

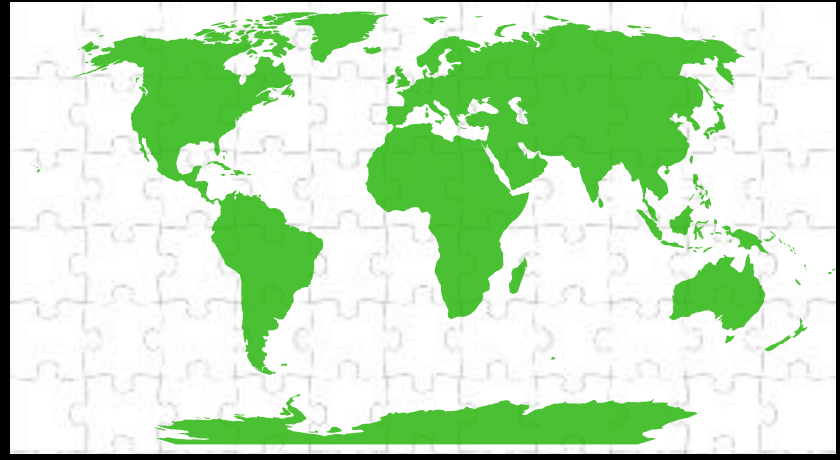
Engineering, Communication, Automation

Accelerating Learning in Physical Product Development

Fredrik Viljesjö

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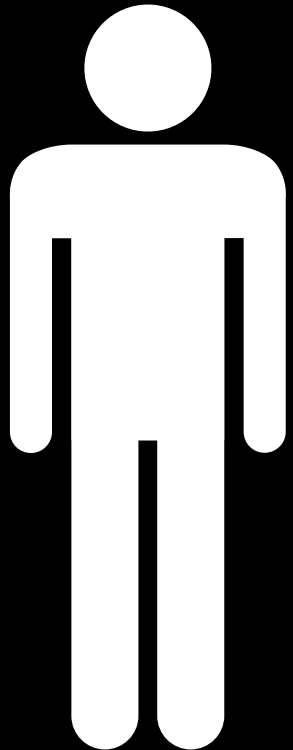
Vision



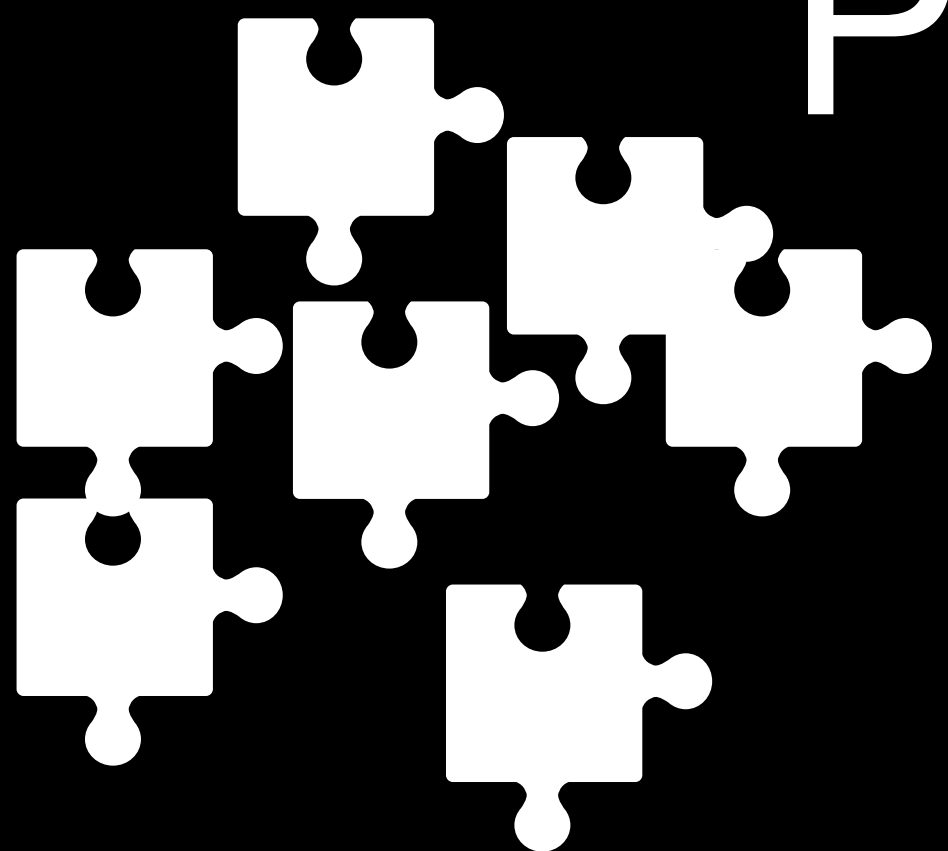
- Start with edges
- Sort in continents
- Build each continent

