Continuous Innovation

- The Art of Set-Based Thinking™ -

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Here are some definitions
(for this presentation only)

- An ***'idea'*** is a novel approach for doing something. Ideation is a process for achieving.
- An ***'invention'*** is the manifestation of an idea into something real.
- An '***innovation***' is an invention that realizes customer value with an economic benefit.

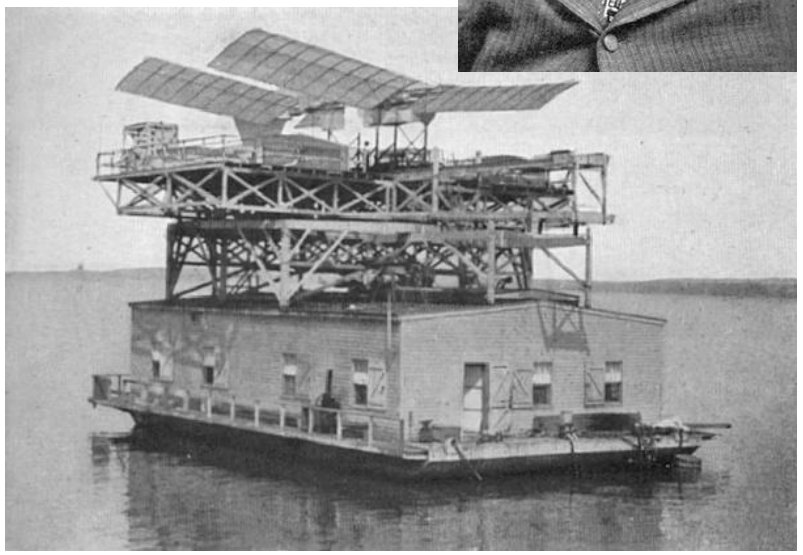
Otto Lilienthal: A great inventor

- Called the father of Flight
- Successfully designed and flew gliders in mid 19th century
- Published “lift / Drag” data

“ *To invent an airplane is nothing, to build one is something, to fly is everything*

Samuel Langley: ?????

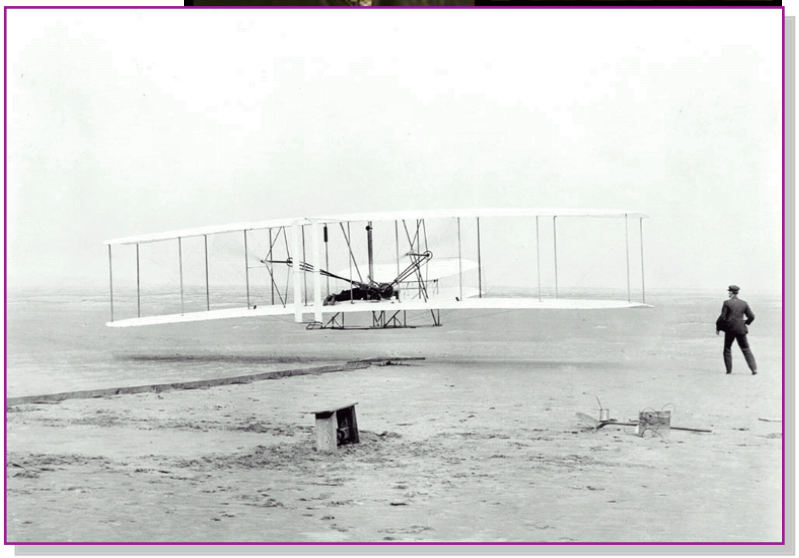
- Using Lilienthal's data, successfully designed and tested several gliders
- Funded by U.S. War department, designed this system for manned flight
- It ended up in the river



How about the Wright Bros?

Invented

- A wind tunnel for measuring lift and drag – corrected Lilienthal's data
- Wing warping technology for flight control
- A highly efficient propeller
- A lightweight engine
- Their inventions spawned an entire industry



What is lean?

- Lots of definitions; but can we all agree, it will always include “Continuous Improvement”
- Can we also agree, for Product Development, it would include “Continuous Innovation”
- Another question: “What is the relationship between ‘lean’ and ‘innovation’?
  - Complementary, adversarial

Lean vs. Innovation

The case for Adversarial:

- lean is about setting standards / reducing variability
- Innovation is about breaking standards and increasing variability

The case for Complementary:

