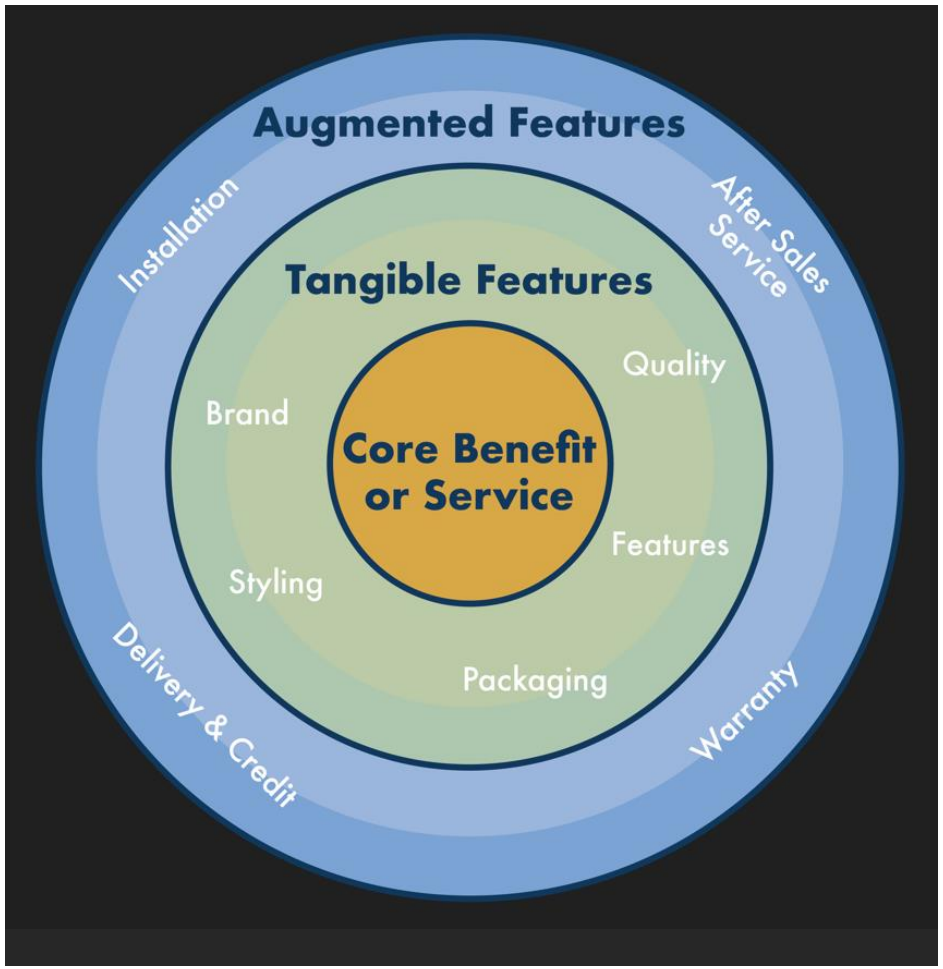
DRIVING GROWTH

Value Chains and Value Engineering

Leah Speser, JD, PhD, RTTP, NPDP

RESEARCH
& INNOVATION
FOUNDATION

The Goal is to Create a Product or Service with Value for the End-User and thus the Customer



Value is a Measure of Relative Utility

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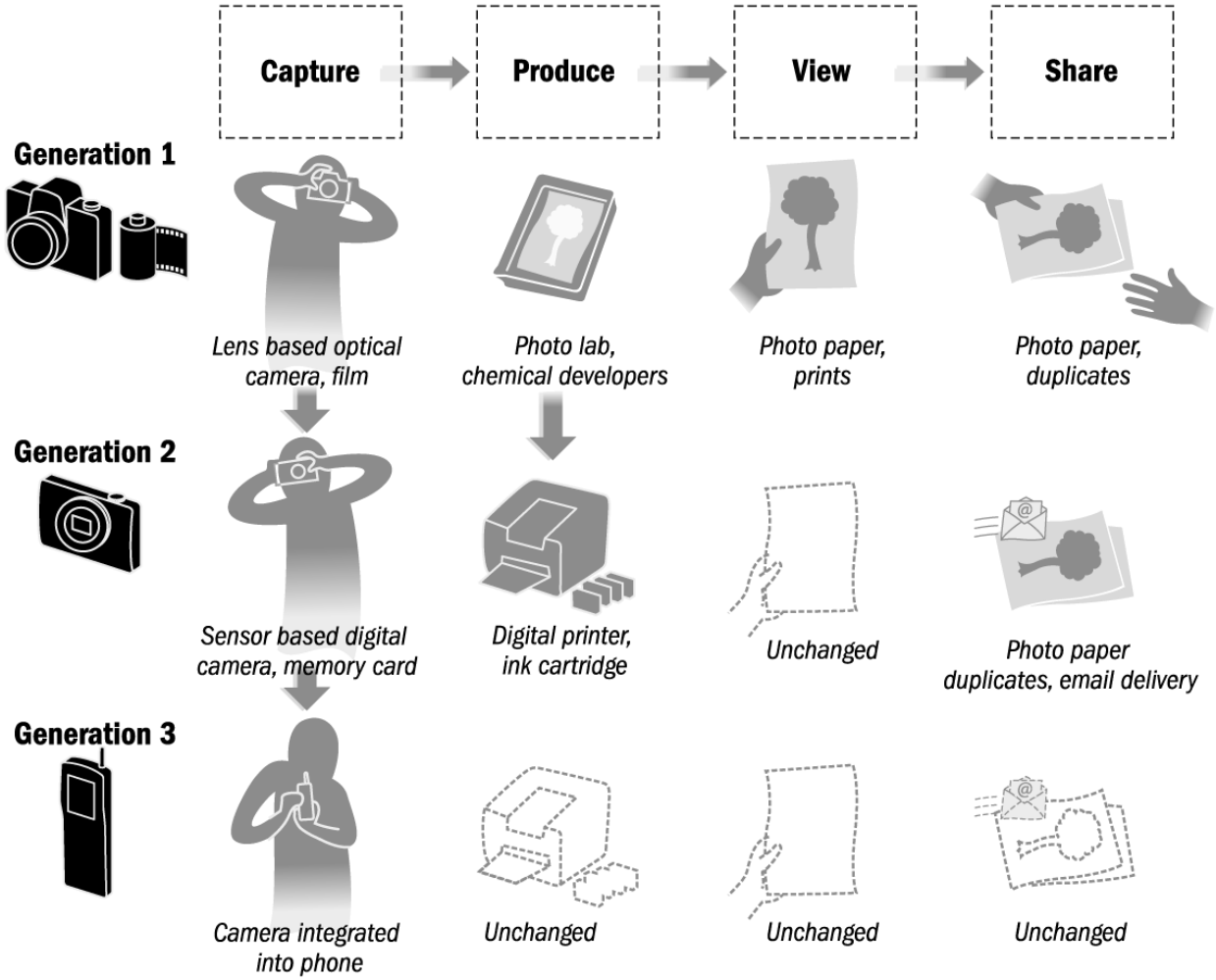
The Value Architecture is What Provides the Value

From Ron Adner,
Wining the Right Game,
https://ronadner.com/books/



Value Architecture versus Value Chain versus Value Engineering

→Value Architecture is the functionality you deliver to the End-User (who may also be the Customer) that provide the Value

> The Design is how you provide the functionality in the Value Architecture

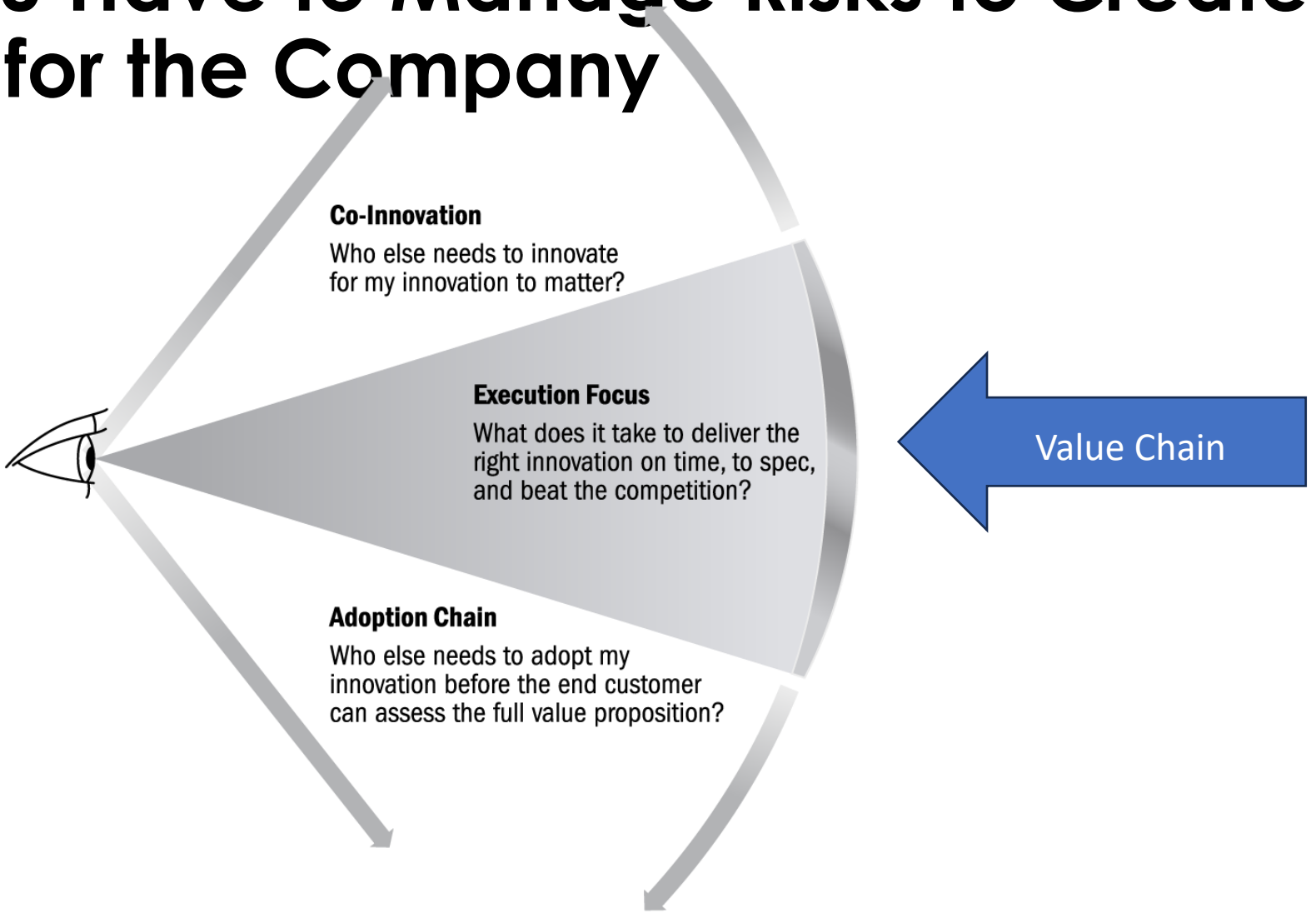
→Value Chain is how you build or create it and get it in the Customer's hands

> The activities and tasking required to create, make, sell, deliver, and support the product or service

→Value Engineering is how you optimize Value for the End-User and Yourself

> The selection of the most effective and cost-efficient options for the Design and the Value Chain

