Engineering Jidoka: An Oxymoron?

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Fundamental Focus of Lean Production

"All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes."

- Taiichi Ohno

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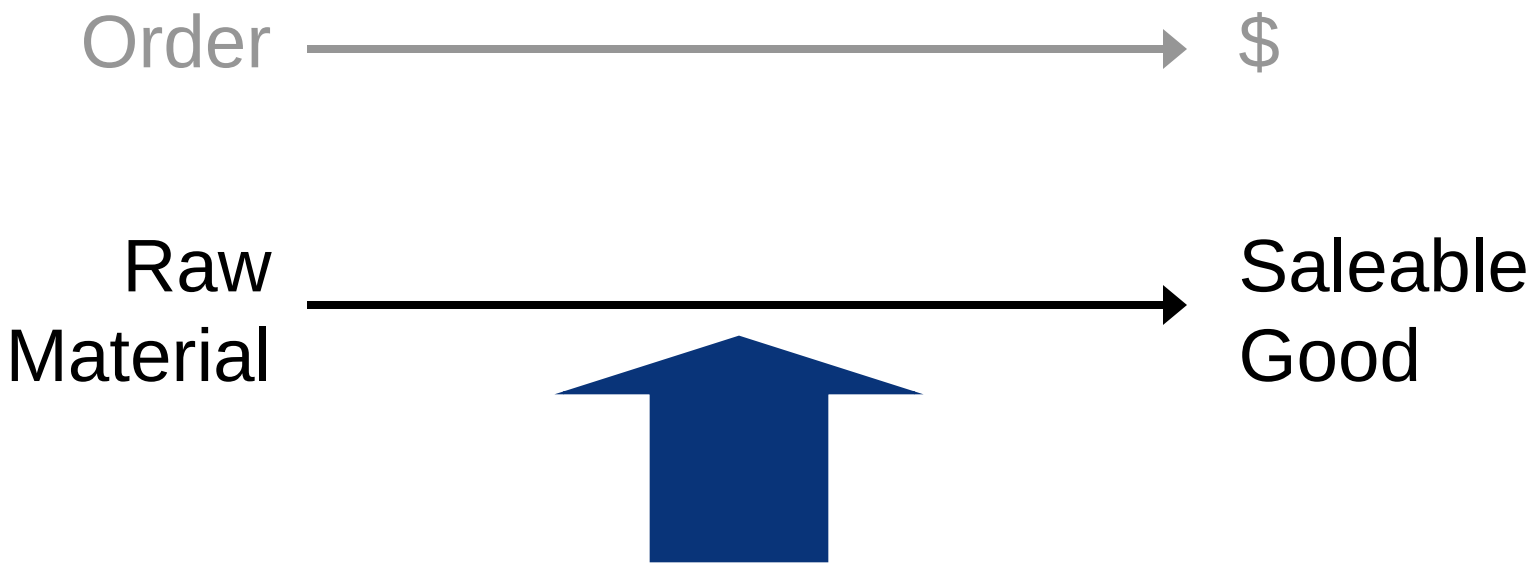
In the Factory



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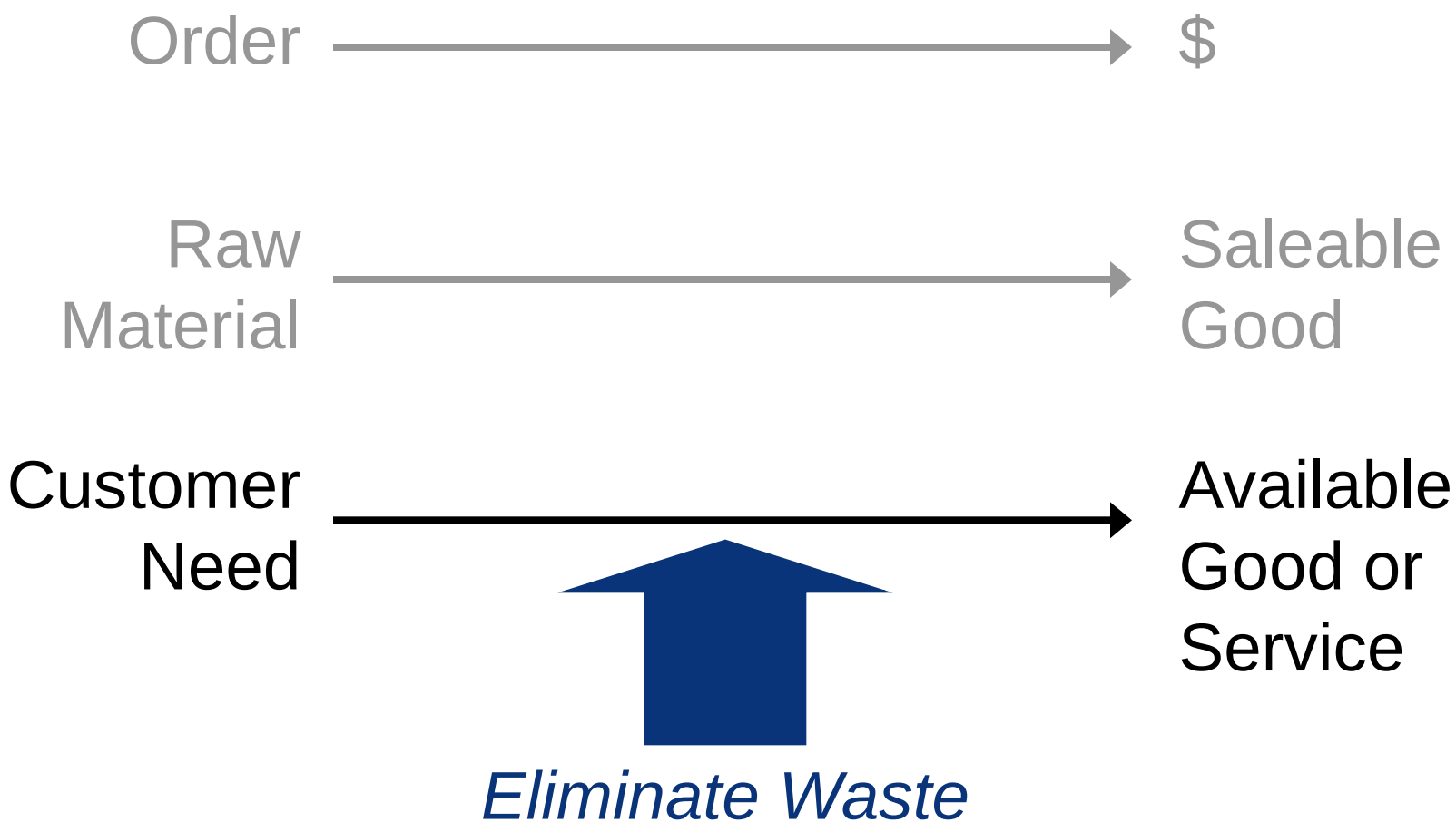
In Product Development



What are the fundamental elements of lean?

Let’s look at the Toyota Production System “House”…

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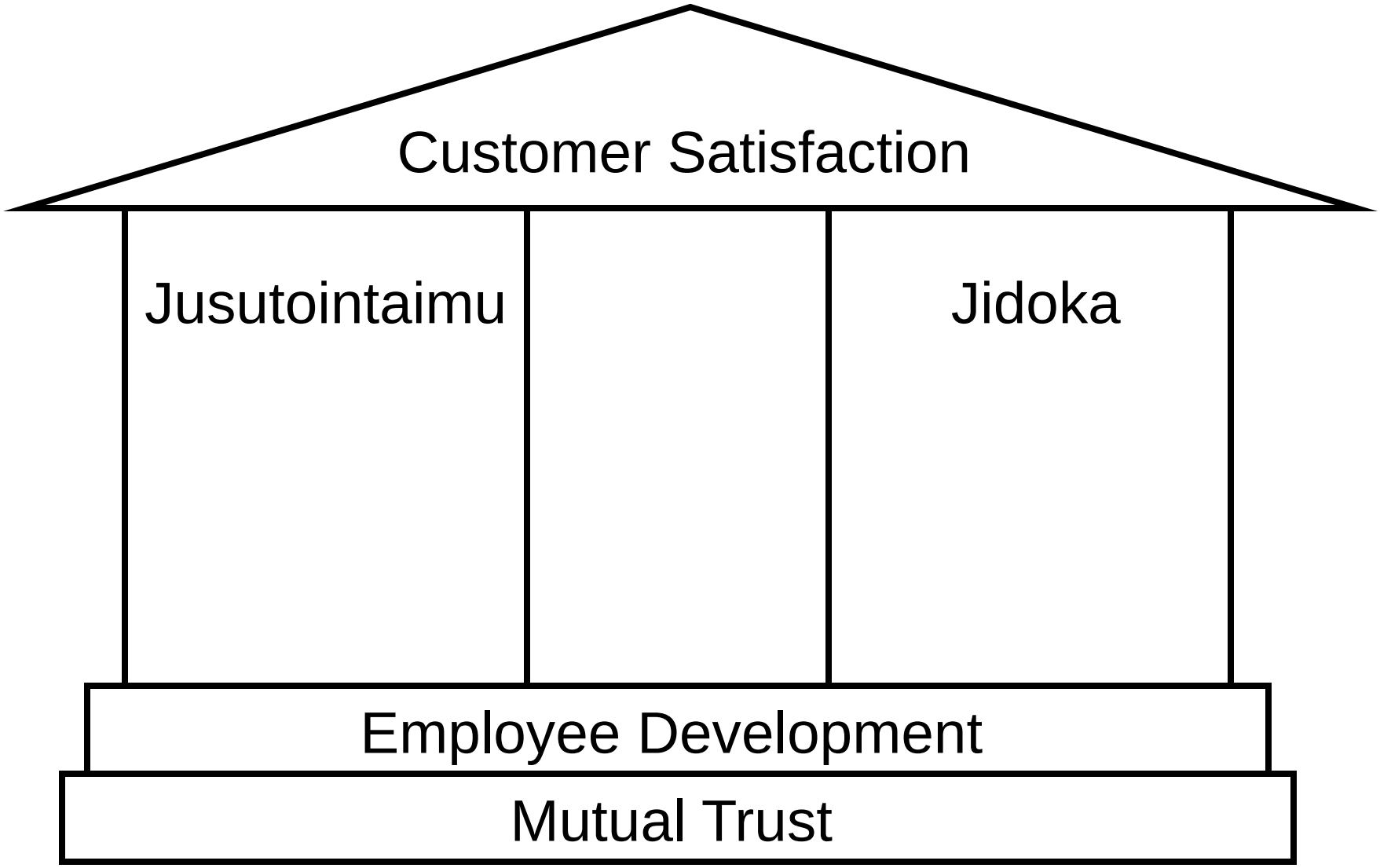