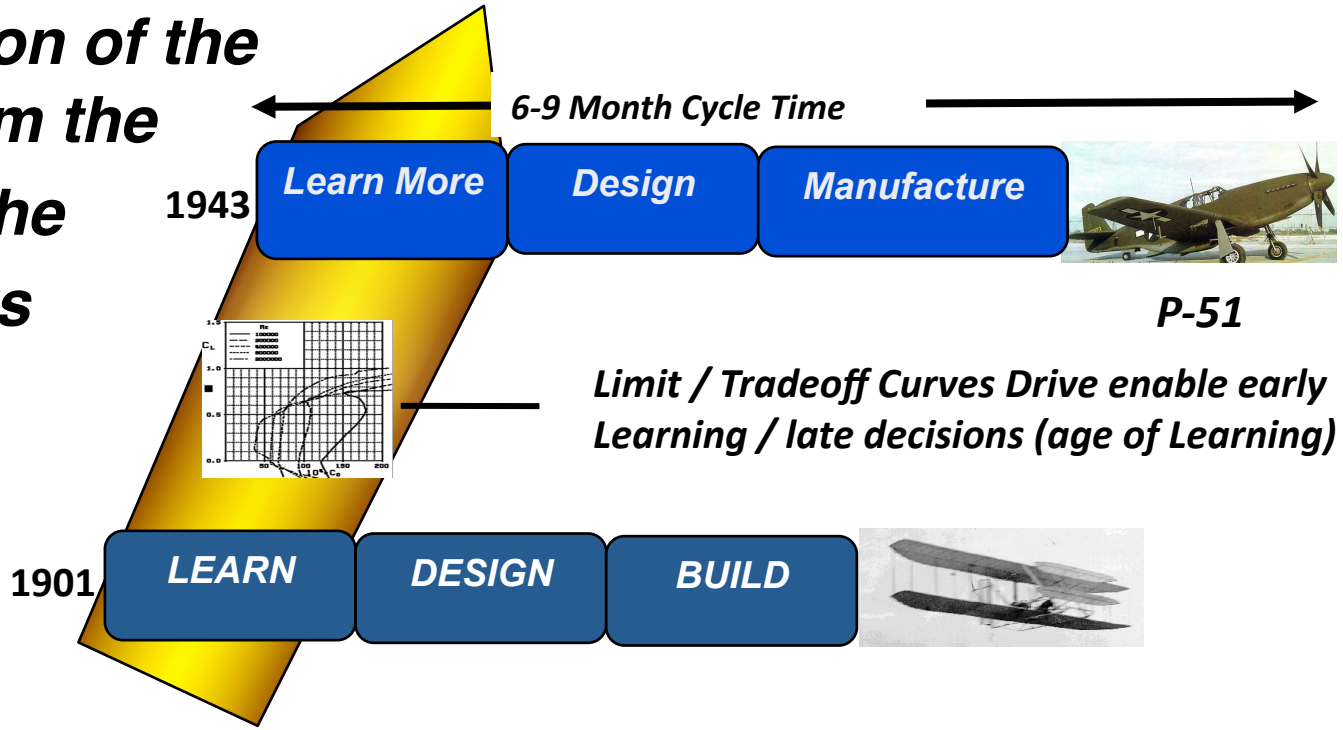
- lean is about establishing a baseline (standard)
- Measuring the baseline
- Continuously innovating to improve the baseline

Were the Wright Brothers Lean?

(we know they were great innovators)

