THE SCIENCE OF IMPROVING INNOVATION

Lean Product Development

The Basics

The LEAN MACHINE | ARGO CONSULTING

HOW DO WE SEE THE DEVELOPMENT PROCESS

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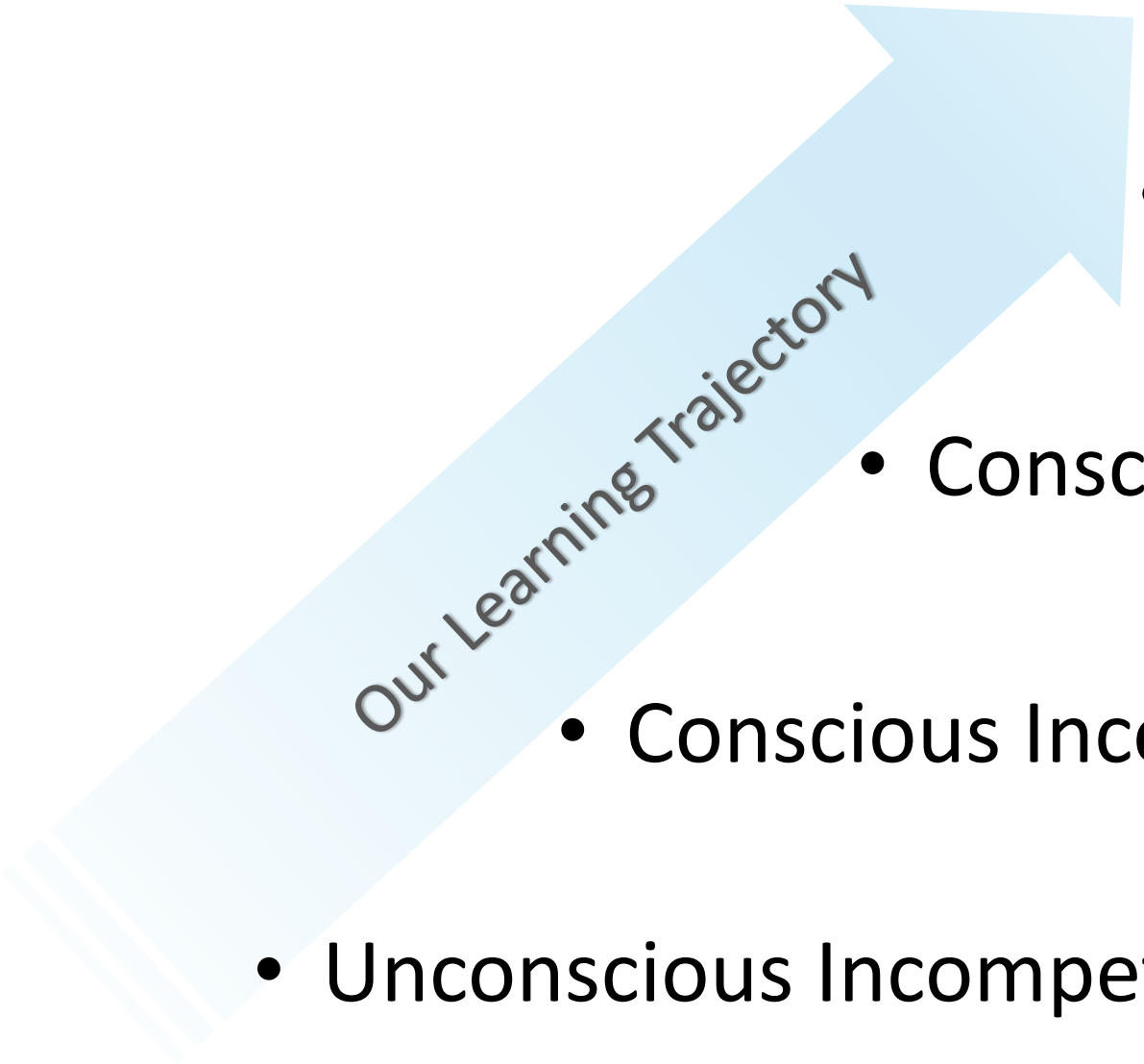
FOUR STAGES OF LEARNING



- Unconscious Competence
- Conscious Competence
- Conscious Incompetence
- Unconscious Incompetence

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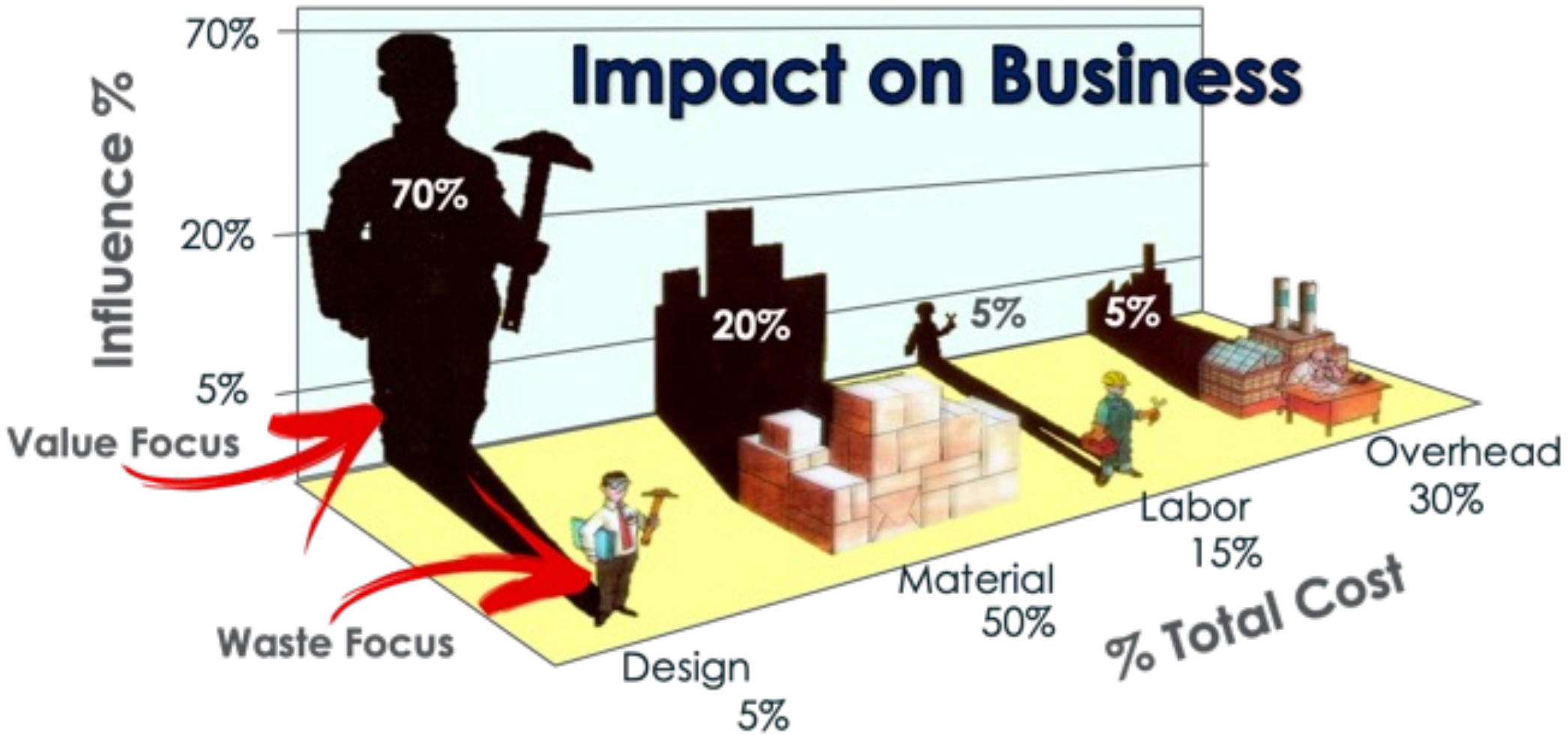
KNOWLEDGE BASED DEVELOPMENT

Our focus is on value, because it generates the greatest benefits



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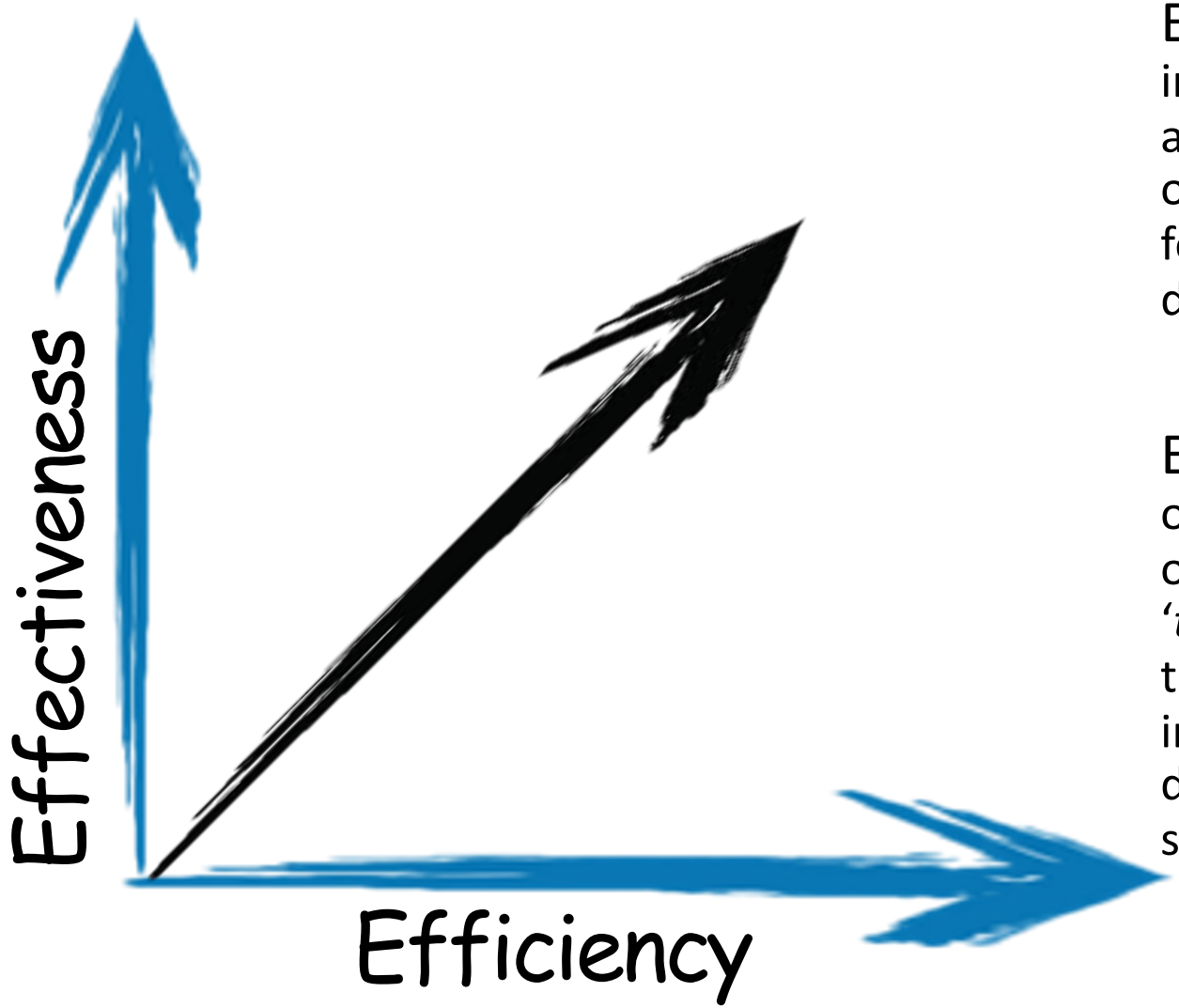
KNOWLEDGE BASED DEVELOPMENT



Effectiveness: The impact a new product or innovation has in the market, which we refer to as the "*lift*." This is generally measured in terms of return on R&D investment, either in the form of revenue, profit, market share, or some direct business metric.

Efficiency: The amount of innovation, change, or number of new products a given organization can produce, which we refer to as '*throughput*'. This is generally measured in terms of the number and type of products introduced per month, quarter, or year, depending on the business, in relation to the size of the organization.

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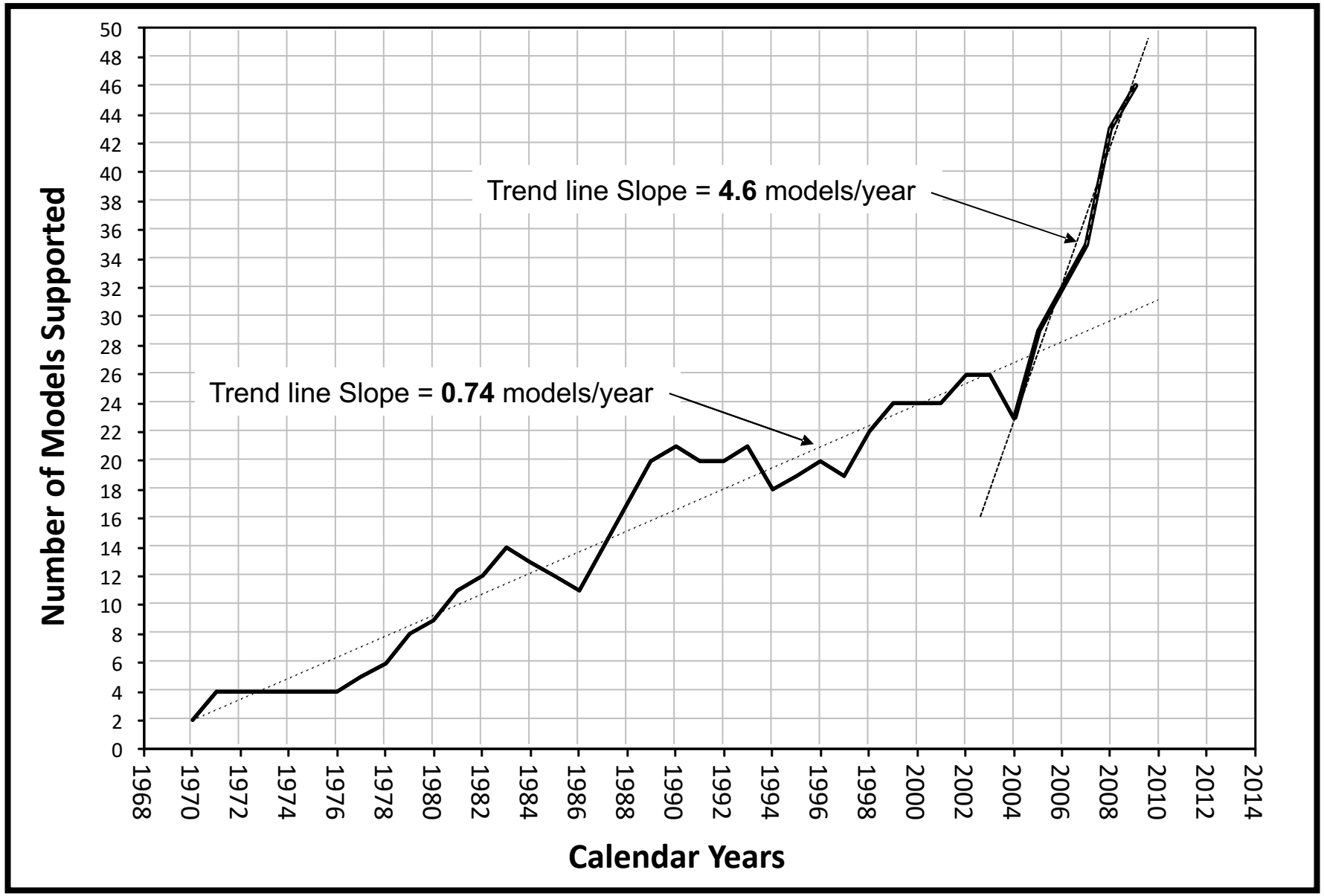
PRODUCT DELIVERY



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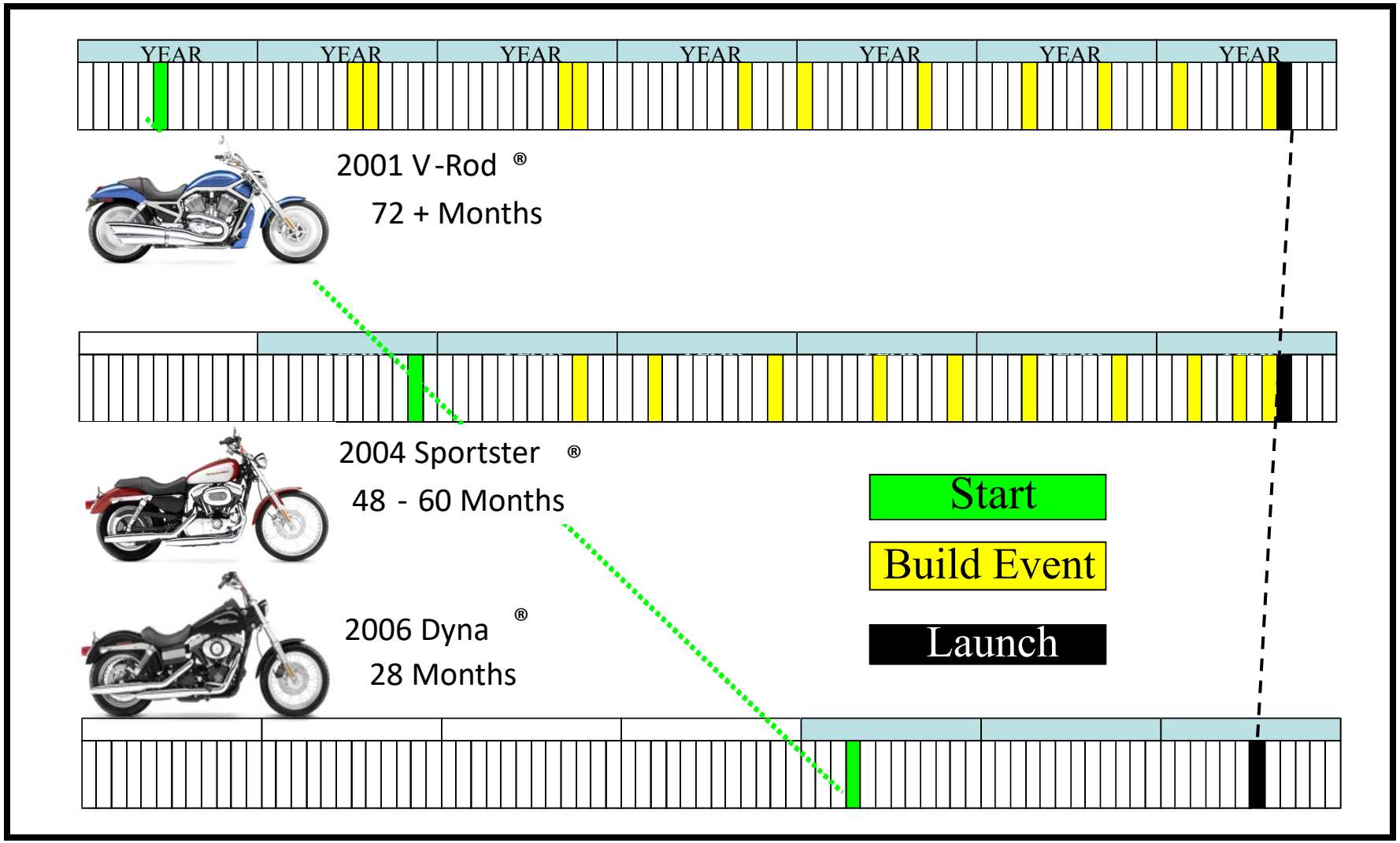
PRODUCT DELIVERY



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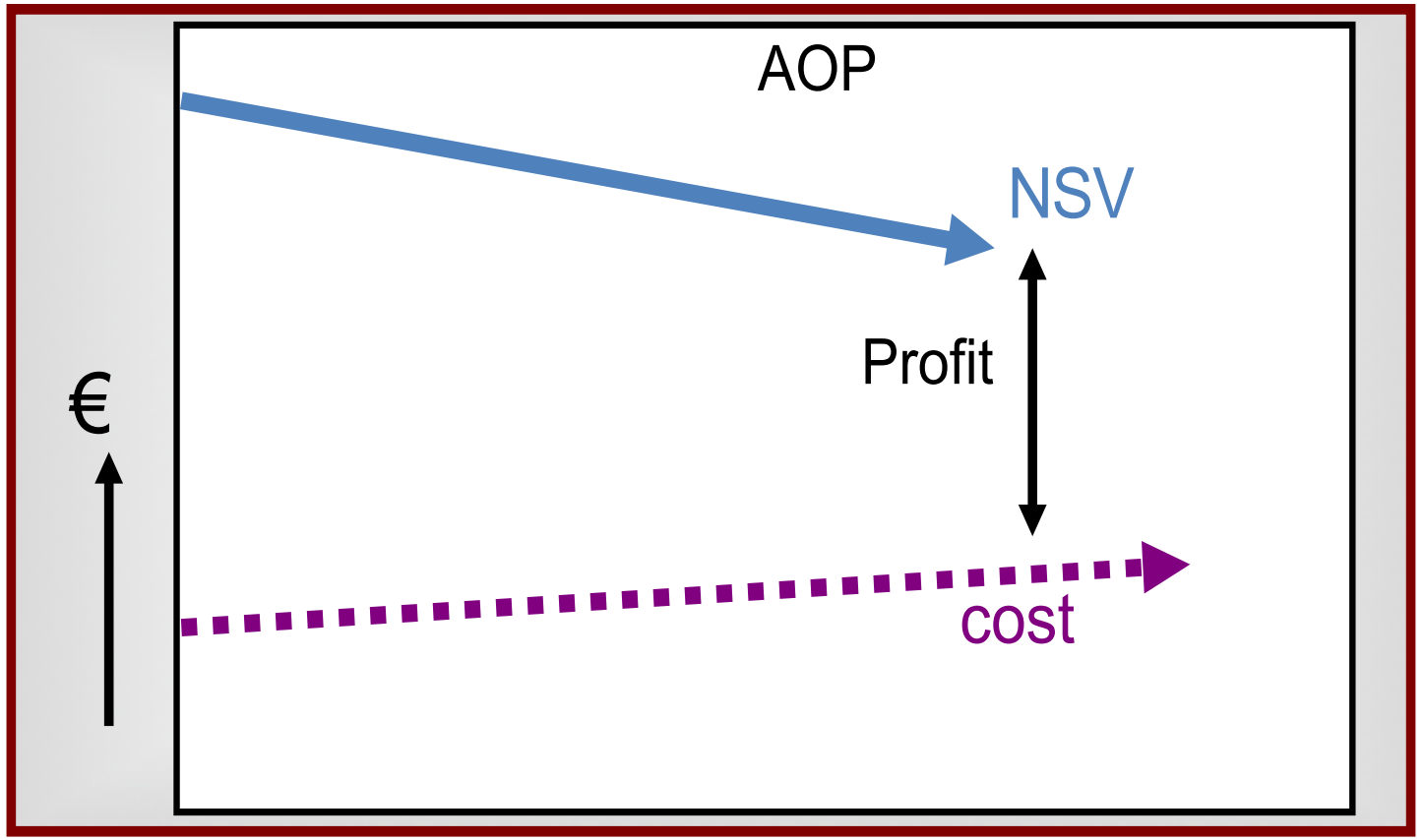
DOES IT WORK?

WHAT'S THE PROBLEM?

- Division's growth declining and not achieving profit targets
- FY06 = -4% vs FY05
  (-6% vs Plan)
- Unreliable NPD timing for trade launches
- Products launched too late vs Plans
- Products not getting preference by consumers
- 50% of projects on time



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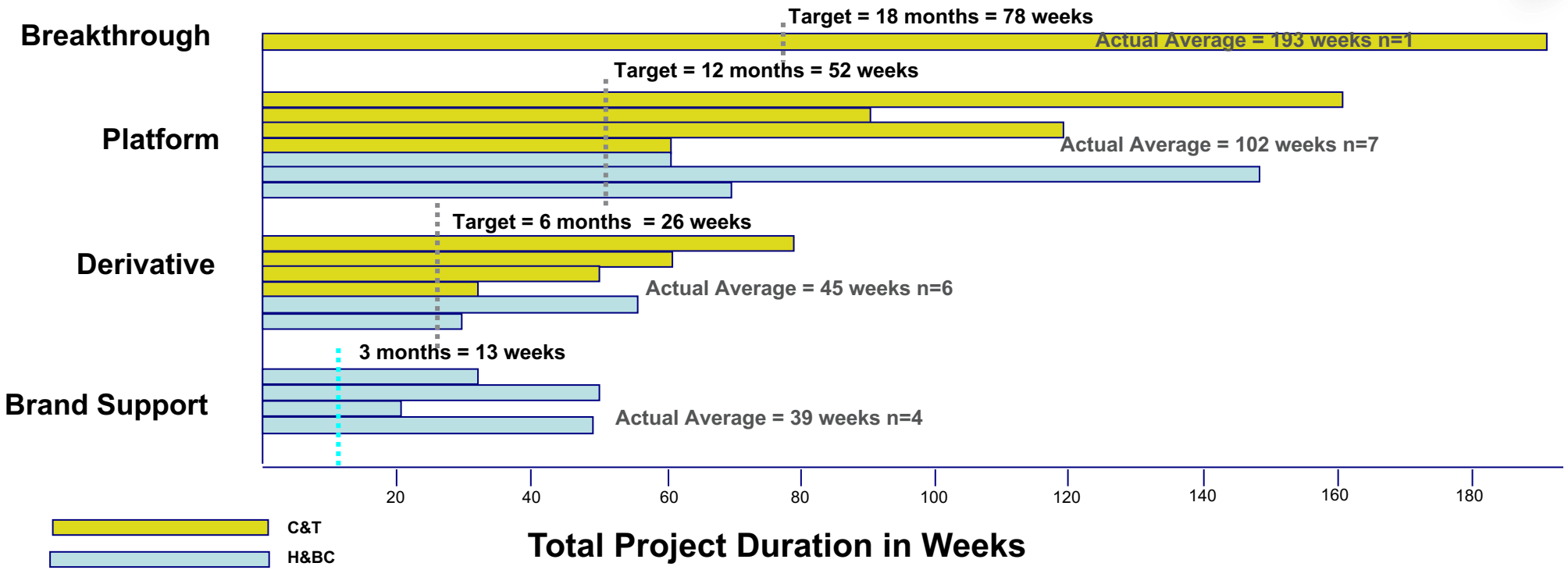
DOES IT WORK?

Example of how our Time-to-Market compared to objectives



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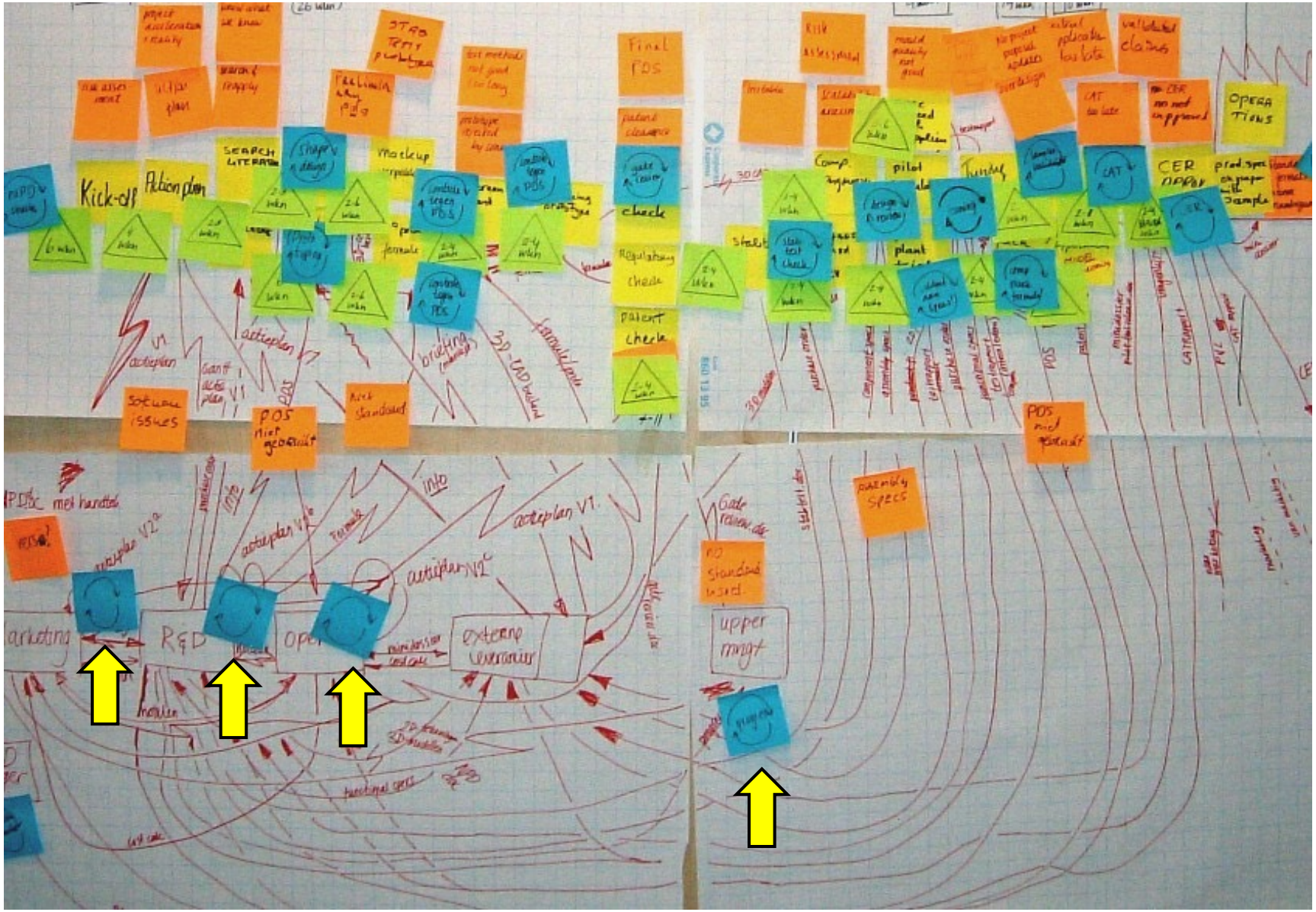
DOES IT WORK?

WHAT'S THE PROBLEM?



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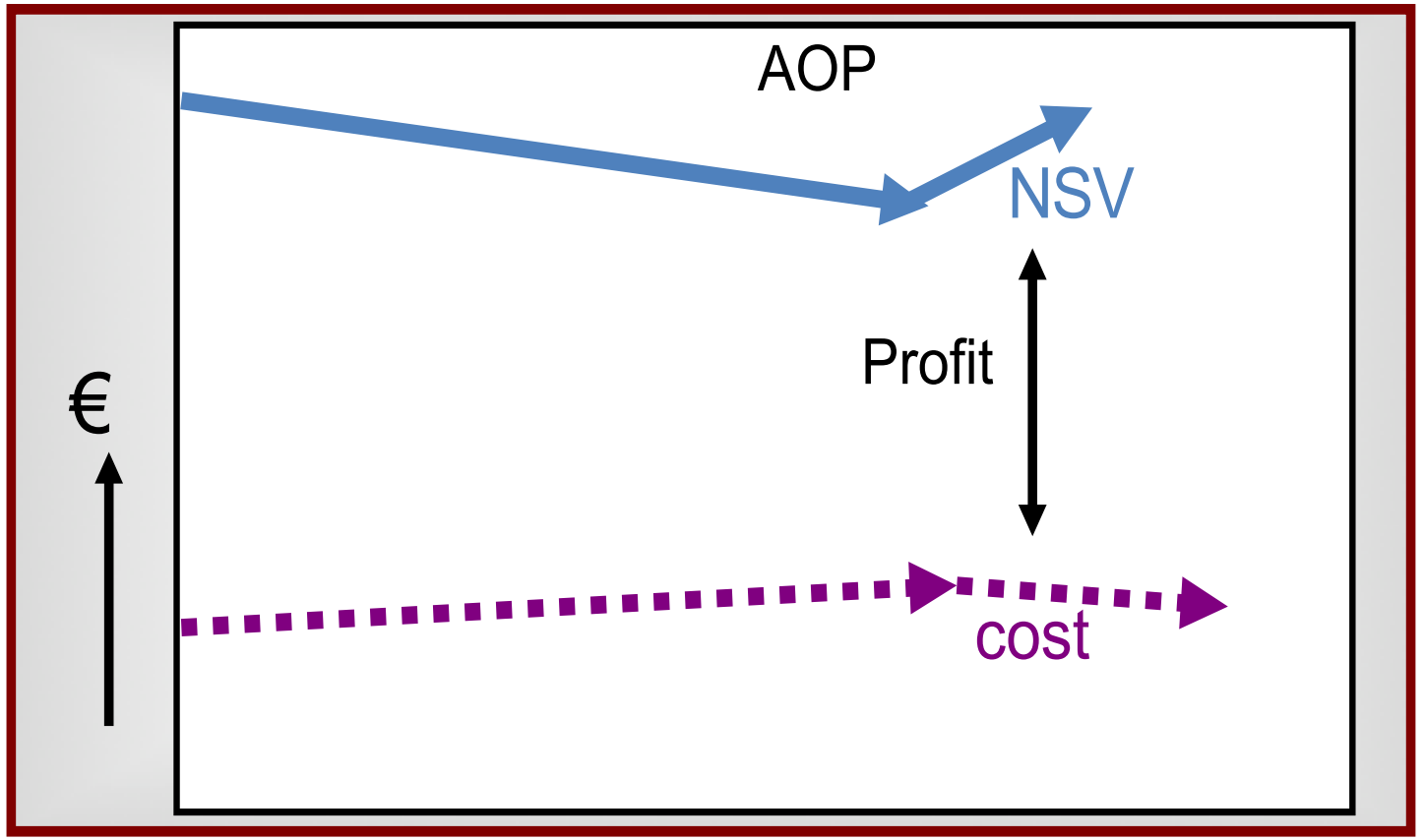
DOES IT WORK?

