TRIZ for Better Competitiveness
Part 2
TRIZ/Systematic Innovation Usage in Industry

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TRIZ Activities

- Engineering Program Manager - Intel
  - TRIZ Projects
    - Technical and Business
  - TRIZ Program Development
    - Organization Integration
    - Program Integration (ex. TRIZ and Lean)
  - TRIZ Training
  - Competitive Analysis
- Executive Committee Member - Altshuller Institute for TRIZ Studies
- Consultant - Innomation, LLC

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Sample TRIZ Organizations

- Airbus
- Alcoa
- Alian
- American Institute of Chem Eng
- American Society of Mech Eng
- Bank of Montreal
- Baylor University MBA program
- Boeing
- Boston Scientific
- British Petroleum Amoco
- Caterpillar
- Coca Cola
- Corning
- Dow Chemical
- Eastman Chemical
- GAF Roofing
- General Mills
- Halliburton
- Intel
- Johnson and Johnson
- Kodak
- Kraft
- M&M Mars
- Motorola
- Proctor and Gamble
- RJR Reynolds
- S.C. Johnson
- Samsung
- Sara Lee
- Siemens
- U.S. Navy
- University of South Florida
- Westinghouse
- World Future Society

Industry Use of TRIZ

- Samsung
  - Thousands of engineers trained
  - Most at MATRIZ L-1, Few at MATRIZ L-2 and L-3
  - Hand full of L-4s
  - Substantial focus on product development
- Intel
  - 1000+ trained
  - 80% at MATRIZ L-1
  - 10% at MATRIZ L-2
  - 10% at MATRIZ L-3
  - Mostly focused on manufacturing process improvement (90%)
  - Some new product development (and growing)
  - Some business process development (and growing)

Industry Use of TRIZ

- Airbus
  - Product and Process Improvement
  - Training Externally driven
- P&G
  - TRIZ/Innovation leader is Russian native L-5
  - Big focus on product development
- Johnson & Johnson
  - Uses TRIZ extensively in product development

Industry Use of TRIZ

- Siemens
  - Internal innovation department
  - "Session" driven
    - Solutions on Demand
    - Innovation on Demand
    - Patents on Demand

- Alian – 3rd largest appliance manufacturer in Europe
  - 70 – L1
  - 18 – L2
  - 8 – L3
  - All product R&D

What You Will Learn

- TRIZ tools can be applied to a wide variety of problems and challenges.
- TRIZ greatly accelerates "natural" innovation by focusing issues and expanding solution concepts.
- The following will provide a taste of the insight and innovation acceleration TRIZ will provide your organization.

Competitively Differentiated Products

- Competitive advantage = Value + Market Vision + Quality
  - Value = function / cost
  - Market Vision = system evolution knowledge and system function understanding
  - Quality = performance to specification
- TRIZ supports the pursuit of all three components

TRIZ for Competitive Improvement

- Product Development (market impact)
  - *Functional Analysis* — Value (function / cost)
  - *Trends of System Evolution* — Market Vision
  - *Patent Analysis and Circumvention* — Market Vision
- Problem Solving / System Improvement (operations impact)

Functional Analysis

- The function of a system is the reason for it's existence.
- What is the system designed to do?

Component: mirror

function: reflect

function: inform

Functional Analysis

People buy functions not products.

All I needed was a hole!

Tutto quello di cui avevo bisogno era un foro!

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Functional Analysis

People buy functions not products.

Both of these products deliver the same base function.

Which one provides the best value?

function: entertains *people*

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Functional Analysis

Delivering a function is the purpose of a system.

How the function is enabled will change.

function: informs (Communication)

Functional Analysis

To increase a system's value

increase its effectiveness

(function) or decrease its cost

Single blade to multi-blade razors

Electric to disposable razors

function: cuts *hair*

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Functional Analysis

- Component Analysis results in system evolution

Components: motor, pump, drum

Functional Analysis

- Function analysis results in system innovation

System: handheld cleaner, bleach pen

System: washer

function: removes *dirt*

System: no water ionizing washer

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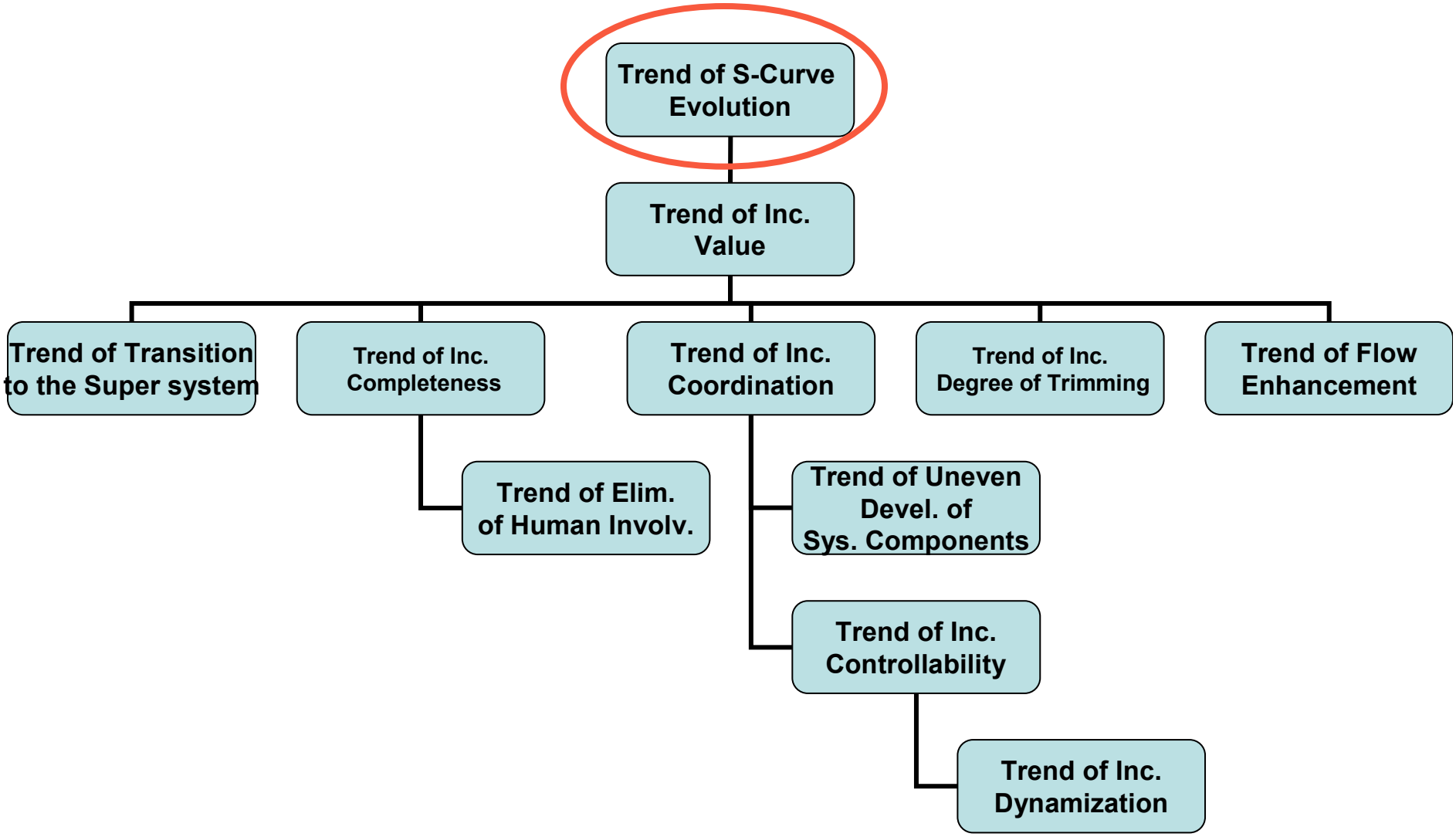
Trends of System Evolution