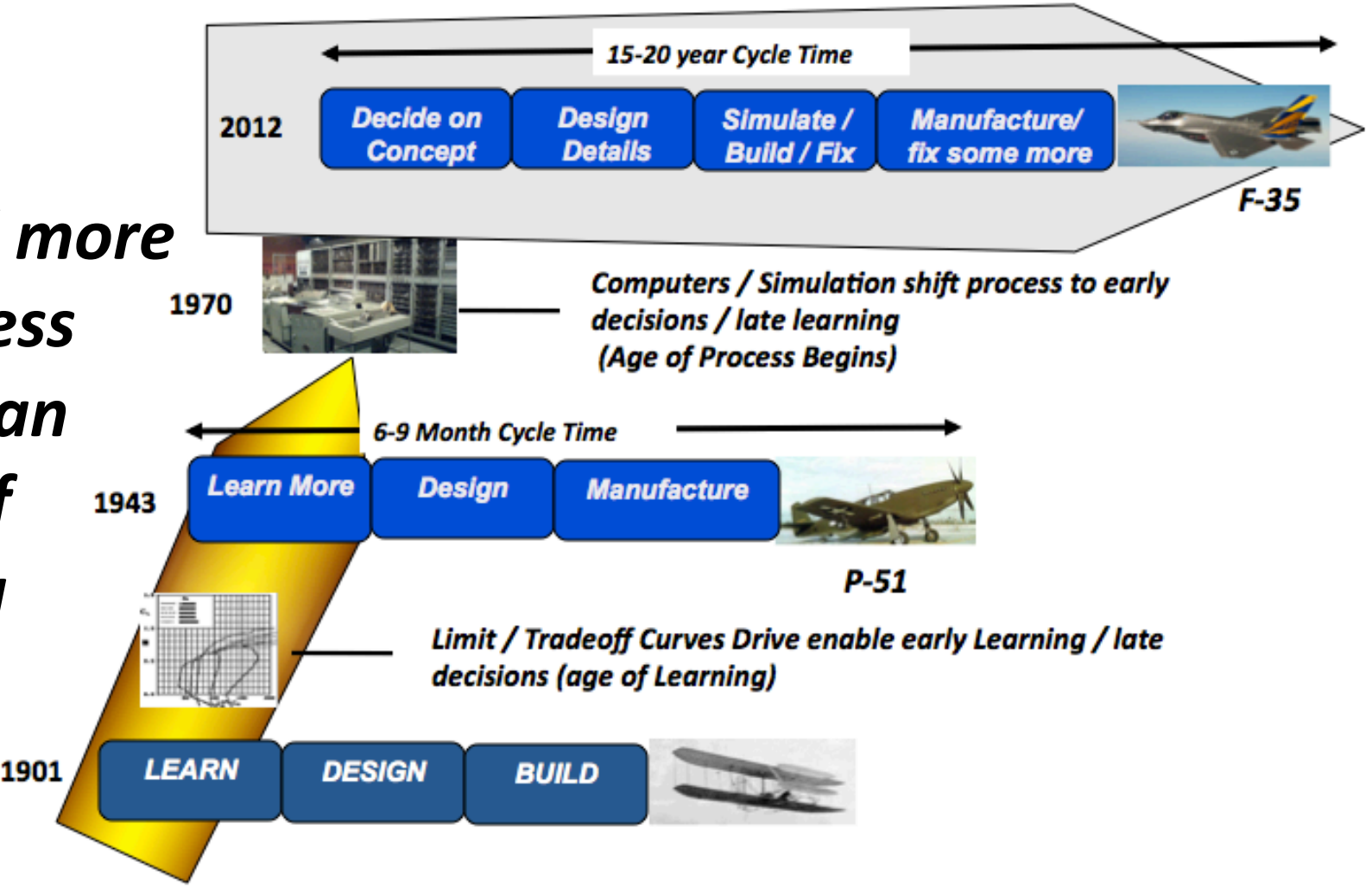
Consider the P51 Mustang

- ***Direct evolution of the knowledge from the inventions of the Wright brothers***



The aircraft industry today

Focused more on process tasks than cycles of learning



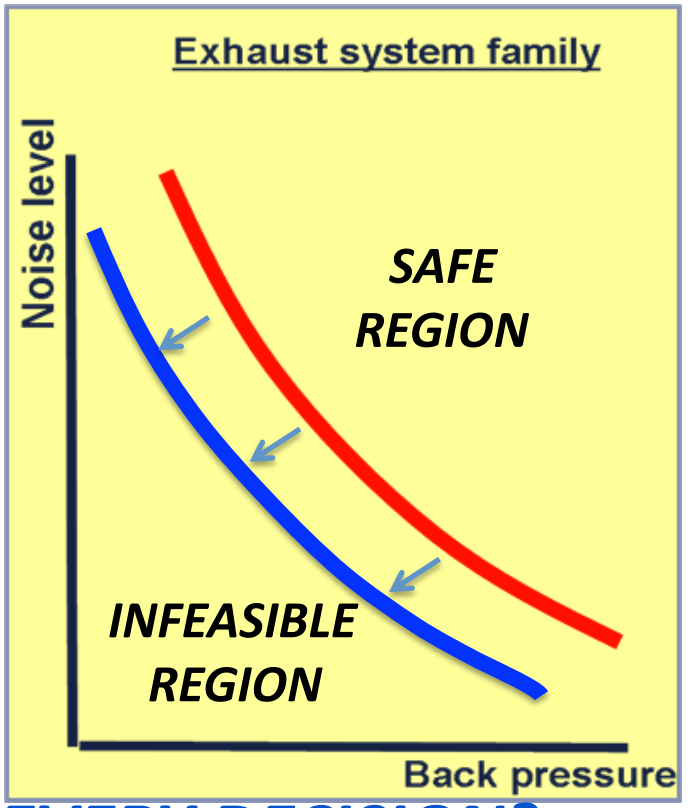
Is Toyota Innovative?
(we know they are lean)

- Many say they are not; point to 'boring' styling; breakthrough new models few and far between

- However, consider they seldom yield the lead:
  - The Lexus and Prius look largely the same, but are still market leaders after 25 and 15 years
  - How?: they follow the lean principles of continuous innovation to stay ahead

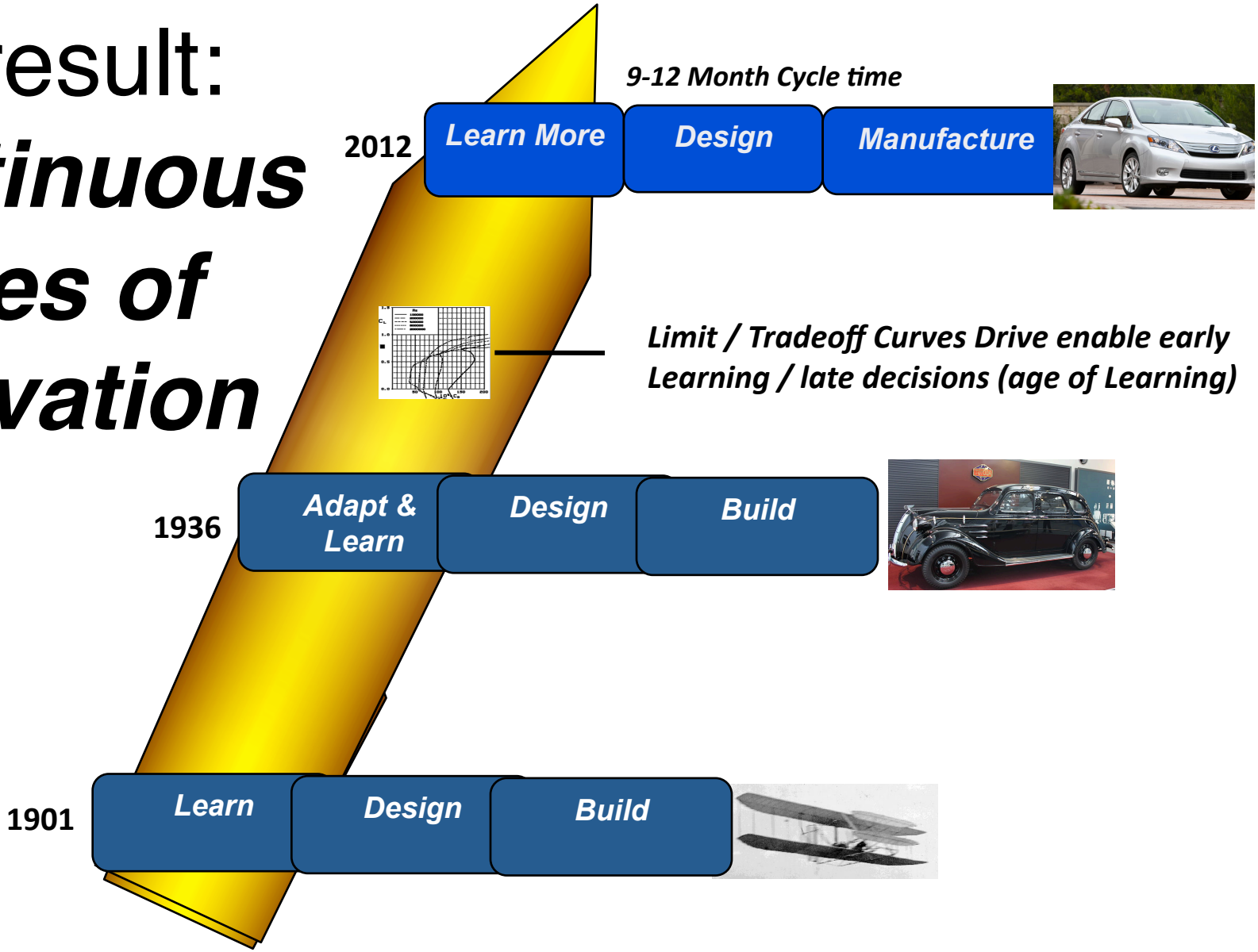
What has Toyota taught us about continuous innovation

