to the schedule Roadmap

Your team can see inventory that the schedule will not consume within the horizon, with its value and carrying cost.

What you get: Cash released from stock the plan does not need.

[All industries](#)

Engineering change effectivity Roadmap

When a routing, BOM or formula change takes effect, your team sees the scheduled orders affected, the material and training implications, and whether to run old or new versions.

What you get: Controlled cut-ins with no surprises on the floor.

[Pharma & biotech](#), [Medical devices](#), [Aerospace & defense](#), [Automotive & discrete](#), [Chemicals & process](#), [Food & beverage](#)

Label and artwork readiness Roadmap

Approved labels, packaging and artwork become a readiness gate for packaging operations.

What you get: Fewer packaging-line stops and fewer labeling errors.

[Pharma & biotech](#), [Cosmetics & CPG](#), [Food & beverage](#), [Medical devices](#)

Topic 5 of 17

Shop Floor & Live Progress

The schedule becomes a live view of what is actually happening.

9 features in this topic, 3 in the current build. Each is described below.

In-flight operations view Current build

Supervisors can see operations in progress, active resources, average progress, orders in flight and bottleneck flags.

What you get: Faster detection of stalled work and uneven load.

[All industries](#)

Started operations register Current build

Your team can list active operations by order, product, resource, start and progress.

What you get: A clean actual-versus-plan fact base.

[All industries](#)

Production lifecycle status flow Current build

Your team can track orders through created, cost-estimated, scheduled, released, started, reported finished and completed.

What you get: Stalled orders and long dwell become visible.

[All industries](#)

Batch and order live progress Roadmap

Your team can see each order or batch completion as quantity or step progress, with step-level status and expected completion.

What you get: One live view of where each order or batch is and how far it has progressed.

[All industries](#)

Delay propagation and impact Roadmap

When an operation slips, Zeak calculates downstream operations and orders at risk and the earliest recoverable finish.

What you get: Recovery effort goes where delay propagates most.

[All industries](#)

Highlights

- In-flight operations view
- Started operations register
- Production lifecycle status flow
- Batch and order live progress
- Delay propagation and impact

Event timeline and exception capture Roadmap

Your team can record holds, breakdowns, changes, handoffs, delays and operator notes against the order or batch timeline.

What you get: A factual history for learning and accountability.

[All industries](#)

Predicted finish from actual rates Roadmap

Expected finish updates from actual run rates, not the standard, with the confidence range shown.

What you get: Earlier, more honest warning of late orders.

[All industries](#)

Stop and downtime reason capture Roadmap

Operators and supervisors can record stops, reasons and durations by resource when machine telemetry is not connected.

What you get: A downtime baseline in weeks without a hardware project.

[All industries](#)

Governed production reporting Roadmap

Authorized users can report quantity, scrap and labor time from Zeak, written back to the ERP or MES only where write-back is enabled.

What you get: One place to see the plan and record what happened.

[All industries](#)

Topic 6 of 17

Maintenance & Asset Availability

Production capacity already knows when the machine is unavailable.

19 features in this topic, 1 in the current build. Each is described below.

Machine performance baseline Partly in current build

Your team can see machine resources, scheduled and registered hours, bottleneck flags and available efficiency facts; OEE shows as unavailable when telemetry inputs are missing.

What you get: A reliable baseline now, with a clear path to live OEE when telemetry arrives.

[All industries](#)

Machine telemetry and OEE Roadmap

Zeak connects run and idle, cycle, downtime reason and quality signals to calculate availability, performance, quality and OEE.

What you get: Real asset availability and downtime loss by line and resource.

[All industries](#)

Predictive maintenance signals Roadmap

Zeak relates condition, maintenance history, failures and production impact to raise early intervention signals.

What you get: Maintenance can act before a critical asset stops production.

[All industries](#)

Unified maintenance calendar Roadmap

Your team can see preventive, corrective, predictive, calibration, inspection and turnaround maintenance on the same resource calendar as production.

What you get: One time-based source of resource availability.

[All industries](#)

Maintenance hard block on allocation Roadmap

A resource on an approved maintenance window is unavailable for production unless an authorized override is recorded.

What you get: Maintenance commitments become real capacity constraints.

[All industries](#)

Highlights

- Machine performance baseline
- Machine telemetry and OEE
- Predictive maintenance signals
- Unified maintenance calendar
- Maintenance hard block on allocation

Click-to-add maintenance Roadmap

Your team can create or request maintenance from the schedule with asset, type, start and end, crew, parts and tools, and expected capacity impact.

What you get: Faster conversion from observed risk to owned maintenance work.

[All industries](#)

Maintenance readiness gate Roadmap

Before maintenance starts, Zeak confirms technician skill and certification, parts, tooling, permits and access.

What you get: Higher wrench time and fewer delayed restarts.

[All industries](#)

Maintenance cost and lost-capacity view Roadmap

Your team can see planned and unplanned maintenance cost, downtime cost, backlog and production value at risk.

What you get: Maintenance prioritized by reliability, capacity and cost impact.

[All industries](#)

Best maintenance window finder Roadmap

For a maintenance task, Zeak proposes the windows that lose the least production value while meeting the due date.

What you get: Planned work lands where it costs least.

[All industries](#)

Preventive maintenance forecast Roadmap

Your team can see upcoming time-, usage- and meter-based maintenance from the CMMS projected onto the production horizon.

What you get: Fewer collisions between due maintenance and committed production.

[All industries](#)

Topic 6 of 17: feature detail (continued)

Maintenance & Asset Availability

Asset criticality ranking Roadmap

Your team can rank assets by safety, quality, throughput and cost impact, and use the ranking in prioritization.

What you get: Maintenance effort goes to the assets that stop the plant.
[All industries](#)

Critical spares readiness Roadmap

Your team can see whether critical spare parts are on hand for planned work and for the most critical assets.

What you get: Shorter repairs and lower expediting cost for parts.
[All industries](#)

Calibration status gate Roadmap

Instruments and equipment with overdue or failed calibration are blocked from use in the schedule.

