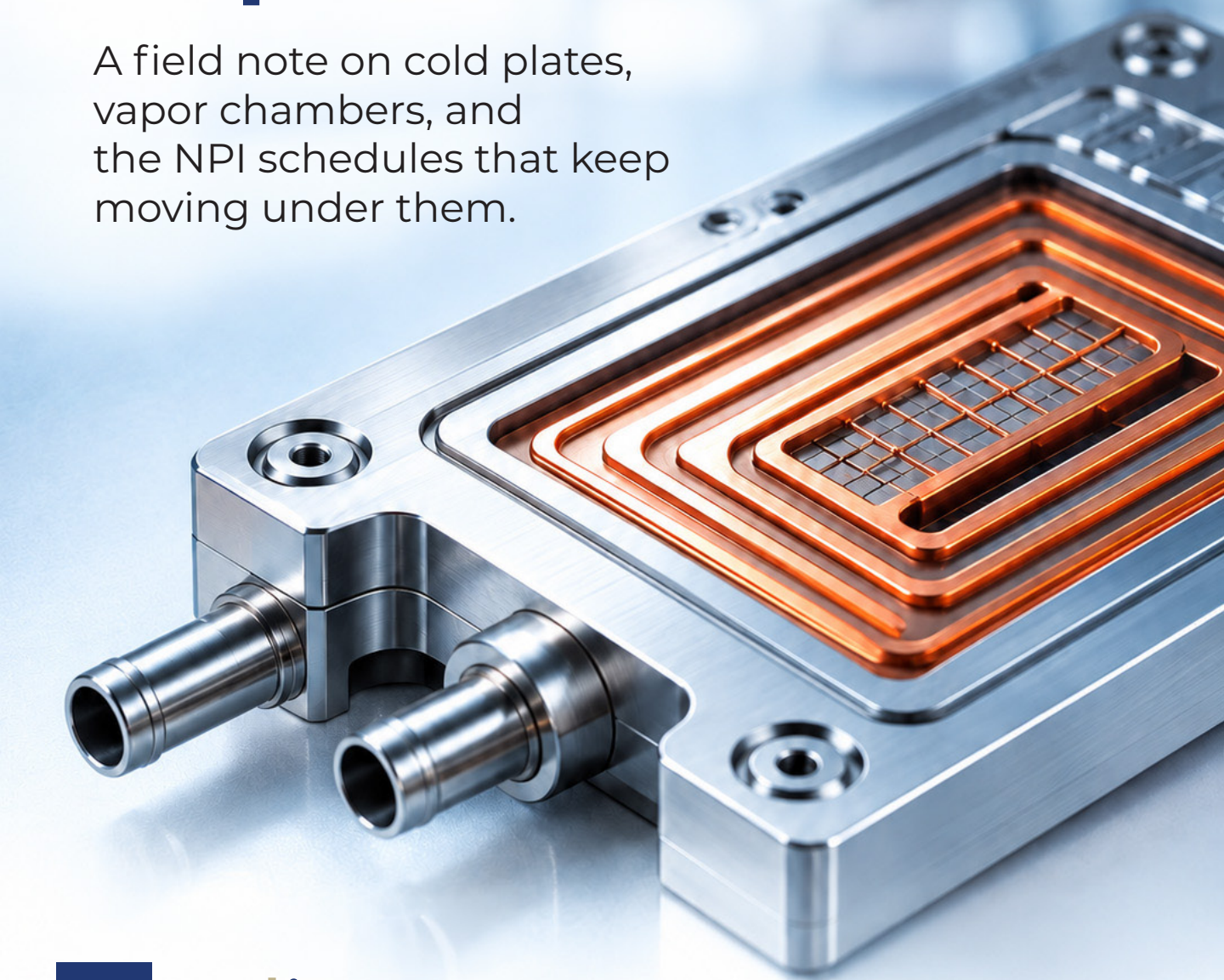
Your Thermal Design Is Not Late Your Thermal Requirements Are

A field note on cold plates, vapor chambers, and the NPI schedules that keep moving under them.