- Division is growing and profit targets are being achieved
- FY07 - 09 = +6-7% growth
  (FY07 over plan)
- NPD timing to trade is more reliable
- 90%-95% OTIF for Scorecard Projects
- Products are getting preference by consumers as seen in results



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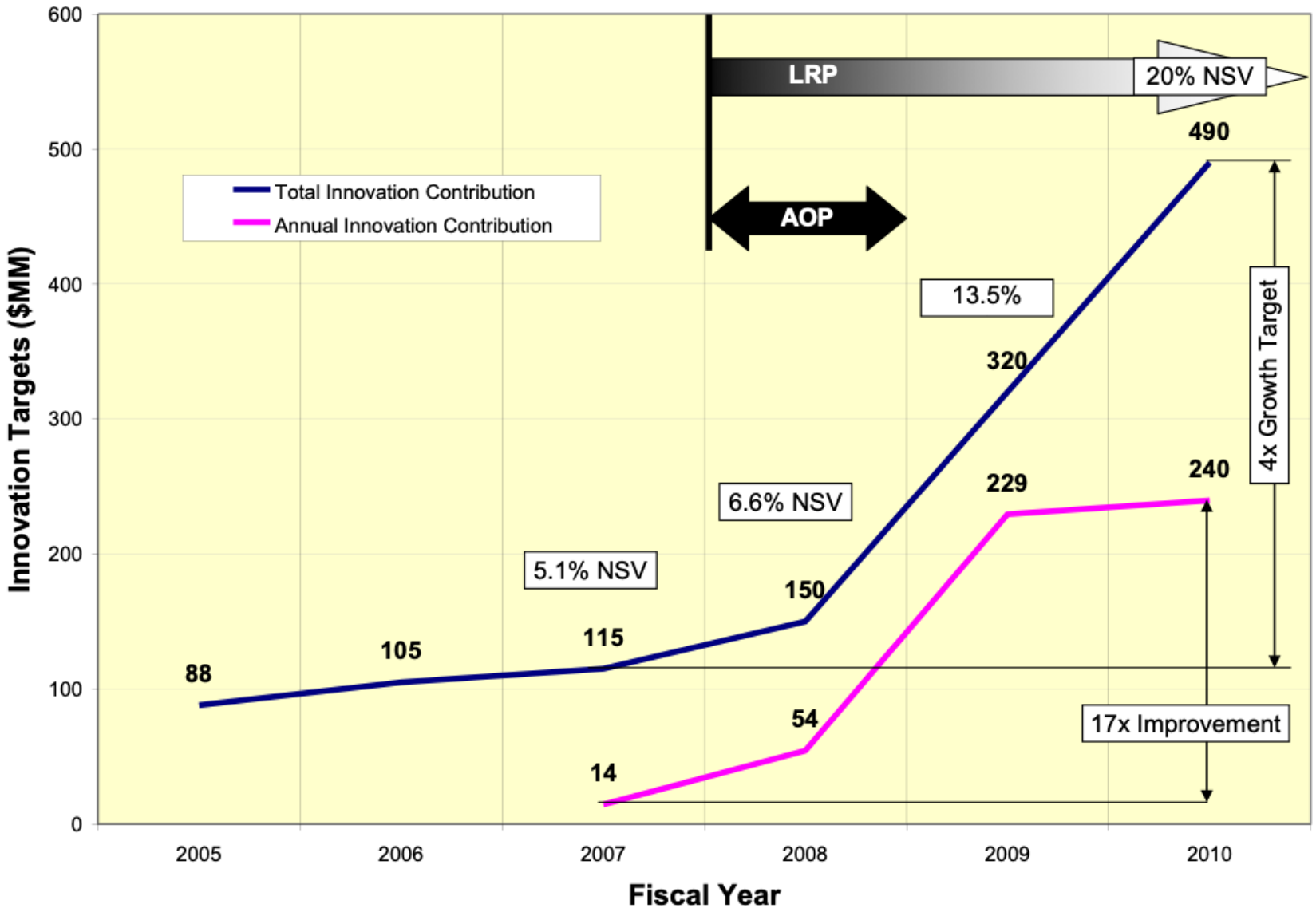
DOES IT WORK?



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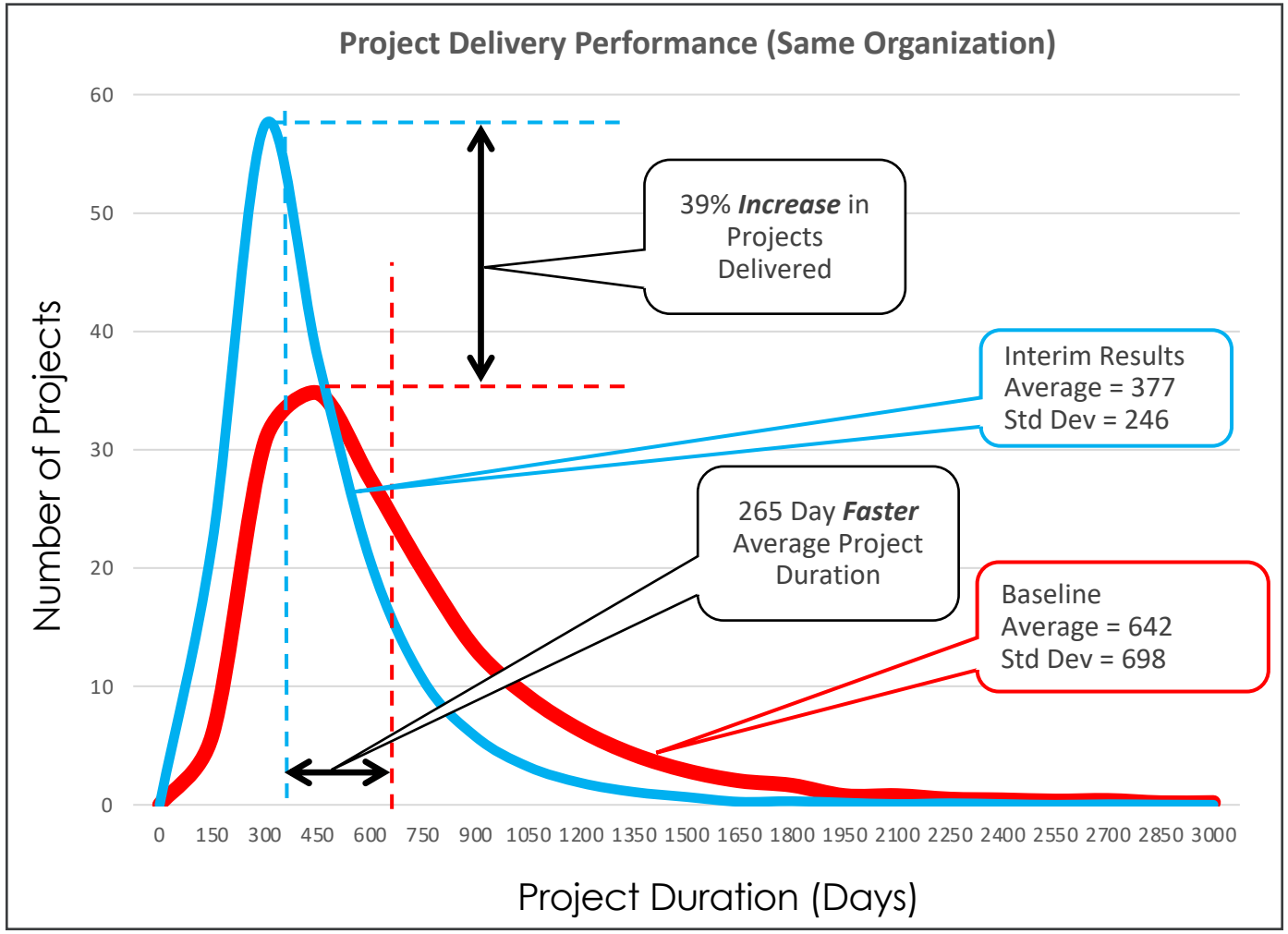
WHAT HAS BEEN ACHIEVED:
CUSTOMER EXAMPLE

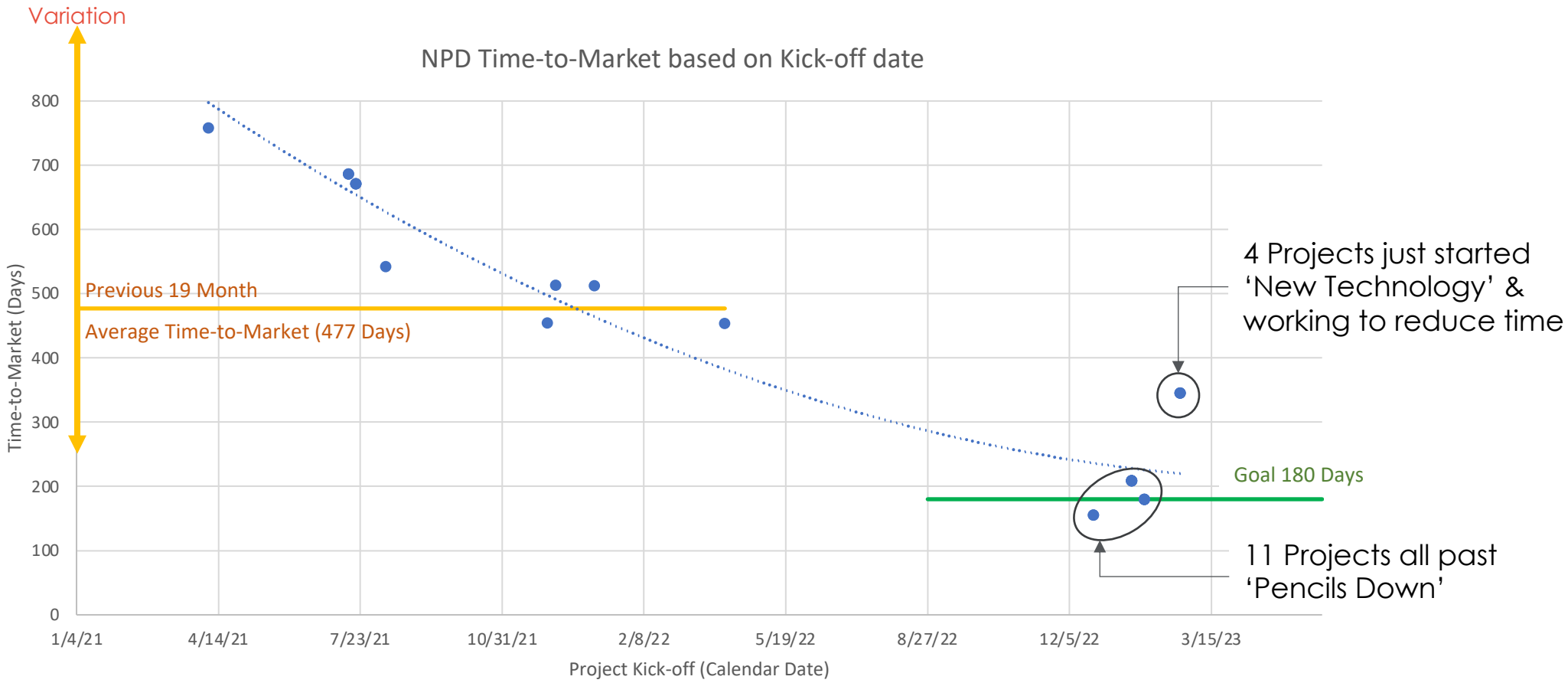
Implementing LPD has led to:

- **$160 Million** Annual **revenue increase**
- **42% reduction** in average project **duration**
- **65% reduction** in **std dev**.
  - ➢ Variation reduction leads to predictable delivery
- **39% Increase** in **Projects delivered.**
- **# of projects (WIP)** was held constant – duration reduction is relational to throughput increase
- **3% reduction in workforce** due to drop in price of oil



WHAT HAS BEEN ACHIEVED:
CUSTOMER EXAMPLE

*The **Time-to-Market for NPD has been cut in half** between projects launched in the old process and the new process, indicating **throughput capacity has doubled** (holding the WIP constant).*



Source: Previous project data from Historical Project Financials rev 2 DPO.xls and new projects data from ELT New Product Dashboard 26FE23_DPO.xls

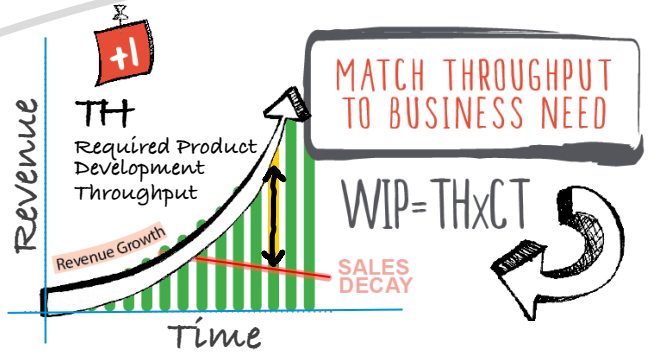
Note: Based on projects with data available

Seven Principles of LPPD
+ Connection to the Business

LEAN PRODUCT DEVELOPMENT (in a nutshell)

7 ESSENTIALS

PURSUE PERFECTION AND DRIVE IMPROVEMENT EVERY DAY



MATCH THROUGHPUT TO BUSINESS NEED

WIP=THxCT

Manufacture customers 1

Ideas

Bin 6 Bin 4 Bin 1

Portfolio cadence & flow 2

Visual management 5

Teams of responsible experts 7

Lead with entrepreneur system designers 6

Reusable knowledge 4

Limit and Trade-Off Curves

Causal Diagrams

Setbased 3

FIND LIMITS (RESEARCH)

REUSABLE KNOWLEDGE

INTEGRATION EVENTS

Detail, Mix, Match, Find more limits & Cull concepts

safe optimized design

LAUNCH ON CADENCE

PROACTIVE LEARNING CYCLES

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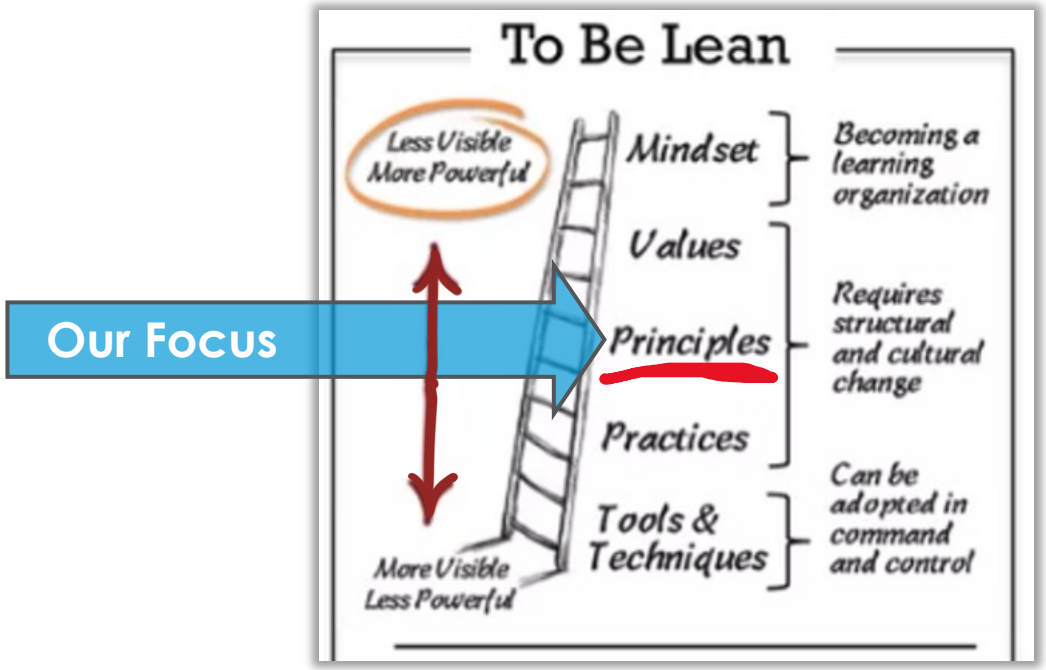
LPD PRINCIPLES IN CONTEXT



7 LPPD Principles in brief

- **Portfolio Cadence, Flow & Pull:** *Match R&D output to market rhythm; 5 year horizon*
- **Close to Customer:** *Look your customer in the eye with empathy, solve their problem*
- **Entrepreneur System Designer (ESD):** *Lead as a founder, with skin in the game, for the success of the business*
- **Visual Management:** *Communicate path, status & actions - visually*
- **Set Based Design:** *Explore full spectrum of solutions, learn fast, sideline the weak*
- **Teams of Responsible Experts:** *Adaptive, learning teams are necessary to win*
- **Reusable Knowledge:** *Learn fast & deep; don't forget what you learned*

- Full LPPD methodology encompasses all aspects of running a business *(culture, mindset, talent, values…)*
- Toyota is the prime example for full LPPD *(But do not try to be Toyota)*
- Transformation Office focus is on broadly applying the 7 core principles
  Why? Fastest path to R&D team innovation & value creation
  Create local examples of LPPD principles then, spreading adoption is path of least resistance

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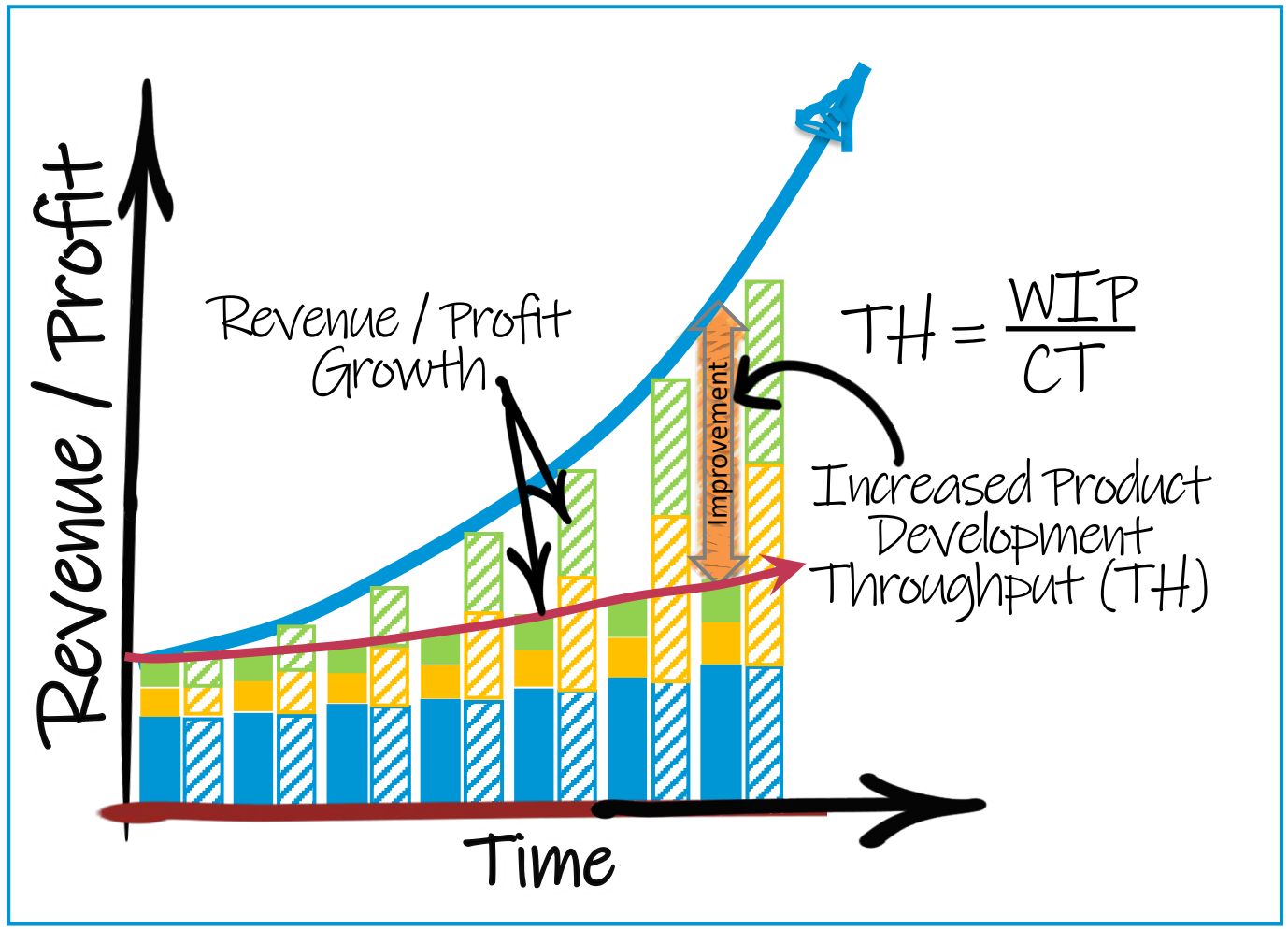
CONNECTING TO THE BUSINESS



Match the Project Delivery Throughput to Business Need

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WHY ARE WE DOING THIS

Innovation Powers Performance

Competitiveness is shifting from Manufacturing to Innovation

Studies show that as manufacturing capacity becomes globally available at low cost, its competitive value declines and competitiveness shifts to innovation. (*Competitiveness Index: Where America Stands Council on Competitiveness*, 2007)

Innovation is the primary mechanism by which firms grow

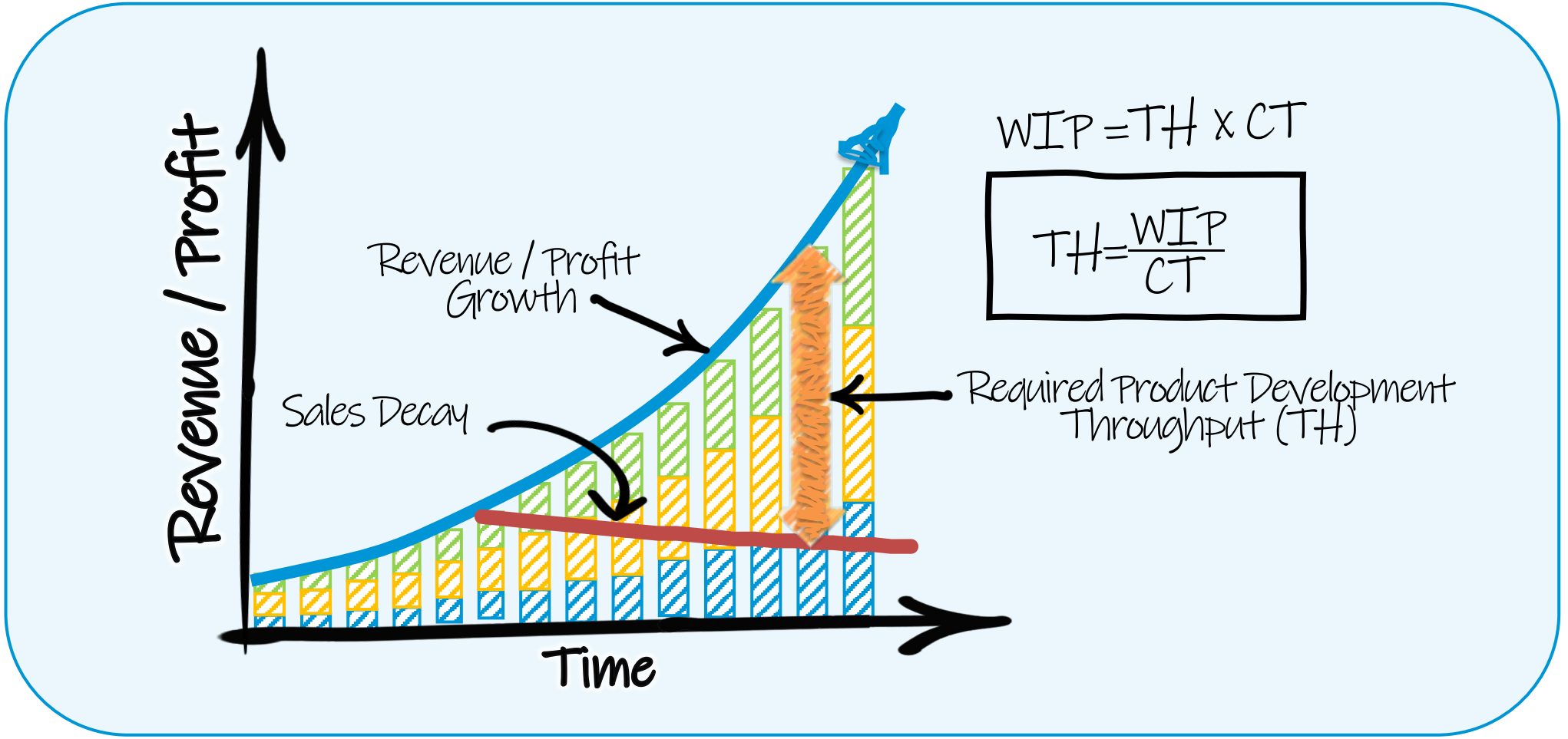
There is a strong association between R&D intensity (R&D expenditure per dollar of sales) and subsequent growth in sales. Industries which have greater intensity grow at a faster rate over a sustained period of time. Companies which invest a larger percentage of sales in R&D benefited with a greater growth rate in sales than their competitors, irrespective of industry. *(Morbey & Reithner, 1990)*

Companies that are more efficient in Innovation do better

A study published in the Journal of Financial Economics concludes "… firms that are more efficient in innovation on average have higher contemporaneous market valuations and superior future operating performance, market valuation, and stock returns". *(Hirshleifer, Hsu, & Li, 2013)*

INNOVATION POWERS PERFORMANCE

What Product Development throughput do we need?



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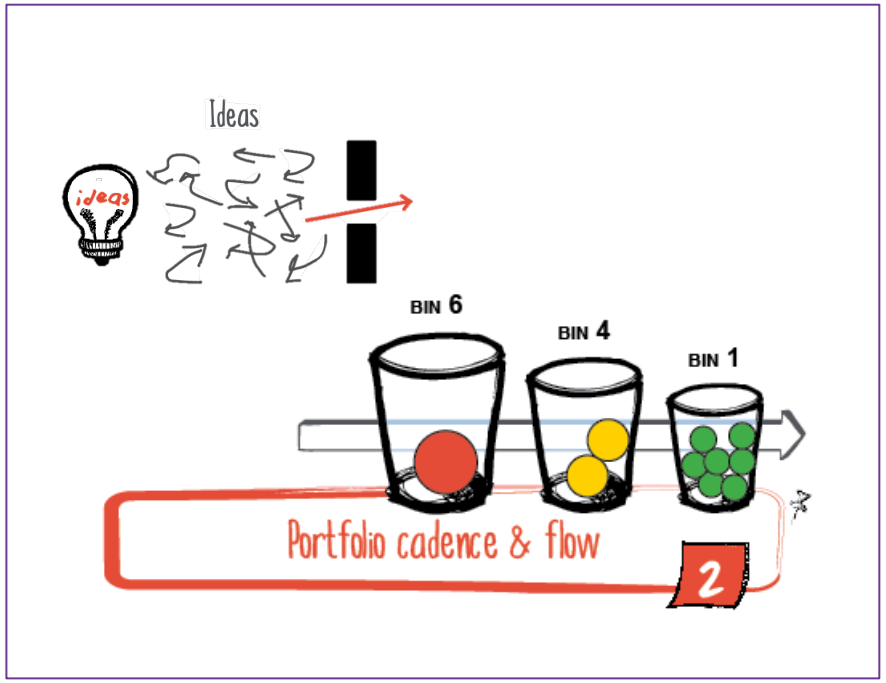
PORTFOLIO CADENCE, PULL, & FLOW



Optimizing the portfolio and the Development System

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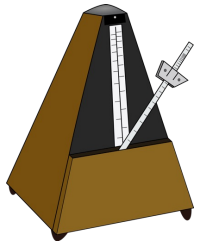
PORTFOLIO CADENCE, PULL, & FLOW

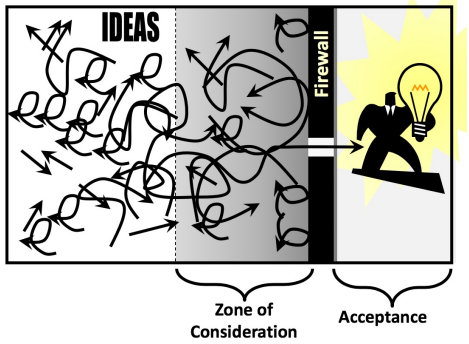
What is Cadence, PULL, & Flow?

***Cadence**, **Pull**, & **Flow** organizes, synchronizes, and aligns the workload to standardize projects (BINS) to improve project throughput by by managing at the portfolio level.*

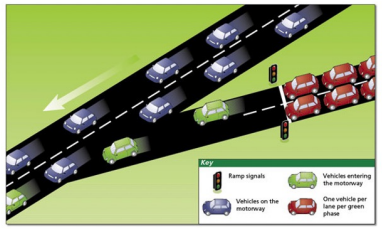
Cadence is the 'metronome' that paces the work of the development organization. Cadence establishes integration event timing, and in turn, determines the length of learning cycles.



Pull determines how projects are brought into the system based on customer and business demands. It aligns project delivery dates with the available capacity of development system.

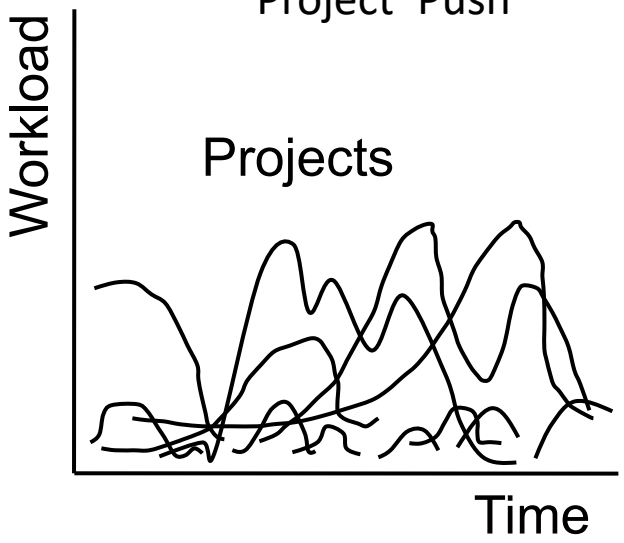


Flow considers how work progresses through the system. It assesses the linkages and handoffs associated with work as well as the uniformity of the movement or progression of work through the system.



