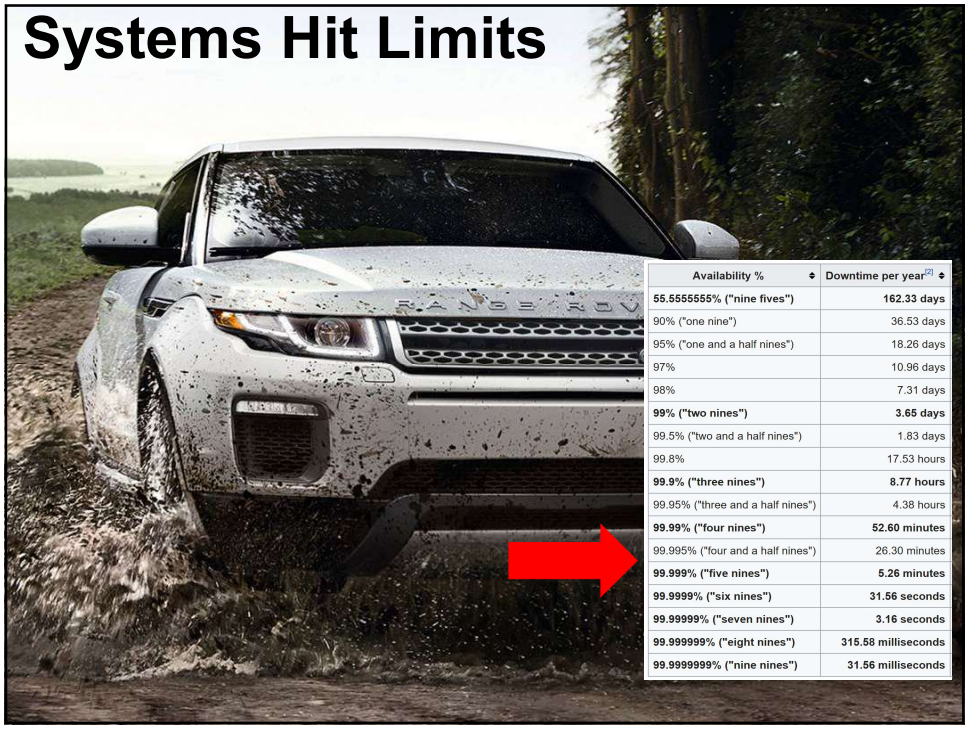
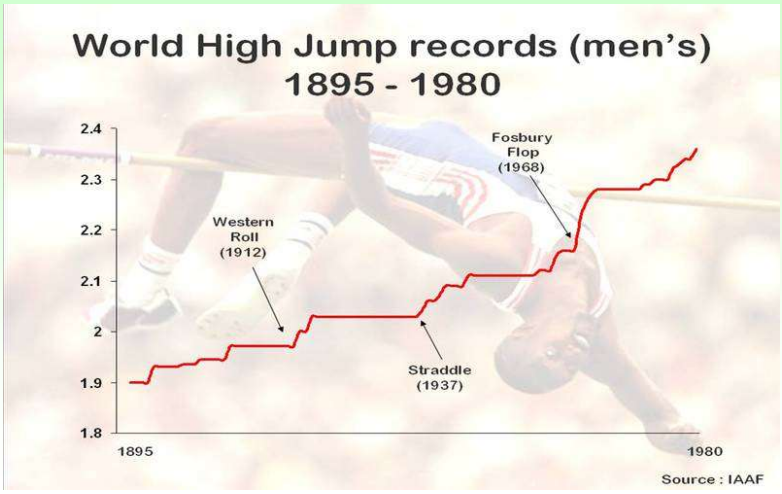


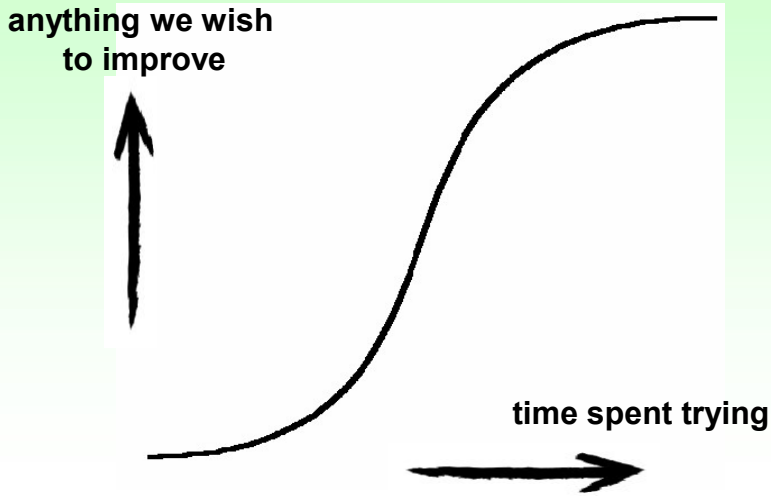
Availability %	Downtime per year[2]
55.5555555% ("nine fives")	**162.33 days**
90% ("one nine")	36.53 days
95% ("one and a half nines")	18.26 days
97%	10.96 days
98%	7.31 days
99% ("two nines")	**3.65 days**
99.5% ("two and a half nines")	1.83 days
99.8%	17.53 hours
99.9% ("three nines")	**8.77 hours**
99.95% ("three and a half nines")	4.38 hours
99.99% ("four nines")	**52.60 minutes**
99.995% ("four and a half nines")	26.30 minutes
99.999% ("five nines")	**5.26 minutes**
99.9999% ("six nines")	**31.56 seconds**
99.99999% ("seven nines")	**3.16 seconds**
99.999999% ("eight nines")	**315.58 milliseconds**
99.9999999% ("nine nines")	**31.56 milliseconds**