Process

Problem

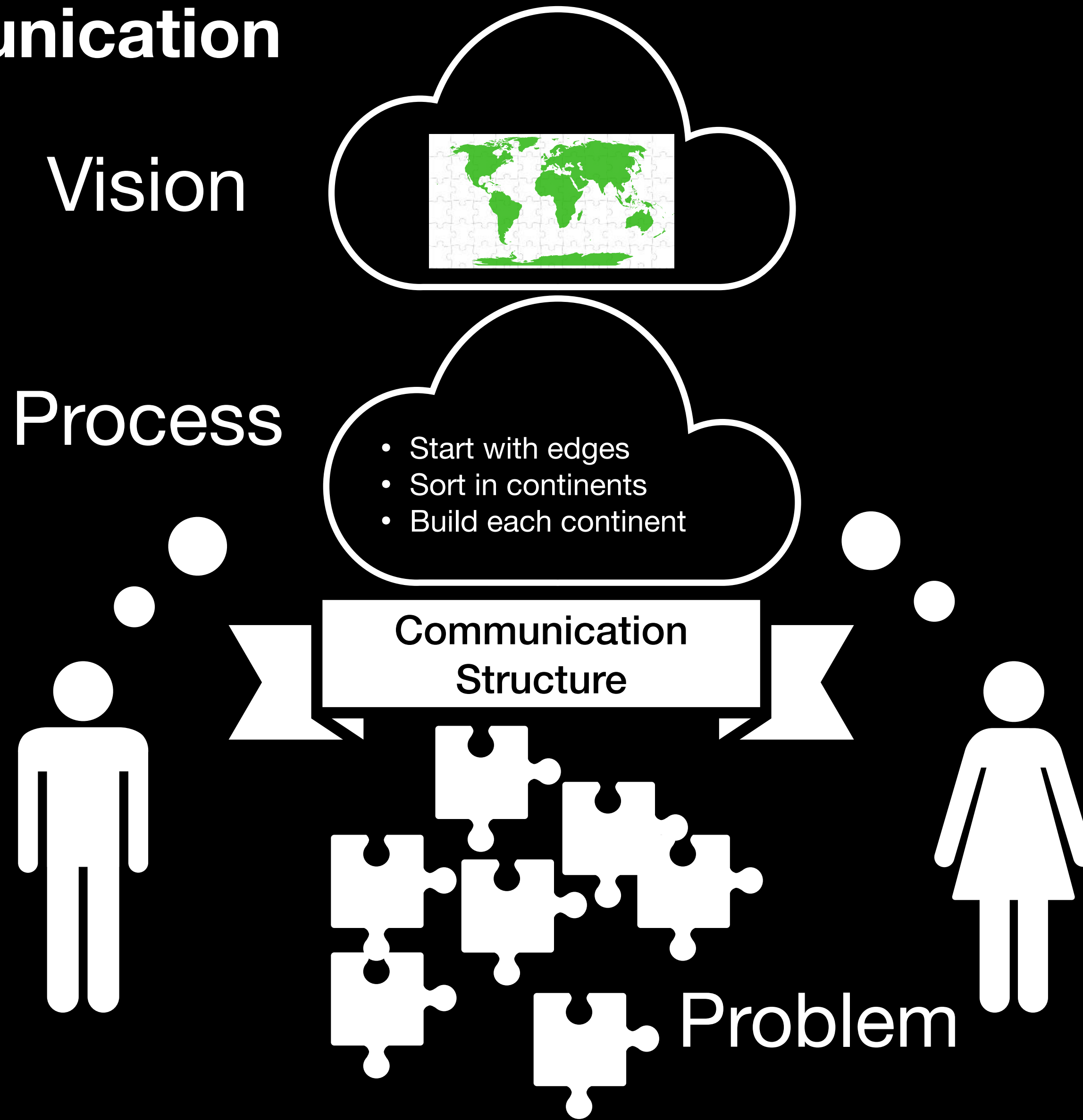


Problem-solver



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Shared Mental Model Through Communication