- Focus on decisions and customer interests
- Know the limits of current capability (baseline)
- Design within it today
- Relentlessly move the limits for tomorrow



WHAT IF YOU DID THAT ON EVERY DECISION?

The result: ***Continuous Cycles of innovation***



Let's consider PING™

A small company competing in a land of giants

Over the last decade:

- 5X in new products introduced
- Reduced TTM by 50%
- with 20% less people

They relentlessly focus on performance limits

PING P3 Limit Curve — CGx vs. Trajectory

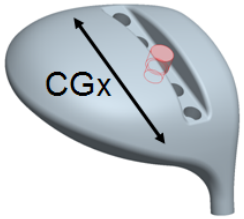
Nugget: By moving the CGx (heel/toe) on a driver, shot bend is influenced by [redacted] yards/[redacted]" of CG movement and offline is influenced by [redacted] yards/[redacted]" CG movement for drives of ~[redacted] yards.

Document Owner: [redacted]	Date: [redacted]	ID#: 390	Description: CGx Ball Fight Effect on Drivers	Project: Pull Innovation

Problem Statement:
Develop a trade-off for Ball Flight Performance vs. CGx (heel/toe direction).

Description of the Test/Analysis:
A driver was made with a channel in the X-axis through the head's natural center of gravity. A [redacted] gram tungsten weight could then be screwed into the head and move the center of gravity by +/- 0[redacted]" ([redacted]" total range). This club was hit on PING Man and by players in a Player Test. The results are shown in the graphs to the right.

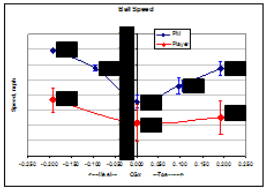
Variable CGx Driver (shown in CG center position)



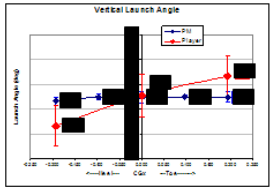
Results:
The most valuable and applicable results from this test are the trade-offs for CGx vs. Spin Axis, Offline, and Shot Bend. The following trade-offs can be used for design optimization and research purposes for drivers, noting that the offline and shot bend are for shots that are ~[redacted]mph ball speed and [redacted] yard carry.

Spin Axis = [redacted] degrees / [redacted]" CGx
Shot Bend = [redacted]yards / [redacted]" CGx
Offline = [redacted] yards / 0[redacted]" CGx

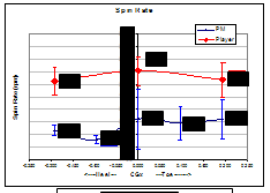
Limit Curves:



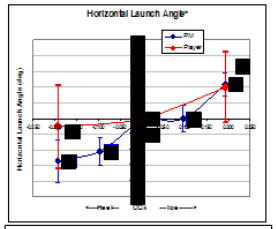
Inconclusive due to structural design of prototypes



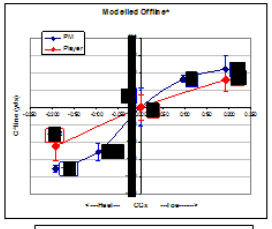
Player: LA = [redacted]d / 0.[redacted] CGx



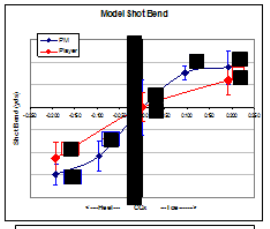
Spin = [redacted] CGx



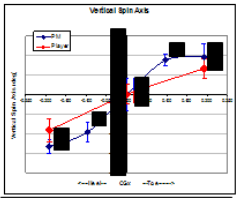
Player*: Horizontal LA = [redacted]deg / [redacted]" CGx
PM: Horizontal LA = [redacted]deg / [redacted]" CGx



Player: Offline = [redacted] yds / [redacted]" CGx
PM: Offline = [redacted] yds / [redacted]" CGx