Systems Hit Limits…

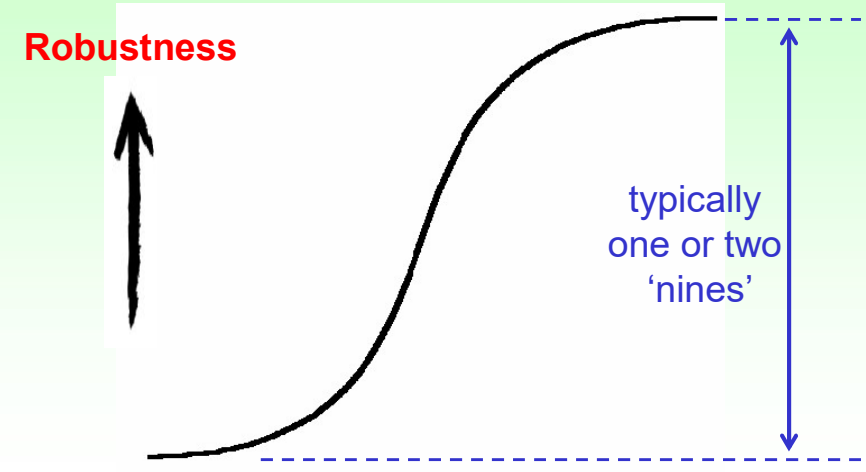


…And Then We Innovate

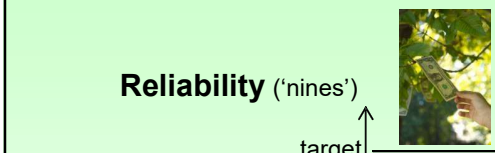
First Principles: S-Curve

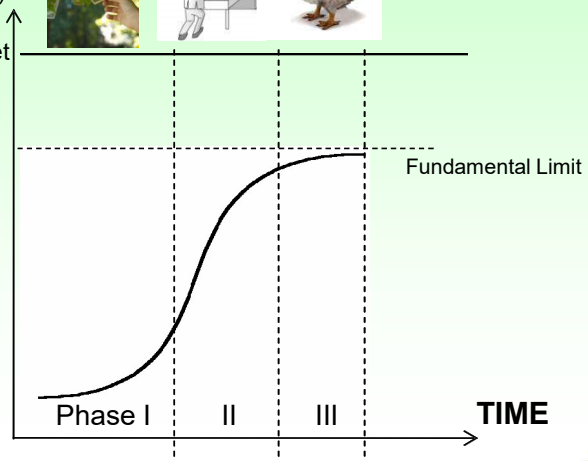


First Principles: S-Curve



Robustness & S-Curves



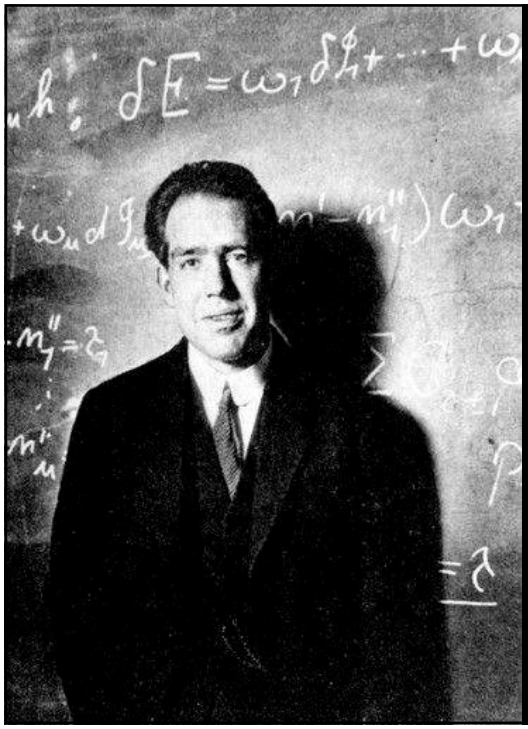


Robustness Phase II

Robustness with Consequences

Each time we do something to improve the robustness of the system, something gets worse

Robustness increases
Cost becomes higher
Power decreases
etc



"How wonderful that we have met with a paradox. Now we have some hope of making progress."