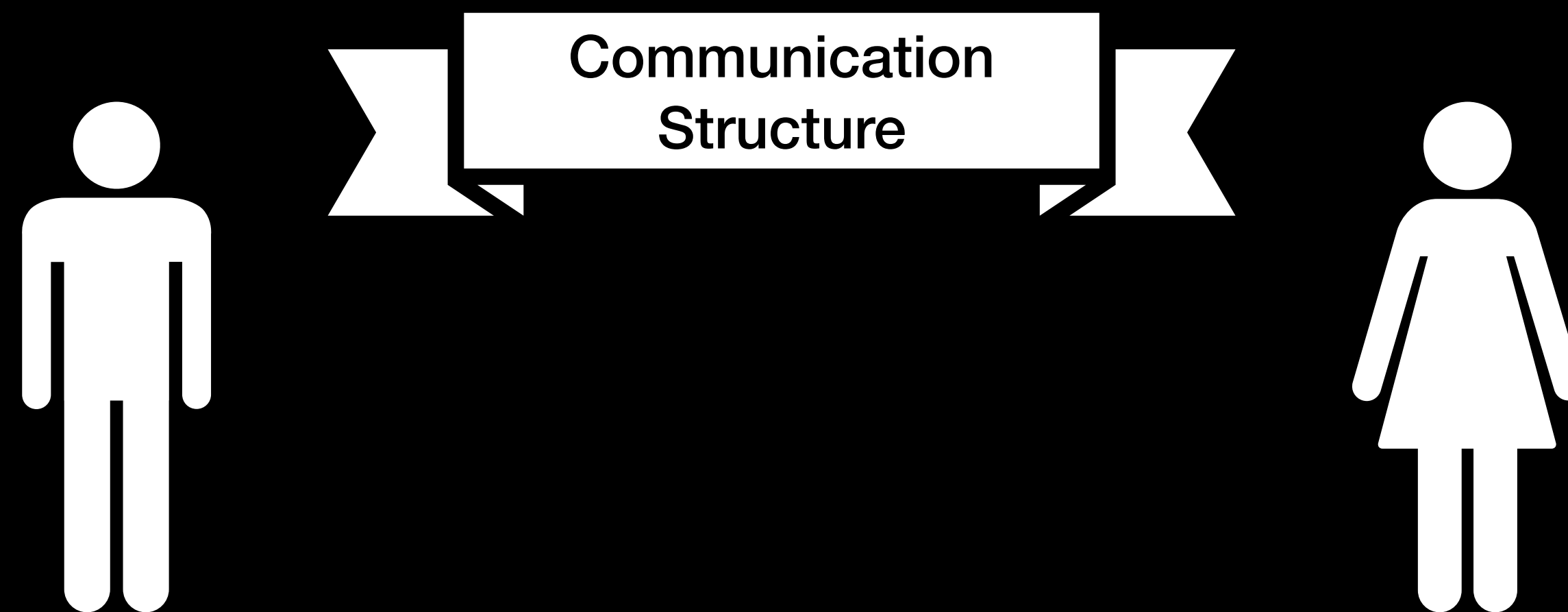


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Responsible Problem Solvers

Working Together Toward A Shared Vision

- No orders given
- No hierarchy
- No turfs



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Example: SpaceX

Responsible Engineers



- Everyone knows the vision and strategy
 - “to make life multi-planetary by establishing a self-sustaining city on Mars”
 - “fully reusable transportation system designed to carry both crew and cargo to Earth orbit, the Moon, and Mars”
- The engineer closest to the problem makes the decision
- Everyone is a systems engineer
 - Design for the global system first - local sub-system second
- Engineers own the requirements they design against and can question the requirements
 - Internal Requirements = Design Criteria

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Agile Teams

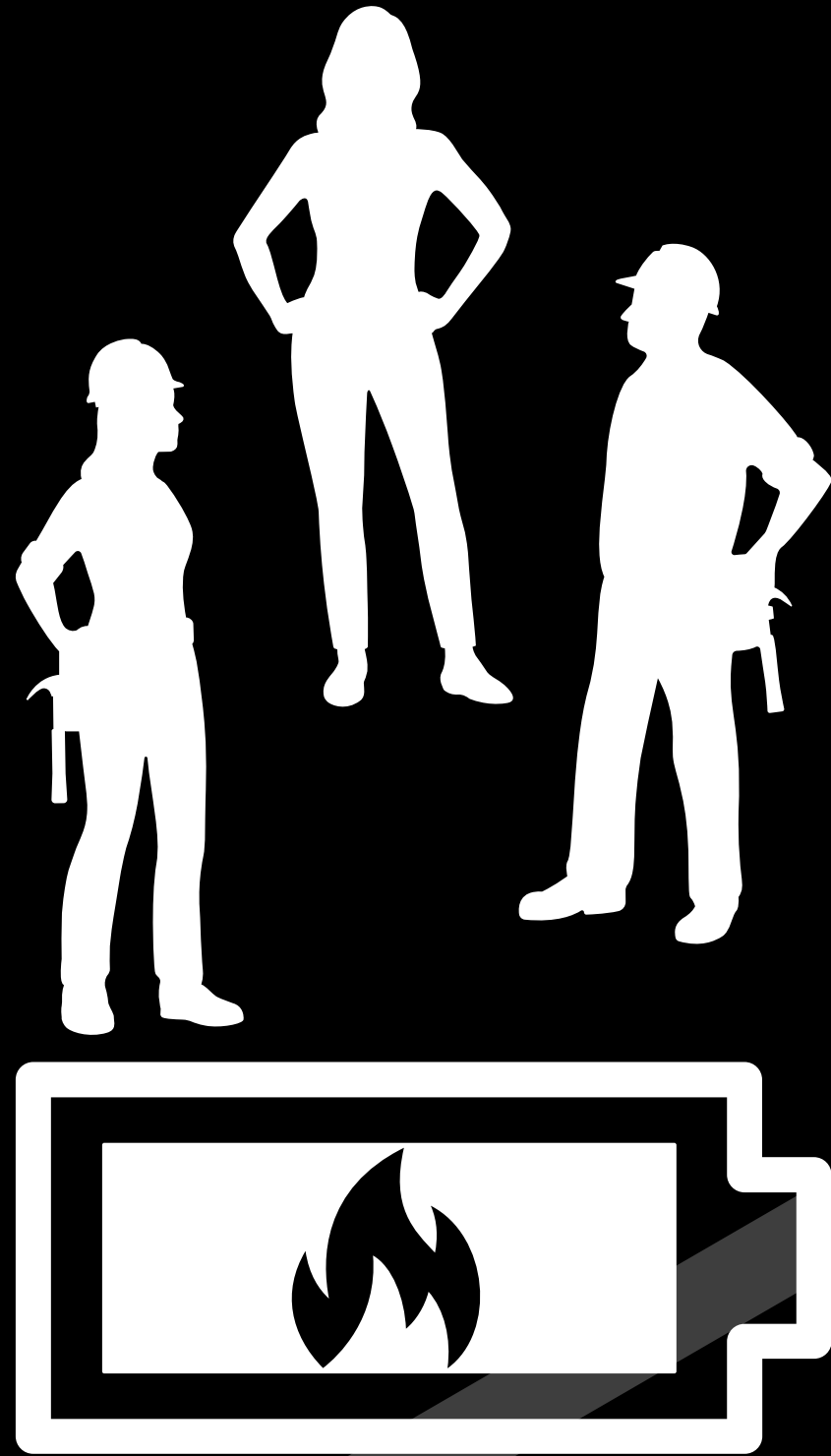
Example of Communication Structure

- Engaged responsible team members
- Align on the problem to solve
 - Planning meeting every iteration
- Focused work
 - ie two-week iterations
 - Visual overviews
- Daily sync/planning meeting