What you get: Calibration compliance is enforced where work is planned.
[Pharma & biotech](#), [Medical devices](#), [Aerospace & defense](#), [Semiconductors](#), [Food & beverage](#)

Maintenance backlog analytics Roadmap

Your team can see backlog in hours and weeks of crew capacity, by asset, priority and age.

What you get: Backlog managed before it becomes downtime.
[All industries](#)

Failure history and repeat-failure detection Roadmap

Your team can see failure modes, root causes and repeat failures by asset and component.

What you get: Fewer repeat failures and better reliability decisions.
[All industries](#)

Shutdown and turnaround planning Roadmap

Your team can plan multi-day shutdowns and turnarounds with their production build-ahead, crews, contractors and restart sequence.

What you get: Shorter, better-prepared turnarounds and protected supply during them.
[Chemicals & process](#), [Food & beverage](#), [Pharma & biotech](#), [Semiconductors](#)

Permit and contractor readiness Roadmap

Your team can see whether permits (lockout-tagout, hot work, confined space) and contractor approvals are in place for planned work.

What you get: Safer starts and fewer last-minute delays.
[Chemicals & process](#), [Food & beverage](#), [Pharma & biotech](#), [Industrial & electrical](#)

Maintenance calendar views and drag and drop Roadmap

Maintenance planners can view maintenance by day, week and month, and move windows by drag with a production-impact preview before confirming.

What you get: Windows agreed on one calendar, with the cost of each option visible.
[All industries](#)

Equipment status and logbook Roadmap

Your team can track equipment status (clean, dirty, in use, out of service), clean-hold and dirty-hold expiry, and an equipment use log that gates scheduling.

What you get: Fewer batches started on equipment that is not ready, and cleaner audit evidence.
[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Cosmetics & CPG](#), [Chemicals & process](#)

Topic 7 of 17

Workforce, Shifts, Training & Certifications

Available labor is not the same as qualified labor.

23 features in this topic, 2 in the current build. Each is described below.

Workforce load view Current build

Your team can see personnel resources, linked workers, scheduled hours, registered hours and work share.

What you get: See overload, idle capacity and mismatched work share.

[All industries](#)

Operator rebalance signal Current build

Supervisors get a flag for uneven scheduled workload with proposed moves to feasible work.

What you get: Faster labor balancing and less idle and overload time.

[All industries](#)

HR shift calendar integration Roadmap

Zeak brings shift definitions, worker availability, vacation and leave, and planned absence into resource scheduling.

What you get: Schedule feasibility uses actual labor availability.

[All industries](#)

Labor shortage heatmap Roadmap

Your team can see required versus available labor hours and skills by plant, location, line, shift and time bucket.

What you get: Leaders can move, cross-train, contract or reschedule before the shift.

[All industries](#)

Training and certification record Roadmap

Your team can store training and certification by person with course or certificate, issuer, start, completion and expiry dates, grade or rank, and the certificate attachment or reference.

What you get: Eligibility is visible at the point of assignment.

[All industries](#)

Highlights

- Workforce load view
- Operator rebalance signal
- HR shift calendar integration
- Labor shortage heatmap
- Training and certification record

Requirement-to-certification mapping Roadmap

Your team can map required training and certifications to a project, order, operation, process, equipment, site or product family.

What you get: The schedule knows what qualification is required before assignment.

[All industries](#)

Certification assignment gate Roadmap

Zeak warns or blocks when a selected worker lacks a required, valid certification, and shows qualified alternatives.

What you get: Fewer invalid assignments, less rework and lower compliance risk.

[All industries](#)

Expiry and recertification planning Roadmap

Zeak alerts before certifications expire and reserves training or recertification time in the workforce calendar.

What you get: Future schedules stay feasible and emergency substitutions fall.

[All industries](#)

Overtime and fatigue visibility Roadmap

Your team can see overtime hours, consecutive-shift exposure and configurable policy limits where HR data permits.

What you get: Service recovery balanced against labor cost and policy.

[All industries](#)

Training requirements by role Roadmap

Your team can define the courses, certifications and refresher intervals each role and job requires.

What you get: A clear, current list of what every person must hold.

[All industries](#)

Topic 7 of 17: feature detail (continued)

Workforce, Shifts, Training & Certifications

Skills and competency matrix Roadmap

Your team can maintain a skills matrix with proficiency levels (for example trainee, supervised, independent, trainer) by person, operation and machine.

What you get: Visible skill coverage and single points of failure before they bite.

[All industries](#)

Procedure-change training Roadmap

When a procedure or work instruction changes version, affected people are assigned read-and-understand training automatically.

What you get: Training stays in step with the documents it depends on.

[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Aerospace & defense](#), [Cosmetics & CPG](#)

On-the-job training sign-off Roadmap

Trainers can record on-the-job training and observed performance, signed by trainee and trainer.

What you get: Defensible evidence that people can do the job, not just that they attended.

[Pharma & biotech](#), [Medical devices](#), [Aerospace & defense](#), [Food & beverage](#)

Training effectiveness checks Roadmap

Your team can attach assessments or observed checks to training and require a pass before qualification.

What you get: Qualification that reflects ability.

[All industries](#)

Training compliance dashboard Roadmap

Your team can see overdue, expiring and missing training, and percent compliant, by plant, line, shift, role and person.

What you get: Gaps closed before they stop work or appear in an audit finding.

[All industries](#)

Learning system and HR sync Roadmap

Zeak reads course completions and certifications from your learning management and HR systems, and keeps the source of each record.

What you get: Training data used in scheduling without double entry.

[All industries](#)

Cross-training planner Roadmap

Zeak identifies the skills where too few people are qualified and suggests who to train next to protect bottleneck operations.

What you get: Training spend directed to the gaps that protect output.

[All industries](#)

Contract and temporary labor pool Roadmap

Your team can include agency and contract workers with their qualifications and availability windows in labor planning.

What you get: Flexible labor used safely and planned ahead.

[All industries](#)

Crew size and labor standards Roadmap

Your team can define minimum and standard crew size and skill mix per operation, line and shift.

