



Innovation, TRIZ and Lean Product Development

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Presentation Outline

- **Innovation and Value Creation**
- **Theory of Inventive Problem Solving**
 - What is TRIZ?
 - Samsung Case Study
- **Lean Product Development**
 - The Nature of Product Development
 - Waste in Product Development
 - Toyota Product Development System
 - Voice of Customers
- **Open Discussion**

Innovation and Value Creation

Value Creation Map
Innovation Creation Map
Three Types of Innovation

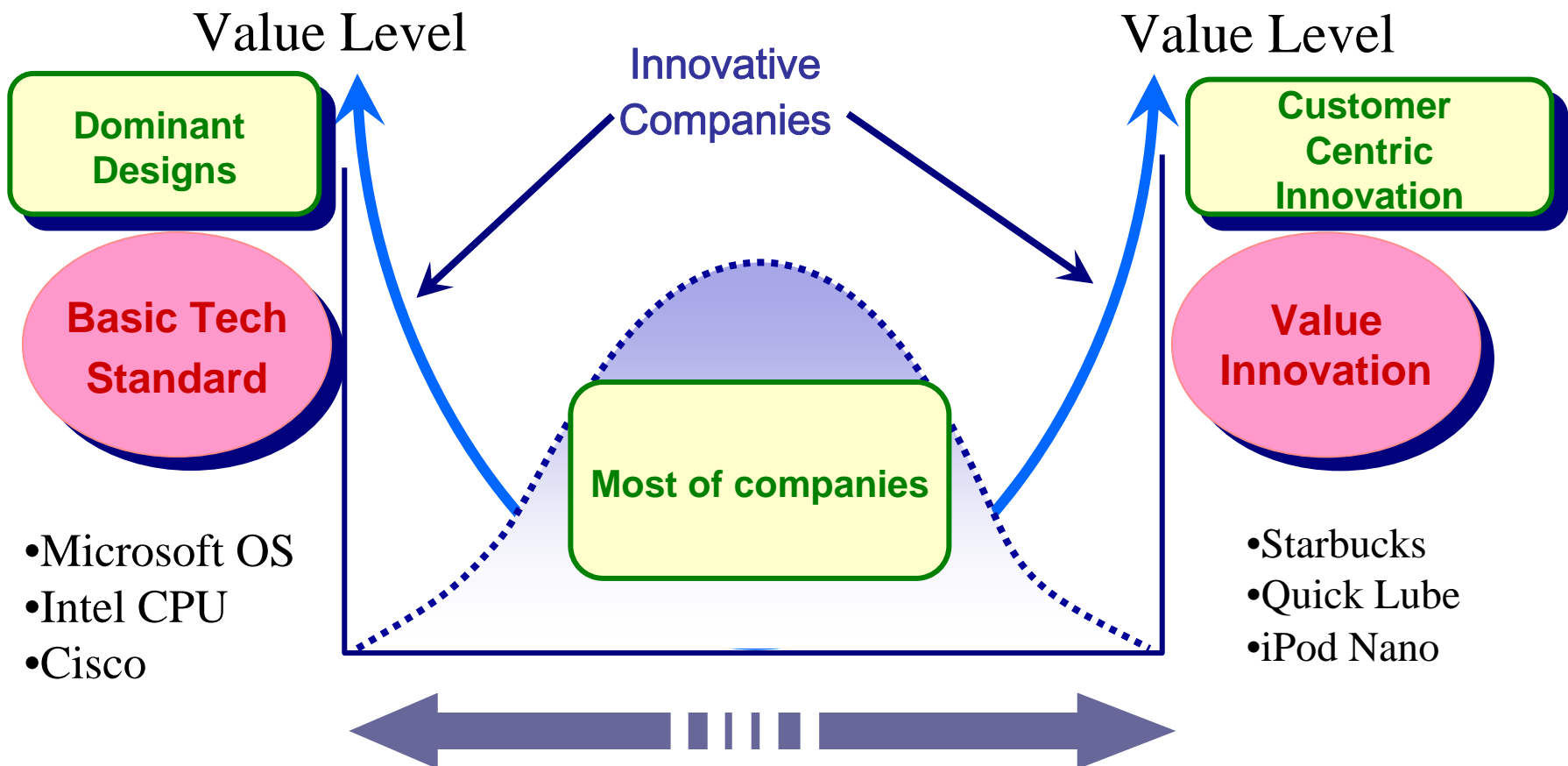


Innovation and Value Creation

Success Factors for every company:

$$\mathbf{Profit = Revenue - Cost}$$

Value Creation Map





Innovation Map

- **Type of Product Development**
 - Technology/Innovation Push
 - Customer/Market Pull
- **Creativity/Ideas Generation- *driver for technology push***
- **Customer Centric Innovation**
 - Identify hidden unmet needs
 - Identify customer value
 - Make creative ideas to commercial success
 - Deliver better business processes



Innovation Map continued

- **Make creative ideas/customer centric innovation quickly into quality products with low cost**
 - Robust design
 - Lean Product Development
 - Product development Kaizan cycles



Three Types of Innovation

Innovation is not only a product/technology matter

- 1. Product Innovation**
- 2. Process Innovation**
- 3. Business Model Innovation**

Example: iPod

Business Model/Process

Business alliance, interface and software, marketing/sales channel

Networking

Apple Musicians, Music/publisher work together

Product System: Accessories, web, iTunes,

Service: Genius Bars

Brand: Cool and innovative image

Customer Total Experience: Download, store, carry, share

Theory of Inventive Problem Solving (TRIZ)

What is TRIZ?