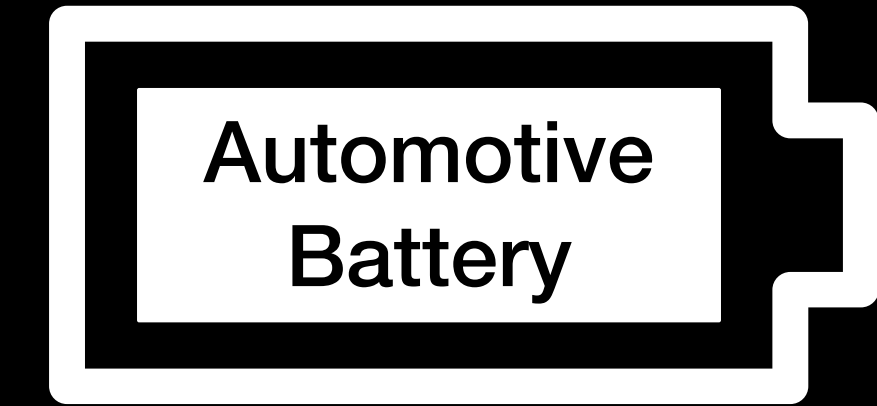
Case: Battery Team

Agile is a Communication Structure
Bringing Engineers Together



Current Problem:
Temperature control

Vision



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**Responsible Problem Solvers
Working Together Toward a Shared Vision**

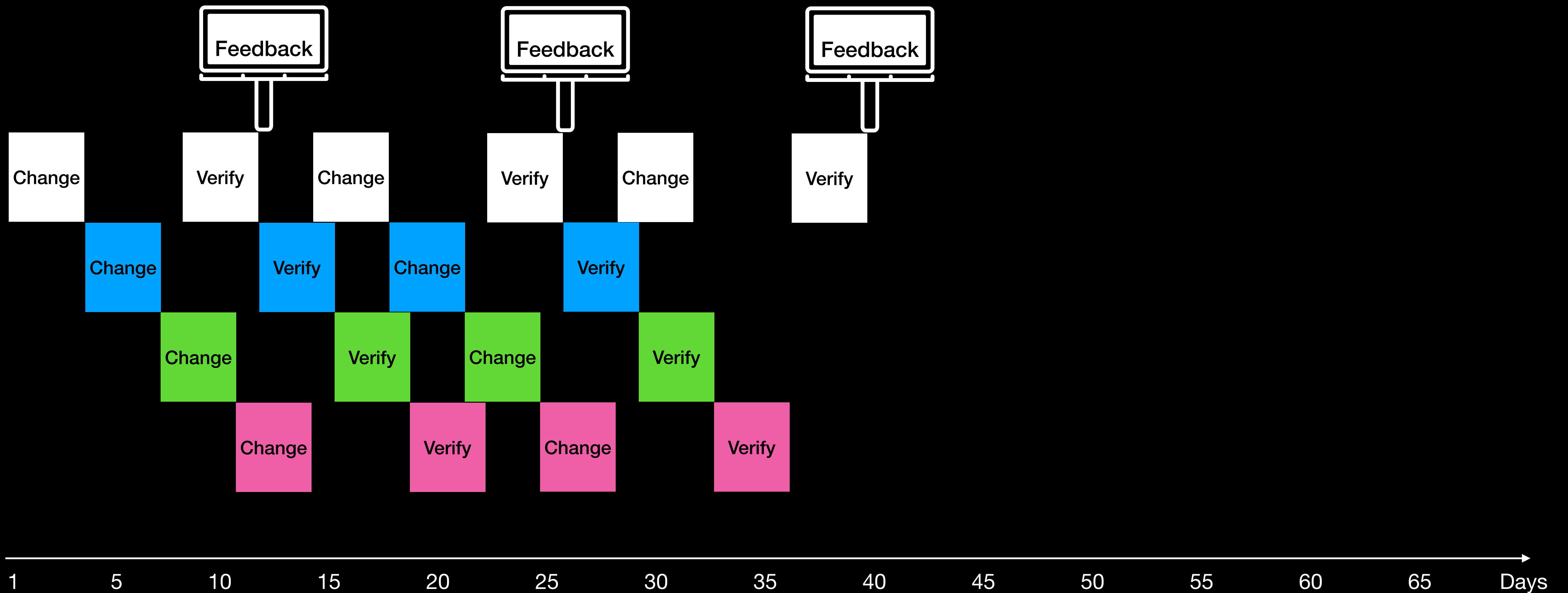
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**Why don't we see our engineers working
together on the workshop floor?**

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Slow Feedback

Waiting is killing collaboration and drives parallel work



Fast Feedback

Needs fast communication structures and technical infrastructure

- How should we work and communicate to get feedback faster and learn faster?
- What should we invest in to get faster feedback and more focus?
 - Hardware in the loop (HIL)
 - Software in the loop (SIL)
 - Automatic verification hardware