But You Have to Manage Risks to Create Value for the Company

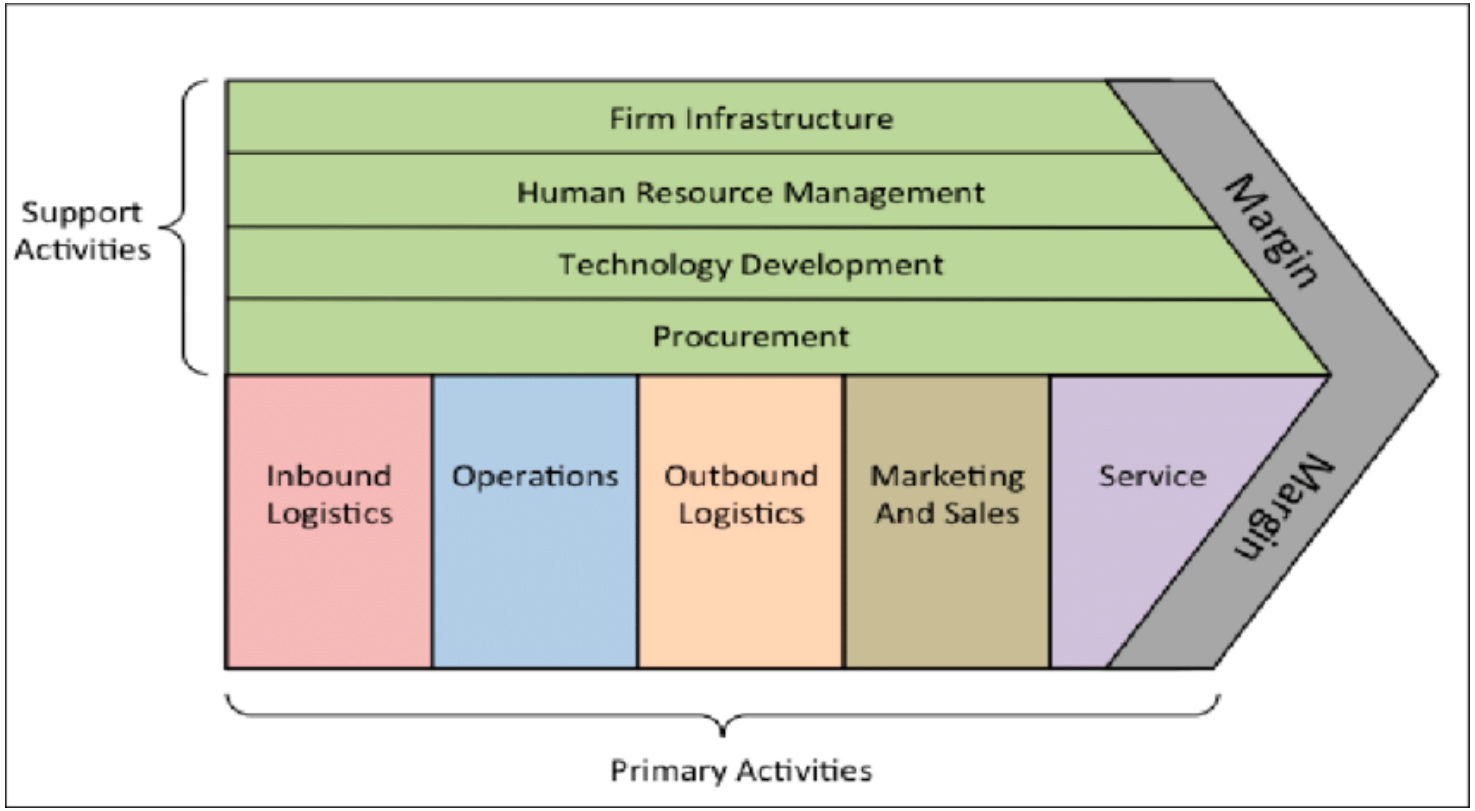


Why Do We Care about Risk?

- Risk is the fear of regret
- What do you regret?

- ❑ Losing Money
- ❑ Needing to Spend More than Budgeted
- ❑ Being Late to Market
- ❑ Failure (Technical, Market) and Bankruptcy
- ❑ Other

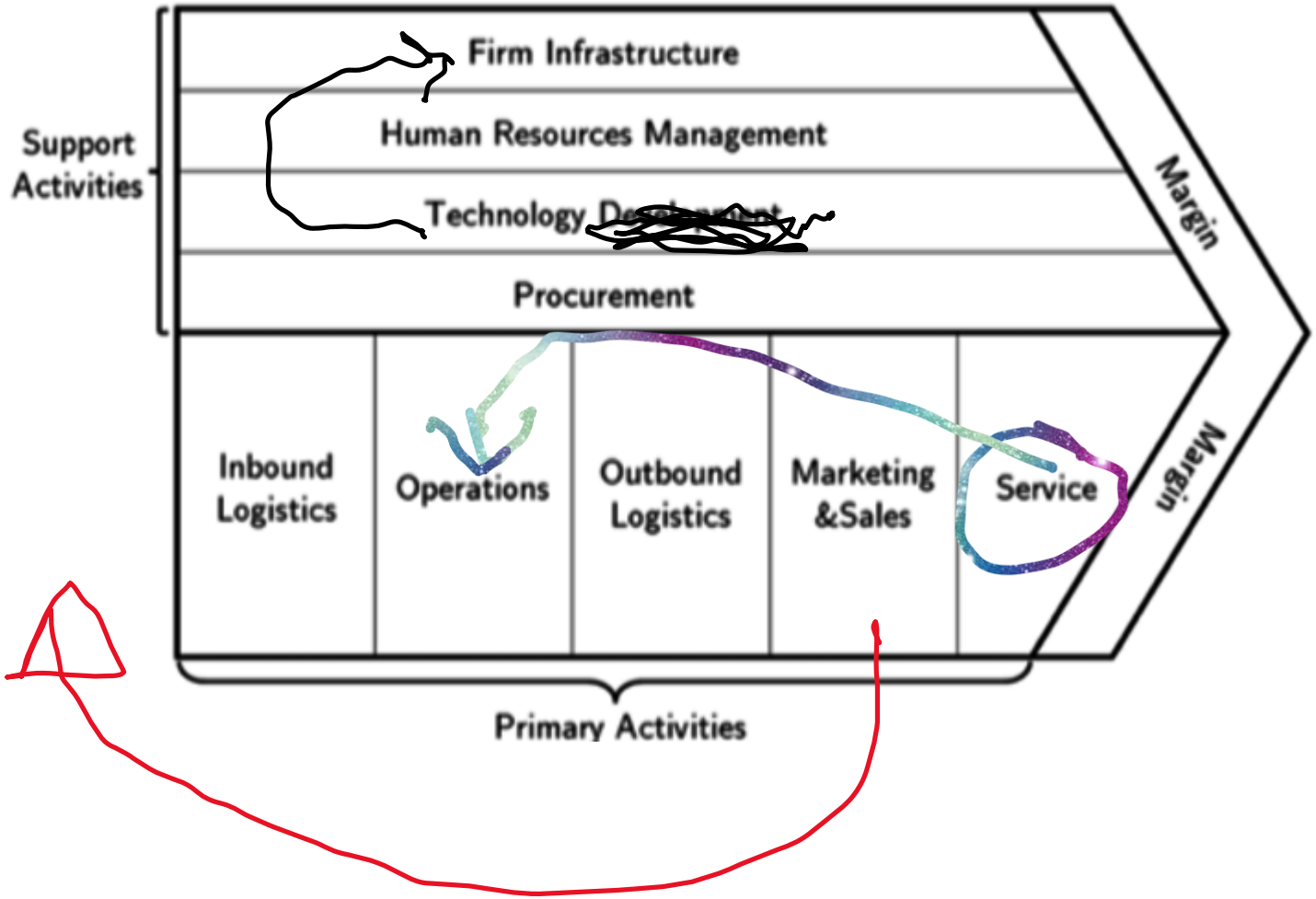
The Value Chain is where Executive Risk Occurs



Porter's Value Chain

From [Toolkit on New Product Development and Inventions in the Public Domain (wipo.int)]

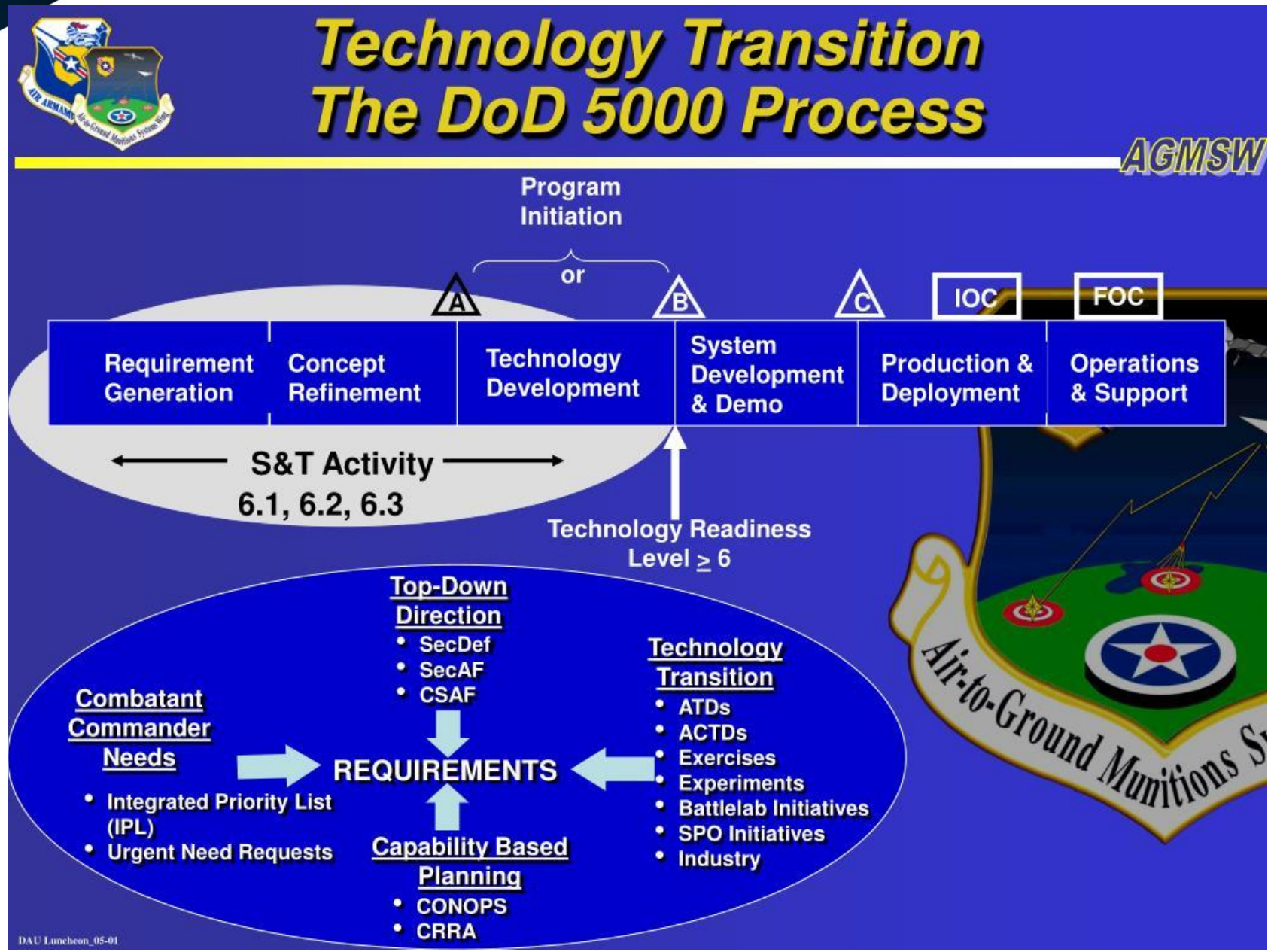
Porter's Value Chain is an Architype of a Manufacturing Operation