PORTFOLIO CADENCE, PULL, & FLOW

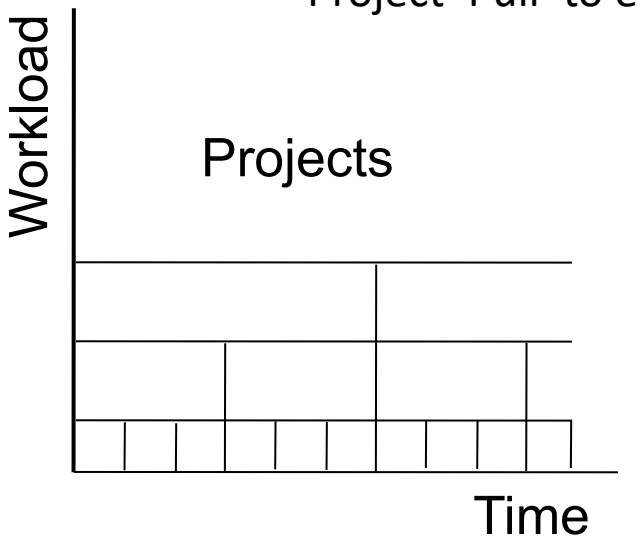
Project 'Push'



From

To

Project 'Pull' to enable flow



Conventional Processes are chaotic:

- Prevents learning
- Difficult to manage
- Causes mistakes
- Wastes resources

Lean Processes are rhythmic to Business Demand:

- Supports learning
- Pulls the team forward: needs little management
- Allows improvement
- Efficient

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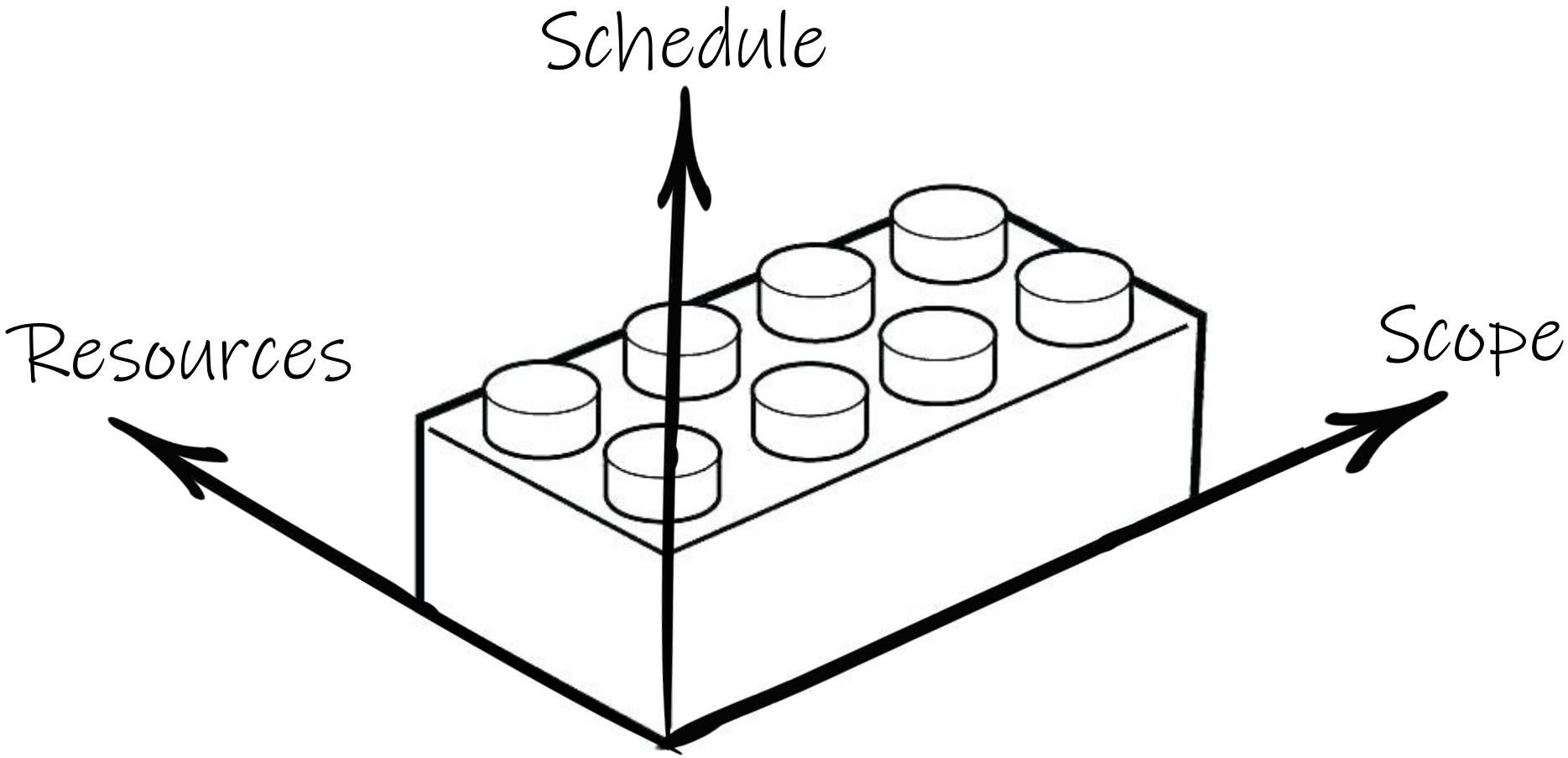
PORTFOLIO CADENCE, PULL, & FLOW



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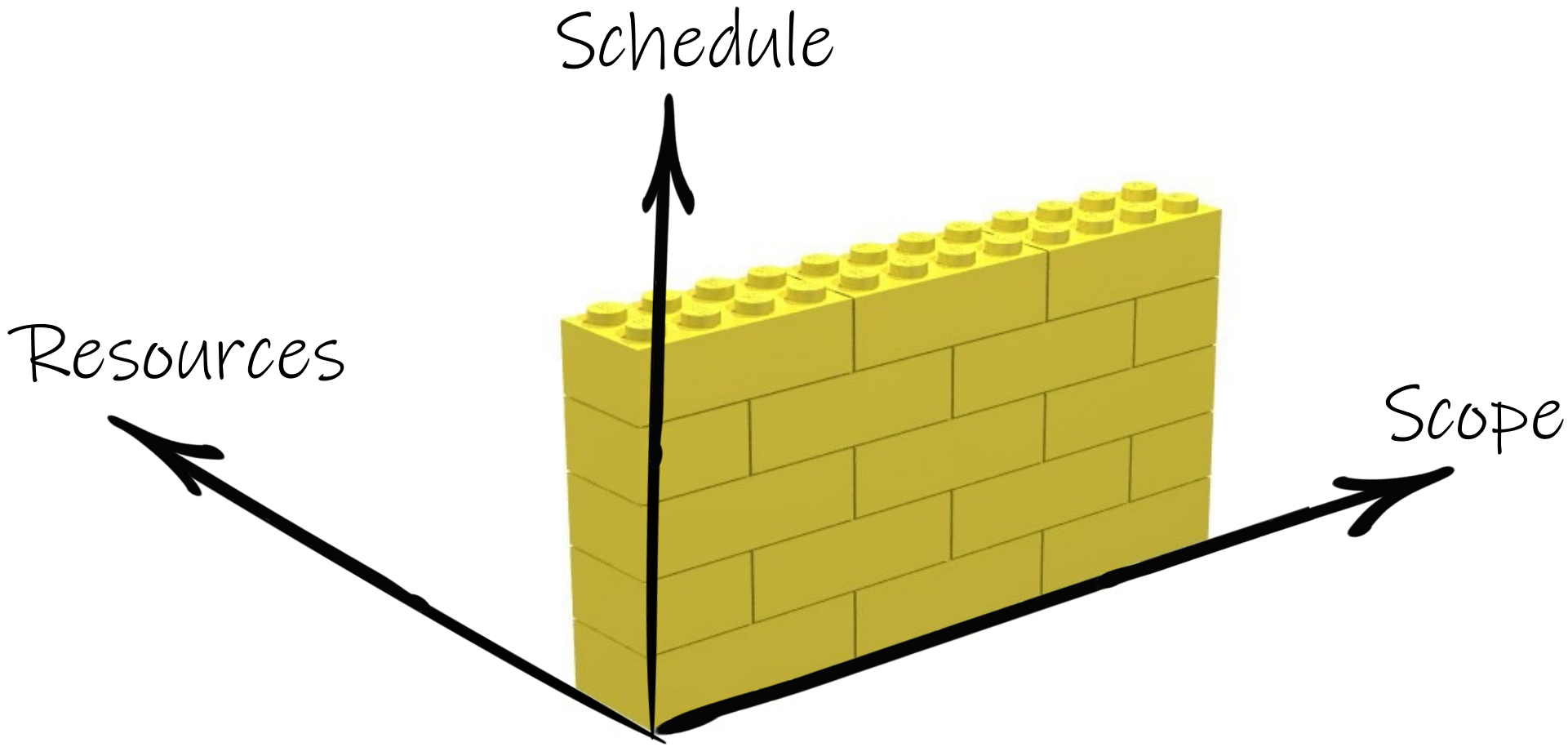
PORTFOLIO CADENCE, PULL, & FLOW



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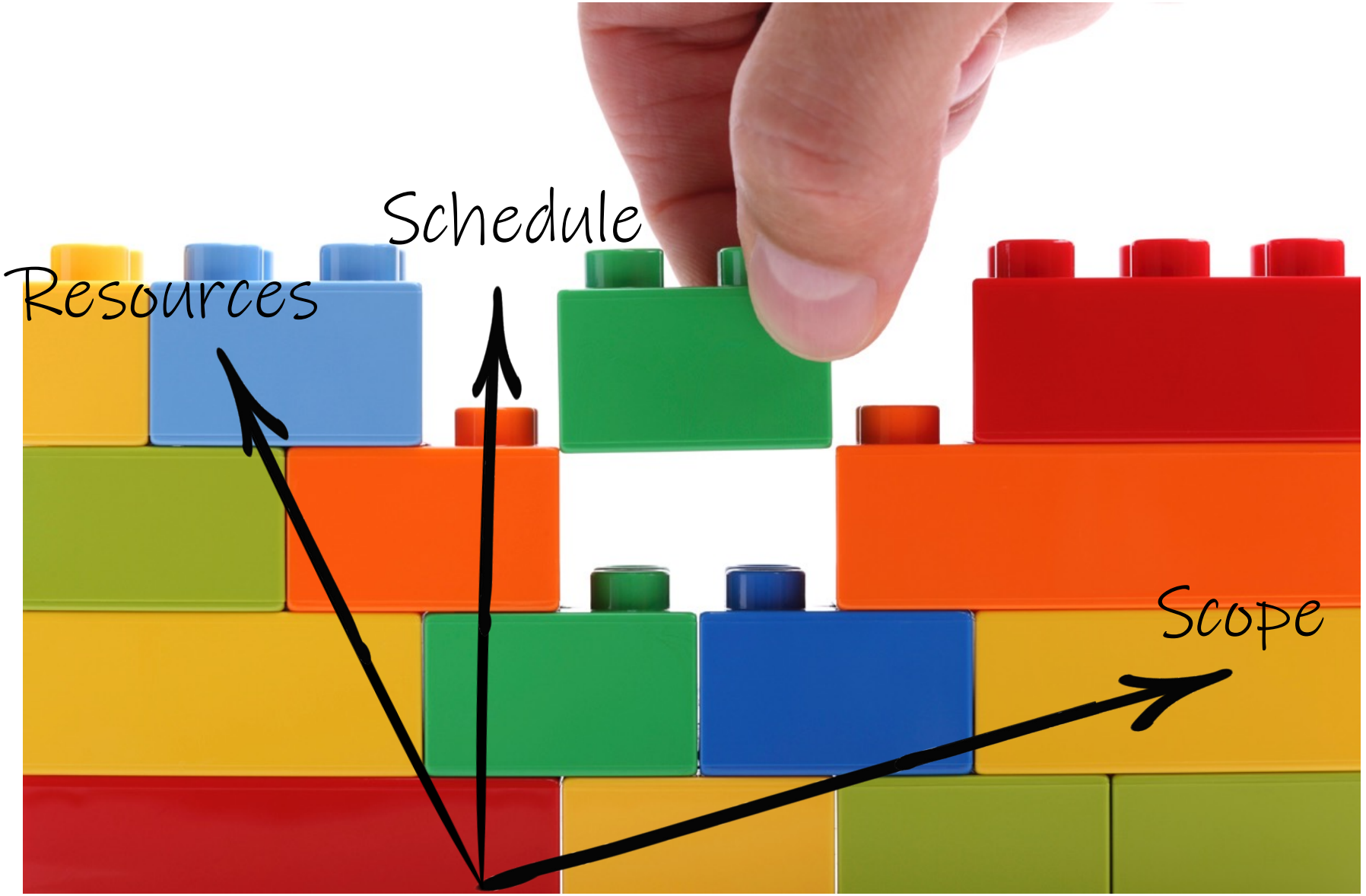
PORTFOLIO CADENCE, PULL, & FLOW



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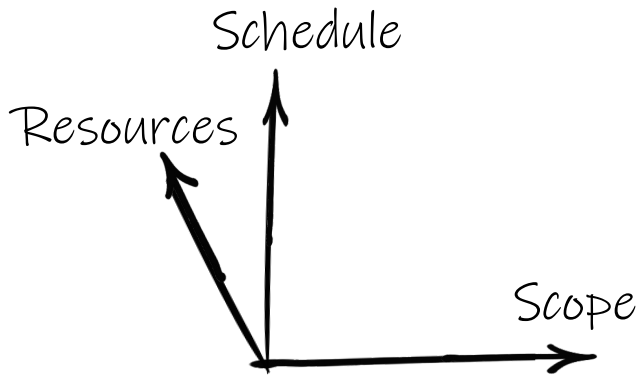
PORTFOLIO CADENCE, PULL, & FLOW

Standardize projects - BINs

	Small Scope	Medium Scope	Large Scope
Abbreviated Methodology Deliver as Fast as Possible	3	Not Allowed	Not Allowed
Common Development Method Compressed Timing	2	5	Not Allowed
Common Development Method Standard Cadence & Timing	1	4	6

Project Designation



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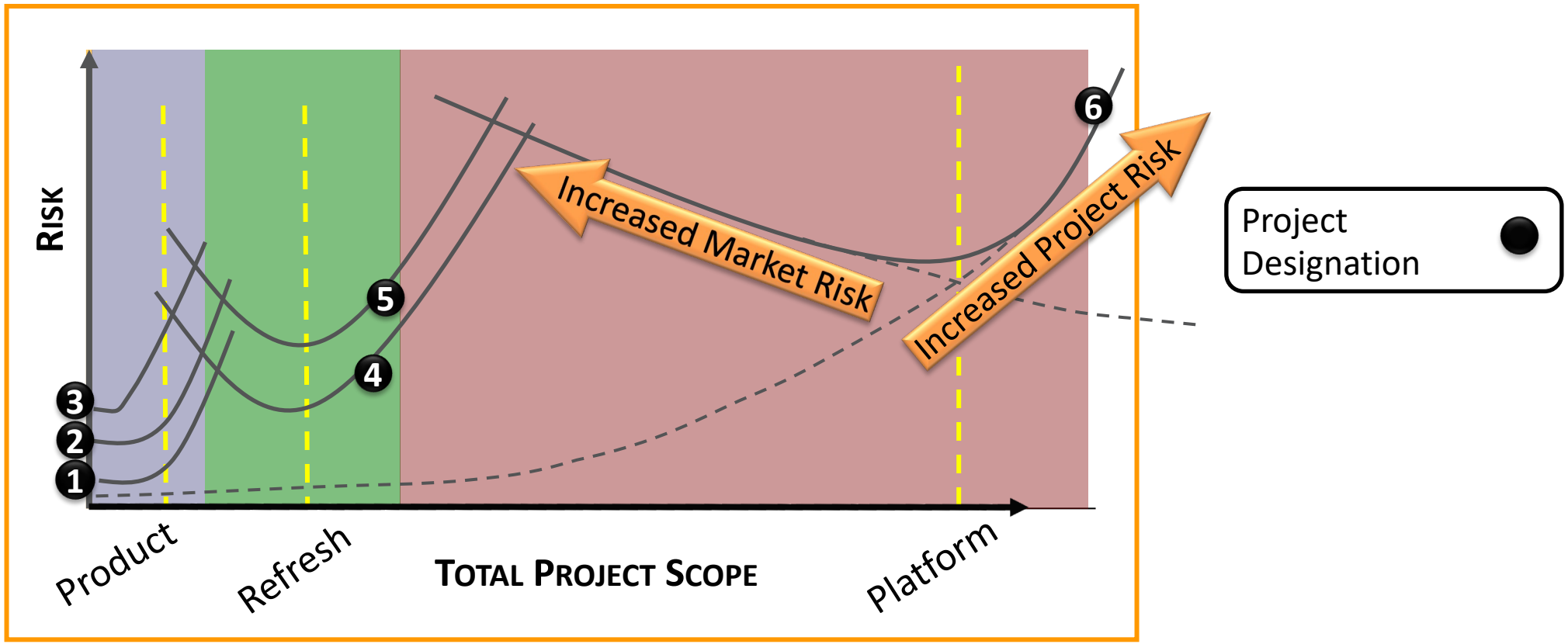
PORTFOLIO CADENCE, PULL, & FLOW

Standardized risk



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PORTFOLIO CADENCE, PULL, & FLOW

Bin designation

Bin Designation allows the organization to operate at peak efficiency by rightsizing projects.

Bin Designation allows for portfolio and Life Cycle Management through aligning a cadence of projects to flow through Product Development.

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PORTFOLIO CADENCE, PULL, & FLOW

- To ensure proper flow, the cadence of projects is managed within the Life Cycle Plan and projects are expanded or scaled back to fit a particular Bin size.
- Projects may also be “Right-Sized” to fit the cadence.
- Cadence and BINs work together to create a flow in the Product Development System.
- Projects are ‘Pulled’ through the firewall.

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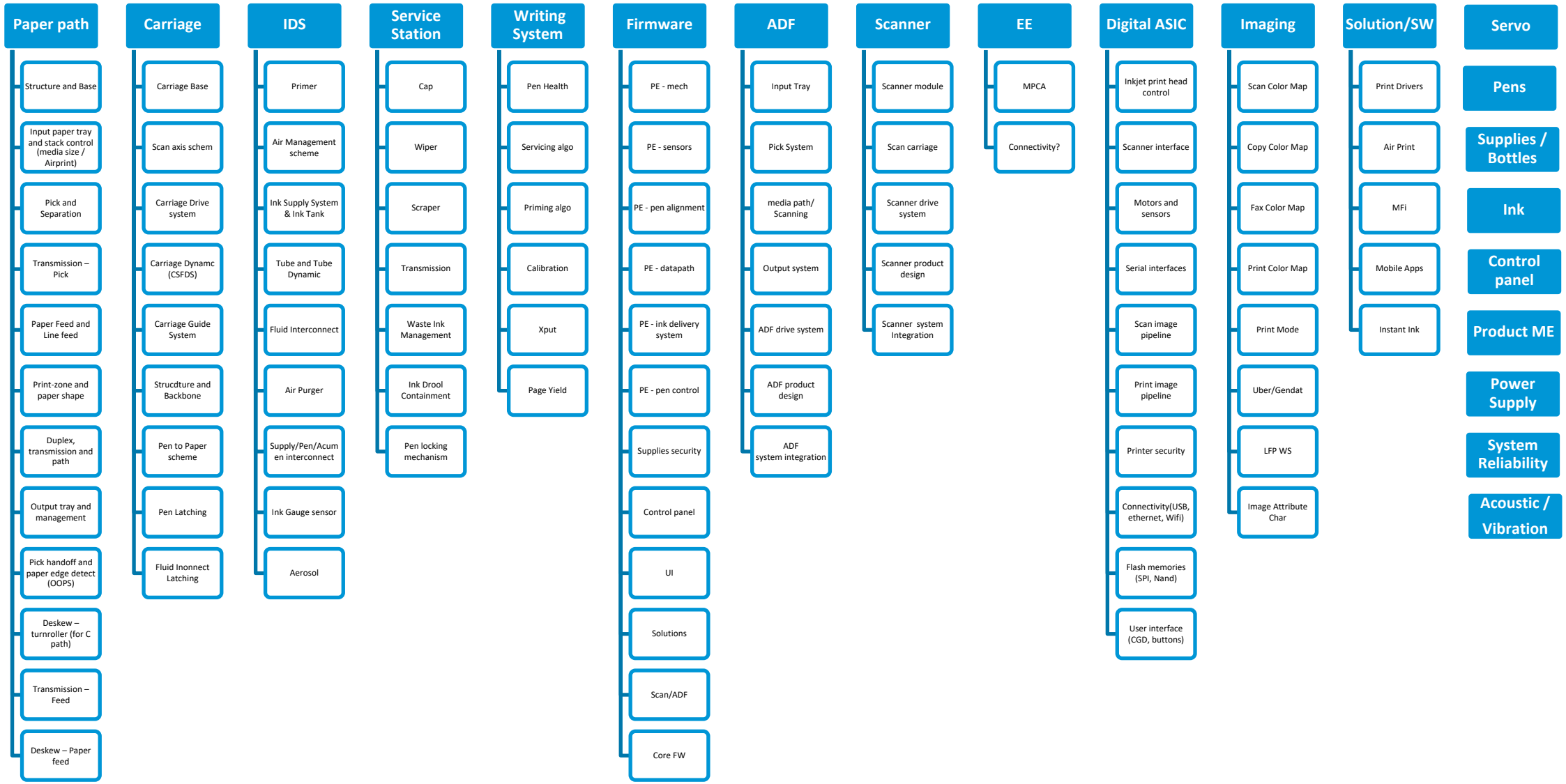
BASELINE: Functional Block Diagram – *example*



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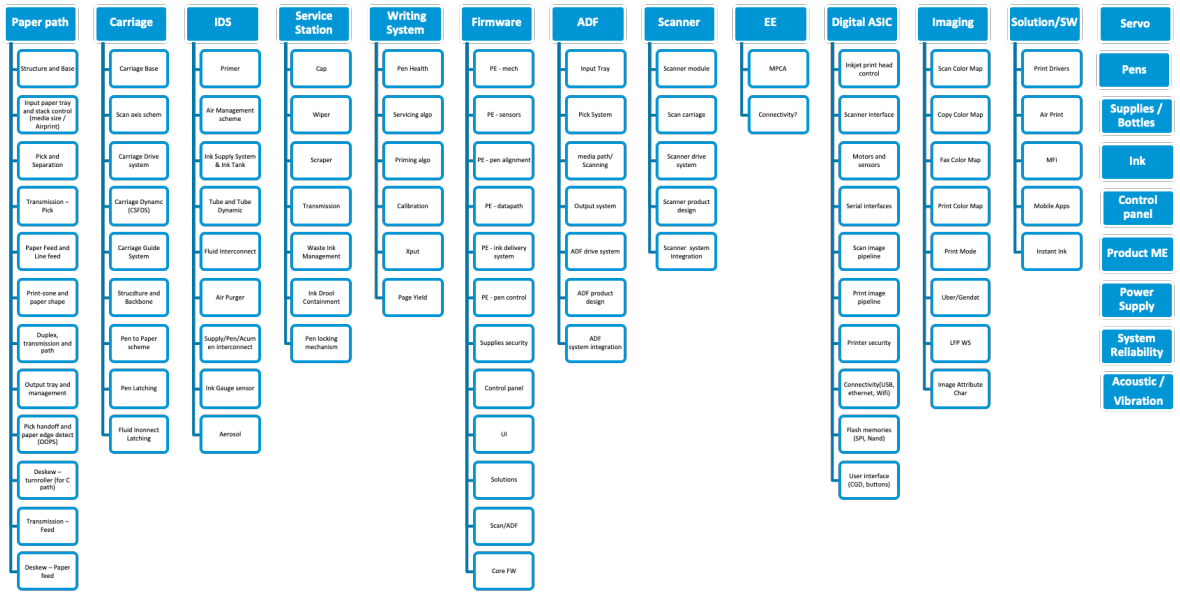
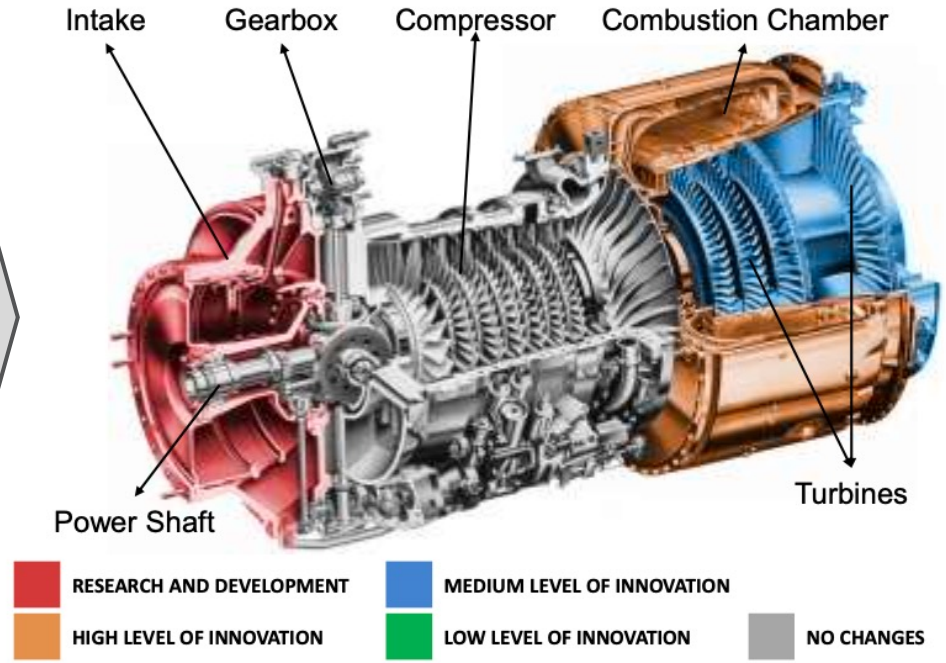
A VISUAL EXAMPLE FOR A JET ENGINE:





		A All proposed alternative subsystem solutions						B Selected alternative subsystem solutions	
Subsystem	**Functions**	**Alt. Sol. 1**	**Alt. Sol. 2**	**Alt. Sol. 3**	**Alt. Sol. 4**	**Alt. Sol. 5**	**Alt. Sol. 6**		
Subsystem 1	Intake air (6)	1.1	1.2	1.3	1.4	1.5	1.6	1.4	1.6
	Clean air (5)	2.1	2.2	2.3	2.4	2.5		2.2	2.3
Subsystem 2	Provide fuel (2)	3.1	3.2					3.1	
	Provide ignition (3)	4.1	4.2	4.3				4.2	4.3
	Burn fuel (1)	5.1						5.1	
Subsystem 3	Generate torque (5)	6.1	6.2	6.3	6.4	6.5		6.4	6.5
	Release gas (3)	7.1	7.2	7.3				7.2	

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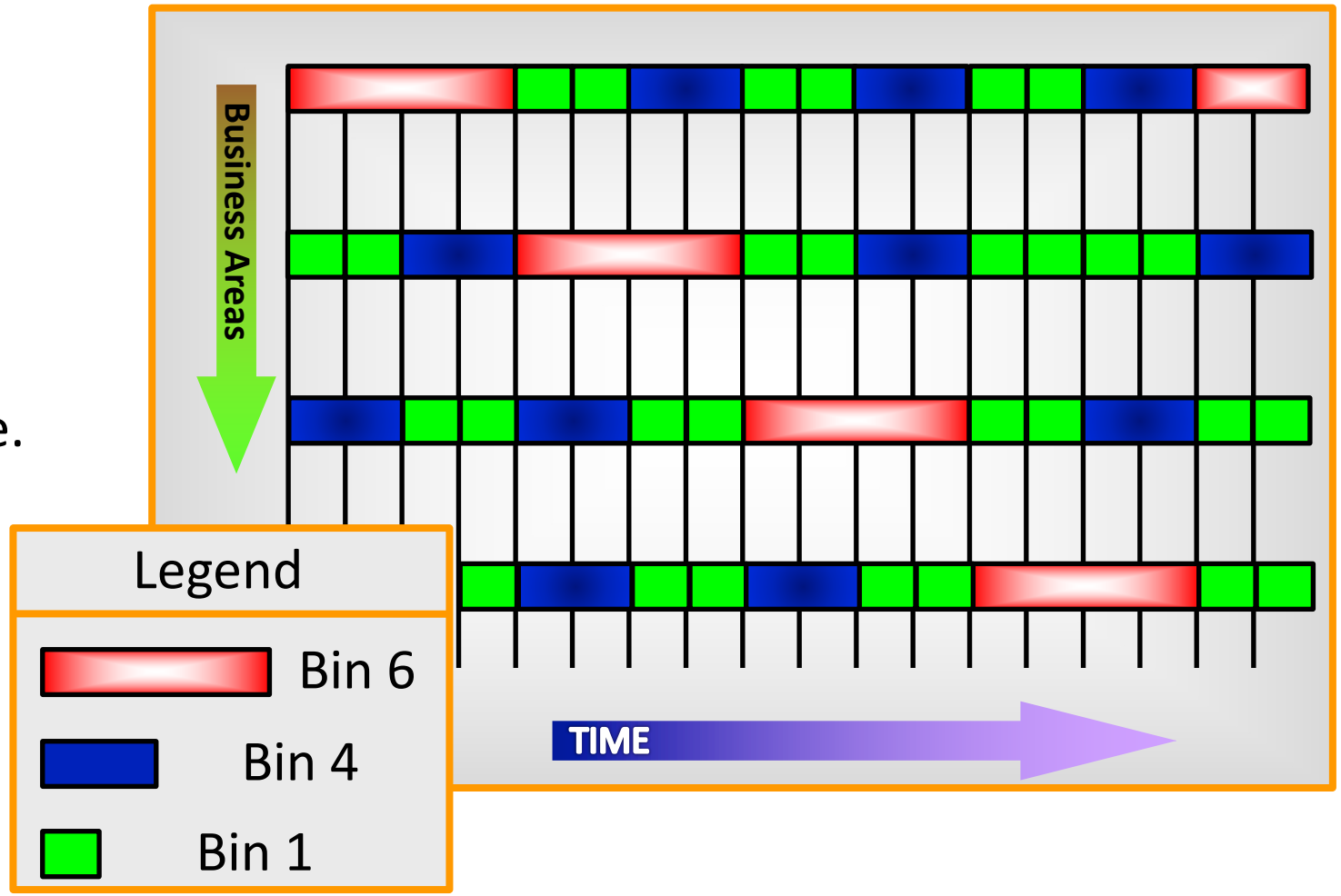
PORTFOLIO CADENCE, PULL, & FLOW

Cadence is critical to a lean development process. Projects sorted by Bins fall into a rigorous development execution cycle.

Once a project is committed (*passes through the firewall*) it is launched based on a set schedule.