What you get: Realistic labor plans and safer starts.

[All industries](#)

Policy-aware assignment Roadmap

Assignments can respect configurable rules such as rest periods, maximum hours, seniority and agreed work rules.

What you get: Fair, compliant assignment that the floor trusts.

[All industries](#)

Training session scheduling Roadmap

Training coordinators can schedule sessions on the calendar by drag, book attendees and see shift coverage and production impact before confirming.

What you get: Training that happens, without starving the line.

[All industries](#)

Shift swaps and overtime requests Roadmap

Workers and supervisors can request shift swaps and overtime, checked against qualifications and work rules and approved by the right person.

What you get: Flexibility for people, coverage protected for the plant.

[All industries](#)

Topic 7 of 17: feature detail (continued)

Workforce, Shifts, Training & Certifications

Training assignment sync Roadmap

Training assignments created in Zeak are written to your learning system when that write-back is enabled.

What you get: One training record, wherever it was assigned.

[All industries](#)

Topic 8 of 17

Quality, Yield & Traceability

Yield and holds are capacity and margin, not just quality metrics.

11 features in this topic, 2 in the current build. Each is described below.

Quality impact dashboard Current build

Your team can track planned scrap, reported error quantity and quality impact by operation and product where source data exists.

What you get: Defects connected to output and cost.

[All industries](#)

Yield and scrap view Current build

Your team can track batch-order yield, expected output and below-full-yield events.

What you get: Yield loss visible alongside schedule and cost.

[All industries](#)

Cost of poor quality Roadmap

Zeak converts scrap, rework, retest, disposal, hold and delay into cost and margin impact.

What you get: Quality improvement ranked by dollars, hours and capacity.

[All industries](#)

Quality holds in schedule feasibility Roadmap

Material, batch and equipment quality holds act as availability constraints in the schedule and material readiness.

What you get: Fewer infeasible starts and late quality surprises.

[All industries](#)

Lot and batch genealogy with release context Roadmap

Your team can trace input lots, output batches, operations, equipment and release status across the production flow.

What you get: Faster containment, investigation and release decisions.

[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Aerospace & defense](#), [Automotive & discrete](#), [Semiconductors](#)

Highlights

- Quality impact dashboard
- Yield and scrap view
- Cost of poor quality
- Quality holds in schedule feasibility
- Lot and batch genealogy with release context

In-process checks and SPC signals Roadmap

In-process results and statistical process control signals appear on the order and resource, and out-of-control signals raise a hold risk.

What you get: Earlier intervention before a batch is lost.

[All industries](#)

Release readiness and review-by-exception Roadmap

Your team can see the status of batch record review and the open items blocking release for each batch.

What you get: Shorter release lead time and less working capital in quarantine.

[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Cosmetics & CPG](#)

Deviations and corrective actions linked to operations Roadmap

Deviations, nonconformances and corrective actions from Zeak Quality Management or your QMS link to the orders, resources and people involved.

What you get: Patterns across products, machines and people become visible.

[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Cosmetics & CPG](#), [Aerospace & defense](#), [Automotive & discrete](#)

Cleanroom and environment status Roadmap

Environmental monitoring status of rooms and zones acts as a constraint for operations that require them.

What you get: Fewer lost batches and cleaner audit evidence.

[Pharma & biotech](#), [Medical devices](#), [Semiconductors](#)

Line clearance and first-article gates Roadmap

Line clearance and first-article inspection can be required before an operation is shown as running.

What you get: Fewer mix-ups, recalls and rework.

[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Cosmetics & CPG](#), [Aerospace & defense](#), [Automotive & discrete](#)

Topic 8 of 17: feature detail (continued)

Quality, Yield & Traceability

QC lab capacity Roadmap

Quality-control lab capacity (analysts, instruments and test lead times) is used to calculate realistic release dates.

What you get: Release dates customers can trust and less finished stock waiting for test.

[Pharma & biotech](#), [Food & beverage](#), [Chemicals & process](#), [Medical devices](#), [Cosmetics & CPG](#)

Topic 9 of 17

Bottlenecks, Risk & Recovery

Know how long you can survive a disruption and what recovery costs.

8 features in this topic, 2 in the current build. Each is described below.

Bottleneck exposure Current build

Your team can see the resources, operations and material gaps that constrain output.

What you get: Improvement focused on the constraint that limits throughput.

[All industries](#)

Production risk register Current build

Your team can list operational risks by severity, evidence, affected orders and action.

What you get: One queue for what can disrupt production and why.

[All industries](#)

Time to recover and time to survive Roadmap

Your team can measure time to recover, time to survive and the survival gap for critical materials, assets and external dependencies.

What you get: Resilience measured in time and economic impact.

[All industries](#)

Costed recovery playbooks Roadmap

Your team can compare overtime, alternate resource, transfer, expedite, substitute, maintenance acceleration and resequencing options with their time and cost.

What you get: The recovery that protects the most value for the least cost.

[All industries](#)

Scenario stress test Roadmap

Your team can run plant, line, machine, labor or material outage scenarios and see affected output, orders and economic exposure.

What you get: Evidence to prioritize buffers, alternates and capacity investment.

[All industries](#)

Highlights

- Bottleneck exposure
- Production risk register
- Time to recover and time to survive
- Costed recovery playbooks
- Scenario stress test

Shifting bottleneck detection Roadmap

Zeak detects when the constraint moves between resources as mix and schedule change, and shows when it will move.

What you get: Effort follows the real constraint as it moves.

[All industries](#)

Constraint buffer management Roadmap

Your team can protect the constraint with time buffers and see buffer consumption by color zone.

What you get: More throughput from the same constraint.

[All industries](#)

Early warning for late orders Roadmap

Zeak predicts which orders will miss their due date one to fourteen days out, with the reason.

What you get: Days of warning to recover or reset customer expectations.

[All industries](#)

Topic 10 of 17

Cost, Margin, Energy & Value

Every hour, unit and decision connected to the P&L.