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It's Tempting to Say Thermal Engineering Starts Too Late

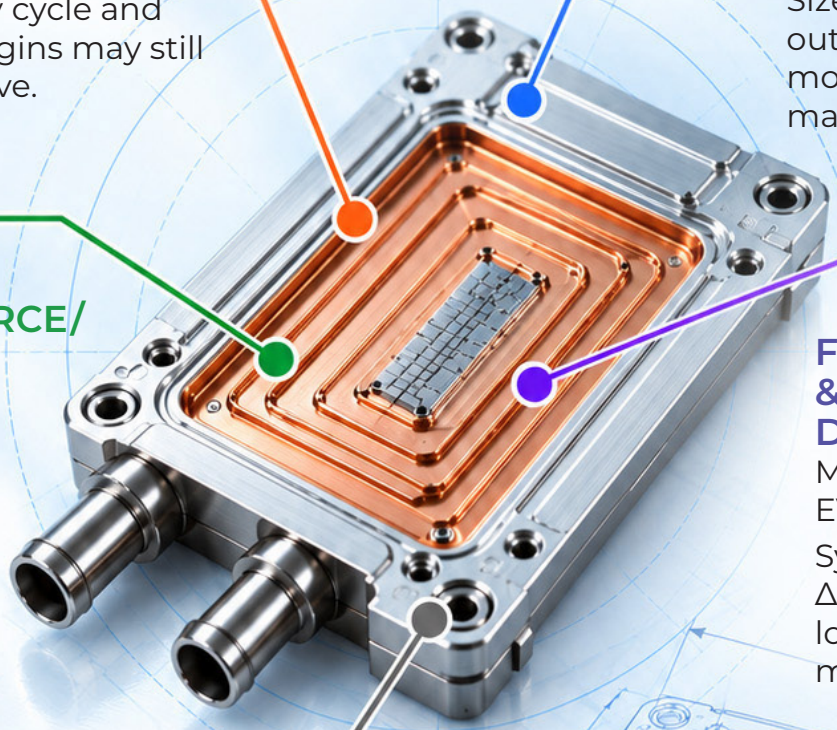
In most programs, that's not what actually happens. The thermal team is in the room early. The problem is that the requirements it's designing against are still moving when it's expected to commit to a design.



Five Things Still in Motion When Thermal Is Asked to Commit.

POWER
STILL CHANGING
TDP, peak power, duty cycle and margins may still evolve.

MECHANICAL ENVELOPE
BEING FROZEN
Size, height, keep-out zones and mounting constraints may still be in flux.