Technical Contradiction & Parameters

Interactive Case Study

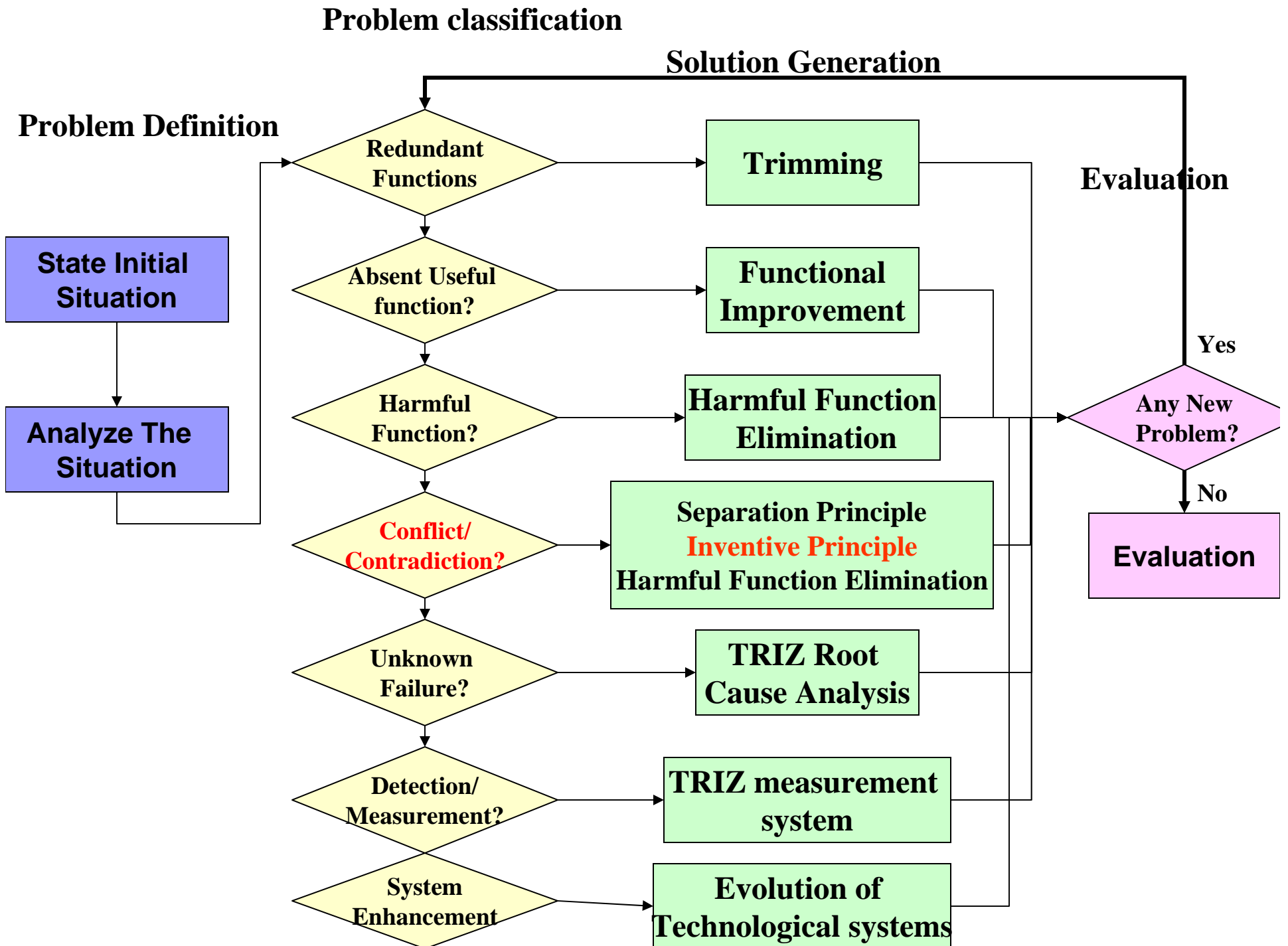
Physical Contradictions

Samsung Case Study



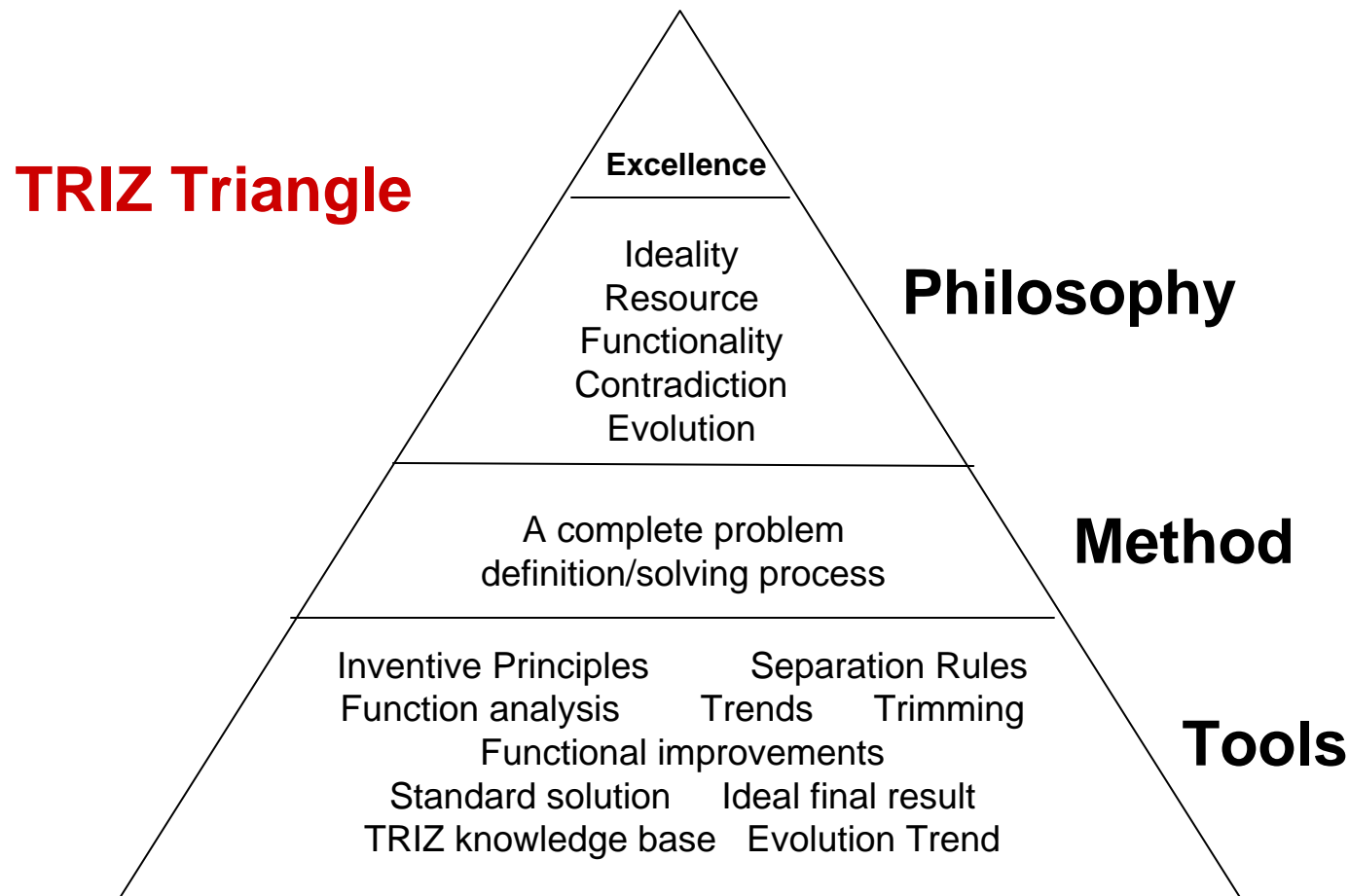
Theory of Inventive Problem Solving (TRIZ)