11 features in this topic, 0 in the current build. Each is described below.

Campaign optimization workspace Roadmap

Your team can group compatible products and batches to reduce setup, cleanout, changeover and campaign-transition loss.

What you get: More productive hours and lower transition cost.

[Chemicals & process, Food & beverage, Pharma & biotech, Cosmetics & CPG](#)

Cost intelligence by run or order Roadmap

Your team can see material, labor, machine, overhead and variance by production run or order where finance data exists.

What you get: Production behavior connected to unit cost and margin.

[All industries](#)

Manufacturing margin bridge Roadmap

Your team can bridge selling value and mix to material, freight, conversion, overtime, downtime, yield and scrap, rework, expedite, WIP carrying cost and contribution margin.

What you get: One economic view of where manufacturing margin is leaking.

[All industries](#)

Schedule leakage calculator Roadmap

Zeak quantifies changeover loss, waiting, idle bottleneck time, frozen-window churn and late-order recovery cost.

What you get: Schedule loss converted into hours and dollars.

[All industries](#)

Downtime leakage calculator Roadmap

Zeak calculates downtime cost from lost contribution or throughput plus recovery overtime, scrap and startup, and expedite, where inputs exist.

What you get: Reliability work prioritized by economic impact.

[All industries](#)

Highlights

- Campaign optimization workspace
- Cost intelligence by run or order
- Manufacturing margin bridge
- Schedule leakage calculator
- Downtime leakage calculator

Labor effort and FTE-equivalent capacity Roadmap

Zeak tracks manual scheduling and status effort before and after adoption and converts hours released to loaded cost and FTE-equivalent capacity.

What you get: Effort reduction and hiring avoided, quantified without assuming layoffs.

[All industries](#)

Value realization register Roadmap

Your team can track each opportunity's baseline, owner, action, gross value, overlap removal and Finance-validated realized value.

What you get: Margin protection, cost avoidance, productivity and cash claims kept separate and auditable.

[All industries](#)

Decision cost ledger Roadmap

Every approved schedule decision with a cost effect (overtime, expedite, changeover, displacement) is recorded with its estimated cost.

What you get: Visible cost of firefighting, and a baseline to reduce it.

[All industries](#)

Energy cost and intensity per unit Roadmap

Your team can see energy use and cost per unit, line and batch, and schedule energy-intensive work against time-of-use tariffs.

What you get: Lower energy cost per unit without new equipment.

[Chemicals & process, Food & beverage, Semiconductors, Industrial & electrical](#)

Emissions per unit and batch Roadmap

Your team can see Scope 1 and 2 emissions per unit and batch where energy and emission factors are available.

What you get: Credible product-level data for customers and reporting.

[All industries](#)

Topic 10 of 17: feature detail (continued)

Cost, Margin, Energy & Value

Capacity cost and absorption Roadmap

Your team can see standard versus actual capacity cost and under-absorbed overhead by line and period.

What you get: The cost of unused capacity made visible and actionable.

[All industries](#)

Topic 11 of 17

External Supply & Outsourced Production

One capacity picture across your plants, suppliers and contract manufacturers.

8 features in this topic, 0 in the current build. Each is described below.

Supplier and source exposure on readiness Roadmap

Next to material shortages, your team can see source, qualification, inbound status and supplier risk when data is available from adjacent systems, including Zeak Supplier Intelligence.

What you get: Production impact joined to the external dependency causing it.
[All industries](#)

Cross-border and tariff scenario Roadmap

Your team can model duty, tariff, freight and currency changes on material landed cost and production margin.

What you get: Sourcing economics visible inside production decisions.
[All industries](#)

Toller and contract manufacturing capacity Roadmap

Your team can see outsourced capacity, committed batches, quality and release state, and make-versus-buy economics.

What you get: One capacity picture across internal and outsourced production.
[Chemicals & process, Pharma & biotech, Food & beverage, Cosmetics & CPG](#)

Alternate material and source recovery Roadmap

When shortage risk opens, your team sees approved alternates and their expected qualification lead time.

What you get: Faster shortage recovery with feasibility visible.
[All industries](#)

Customer priority and allocation rules Roadmap

Your team can set customer and order priority, contractual penalties and allocation rules used when capacity or material is short.

What you get: Scarcity allocated by agreed commercial priority.
[All industries](#)

Highlights

- Supplier and source exposure on readiness
- Cross-border and tariff scenario
- Toller and contract manufacturing capacity
- Alternate material and source recovery
- Customer priority and allocation rules

Contract manufacturer collaboration Roadmap

Contract manufacturers can see the slots and batches you plan with them and confirm or propose changes.

What you get: Fewer surprises from outsourced capacity.
[Chemicals & process, Pharma & biotech, Food & beverage, Cosmetics & CPG](#)

Outside processing steps Roadmap

Routings can include subcontracted operations (plating, sterilization, coating) with supplier lead times and shipments, visible on the schedule.

What you get: Complete lead times and earlier warning when a subcontractor is late.
[Automotive & discrete, Aerospace & defense, Industrial & electrical, Medical devices](#)

Customer promise-change notifications Roadmap

When an order's expected finish moves past its promised date, customer service is notified with the new date, the reason and the recovery options.

What you get: Earlier, honest conversations with customers.
[All industries](#)

Topic 12 of 17

Workflow, Collaboration & AI Agents

Agents recommend; people decide; everything is recorded.

22 features in this topic, 2 in the current build. Each is described below.

Recommended action workflow Current build

Major insights link to the next operational workspace or action.

What you get: From signal to action with less navigation and ambiguity.

[All industries](#)

Connection health and freshness Current build

Your team can see connected-system status, last refresh and stale-data warnings.

What you get: Trustworthy use of current versus stale facts.

[All industries](#)

Connect Anything integration layer Roadmap

Zeak connects ERP, MES, WMS, CMMS and EAM, QMS and LIMS, HR and time, learning systems, PLM and device or MQTT sources through governed adapters.

What you get: A single decision layer without replacing systems of record.