x 9million cases =

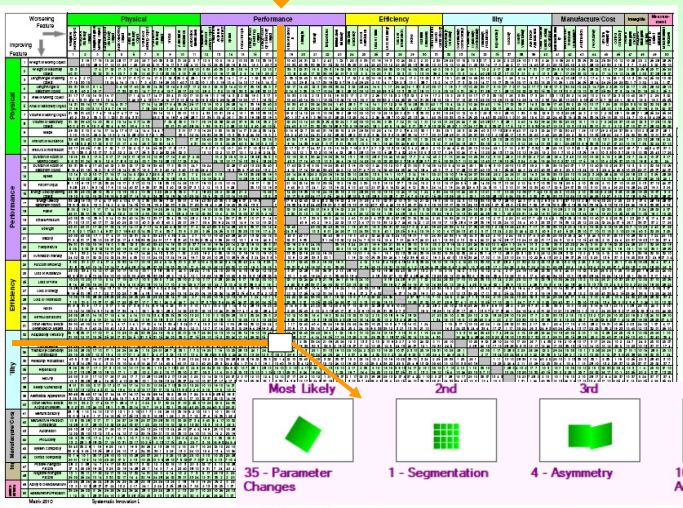
Progress Engine

power is reduced

but…

we want to improve…

Reliability



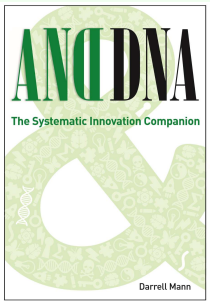
solutions already found by others

TRIZ

Teoriya Resheniya Izobreatatelskikh Zadatch

Теория Решения Изобретательских Задач

Theory of Inventive Problem Solving



TRIZ – As a Philosophy

MILLIONS of systems

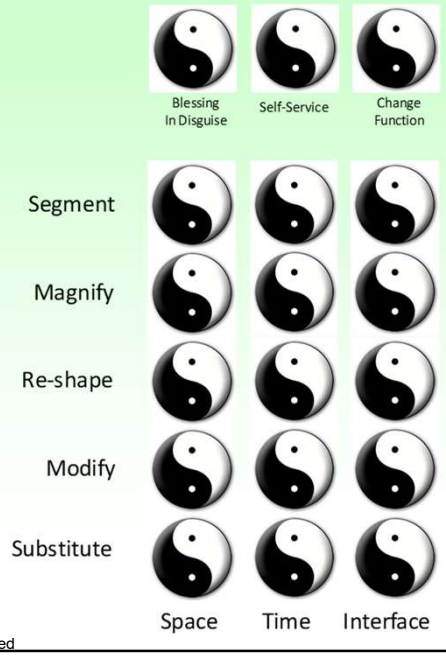
HUNDREDS of different problems

TENS of successful
(First Principle) solutions

40 Inventive (First) Principles

1. Segmentation
2. Taking Out
3. Local Quality
4. Asymmetry
5. Merging
6. Universality
7. 'Nested Doll'
8. Counterweight
9. Prior Counter-Action
10. Prior Action
11. Prior Cushioning
12. Remove Tension
13. 'The Other Way Round'
14. Rotate
15. Dynamics
16. Slightly Less/Slightly More
17. Another Dimension
18. Vibration
19. Periodic Action
20. Continuity of Useful Action
21. Skipping
22. 'Blessing in Disguise'
23. Feedback
24. Intermediary
25. Self-Service
26. Copying
27. Cheap/Short Living
28. Emotional Fields
29. Fluid
30. Thin & Flexible
31. Holes
32. Transparency
33. Homogeneity
34. Discarding and Recovering
35. Parameter Changes
36. Phase Transitions
37. Relative Change
38. Enriched Atmosphere
39. Calmed Atmosphere
40. Composite Structures

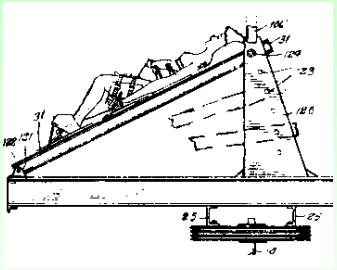
18 Actual Inventive (First) Principles



Optimization & Innovation

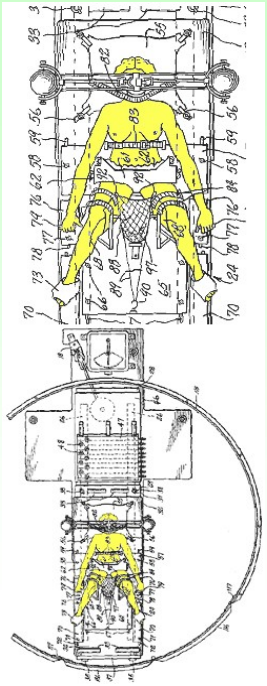
‘successful step change’

Innovation?