- **TRIZ is the Theory of Inventive Problem Solving (TIPS) developed in Soviet Union starting in late 1940s**
- **TRIZ research started by studying patents, the documentation of inventions**
- **TRIZ found that the level of invention often depends on the breakthrough solutions toward a ‘contradiction’**



What is TRIZ?

TRIZ is a combination of methods, tools and a way of thinking.





Technical Contradiction

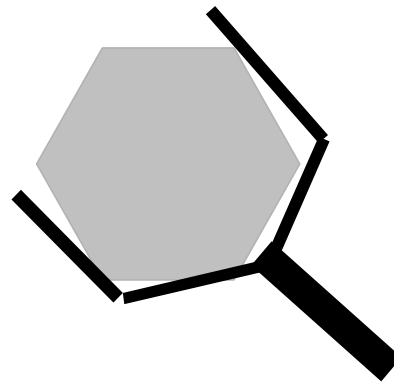
- **A technical contradiction is a situation when efforts to improve some technical attributes of a system will lead to deterioration of other technical attributes.**
- **For example, as a container becomes stronger (good), it becomes heavier (bad), and faster automobile acceleration (good) reduces fuel efficiency (bad).**
- **In TRIZ, the technical contradiction may be solved by ‘inventive principles’ and contradiction matrix.**

39 Technical Parameters

1	Weight of moving object	21	Power
2	Weight of non-moving object	22	Waster of energy
3	Length of moving object	23	Waster of substance
4	Length of non-moving object	24	Loss of information
5	Area of moving object	25	Waster of time
6	Area of non-moving object	26	Amount of substance
7	Volume of moving object	27	Reliability
8	Volume of non-moving object	28	Accuracy of measurement
9	Speed	29	Accuracy of manufacturing
10	Force	30	Harmful factors acting on object
11	Tension, pressure	31	Harmful side effects
12	Shape	32	Manufacturability
13	Stability of object	33	Convenience of use
14	Strength	34	Repairability
15	Durability of moving object	35	Adaptability
16	Durability of non-moving object	36	Complex of device
17	Temperature	37	Complexity of control
18	Brightness	38	Level of automation
19	Energy spent by moving object	39	Productivity
20	Energy spent by non-moving object		

Interactive Case Study: Wrench Design

When we use a conventional wrench to undo an over-tightened or corroded nut (as shown in the picture), one of the problems is that the corners of the nut are getting concentrated load so they may wear out quickly. You can reduce the clearance between wrench and nut, but it will be difficult to fit in. Is there anything we can do to solve this problem?



Step 1: Build contradiction model.

Things we want to improve: Reliability (parameter 27)

Things are getting worse: Ease of operation (parameter 33)

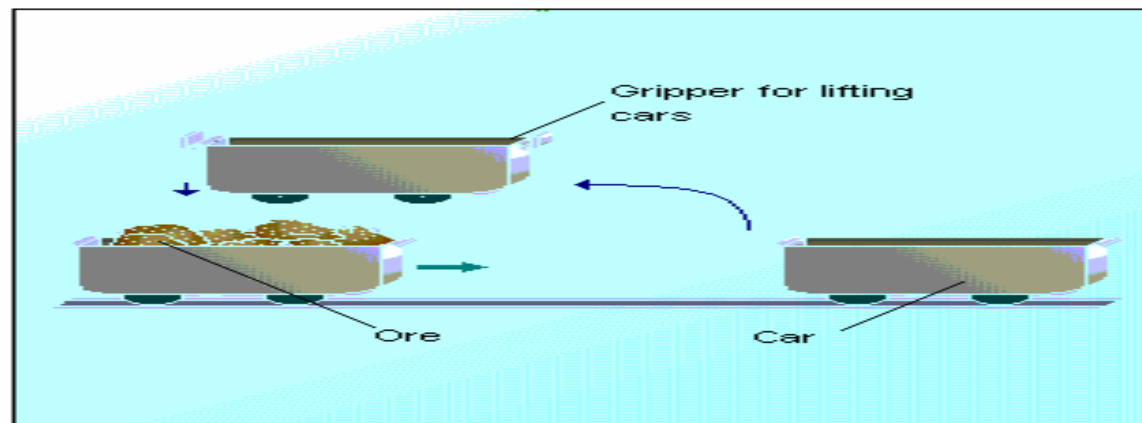
Step 2: Check Contradiction table

What is deteriorated ? What should be improved?	25. Waste of time	26. Quant ity of subst ance	27. Reliab ility	28. Meas ureme nt accur acy	29. Manuf acturi ng precisi on	30. Harmf ul action at object	31. Harmf ul effect cause d by the object	32. Ease of manuf acture	33. Ease of opera tion	34. Ease of repair	35. Adapt ation
25. Waste of time		35 38 18 16	10 30 4	24 34 28 32	24 26 28 18	35 18 34	35 22 18 39	35 28 34 4	4 28 10 34	32 1 10	35 28
26. Quantity of substance	35 38 18 16		18 3 28 40	3 2 28	33 30	35 33 29 31	3 35 40 39	29 1 35 27	35 29 10 25	2 32 10 25	15 3 29
27. Reliability	10 30 4	21 28 40 3		32 3 11 23	11 32 1	27 35 2 40	35 2 40 26		27 17 40	1 11	13 35 8 24
28. Measurement accuracy	24 34 28 32	2 6 32	5 11 1 23			28 24 22 26	3 33 39 10	6 35 25 18	1 13 17 34	1 32 13 11	13 35 2
29. Manufacturing precision	32 26 28 18	32 30	11 32 1			26 28 10 36	4 17 34 26		1 32 35 23	25 10	