[All industries](#)

Approval and audit trail Roadmap

High-impact schedule, resource and maintenance changes route for approval, and who, what, when and why is preserved.

What you get: Faster action without losing accountability.

[All industries](#)

Schedule comments and ownership Roadmap

Your team can attach comments, decisions, owner and due date to schedule exceptions or changes.

What you get: Decision context stays with the operational object.

[All industries](#)

Highlights

- Recommended action workflow
- Connection health and freshness
- Connect Anything integration layer
- Approval and audit trail
- Schedule comments and ownership

Schedule subscriptions and alerts Roadmap

Subscribed roles are notified when a published schedule, delay, maintenance block, labor gap or shortage crosses configured thresholds.

What you get: Only material changes pushed to the people who own them.

[All industries](#)

Autonomy ladder per capability Roadmap

Each capability that recommends, drafts or writes has a stage you set: Observe, Advise, Assist or Act.

What you get: Automation adopted step by step, on your criteria.

[All industries](#)

Monitoring agents Roadmap

Agents watch schedule feasibility, material coverage, maintenance conflicts, certification expiry and live delay, and raise findings with evidence.

What you get: Continuous checking without adding planners.

[All industries](#)

Recommendation evidence card Roadmap

Every recommendation shows inputs, alternatives considered, expected effect and confidence, and records accept or reject with a reason.

What you get: People decide faster and with reasons on record.

[All industries](#)

Approvals in Teams, Slack, email and mobile Roadmap

Approvers can review and approve schedule changes from collaboration tools and mobile with the evidence attached.

What you get: Decisions made in minutes, not at the next meeting.

[All industries](#)

Topic 12 of 17: feature detail (continued)

Workflow, Collaboration & AI Agents

Backtest on history Roadmap

Before switching on an agent or rule, your team can run it on past months to see what it would have caught.

What you get: Confidence based on your own history.

[All industries](#)

Calendar sync to Outlook and Teams Roadmap

People can see their confirmed assignments, maintenance windows and training sessions in their own work calendar.

What you get: Everyone sees their part of the plan where they already look.

[All industries](#)

Outbound events and webhooks Roadmap

Zeak publishes confirmed schedule changes, exceptions and status events to other systems through governed events and webhooks.

What you get: Downstream systems and partners stay in step automatically.

[All industries](#)

Approval policy settings Roadmap

Administrators can decide in settings which changes need a secondary sign-off after the requester confirms, per plant, line, schedule horizon and change type (production schedule, maintenance, workforce, training, order release, write-back).

What you get: Second sign-off exactly where your plant needs it, and nowhere else.

[All industries](#)

Approval conditions Roadmap

Administrators can define the conditions that trigger sign-off without code: inside the frozen window, cost or overtime above an amount, orders made late, customer priority affected, locked work moved, overrides of maintenance, calibration, certification or release gates, and write-back to your systems.

What you get: Consistent, visible rules for when a second person must agree.

[All industries](#)

Approver routing Roadmap

Administrators can assign approvers by role, plant or named person, in sequence or in parallel, as any one or all of a group, with delegates for absence and an escalation path.

What you get: Approvals reach the right person, even when people are out.

[All industries](#)

Segregation of duties Roadmap

A person cannot give the secondary sign-off on their own change, and approvers must hold the configured role for that plant and change type.

What you get: A real four-eyes check that auditors recognize.

[All industries](#)

Approval inbox and decision record Roadmap

Approvers see pending changes with the impact preview and evidence, and approve, reject or send back with a reason; regulated customers can require an electronic signature with its meaning.

What you get: Faster, better-informed decisions with a complete record.

[All industries](#)

Pending-approval status, time limits and escalation Roadmap

Changes waiting for sign-off are shown as pending on every calendar and never reach the floor or your systems; administrators set time limits, reminders, escalation and what happens on expiry.

What you get: Everyone knows what is decided and what is still waiting.

[All industries](#)

Urgent change path Roadmap

For defined emergencies (breakdown, safety, quality hold), an authorized person can apply a change immediately with retrospective sign-off required within a set time.

What you get: Speed when it matters, with accountability afterwards.

[All industries](#)

Policy versioning and simulation Roadmap

Approval policies are versioned, their own changes need approval, and administrators can simulate a draft policy on past changes to see how many would have needed sign-off.

What you get: Approval policies that are tuned on evidence and fully auditable.

[All industries](#)

Approval analytics Roadmap

Your team can see approval volume, time to sign-off, rejections, expiries, urgent changes and approver workload by plant and change type.

What you get: Approval rules adjusted where they add delay without reducing risk.

[All industries](#)

Topic 13 of 17

Self-Service, Reporting & Automation

Answers without a ticket to IT, and no metric drift.

13 features in this topic, 3 in the current build. Each is described below.

Custom dashboard widget builder Current build

Authorized users can compose dashboard widgets from governed measures without engineering changes.

What you get: Self-service visibility without metric drift.
[All industries](#)

Calculated-metric builder Current build

Authorized users can create calculated metrics from approved fields with formula, source and freshness visible.

What you get: Reusable calculations that are explainable and reconcilable.
[All industries](#)

Saved views and report templates Current build

Your team can save and share filtered views and reporting layouts for recurring routines.

What you get: Less recurring reporting effort and more consistent reviews.
[All industries](#)

Custom alert rule builder Roadmap

Admins can configure governed threshold and condition alerts on approved measures.

What you get: Local flexibility without hard-coded logic.
[All industries](#)

Ask-to-build AI Roadmap

Your team can turn a natural-language request into a draft view, metric or alert for review.

What you get: Less time from question to usable analysis.
[All industries](#)

No-code automation recipes Roadmap

Your team can create condition-and-action recipes for reminders, approvals and follow-up.

What you get: Routine follow-up and exception handling standardized.
[All industries](#)

Highlights

- Custom dashboard widget builder
- Calculated-metric builder
- Saved views and report templates
- Custom alert rule builder
- Ask-to-build AI

Personalized daily digest Roadmap

Each user gets a summary of changes, risks and owned actions by plant, role or watchlist.