Portfolio Cadence



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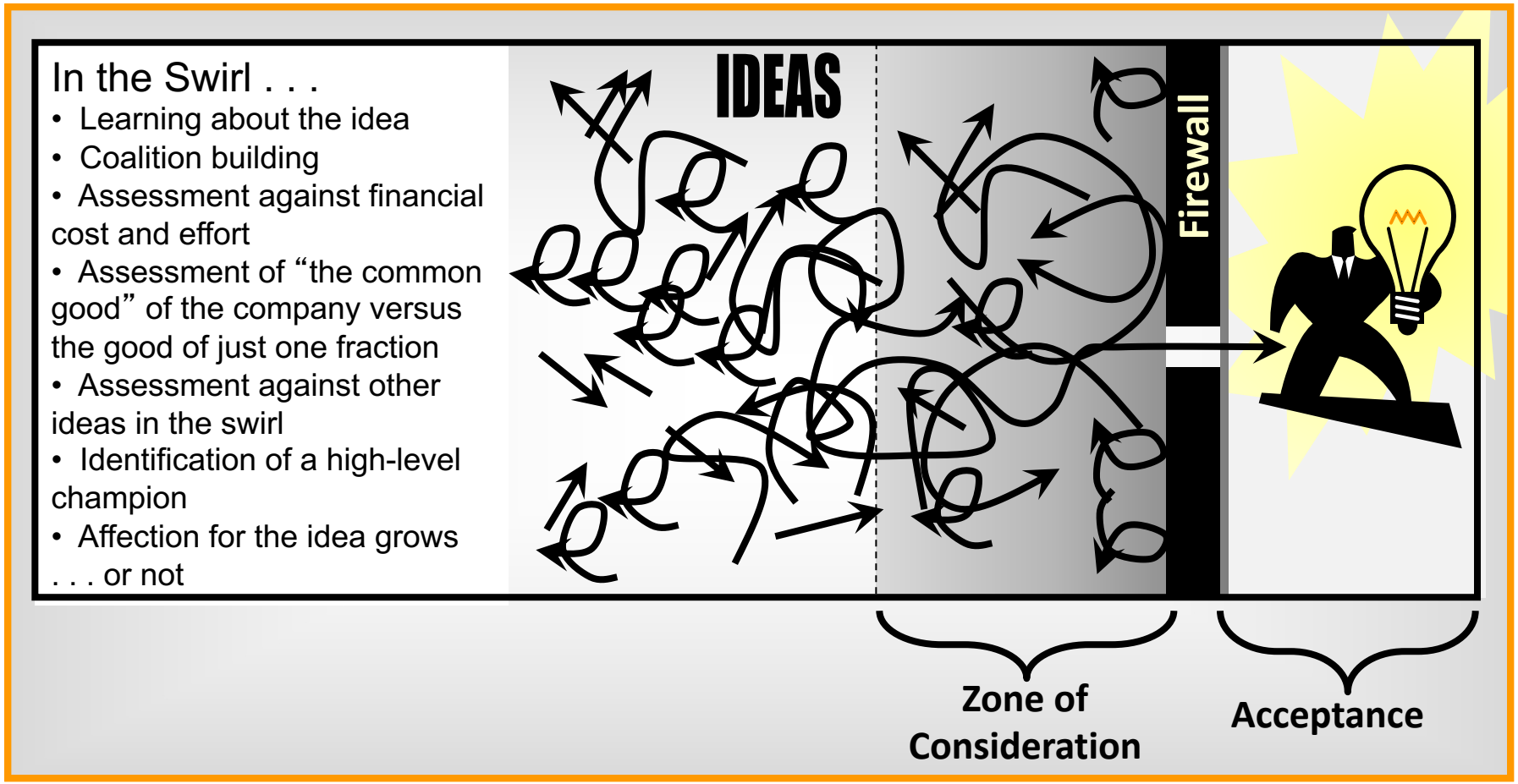
PORTFOLIO CADENCE, PULL, & FLOW

The Swirl Model



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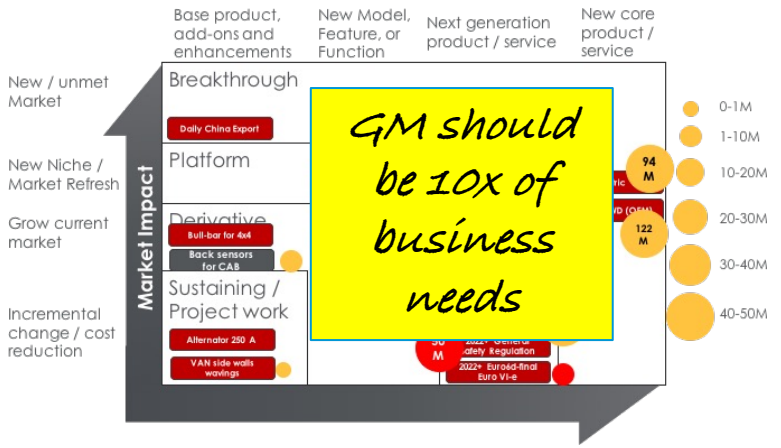
PORTFOLIO PLANNING – BUSINESS ALIGNMENT

Pre-firewall product portfolio value should be 10x of what we want to achieve in "lift"

Pre-Firewall Portfolio
(total lifecycle)



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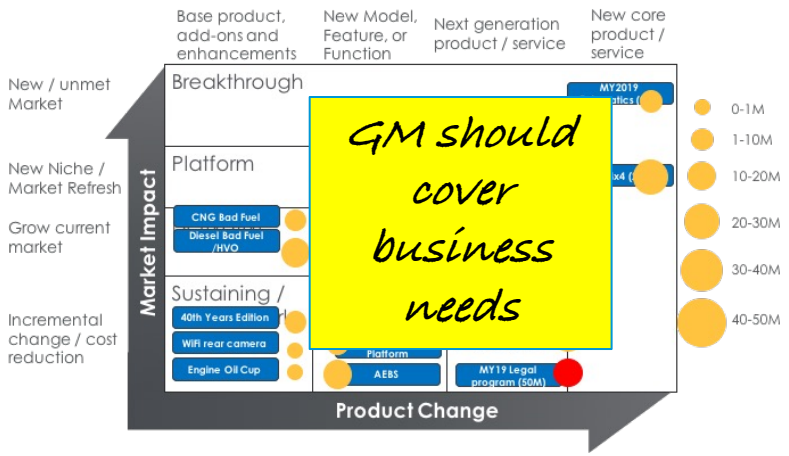
Innovation (qualitative)

Quality

GM €1,416MM x ~30% "accuracy" = €425MM

model

Post-Firewall Portfolio
(total lifecycle)

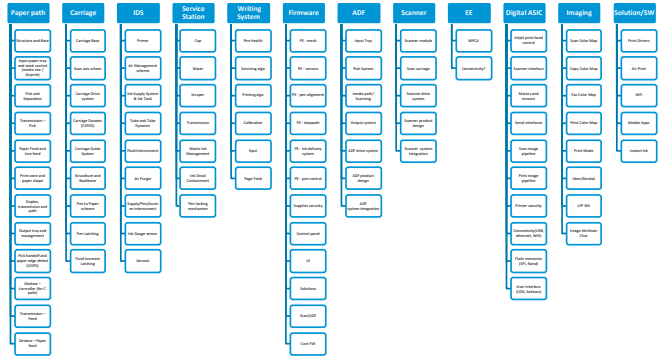


GM €424MM x 80% "historic accuracy" = €340MM

model

"Product change" level depends on how much changes of the function blocks

Functional Block Diagram



"Market impact" level may be BIN 1,2, or 3

Accuracy based on field studies

	Idea	Concept	Feasibility	Development	Scale-up	Launch
Break-through	3%	13%	25%	35%	42%	45%
Platform	15%	25%	40%	45%	50%	60%
Derivative	35%	45%	65%	75%	80%	80%
Sustaining	50%	60%	80%	90%	90%	90%

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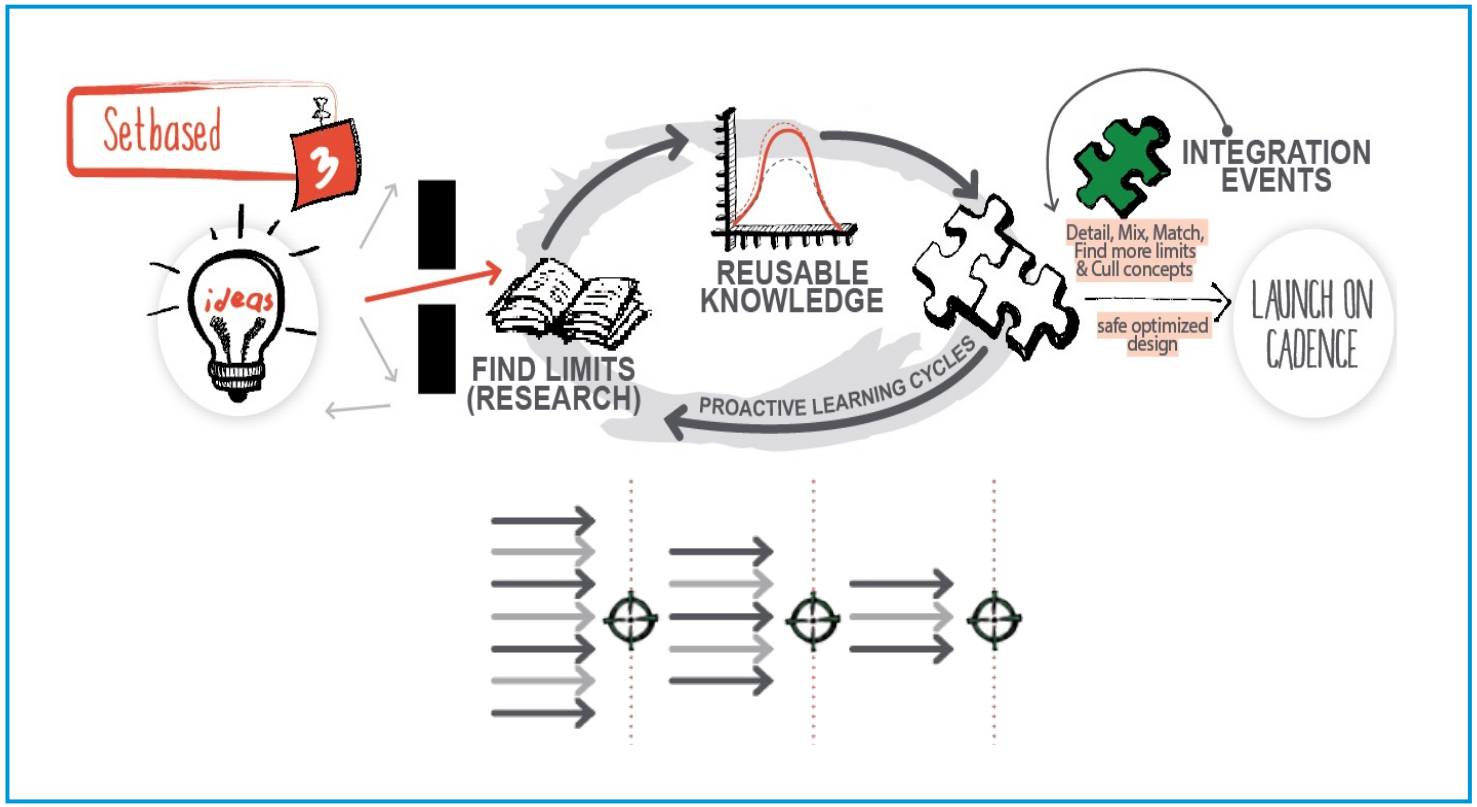
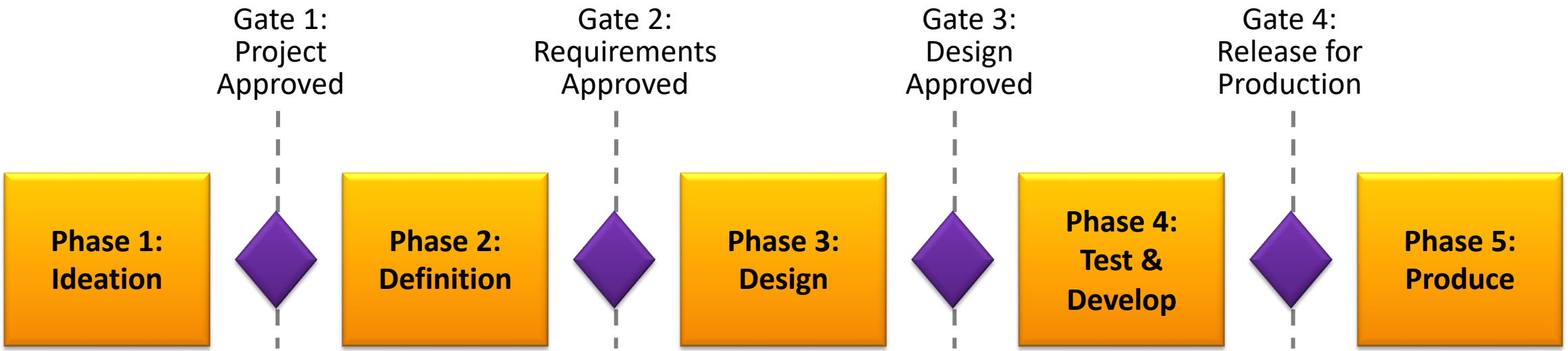
SET-BASED DEVELOPMENT SYSTEM



Set-Based enables continual learning through creation of reusable knowledge and predictable delivery on cadence

TYPICAL PRODUCT DEVELOPMENT

The Phase and Gate Process



Phase (Stage)**:** A set of logically grouped tasks and activities with defined deliverables
Gate: A "Go" / "No Go" project decision point

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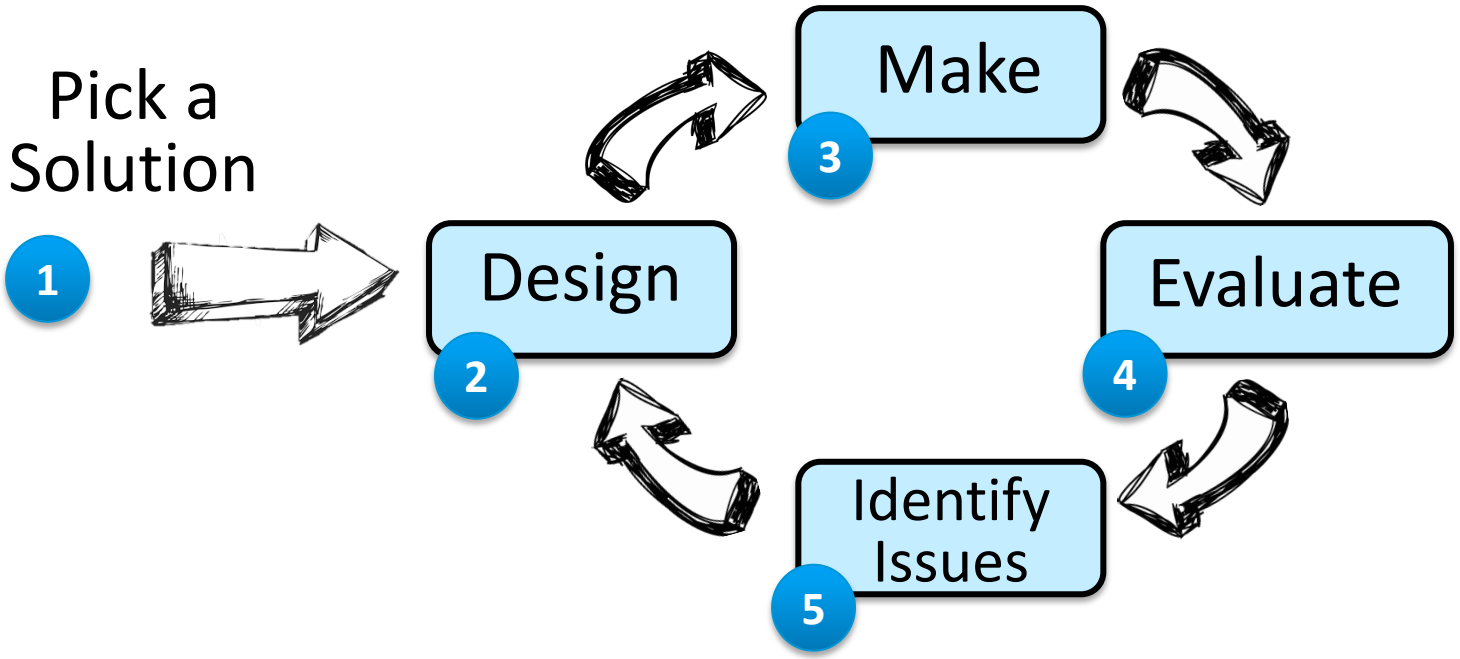
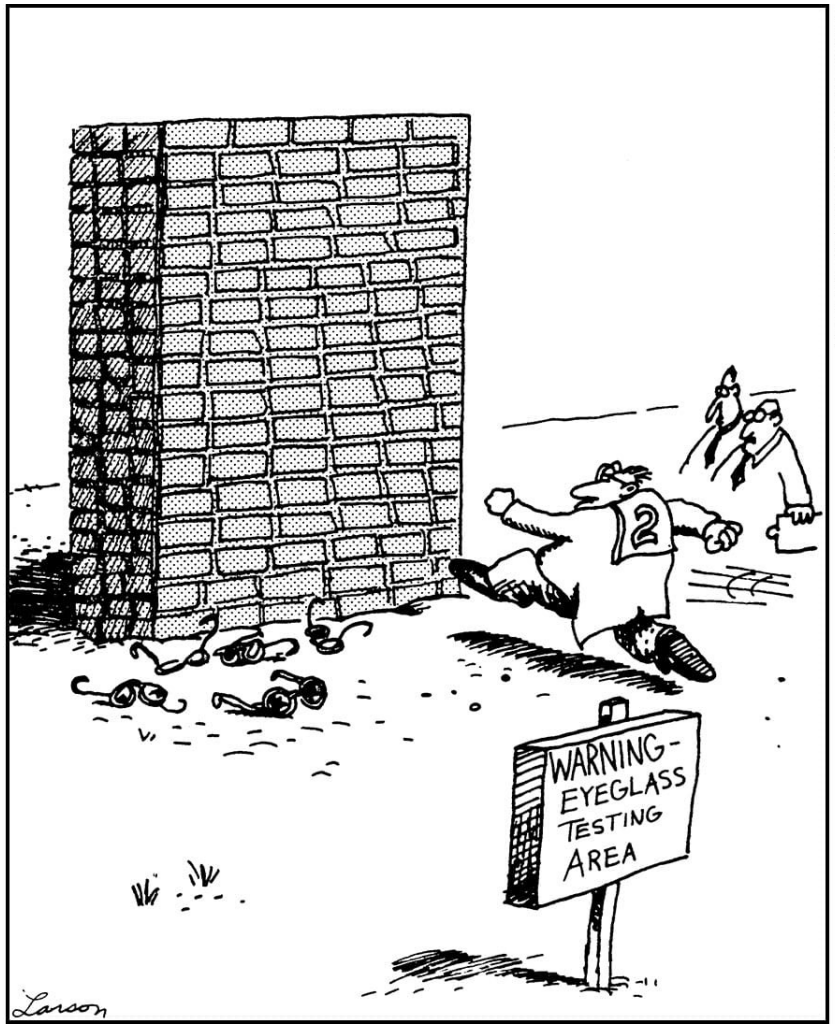
POINT-BASED DEVELOPMENT

When do we set our requirements?





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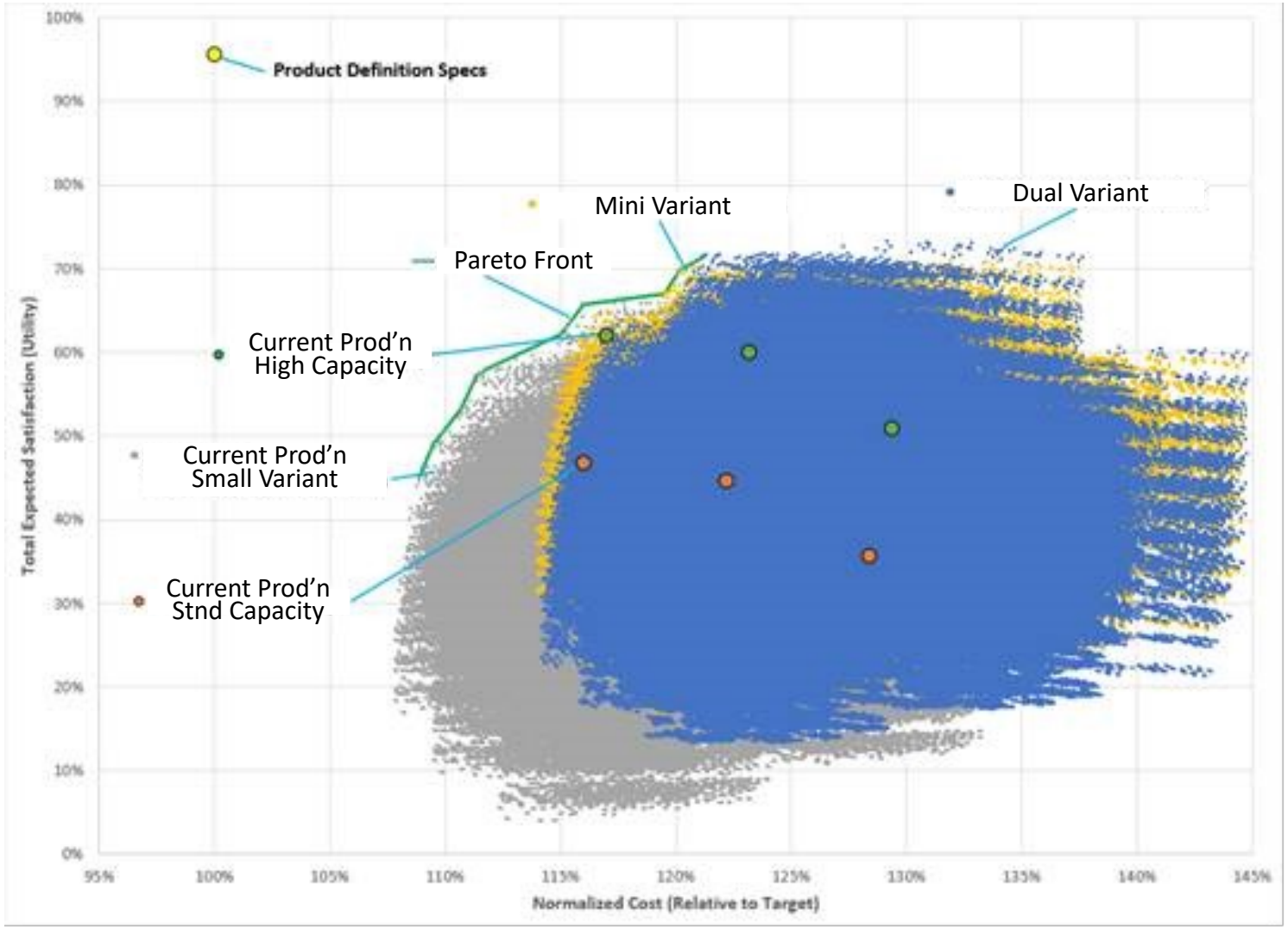
POINT-BASED vs SET-BASED DEVELOPMENT

Example of solution selection
VS
Known capabilities



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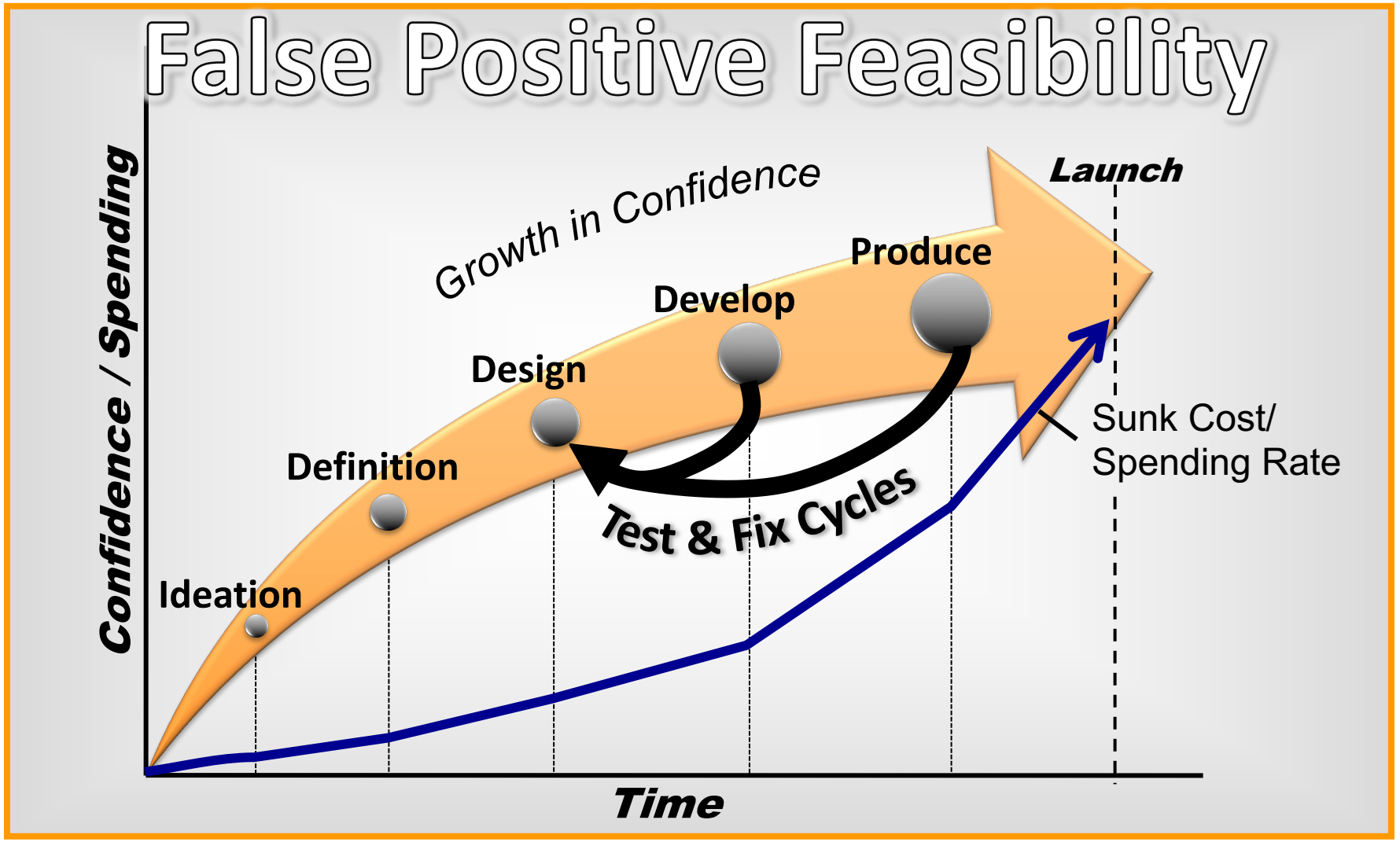
HOW DEVELOPMENT WORKS



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HOW DEVELOPMENT WORKS

The most common reason for project delays, cost over runs, and failures is ***False Positive Feasibility***.

- *You think something is feasible and commit to it only to learn later that it is not.*
- *You think you have a clear project definition or target, only to learn that it changes.*

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HOW DEVELOPMENT WORKS

The challenge in delivering a project is to close the gap between what is known and what needs to be known in time for launch.

- *Knowledge may be gained Proactively or Reactively*

  … but the knowledge gap must be closed.

- *There are many organizations*

  … who learn the same thing over and over.

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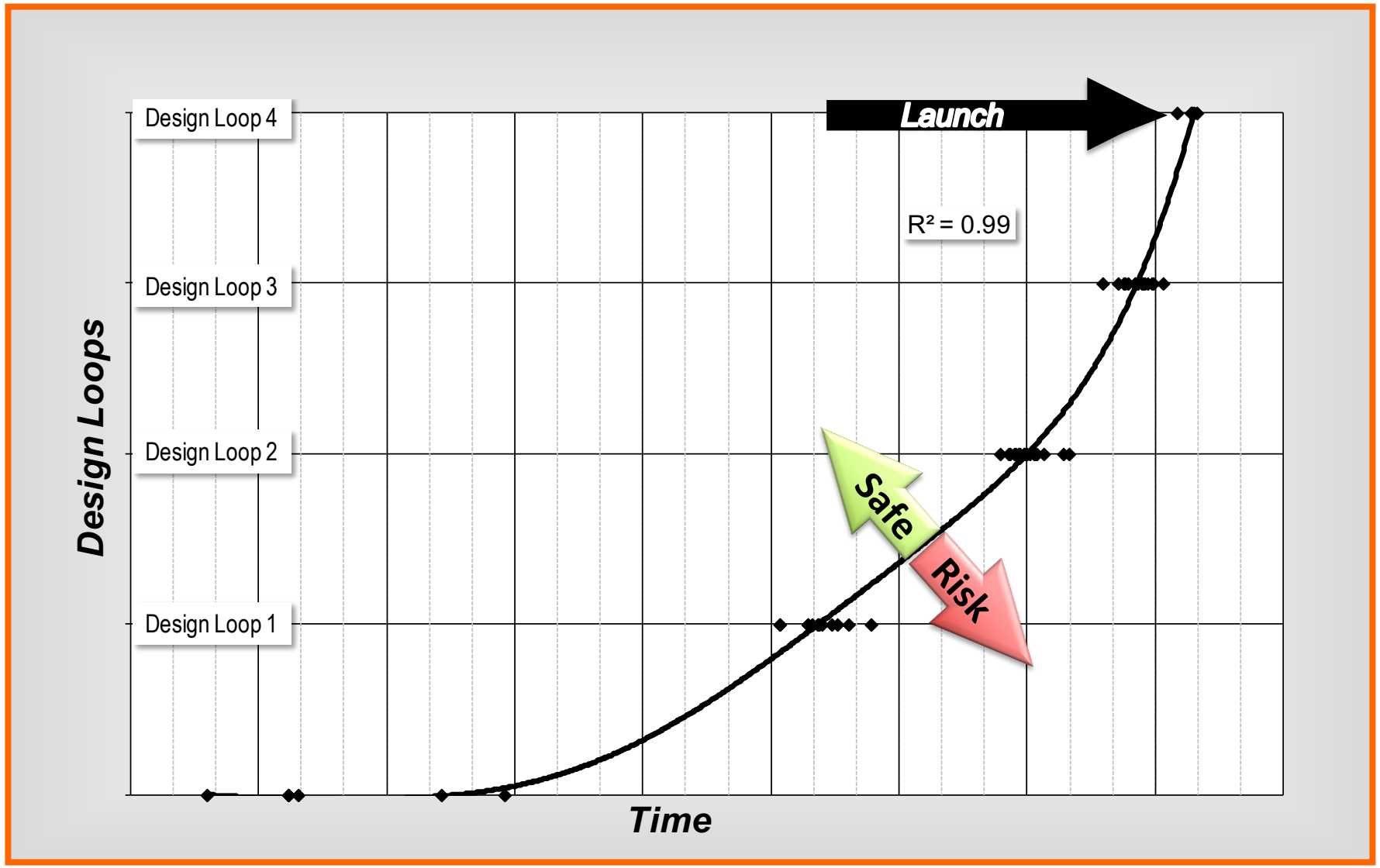
HOW DEVELOPMENT WORKS



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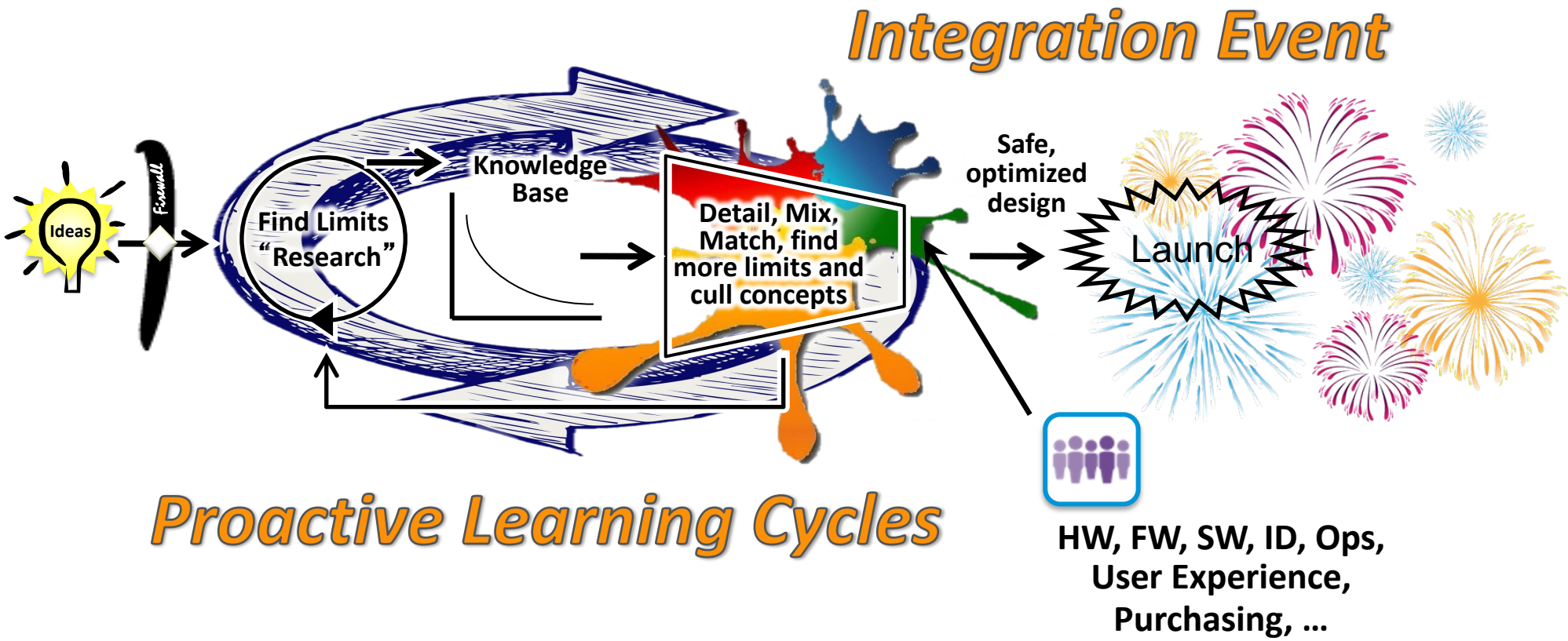
SET-BASED DEVELOPMENT