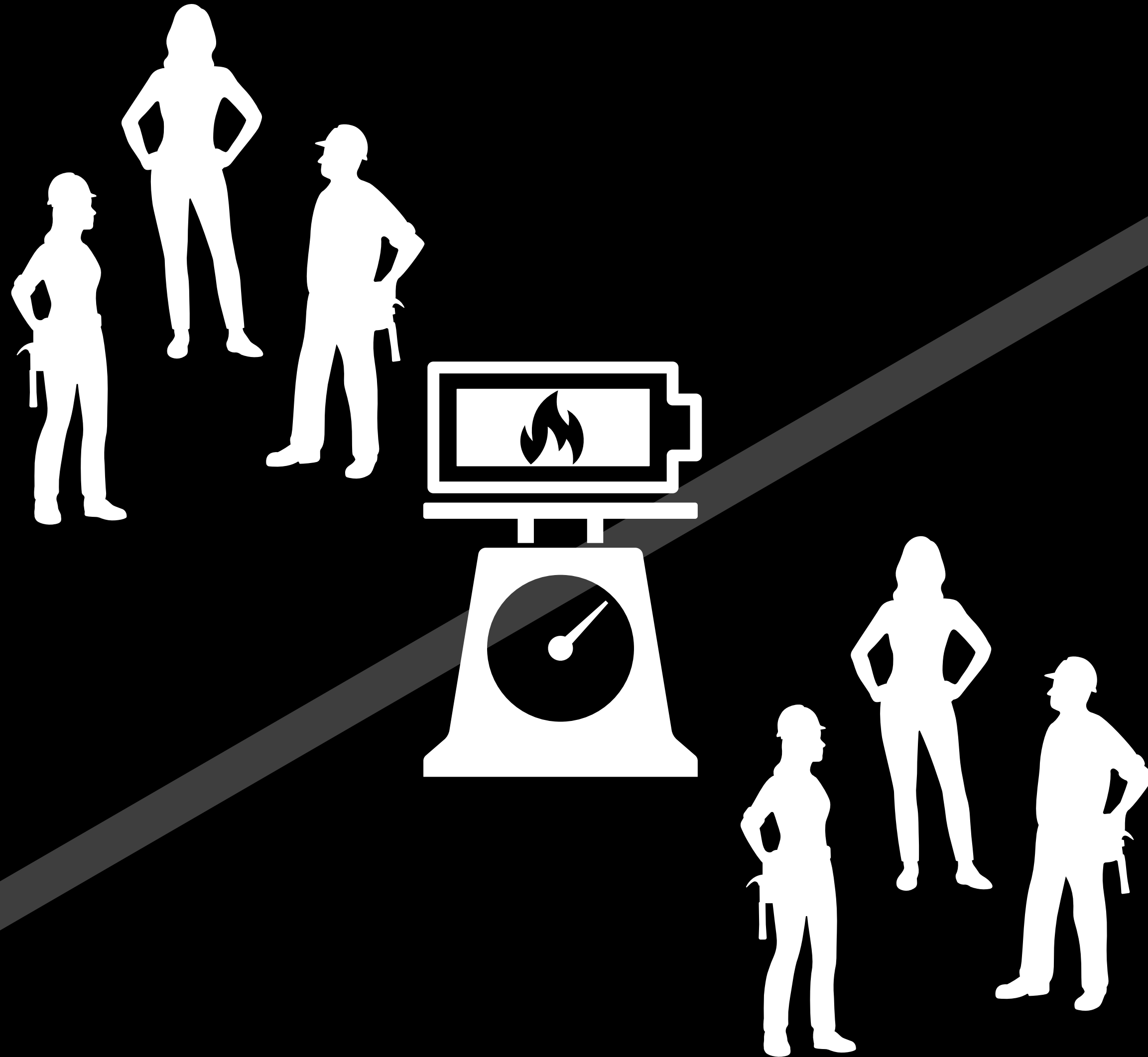
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Invest in automated verification