- Engineering systems (products) do not evolve randomly but rather according to objective trends.
    - The trends were established by statistical observations of a wide variety of technologies.
    - The trends can be used to predict future technologies and systems.

Hierarchy of Trends



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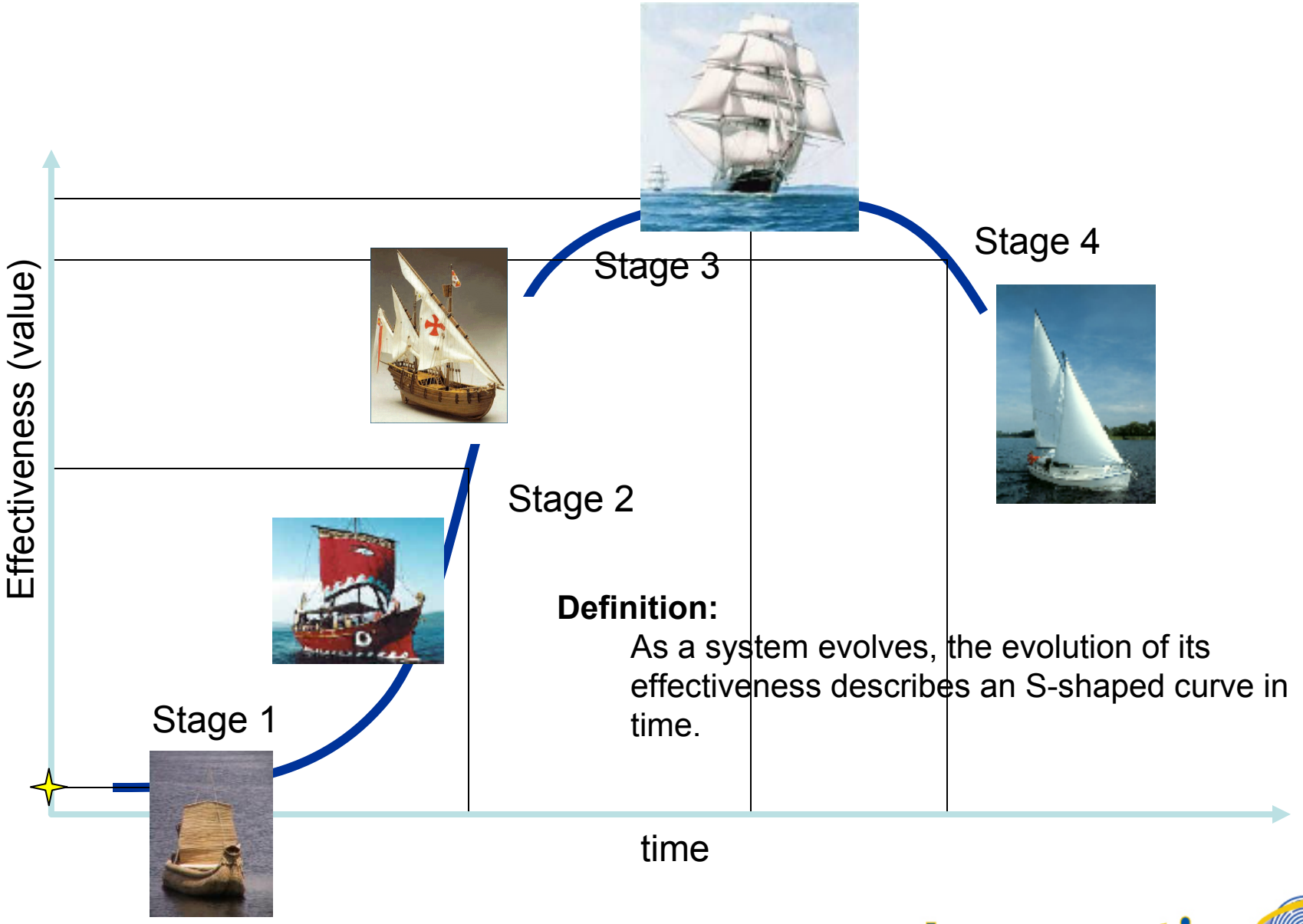
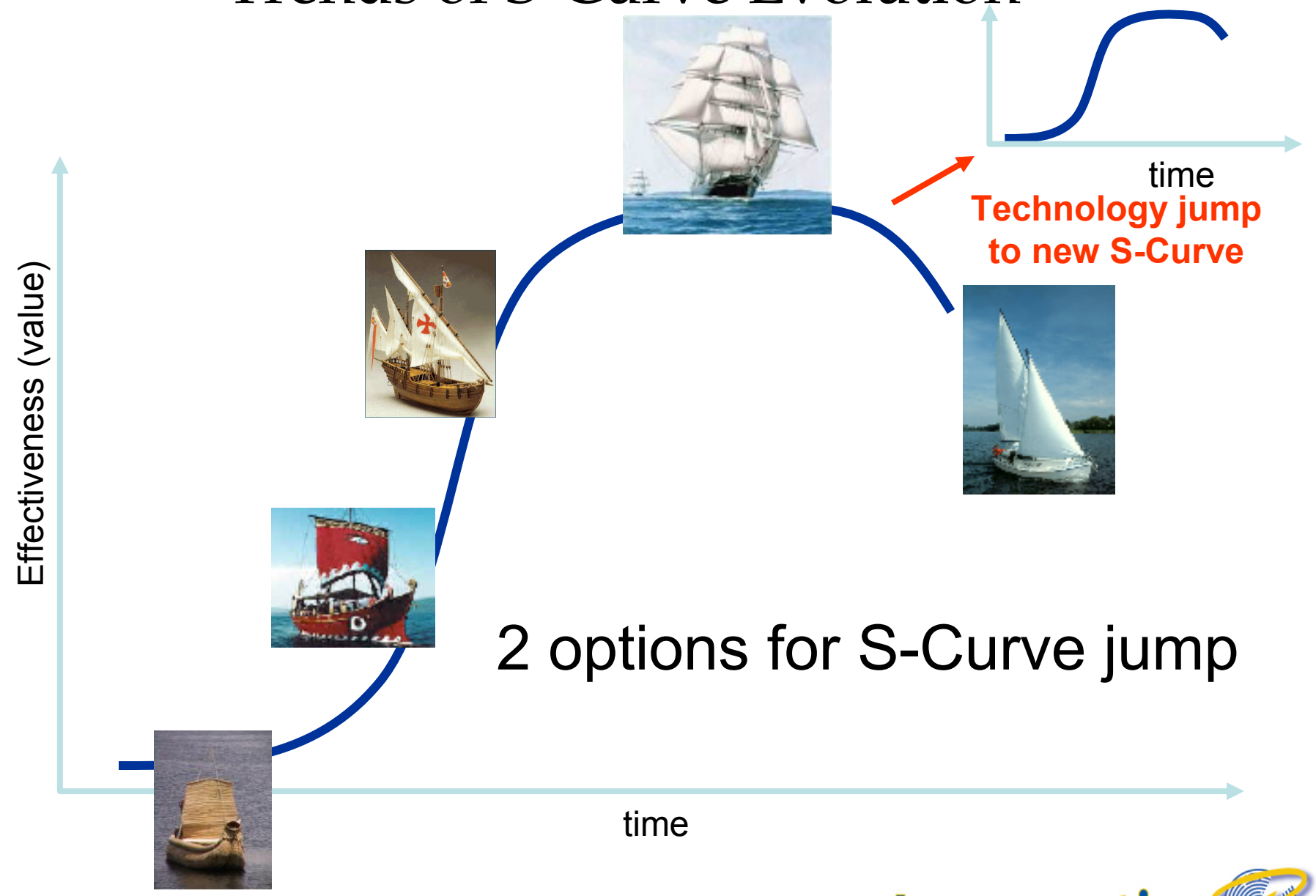
Trends of S-Curve Evolution



