Context-Aware Production Planning

Closing the gap between engineering change and production reality.

The structural failure

Why PLM, ERP, and MES still leave a gap

A new planning layer

Production planning as a living system

Deterministic change

ECO propagation without re-planning loops

DIRAC

What we'll cover

01 The Engineering Change Paradox

02 Production Planning Drift

03 Context-Aware Production Planning

04 The Dirac Layer

05 Where the Modern Stack Fails

06 Object vs. Instance, Multi-View

07 Static vs. Living Production Plans

08 Impact & Outlook

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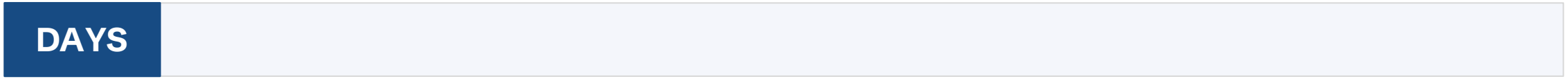
The Paradox: Small edit. Vast operational tail.

ENGINEERING EFFORT *to implement a change*



OPERATIONAL PROPAGATION *to land it reliably on the shop floor*

In the gap, production runs with ambiguity and organizations normalize it as unavoidable.

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Each system owns its data. None owns the build.

The enterprise stack is architected around ownership of data rather than coherence of use. Between PLM, ERP, and MES lies a layer of static artifacts. There is no system that keeps the production plan continuously correct under change.

PLM

Product Lifecycle Management

Authority on design.

CAD, EBOMs, revisions, ECO workflows.

ERP

Enterprise Resource Planning

Authority on resources.

Supply chain, cost, procurement, scheduling.

MES

Manufacturing Execution

Authority on execution.

Shop-floor traceability, compliance, records.

THE GAP

No system ensures production planning is continuously correct and actionable under change. EBOM, MBOM, BOP, routing, and work instructions sit between the pillars: static, manually maintained, and updated asynchronously.

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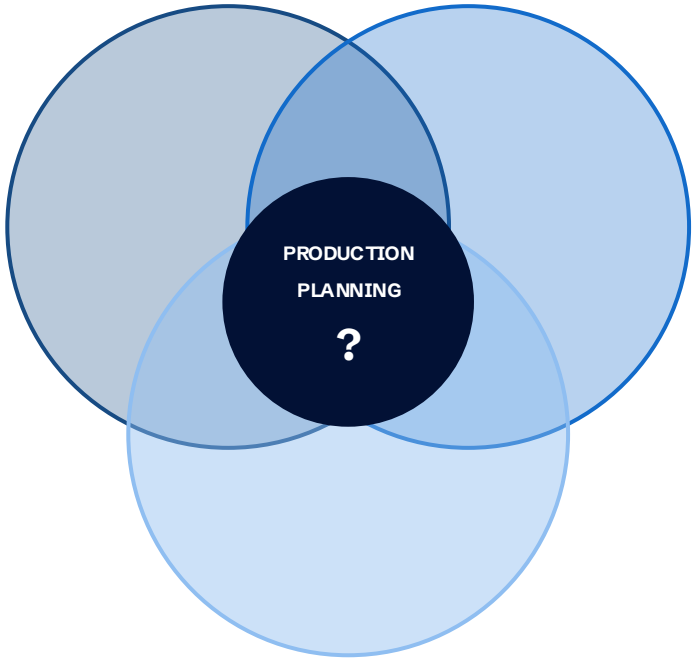
PLM

Authority on design

ERP

Authority on resources



MES

Authority on execution

*Production planning lives at their intersection in **static artifacts and tribal knowledge**.*

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Production planning drift from design.

The production plan — how a product is actually built — lives across EBOM, MBOM, BOP, routing, and work instructions. Today, these are static translations, updated by hand only after change is detected, and often after execution has already diverged.

Retrieval is costly

Fragmented data across overlapping representations makes the correct view hard to find.

Semantics mismatch

Inconsistent meaning across systems-of-record creates ambiguity at hand-off.

Updates lag execution

Reconciliation happens after divergence. Re-planning loops are the steady state.

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Configuration complexity is structural.