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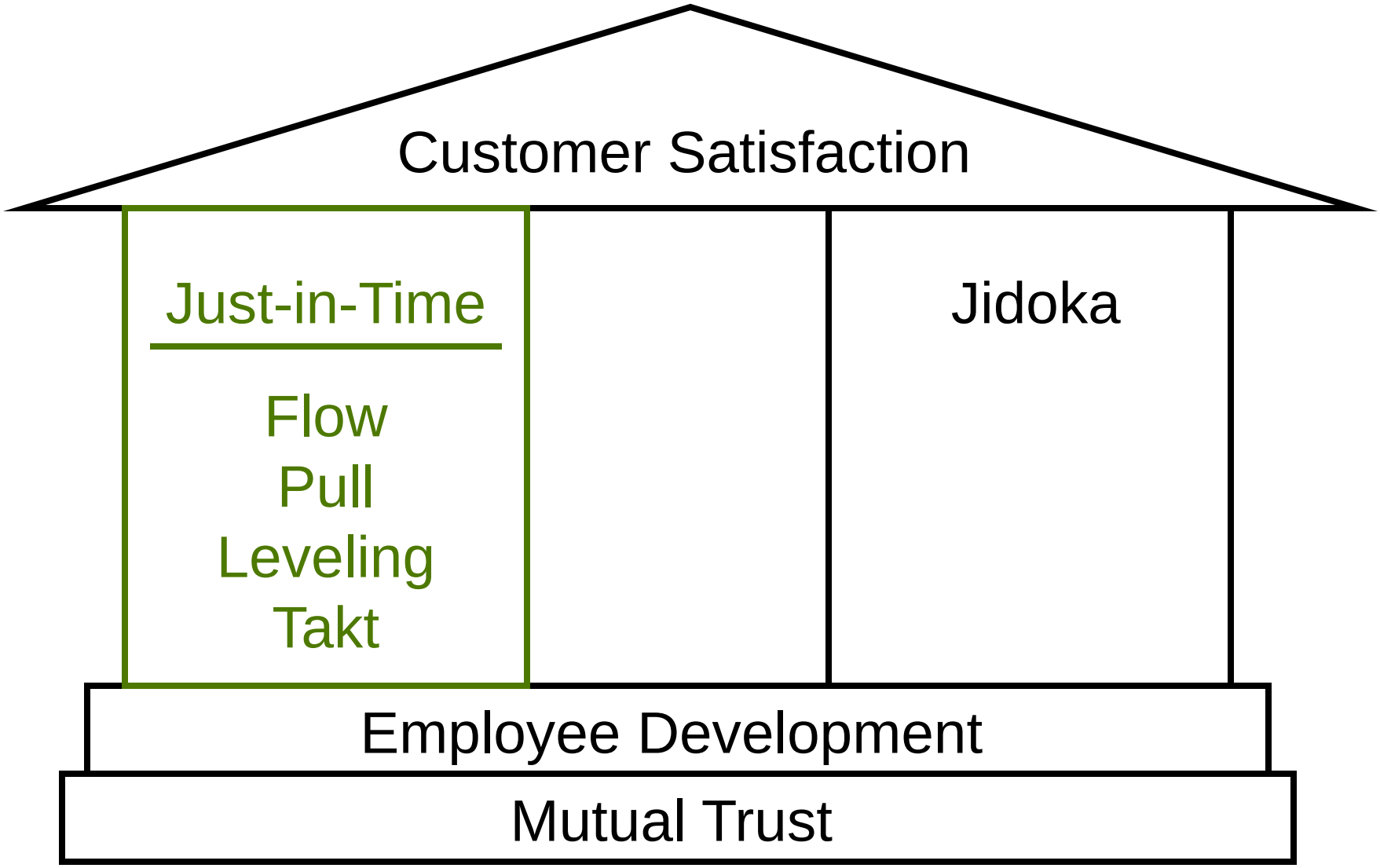

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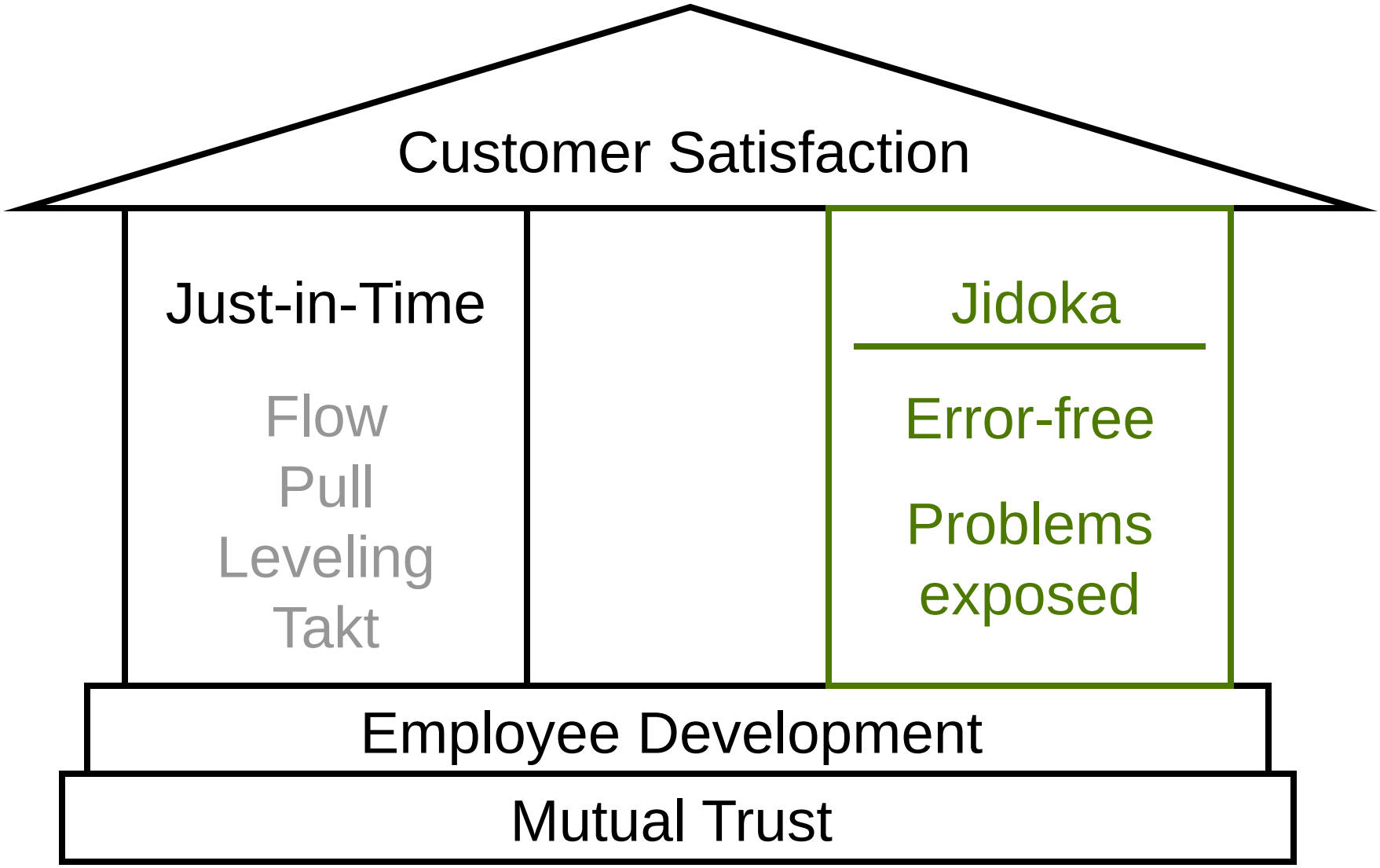