Definition:

As a system evolves, the evolution of its effectiveness describes an S-shaped curve in time.

Trends of S-Curve Evolution



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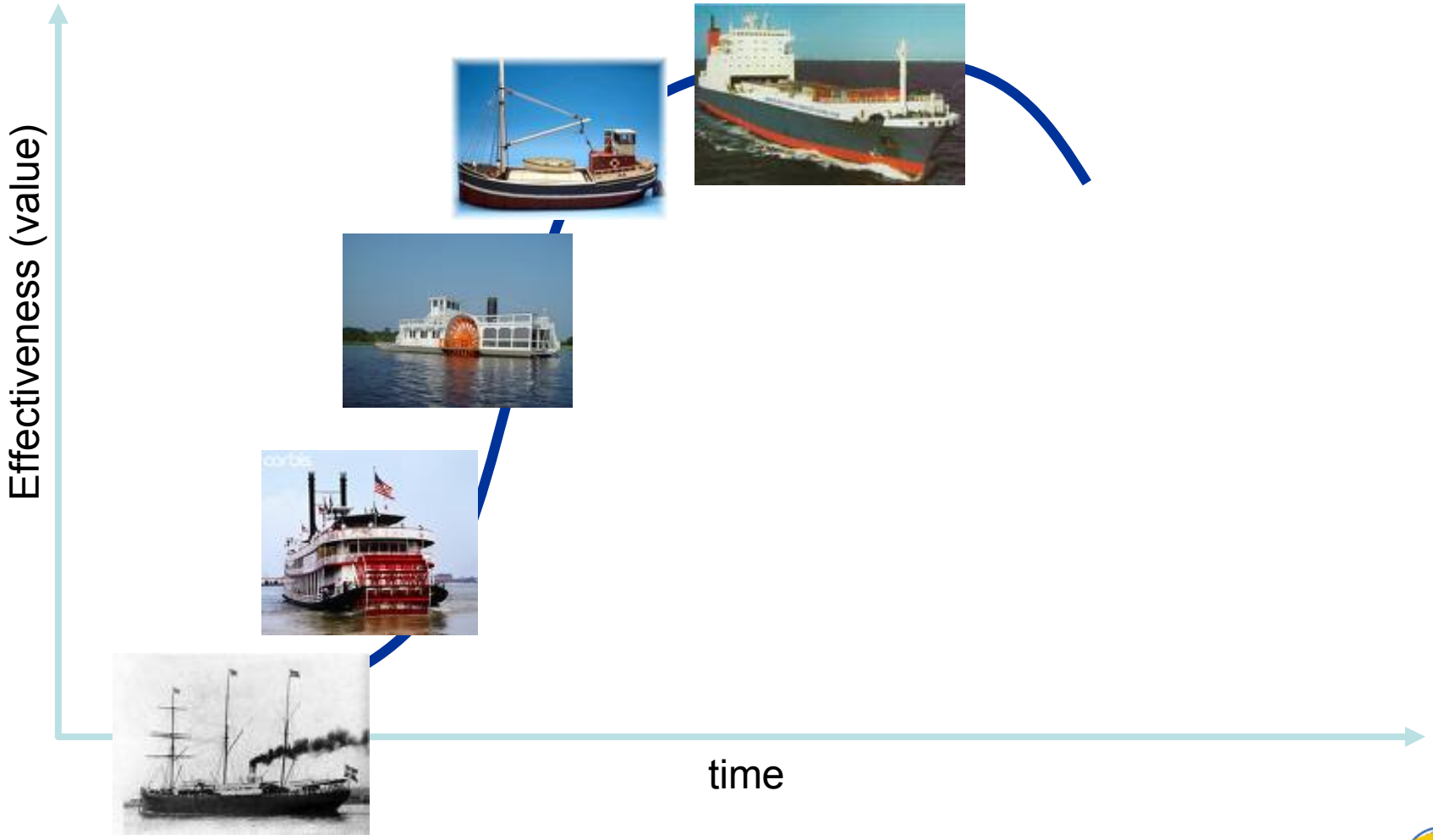
Trends of S-Curve Evolution