US Patent 3,216,423

98% of attempted ‘innovations’ fail



Innovation – Cruellest Game In The World

Right Problem

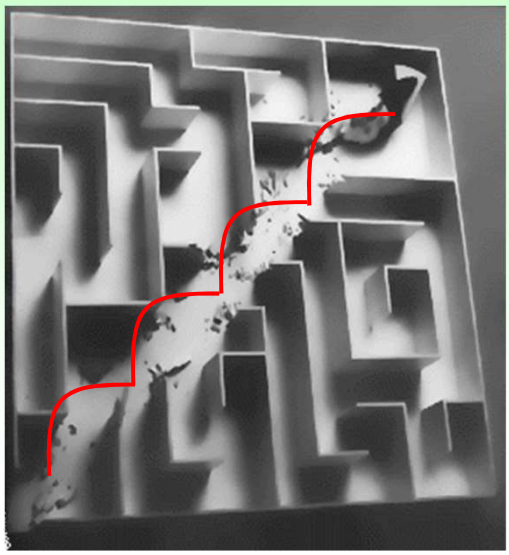
Right Solution

Right Customer

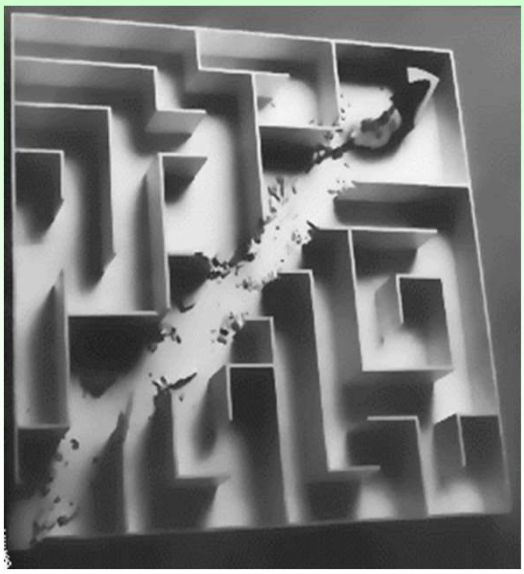
Right Time

Right Price

First Principle Contradiction Solution Patterns



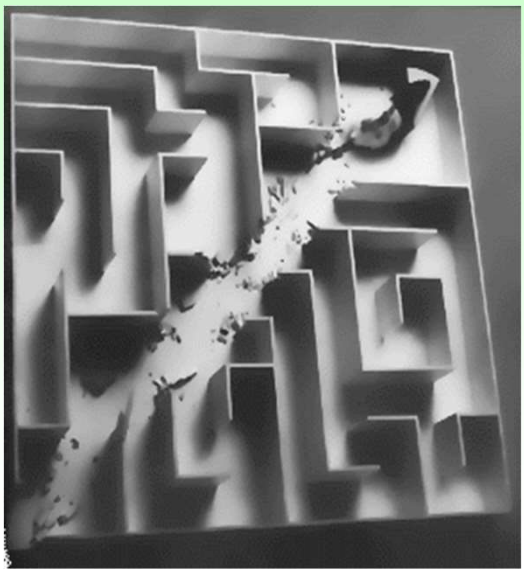
TRIZ Pillar #1



Everything evolves to a '**perfect**' end-state

(which includes 100% reliability, availability, etc)

TRIZ Pillar #2

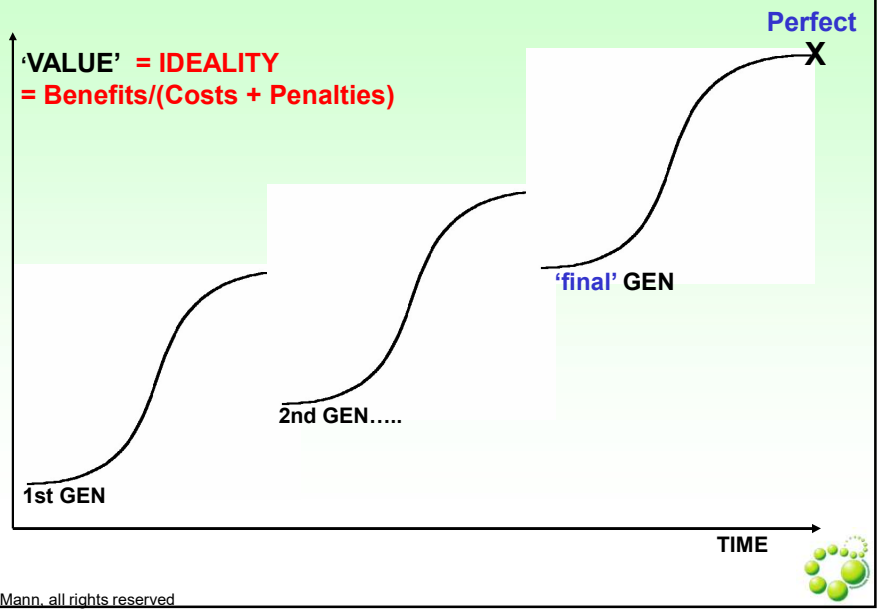


Two Ways To Get There:

Add new (self) functions

Solve a contradiction

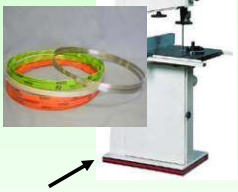
S-Curve Journey To 'Perfect'