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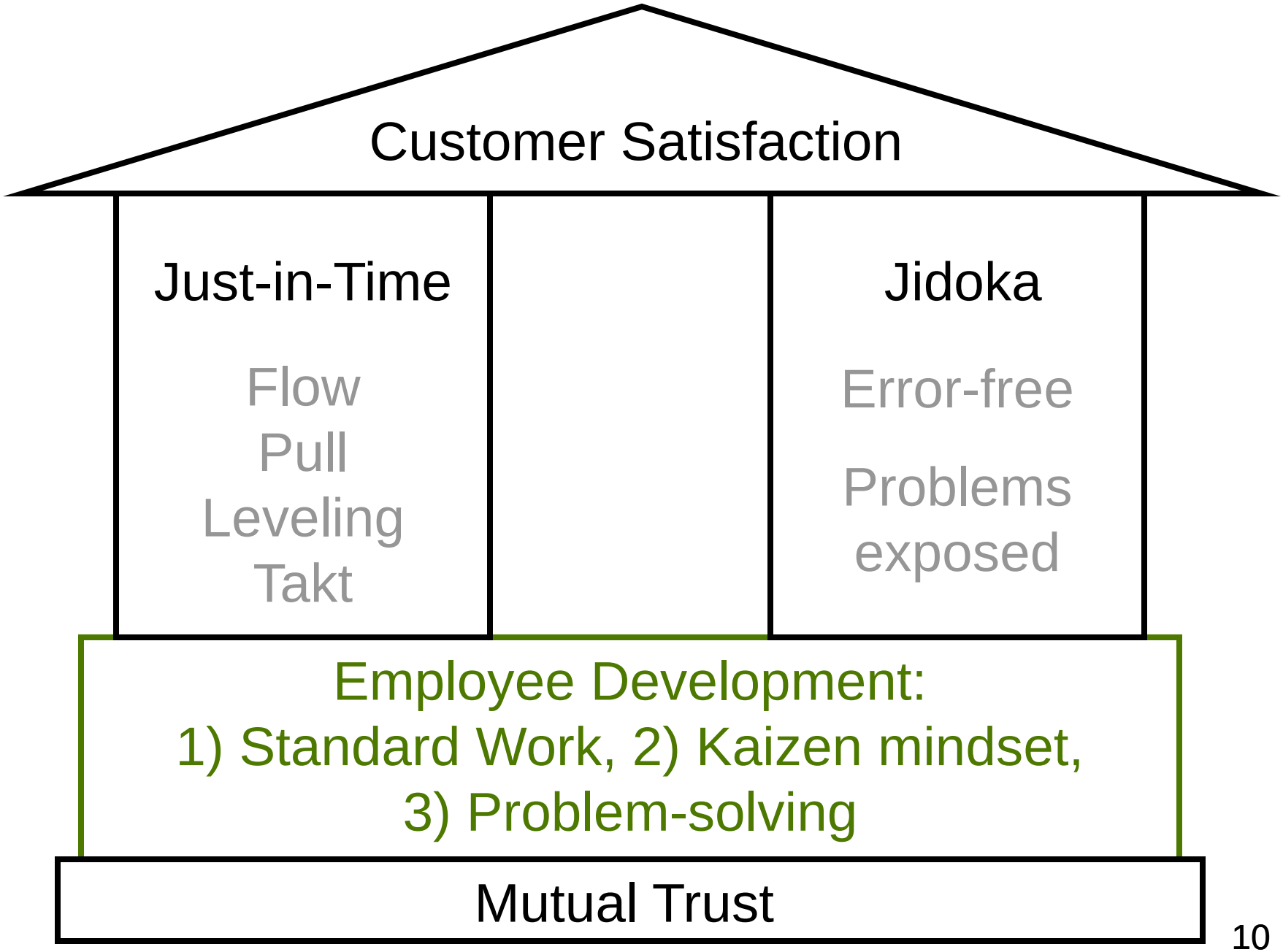
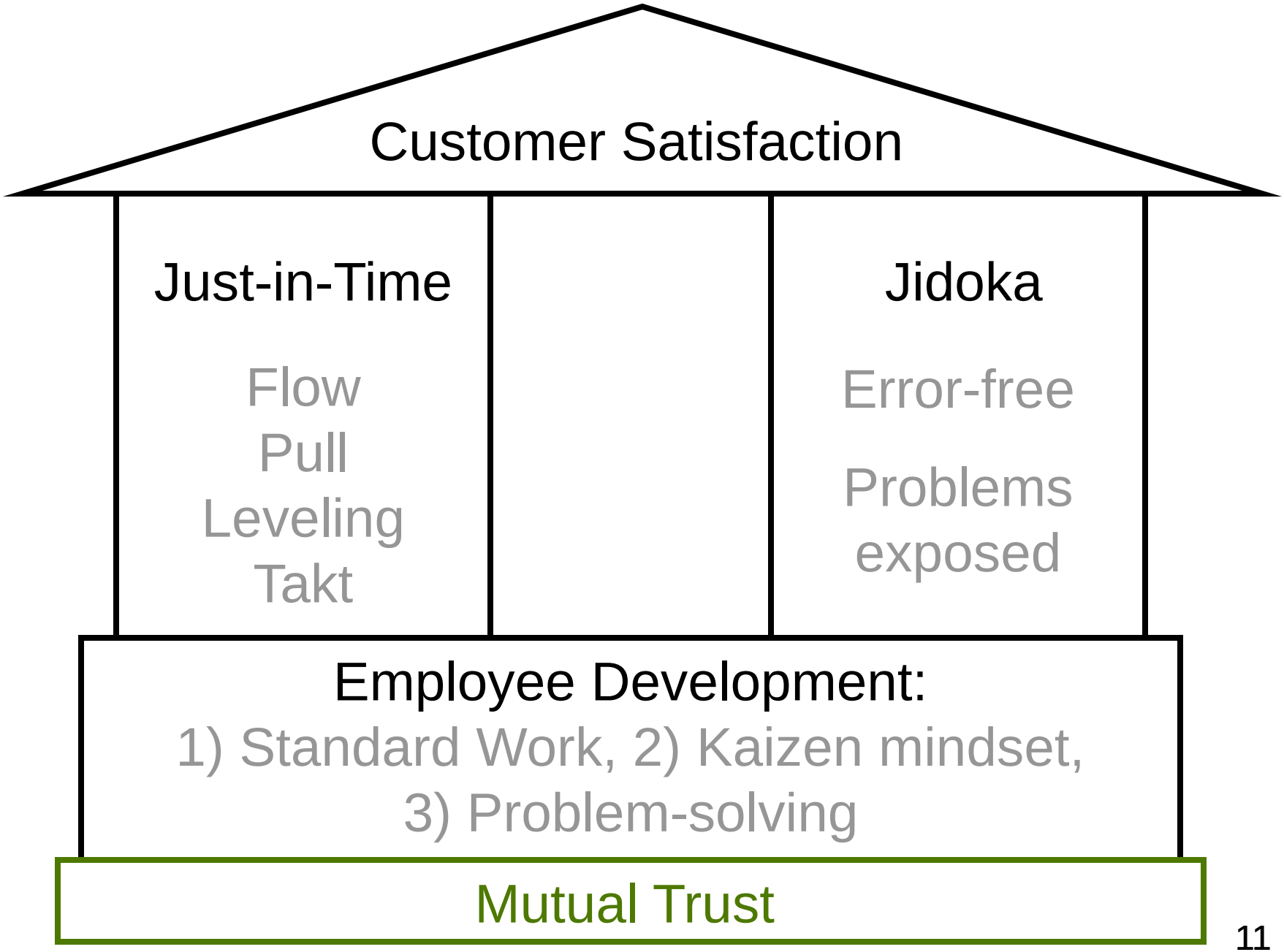

Customer Satisfaction
Just-in-Time
Flow
Pull
Leveling
Takt
Jidoka
Error-free
Problems exposed
Employee Development:
1) Standard Work, 2) Kaizen mindset,
3) Problem-solving
Mutual Trust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Does the Toyota Production System apply to product development?

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Ohno seemed to think so.

"The Toyota production system, with its two pillars advocating the absolute elimination of waste, … represents a concept in management that will work for any type of business."

T. Ohno, *Toyota Production System*, 1988; p.9

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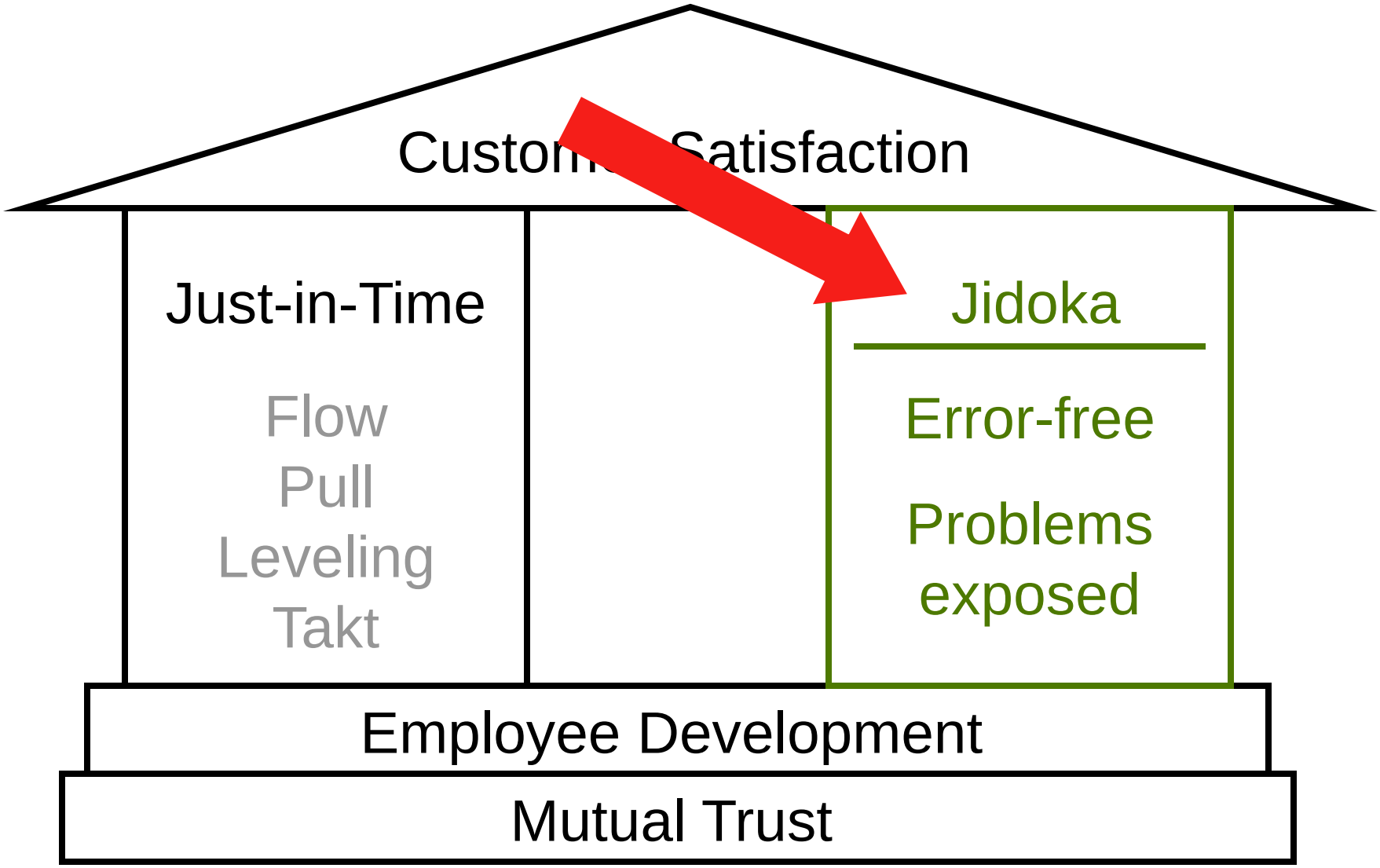

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What is Jidoka?