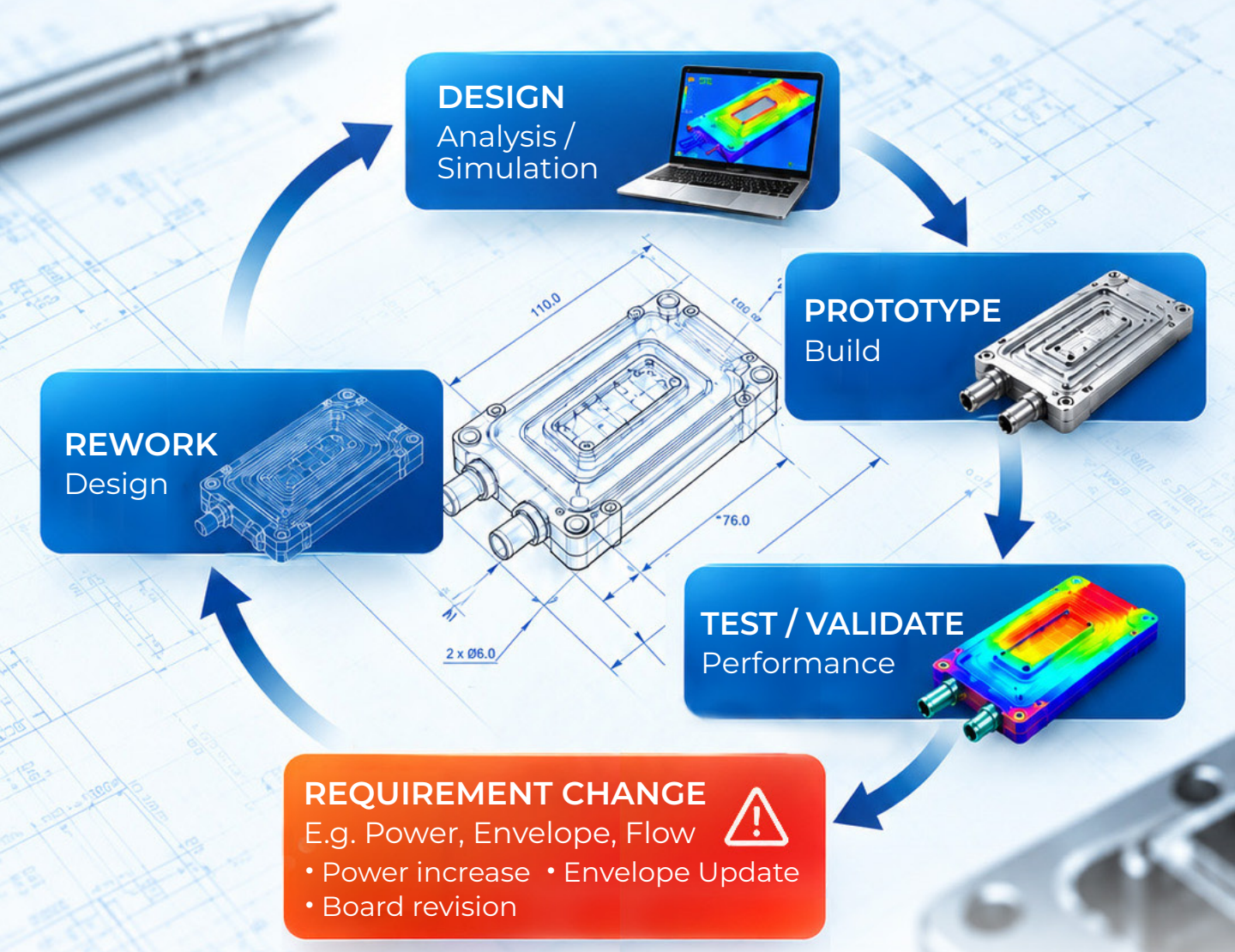
HEAT-SOURCE/ HOTSPOT LOCATION
NOT FULLY DEFINED
Location, size and heat flux may still be evolving.

FLOW RATE & PRESSURE-DROP BUDGET
MAY STILL BE EVOLVING
System flow, ΔP limits and loop configuration may change.

MANUFACTURING CONSTRAINTS
BECOME CLEARER AS THE DESIGN PROGRESSES
Process capability, tolerances, materials and volume requirements may still be under review.

The Thermal Team Ends Up Optimizing A Design Around Still Changing Assumptions

Every one of those five inputs can shift again after the design is "done." Depending on the cooling architecture, each shift can mean re-checking channel geometry and pressure drop, vapor-chamber performance, TIM / contact conditions, or mechanical fit...

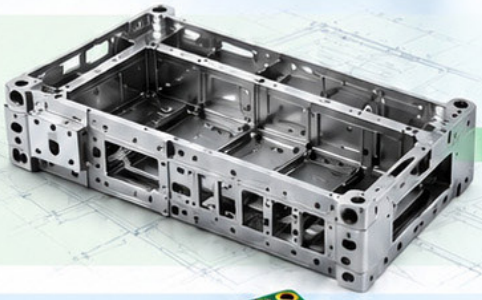


It Is Not A Failure In Communication

Mechanical, electrical and thermal are being finalized in parallel, each under its own pressure to lock and move forward. Thermal just happens to be the domain most sensitive to whatever is still changing everywhere else - a power bump, a board revision, a connector swap.