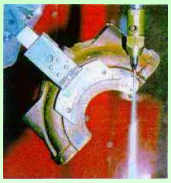


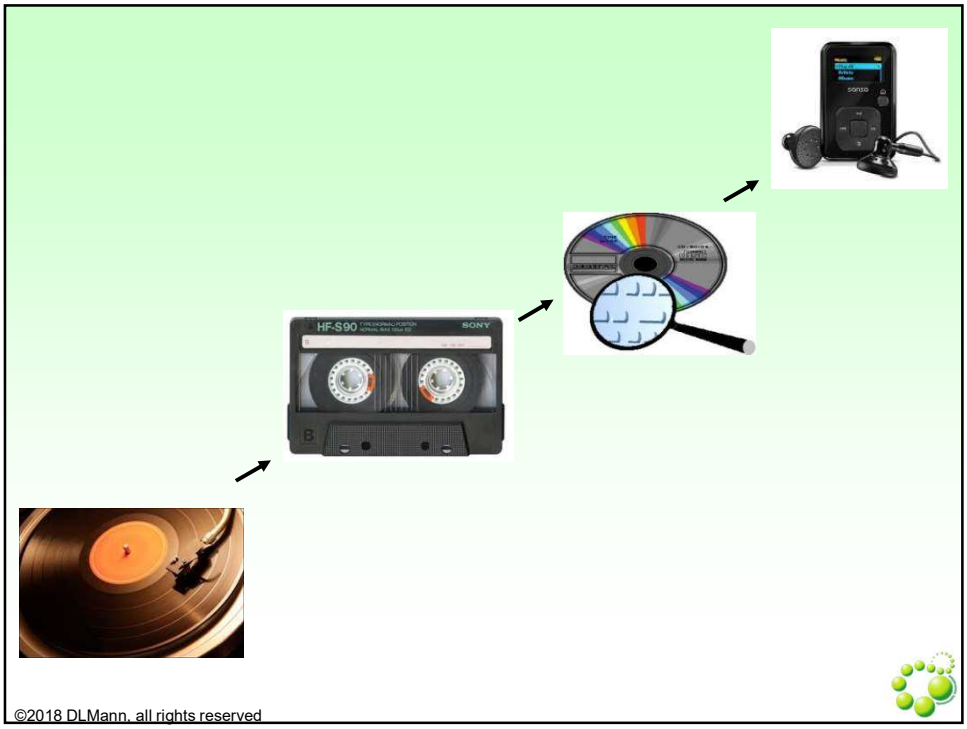
System Evolution

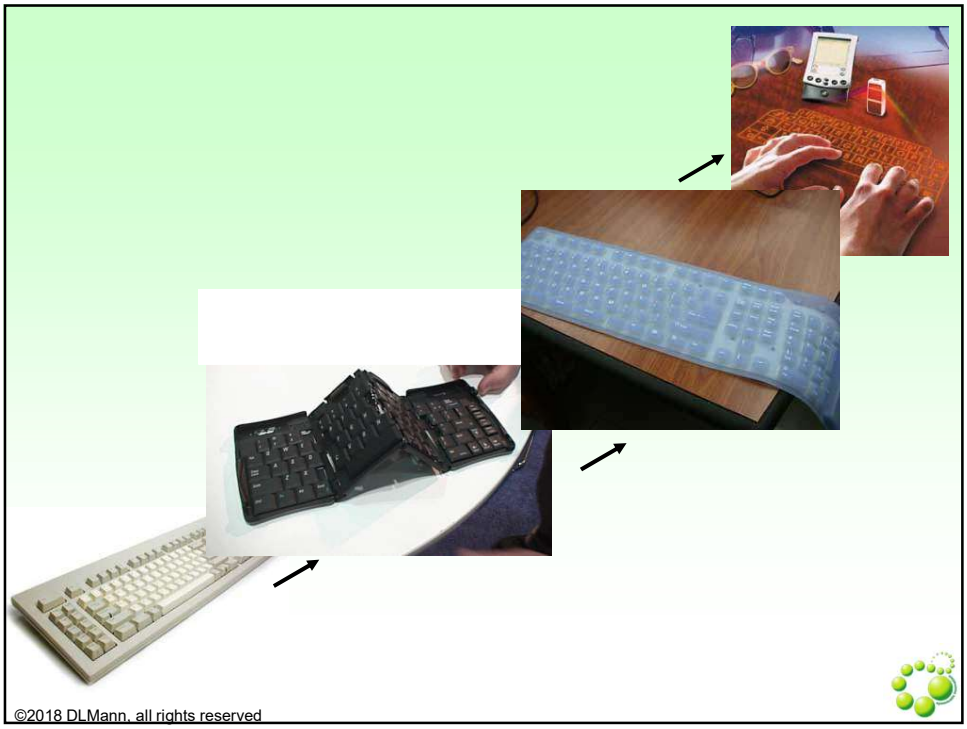
- Evolution is not random
- It follows certain patterns
- Different Stages can be predicted
- This knowledge can help solve problems
- It can also help define strategic opportunities

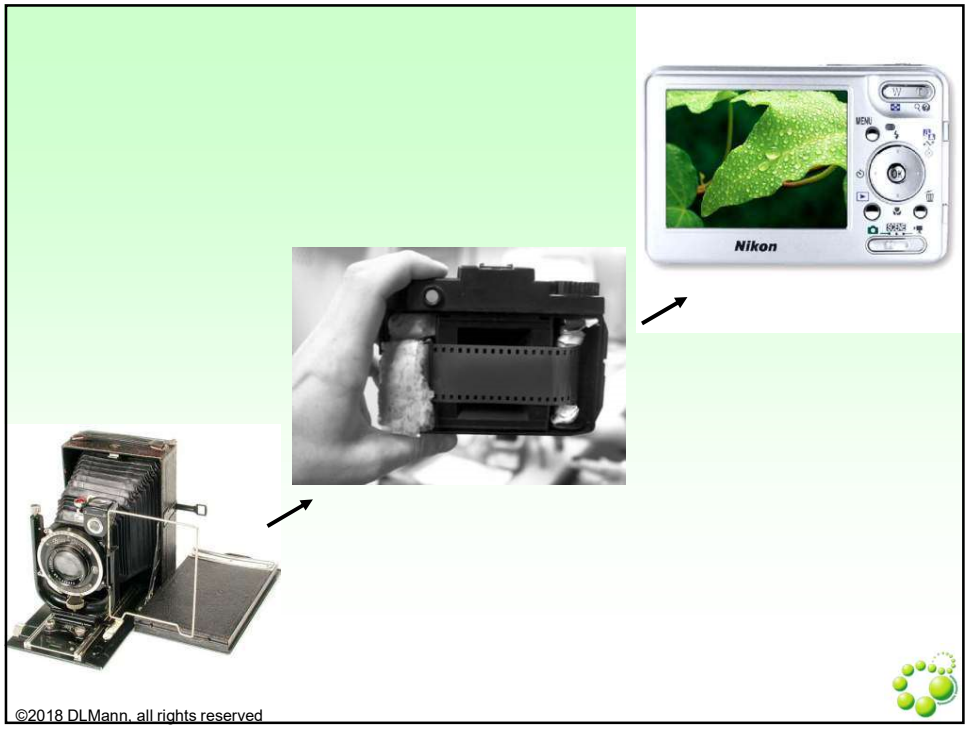
Looking For Patterns:





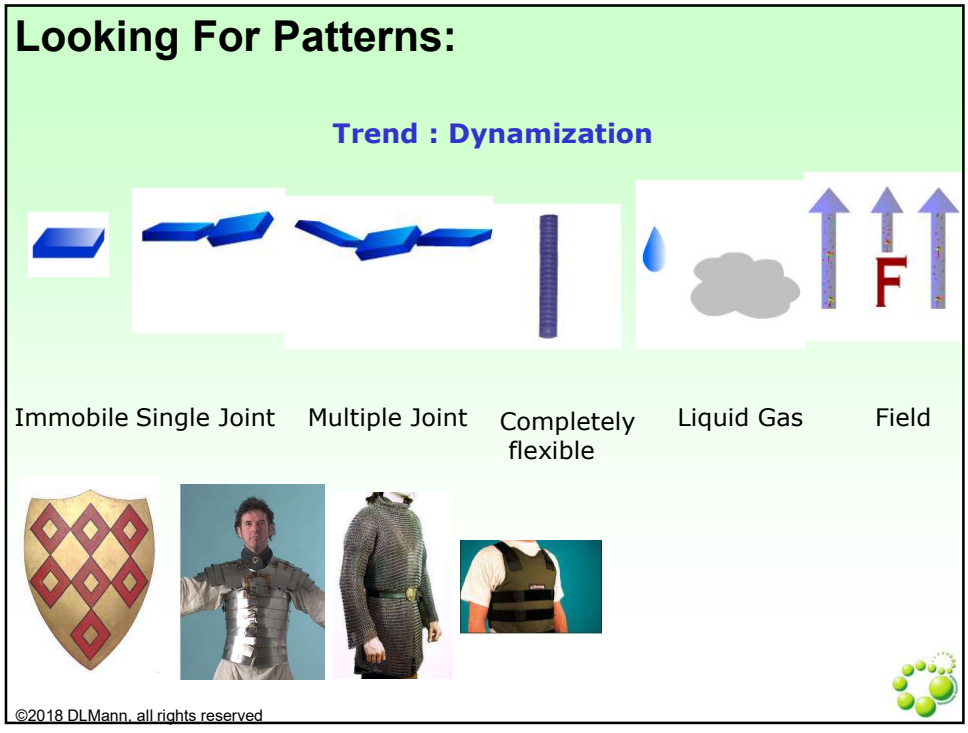




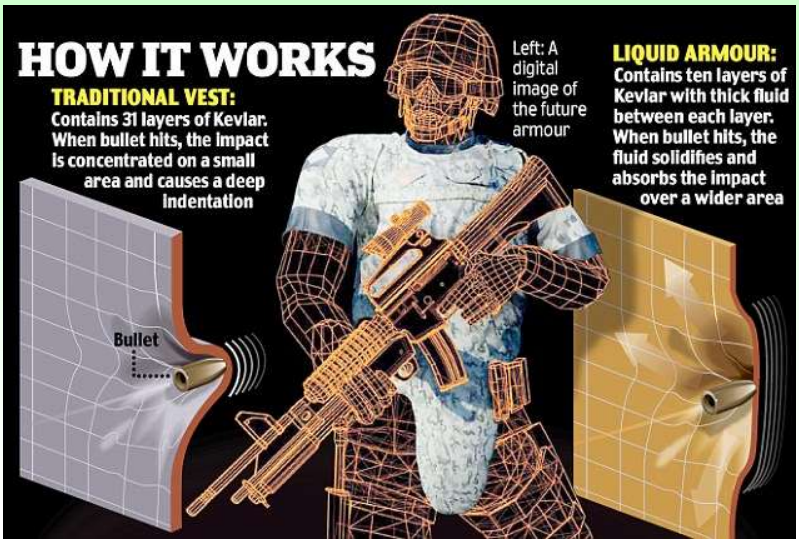


Looking For Patterns:

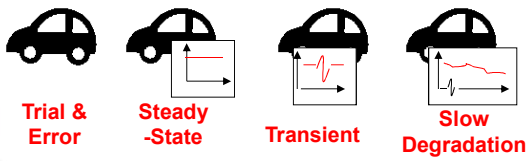
Trend : Dynamization



(Predictable) Liquid Armour

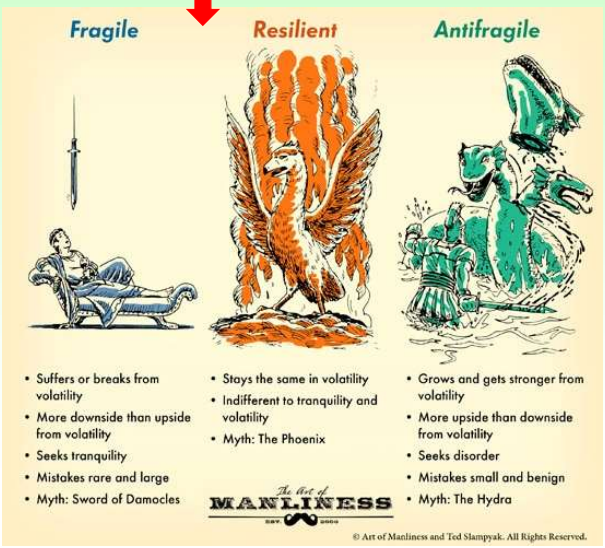


ROBUST DESIGN

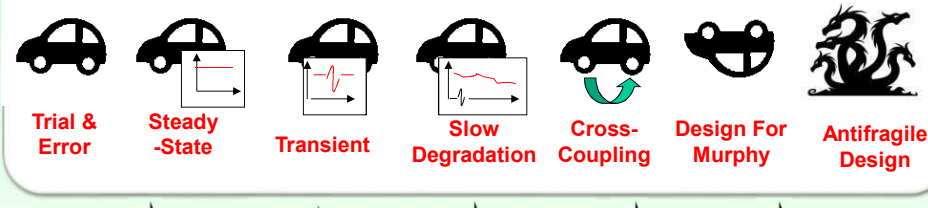


Recalibrating 'Robust'

Robust



RESILIENT DESIGN/ANTIFRAGILE



-improved use of design resources
-reduced waste in development time/cost
-reduced waste of materials
-reduced product development time

'one nine' failure rate

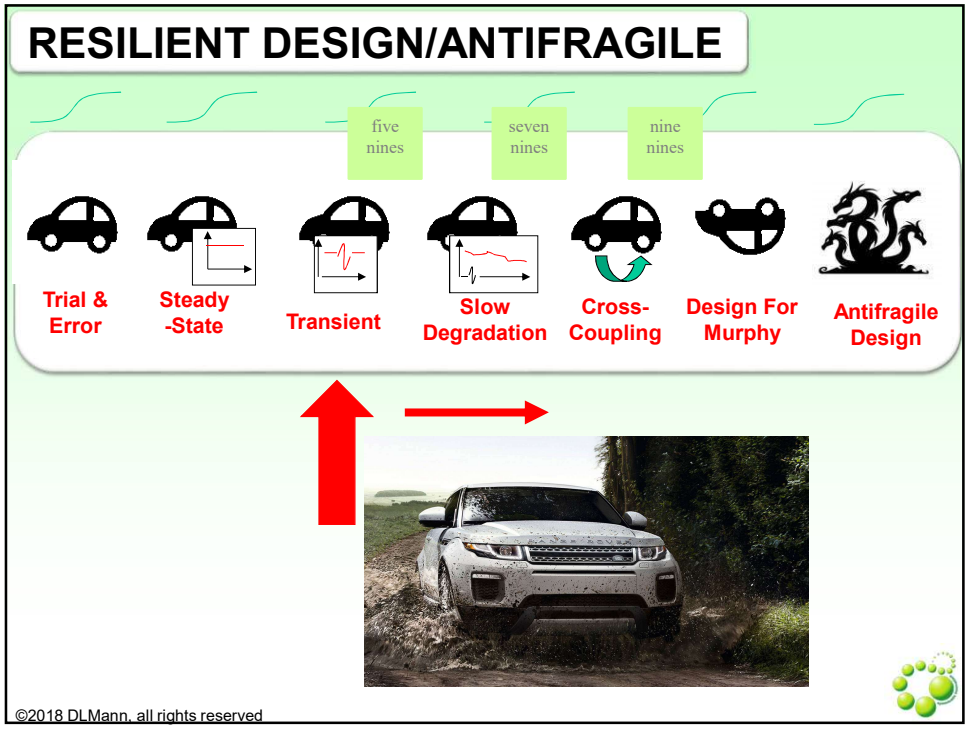
-improve product reliability

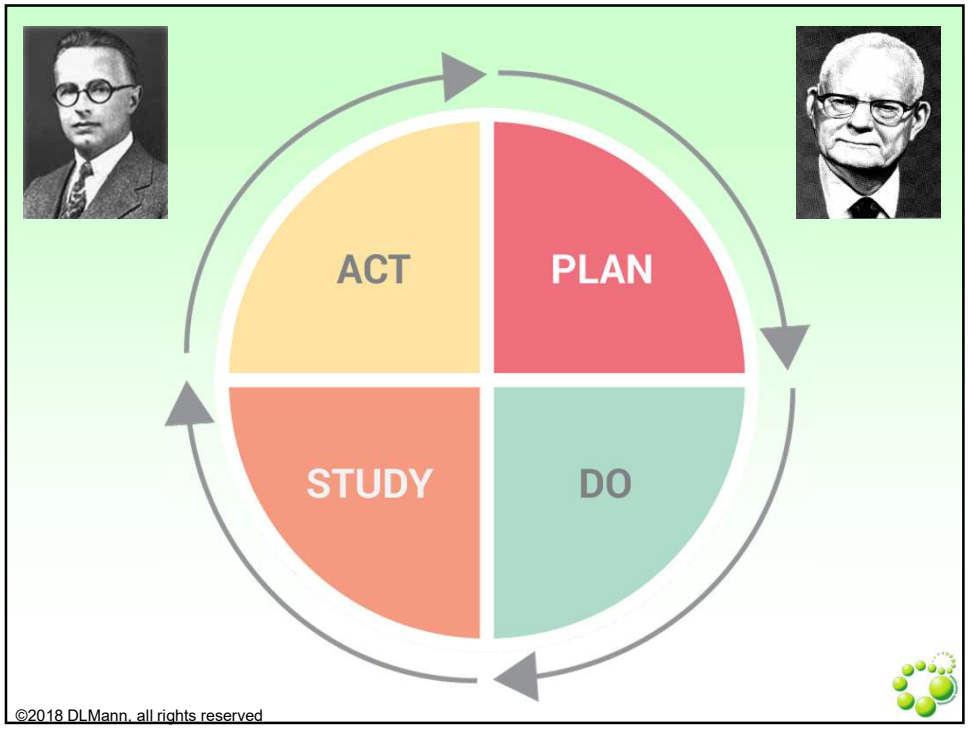
three nines
five nines
seven nines
nine nines