- Goal: defect-free production
- Achieved by:
  - automatic **detection** of errors or “abnormal conditions”
  - immediate **response** to errors
  - implementation of countermeasures to **prevent recurrence** of the error

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Does it make sense to think about “engineering jidoka”?

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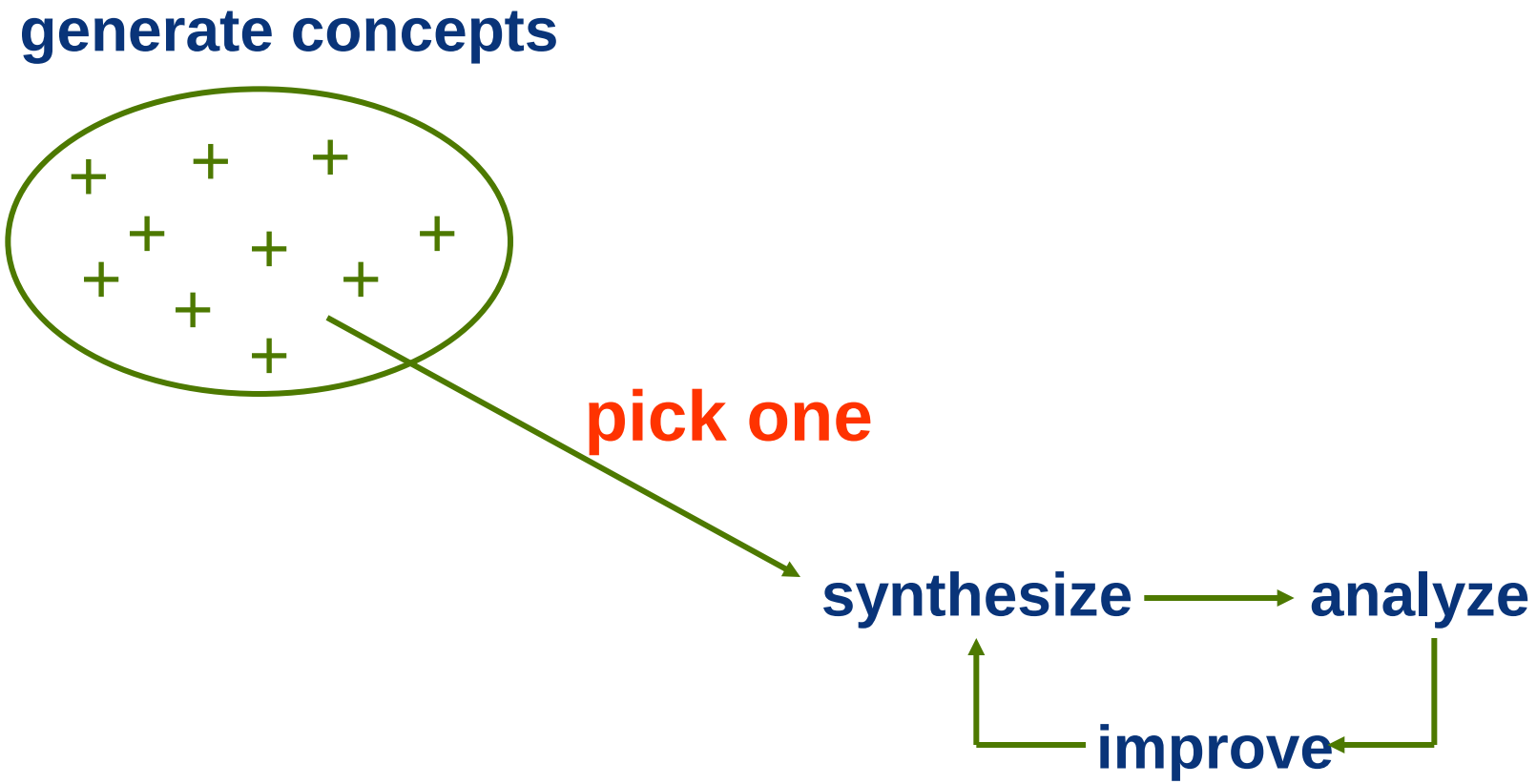
Our Basic Concept of Design



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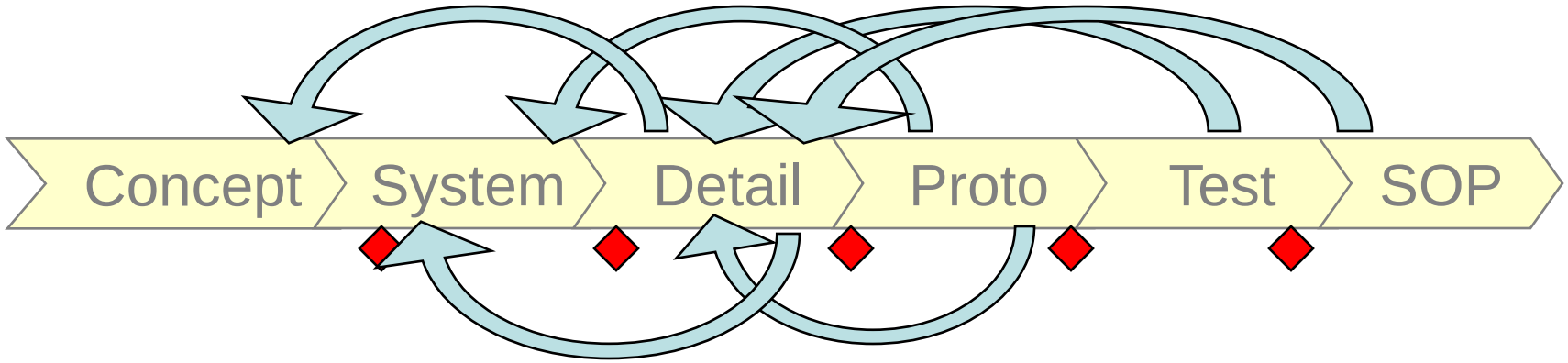
Typical PD Process



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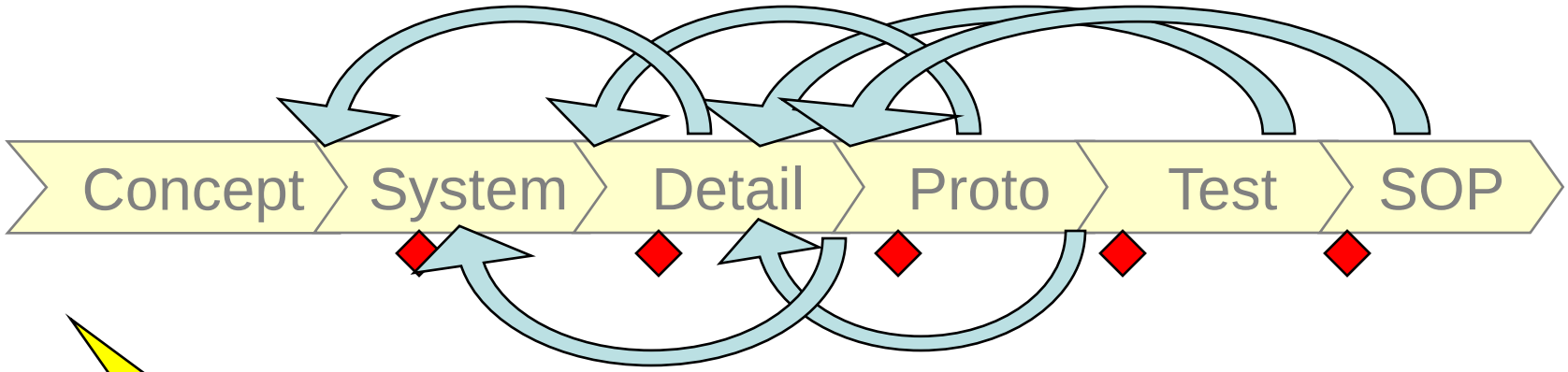
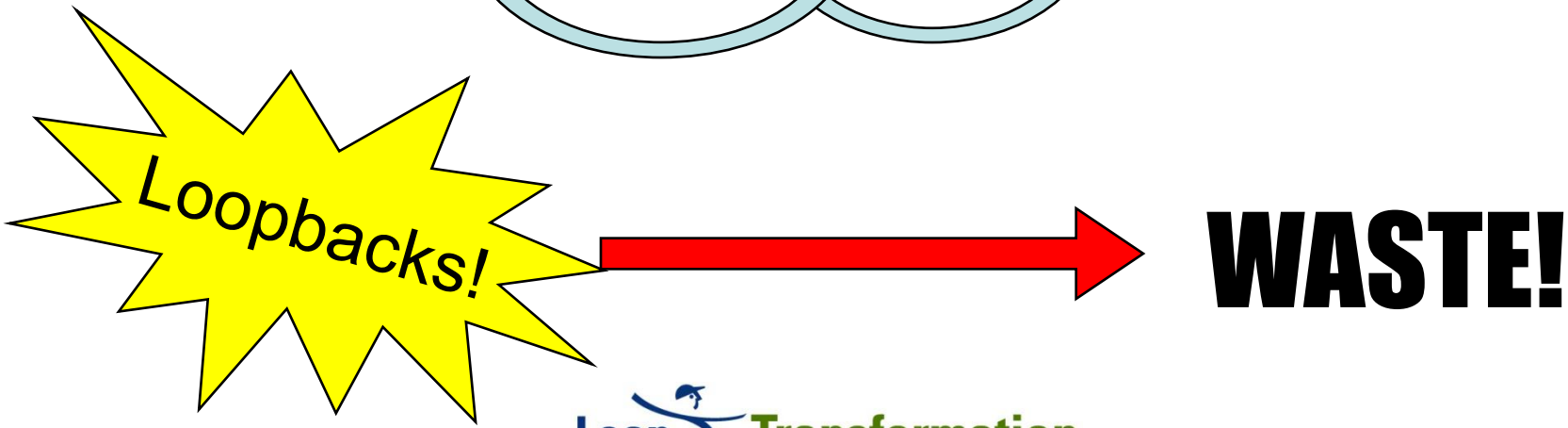
Typical PD Process