What you get: Focused daily handoff and less status chasing.
[All industries](#)

Extensible custom fields Roadmap

Admins can add governed custom attributes to orders, resources, products and exceptions.

What you get: Local operational context kept in the governed workflow.
[All industries](#)

Branded exports Roadmap

Your team can export views and reports with source timestamp, filters and organization branding.

What you get: Shareable evidence with traceability.
[All industries](#)

Scheduled report packs Roadmap

Your team can schedule plant, shift, weekly and monthly report packs from saved views.

What you get: Less meeting-pack preparation and consistent measures.
[All industries](#)

Natural-language schedule edits Roadmap

Planners can type a change such as 'move batch 4471 to Line 2 after cleaning' and get the same preview and validation as a drag-and-drop move.

What you get: Faster edits with the same guardrails.
[All industries](#)

Spreadsheet round-trip Roadmap

Planners can export a governed view to Excel, edit agreed fields and import the changes back through validation.

What you get: Adoption without forcing people to abandon familiar tools, and no ungoverned copies.
[All industries](#)

Topic 13 of 17: feature detail (continued)

Self-Service, Reporting & Automation

Planner sandbox and in-app guidance Roadmap

New planners and supervisors can practise on a copy of real data in a sandbox, with in-app guidance on each screen.

What you get: Faster onboarding without risk.

[All industries](#)

Topic 14 of 17

Industry Configuration & Starter Packs

One core product, configured for how your industry runs.

9 features in this topic, 0 in the current build. Each is described below.

Semiconductor starter pack Roadmap

Preconfigured tool and recipe compatibility, WIP and queue time, maintenance windows, yield, cycle time and qualified-resource rules.

What you get: A relevant operating model without changing the core platform.

[Semiconductors](#)

Aerospace and defense starter pack Roadmap

Preconfigured work-package readiness, certified technician and tooling gates, serial and lot trace, and priority or rated-order views.

What you get: Work planned around readiness and authorization rather than nominal capacity.

[Aerospace & defense](#)

Chemical and process starter pack Roadmap

Preconfigured campaigns, reactor, tank and line availability, cleanout and changeover, batch yield, maintenance turnaround and formula constraints.

What you get: Campaigns, yield and resource availability optimized together.

[Chemicals & process](#)

Biotech, pharma and life-sciences starter pack Roadmap

Preconfigured batch readiness, trained-operator gates, material release, equipment calibration and maintenance, and quality-hold constraints.

What you get: Readiness and schedule connected without weakening quality controls.

[Pharma & biotech](#)

Discrete and industrial starter pack Roadmap

Preconfigured assembly cells, takt and line balance, machine and operator capacity, component shortages and changeover.

What you get: Better load balancing and on-time execution.

[Automotive & discrete, Industrial & electrical, General manufacturing](#)

Highlights

- Semiconductor starter pack
- Aerospace and defense starter pack
- Chemical and process starter pack
- Biotech, pharma and life-sciences starter pack
- Discrete and industrial starter pack

Medical technology starter pack Roadmap

Preconfigured device and lot trace, validation and calibration, trained-resource gates, material and quality holds, and release readiness.

What you get: Only work that is both operationally and quality ready is scheduled.

[Medical devices](#)

Food and beverage starter pack Roadmap

Preconfigured allergen sequencing, sanitation windows, shelf life, hold-and-release, and lot traceability aligned to the US FSMA food traceability rule.

What you get: Safe sequences, shorter sanitation loss and audit-ready trace.

[Food & beverage](#)

Cosmetics and consumer goods starter pack Roadmap

Preconfigured packaging-line changeovers, SKU and promotion variants, fill-and-pack balance, and batch-to-pack linkage.

What you get: More packaging hours and fewer late promotions.

[Cosmetics & CPG](#)

Validation accelerator Roadmap

Regulated customers get a requirements traceability matrix, risk assessment templates and test scripts aligned to computer software assurance practice.

What you get: Faster, risk-based validation of the configured scope.

[Pharma & biotech, Medical devices, Food & beverage, Cosmetics & CPG](#)

Topic 15 of 17

Integrations, Governance & Deployment

Your systems stay the system of record. You decide when Zeak writes.

13 features in this topic, 1 in the current build. Each is described below.

Formula and data lineage Partly in current build

For each critical KPI, your team can see the formula, source fields, source system and freshness; unavailable values display as unavailable.

What you get: Operational and financial decisions rest on traceable measures.

[All industries](#)

Role, site and entity security Roadmap

Data and actions are scoped by role, legal entity, plant, site and defined sensitive fields.

What you get: Scale across plants while preserving data ownership.

[All industries](#)

Read-only start, governed write-back Roadmap

Deployment starts read-only; write-back is enabled object by object only after approval, validation and audit controls.

What you get: Value proven without disrupting the system of record.

[All industries](#)

Pilot baseline and value measurement Roadmap

Your team can capture before-and-after baselines for scheduling effort, downtime, shortage response, quality loss, throughput, cost and cash, keeping estimated and validated value apart.

What you get: Finance can verify time, cost, margin and capacity impact.

[All industries](#)

Data-quality readiness monitor Roadmap

Zeak flags missing calendars, stale BOMs and routings, unassigned operations, missing actuals, invalid capacities and stale inventory facts.

What you get: Data gaps visible before they distort the schedule.

[All industries](#)

Highlights

- Formula and data lineage
- Role, site and entity security
- Read-only start, governed write-back
- Pilot baseline and value measurement
- Data-quality readiness monitor

Performance and scale controls Roadmap

Response-time, refresh, batch-volume and concurrent-user targets are defined and measured for plant and network use.

What you get: Predictable performance at enterprise scale.

[All industries](#)

Electronic records and signatures controls Roadmap

Zeak supports controls used for electronic records and signatures (unique identity, signature meaning, audit trail, reason for change) for regulated workflows.

What you get: A path to validated use in GMP and similar environments.