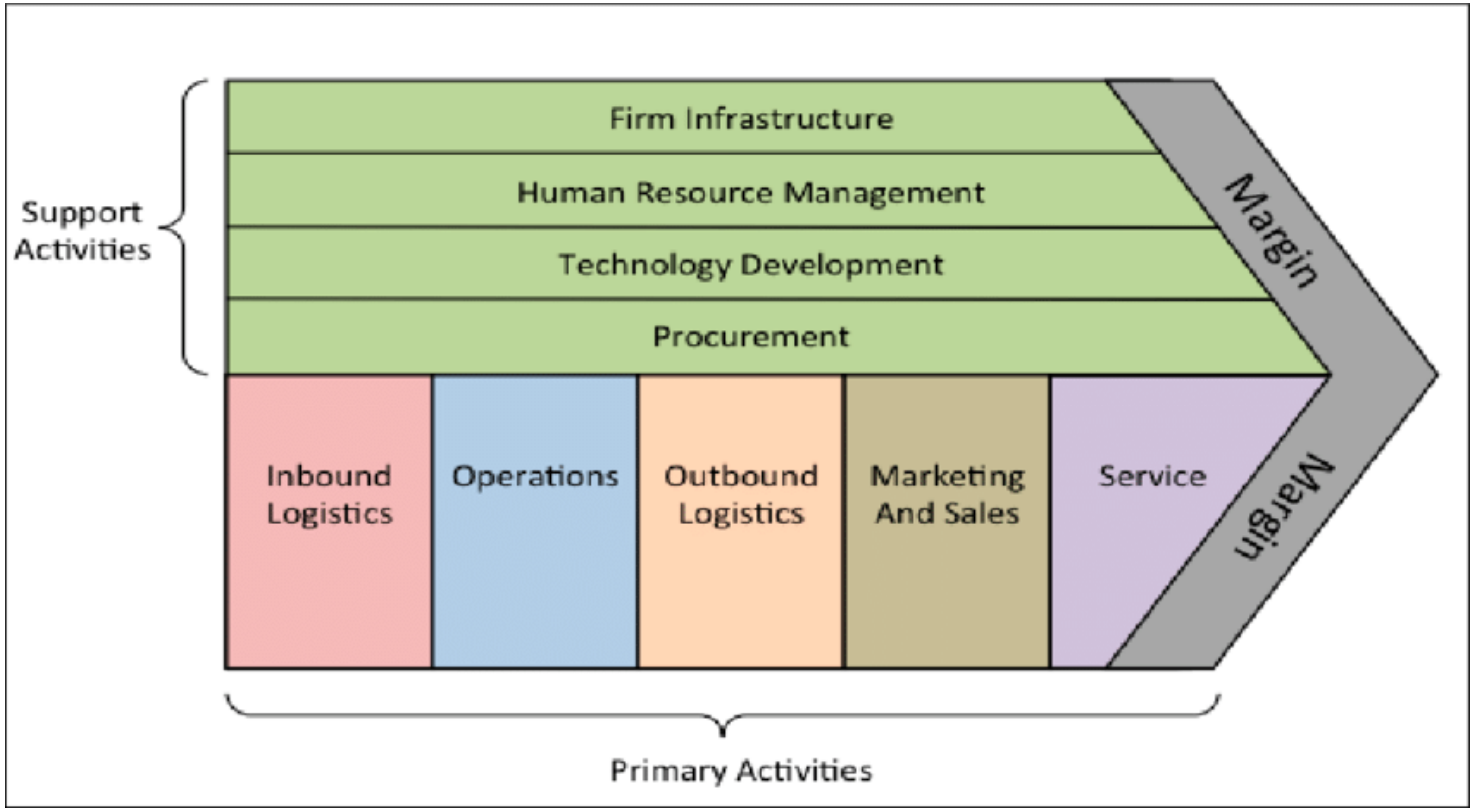
Traditional Service Business

Technology Transition
The DoD 5000 Process

AGMSW



Research “Company” Applying for Pre-Seed?



Seed Applicant?

Cyprus Seeds?

Innovate?

Risks

Step Function

- Within your control
  - ❑ Technical Risk
  - ❑ Firm Specific (People, Equipment, Facilities, Funding, Etc.)
- Address with slack budget and time to allow implementing alternative approaches

Probability Distribution

- Outside your control
  - ❑ Market
  - ❑ IP
  - ❑ Regulatory
- Address with early preventative measures

When to Worry About Risk

RISK ASSESSMENT MATRIX

Risk Description	Business Impact	Probability of Occurance	Priority
	(1, 3, 5)	(1, 3, 5)	
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0

1-low, 5-high

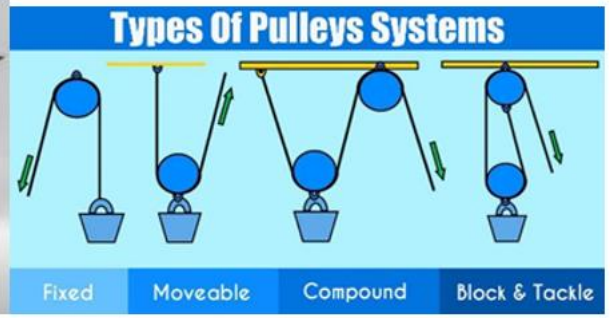
Management of Risks

Presence of Prior Experience, Skills, Knowhow, and Education

Time and Money Impact

Significance/ /Likelihood of / Occurance	High	Low
High	Avoid	Mitigate (Contingency Plans)
Low	Mitigate (Contingency Plans)	Accept (Muddle Through)

Exercise: Which is Higher Risk and Why



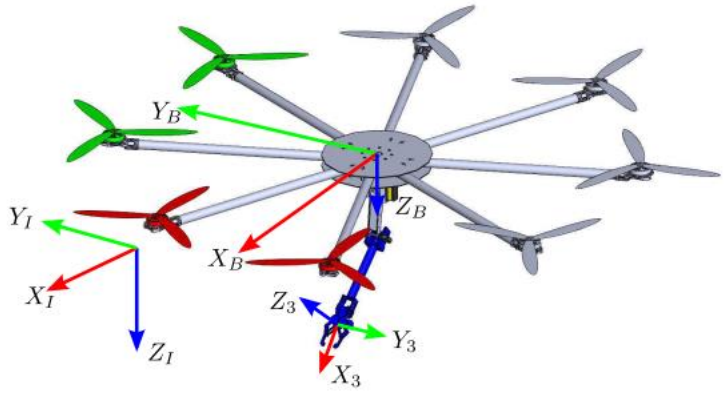


Figure 3. Conceptual design of the octorotor UAV with manipulator arm.

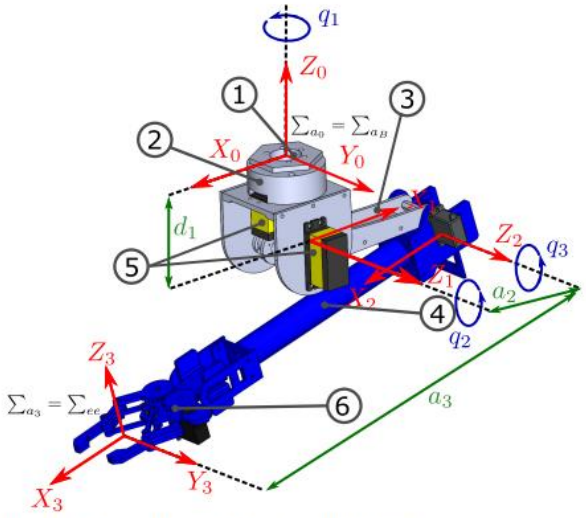
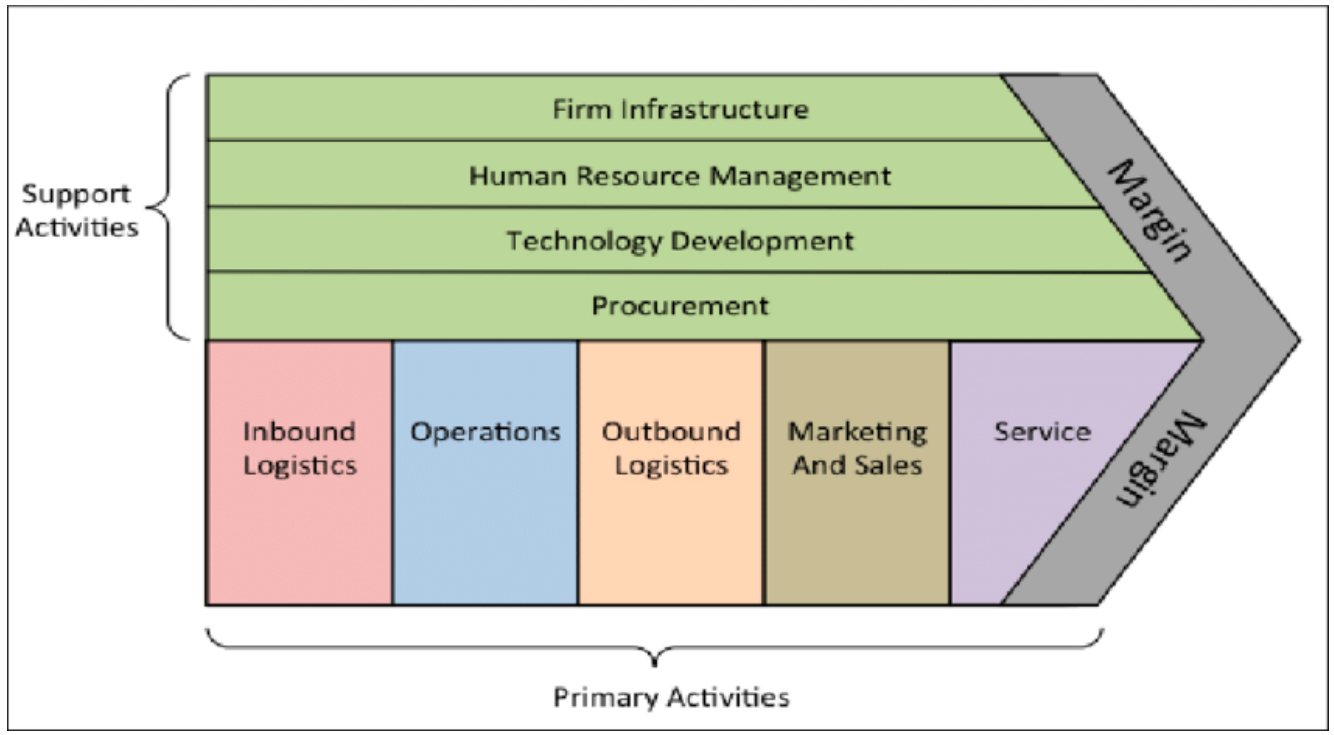


Figure 4. Design and components of the manipulator arm.