Enabling teams can be used

Vision

Automotive
Battery



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Responsible Engineers

Wants feedback faster

Vision

Automotive
Battery

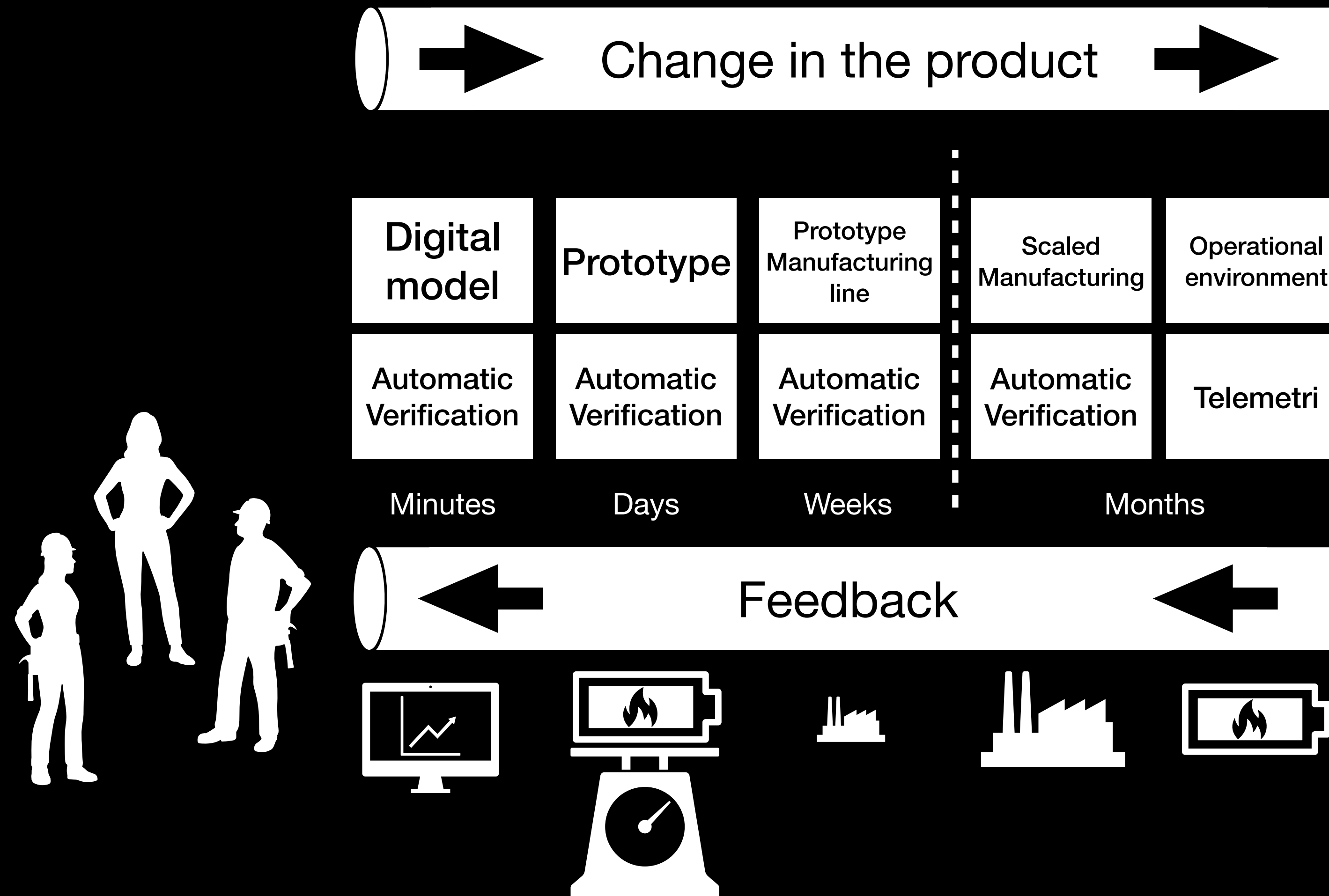


And we want to help build the
best automotive battery!

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Feedback from different environments

As fast as possible



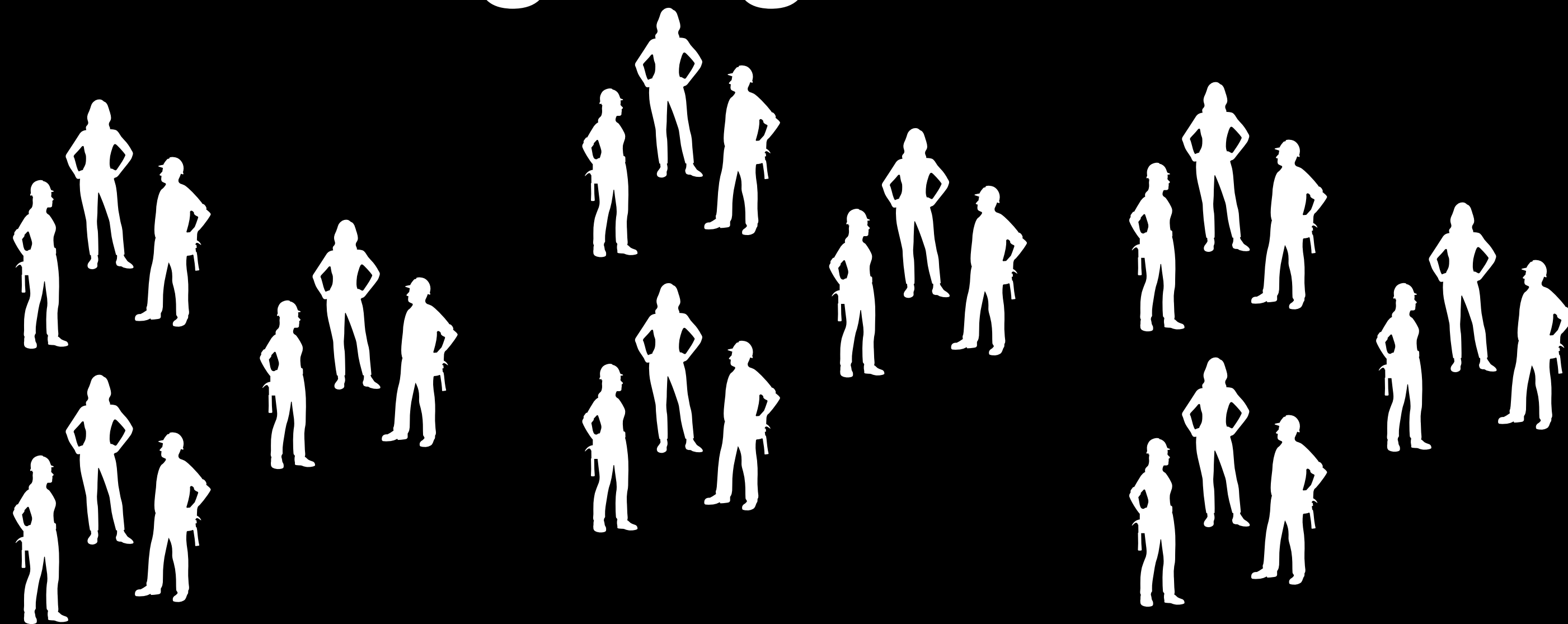
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Scaling

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Responsible Problem Solvers Working Together Toward a Shared Vision