[Pharma & biotech](#), [Medical devices](#), [Food & beverage](#), [Cosmetics & CPG](#)

Standalone mode Roadmap

Zeak can run with its own orders, resources, calendars and training records where no connected system exists, for pilots or small sites.

What you get: Start anywhere, connect later.

[All industries](#)

Microsoft Dynamics 365 connector first Roadmap

Zeak reads production orders, routes, resources, BOMs and formulas, workers, calendars and asset management work orders from Dynamics 365, with SAP, Oracle, NetSuite and others through the same approach.

What you get: Connected in weeks, not a separate integration project.

[All industries](#)

Your cloud and full export Roadmap

Zeak deploys in your cloud or Zeak's, and every record, configuration and audit entry can be exported in open formats.

What you get: Control over where data lives and freedom to leave.

[All industries](#)

Topic 15 of 17: feature detail (continued)

Integrations, Governance & Deployment

Multi-site localization Roadmap

Zeak supports multiple languages, time zones, units of measure and local calendars across sites.

What you get: One product across your network.

[All industries](#)

Adoption and usage analytics Roadmap

Admins and sponsors can see usage by site, role and feature, alongside value, during and after the pilot.

What you get: Evidence that people use it, not just that it works.

[All industries](#)

Data retention and archival Roadmap

Retention periods for schedule versions, audit trails, training evidence and events are configurable, with archival and legal hold.

What you get: Records kept as long as required, and no longer.

[All industries](#)

Topic 16 of 17

Resource Profiles

A complete profile for every person, machine, line, tool, material and order.

13 features in this topic, 0 in the current build. Each is described below.

Person profile Roadmap

Each person has a profile showing role, plant, shifts, supervisor, skills and proficiency, certifications and expiry, training history, current and upcoming assignments, hours and overtime, and the operations they are qualified for.

What you get: Assignment, training and coverage decisions made from one page.

[All industries](#)

Machine and asset profile Roadmap

Each machine or asset has a profile with capabilities, products and routings it can run, schedule, maintenance history and calendar, calibration status, performance and downtime, spare parts, cost rate, criticality and documents.

What you get: One page that answers whether this asset can run this job, and what it costs when it cannot.

[All industries](#)

Line and work center profile Roadmap

Each line or work center has a profile with its resources, crew standards, rates, changeover matrix, schedule, attainment and bottleneck history.

What you get: Faster, consistent decisions about what each line can do.

[All industries](#)

Tool, mold, die and fixture profile Roadmap

Each tool has a profile with life and usage counts, location, condition, calibration, compatible products and machines, and upcoming bookings.

What you get: Fewer quality escapes and stoppages caused by tools.

[Automotive & discrete, Industrial & electrical, Aerospace & defense, Medical devices, Semiconductors](#)

Material and lot profile Roadmap

Each material and lot has a profile with specification, status, expiry and retest, holds, location, where used, supplier and projected coverage.

What you get: Material decisions made with full context.

[All industries](#)

Highlights

- Person profile
- Machine and asset profile
- Line and work center profile
- Tool, mold, die and fixture profile
- Material and lot profile

Order and batch profile Roadmap

Each production order or batch has a profile with timeline, genealogy, materials, people and resources used, quality events, cost and documents.

What you get: Investigations and customer questions answered in minutes.

[All industries](#)

Product profile Roadmap

Each product has a profile with routing or formula versions, approved resources, changeover family, yield and scrap history, cost and margin.

What you get: Product decisions grounded in how the product actually runs.

[All industries](#)

Plant and site profile Roadmap

Each plant has a profile with calendars, shift patterns, capacity by resource and skill, headcount by qualification, key measures and open risks.

What you get: Plant reviews on comparable facts.

[All industries](#)

Crew and shift profile Roadmap

Each crew and shift has a profile with members, skill mix, coverage, handover notes and performance.

What you get: Fair comparisons and targeted support for each shift.

[All industries](#)

Profile timeline, documents and comments Roadmap

Every profile has an activity timeline, attached documents (manuals, certificates, procedures) and comments.

What you get: The right document at the point of decision.

[All industries](#)

Topic 16 of 17: feature detail (continued)

Resource Profiles

Relationship map

Roadmap

Your team can see how people, machines, products, orders, materials and suppliers connect, and follow a link from one profile to the next.

What you get: Impact of a change seen across everything it touches.

[All industries](#)**Profile completeness score**

Roadmap

Each profile shows how complete and current its data is, and what is missing.

What you get: Data owners know exactly what to fix first.

[All industries](#)**New Product Creation handoff**

Roadmap

When a new product is set up through Zeak New Product Creation, its routings, approved resources, changeover family and training requirements flow into Manufacturing Ops.

What you get: First production runs planned on complete, approved setup.

[All industries](#)

Topic 17 of 17

Frontline Operations

The people on the line see the same plan, in the place they work.

8 features in this topic, 0 in the current build. Each is described below.

Operator task list Roadmap

Operators see what to run next on their machine or line, with materials staged, instructions and quality checks, on a tablet or kiosk.

What you get: The line runs to the current plan, not yesterday's printout.
[All industries](#)

Digital work instructions viewer Roadmap

Operators can open the current, approved work instruction for the operation, with images and video, from the task.

What you get: Fewer errors and faster onboarding of new operators.
[Pharma & biotech](#), [Medical devices](#), [Aerospace & defense](#), [Automotive & discrete](#), [Food & beverage](#)

Structured shift handover Roadmap

Outgoing and incoming supervisors complete a structured handover covering safety, quality, equipment, material and open issues, linked to records.

What you get: Fewer repeated problems and a clean start to every shift.
[All industries](#)

Andon and help requests Roadmap

Operators can raise a help request from the line that routes to maintenance, quality or materials, with response and resolution time tracked.

What you get: Shorter stops and data on where the line waits.
[All industries](#)

Tiered daily meeting board Roadmap

Teams can run tier 1 to tier 3 meetings from live measures, with actions captured, owned and escalated.