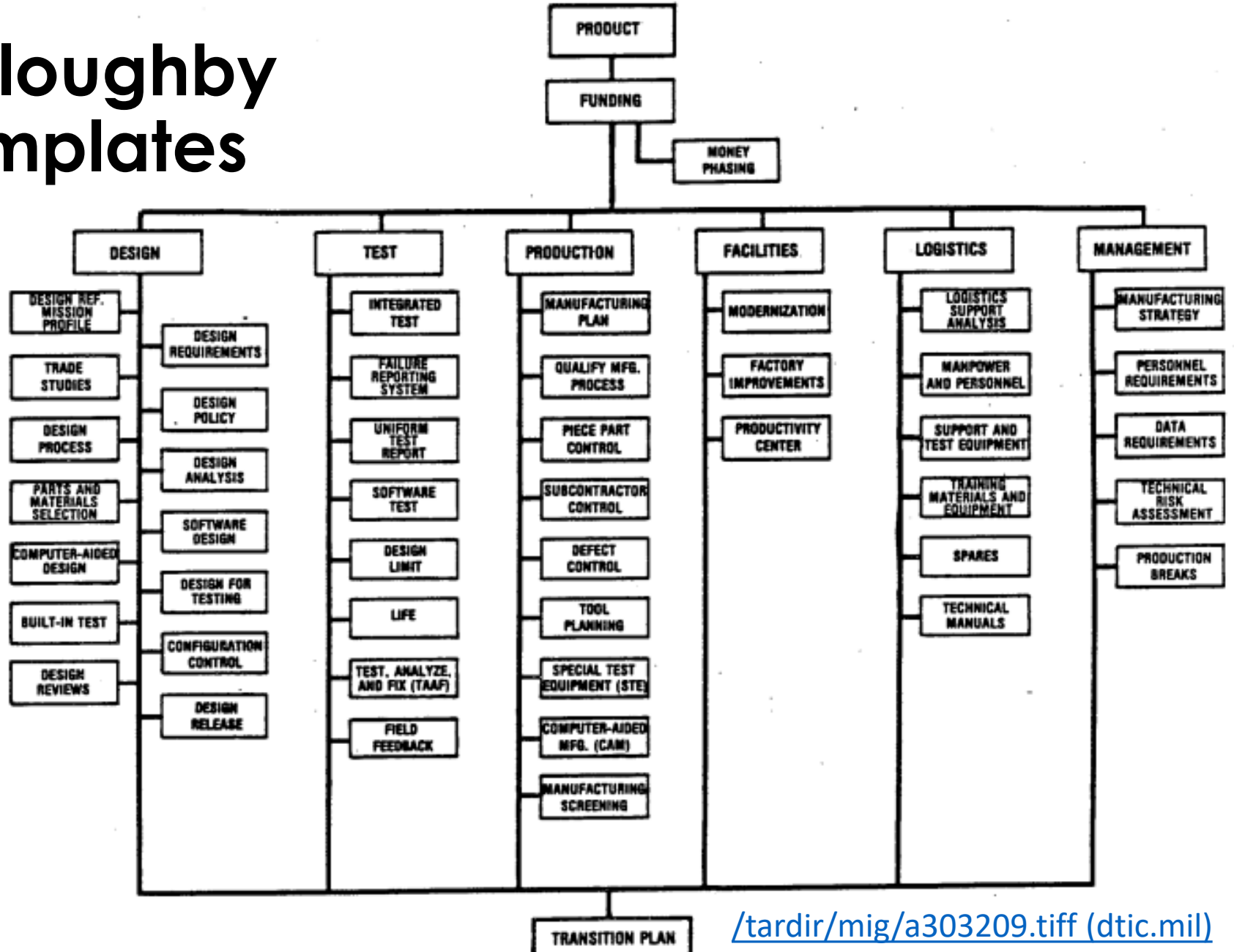
Exercise: Rank as 1 – Low Risk, 2 – Moderate Risk, or 3 – High Risk and Explain Why, Where it Occurs in the Value Chain, and Best Response to Risk

(Ask what you want to know before answering.)



1. Developing a hierarchically structured bioinspired nanocomposite arm rather than using a titanium one.
2. Buying COTs cables, miniactuators, and integrating them with your own proven software for precise package delivery.
3. Having a vendor make a custom acoustic, pressure, and visual sensor package and software and integrating it with your software for package delivery.

Willoughby Templates



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Structure of the Willoughby Templates