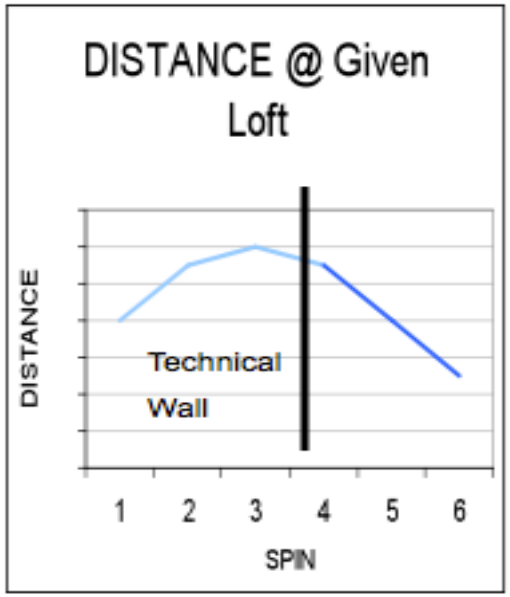


Player: Shot Bend = [redacted] yds / [redacted]" CGx
PM: Shot Bend = [redacted] yds / [redacted]" CGx

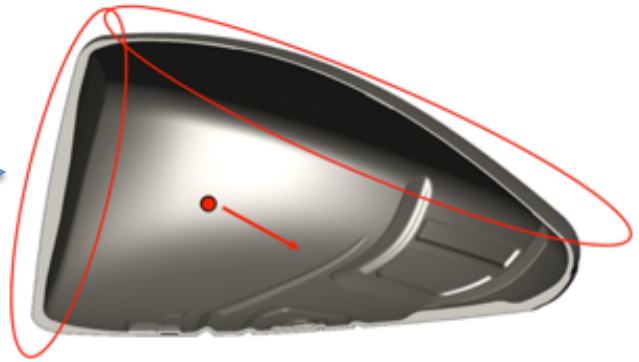


Player: Spin Axis = [redacted] deg / [redacted] CGx
PM: Spin Axis = [redacted] deg / [redacted]" CGx

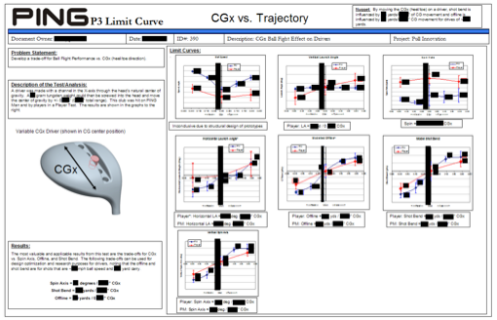
They move limits on Decisions



We need to move the wall

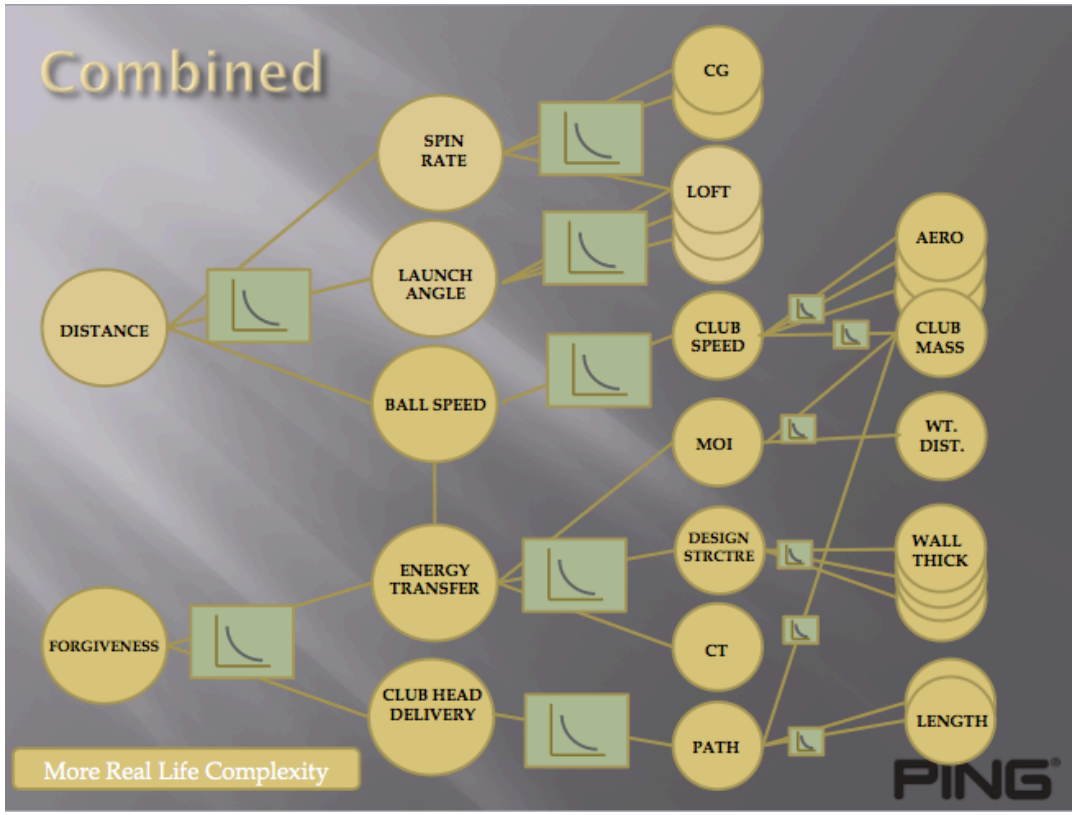


By removing the technical restrictions



Then setting the new baseline

This allows continuous system innovation



The Teledyne Benthos Story

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Planned product development schedule…"DESIGN & TEST"