What you get: Shorter meetings and actions that do not get lost.
[All industries](#)

Highlights

- Operator task list
- Digital work instructions viewer
- Structured shift handover
- Andon and help requests
- Tiered daily meeting board

Badge clock-on to operations Roadmap

Operators can clock on and off orders and operations by badge or kiosk, feeding actual labor.

What you get: Real labor data for cost and planning.
[All industries](#)

Offline-tolerant mobile Roadmap

Frontline apps keep working through short network loss and sync safely when back online.

What you get: Reliable use everywhere on the floor.
[All industries](#)

Safety observations and near misses Roadmap

Your team can record safety observations and near misses against the line, machine or area, with follow-up actions.

What you get: Safety risks seen alongside the schedule and the assets involved.
[All industries](#)

How the numbers work

Every measure has a published definition. Nothing is a black box.

The same definition is used on every screen. When an input is missing, the measure displays as unavailable.

Measure	Definition
Schedule attainment	Share of scheduled orders or operations completed within the agreed tolerance of planned finish
Schedule stability	Share of orders or operations not moved after the configured frozen time fence
Ready to start	All configured material, resource, labor, maintenance and quality gates are satisfied
Resource availability	Calendar capacity minus maintenance, absence, reserved and other hard-blocked time
Labor coverage	Qualified available labor hours ÷ required labor hours, for a plant, shift and time bucket
OEE	Availability × performance × quality; calculated only when all source inputs exist
MTTR / MTBF	Mean time to repair / mean time between failures, from maintenance and asset event data
TTR / TTS / survival gap	Time to recover; time the operation can survive a disruption; TTR minus TTS [R10]
Training compliance	People holding all required, valid training for their roles ÷ people in those roles
Changeover hours	Sum of sequence-dependent setup and cleaning time from the changeover matrix
Cost of poor quality	Scrap + rework + retest + disposal + hold and release delay and other approved quality costs
FTE-equivalent capacity	Hours released ÷ standard annual productive hours; a capacity measure, not a headcount reduction
Production value at risk	Approved economic exposure of orders or production at risk; formula and inputs visible
Validated value	Realized benefit confirmed by Finance under the agreed rule; kept separate from estimates

Bring us your production problem.

Choose a line, a plant or a scheduling, maintenance or staffing decision. We will define the data, pilot scope and value measure with your team, and prove the economics before you commit to more.



Sources and definitions

Research cited in this document.

Benchmarks are directional evidence for metric selection and value hypotheses. They are not Manufacturing Ops performance guarantees.

Ref	Source	Used for
R1	BCG. How AI Maintains Manufacturing Productivity Amid Reduced CapEx. 2023.	Advanced scheduling: >3% OEE uplift (~30 min/day) and >50% lower planning labor after eight weeks in cited client work
R2	McKinsey. Industry 4.0: Capturing the true value. 2022.	30-50% lower machine downtime, 10-30% higher throughput, 15-30% higher labor productivity
R3	McKinsey. Labor-intensive factories: analytics-intensive productivity. 2021.	Dynamic scheduling removed 1-2 h/shift of assignment effort; OTD 50% to 90%
R4	McKinsey. Digital collaboration for a connected manufacturing workforce. 2020.	10-15% lower maintenance spend, +2-3 OEE points, +5-10% wrench time
R5	Bain. AI Is Revolutionizing Industrial Operations. 2024.	15-20% planning productivity, 5-10% yield, 10% lower maintenance cost
R6	Bain. Digital Lean: A Guide to Manufacturing Excellence. 2025.	Planning and scheduling, maintenance, OEE, quality, line balancing and workforce flexibility as core levers
R7	BCG. Lean Manufacturing Demands Agile Production and Support. 2020.	Support functions 25-40% of factory cost; faster ramp-up and quality resolution
R8	BCG. The AI-First Refiner: Faster Decisions, Better Margins. 2026.	AI scheduling re-optimized in minutes; \$0.15-\$0.30/bbl margin. Refining-specific
R9	Accenture. Factory OS: turn factory data into real-time action with AI agents. 2026.	20-40% lower unplanned downtime, 10-20% lower operational cost
R10	MIT Center for Transportation & Logistics / Data Science Lab. Time-to-Recover and Time-to-Survive (Ford).	Quantifying disruption exposure with operational and financial metrics
R11	McKinsey. Digital twins: the next frontier of factory optimization. 2024.	Factory twins combine asset, MES, ERP and HMI data for scheduling and what-if
R12	BCG. Older Aircraft, Too Few Technicians: The Aerospace Fix. 2026.	About half of technician time on non-wrench work; readiness checks before maintenance
R13	Siemens (Senseye). The True Cost of Downtime 2024.	~\$1.4T a year, ~11% of revenue, at the world's 500 largest companies; ~\$2.3M/h idle automotive line
R14	Deloitte and Manufacturing Leadership Council. 2025 Smart Manufacturing and Operations Survey.	10-20% output improvement, 7-20% employee productivity, 10-15% unlocked capacity
R15	Deloitte. Making maintenance smarter: Predictive maintenance and the digital supply network. 2017.	10-20% uptime increase, 5-10% lower maintenance cost, 20-50% less planning time
R16	ISO 9001:2015 and ISO 13485:2016 (competence), IATF 16949, AS9100D; FDA 21 CFR Part 11; EU GMP Annex 11; FDA Computer Software Assurance guidance.	Competence evidence, electronic records and signatures, risk-based validation
R17	World Economic Forum with McKinsey. Global Lighthouse Network reports, 2019-2025.	Frontline digital tools among the use cases that scale in leading plants
R18	MIT NANDA. The GenAI Divide: State of AI in Business 2025.	Most enterprise GenAI pilots showed no measurable P&L impact; partnered deployments succeeded more often
R19	McElheran, Yang, Kroff, Brynjolfsson. The Rise of Industrial AI in America: Microfoundations of the Productivity J-curve(s). MIT / US Census Bureau, 2025.	AI adoption in manufacturing often followed by a short-term productivity dip before gains
R20	Deloitte and The Manufacturing Institute. Manufacturing talent study, 2024.	3.8M US manufacturing jobs needed by 2033; about 1.9M could go unfilled