Principle 17 – Another Dimension

- *Move an object in two- or three-dimensional space*
- *Use a multi-story arrangement of objects instead of a single-story arrangement*
- *Tilt or re-orient the object, lay it on it's side*
- *Use 'another side' of a given area*

Example for principle 17 - Another dimension

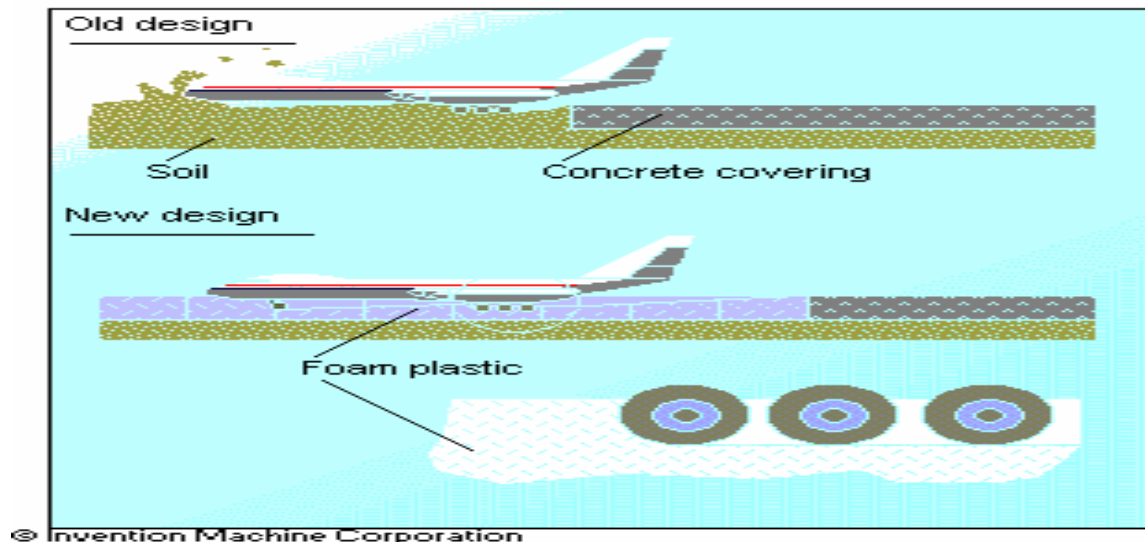


© Invention Machine Corporation

Principle 27 – Cheap Short-Living

Replace an expensive object with a multitude of inexpensive objects, compromising certain qualities (such as service life, for instance).

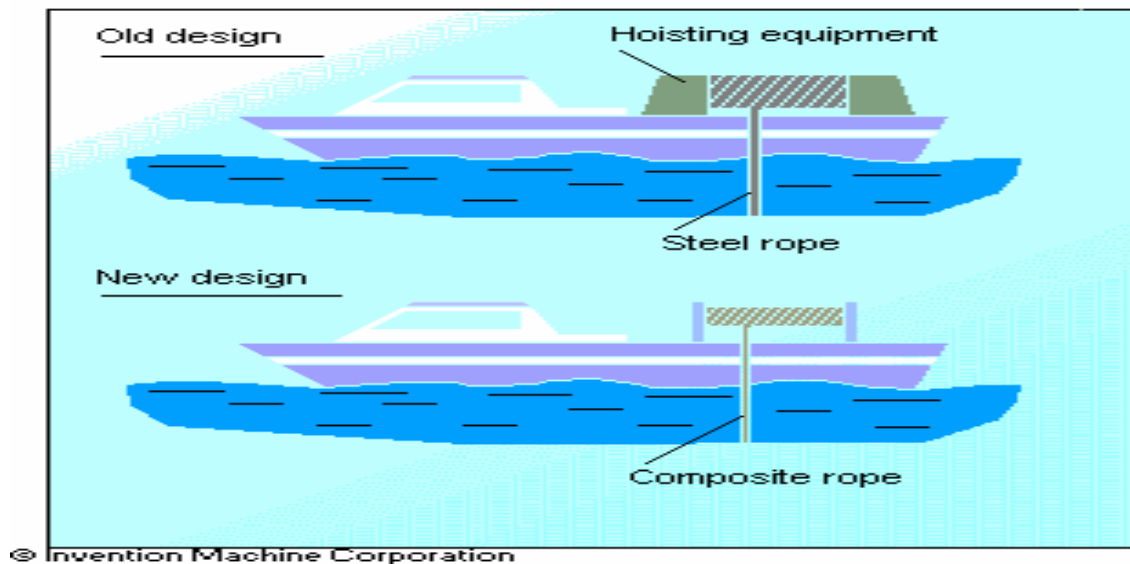
Example for principle 27 - Cheap short-living



Principle 40 – Composite Materials

Change from uniform to composite (multiple) materials.