Understand the limits first …

… then design within them



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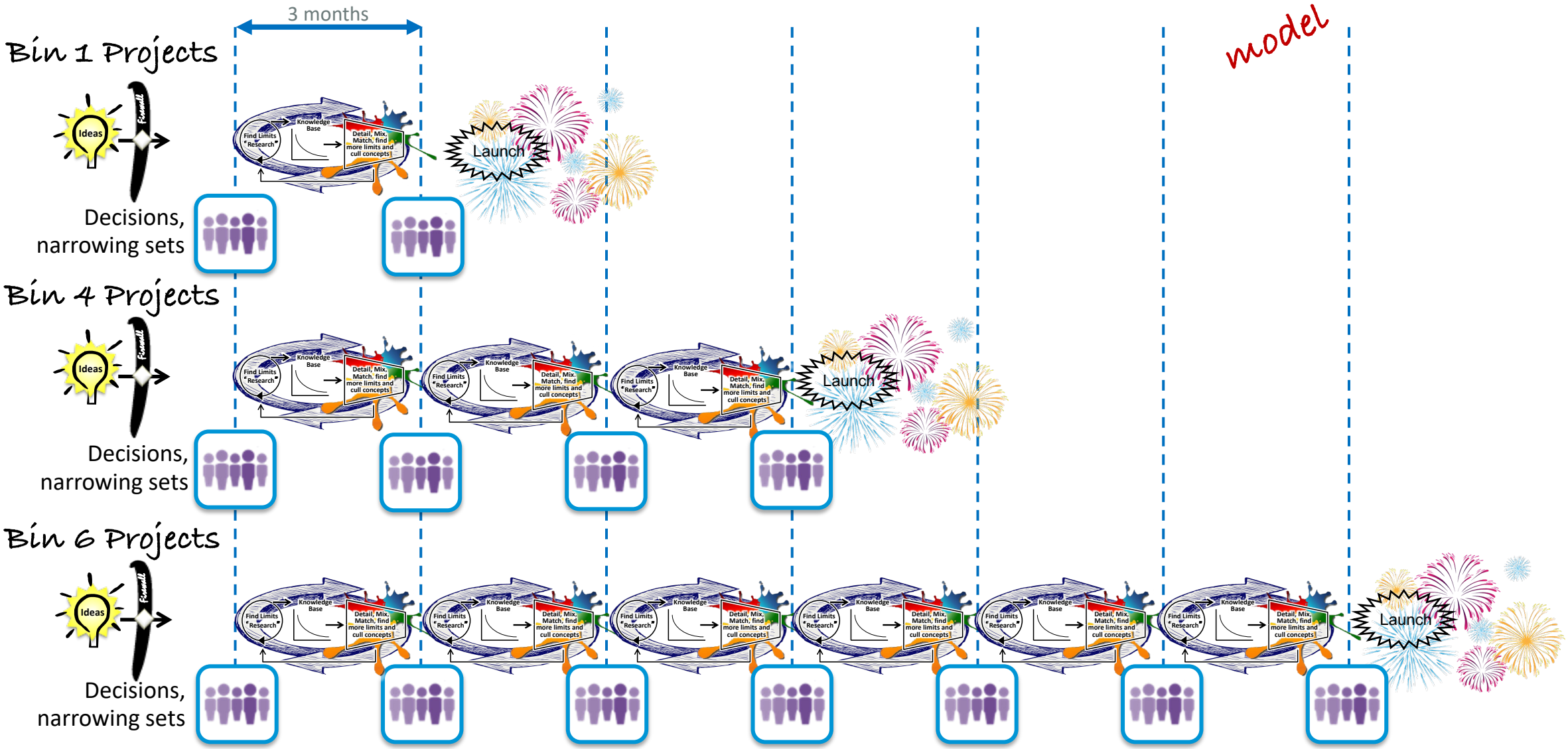
SET-BASED DEVELOPMENT WITH BINS



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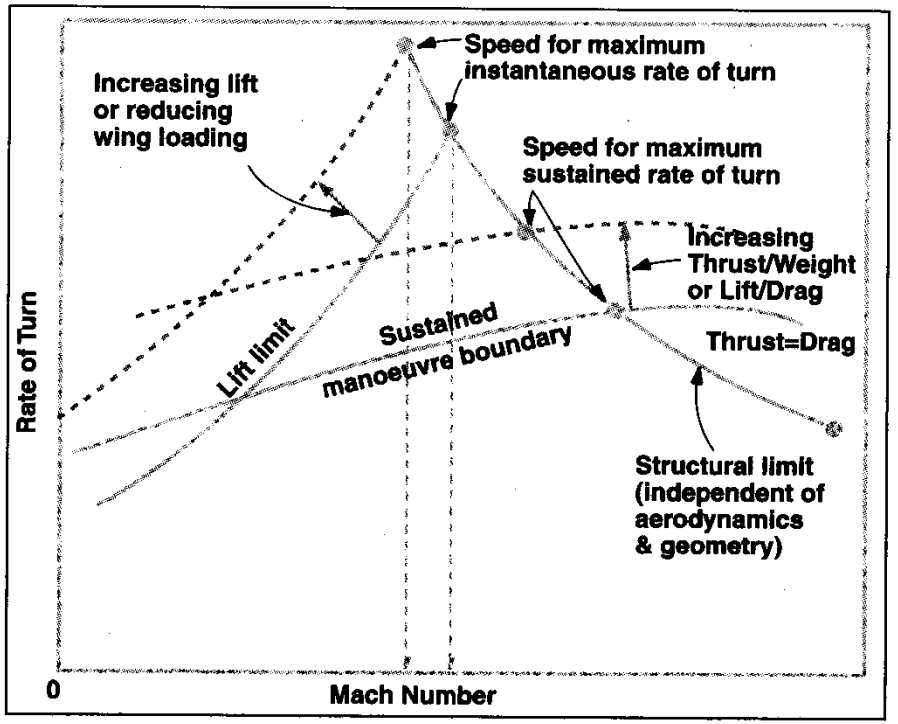
SET-BASED DEVELOPMENT

Principles of Lean Set-based concurrent engineering

1. Map the design space
   - Define feasibility regions
   - Explore trade-offs by designing multiple alternatives
   - Communicate sets of possibilities
2. Integrate by intersection
   - Look for intersections of feasible sets
   - Impose minimum constraints
   - Seek conceptual robustness
3. Establish feasibility before commitment
   - Narrow sets gradually while increasing detail
   - Stay with sets once committed
   - Control by managing uncertainty at Integration points



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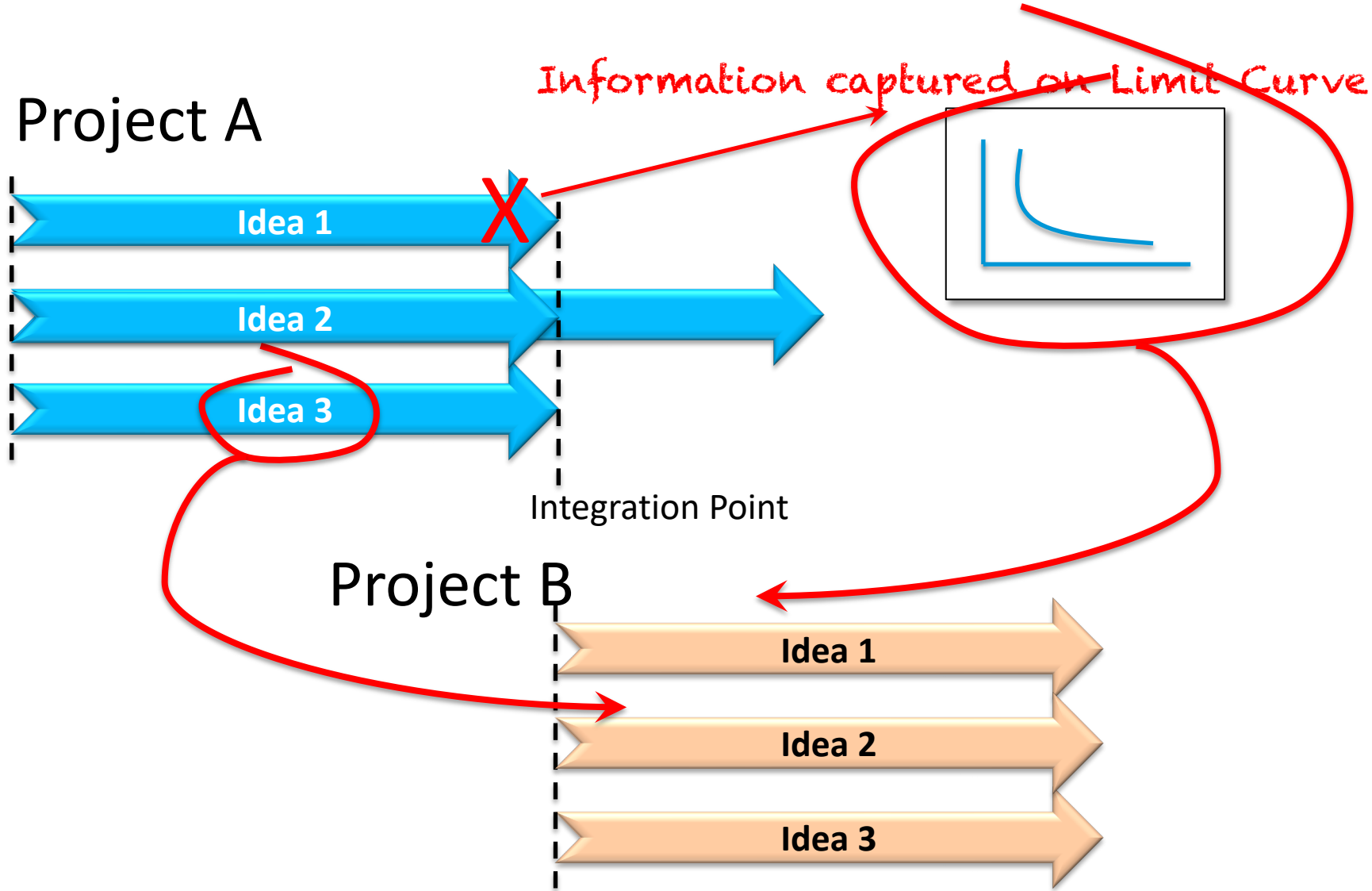
SET-BASED DEVELOPMENT – *Portfolio*



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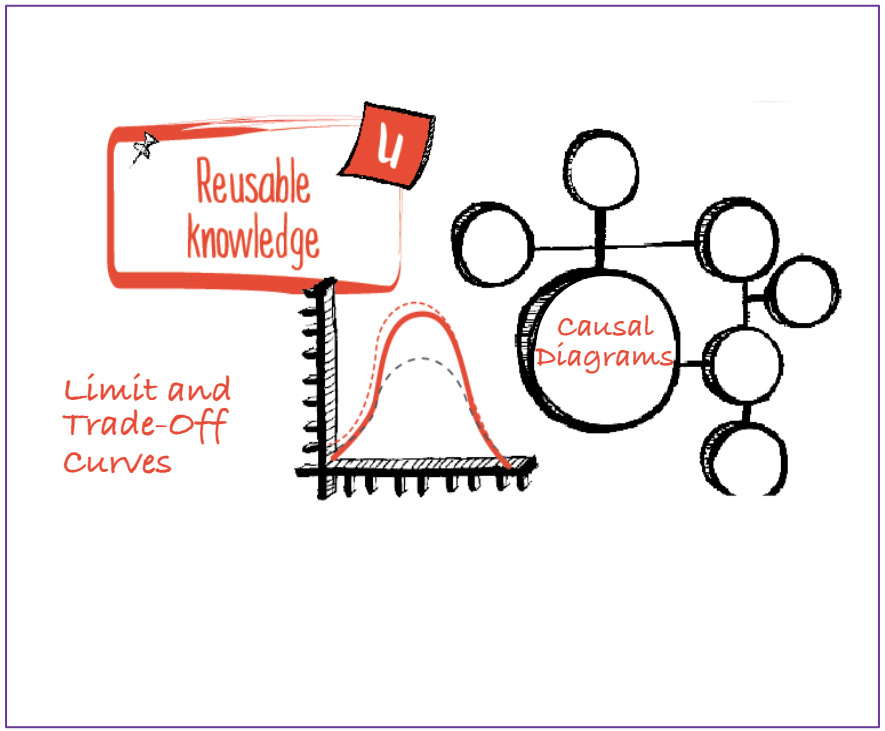
REUSABLE KNOWLEDGE



Creating visible reusable knowledge

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REUSABLE / VISIBLE KNOWLEDGE

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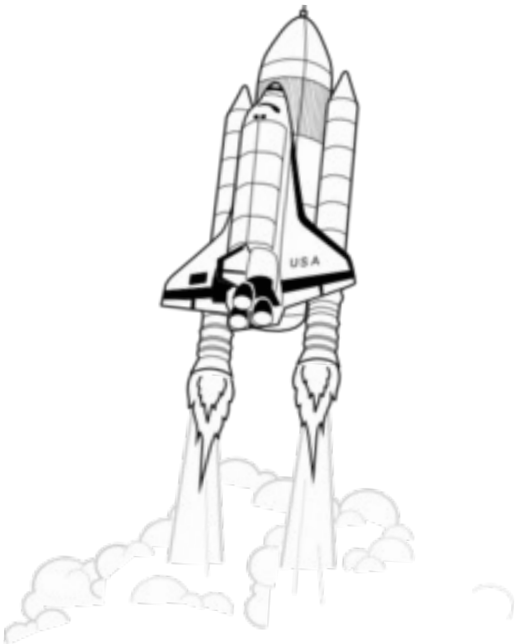
REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5			8	9	10	11
12			15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Liftoff was initially scheduled from Kennedy Space Center on January 22, 1986.



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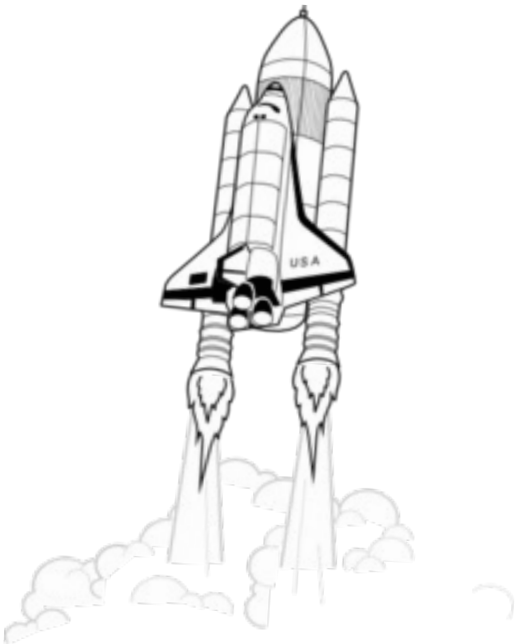
REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				2	3	4
5				9	10	11
12				16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Delays in mission 61-C (*Ulysses and Galileo space probes*) delayed launch to Jan. 23rd .



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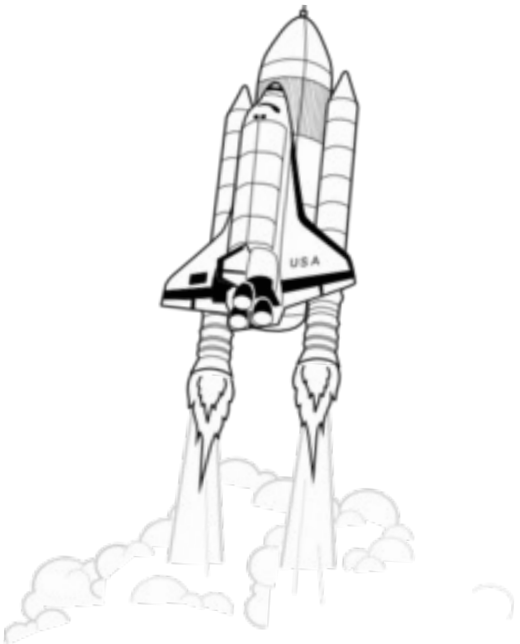
REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					3	4
5	6				10	11
12	13	14	15		17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Delays in mission 61-C (*Ulysses and Galileo space probes*) delayed launch then again to Jan. 24th.



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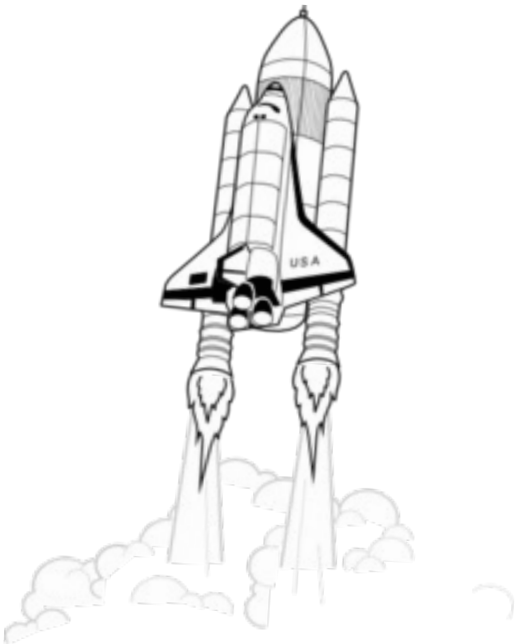
REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						4
5	6	7				11
12	13	14	15	16		18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Bad weather at transoceanic abort landing site in Dakar delayed it to Jan. 25th.



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REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

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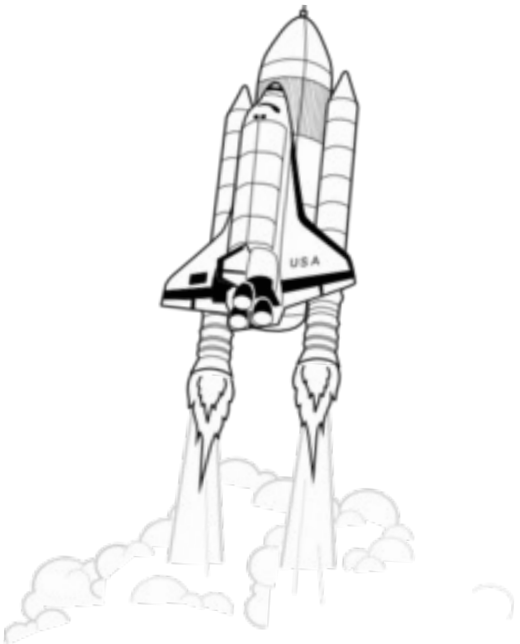
			1	2	3	4
				9	10	11
1				16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

The launch was postponed to Jan 26th when launch processing could not meet the new morning liftoff time.



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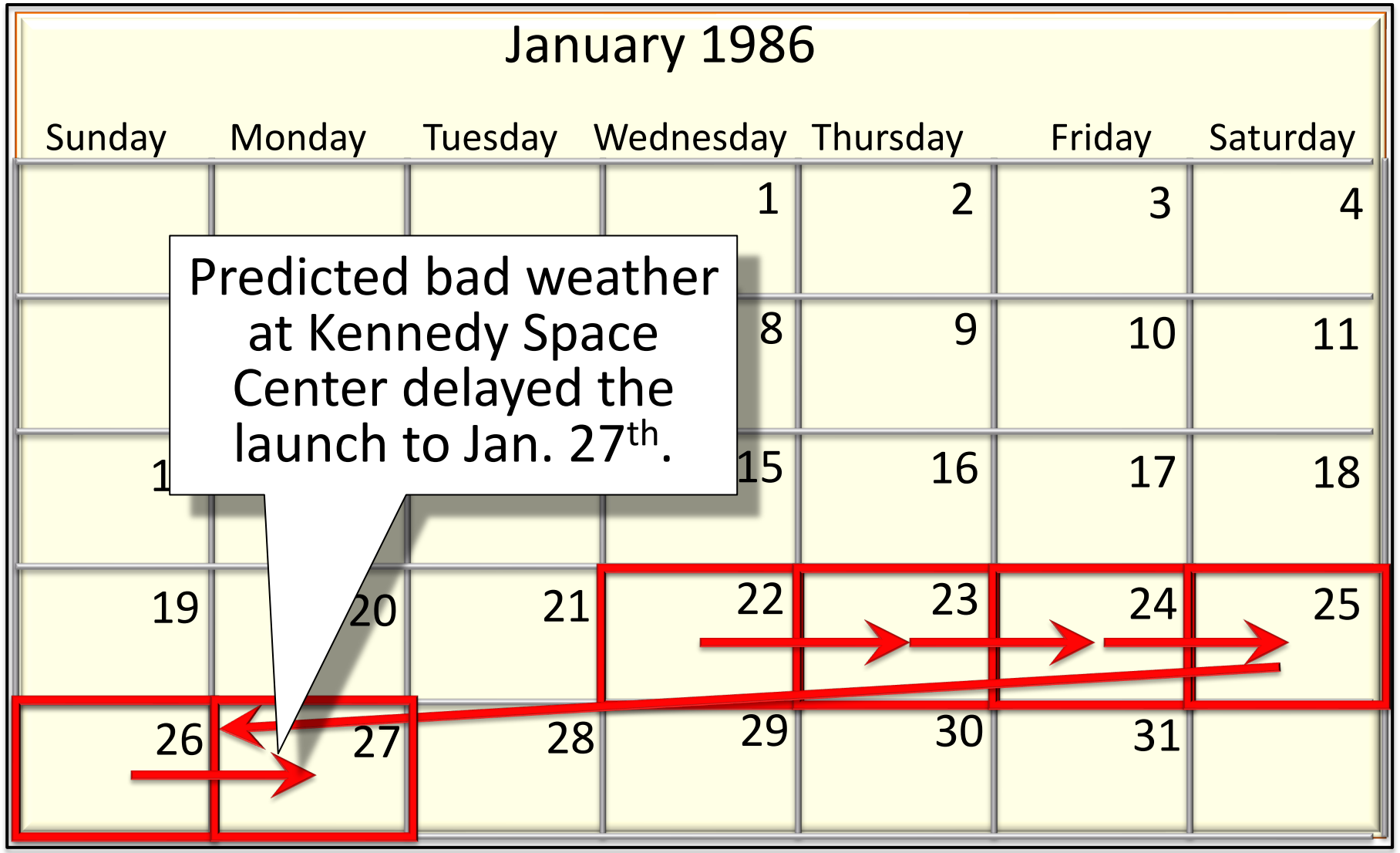
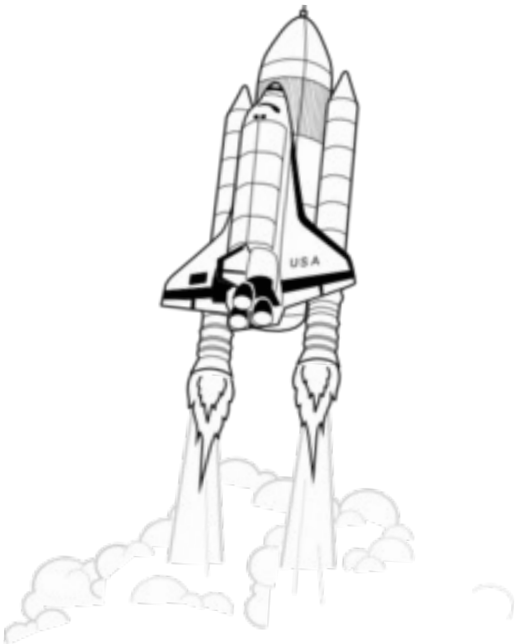
REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L





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REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

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			1	2	3	4
				9	10	11
1				6	17	18
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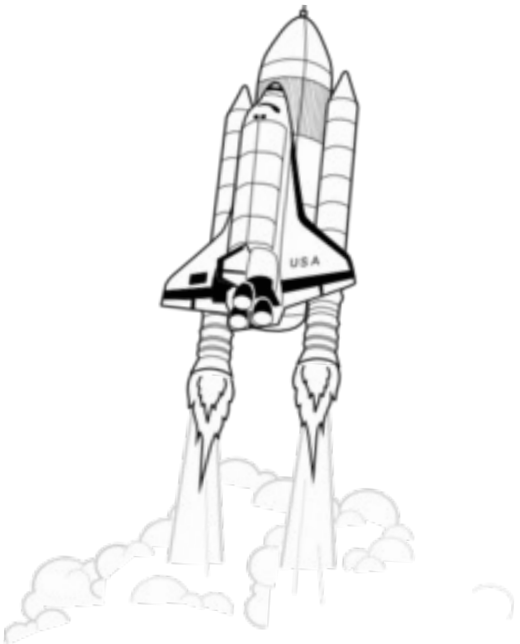
26	27	28	29	30	31	

The ground servicing equipment hatch closing fixture could not be removed from the orbiter hatch so the fixture was sawed off delaying launch to Jan 28th.



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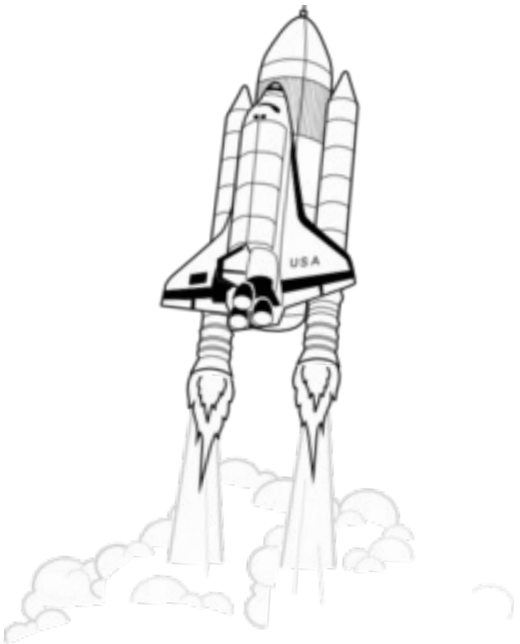
REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
					10	11
1					17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

A hardware interface module which monitors fire detection system failed during liquid hydrogen tanking procedures delaying launch a final two hours.



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REUSABLE / VISIBLE KNOWLEDGE

Shuttle Mission STS-51L

January 1986

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			1	2	3	4
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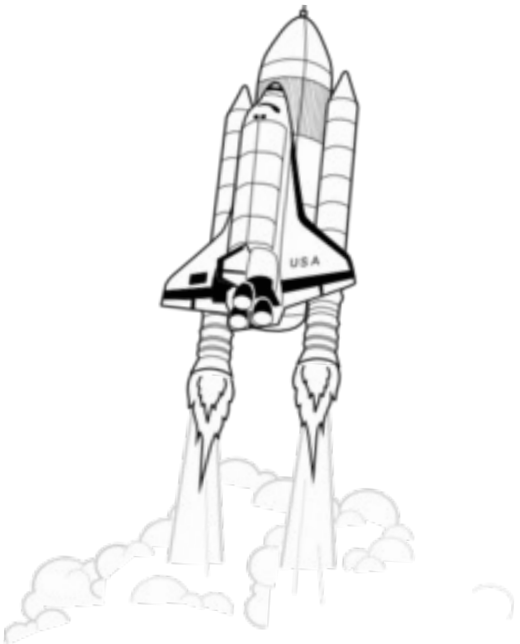
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

The Challenger finally lifted off at 11:38:00 a.m. EST.



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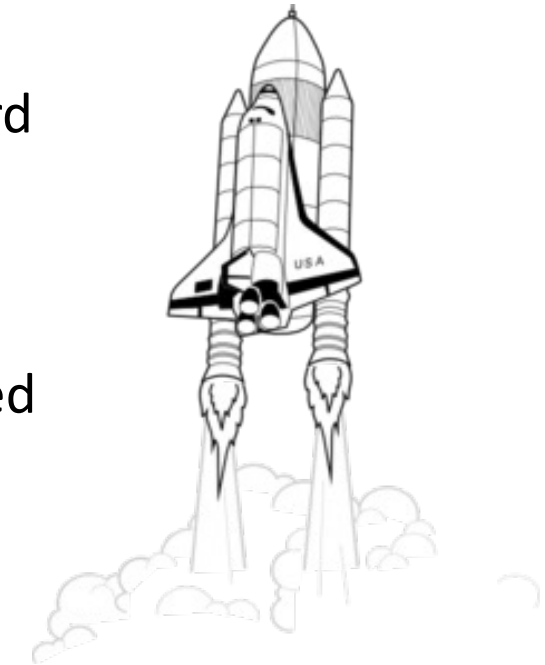
REUSABLE / VISIBLE KNOWLEDGE

Economic

Competition from the European Space Agency required NASA to fly the shuttle dependably on a very ambitious schedule in order to prove the cost effectiveness and viability for commercialization. NASA had scheduled a record number of missions in 1986 to make a case for its budget requests.



Schedule

NASA needed to launch the *Challenger* so the launch pad could be refurbished in time for the next mission, which would be carrying a probe to examine Halley's Comet. An on-time launch would allow data to be collected a few days before a similar Russian probe would be launched.

Political

President Reagan planned to gave his State of the Union address with his main topic to be education. He was expected to mention the shuttle and the first teacher in space, Christa McAuliffe.

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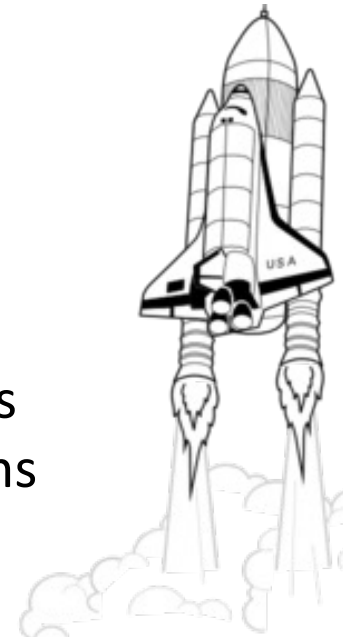
REUSABLE / VISIBLE KNOWLEDGE

After action investigation findings…

The cause of the Challenger accident was determined to be a rubber ring (O-ring) that sealed the joint between two sections of one of the Challenger's ancillary rockets (boosters).



With temperatures forecast between 26 and 29 degrees Fahrenheit, the technicians of Morton Thiokol advised against the launch. None of the previous launches had occurred at such low temperatures and some flights had problems related with the joints.

The technicians had sent a 13 page fax to the NASA officers who found the data and tables insufficient to conclude a relation between low temperatures and the O-ring joint . After an intense debate it was decided to go on with the launch, despite the fact that it was the first time that Morton Thiokol advised a no-launch in 12 years.

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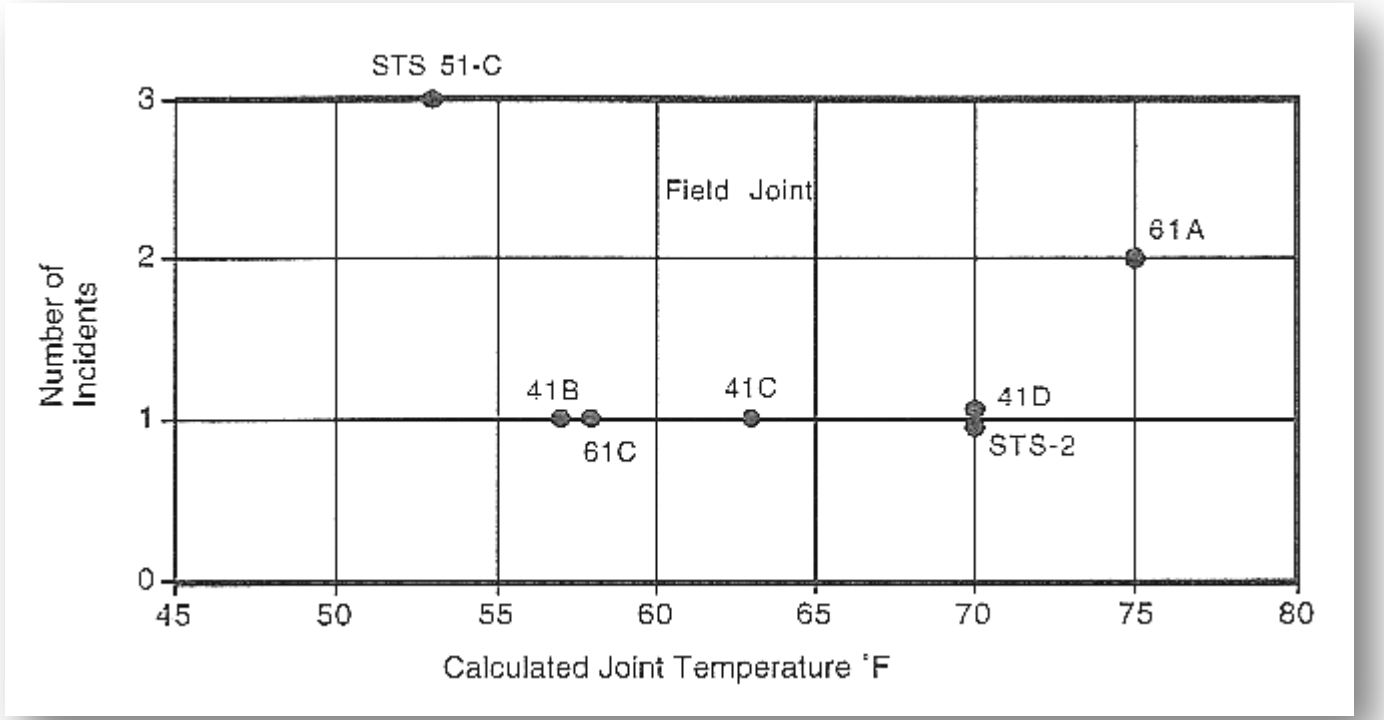
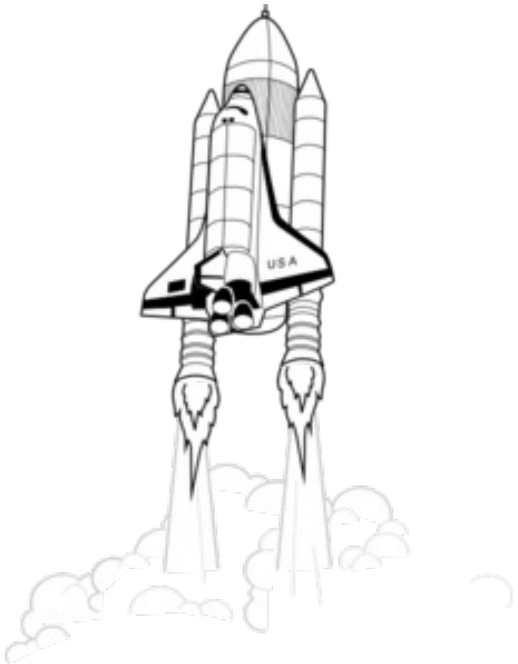
REUSABLE / VISIBLE KNOWLEDGE





This figure (scanned from the report) shows a graph accompanying the *Report of the Presidential Commission on the Space Shuttle Challenger Accident*, 1986 (vol 1, p. 145) in the aftermath of the disaster.