Design to Specifications → Build 1st Prototype → Test & Finalize Design → Release to Production → Deliver to Customers

11 months

Actual schedule result:

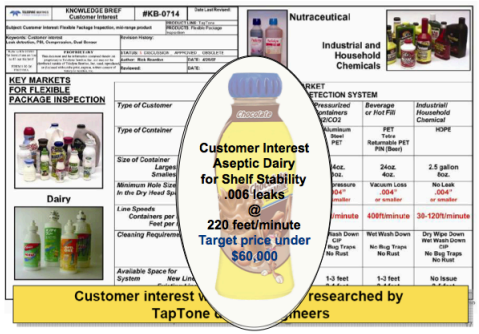
Fear Based Design to Specifications → Build Prototype → Loop back -- Re-design based on in-house testing results. → Address Customer Issues in Field → 2nd loop back -- design → Re- → Production Release → Deliver to customers / Ongoing fit for use issues

18 months

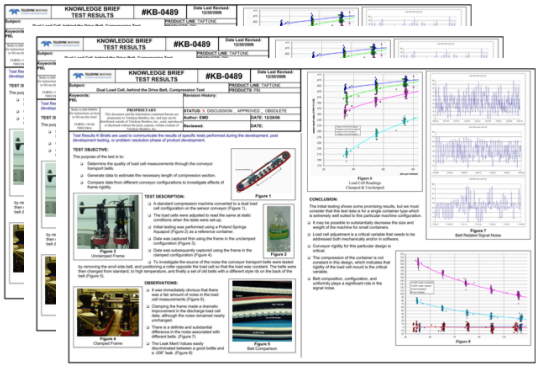
Traditional Specification Driven Design

Teledyne Benthos: They changed the process

What does the customer want?

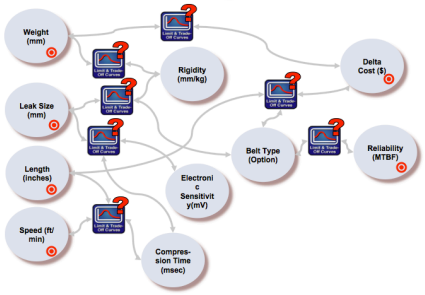


Can we innovate and extend the limits?



Are our knowledge limits captured?

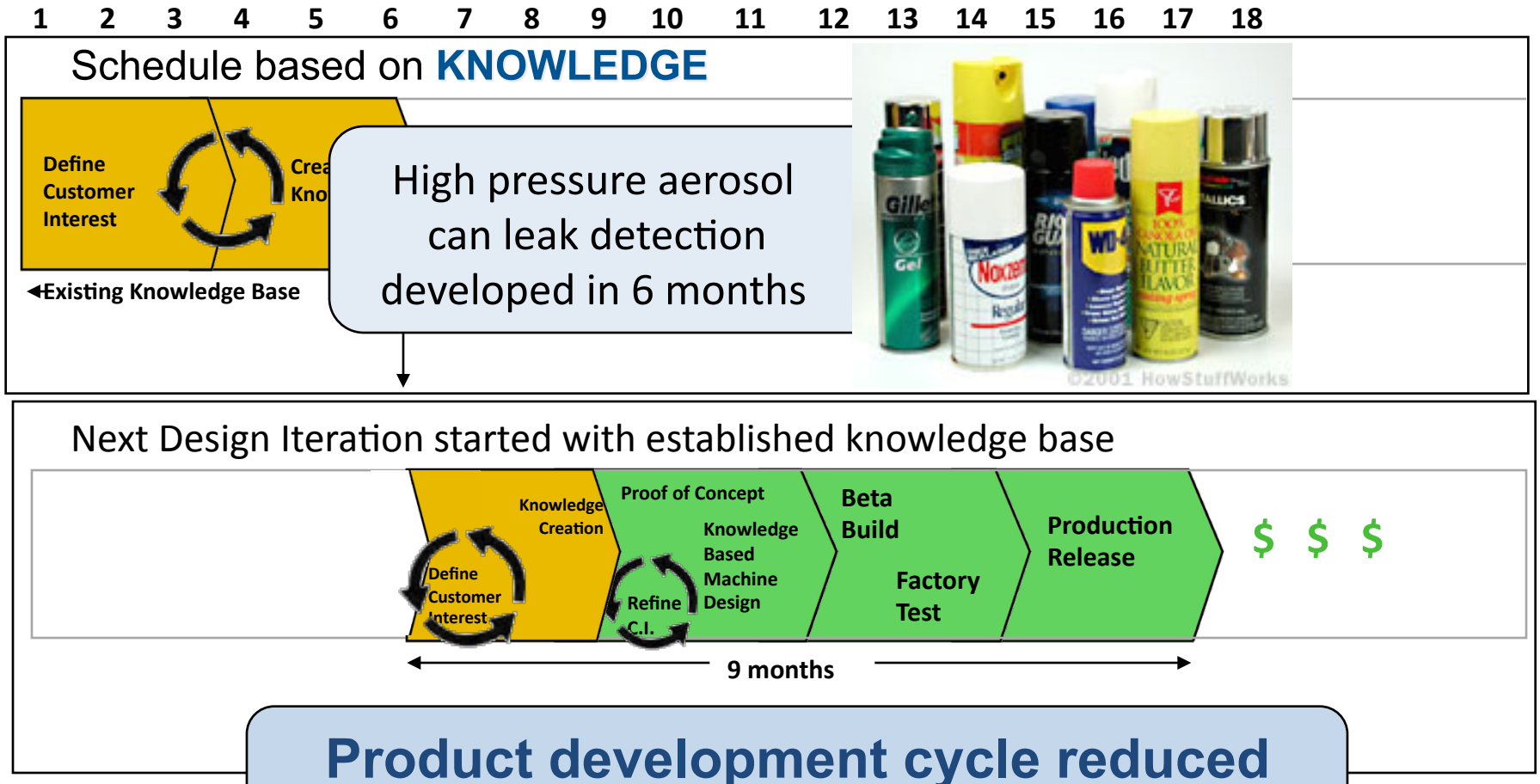
What are the tradeoffs / gaps?