Example for principle 40 - Composite materials





Physical Contradiction

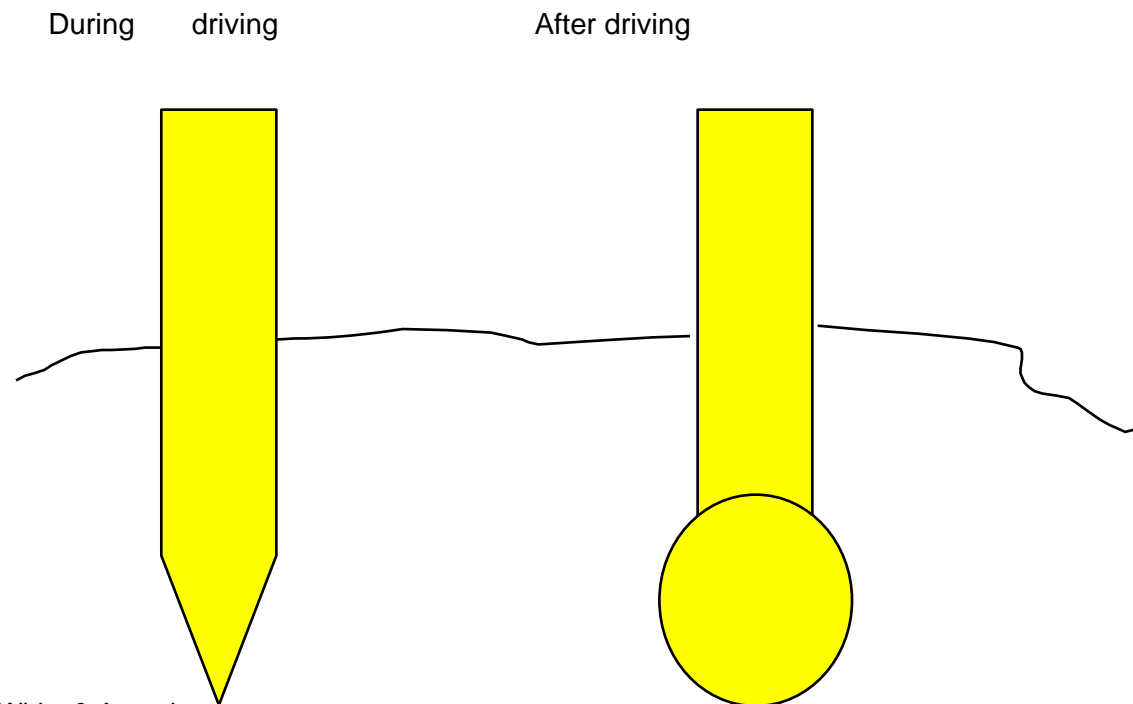
A physical contradiction is a situation when a subject or an object has to be in mutually exclusive physical state.

A physical contradiction has the typical pattern: “To perform function F1, the element must have property P, but to perform function F2, it must have property $-P$, or the opposite of P”. For example, an automobile has to be light in weight (P) to have high fuel economy (F1), but it also has to be heavy in weight ($-P$) in order to be stable in driving (F2).

- **Separation by time**
- **Separation by space**
- **Separation by parameters**
- **Separation by system and components**
- **Separation by parameter**

Example: Separation By Time

Some buildings are supported by piles. The pile should have a sharp tip to facilitate the driving process. However, the sharp piles have reduced support capability. For better support capacity, the piles should have blunt ends. However, it is more difficult to drive blunt tipped pile.