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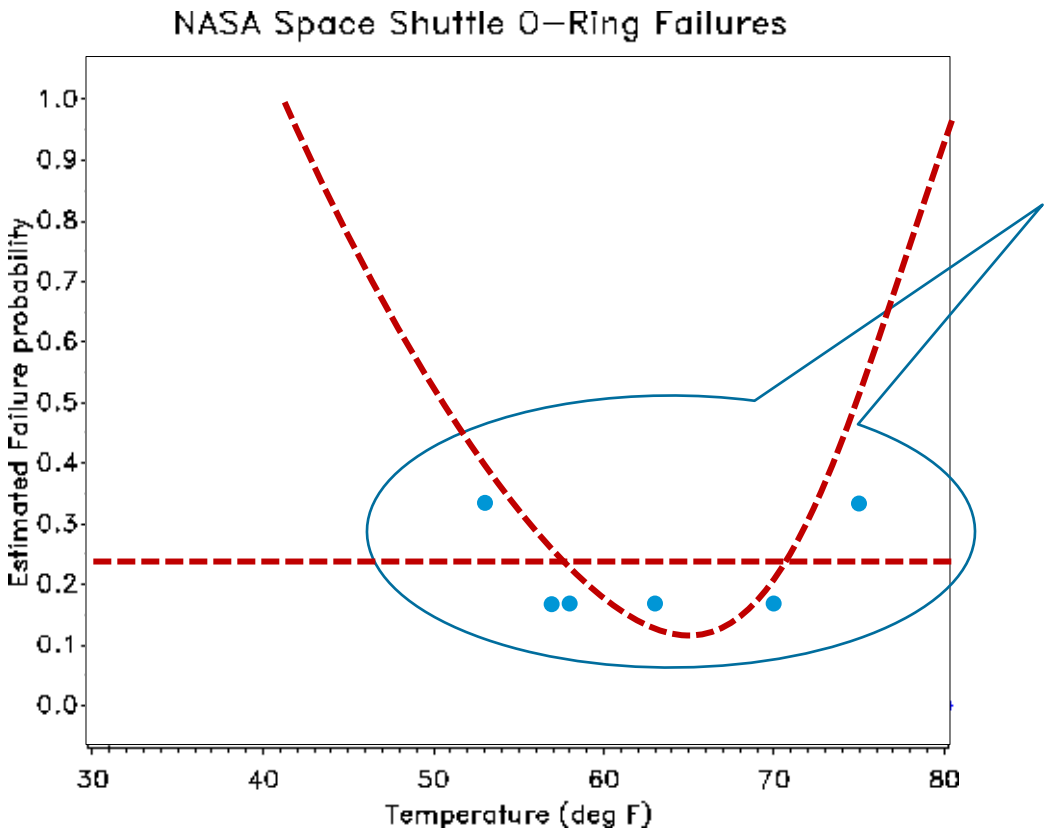
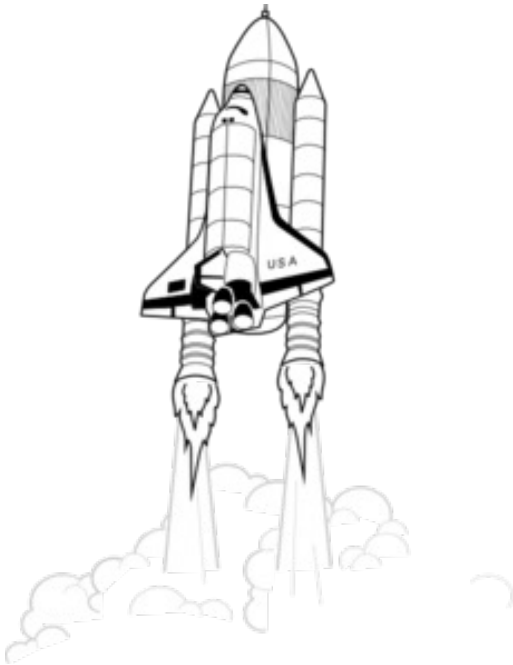
REUSABLE / VISIBLE KNOWLEDGE



NASA staff had analyzed the data on the relation between ambient temperature and number of O-ring failures (out of 6), excluding data where no O-rings failed, believing that they were uninformative.



Reanalysis of the O-ring data involved fitting a logistic regression model providing a predicted extrapolation (black curve) of the probability of failure to the low (31˚ F) temperature and confidence bands of the extrapolation (red curves).

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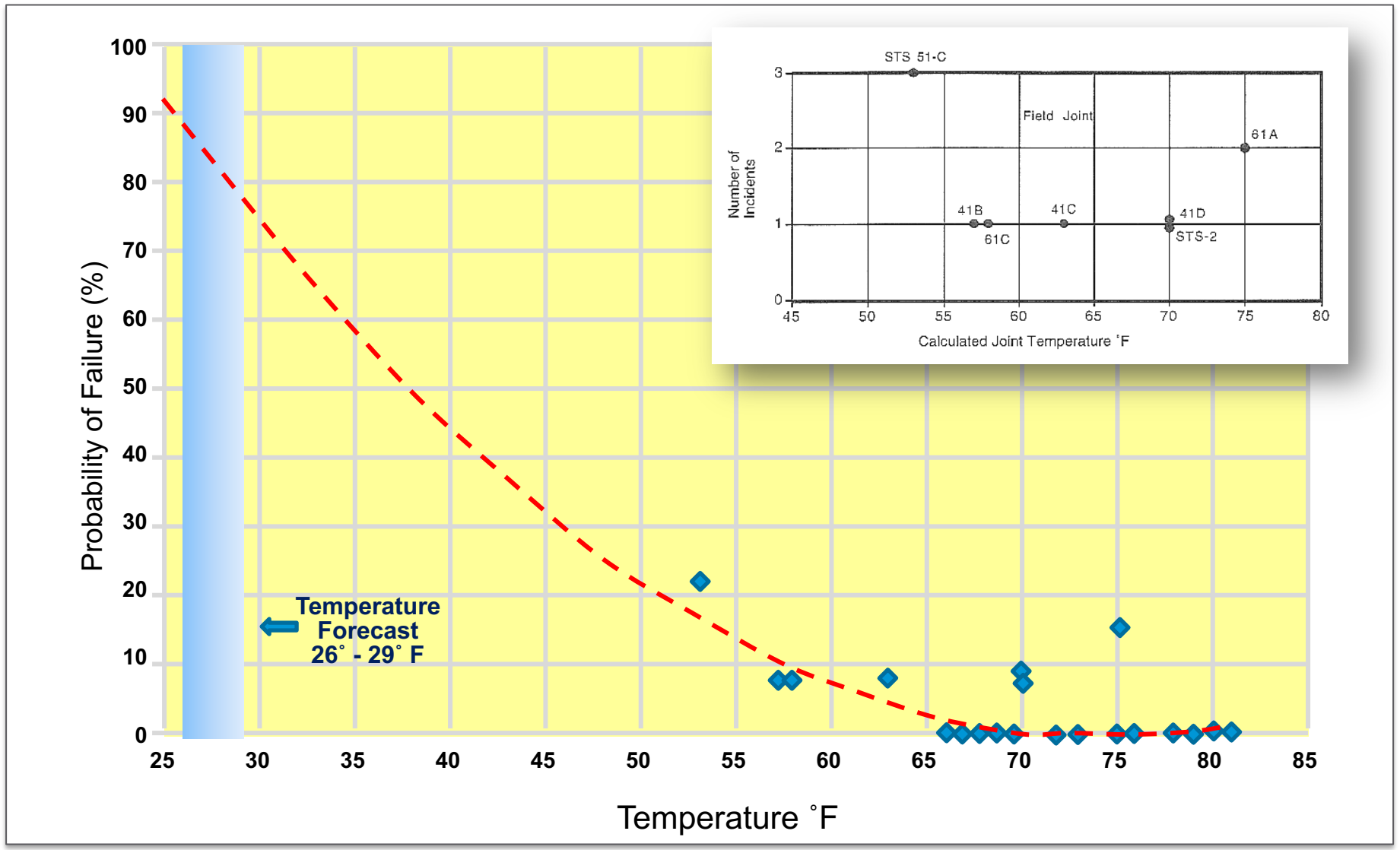
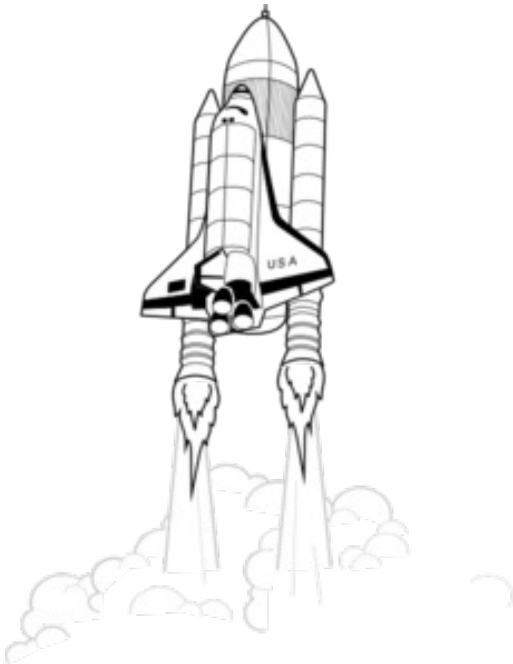
REUSABLE / VISIBLE KNOWLEDGE





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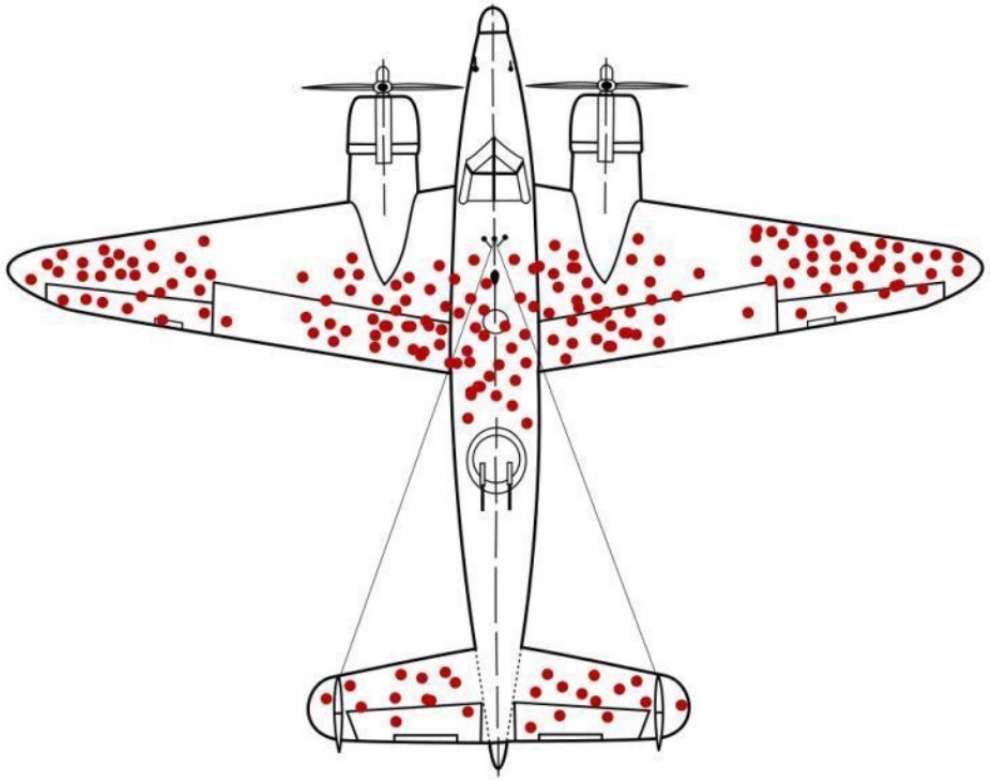
Visualizing data – Re-armoring planes

During World War II, fighter planes would come back from battle with bullet holes. In an effort to improve survivability, The Allies found and marked those areas that were most commonly hit by enemy fire. Their objective was to re-armor the planes to reduce the number that were shot down.

A mathematician by the name of Abraham Wald pointed out that perhaps there was another way to look at the data. Perhaps the reason certain areas of the plane didn't have bullet holes was because the planes that were shot in those areas didn't come back. The insight led to the armor being placed on the parts of the plane where there were no bullet holes.

The story behind the data is arguably more important than the data, or more precisely, the reason behind why we are missing certain pieces of data may be more meaningful than the data we have



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A CLOSE CALL WITH A RECALL

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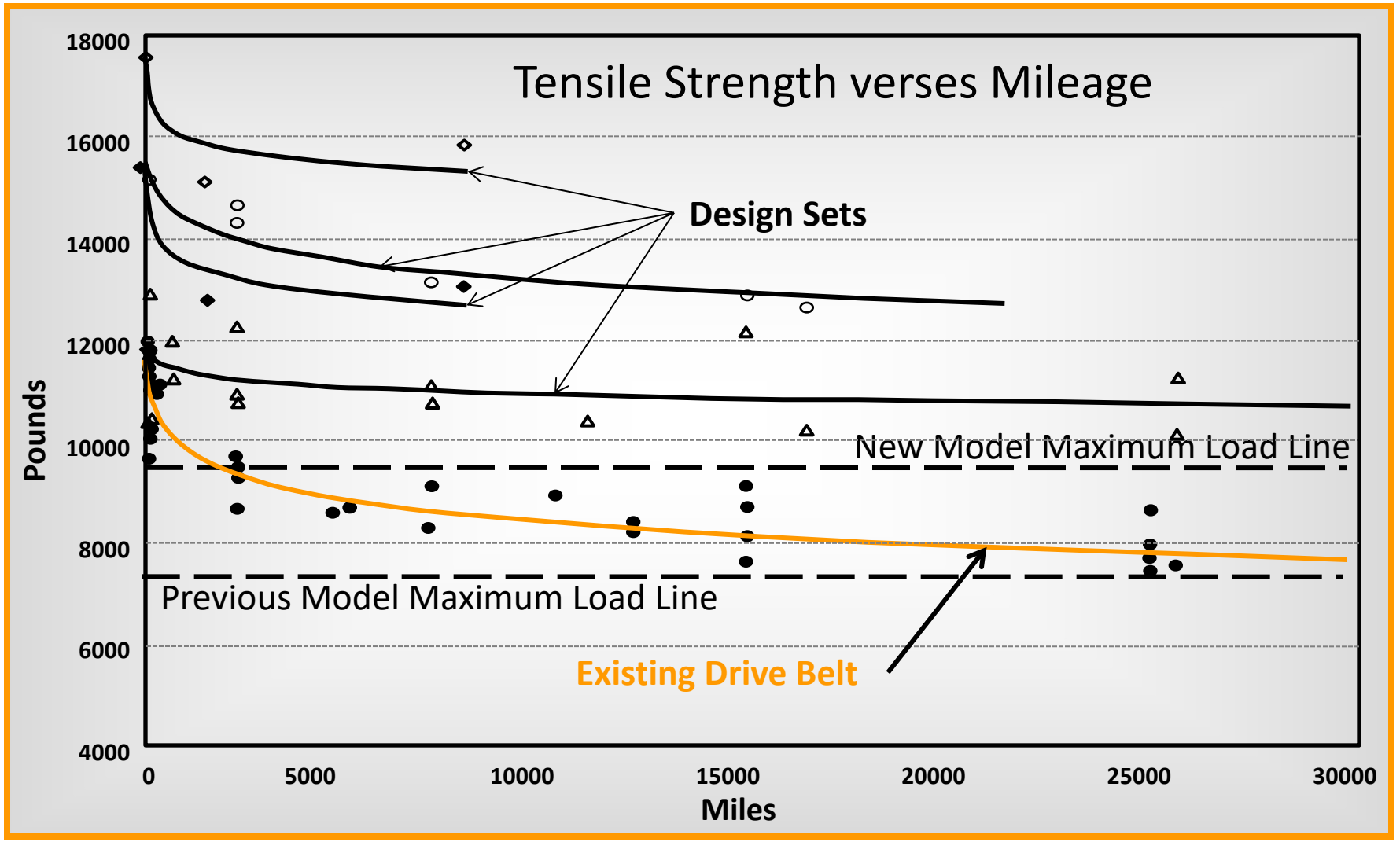
A CLOSE CALL WITH A RECALL



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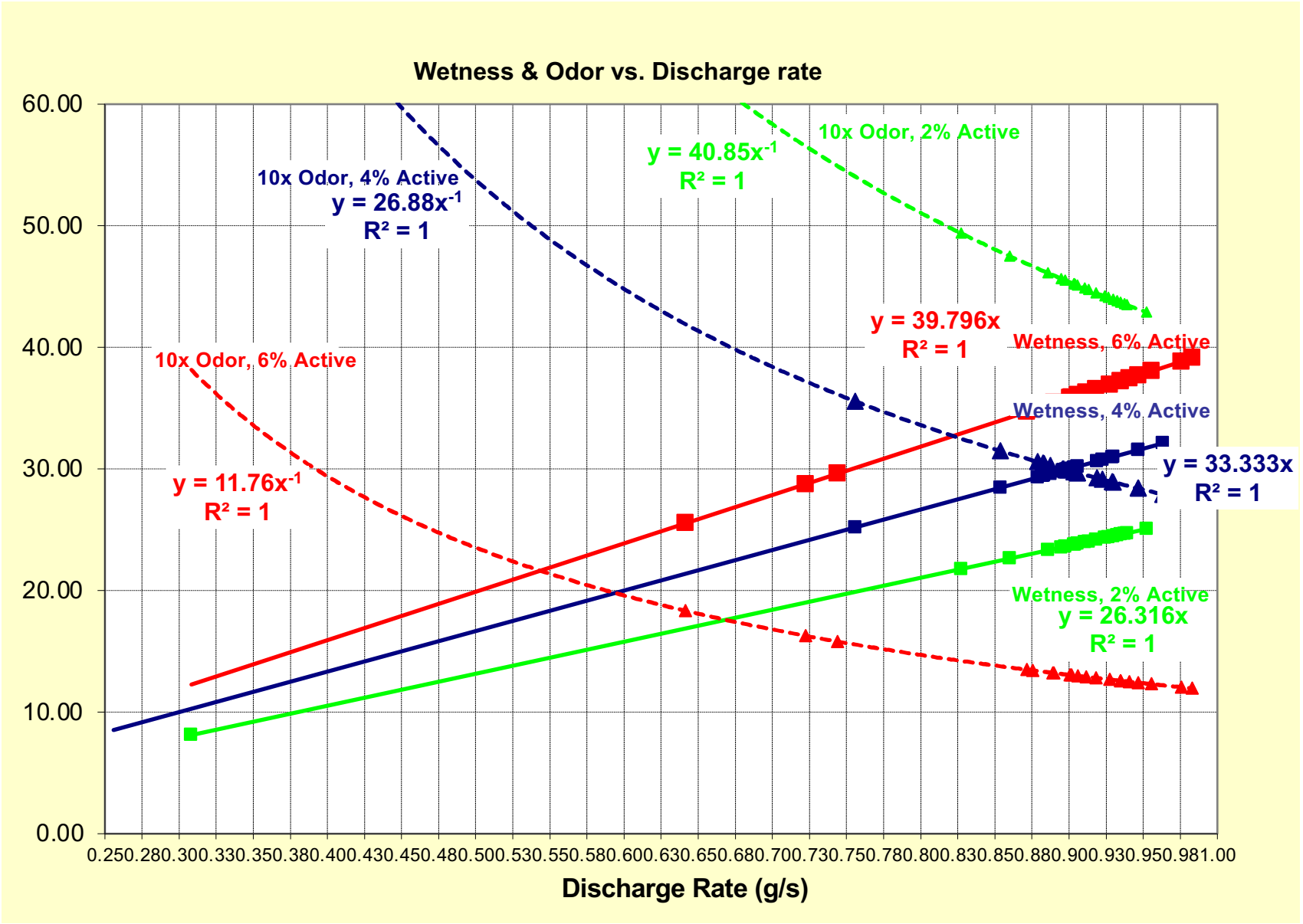
A STORY ABOUT ANTIPERSPIRANT



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A RUSTY CAN

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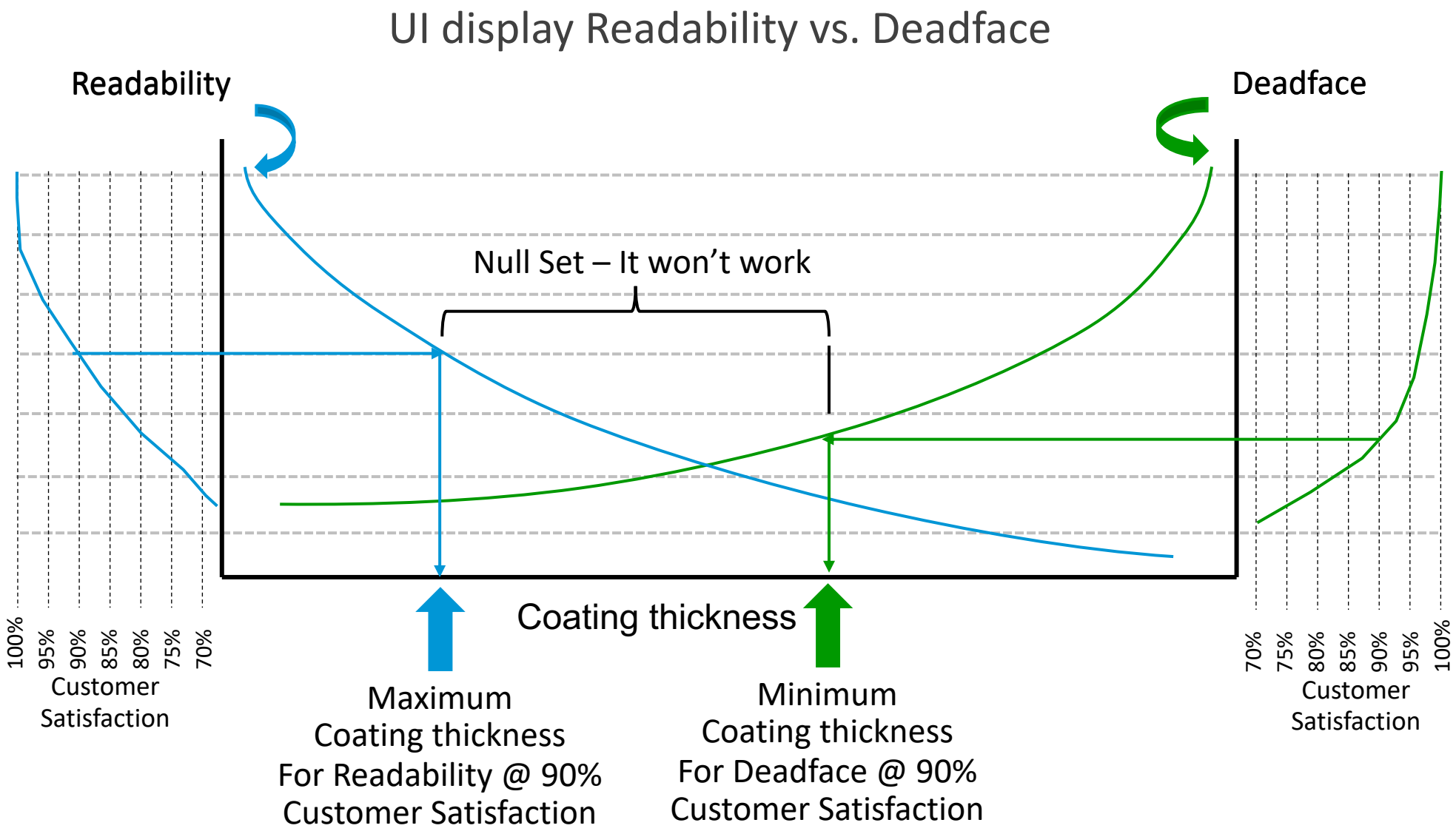
CREATING VISIBLE & REUSABLE KNOWLEDGE



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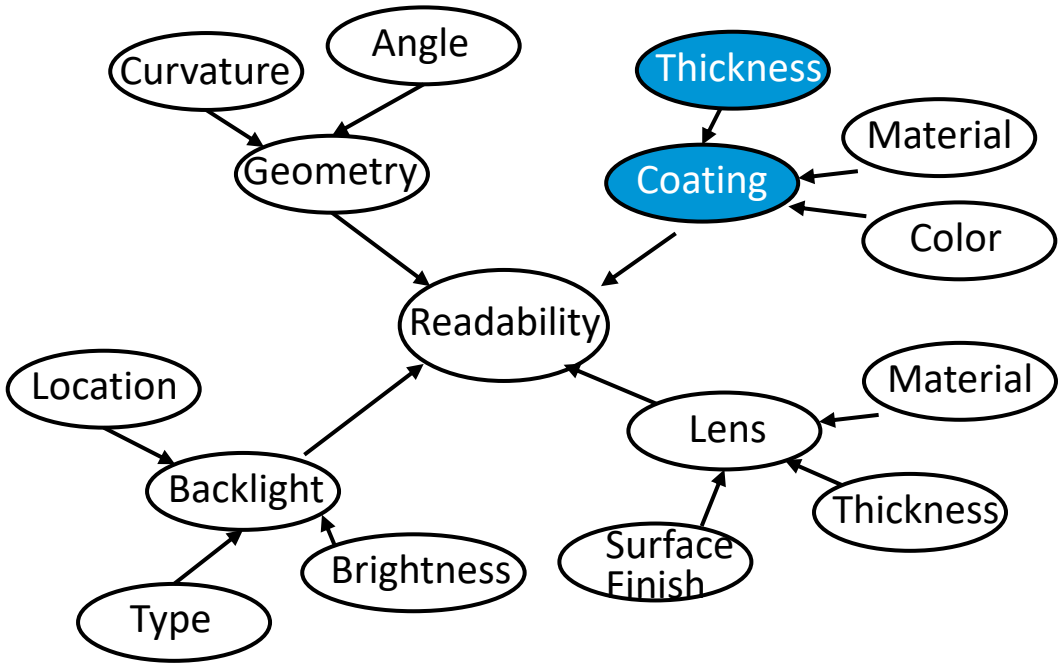
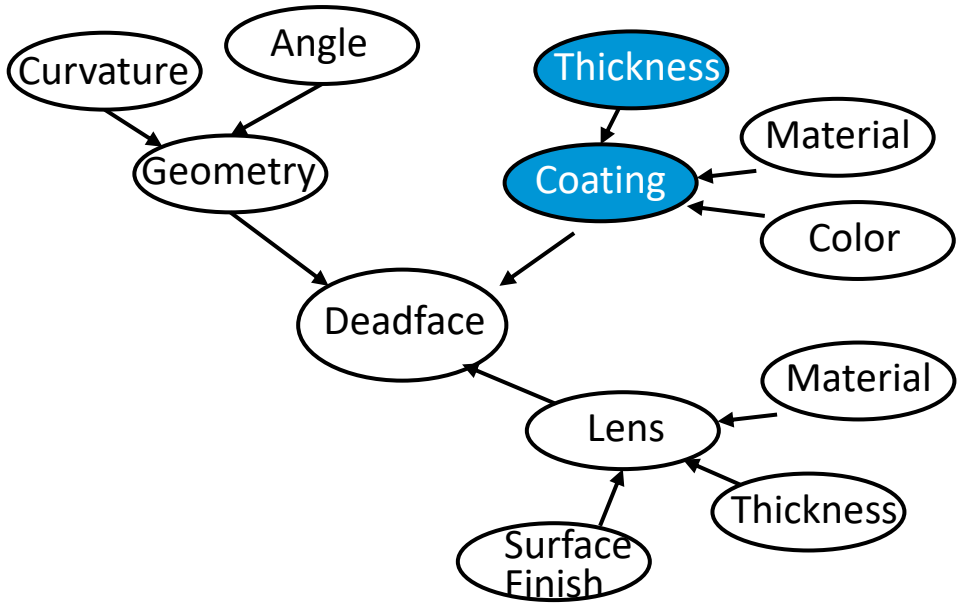
CREATING VISIBLE & REUSABLE KNOWLEDGE

Causal Diagram: UI display Readability vs. Deadface

Readability



Deadface



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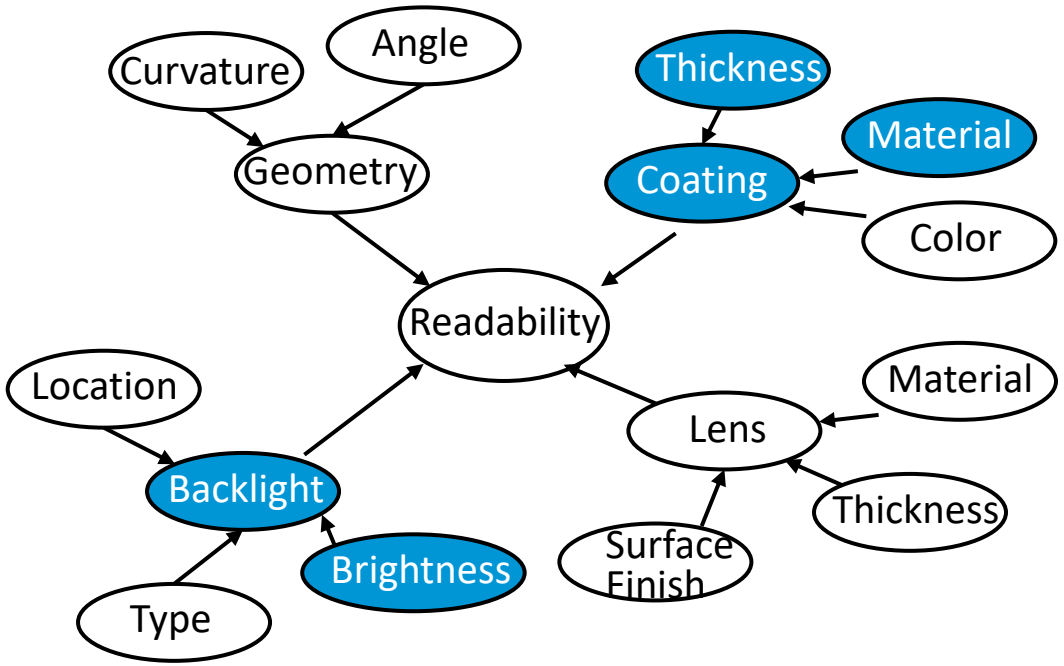
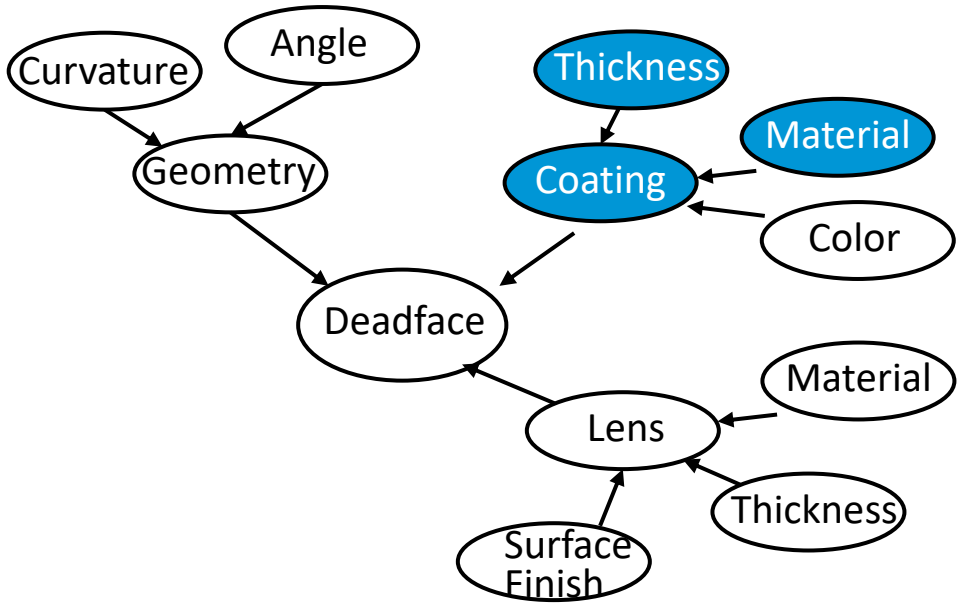
CREATING VISIBLE & REUSABLE KNOWLEDGE