Research in PLM configuration management distinguishes object products (digital representations) from instance products (physical units). Each has its own lifecycle, and those lifecycles intersect with manufacturing systems and customer orders. Production planning lives at the intersection.

OBJECT vs. INSTANCE

Two lifecycles that must reconcile.

OBJECT

Digital representation

CAD, EBOM, revisions, design intent

INSTANCE

Physical unit

Built hardware, serialized state, history

Designs evolve, inventory shifts, orders flow. Production planning lives at this intersection.

MULTI-VIEW CONFIGURATIONS

No single flat model fits all stakeholders.

PLM	Engineering structure
ERP	Supply chain & finance
MES	Execution records

None of these views is structured for production planning, the specific intersection where build decisions are made.

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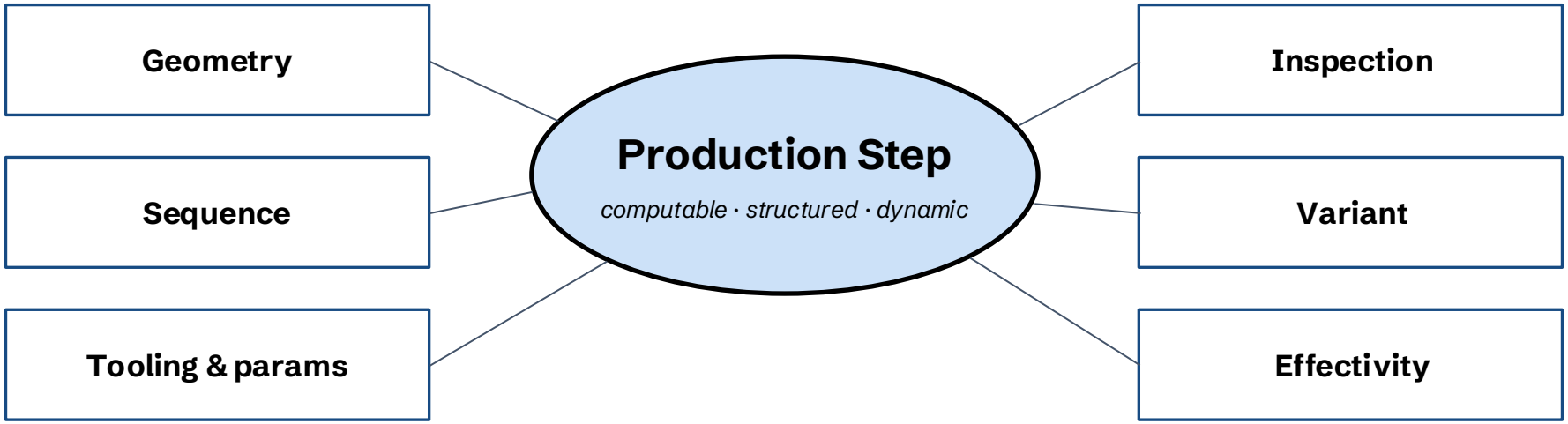
Context-Aware Production Planning.

A production step is only meaningful in the context where it applies. Context-aware production planning makes that context explicit, structured, and computable.



Automated impact analysis
Structural relationships tell systems where change matters.

Part-aware sequencing
Geometry and physics inform valid execution paths.

Variant builds w/o redundancy
Applicable steps filter and validate automatically.

Living work instructions
Update deterministically as change occurs, not reactively.

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From static artifacts to a living system.

STATIC ARTIFACT APPROACH

Trigger

Updates asynchronously occur when change is detected.

Work instructions

Documents awaiting manual revision.

Impact analysis

Manual and slow; depends on tribal knowledge.

Execution

Systems may work from outdated information.

CONTEXT-AWARE PRODUCTION PLANNING

Trigger

Change triggers structural propagation.

Work instructions

Synthesized and updated as part of change implementation.

Impact analysis

Computed, surfaced, and resolved before execution.

Execution

First build reflects current reality.

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The production planning layer.