→Activity

> Description of Activity

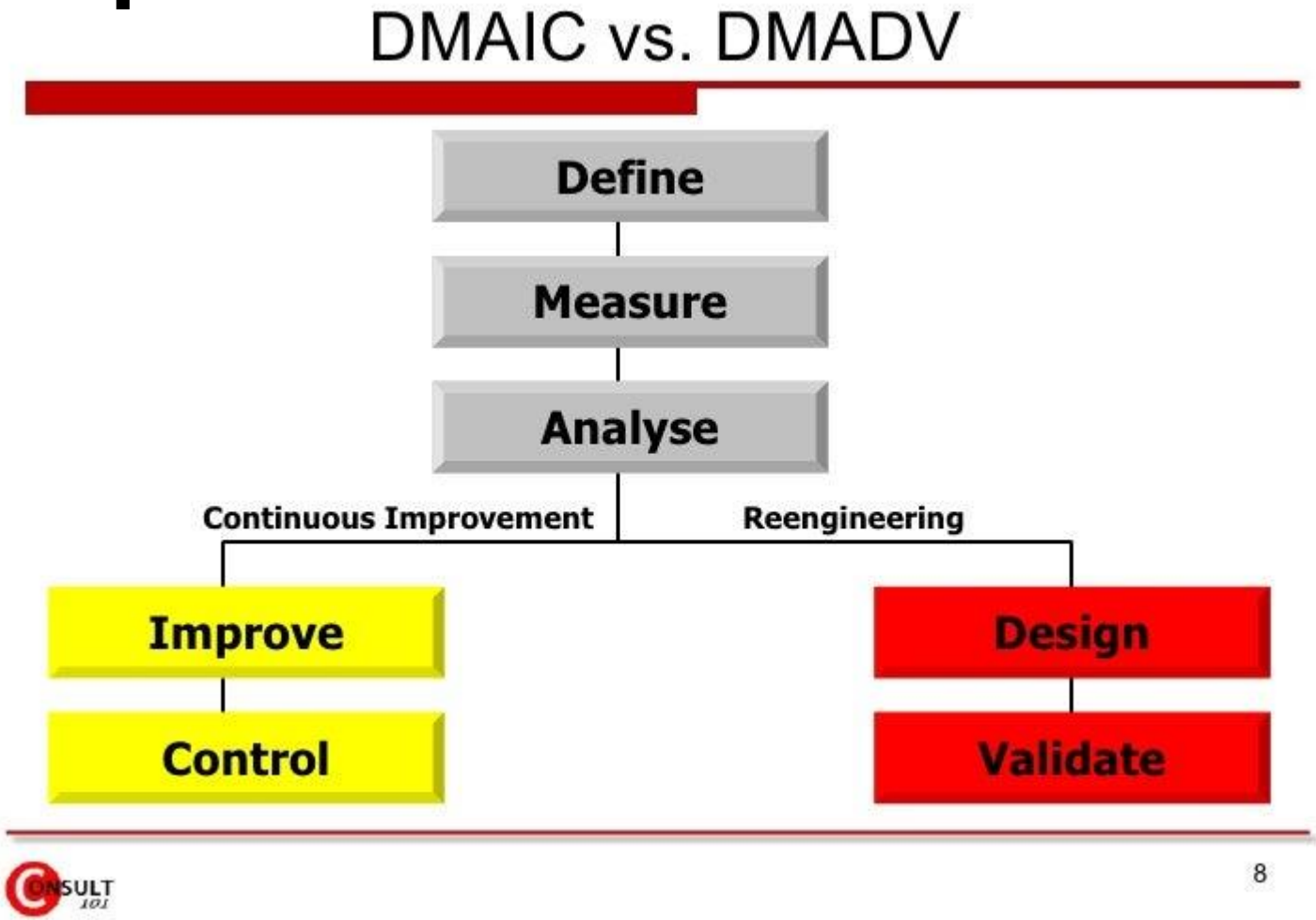
> Areas of Risk

> Outlines for Reducing Risk

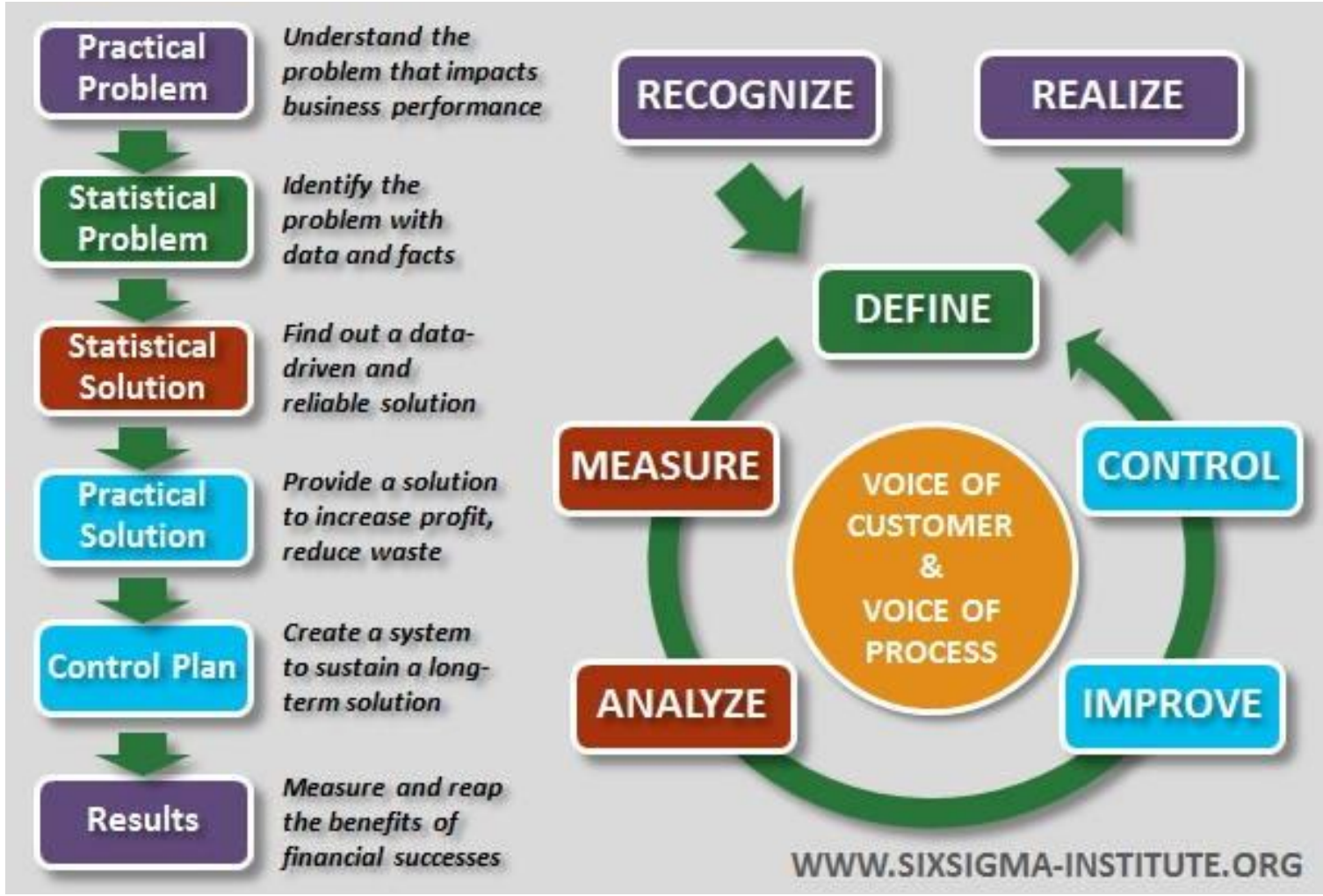
> Timeline for Activity

> Personnel Required

Six Sigma Steps

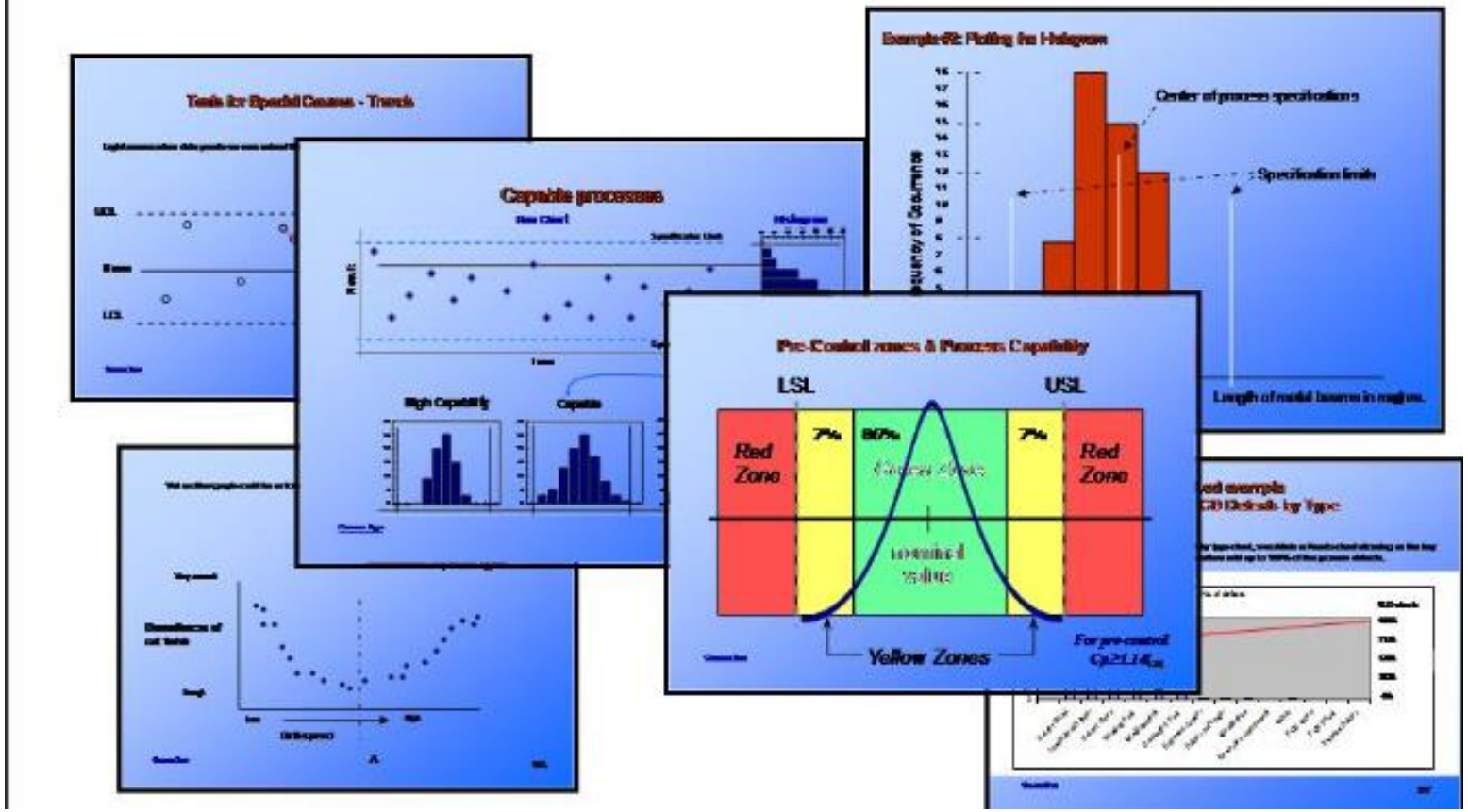


Six Sigma Tasks



Statistical Process Control

There are a wide range of statistical tools and techniques which can be applied to process improvement, such as Pareto charts, Histograms, Scatter diagrams, Run charts, etc.. The technique most synonymous with statistical process control is the SPC Control Chart or Shewart Chart.



[What is Statistical Process Control : PresentationEZE]

Value Chains and Risk

1. Understand the activities and their risks
2. Eliminate, avoid, or mitigate the risks
3. Plan how to monitor for missed or known risks (i.e., it is a continuous process)
4. Rapidly respond to eliminate or mitigate risks when they occur
5. Implement a fix for the future

Stretch, Coffee, Network and Discuss

Value Engineering

→Eliminates activities which do not contribute to implementing the Value Architecture

→Is an NPD activity tied to design and value chain creation and review

→Asks how can you deliver value (i.e., benefits) sought at the least possible cost

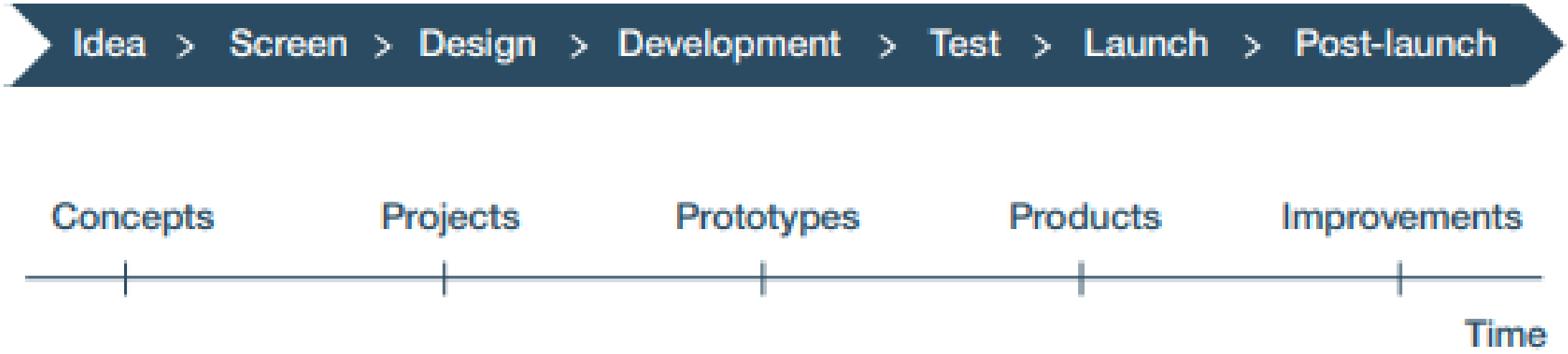
Measuring Value

→Product Value = Desired Functionality/Cost

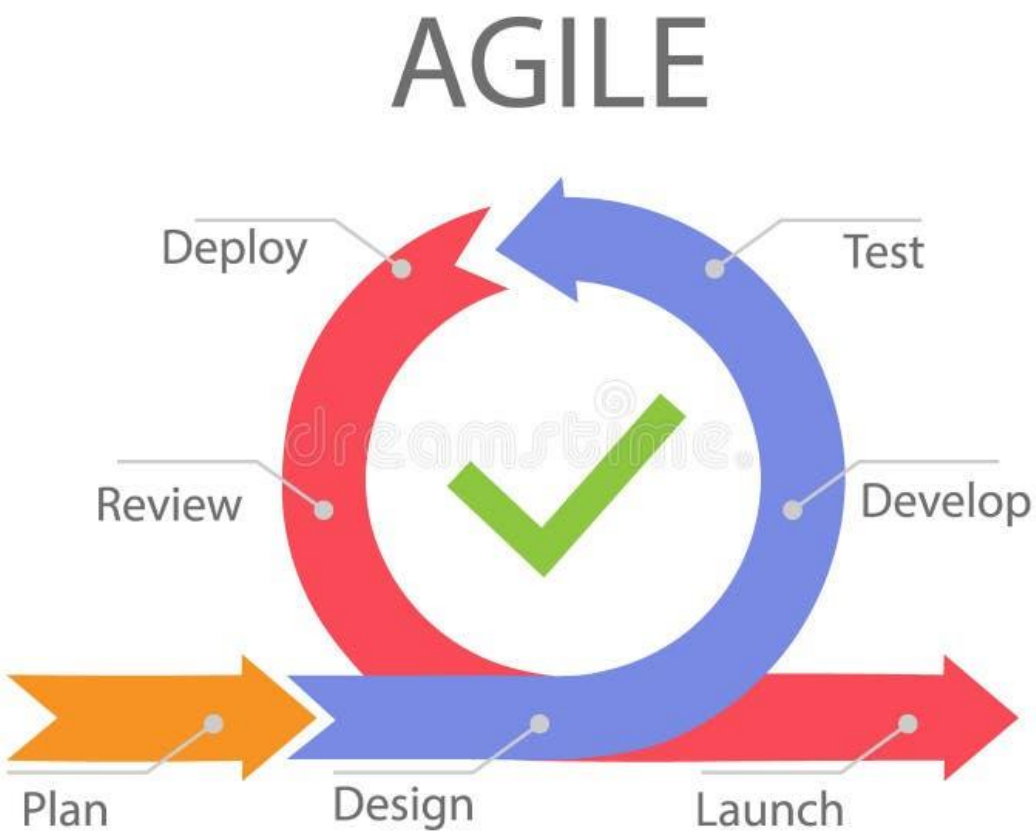
> Product Value = Use Value + Cost Value + Esteem Value - Exchange Value

> Functionality is set by End-user and Customer Requirements ("Voice of the Customer")

Tied to NPD

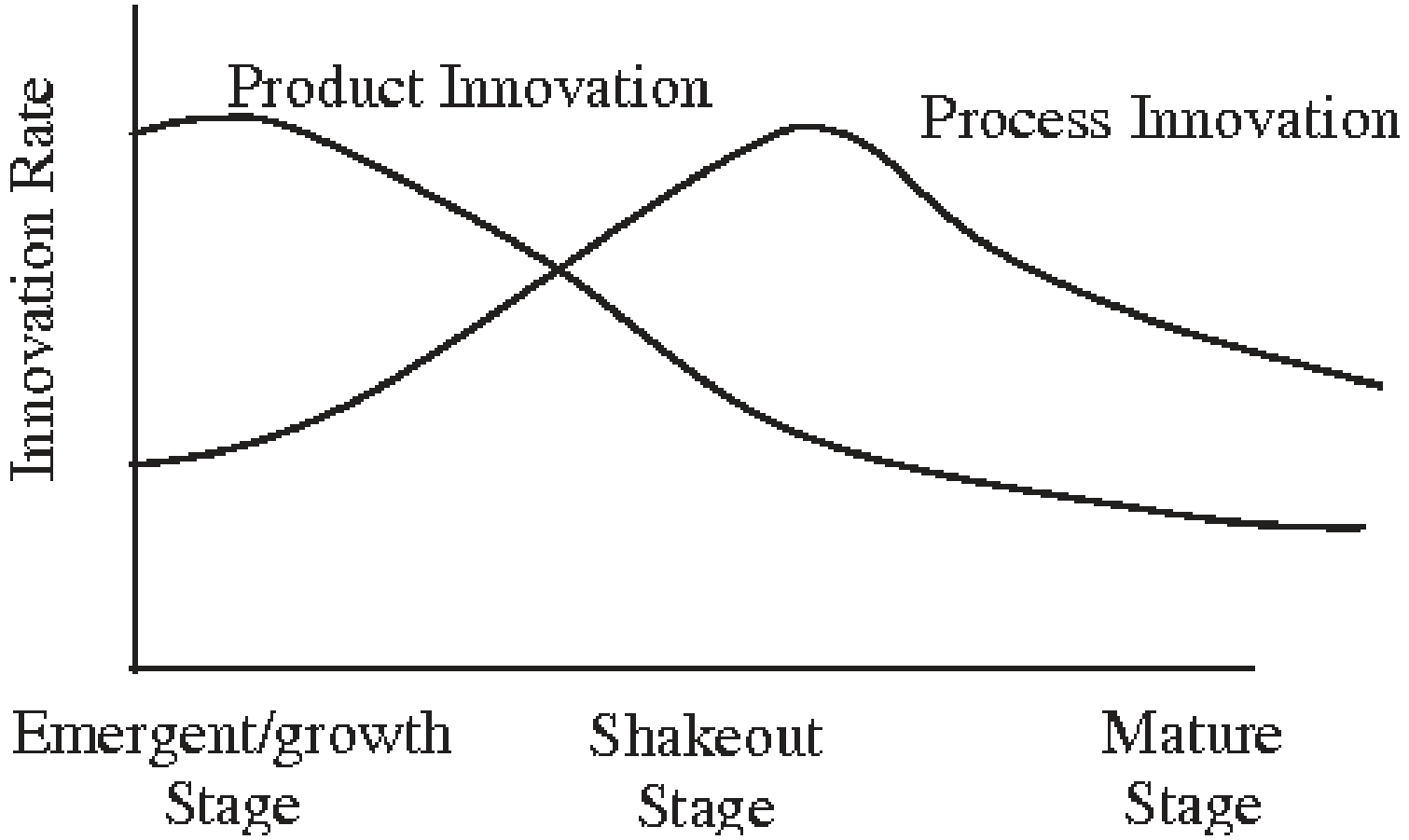


tisc-toolkit-learners-guide.pdf (wipo.int)