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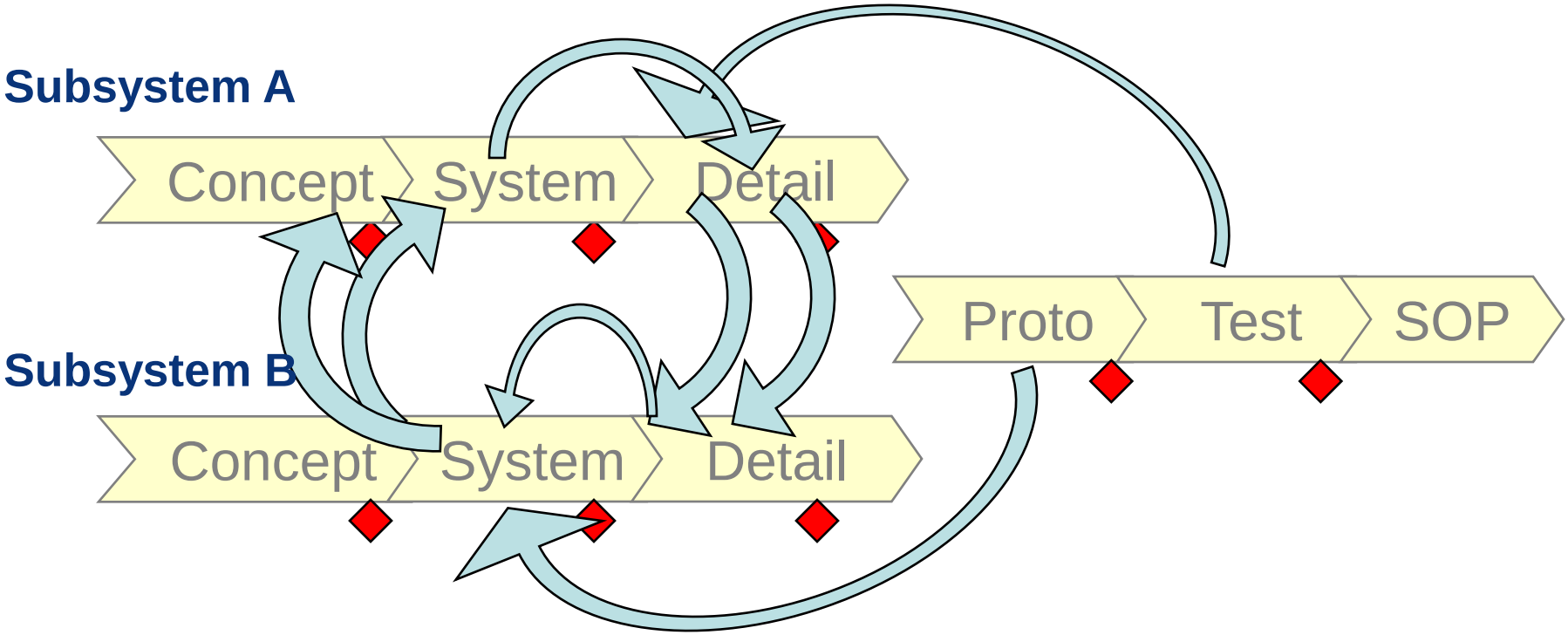
Typical PD Process



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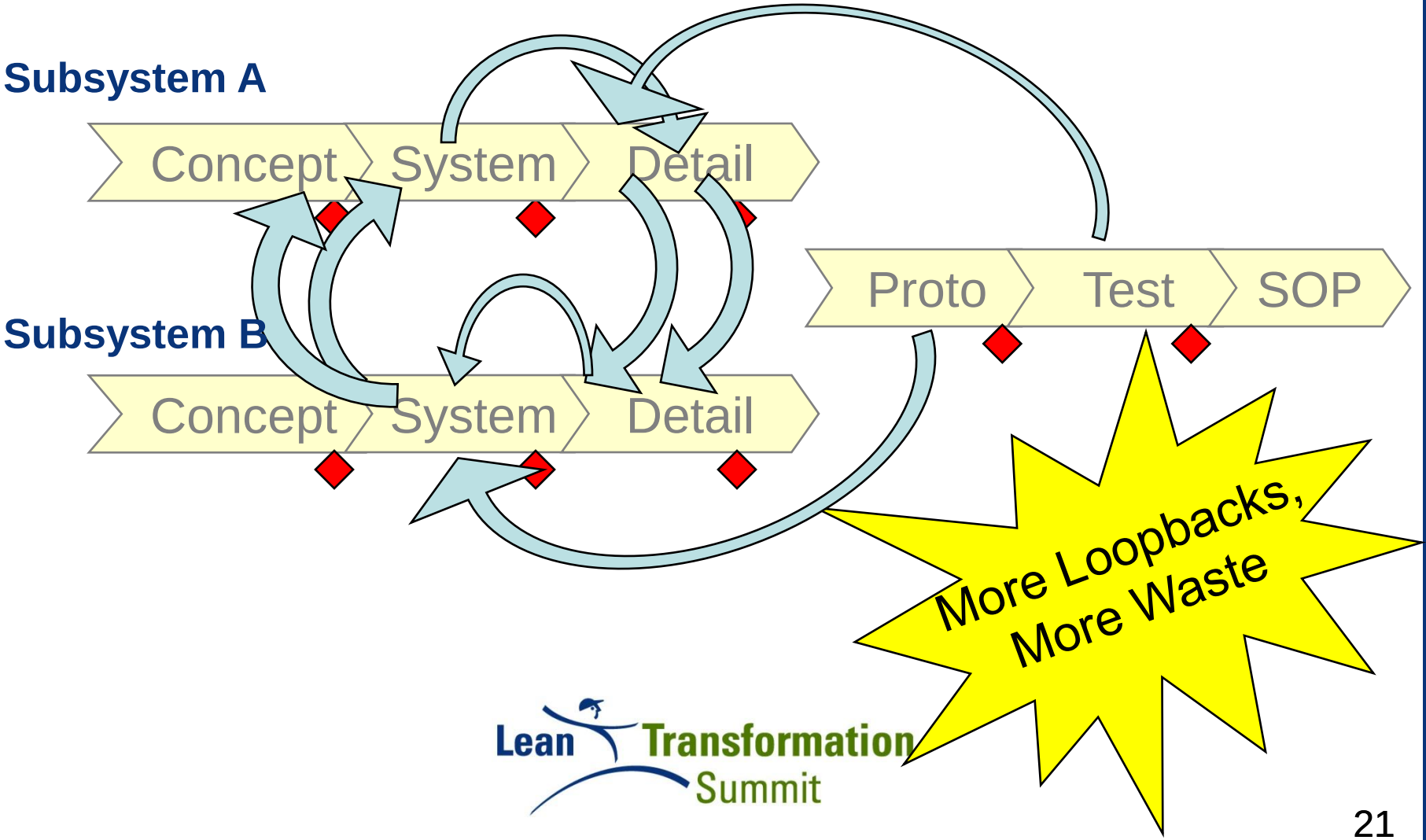
Typical PD Process



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Root Cause Analysis

Let's do this as an exercise….

1. Introduce yourself to 1-2 people nearby.
2. Together, do a "5 Why's" analysis on PD loopbacks. Write it down.

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Example

Why do we have loopbacks in PD?

A: customer changes requirements.

Why do customers need to change requirements, or
Why are requirements so volatile, or
Why don't we understand our customers better?

A: ?

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Call Out!

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My Root Cause Analysis

Loopbacks in PD

- Why? Make decisions with insufficient knowledge
  - Why? Right knowledge does not exist or is not available

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My Root Cause Analysis, cont.

Knowledge Unavailable

- Why? Knowledge from previous project disappeared
  - Why? Assigned to new project
  - Why? Not valued
  - Why? No KM system

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My Root Cause Analysis, cont.

Knowledge Unavailable

- Why? Knowledge from previous project not useful
  - Why? Incompatible reassignments
  - Why? KM system no good
  - Why? No good tools / representations

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My Root Cause Analysis, cont.