Can we resolve the gaps?

Is the product optimized?

They now dominate



Product development cycle reduced from 18 months to under 9 months

Is there a common ground?

- All understood their customer interests
- All knew their capabilities / limits
- All knew the needed decisions and the tradeoffs
- All defined / resolved the knowledge gaps
- All optimized the design and established new baselines

TOYOTA

intel

PING
Play Your Best.™

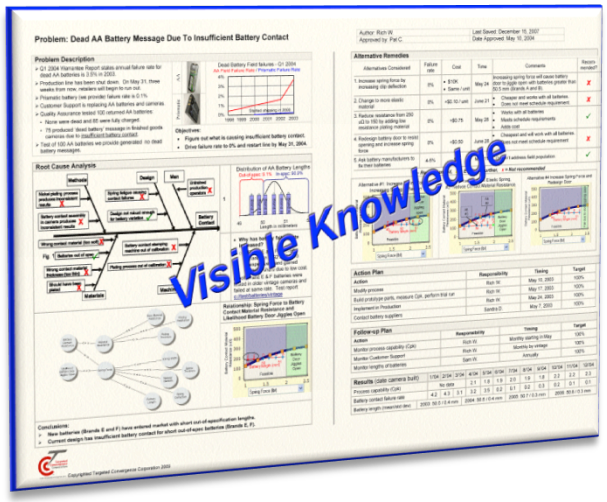
TELEDYNE BENTHOS
Everywhereyoulook™

Are there simple models to build from for continuous innovation?

From the President of Toyota North America:

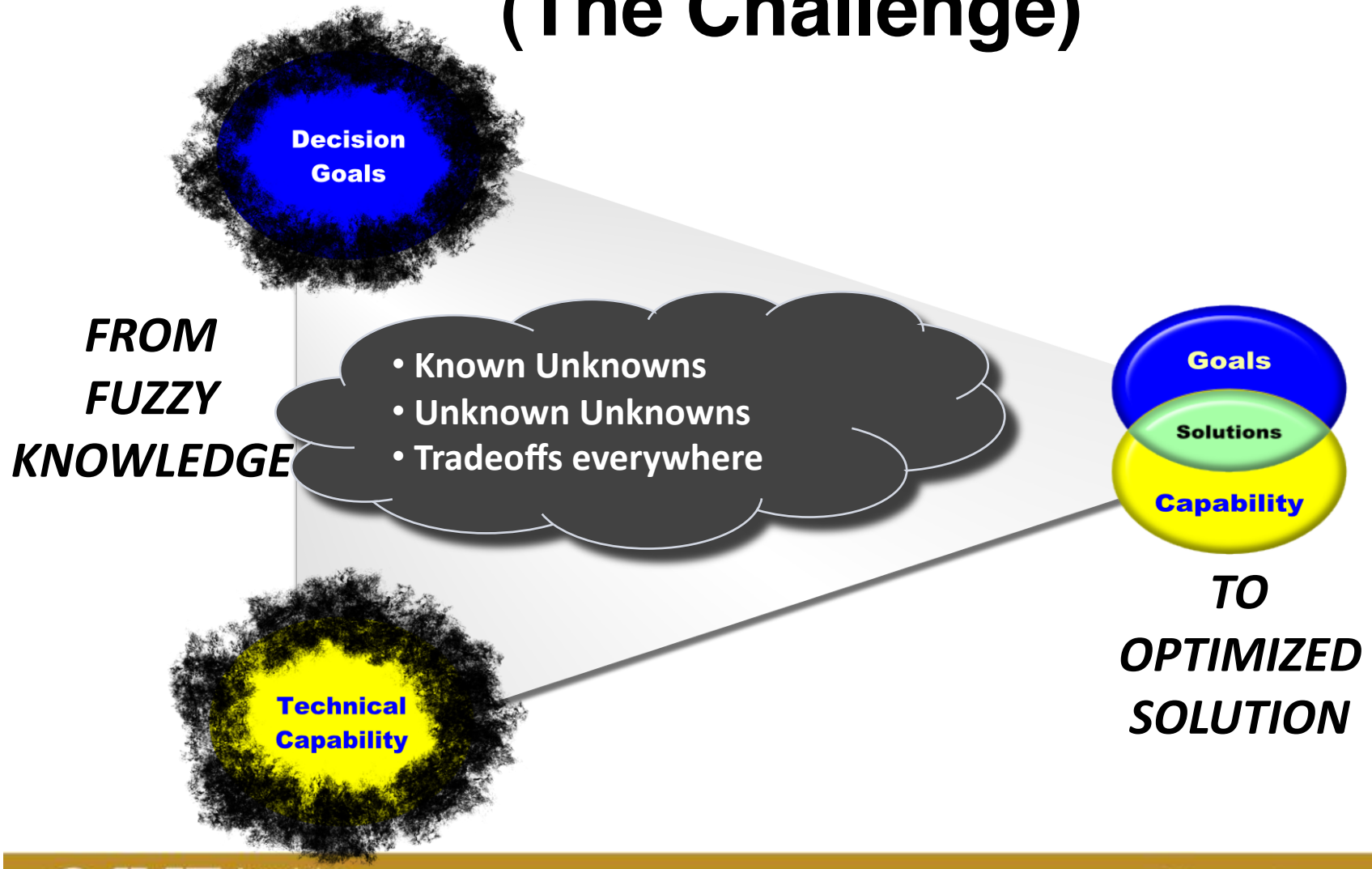
- ***Keep it simple***
- ***Make everything visual***
- ***Trust your people to do the right thing***