[Agile Sprint Infographic Stock Illustrations – 197 Agile Sprint Infographic Stock Illustrations, Vectors & Clipart - Dreamstime]

Acts as a Hedge against Innovation Resistance



[PDF] 1 Technology and Industry Evolution | Semantic Scholar

Dominant Designs

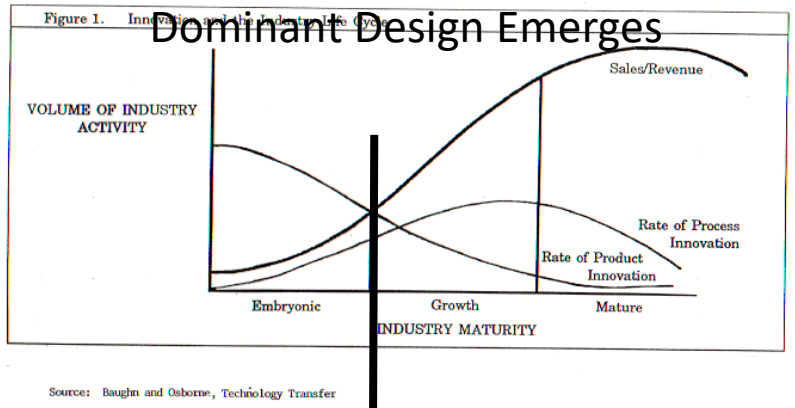
Innovation Focus

→Product Innovation

- > Features and Functionalities
- > Equipment and User Interfaces

→Process Innovation

- > Eliminate Steps
- > Improve efficiency of resource use
- > Improve Ease-of-Use

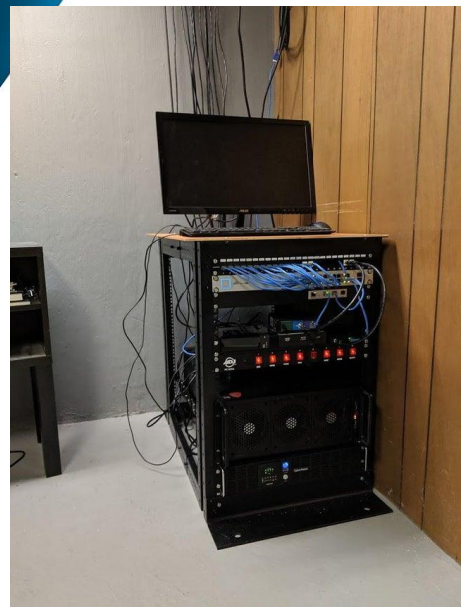


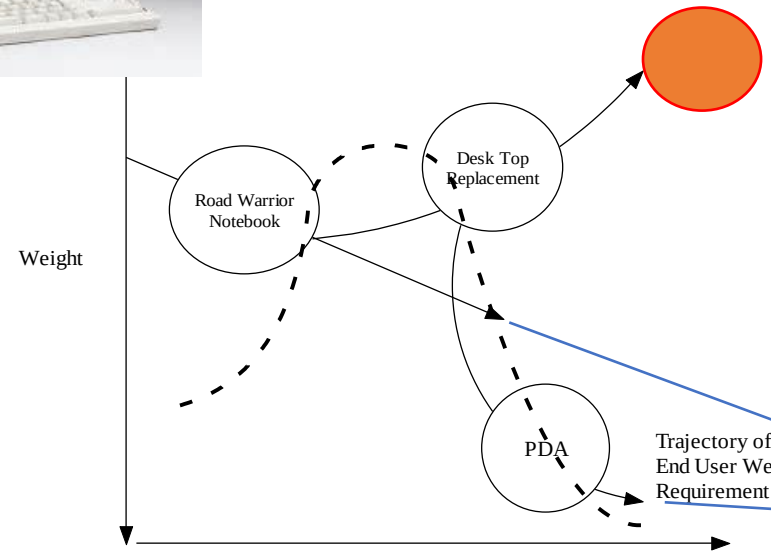
Dominant Design Emerges

Dominant Designs Solidify Over Time

- Standards
- Regulations
- Certifications

Portable Computers



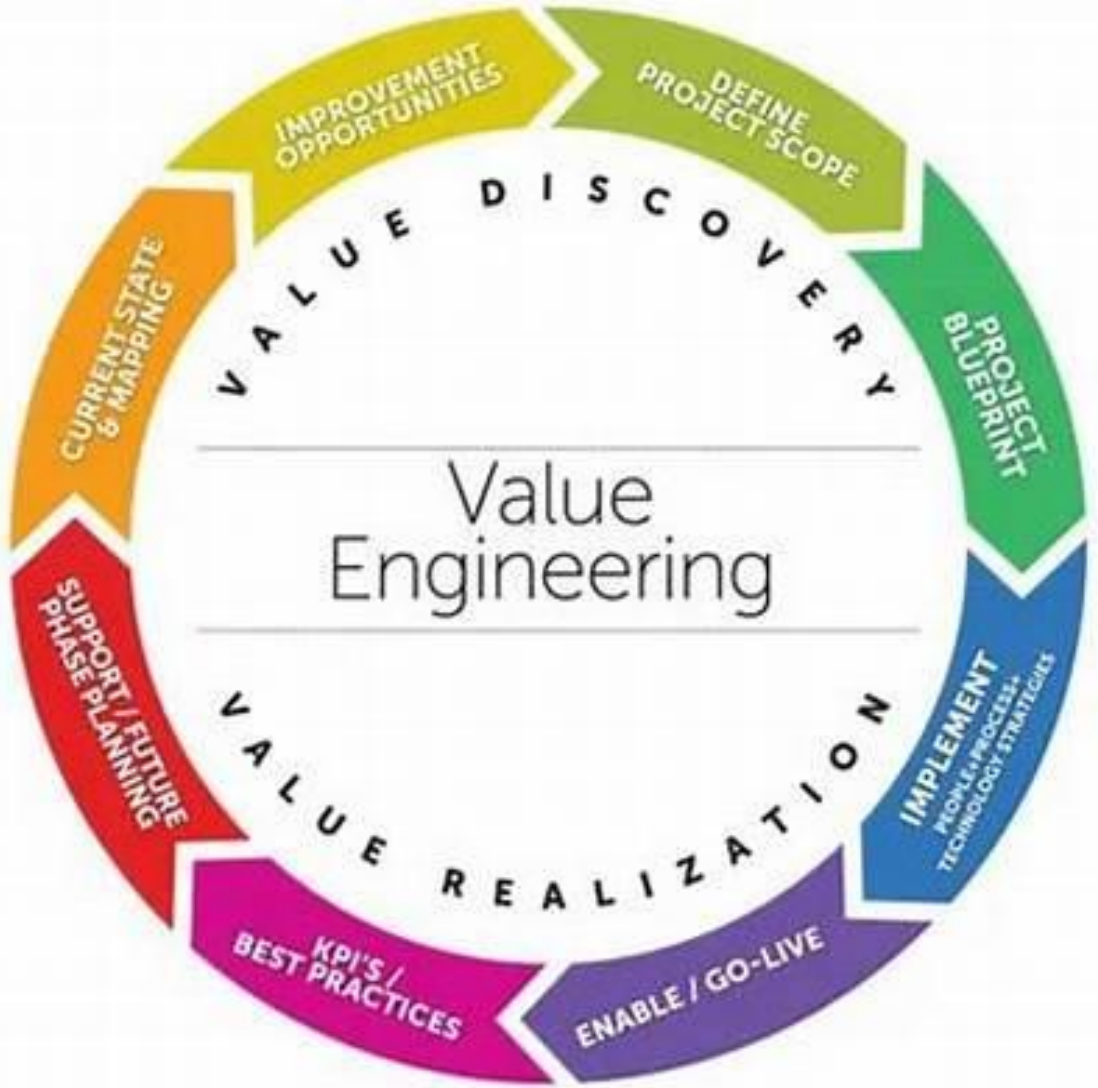


Peripherals

Dominant Designs and their evolution are a commonly used implicit basis for most Value comparisons (i.e., functionality and cost)

Steps in Value Engineering

1) Collect Information on functionality, cost, and the activity
2) Find Alternatives
3) Evaluate the Alternatives
4) Develop the Implementation Plan
5) Get Sign-off to Implement
6) Implement
7) Capture and Share