Knowledge Unavailable

- Why? Didn't do our homework before deciding
  - Why? Management pressure
  - Why? Wrong design model
  - Why? No good tools

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Some Proposed Countermeasures…

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Design, Then Test/Analyze

Test 1	P
Test 2	P
Test 3	F
…	

Does not generate useful knowledge

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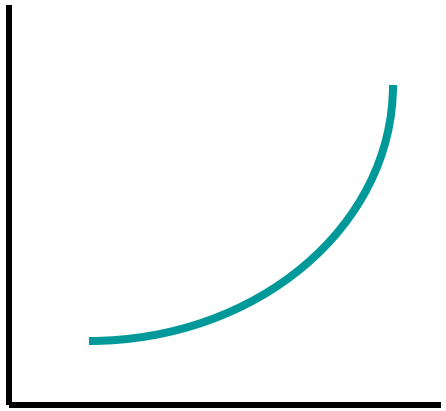
Design, Then Test/Analyze

Vs.

Test/Analyze, Then Design

Test 1	P
Test 2	P
Test 3	F
…	



Does not generate useful knowledge

Creates knowledge useful now and in the future

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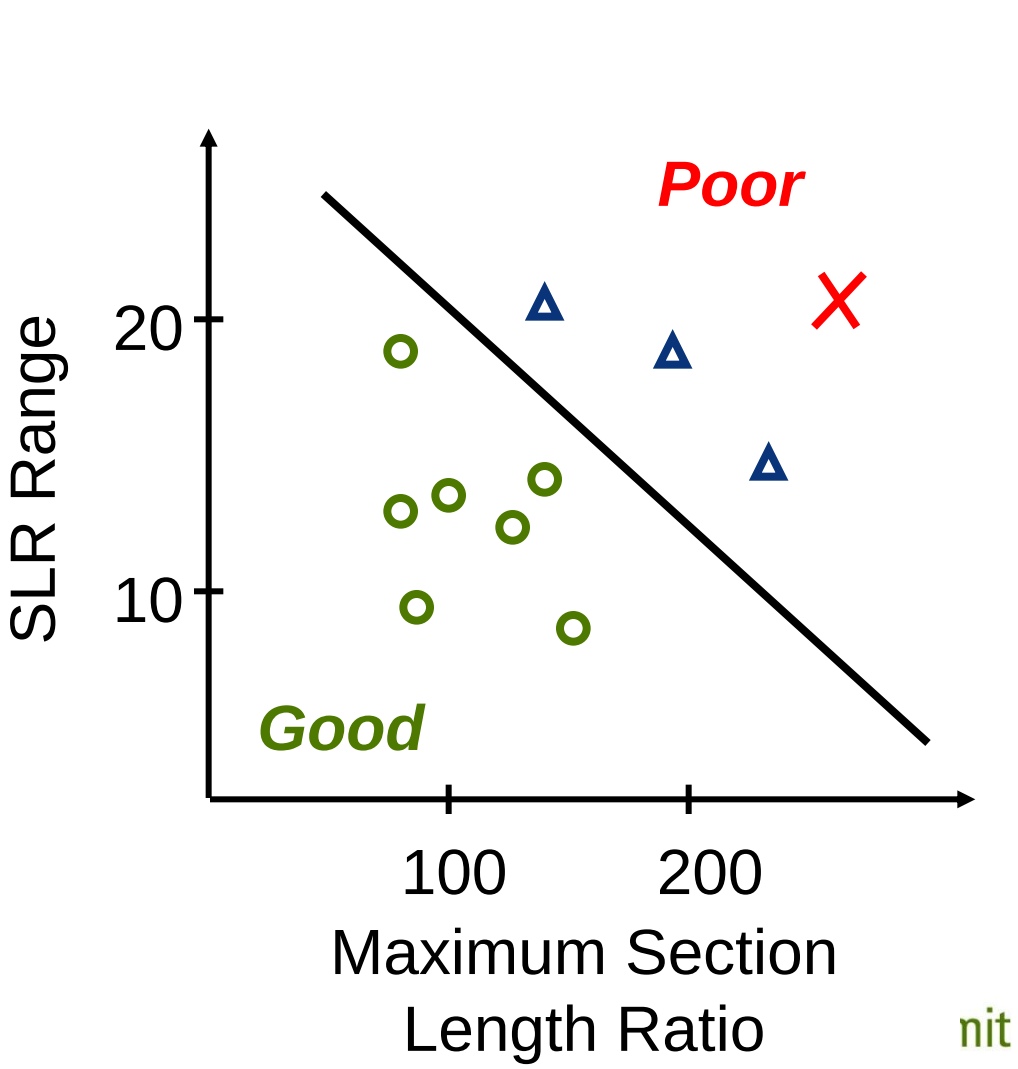
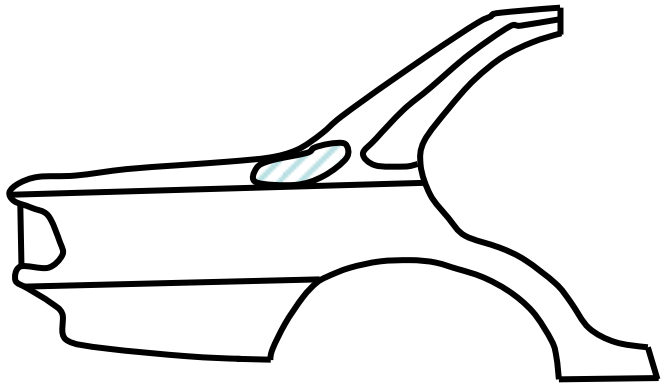
Limit Curve Example

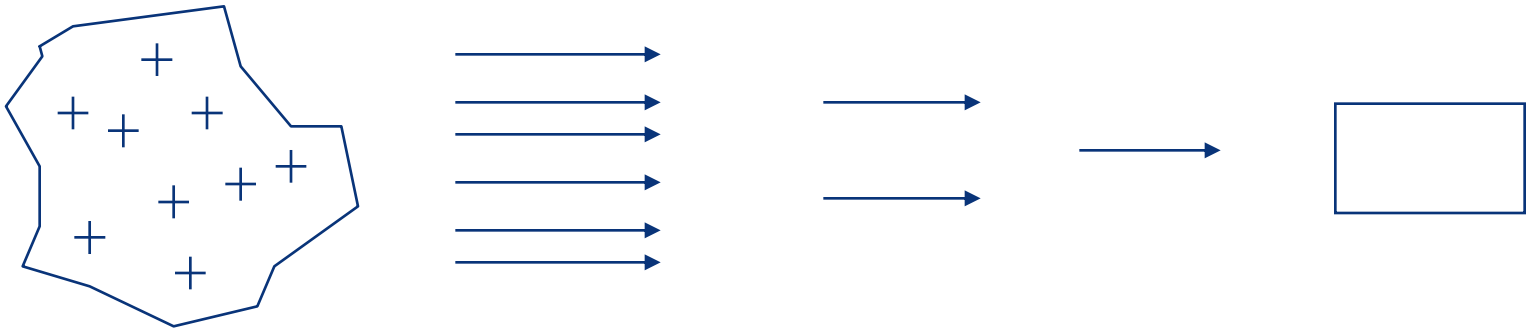




Tryout Hours	
○	500
△	900
×	1200

Down Select with Knowledge

Ex. Styling development.



Sketches

Full-scale renderings

1/5 Scale Clay Models

Full-scale Clay Models

CAD Release

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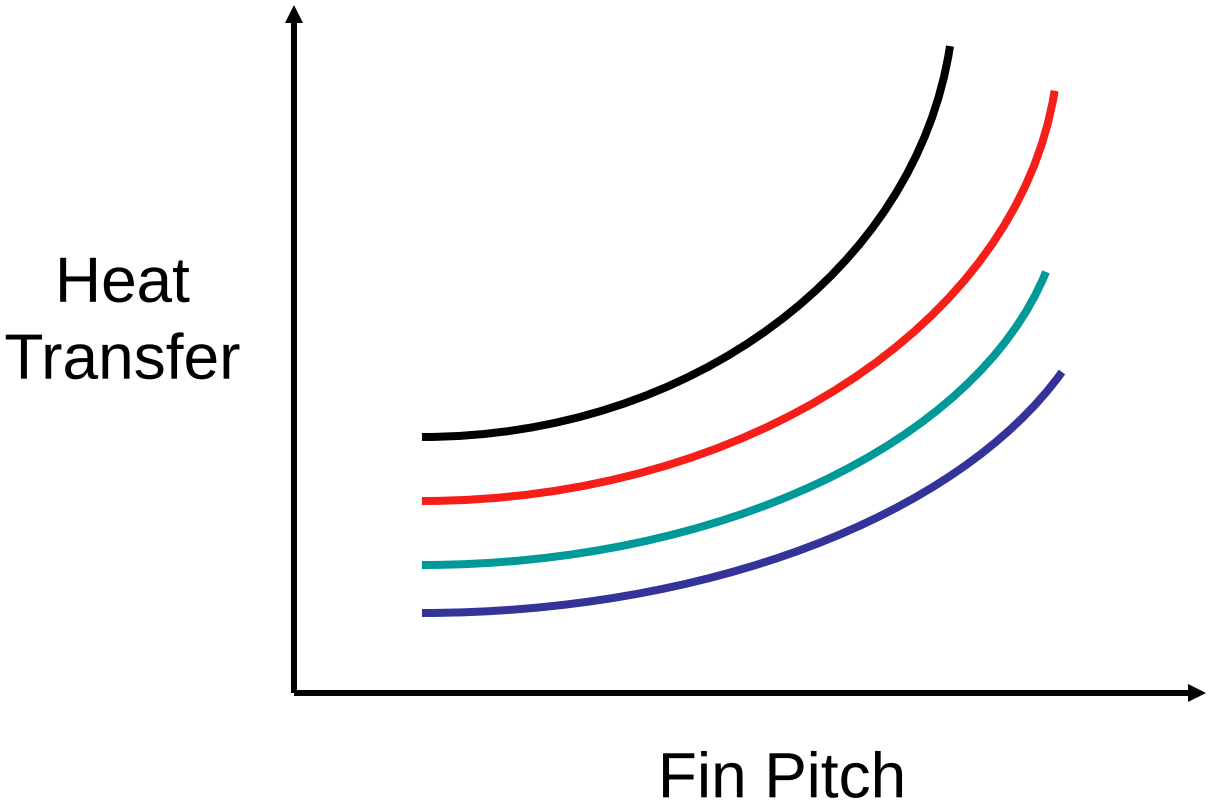
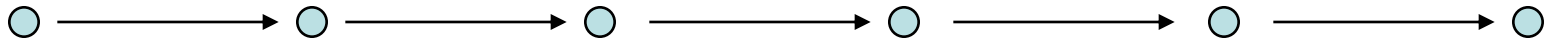
Trade-off Curves