MECHANICAL
Envelope Changes

- Size / height/ keep-out
- Mounting and interface
- Mechanical tolerances



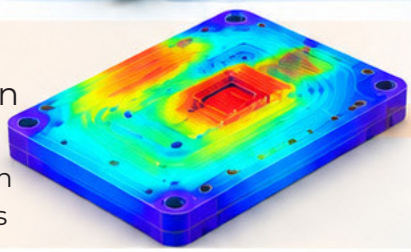
ELECTRICAL
Power/ Board Revision

- Power consumption (TDP)
- Board layout changes
- Component updates



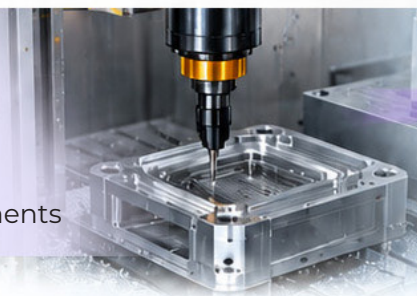
ELECTRICAL
Recalculation / Redesign

- Thermal analysis (CFO)
- Heatsink / cold plate design
- TIM and contact conditions



MANUFACTURING
Feasibility / Tolerance

- Process capability
- Material availability
- Cost and volume requirements



ALL MOVING TOGETHER

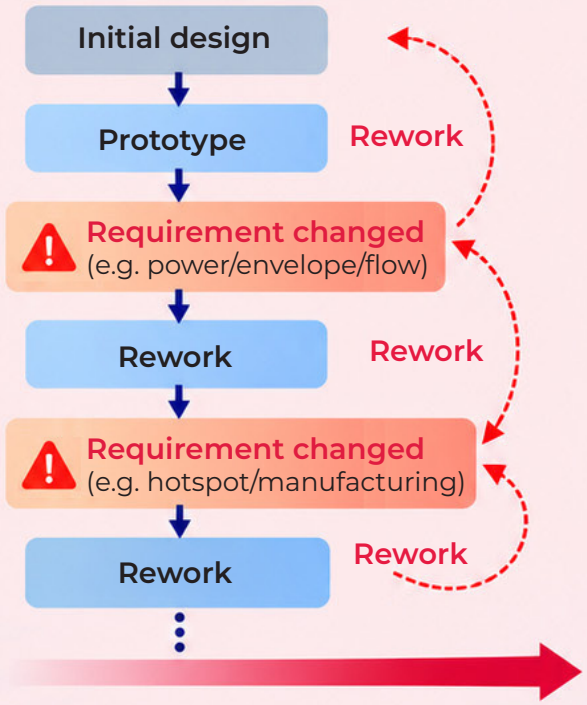
Different timelines. Different constraints. A common goal.

The Earlier These Five Inputs Are Factored, the Fewer Surprises Appear Later

- Fewer redesign loops between first prototype and second.
- A cleaner handoff from prototype to volume production.
- Real trade-offs get made while they're still cheap to make - not guessed at under schedule pressure.

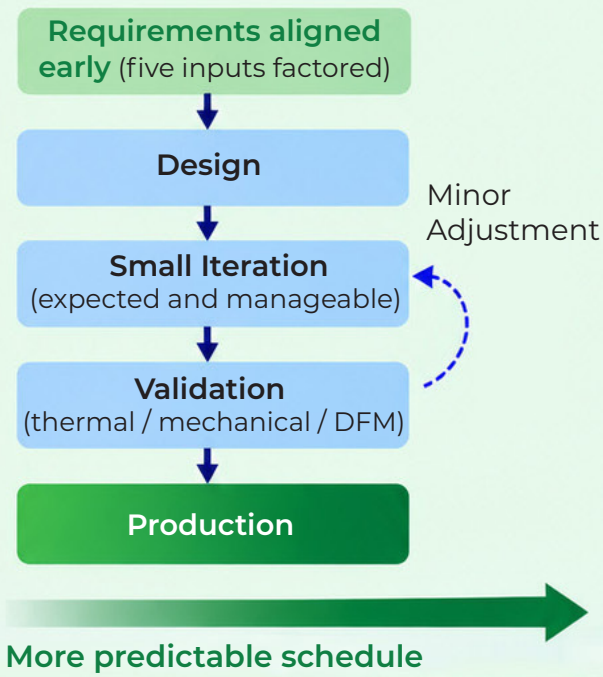
WITHOUT EARLY ALIGNMENT

More changes. Higher risk. Longer time.



WITH EARLY ALIGNMENT

Fewer surprises. Smoother path to production.





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Six Questions Worth Asking in the First Thermal Conversation

1. **What's the actual power number, and how much room does it have to move?**
   TDP, peak power, duty cycle and future headroom.