New action principle for same use



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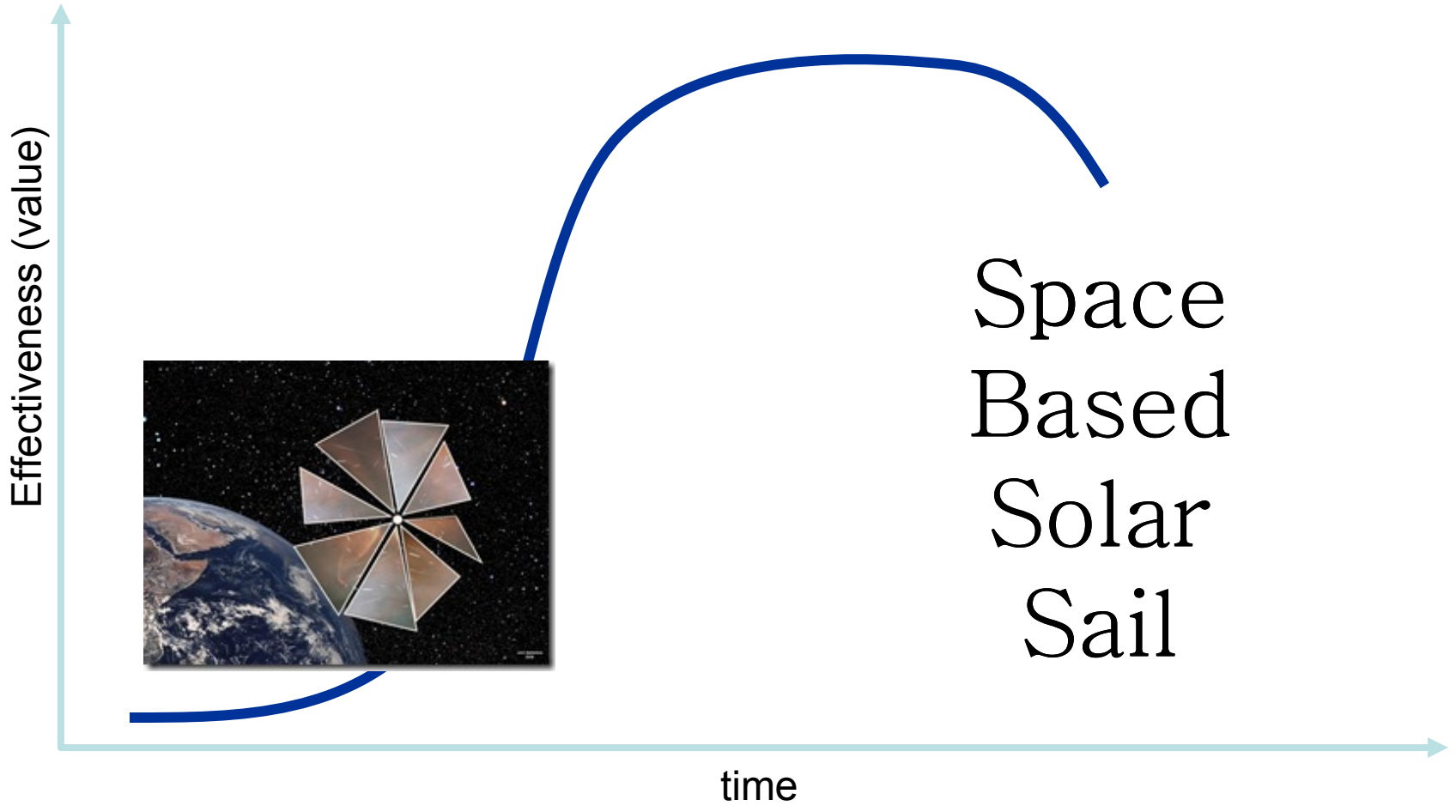
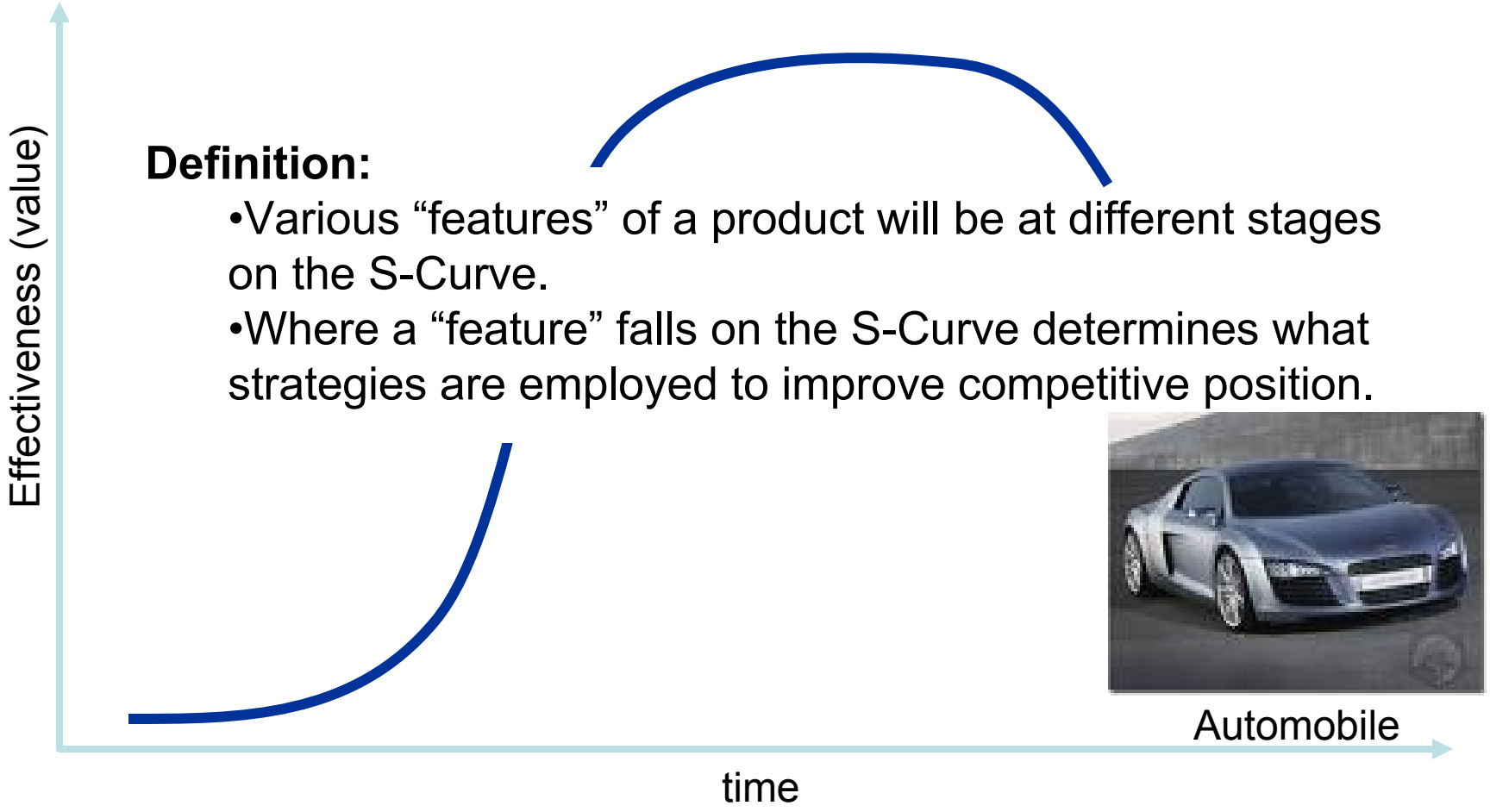
Trends of S-Curve Evolution