Ex. Radiators



Allow Specifications to Emerge

Toyota A/C Example



General req’ts	5-7 paper ideas	3-4 prototyped ideas	1-2 detailed designs	Final design	Mass prod. order

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Exposing Errors Early

Expose, don’t hide, problems through:

- Checklists
- Design reviews
- LAMDA

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Engineering “Checklists”

- Design standards for each part and tool.
  - Define known feasible solution space.
  - Derived from solutions to past problems.
  - Describe current manufacturing capability.
  - Working-level engineers update regularly.
  - Everyone can access them.

- Every project begins with the design standard.

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Design Reviews

- True integrating events
  - Results-based, not task-based
  - Knowledge-oriented, not metrics-oriented
  - Hardware or models, not presentations
- In cadence
- Clear follow-up responsibility, with deadlines

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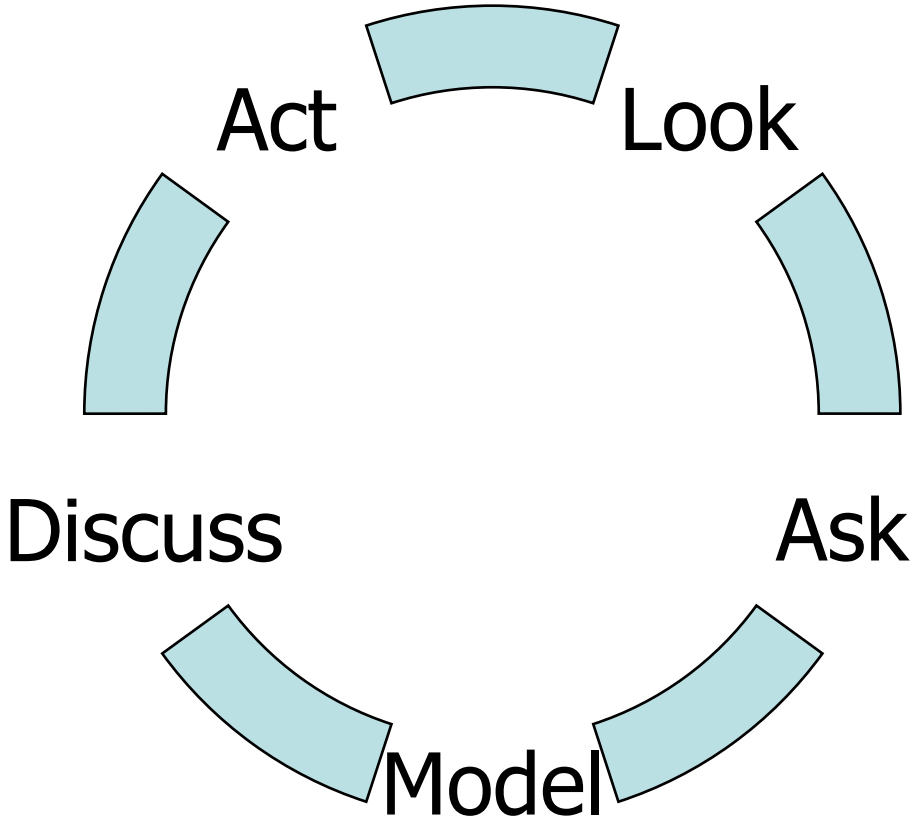
LAMDA™: PDCA for Developers



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How should we organize to best support engineering jidoka?

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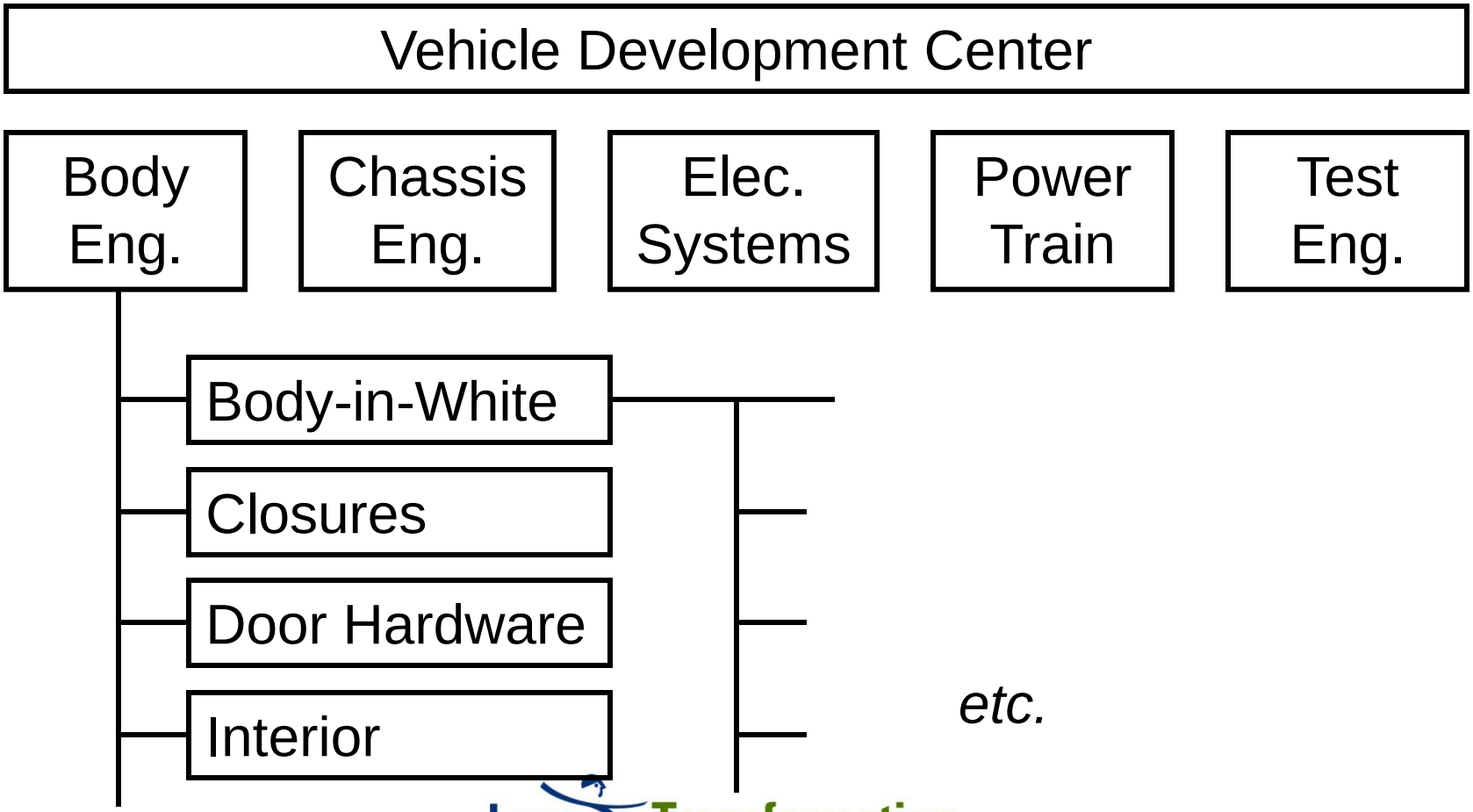
Organize by Knowledge Area



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Why not dedicated cross-functional teams?

Strong functions organized around technologies better enable:

- creation of knowledge bases
- development of design standards
- development of standard procedures
- rapid learning cycles
- mentoring managers

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Is deep technological know-how enough?

NO!

It must be **integrated**.