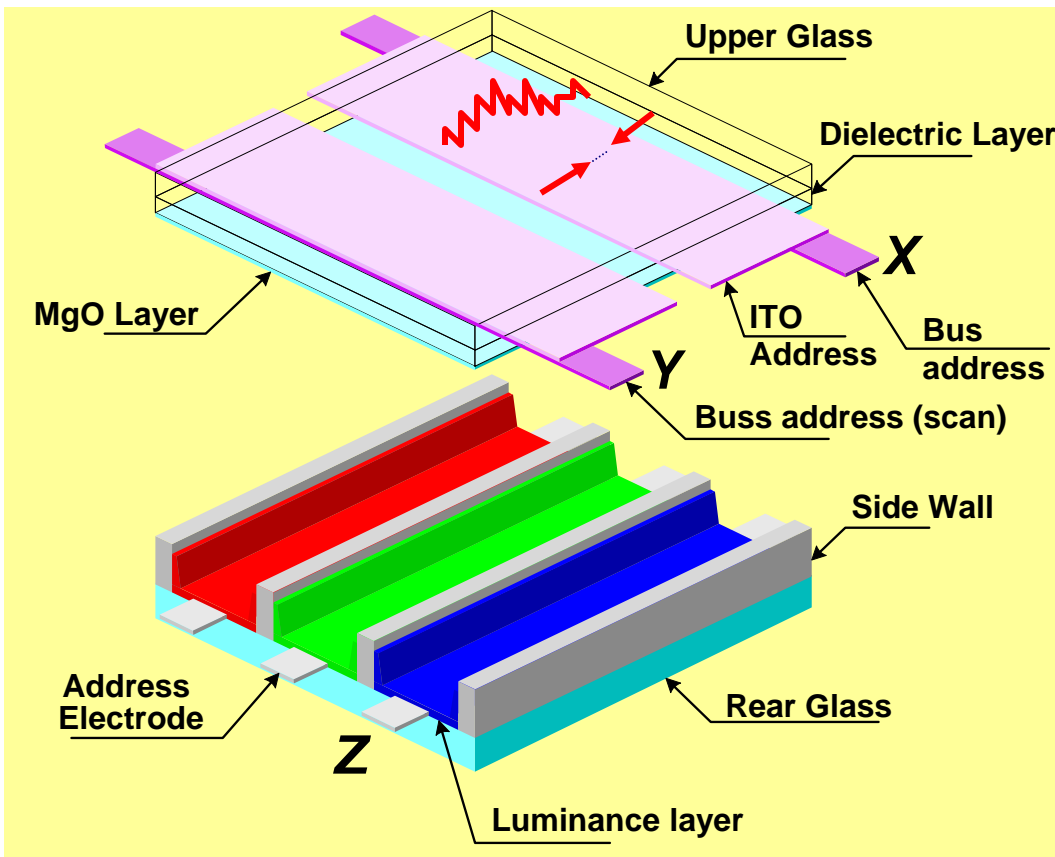


Samsung's Success Story of TRIZ

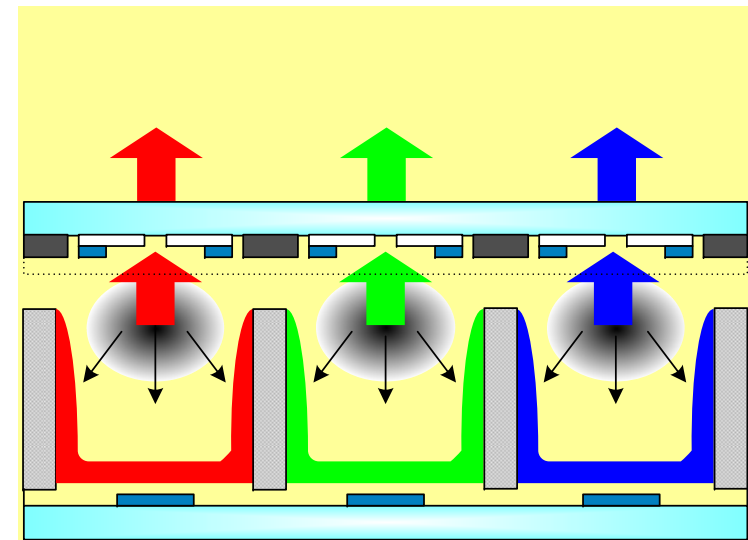
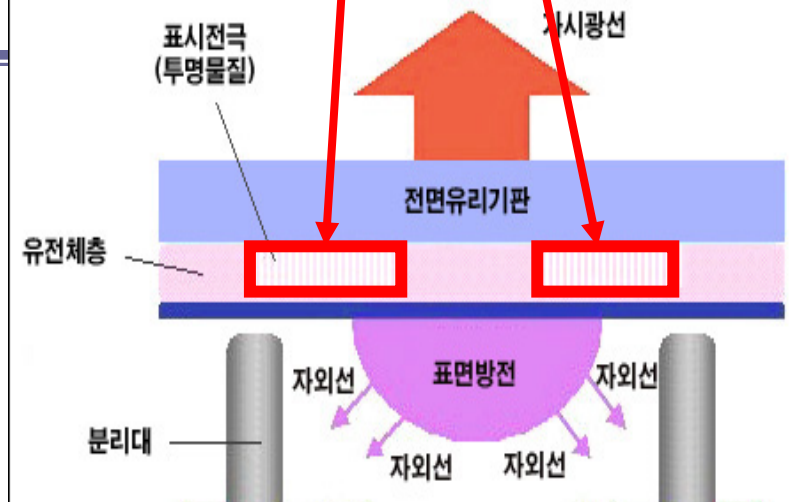
Samsung Facts:

- Rank 39th Fortune Global 500 in 2004 in terms of revenue
- Larger than Sony
- Profit is larger than top 4 Japanese electronics companies combined
- 10 years ago was a 'quick learner'
- Now a R&D power house
- Its excellent DFSS/TRIZ program an important factor

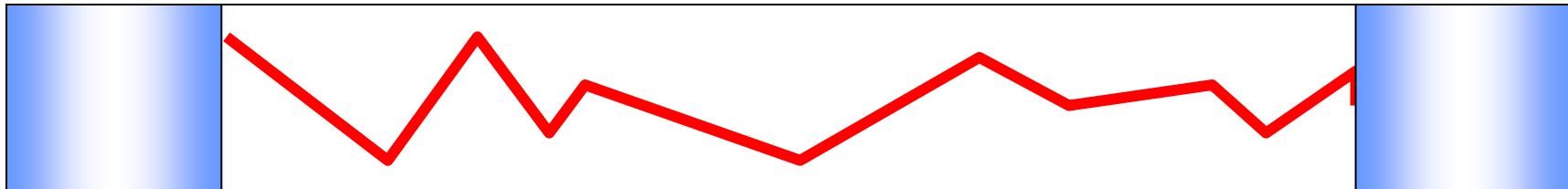
Samsung Case Study: Ignite Electrode for PDP



Discharge electrodes



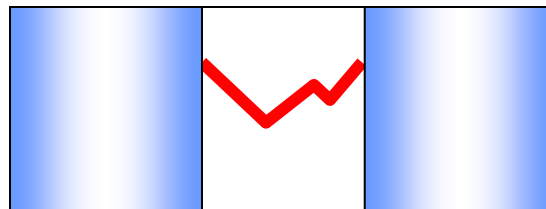
Samsung's Contradiction



TC-0: If gap between electrodes is wide, light efficiency is high (good),
but discharge voltage is high (bad)

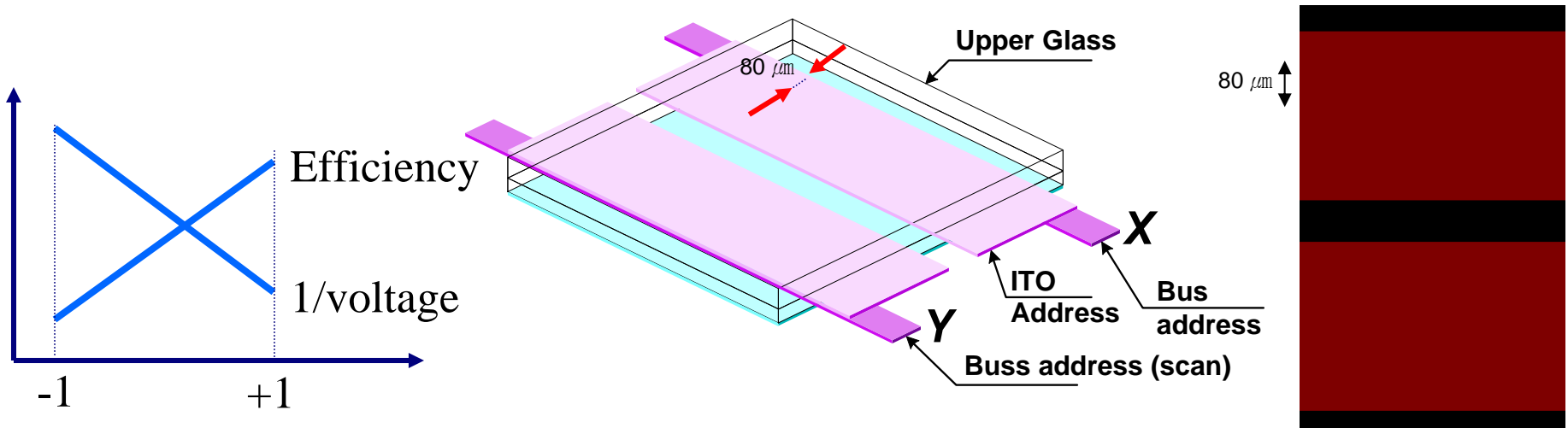
Gap between Electrodes : TRADE-OFF

- ◆ Gap distance of electrodes should be long.
To increase light efficiency (CTQ)
- ◆ Gap distance of electrodes should be short.
To decrease ignition voltage (CTQ)