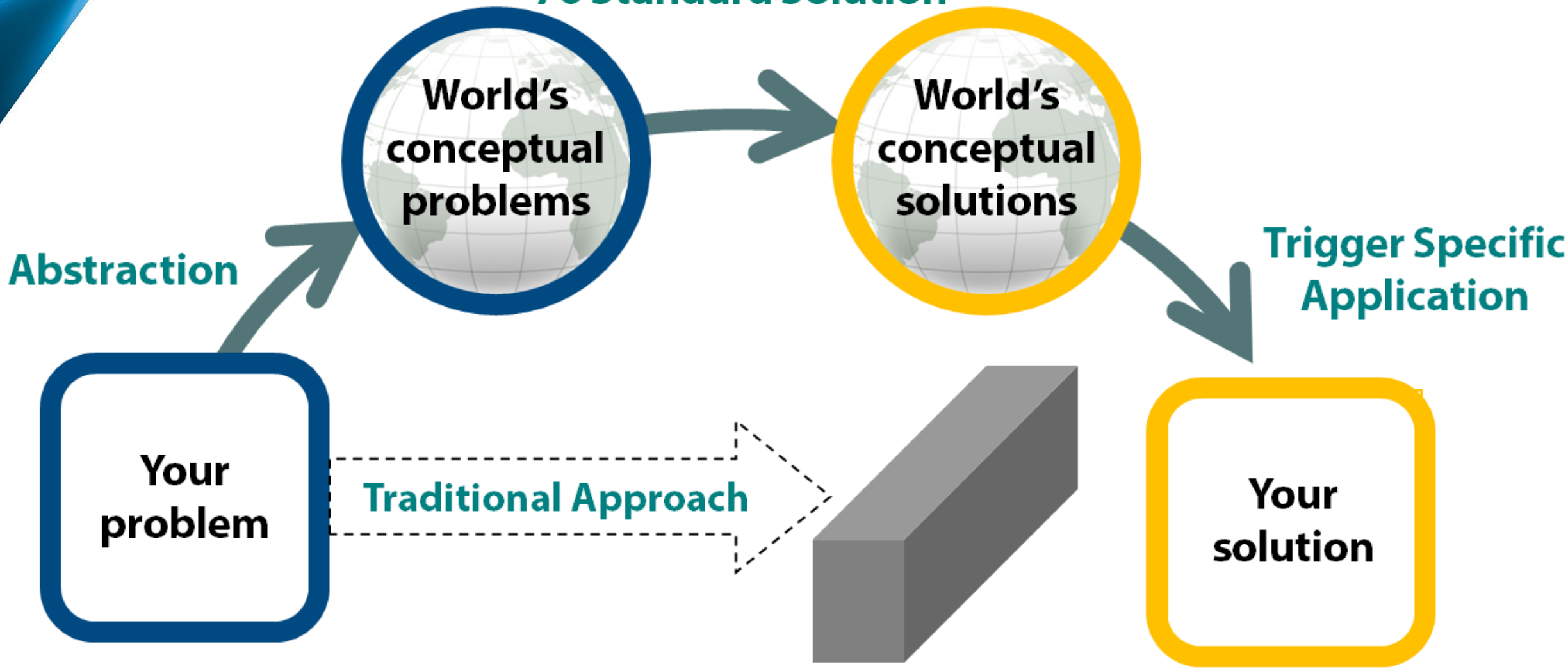
(720) Pinterest

Example of Solutions

[Value Engineering - Creative Solutions (letsworktogether.us)]

TRIZ

40 Principles
Trends of Technical Evolution
Effects Database
76 Standard Solution



page A - 40 principles of invention in TRIZ method, sketches rendered into vector graphics

page B - 40 principles of invention in TRIZ method, sketches rendered into vector graphics

01) DIVISION

a) a ship built, made of removable / replaceable bulkheads
b) multi-engine aircraft
c) multi-piston engine of internal combustion
d) a toy made from Lego blocks
e) brekeable chocolate
f) multi-grip gators
g) a binded file of paper sheets
h) multi-blade cartridge razors
i) multi-blade airscrews of aircrafts, or wind power-plants

02) TAKING OUT

a) taking of notoriously noisy power unit, or compressor out of the main boat
b) {engines, turbines, blades} combined with internal ducts for air ventilation system, taken out of the building, i.e. placed on the buildings elevations
c) sound of bird's predator, previously registered on a tape, and played back, can be used scaring away the birds, notoriously flying near or around the airports

03) LOCAL QUALITY

a) dustless excavation of coal - the dust is captured by tiny droplets inside of the water cone - bigger droplets outside of the cone keep the dust in a place

other examples:
b) weighed average from marks
c) weighed estimation produced for rankings of computers, printers, etc.

04) ASYMMETRY

a) pneumatic tyre asymmetrically reinforced from outside, due to contact with pavement curb
b) left- or right-handed rules of priority, in right of road
c) slanted concrete mixer, blender,
d) asymmetrically built conjuctions, handles
e) asymmetrically defined functionality of the 'trap-the-door' mechanisms
f) asymmetrically built car, due to either left- or right-sided driver's sit

05) MERGING

a) several computers combined into functionning network
b) a hedge made of pales
c) textiles made of wool/poliestre/cotton fibres
d) roofing tiles combined into coverage of house roof
e) mobile concrete mixer, mobile crane, refridgerator, merged into single mobile machine unit, combining of the stationary machines with mobile undercarriages

06) UNIVERSALITY

a) a helmet in use, within field conditions, rendered as:
b) universal "handy-tools"
a1) spade
a2) frying pane
Swiss Army knife
c) sets of universal kitchen robots, mixers, blenders, with operating actuators (rasps, juice extractors, etc.)

07) EMBEDED STRUCTURES (nested "Dolls" - Matryoshka)

a)
b)
retractable car radio antennae, retractable fishing rods, etc.
c) radiators of ultrasound welders

08) ANTI-WEIGHT (ballance preserving)

a) wind turbines (moment of inertia in set of smoothing gusts of wind)
b) anti-airscrews
c) fish bladder (fish submerged in water)
d) baloon filled with hot air
e) slipping hydrofoils boats
f) concept of hoover crafts
g) fishing floats, floating beacons, etc.

09) PRE-ELIMINARY ANTI-ACTION (COUNTER-ACTION)

surrounding sounds
counter-acting acoustic waves
active earphones
piezoelectric anti-impact system for cutting tool

10) PRE-ELIMINARY ACTION

a) b) parking of hard disc reading/writing heads (when it is needed)
OFF (parking mode)
ON (operational mode)
blowing off of the (potentially chocked) nozzles in printing catridges

11) BEFOREHAND CUSHIONING

a) for instance: a method of "dressing" of the cut tree branches (this action, actually forces a tree to beforehand reaction, to gather healing substances)
a pressure band
b) driver's airbag
c) masking of the chosen elements, within patches on the object, before its painting

12) EQUIPOTENTIALITY

a) a sequence of linear movements is replaced by single seamless movement on section of arc
a heavy element of the press, lifted up, and carried away usually in sequence of linear movements,is replaced with press deflected on remotely fasten long arm
a sequence of linear movements
a press deflected from position (3-4) on long arm
b) dissolvable surgeon threads
c) rather to cool down stuck inner object, than to heat up other bigger outer object, which seizes the former one

13) INVERSION (UPSIDE DOWN)

a) for instance: in reversing the working mode of vacuum cleaner (then, vapour could be used in cleaning of carpets)
b) to turn mounted object upside down, on assembling line
c) turning (object in move, while motionless turning tool), against milling (mobile milling cutter)
d) binary tree's structure is sought from root to leaves in one (in-depth) search algorithms, while another algorithm seeks throught nodes from leaves to root

14) SPHEROIDALITY, CURVATURES

a) applications of: bearing rollers, spirals, shafts, spheres, demi-domes
b) replacement of linear movements by circular movements
c) application of arcs in architecture demi-domes in vaults of building
d) circular accelators (synchrotrons / magnetrons), in place of concept of linear accelators of particles
e) extensible, retractable measuring tape

15) DYNAMICS

a) automatically extensible/opened doors, air-locks ,etc., reacting when it is needed
b) automatic gears in mobiles
c) undercarriages in cars of variable stiffness characteristics, tuned exactly to terrain conditions during the driving
d) electronic controllers for carburettor, electronically controlled fuel injection in depedency of driving conditions

16) EXCESSIVE (OR PARTIAL) ACTION

a) in close fit of both piston and cylinder of the engine
material allowance left in fit on inner side of cylinder destined for lapping
b) to spray excessively paint, and then to remove the excess of the paint
c) to fulfill the fuel tank, and then to remove the excess of fuel

17) ANOTHER DIMENSION

a) two colliding tools in 1D should be rearranged in 2D plane
likewisely, tools colliding on 2D plane should be rearranged into 3D space
b) to stack vertically containers, chairs, laptops, etc.
c) science of complex symmetries in crystallography
d) use of Lie algebra, in analysis of structures of atoms (in studying of electron shells, around atomic nuclei)

18) MECHANICAL SELF-INDUCED VIBRATIONS (IN RESONANCE)

a) piezoelectric engine - a conceptual design
electric circuit of inducement
spring based tighments for set of two discs
direction of relative movement of upper disc
direction of aerial wave & relative movement in lower disc
both sided metal plating of layer ceramic material fasten to lower disc
b) quartz generators, in electric circuits

19) PERIODICAL ACTION, OR PULSED ACTION

a) hammer drill
e) pulse amplifiers
b) pulsed laser, against lasers of continous operational mode
c) "pseudo-analogue" driving (PWM) (Pulse Width Modulation)
d) pulse DC power unit, against conventional DC power unit
f) step motors

20) CONTINUITY ACTION OF USEFUL ACTION

a) enlarging drill, operating in both directions
b) nozzles of catridge, printing also in returning direction (without idle mode)
c) steam turbines of generators for one power plants, working continously (in optimal mode), while the others working, as pump-storage power plants, in aim of storing of energy for afternoon hours
(mode: pumping of the waters into upper reservoir on mornings, while emptying upper reservoir into lower one on afternoons)

21) SKIPPING, QUICK MODE, OR PACE OF REALIZATION

a) wood-borne materials in quick thermal processing
temperature close to point of ignition
quick thermal processing, while preserving properties of the material
b) laser treatments of biological tissues or on processing of hardly processed materials (both extremely soft and extremely hard) without thermal deformations, scorching, burnings
c) pico-second pulsed lasers (femto-second lasers) against laser of micro- and nano-seconds pulses (various materials virtually have been vaporized, while treated with pico-second pulsed laser beam of energy)
d) steel hardening process in abrupt temperatures changes

22) "BLESSING IN DISGUISE" (CONVERT HARM INTO BENEFIT)

a) burning out in outskirts of the main fire, to cut of fire's fluel
b) to blow out the blazing fire from top of oil well in detonation blast
liquid nitrogen (N_2)
c) permafrost materials are to be 'treated' with liquid nitrogen
the material's permafrost rapidly "liquefies"

23) FEEDBACK PRINCIPLE

input signal
object
output signal (indoor's temperature regulation)
closed loop with negative feedback
(temperature)
b) autopilot provided with 3-axis gyro system
c) robot arms movement's back-controlled in set of:
1) diode - 2) photodiode -3) semi-transparent either: protractor, or: linear scale - placed in between

24) INTERMEDIATE MEANS, "FITTING" PRINCIPLE

a) in electronic circuits fitting either of:
- impendance,
- or resistance,
of input source to the receiver
b) fitting in mean of:
- pressure-flowing (fluid mechanics),
- loading of force moments, in transmition gears (mechanical fitting)
- stress of two interfacing surfaces (endurance)

25) SELF-SERVICING PRINCIPLE

a)
b)
self-servicing ling's deicing system:
temp <0°C
temp >0°C
constant regeneration of the glower of halogen lamp
tungsten sublimates to halogens then, to redeposit on tungsten glower

26) COPYING, IMAGING PRINCIPLE (application of optical mapping)

a) use of ultrasounds
ultrasound mapping
b) magnetic resonance mapping
c) X-rays radiography
d) in mapping of material structures the application of:
- infrared
- ultraviolet
- basically of optical methods
e) use of fluoroscence and of scintilation's materials

27) INEXPENSIVE SHORT-LIVED OBJECTS (CHEAP CADUCITY, & OF DISPOSABLE MATERIALS)

a) kitchen utensils, dishes, cutlery made of plastic
b) disposable syringes, gloves, etc.
c) plastic bags, packaging wrappers, etc.
d) printing head integrated with ink catridge
(formerly, each printer possessed built-in printing head)
(presently, each of ink catridge has its own printing head)

28A) PRINCIPLE OF SUBSTITUTING OF MECHANICAL SYSTEM WITH FUNCTIONALLY EQUIVALENT ELECTRO-MAGNETIC SYSTEMS

electric field
to substitute with interaction of:
mechanical pressure or fastening
magnetic field

28B) SUBSTITUTING OF MECH. SYS. WITH ELECTRO-MAGN. SYSTEMS

B) magnetic borne pressure of the machined materials
object's pressure
pneumatico-magnetic pressure cushion
C) mobile fields instead of static fields
D) heterogenous fields