New use for same action principle



Trends of S-Curve Evolution

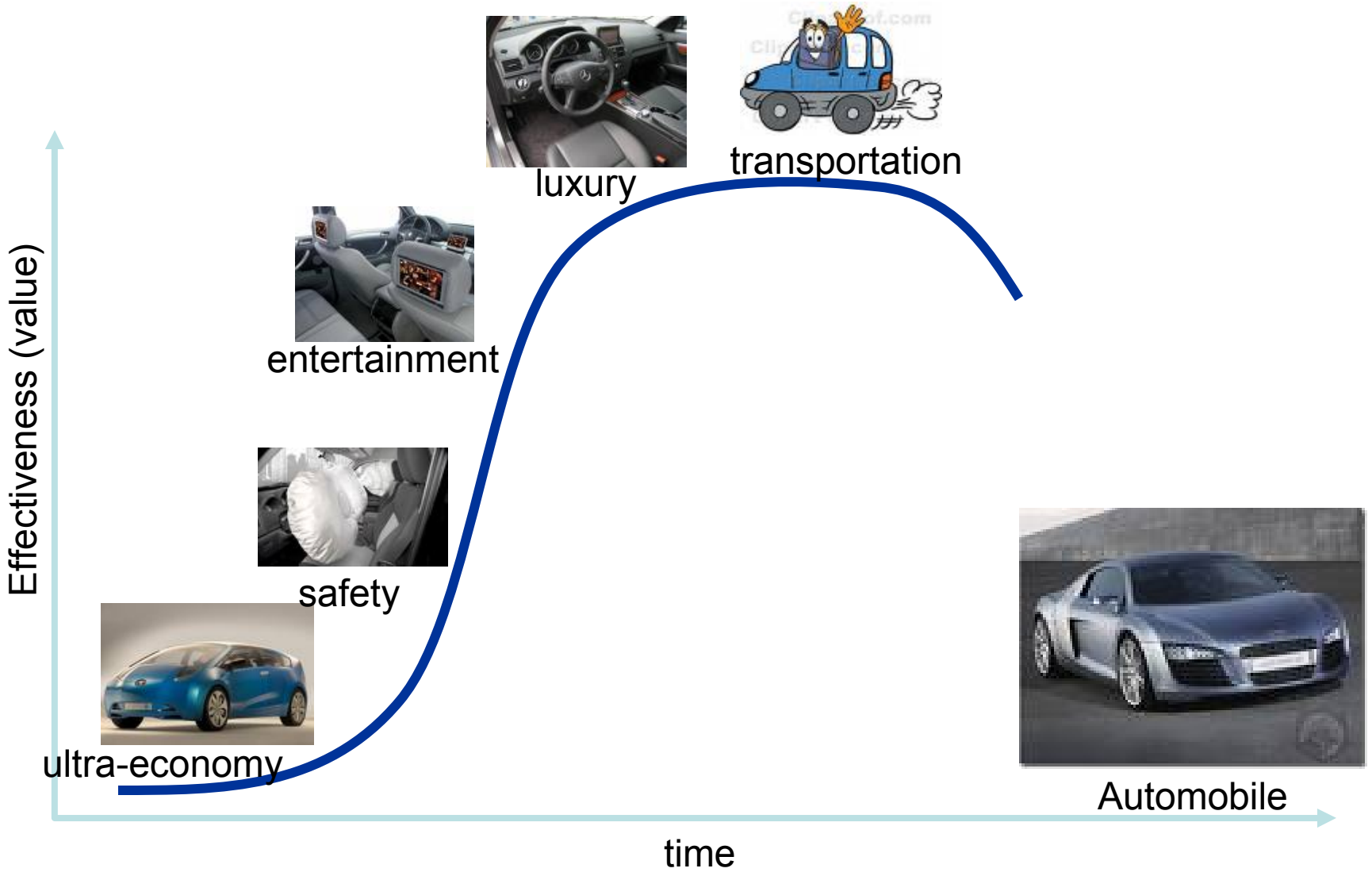


Definition:

- Various "features" of a product will be at different stages on the S-Curve.
- Where a "feature" falls on the S-Curve determines what strategies are employed to improve competitive position.

Automobile

Trends of S-Curve Evolution



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Trends of S-Curve Evolution

luxury

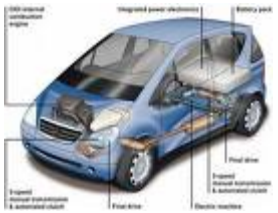
transportation

entertainment

Use Stage 1 Recommendations (ex. Integrate with current leading system)

safety

ultra-economy



Automobile

Effectiveness (value)

time

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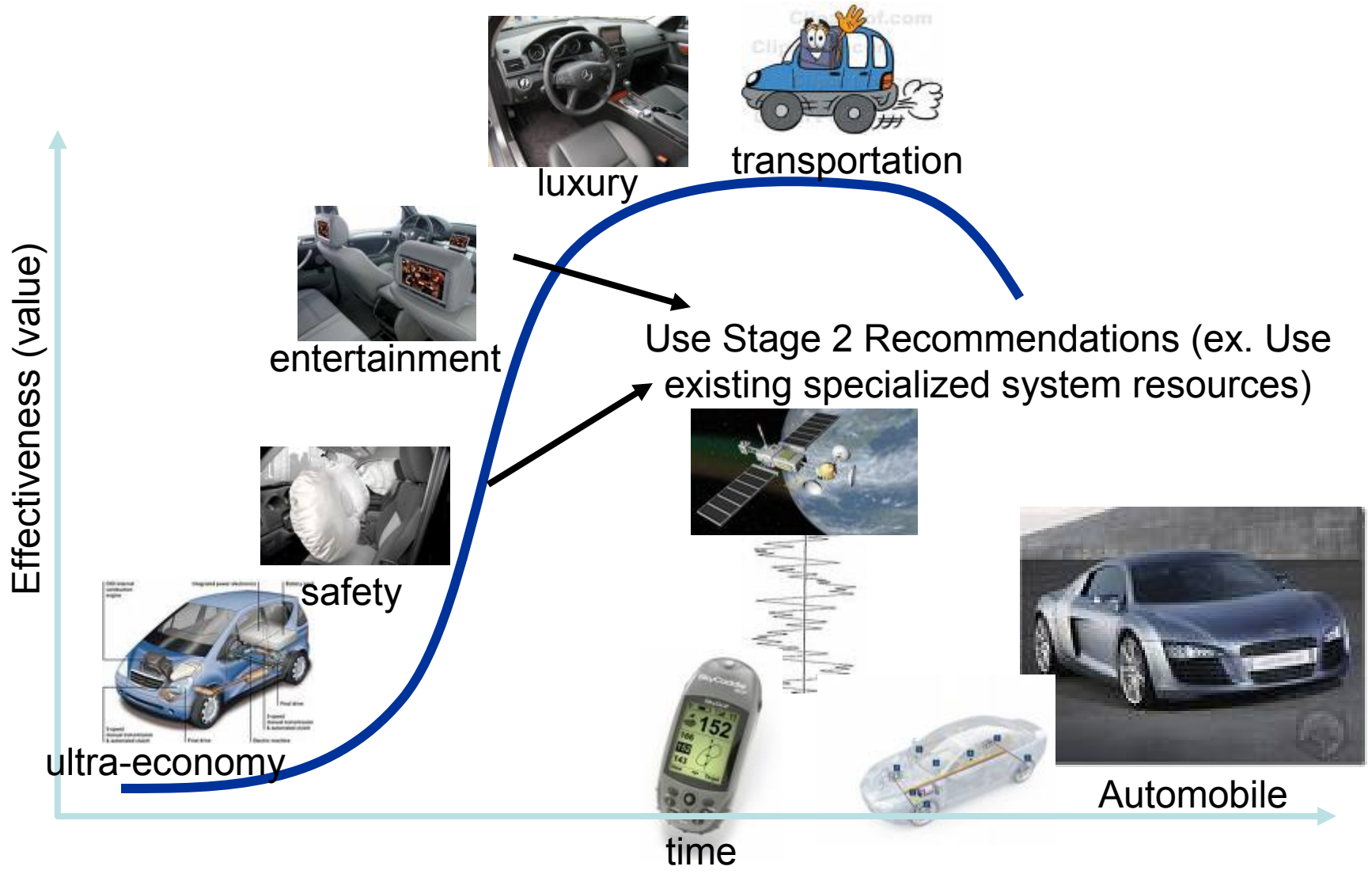
Trends of S-Curve Evolution