1: The Learning Model

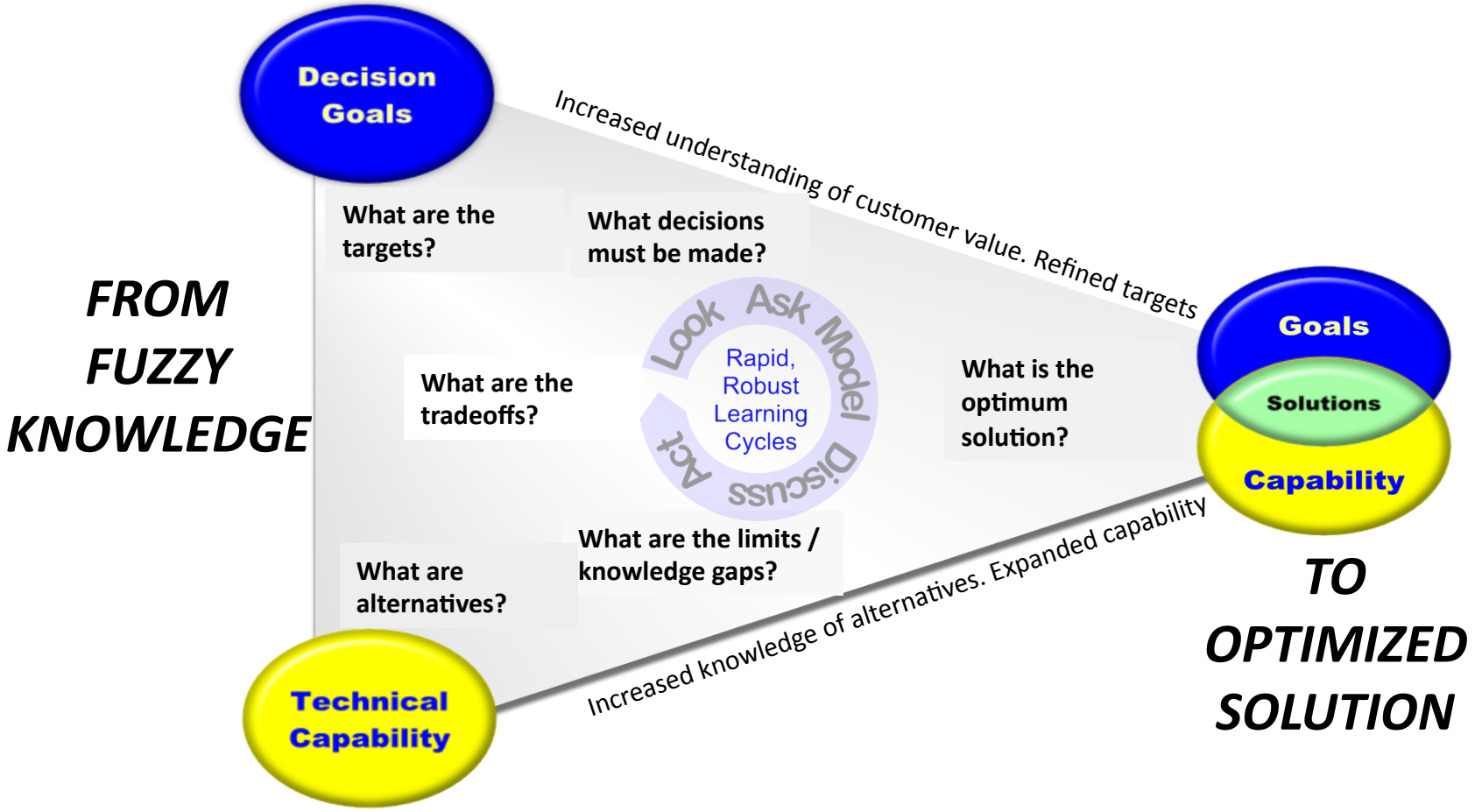


- At Toyota, it is the A3 and the relentless learning to produce it
- Dr. Allen Ward created the term LAMDA for simplicity and focus

2: The Set-Based Convergence Model (The Challenge)



2: The Set-Based Convergence Model (Cycles of focused Learning)



Let me end with some questions

Before you start designing a new product

- Do you really know your customer interests and targets – *or do you assume they are in the specs?*
- Do you really know the limits of your capability?
- Do you know the tradeoffs?
- Are you innovating to remove / extend performance limits?
- Are your innovations the new 'capability' baseline for your next product?

Thank You!

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