Causal Diagram: UI display Readability vs. Deadface

Readability



Deadface



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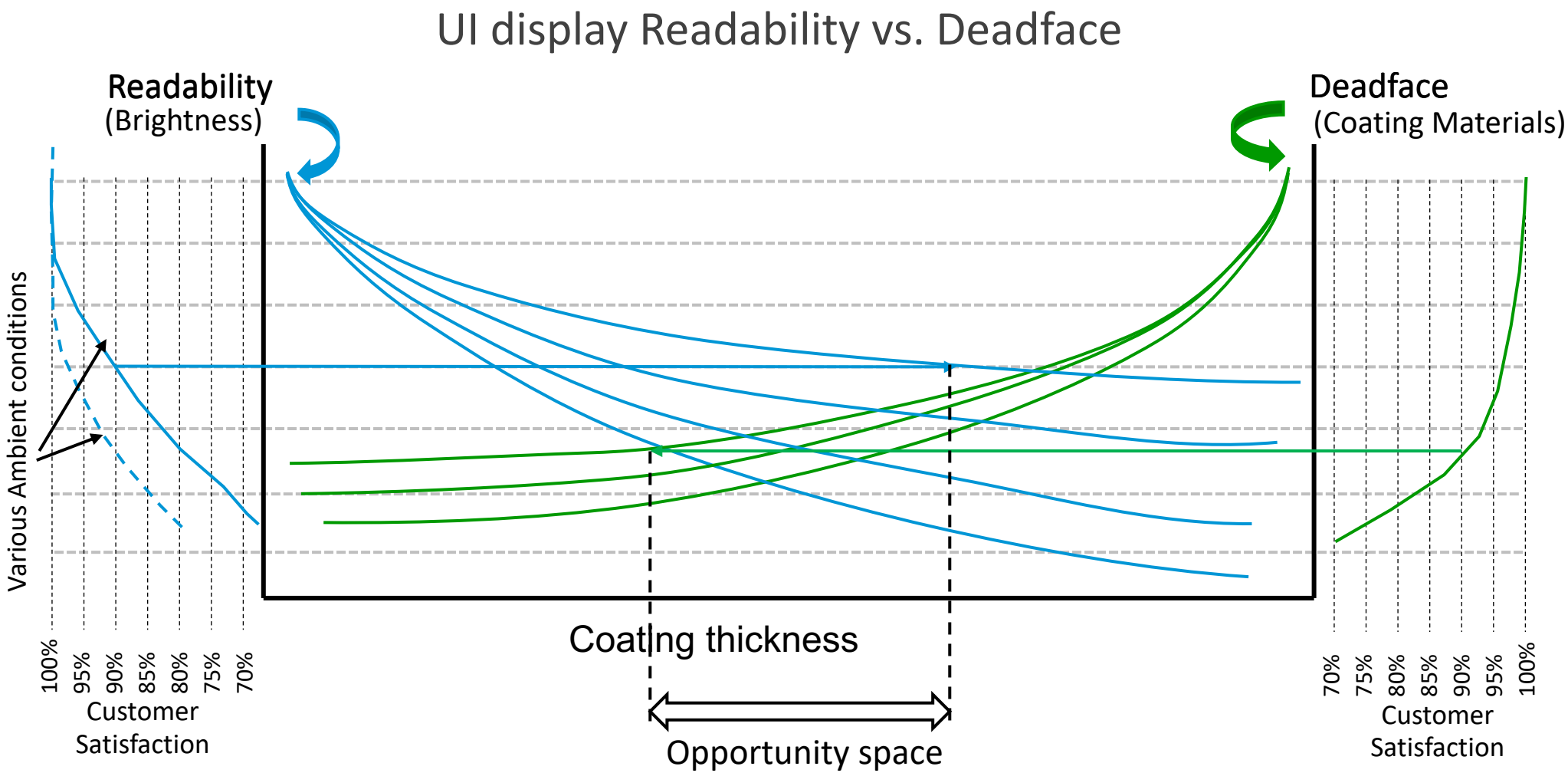
CREATING VISIBLE & REUSABLE KNOWLEDGE



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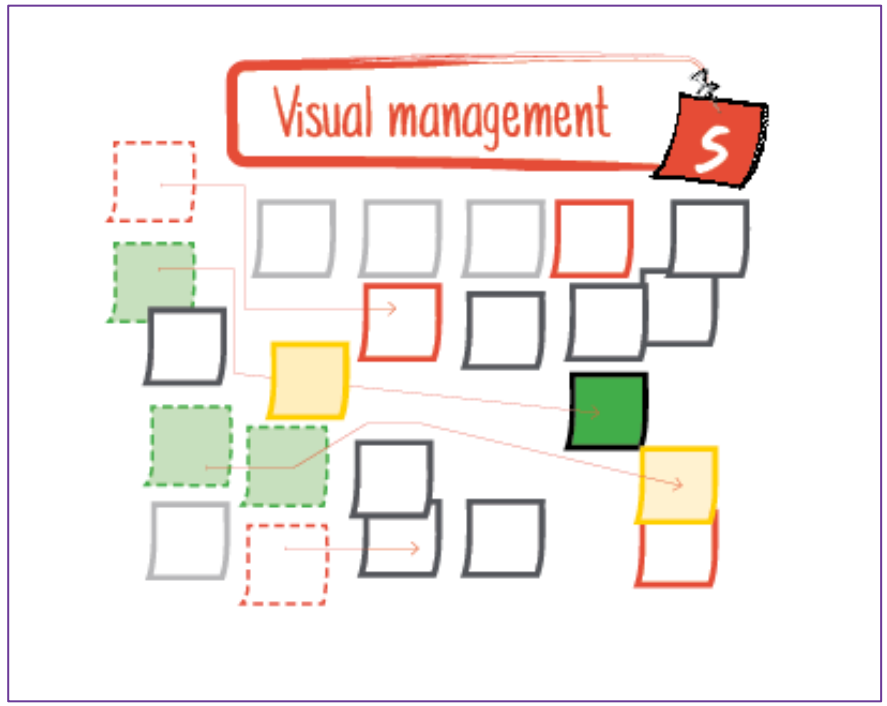
VISUAL MANAGEMENT



One of the greatest challenges in a development organization involves the dynamics of the ever-changing work environment

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VISUAL MANAGMENT

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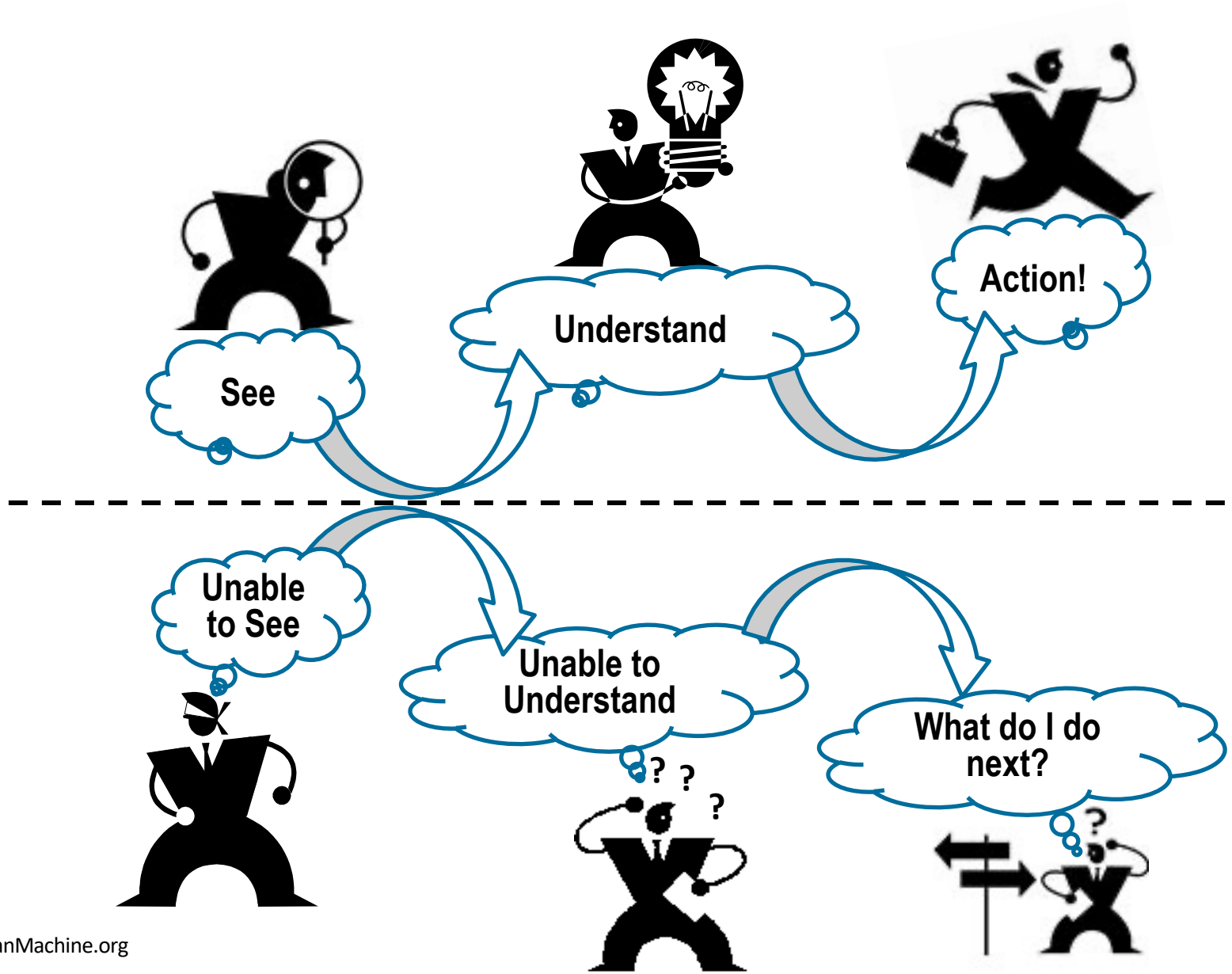
BASIS FOR VISUAL MANAGMENT



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YELLOW TAPE

Visual

‘Seeing the work’ & ‘Seeing the issues’

Management *(Help Chains)*

Clear accountability for
problems, escalation, & resolution

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4 Habits of Highly Effective Organizations

- Design & Operate systems that show abnormalities.
- Quickly solve problems & Improve the System.
- Create learning & share learning.
- Leadership responsible for system & development of people.

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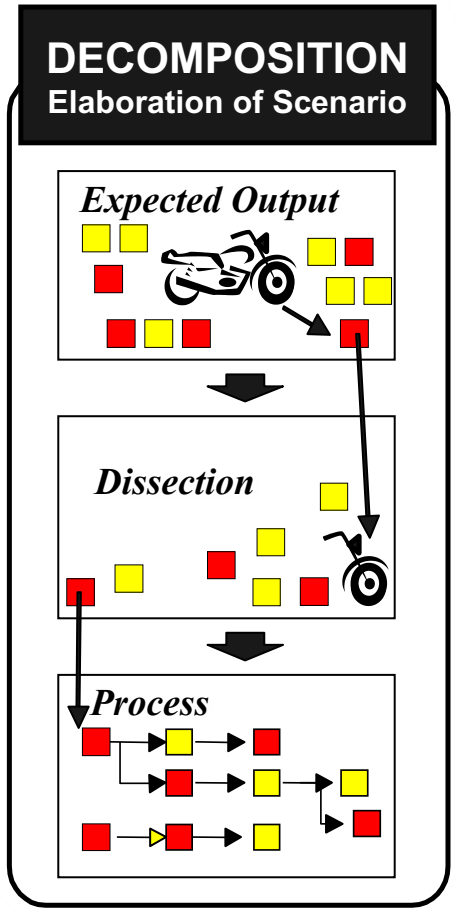
VISUAL MANAGEMENT

Leadership Board



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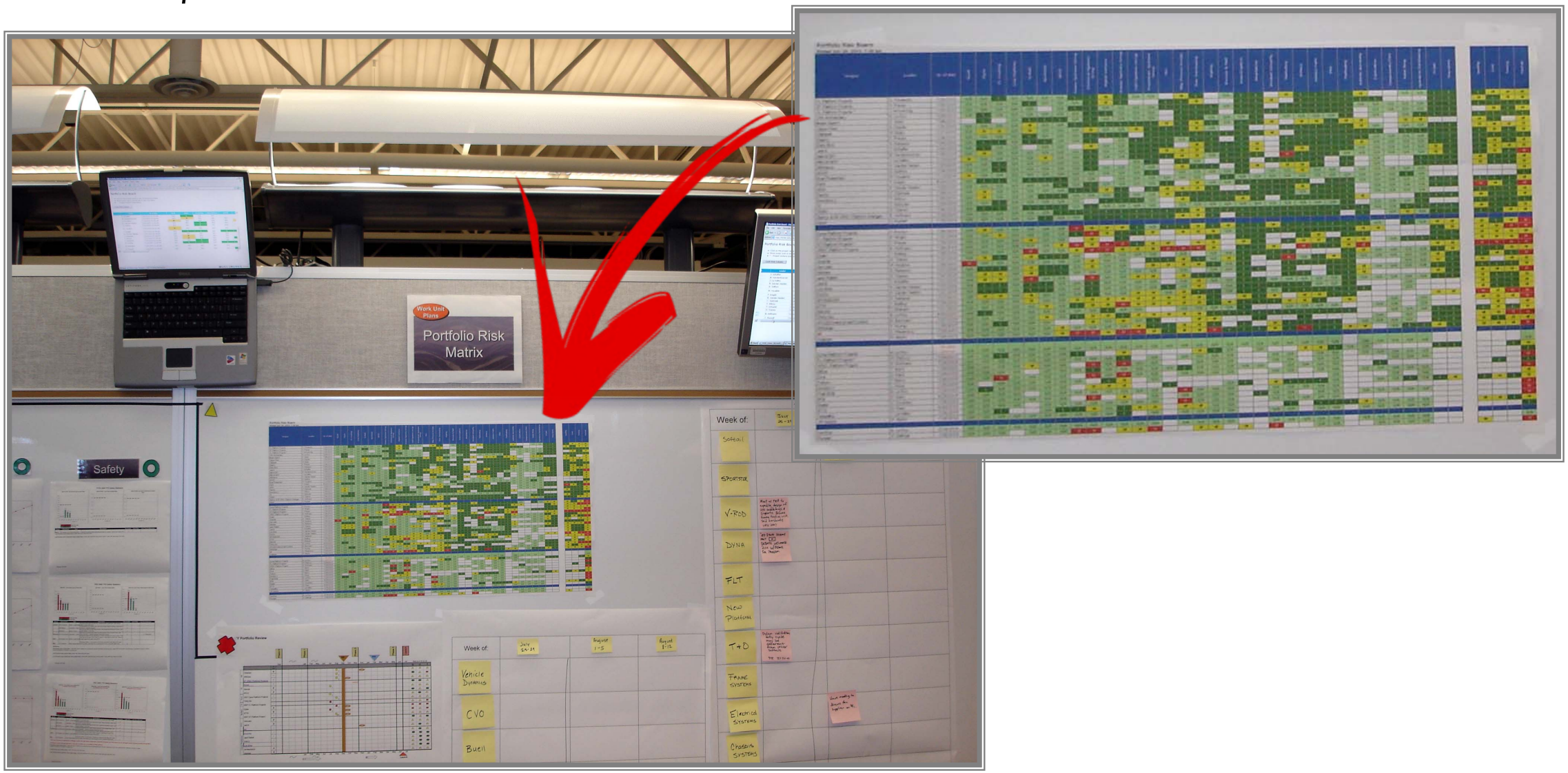
VISUAL MANAGEMENT

Leadership Board



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STRUCTURE OF LEAN WALL: 1st LEVEL

Visual Control Indicator by Leader
- / : Complete
- ● : OK
- X : Problem

Objective

- Company Objective
- PD Objective
- PD Goals

Metrics

- Quality
  - Platform
    - XL — Target 1 2 3 - 12 — Good
    - VRSC — Target 1 2 3 - 12 — Good
  - System
    - Chassis — Target 1 2 3 - 12 — Good
    - Frame — Target 1 2 3 - 12 — Good
- Cost
  - Platform
  - System
- Timing

Action Board

Long-term

	Objective	Responsible / Champion	Action	Jan Feb Mar– Dec
Deliver the Product Plan				
Respect and follow process guidelines				
Improve Effectiveness and Efficiency				

Monthly

1st week	2nd week	3rd week

Issue Board

Potential RISK	Issue	Finished

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ENTREPRENEURIAL SYSTEM DESIGNER

Even with all of the elements of Lean Product Development in place, it can not be successfully orchestrated without the conductor

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Entrepreneurial System Designers (ESD)

Even with all the elements of Lean Product Development in place, it can not be successfully orchestrated without the conductor

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How will I approach extreme leadership as it relates to Entrepreneurial System Designer

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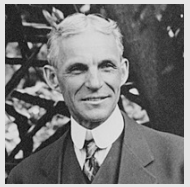
Characteristics of Successful Entrepreneurs

What are the characteristics of a successful entrepreneur?

Andrew Carnegie, Steel Tycoon

Bill Gates, Computers

Sara Blakely, Spanx



Henry Ford, Automobiles

Sir Richard Branson, Industrialist

Jeff Bezos, Amazon

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Characteristics of successful entrepreneurs

Entrepreneurs have the innate ability to understand the connection between the **customer need (*Value*)**, the **technical opportunity** and how to make **profit.**

Entrepreneurs are able to formulate a vision and successfully communicate it to engage others.

Entrepreneurs effectively organize and lead resources to execute their vision but do not delegate authority.

Entrepreneurs take complete ownership of their business …

- The Profit & the Loss
- The Success & Failure
- The End-to-End customer experience

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Entrepreneur System Designers (ESD)

Successful entrepreneurs are almost always superb *System Designers*

- They architect the complete operational *Value Cycle*

  Customers, Product, Manufacturing, & Supply Base

- They tie the fundamental arrangement of product and manufacturing systems to their vision of serving the customer

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Entrepreneurial System Designers – The Model

Successful manufacturing or technical entrepreneurs are almost always superb system designers: that is, they architect the complete operational value cycle, tying the fundamental arrangement of product and manufacturing system to their vision of serving customers.

Entrepreneurs understand the connection between *customer need*, *technical opportunity* and *profit*. They are able to formulate a vision and successfully communicate it to engage others They are able to organize, inspire, and lead resources to execute their vision.

System designers define the fundamental architecture of the complete system or value cycle (customers, product, manufacturing system, and supply base) help team members communicate their expertise to each other and orchestrate the combination of all the elements into a superior whole. They are like the conductors of great symphonies. They apply the LAMDA cycle to the “big picture”.

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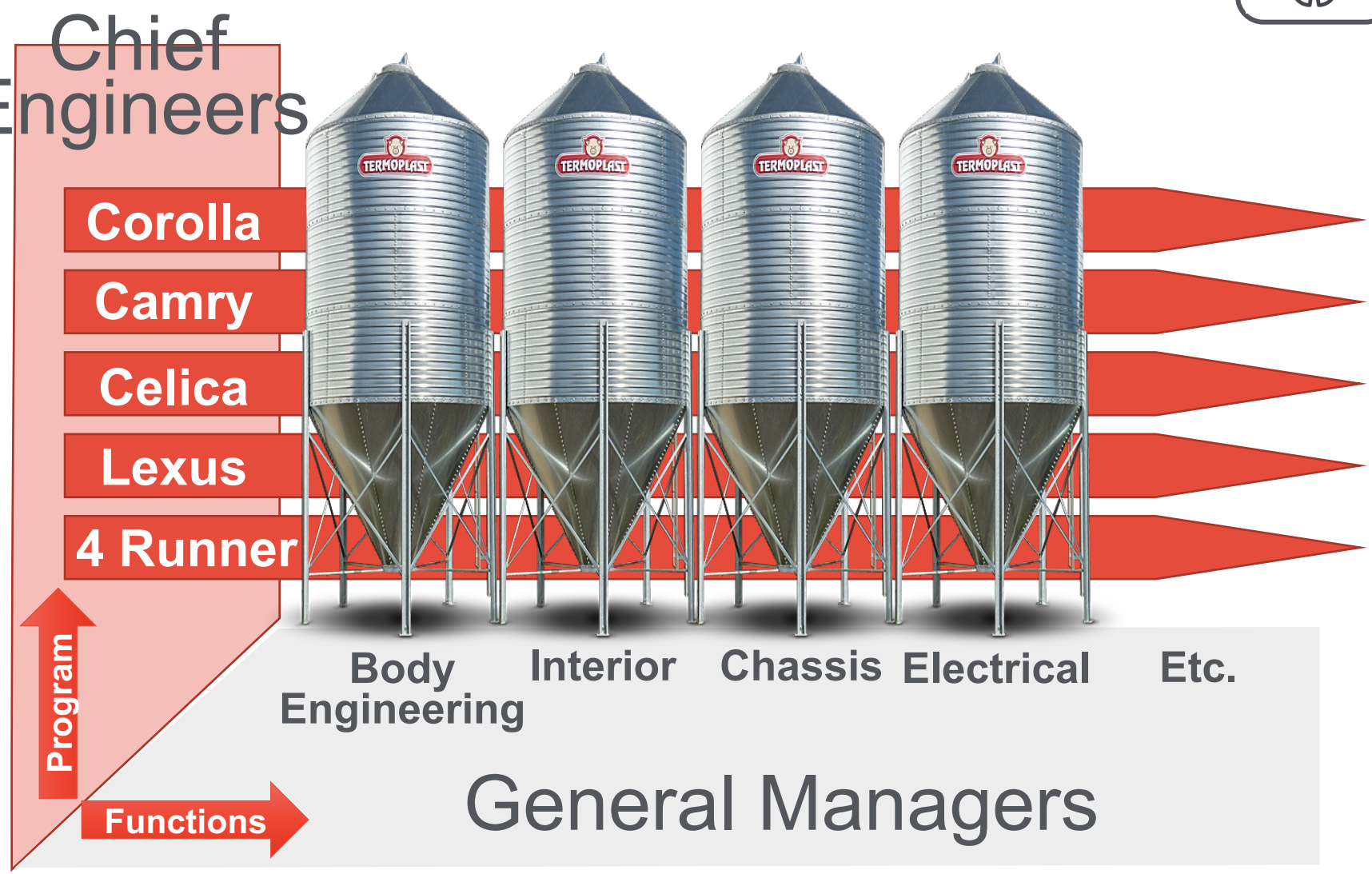
Entrepreneur System Designers (ESD)

Each vehicle line is led by a Chief Engineer



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Entrepreneur System Designers (ESD)

At Toyota, 'It is the Chief Engineer's car'

- The chief engineer leads a small, dedicated team that creates the product concept, develops the business case, leads the technical design of the product, manages the development process, coordinates with production engineering and sales/marketing, and takes the product into production.

- Their most important responsibility is to integrate the work of the development team toward a coherent and compelling vision for the product.

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Entrepreneur System Designers (ESD)

Chief Engineers have strong technical skills coupled with excellent ‘Soft Skills’

- Chief engineers do not directly supervise the developers who work on their products.
- Most members of the development team report to managers within their own functional units.
- The organizational structure sets up a natural tension between the project leader (who wants to realize his product vision) and the functional units (who understand intimately what is possible).

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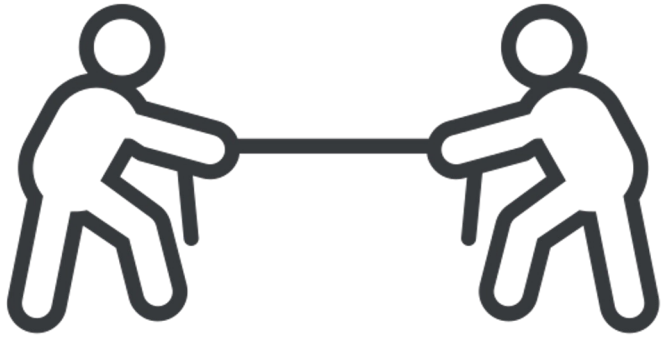
Tension creates great products



Creative tension is a source of innovation as the project leaders continually push the organization into new territory based on market needs, while the functional units try to keep the project leaders true to the organization's technological capabilities.

This is referred to as the ‘Entrepreneur System’

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Entrepreneur System Designers (ESD)

Select leaders based on their personal characteristics:

- ➤Their Business & Technical Vision
- ➤Their Passion
- ➤Their ability to communicate across functional boundaries
- ➤Their ability to identify simple essence of anything
- ➤Their ability to get things done

Choose people who want to create new products more than anything else.

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Entrepreneur System Designers (ESD)

Like an Entrepreneur: leads like a founder, behaves as if home and family future is on the line
Close to the Customer: leads "close to the customer" activities and deliverables on new projects
Provides Vision: creates and communicates compelling and feasible vision
Path to Profit: has deep understanding of business model and leads trade-offs required to meet biz goals
Design the Value Stream: leads across value stream, making changes required to profitably succeed in market
Provide Technical Leadership: defines path to creating an architecture that is feasible and meets customer & business needs
Project Leader: sets scope, schedule, resources and development process (Embraces "Dynamic Planning" to keep moving ahead.)

Signs of ESD

- Engineers and managers on the team give same answer when asked "Who makes the customer, technology, business trade-off decisions?"
- ESD define the fundamental architecture of the complete value cycle (customers, product, manufacturing system, and supply base)
- ESD understand the connection between customer need, technical opportunity and profit.
- ESD effectively formulate and communicate a vision and organize and lead resources.
- Compensation is tied to delivering solutions that improve NPS, revenue and profit
- The ESD has clear product-oriented responsibilities established through combined responsibility, knowledge, action and feedback for product lines, products and sections of the product and manufacturing system.
- The ESD clearly understands the connection between customer need, technical opportunity and profit.
- ESDs formulate and communicate a vision, then organize and lead resources to execute their vision.
- ESDs define the fundamental architecture of the complete system or value cycle (customers, product, manufacturing system, and supply base)
- ESDs treat products as their own creations, rather than the outcome of a bureaucratic process, and demand that the organization support them in this.
- ESDs who do well are kept in place through multiple projects.
- ESDs are responsible for ROI (return on investment) and meet frequently with top executives to discuss the relationship between their projects and the whole business.
- ESDs:
  - Formulate the product vision
  - Define targets
  - Represent customers
  - Design the system (product and operational value stream)
  - Design and manage the development process
  - Negotiate for resources and the support of senior management
  - Manage the development of rough consensus
  - Maintain a model of "expected" ROI and cash flow that considers the possibility and costs of failure
- ESDs help team members communicate their expertise to each other and orchestrate the combination of all the elements into a superior whole.
- ESDs apply the LAMDA cycle to the "big pictures".

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Entrepreneurial System Designers – The Model

Conventional and bureaucratic companies usually force these people underground because they are poor bureaucrats: they won't follow rules and they care more about their dreams than promotion, metrics or their bosses' tastes. If you work in a large, mature company you will have to look for these individuals carefully, provide training and provide support and a willing ear. (It is easier to find an entrepreneur and a system designer independently than the combination in one person. It can be very effective to team them up.)

Eliminate barriers to the entrepreneur system designers. Development of project and business line leaders is crucial to project or business line success. They need most of the skills and qualities of those who originally create companies.

Select leaders on their personal characteristics: their business and technical vision and passion, their ability to synthesize complete systems, their ability to communicate across functional boundaries, their ability to identify the simple essence of anything and their ability to get things done. Choose people who want to create new products more than they want anything else. (Actually, these people will select themselves, given the opportunity: you really only need to eliminate the organizational barriers to their emergence.)

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One hell of an ESD and leader*

ESD-specific leadership is demonstrated through 24 behavioral traits

Demonstrating emotional intelligence	Dealing with engineering change	Maintaining an awareness of cultural differences
Representing the voice of many	Showing enthusiasm	Showing accountability
Being the box top	Learning continuously	Becoming a master of risk
Getting a mentor / being a mentor	Serving as a technical authority	Promoting innovation
Demonstrating knowledge of systems engineering	Maintaining fairness	Building a team
Being the adult in the room	Managing yourself	Having the ability to adapt
Acting as the lead technical integrator	Employing sound engineering judgement	Ensuring technical and business excellence
Negotiating solutions	Being good at both tactics and strategy	Having fun and showing it

*** From "Three Sigma Leadership" – Leadership Skills for NASA's Corps of Chief Engineers by Steven Hirshorn**

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TEAMS OF RESPONSIBLE EXPERTS

Create Empowered Teams of Responsible Experts with Clear Focus

Be a team player –
and work hard to be the best at your position

Dantar@TheLeanMachine.org

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TEAMS OF RESPONSIBLE EXPERTS

Develop empowered teams of responsible experts

- Organize around Product and Process technologies that are critical for the organization's competitive advantage. Consider the Functional blocks of the organization.
- Utilize these units to develop visible, reusable knowledge according to their respective areas of expertise.
- Grow people who can generate new knowledge, apply that knowledge, and effectively communicate their knowledge across multidisciplinary teams.

First and foremost – Be a *team player* …

… make sure you are the best at your position

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TEAMS OF RESPONSIBLE EXPERTS

Just like a surgical team is focused on their patient, teams of responsible experts focus on the customer.

Teams are Cross-functional with each person Accountable and Committed to their Common Goals; the success of the patient or the customer experience.

Surgical teams have all the skills necessary to complete the surgery. Teams of responsible experts are fully empowered with all the skills necessary to define, build, test, and deploy operational value cycles based on a predetermined, synchronized cadence.

Teams succeed or fail together.

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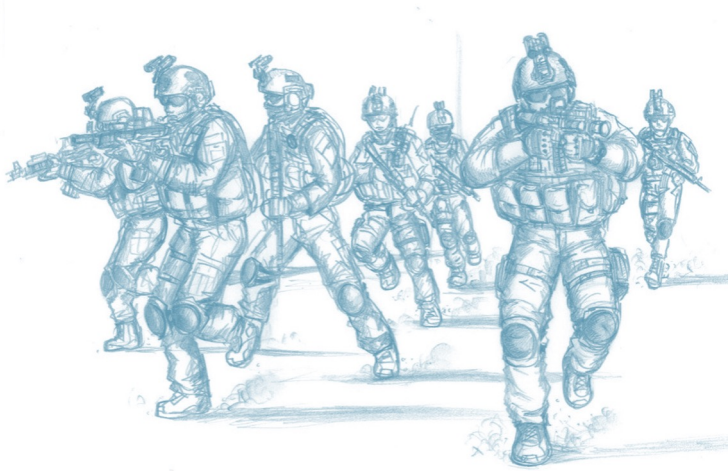
TEAMS OF RESPONSIBLE EXPERTS

Teams of responsible experts practice '*Dynamic Subordination*' similar to elite military forces. It is a technique easy to understand intellectually but harder to implement culturally.



Although there is a 'formal' leader, the person who knows what to do next - who's expertise is most relevant - leads. Teams are entirely non-hierarchical this way. In a combat environment, when split-seconds matter, there's no time for second-guessing. When someone steps up to lead, everyone, immediately, automatically, follows.

This '*Dynamic Subordination*', where leadership is fluid and defined by conditions on the ground, is the foundation of accessing the performance potential of group flow, speed, and agility.