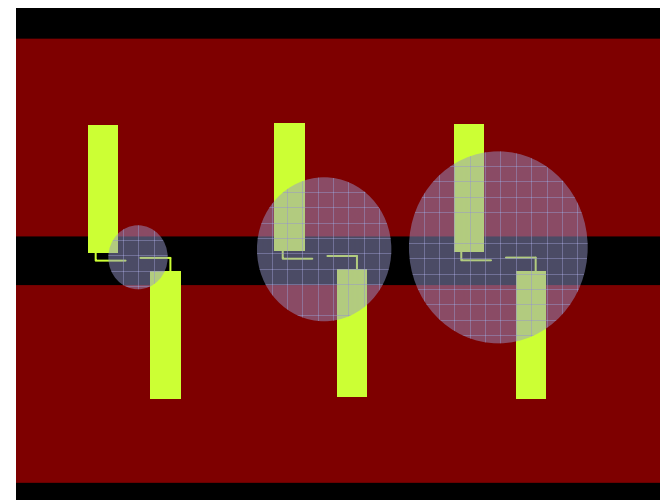
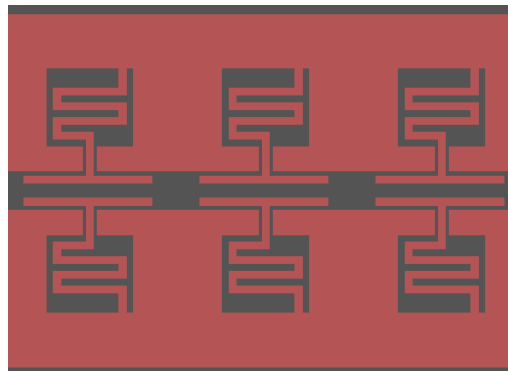


TC-1: If gap between electrodes is narrow, discharge
voltage is low enough (good), but light efficiency is low (bad).

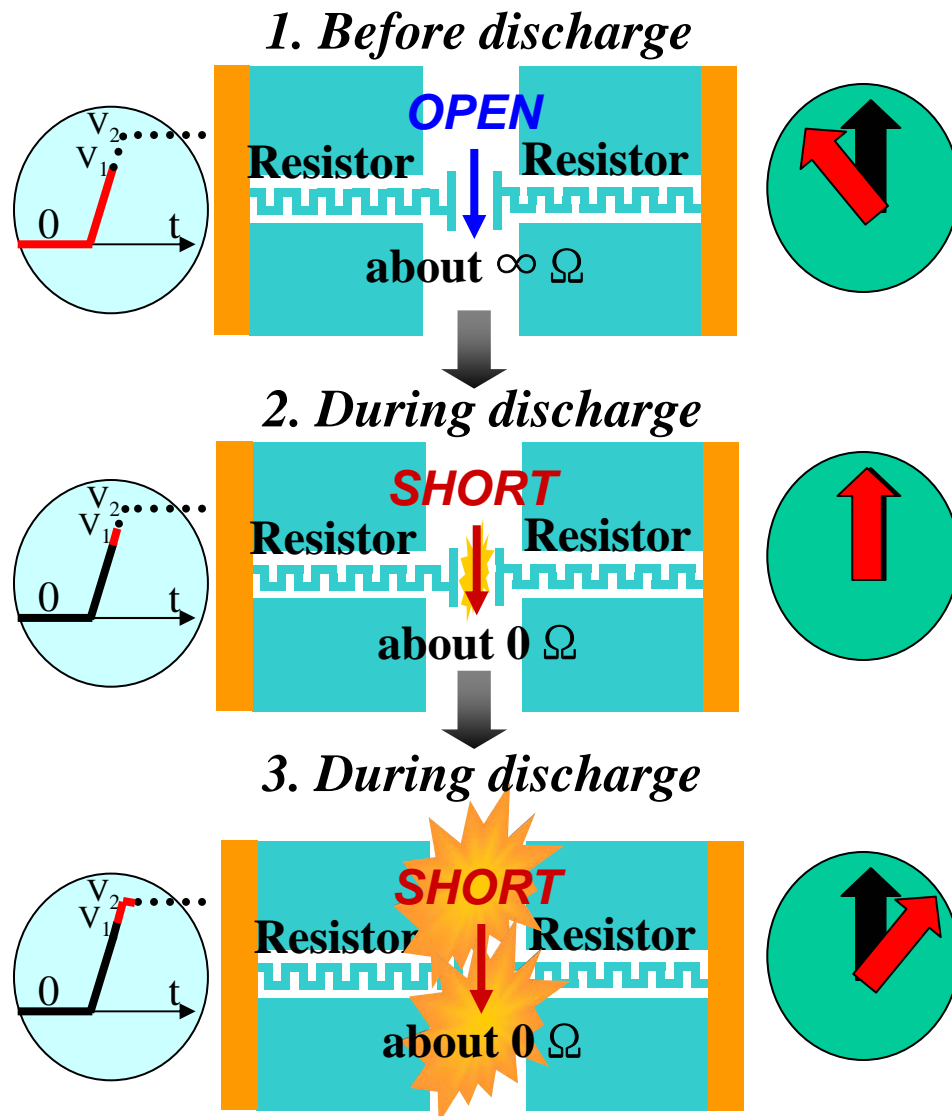
Concept Generation



Optimized 80um by DOE



Breakthrough Concept



- ◆ separation by space : long gap, short gap at the same time
- ◆ separation by time : first time short gap electrodes operate, after ignition long gap electrodes operate.