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Trends of S-Curve Evolution

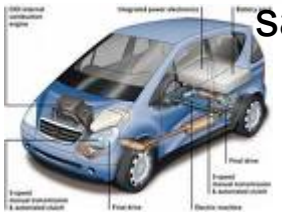
luxury

transportation

entertainment

Use Stage 3 Recommendations (ex. Improve aesthetic and design)

safety



ultra-economy

Automobile

Effectiveness (value)

time

Trends of S-Curve Evolution

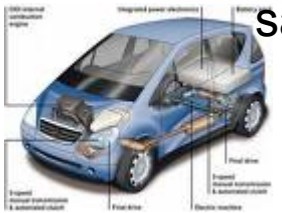
luxury

transportation

entertainment

Use Stage 3 Recommendations (ex. Switching to another Principle of Operation)

safety



ultra-economy

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Trends of S-Curve Evolution

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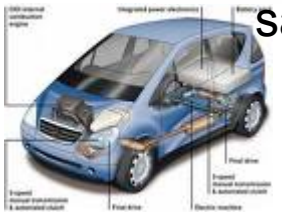

ultra-economy

Automobile

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time

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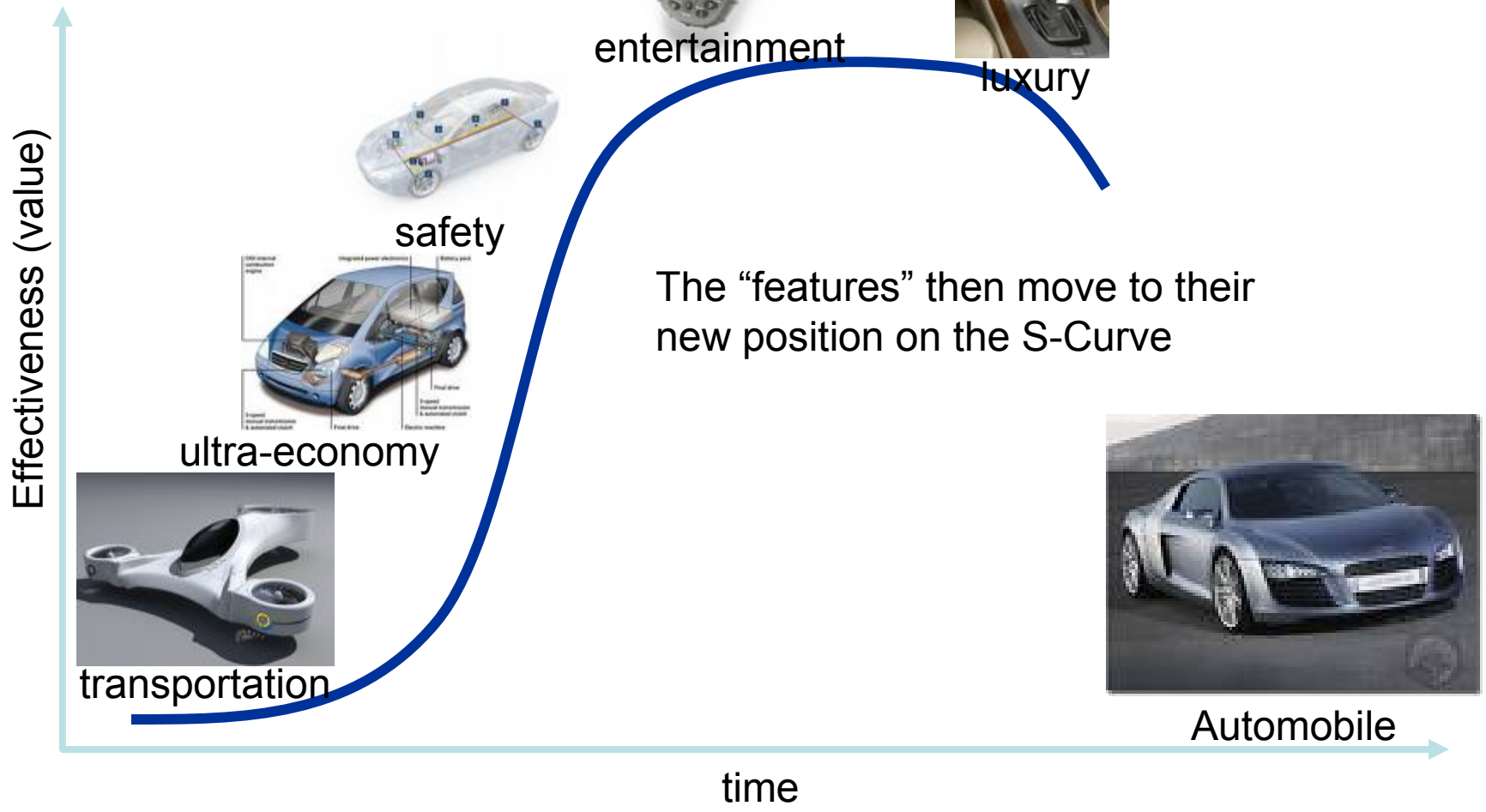
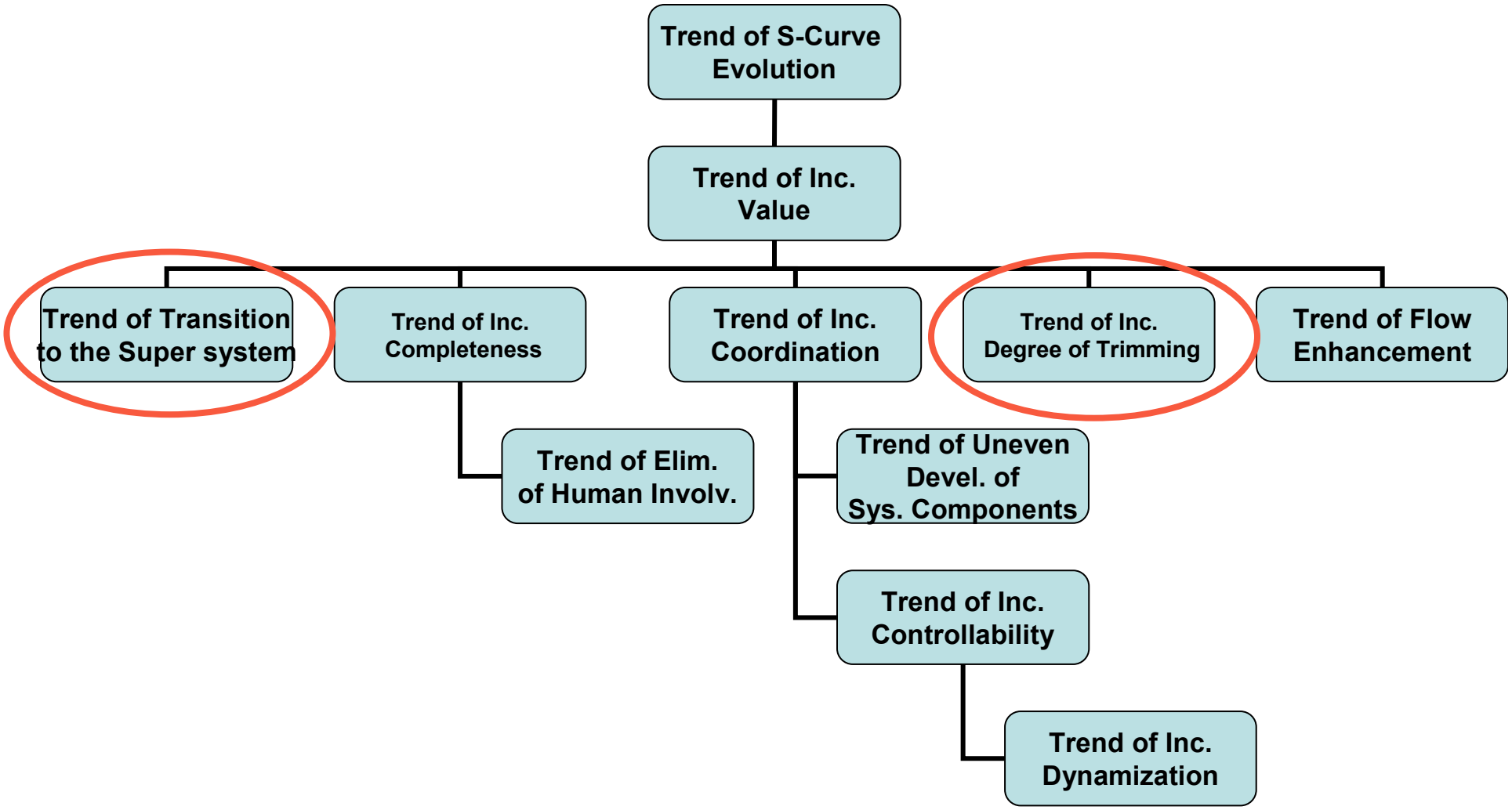