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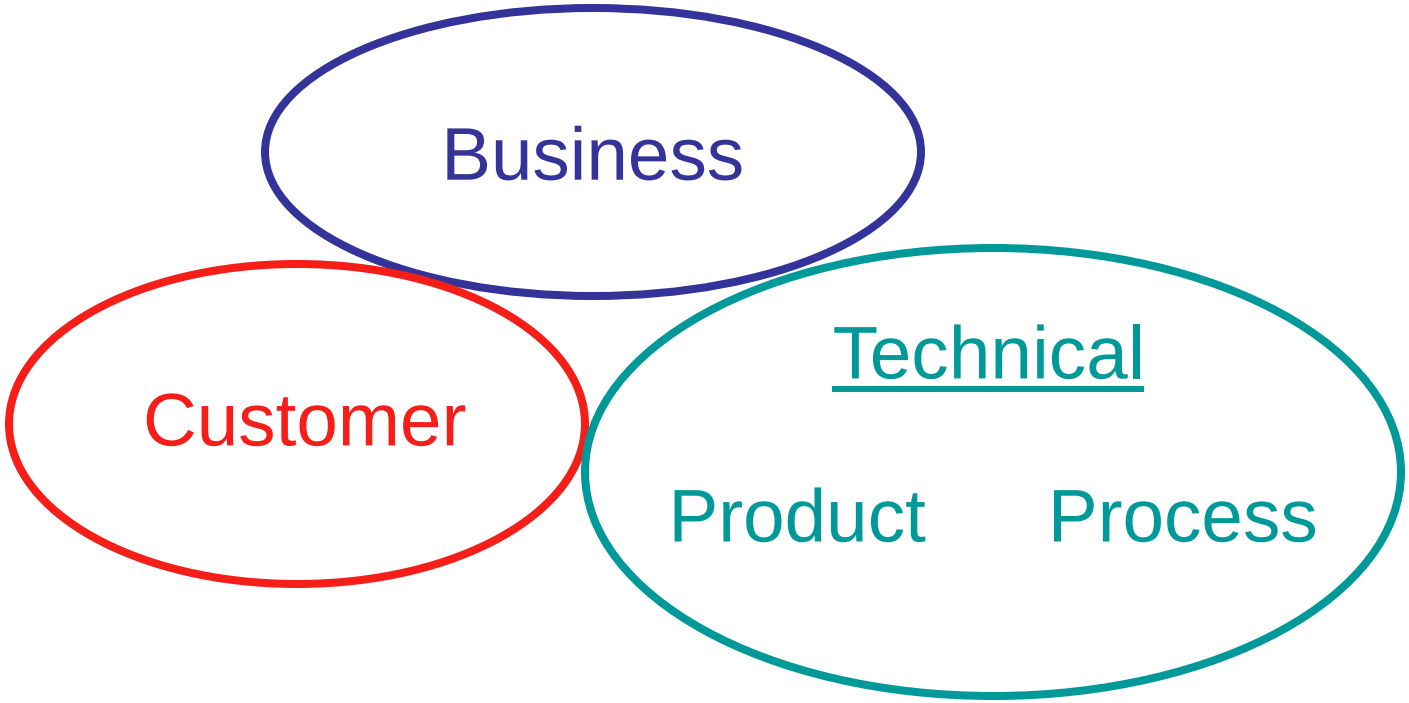
Chief Engineers responsible for product's success



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Chief Engineers build integrative knowledge

	Body	Chassis	Electronics	Engine	Test
CE Camry					
CE Corolla					
CE Celica					
etc.					

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“Lots of conflict makes good cars.”

- A Chief Engineer

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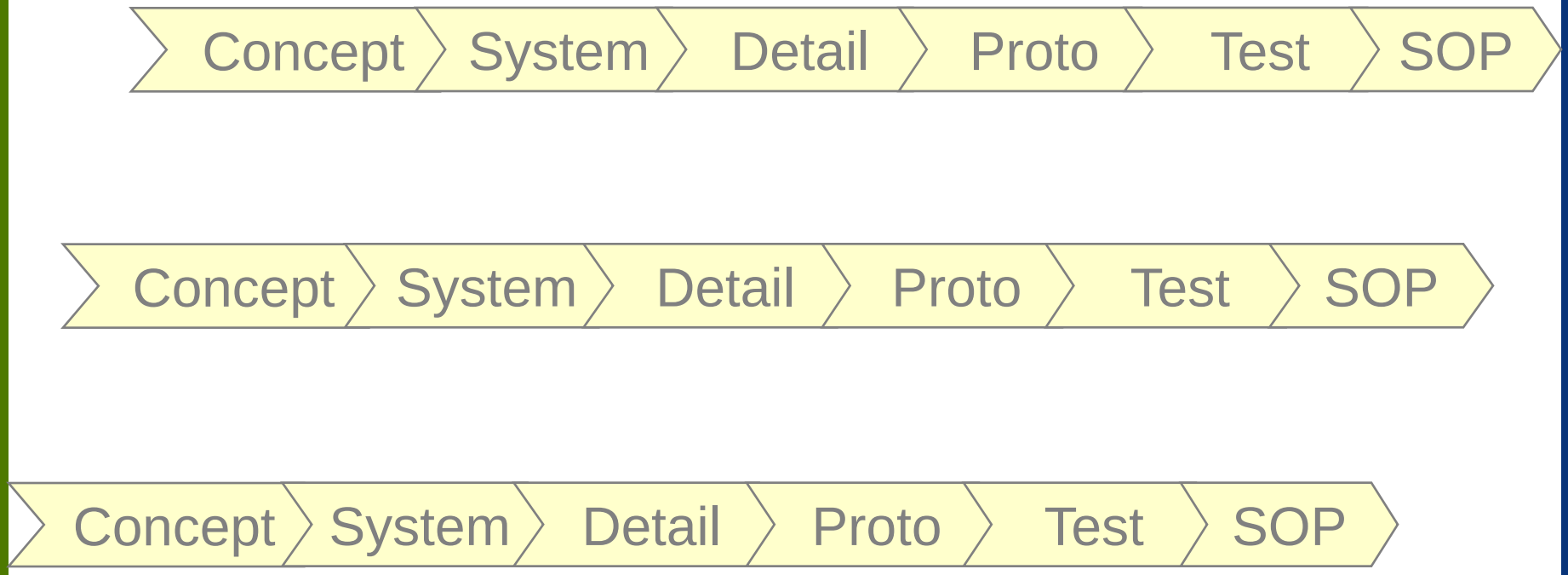
Two Knowledge Flows



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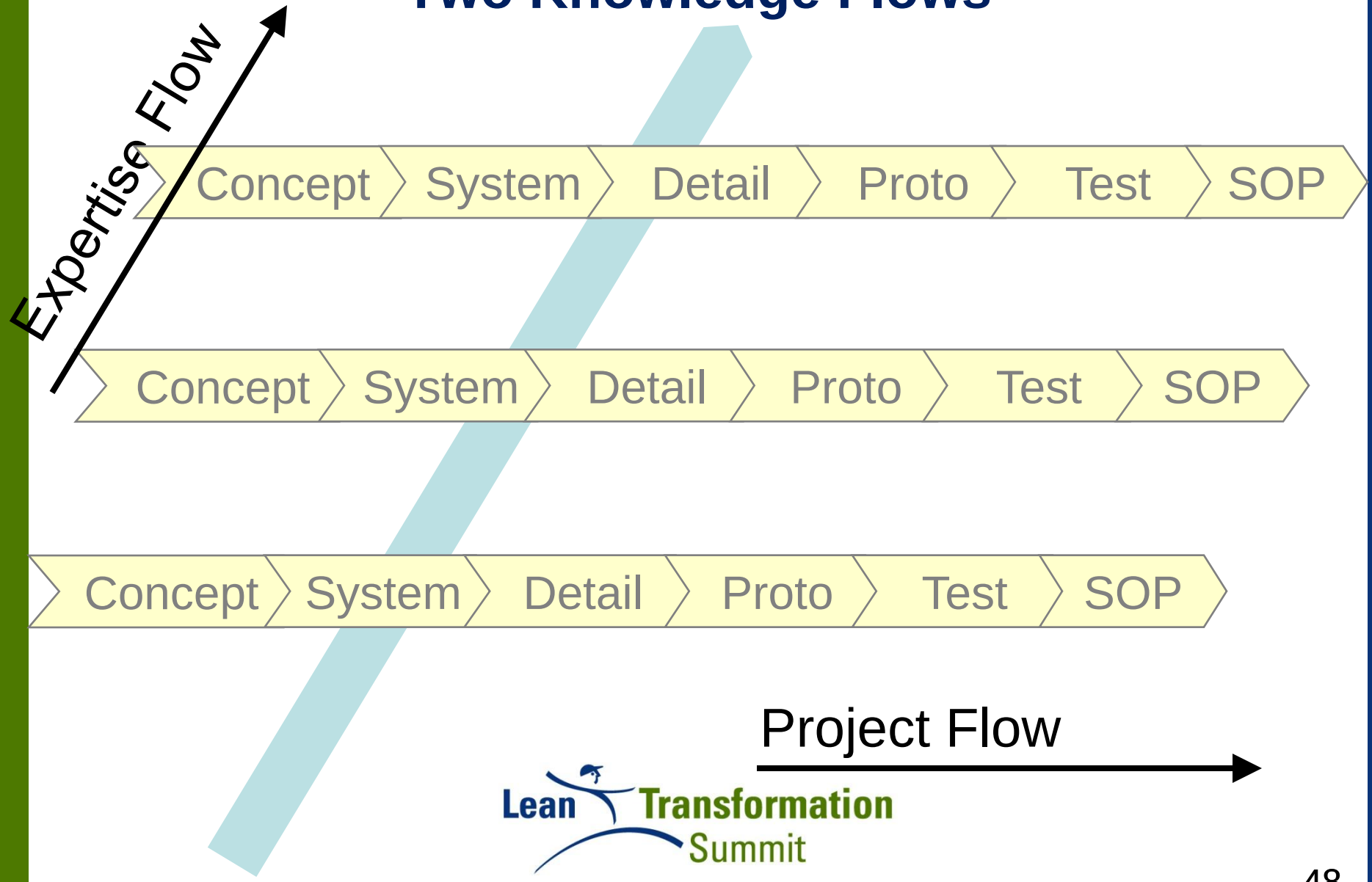
Two Knowledge Flows



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Steps towards Error-Free Development

- Organize around key knowledge areas.
- Implement a chief engineer function.
- Begin projects with targets, then converge to specifications based on learning.
- Demand knowledge curves before committing to a solution.

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Steps towards Error-Free Development, cont.

- Create useable knowledge bases.
- Make knowledge and problems visible.
- Employ a basic learning process (e.g., LAMDA) to generate, validate knowledge.

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Final thought

"There is no magic method. Rather, a total management system is needed that develops human ability to its fullest capacity to best enhance creativity and fruitfulness, to utilize facilities and machines well, and to eliminate all waste."

T. Ohno, *Toyota Production System*, 1988; p.9

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Thank you!

Questions?

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