Concept Development & Result

	Without igniter electrode (Xe 10%)	With Igniter electrode (Xe12%)
Voltage (Vs)	205V	205V
Light efficiency	1.210 lm/W	1.722 lm/W

Light generating efficiency 40% UP!
by overcoming trade-off

Increase discharge gas without increasing ignition voltage

Install Igniter electrode



Lean Product Development

The Nature of Product Development
Waste in Product Development
Toyota Product Development System
Voice of Customer



Nature of Product Development

Product Development is

- A Sequence of Information Mining, Transformation, and Creation Process
- Capturing Real Voice of Customers: Information Mining
- Translating VOC to Functional Requirements, information transformation
- Creation of Design, Technology Development: Information Creation
- Improving Information Creation and Transformation from Developing People, Knowledge Creation and Management



Nature of Product Development

Keys for Success in PD Process

- **Maximize Information Creation Speed**
- **Increase Information Flow**
- **Minimize Information Usage in Each Product**



Minimize the Information Usage in Designs

Implication – Lean Product

Reducing Design Complexity by:

- **Reducing unnecessary product functions and parts**
- **Loosening up unreasonable tolerances**
- **Using standard/off-the-shelf parts**
- **Controlling technical immaturity**
- **Avoiding complicated user/operator requirements**
- **Avoiding complicated interface requirements**

Information Also Has Time Value

- The earlier we get the information, the more valuable
- In general, we want to get information as early as possible (Small scale early tests, robust technology development)
- We want to get the more critical information earlier than non-critical information

(Task sequencing)





Indicators of Waste in Product Development

Excess Requirements: Increases unnecessary design, production and support.

Overloaded Resources: Increases schedule risk, avoidable design defects.

Ineffective Risk Management: Increases schedule, budget and quality risk.

Waterfall Development: Reduces information flow, adds unnecessary rework.

Unintegrated Design: Increases reinvention and adds quality risk.

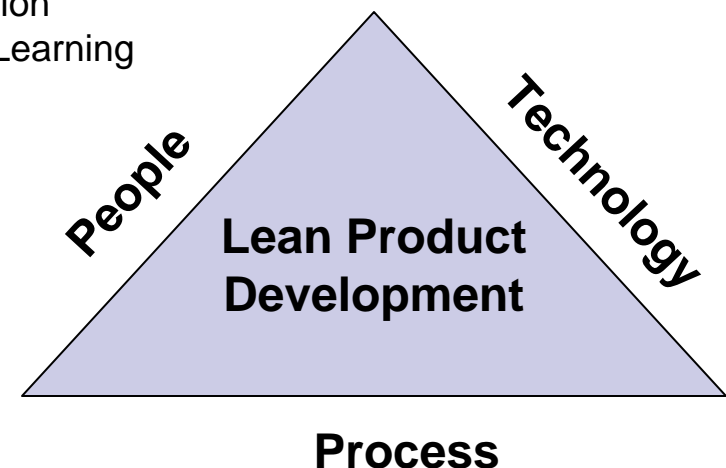
Unproductive Meetings: Increases schedule and quality risk.

Reinvention: Increases schedule and design, production and support costs.

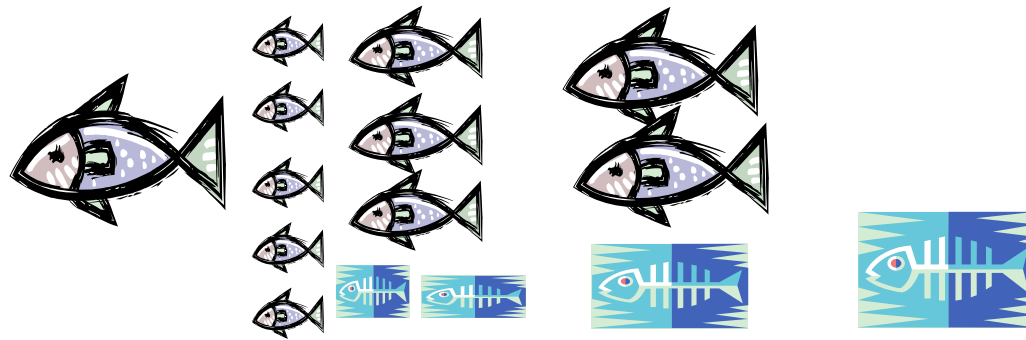
Toyota's 13 Principles of Lean Product Development*

1. Establish Customer-Defined Value to Separate Value-Added from Waste.
2. Front-Load the Product Development Process to Explore Thoroughly Alternative Solutions while there is Maximum Design Space
3. Create a Leveled Product Development Process Flow
4. Utilize Rigorous Standardization to Reduce Variation, and Create Flexibility and Predictable Outcomes
5. Develop a Chief Engineer System to integrate Development from Start to Finish
6. Organize to Balance functional Expertise and Cross-functional integration
7. Develop Towering Technical Competence in all Engineers
8. Fully Integrate Suppliers into the Product Development System
9. Build in Learning and Continuous Improvement
10. Build a Culture to Support Excellence and Relentless Improvement
11. Adapt Technology to Fit your People and Process
12. Align your Organization through Simple, Visual Communication
13. Use Powerful Tools for Standardization and Organizational Learning

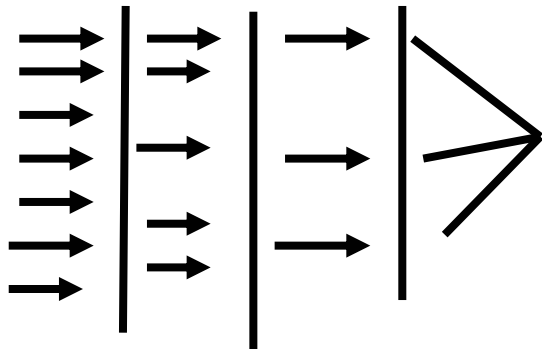
**From Jeff Liker author of "The Toyota Way"*



Principle 2: Front-load the Product Development Process



Set-based Concurrent Engineering



- Evaluate against threats and each other
- Eliminate weak
- Add knowledge
- Combine in different ways

IMPLICATION

Generate information earlier



Principle 3: Create Leveled Product Development Process Flow

- **Synchronize activities across function**
- **Level the work load, no idle, no overload**
- **Create steady speed job flow for design engineers**
- **Stagger the release of data from one function to the next**

IMPLICATION

**Minimize the Product Development Process Complexity
By minimizing variation in job flow, workload, and
Information flow**



Competitive Edge In Product Development

James Morgan, author of “The Toyota Product Development System,” identified the top three competitive advantages of Toyota’s Product Development System over the “Big Three” as

- 1. Empowerment of Engineers**
- 2. Smooth Information Flow: Standardization of Design Process, Design Practices, Shared Information**
- 3. Better Mastering of Voice of Customers**



Thank You

For more information visit the table in the back to review texts published on DFSS, TRIZ, Axiomatic Design and other innovation and product development practices.

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