Hierarchy of Trends



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Trends of Engineering System Evolution (TESE)

TESE describe how technologies have typically developed in the past

TESE can be used to predict how technologies will develop in the future

Illumination Function Example

TESE describe how technologies have typically developed in the past

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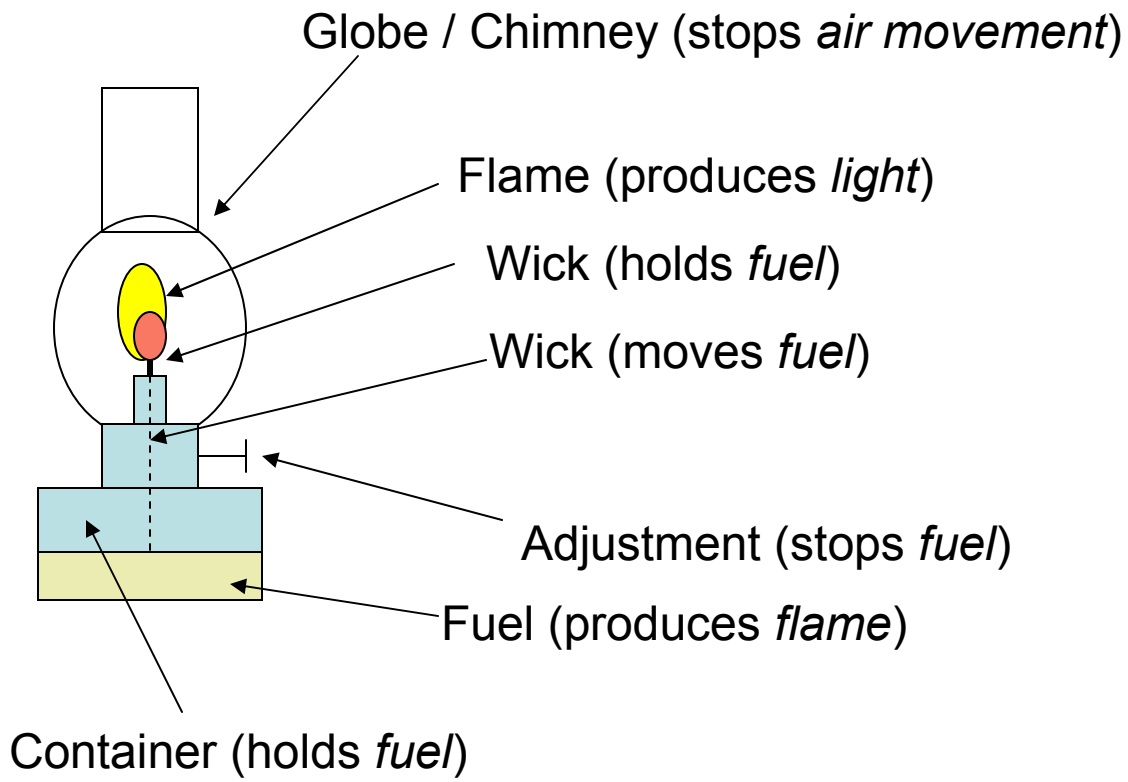
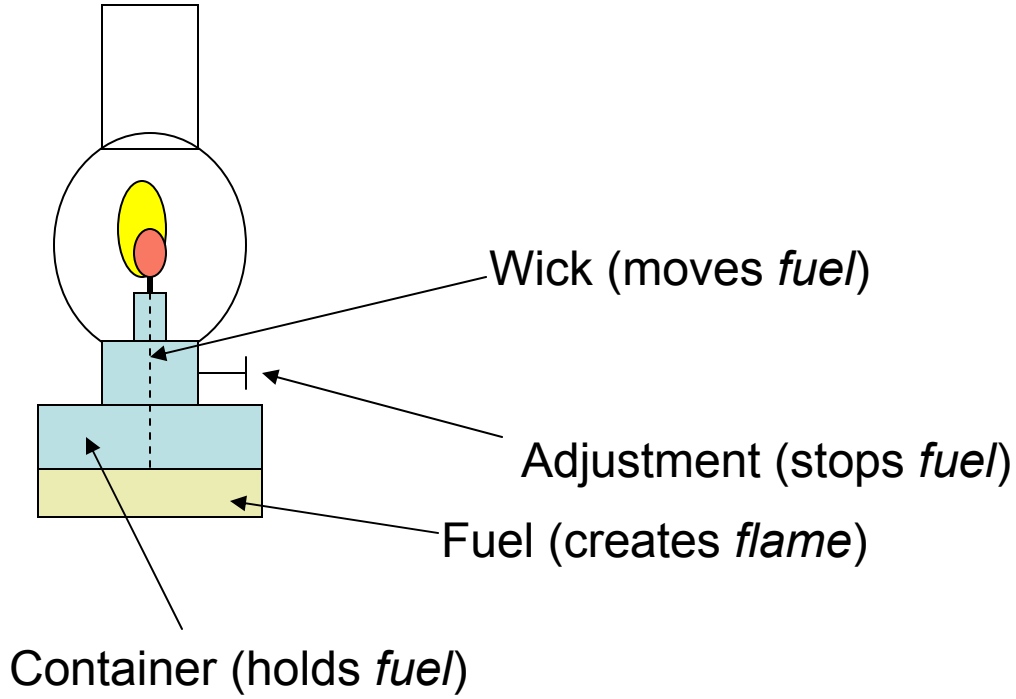