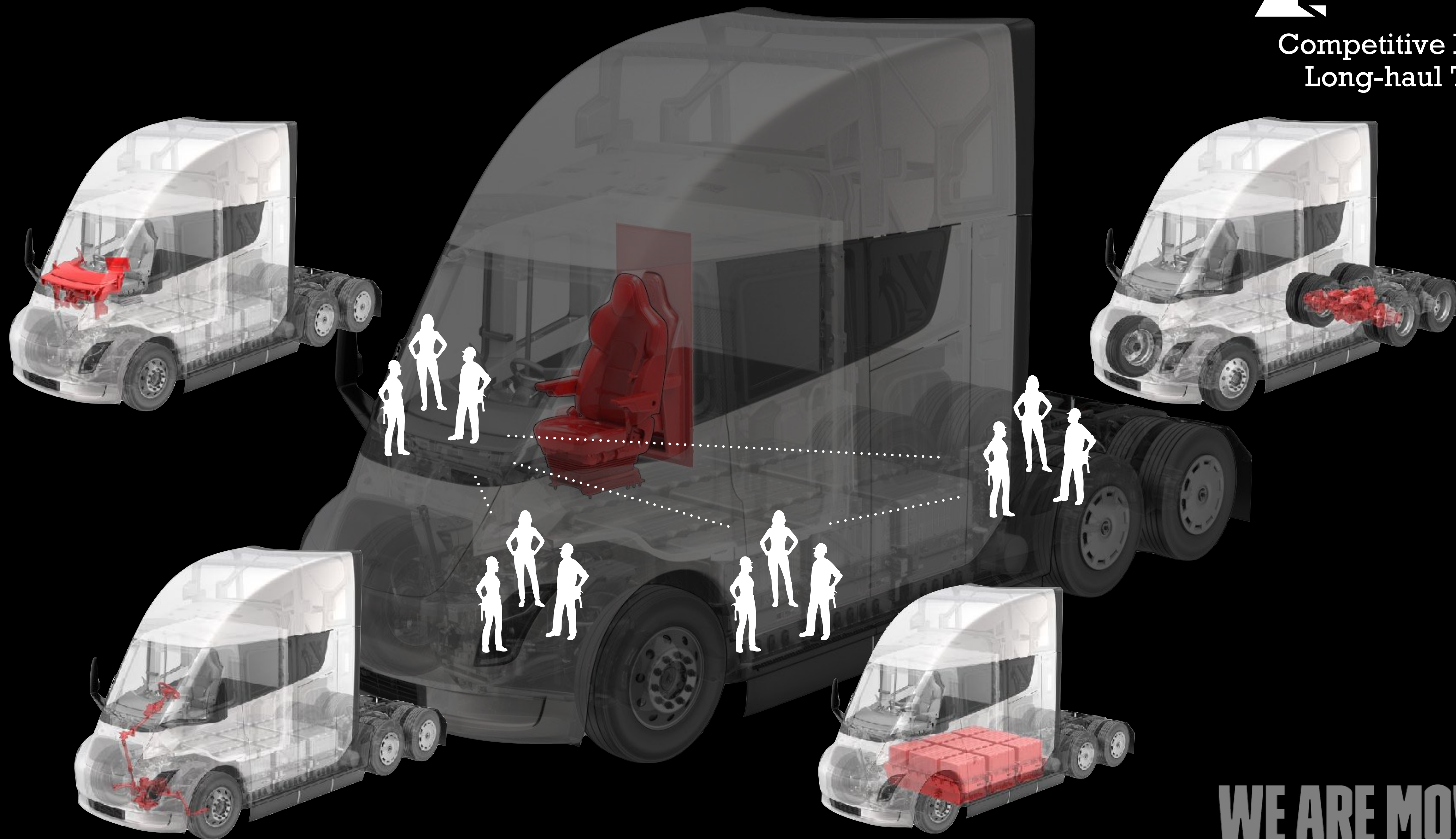
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**Scaling is about dividing the problem
while having clear communication
structures for integrating the result**

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Vision

Competitive Electric
Long-haul Truck



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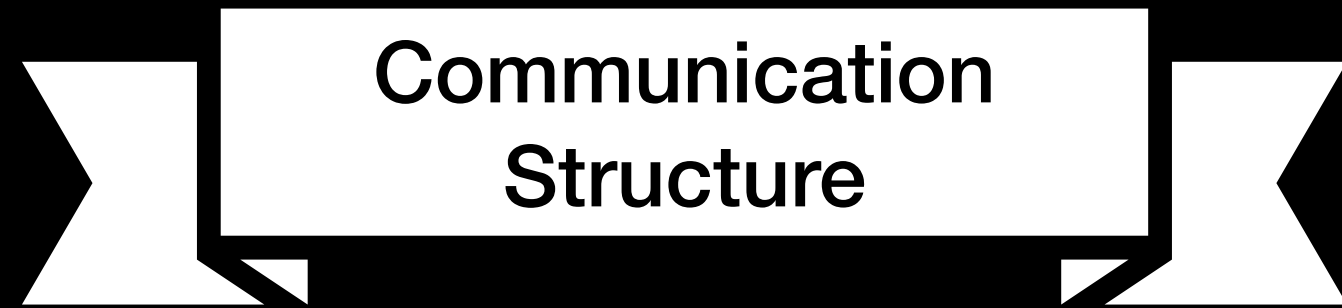
Responsible Problem Solvers

Working Together Toward A Shared Vision



Vision

Competitive Electric Long-haul Truck



Communication Structure



Communication amplifiers

- System Engineers
- Product Managers
- Line Managers
- Architects

- Joint planning sessions
- Visual overviews of plans, architecture and progress
- Sync meetings
- Frequent integration of modules - full vehicle tests