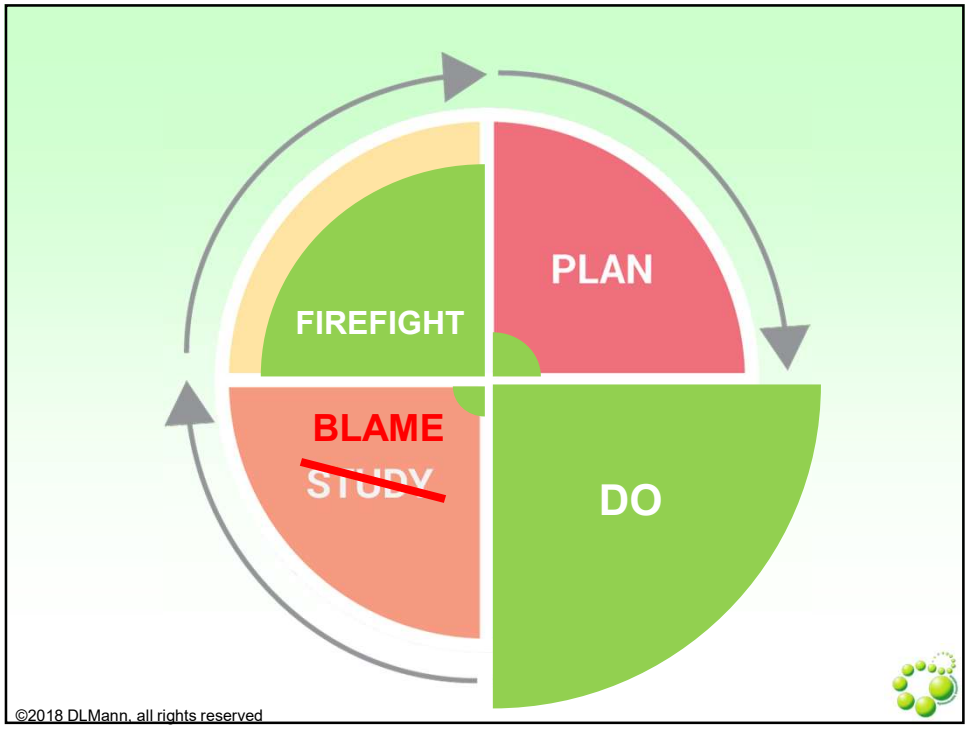
-improve reliability
-enable easy shift to 'functional sales model'

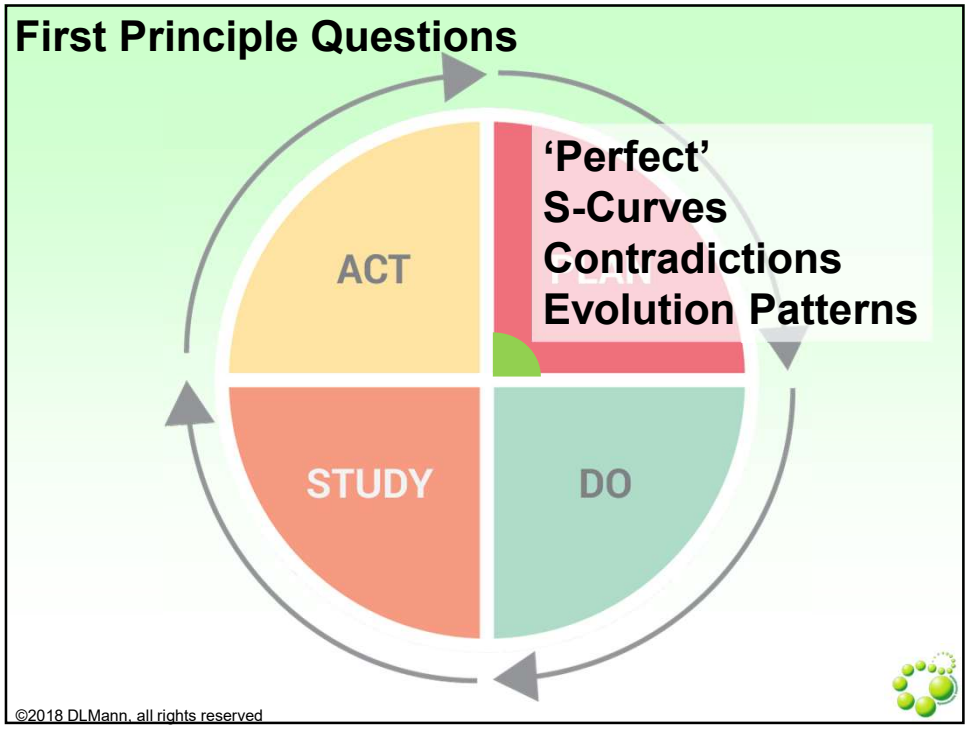
ten nines

Reasons For Jump









Innovation… Most Difficult Game In The World?

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