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TEAMS OF RESPONSIBLE EXPERTS

To ingrain '*Dynamic Subordination*' into operational culture requires breaking with traditional corporate protocols. Positional authority carries less weight than individual capability. *(Note: Toyota strives for this, but many of their problems are caused by the conflict between this ideal and traditional Japanese subservience to authority.)*

To fully experience the power of dynamic subordination, you have to be willing to constantly deconstruct static hierarchies. From the subtle things, like varying who facilitates meetings or sends out calendar invites, to the bigger things, like who claims airtime in strategy sessions or participates in hiring and review processes, you have to repeatedly upend the comfortable conventions of traditional company culture.

… But – it is the only way to win.

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TEAMS OF RESPONSIBLE EXPERTS

A jazz ensemble works because the members work together. With just a backbeat rhythm each musician improvises based on a common theme which ties them together. No musician is more important than another, collectively creating music greater than the sum of the individuals.

Similarly, teams of responsible experts are made up of individuals with deep capability in their specialty tied to a common development cadence or rhythm. Each individual improvises as needed to ensure overall success. Team members develop a ‘T’ expertise; deep in their specialty and broad to understand their part as a whole to the team

Development is a team sport.

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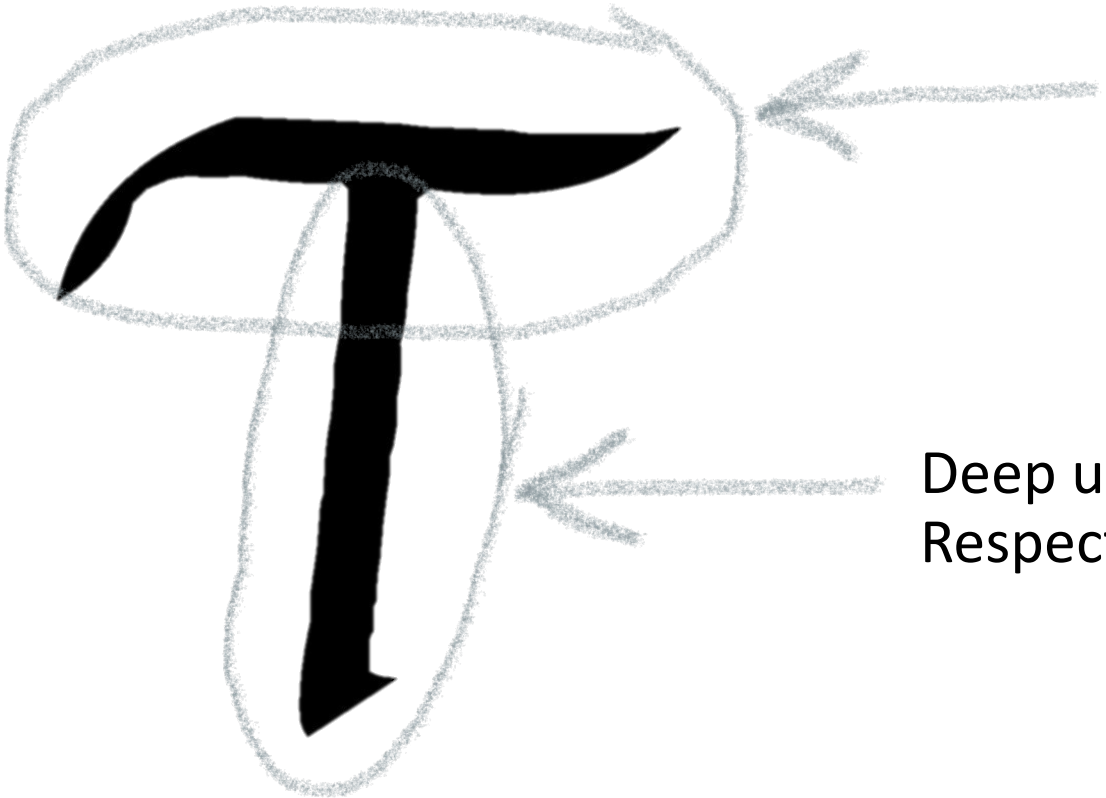
TEAMS OF RESPONSIBLE EXPERTS

Developing Experts for Teams



Broad understanding to understand how they fit in the whole larger picture – The company, the project, and how they impact the customer.

Deep understanding in their area of specialty.
Respected experts in their field.

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MANUFACTURE CUSTOMERS

Creating an effective product plan and development portfolio requires intimate closeness to the customer.

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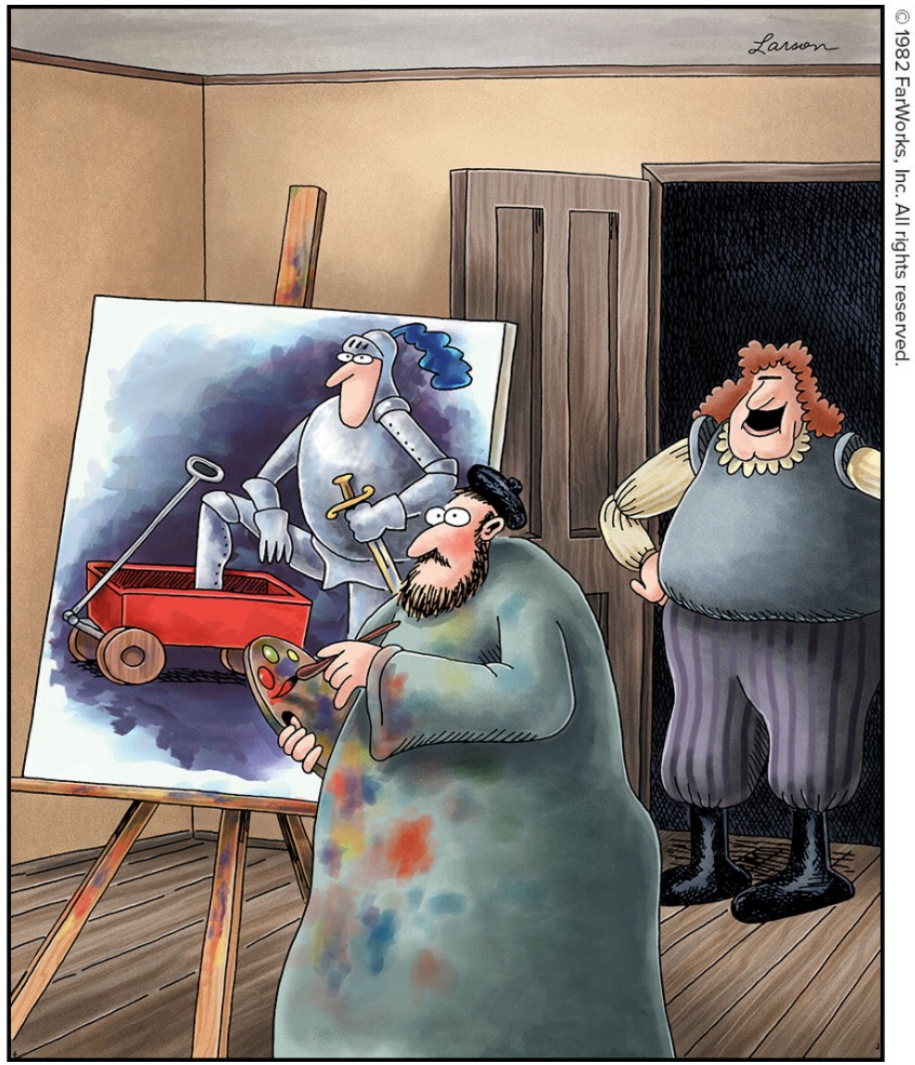
CLOSE TO THE CUSTOMER

How do we ensure we clearly understand what customers want?

How do we use that knowledge & connection to Manufacture Customers?



"So, Andre! ... The king wants to know how you're coming with *St. George and the Dragon.*"

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CLOSE TO THE CUSTOMER

- Close to the customer is the foundation of excellence in development of products & product planning.

- Close to the customer is not Focus groups . . .
  — It's living with the customers!

For Harley-Davidson, even though they are deeply involved in their customers' riding experience, customers are often unaware of the influence and impact they have on developing that very experience.

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CLOSE TO THE CUSTOMER

"We ride with you!"

Willie G.

— ***Willie G. Davidson***

Define VALUE from the customers' point of view

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Close to the Customer– External Examples

Motorcycles:

At rallies, Harley-Davidson sponsors ‘ride-in’ shows where people show the modifications to their bikes with the best bikes receiving prizes. The head of styling judges the shows.

Appliances:

In order to better understand the design implications of their products, Whirlpool created the *‘ride-along program’* where engineers and product developers ride along with independent service technicians on customer service visits. The program allows them direct interaction with customers to understand the customer, the product use environment, and the issues with their products without customers knowing they are dealing with Whirlpool engineers.

Consumer Products:

In development of shampoos and shower gels, Sanex created a program for developers to observe and collect direct feedback from customers about the way their products were being used as well as the effectiveness and customers’ likes and dislikes in real time while customers used the products.

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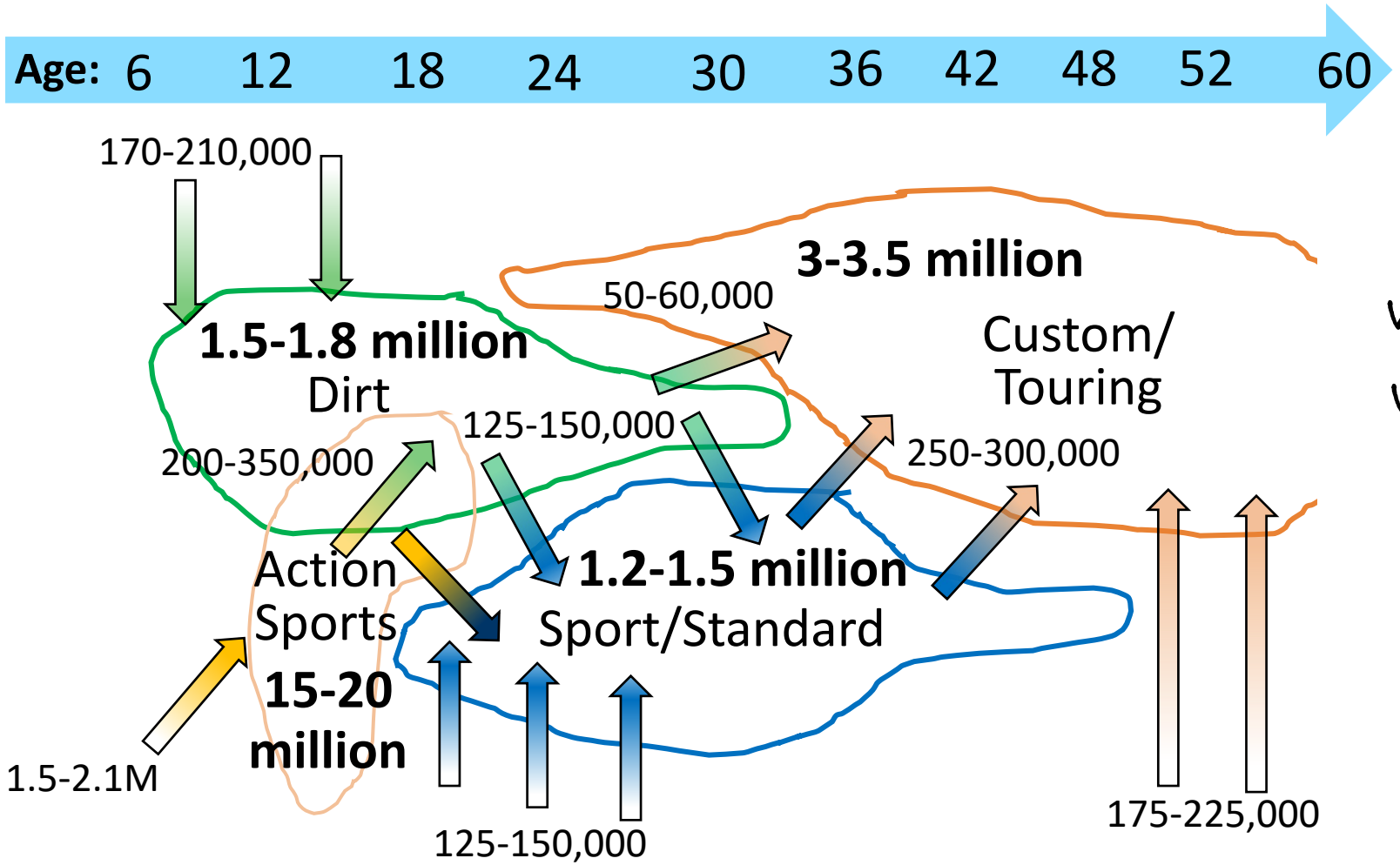
Manufacturing Customers

Once we know our customers –

How do we use this knowledge to *Manufacture Customers*



What are the Barriers?

What are the Exciters?

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Manufacturing Customers

New to Motorcycling: Segmentation – Converting *Dreamers*

Barrier: *Afraid or 'Don't know how to ride.'*

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Manufacturing Customers

New to Motorcycling: Segmentation - *Women*

Barrier: *Intimidated by the dealership*

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Manufacturing Customers

Segmentation – *Female & Inseam Challenged*

Barrier: *Size & Height of product*

Softail Deluxe - Lowest Seat height

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Manufacturing Customers

Exciter: *Early 'Imprinting'*

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Manufacturing Customers

Exciter: ‘Give them a reason to Ride’

- A world-wide program with local chapters
  (1 Million members in 90 countries)
- Local riding clubs run through dealerships
- International, National, Regional, and Local Events & activities

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Manufacturing Customers

Exciter: Building Bonds to create a ‘Lifestyle’

Building bonds, comradery, association, and belonging to a tribe creates a lifestyle
…. Creating a lifestyle creates passion and in turn a *’Lifestyle brand’*.

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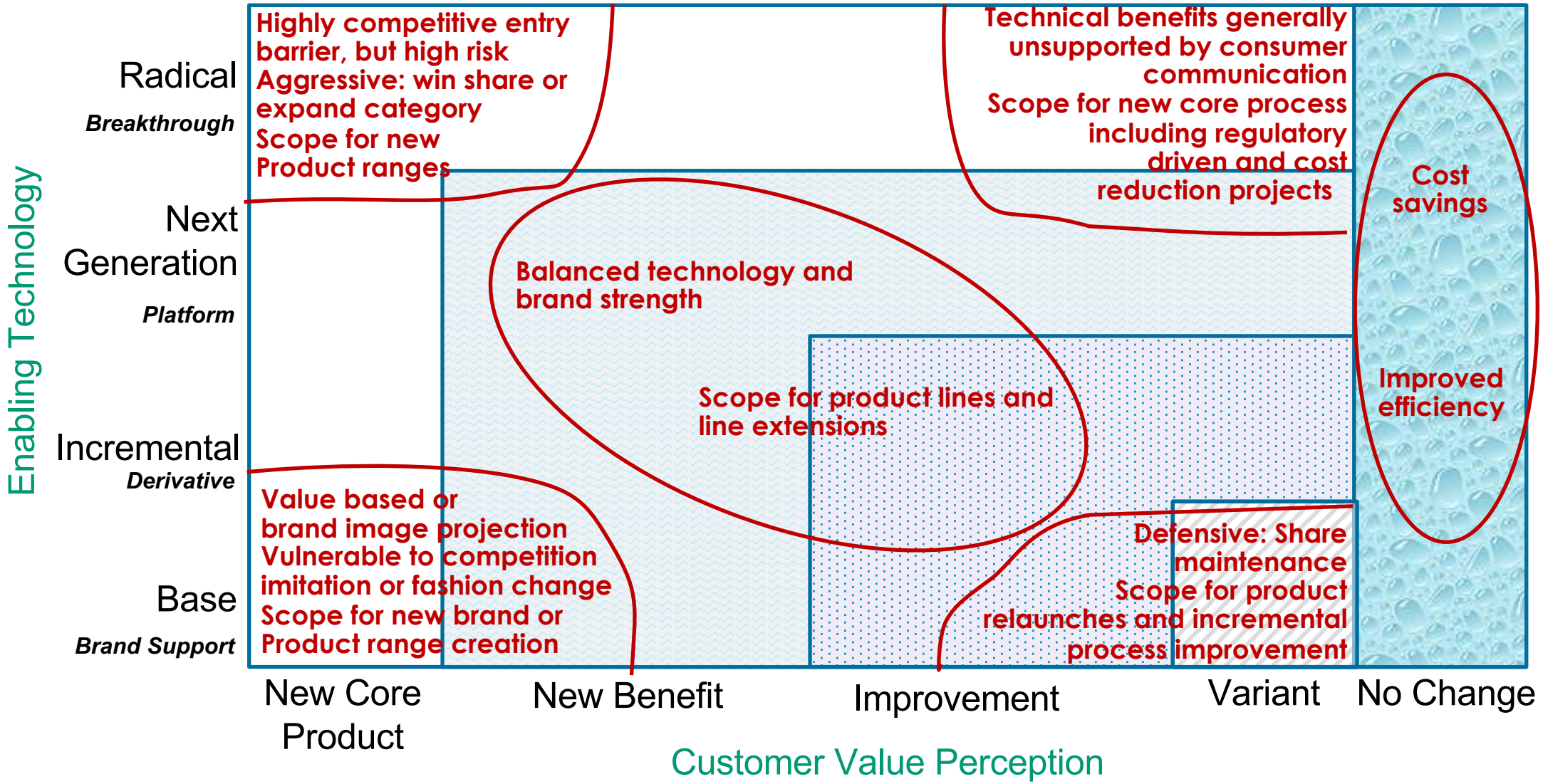
Manufacturing Customers

Consumer Technology Matrix (CTM)



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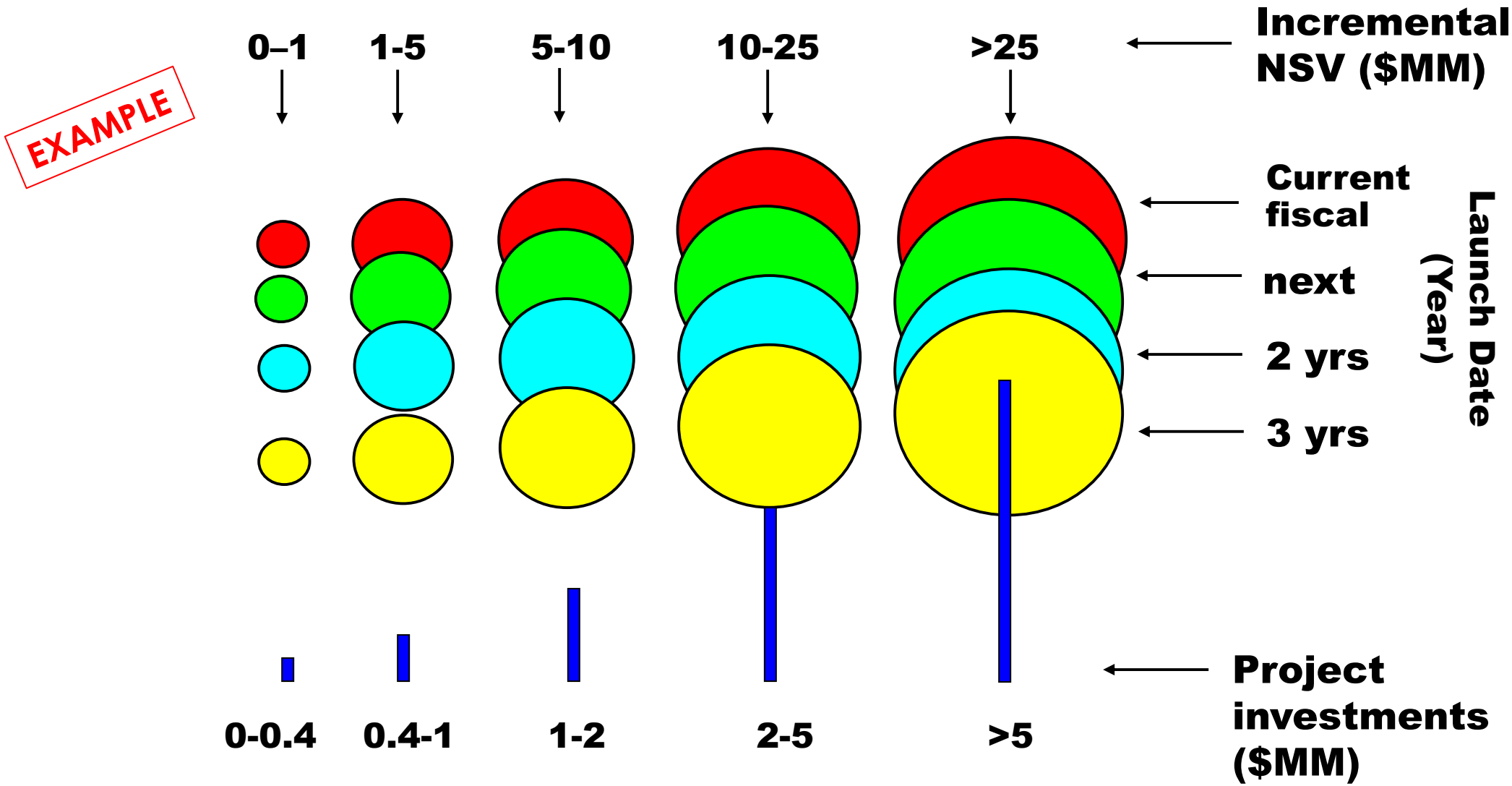
Manufacturing Customers

Consumer Technology Matrix (CTM) - Legend



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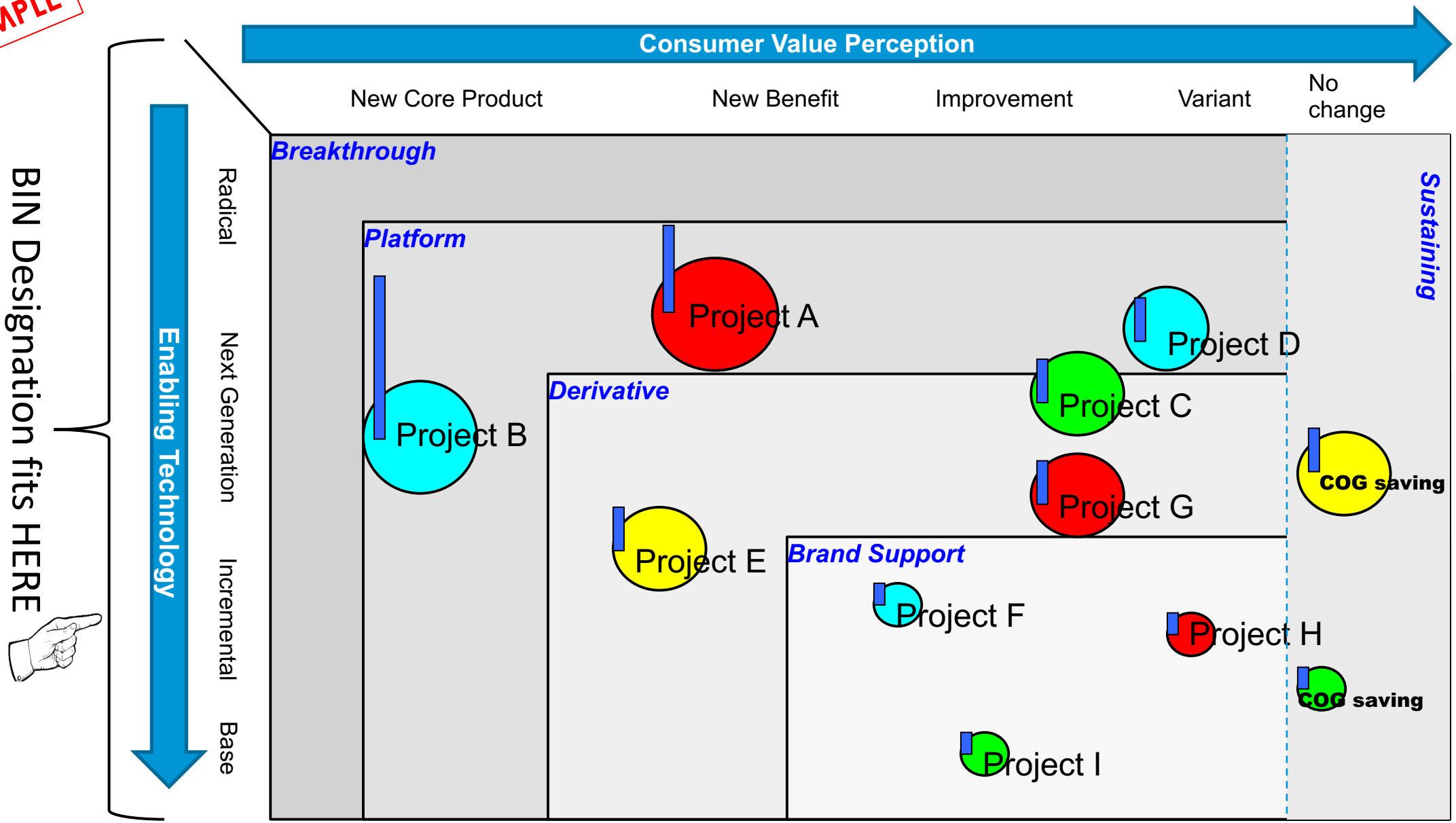
Manufacturing Customers - CTM

EXAMPLE



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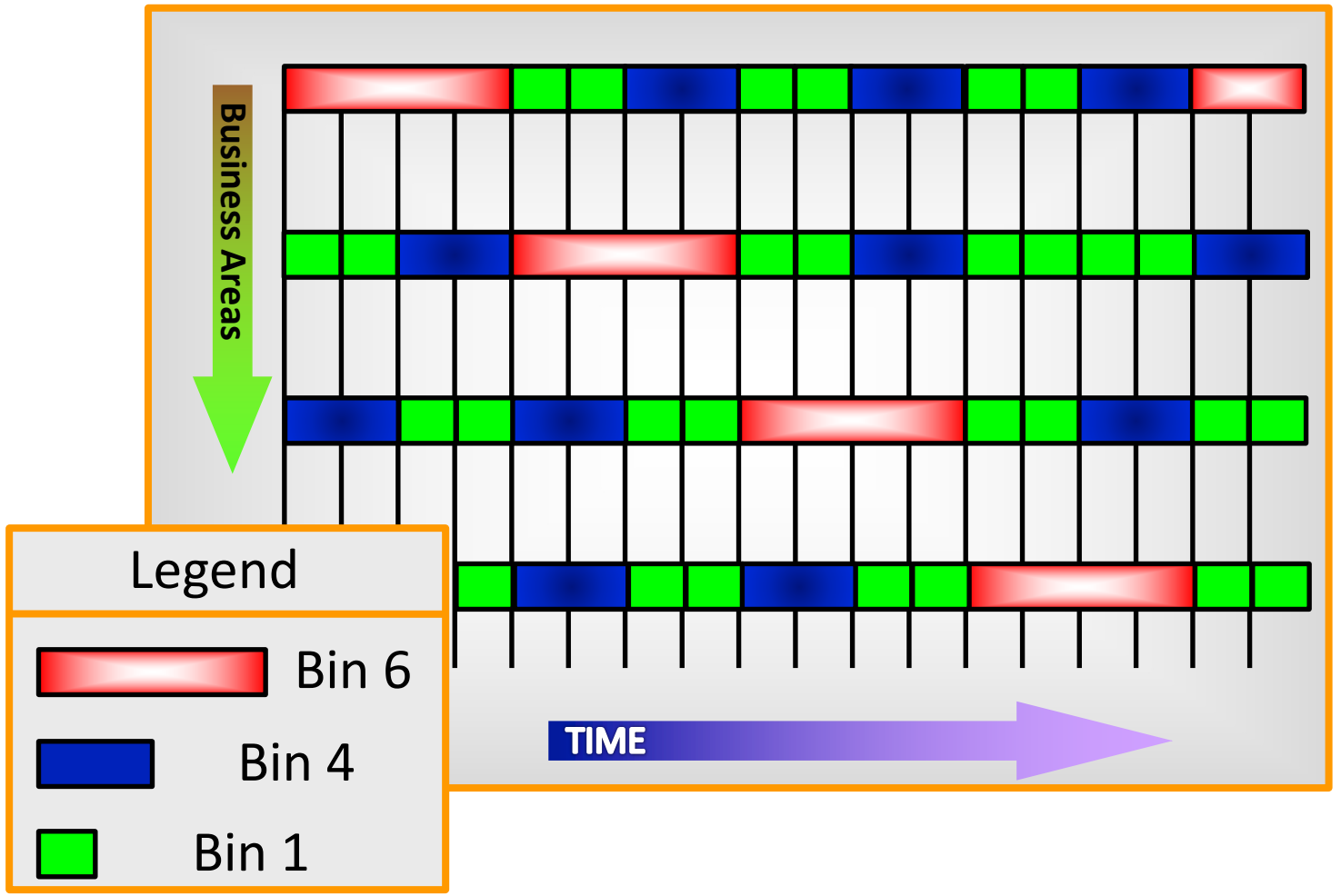
PORTFOLIO CADENCE, PULL, & FLOW

Portfolio Cadence



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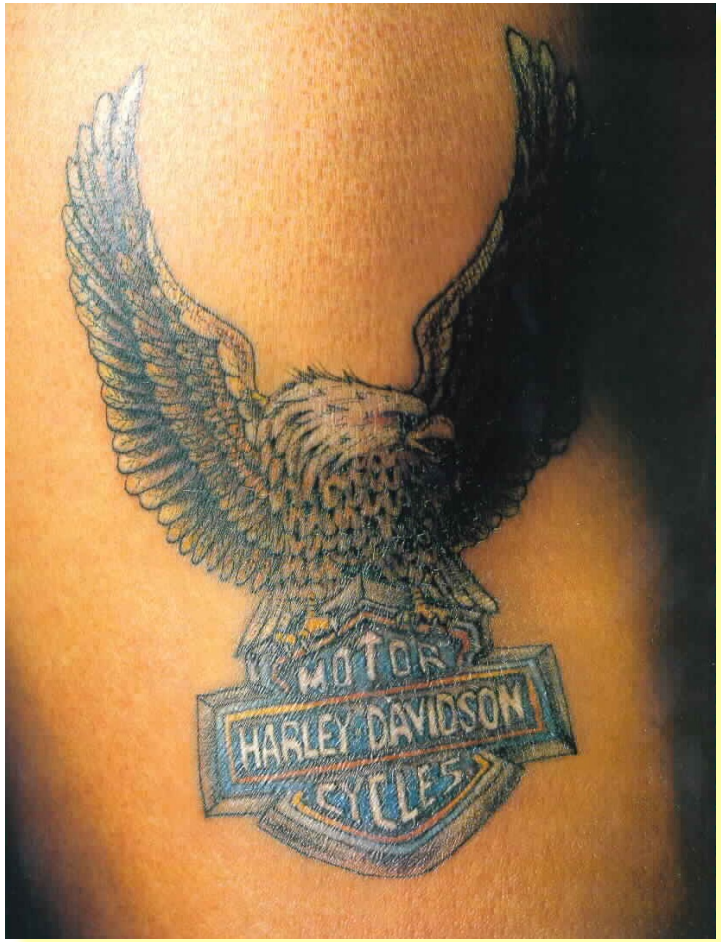
Manufacturing Customers – *for Life*

Passion creates very high switching cost



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BE THE CHANGE!

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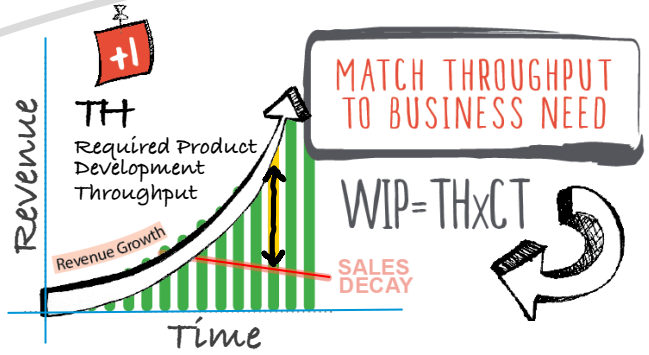
LEAN PRODUCT DEVELOPMENT (in a nutshell)

7 ESSENTIALS

PURSUE PERFECTION AND DRIVE IMPROVEMENT EVERY DAY



MATCH THROUGHPUT TO BUSINESS NEED

WIP=THxCT

Manufacture customers 1

Ideas

Bin 6 Bin 4 Bin 1

Portfolio cadence & flow 2

Visual management 5

Teams of responsible experts 7

Lead with entrepreneur system designers 6

Reusable knowledge 4

Limit and Trade-Off Curves

Causal Diagrams

Setbased 3

FIND LIMITS (RESEARCH)

REUSABLE KNOWLEDGE

INTEGRATION EVENTS

Detail, Mix, Match, Find more limits & Cull concepts

safe optimized design

LAUNCH ON CADENCE

PROACTIVE LEARNING CYCLES

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