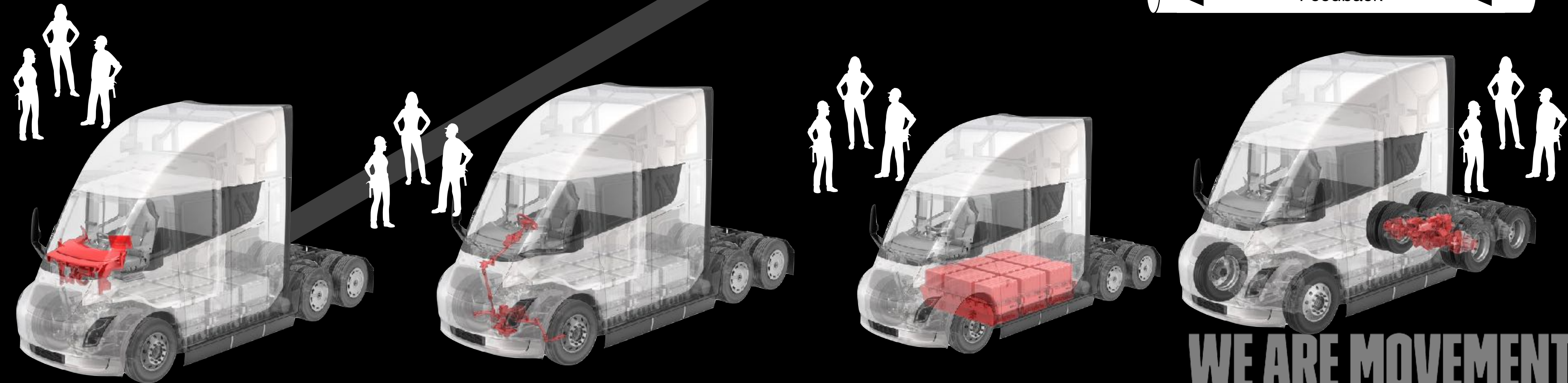


Change in the product

Digital model	Prototype	Prototype Manufact	Scaled Manufact	Operational
Automatic Verificatio	Automatic Verificatio	Automatic Verificatio	Automatic Verificatio	Telemetri
Minutes	Days	Weeks	Months	

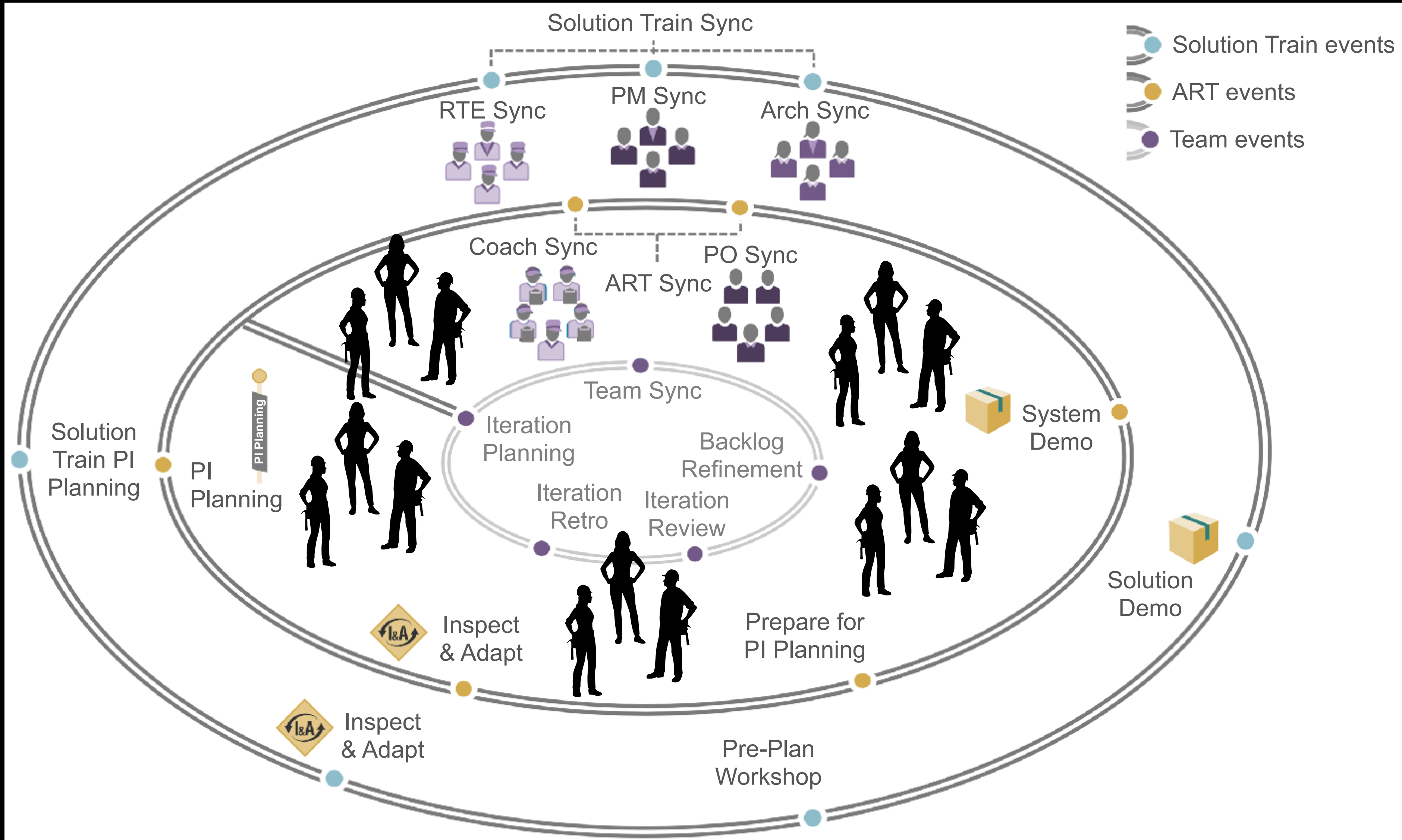


Feedback



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Communication Structure



Summary

Focus on the engineers

- Responsible Engineers Working Together Toward a Shared Vision
- Communication structures should help engineers solve problems together
- Automation is a powerful tool to get faster feedback and improve collaboration