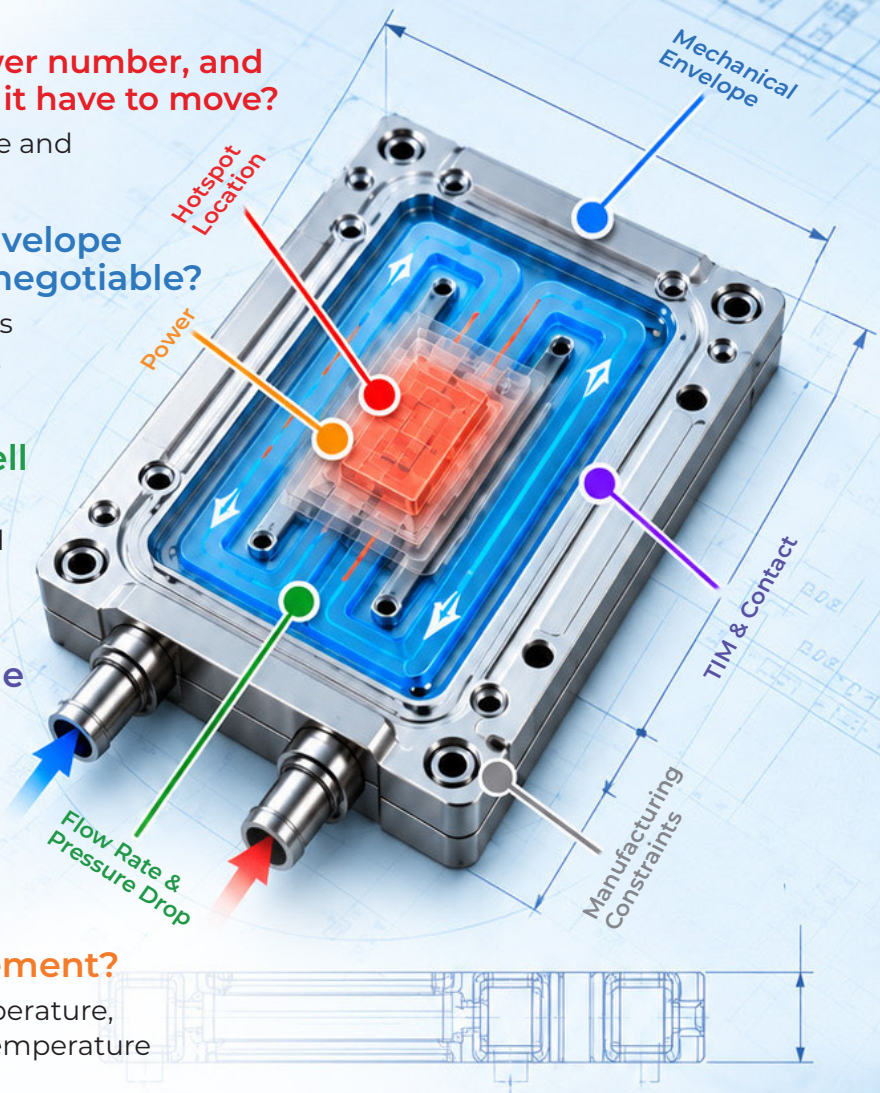
2. **Is the mechanical envelope really frozen, or still negotiable?**
   Size, height, keep-out zones and mounting constraints.

3. **Where exactly is the hotspot, and how well is it characterized?**
   Location, size, heat flux and spatial distribution.

4. **What flow rate and pressure drop can the system actually deliver?**
   Pump capability, loop configuration and system limits.

5. **What is the thermal performance requirement?**
   - Maximum inlet flow temperature,
   - Component maximum temperature
   - °C/W thermal resistance

6. **What manufacturing constraints matter at the volumes this program will need?**
   Process capability, tolerances, materials and cost targets.



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None of This Is Unique To One Program.

It's the pattern in most high-density, fast-moving NPI work right now.

If your team is in the middle of it, we will be happy to compare notes on where the constraints are moving.

What Is the Latest Constraint That Is Showing Up On Your Last Program?