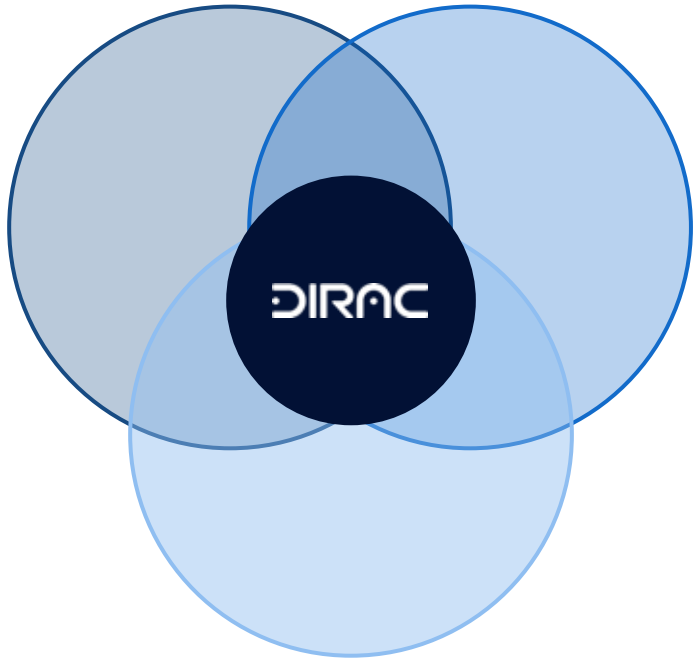
Dirac is a context-aware production planning platform that sits between PLM, ERP, and MES and keeps the production planning continuously correct. PLM remains the authority on design. ERP owns supply chain and costing. MES remains the authority on execution.

PLM

Design Authority

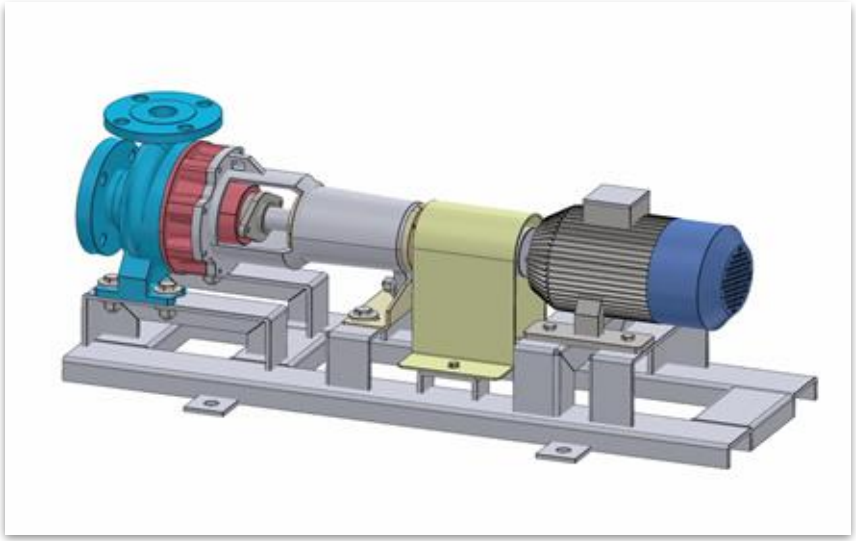
ERP

Resource Authority



MES

Execution Authority



Auto-Update WI from ECO (demo)

WHAT HAPPENS WHEN AN ECO ARRIVES

1. Structural impact analysis identifies affected steps
2. Tooling & inspection implications surface automatically
3. Work instructions update deterministically before execution

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What context-aware planning enables.

When the production planning is correct under change, downstream behavior changes structurally.

Faster ramp

Instructions reflect reality from the first build.

Less rework & scrap

Ambiguity is removed before it reaches the operator.

Prevented quality escapes

Inspection conditions evolve with the build definition.

Reliable commitments

Re-planning loops shorten or disappear.

FIELD BENCHMARKS · DIRAC DEPLOYMENTS

95%

Faster work-instruction generation

33%

Faster first-pass build time

85%

Faster engineering change propagation

99%

Faster new operator onboarding

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The future of high-velocity manufacturing depends on context-aware production planning.

Engineering change will always exist. The question is whether it must remain costly. Treating production planning as a static artifact collapses under complexity. As a computable, context-aware, continuously correct system, it absorbs change with clarity, confidence, and speed.

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