29A) PNEUMATICS & HYDRAULICS

- pneumatic automobile tyre,
- pneumatics (air-tight) dampers,
- automobile airbags,
- pneumatic "discrete", driving of operational actuators, for instance: in automatic welding of packaging covers made of plastic wrapping

on the figure above, in blue: approximate section of automobile pneumatic tyre

29B) PNEUMATICS & HYDRAULICS

- automobile brakes,
- in driving of plane elevator,
- where the precision of driving is needed, as well as enormous force transition

$F_2 >> F_1$
brake's block
hydraulics in communicating vessels
F_1
F_2
S_1
S_2
$F_2 = \frac{S_2}{S_1} F_1$

30) FLEXIBLE FILMS, FOILS, MEMBRANES

a)
not wettable film prohibits evaporation of water
b)
wrapping packaging based on plastic, air-pumped bubbles
c) flattable ballcons, domes, barriers

31) POROUS MATERIALS

a) aerated concrete (porous concrete)
b) porous abrasive tools
c) polyurethane foam
d) catalysing surfaces in chemistry
e) "vacuum" as a "construction building material"
f) openwork structures reinforcements
g) porous, sponge materials in kitchen getters
porous abrasive grains
geometry of grinding wheel
pores in grinding wheel allow for: self-regenerating process, draining of abrasing heat, collecting and depositing of chips
binding material

32) COLOUR CHANGING (ALTERNATING)

in lapping process for inner surfaces of engine pistons & cylinders,the probing of phosphorescence distribution can be used

33) HOMOGENEITY

the two interfacing surfaces should be made of the same material
moreover, the similarities can be applied, regarding:
- comparable mat.'s hardness, chemical inertion, structures,
- comparable thermal expansion's coefficients, (in case of dental materials; metal-glass conjunctions),
- comparable electro-chemical potentials (in avoiding electro-chemical borne corrosion)
- same fatigue characteristics, and amortization specifics

34) DISCARDING & RECOVERING, (REJECT & PARTS REGENERATION)

a) dissolvable medication capsules made of (biologically inert material)
b) IV stage, III stage, II stage, I stage
rocket's stages subsequently discarded during the flight
c) cornstarch-based packages for dry products

35) CHANGING STATE, PARAMETERS, PROPERTIES OF MATERIALS

1) high temperature food processing
temp >>0°C
2) low-temperature food preserving
temp < 0°C
3) a product ready for further processing step (for submerging in liquid chocolate)

36) PHASE TRANSITION

a binary, phase transition cycle for refridgerator construction
heat flows from surroundings (red arrows directed to blue heat exchanger)
heat flows
temp <0°C
temp >0°C
necking
compressor
liquefied ammonia, heat carrier, (freon, ammonia, etc.)
circulation of an external fluid in heat exchanger

37) THERMAL EXPANSION

1) thermal shaft fitting
temp < 0°C
temp > 0°C
2) state of thermal ballance

38) STRONG OXIDANTS

a) oxygen O_2
b) ozone O_3
c) (indirectly vapour) H_2O
in oxidation of metal's surface (iron with over-heated vapour under pressure, at 300°C degree)
the surface with protection layer obtained due to oxydation

39) NEUTRAL ATMOSPHERES, INERT ENVIRONMENTS

a) C_{02} extinguishers
b) N_2 or He_2 proctection atmospheres in processing, and production
c) N_2 or He_2 protection atmospheres in storing of products, and materials, both raw and processed

40) COMPOSITE MATERIALS

1) elements of blades, rotors, airscrews in wind turbines constructions;
2) yacht's & cataraman's constructions;
3) elements exposed to ultra-strong, severe stress

A technique of Engineering Creativity and Inventive Thinking in Problem Solving

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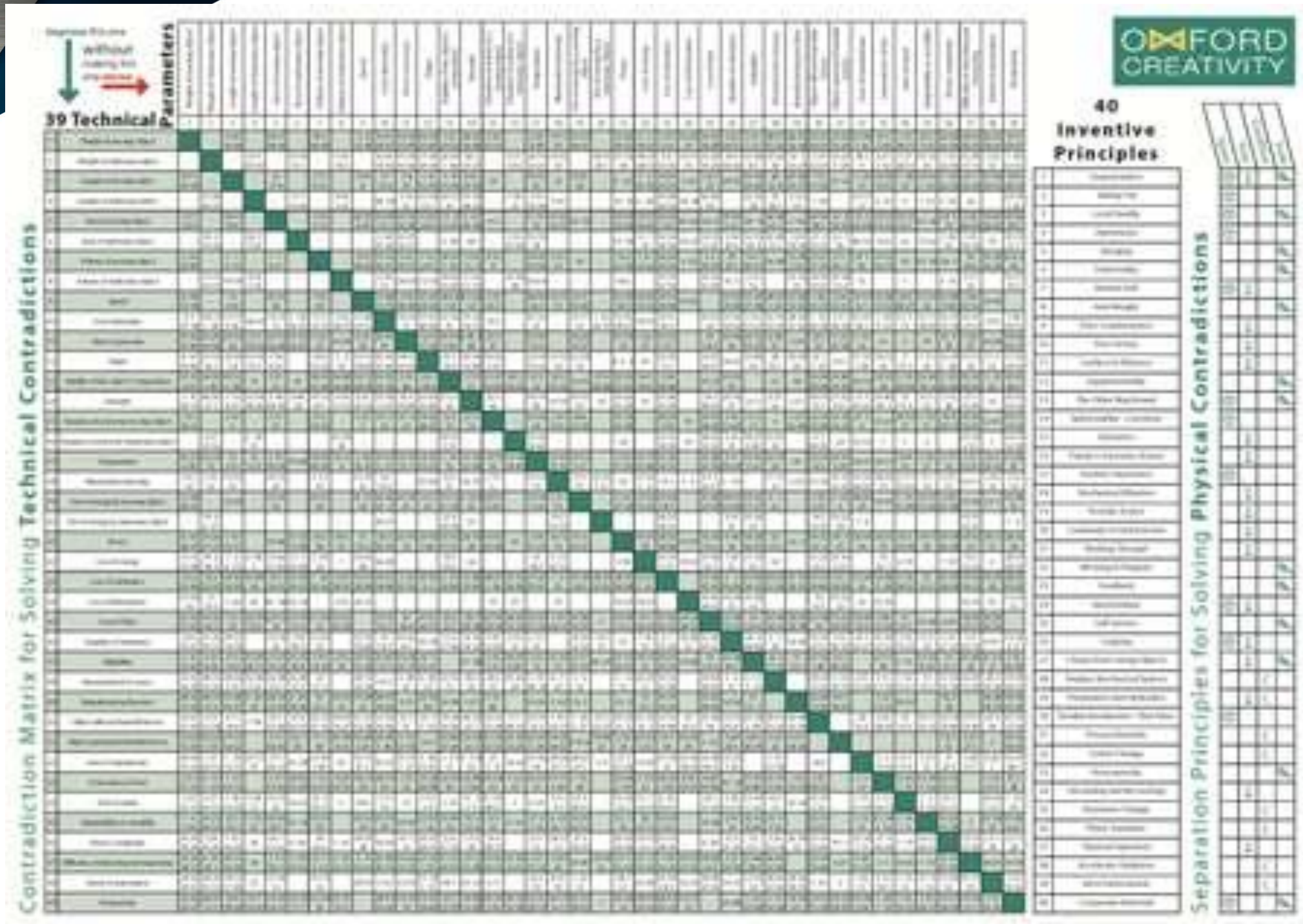

Contradiction Matrix for Solving Technical Contradictions
39 Technical Parameters
40 Inventive Principles
Separation Principles for Solving Physical Contradictions
OXFORD CREATIVITY

Value Engineering and Value Analysis

→Value Engineering is during design and production planning

> Part of New Product Development

> Goal is to prevent unnecessary cost

→Value Analysis is after market entry

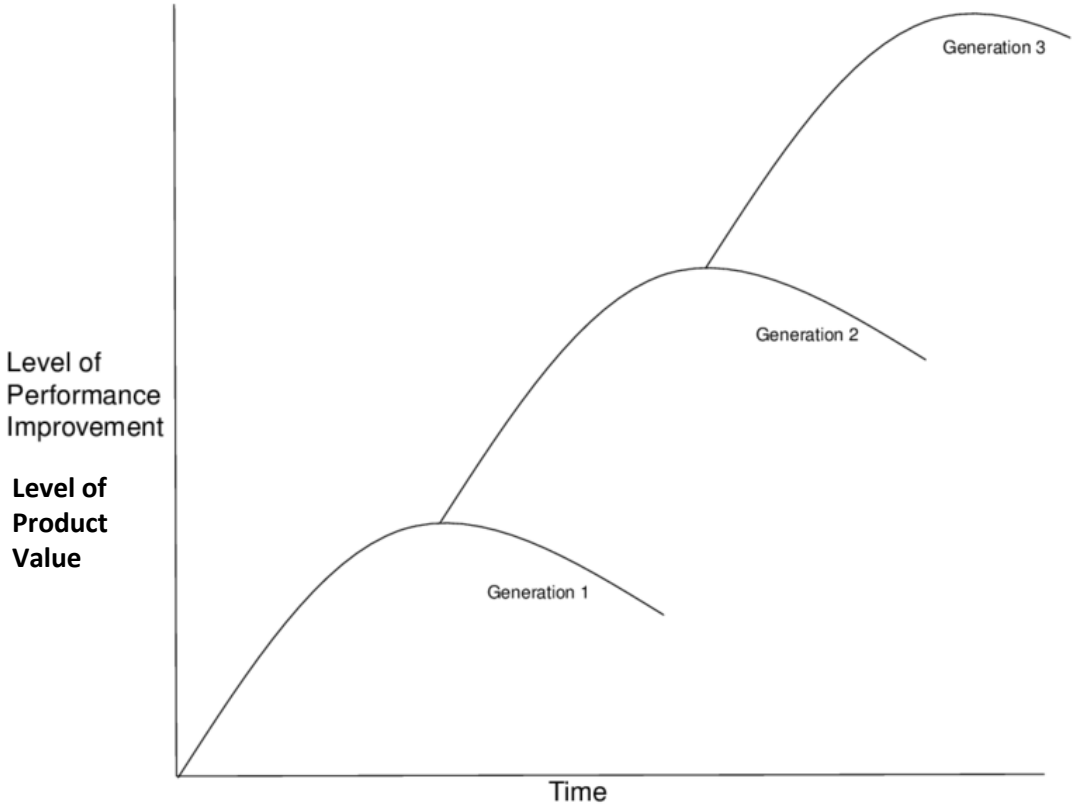
> Remedial

> Goal is to remove and eliminate problems and deficiencies

→Both examine materials, components, methods, etc. to determine if they 1) contribute value and 2) whether an alternative costs less or contributes more value at the same cost.

Value Chains and Value Engineering

- →Optimization Process
- →Requires a Balanced Scorecard
- →Episodic
  - > Product generations
  - > Significant technology or market evolution
- →Value Engineering tied to Design and Concurrent Engineering stage of ND
- →Value Analysis tied to Improvement stage of NPD



New Product Generations and Performance Improvement | Download Scientific Diagram (researchgate.net)

Closing Thoughts

- Nothing happens without a sale.
  David Speser
- If opportunity doesn't knock, build a door.
  Milton Berle
- It is fun to have fun, but you have to know how.
  The Cat in the Hat, Dr. Suess
- A well-defined imagination is the source of great deeds.
  Chinese Fortune Cookie

Thank you!

Research and Innovation Foundation (RIF)

P.O. BOX 23422, 1683 Nicosia
Tel.: +357-22205000
Website: www.research.org.cy