Trim functions and transition them to the Supersystem



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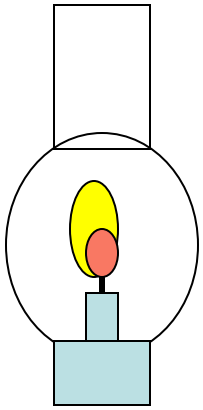


Wick (moves *fuel*)

Adjustment (stops *fuel*)

Fuel (creates *flame*)

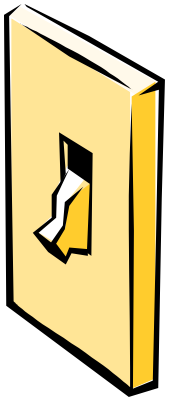
Container (holds *fuel*)

Trim functions and transition them to the super-system

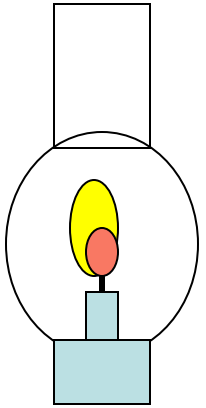
Container (holds *fuel*)

Fuel (creates *flame*)

Wick (moves *fuel*)

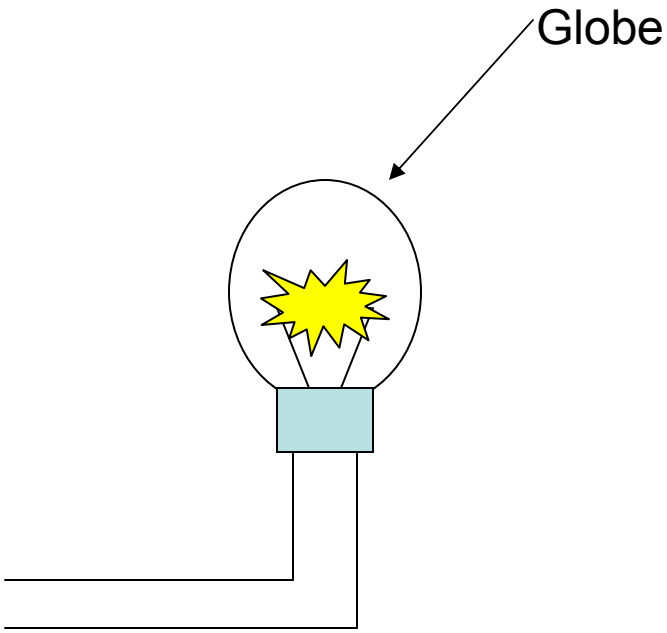


Adjustment (stops *fuel*)



The “fuel” transition to the Supersystem allows for the use of electrical conductors, filament and photon emission.

We can now also Trim the chimney.



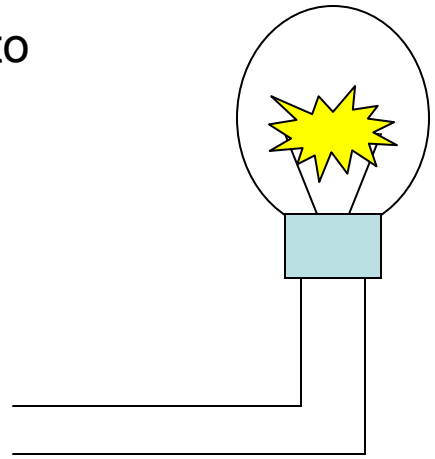
Illumination Function Example

TESE can be used to predict how technologies will develop in the future

What are some problems with this engineering system?

The “fuel” transmission system is inefficient due to resistance and resistive heating

What can be Trimmed to the Supersystem?



The globe, while providing some functionality, still heats up and is harmful.

Illumination Function Example

TESE can be used to predict how technologies will develop in the future

This leaves us with a light emitting device

Illumination Function Example

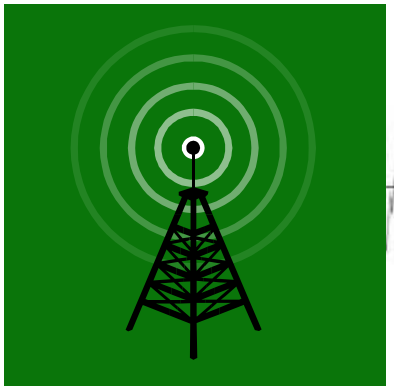
TESE can be used to predict how technologies will develop in the future

Filament (creates *light*)

Electric Conductors
(moves *fuel*)

This leaves us with a light emitting device

What Supersystem components
could replace the Trimmed items?



Electric Conductors
(moves *fuel*)

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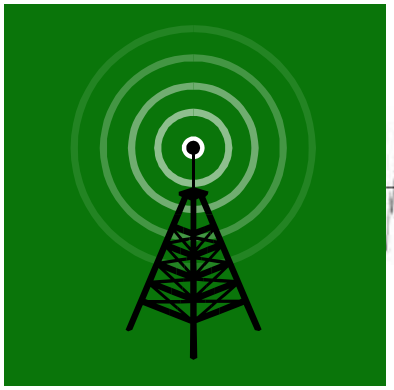
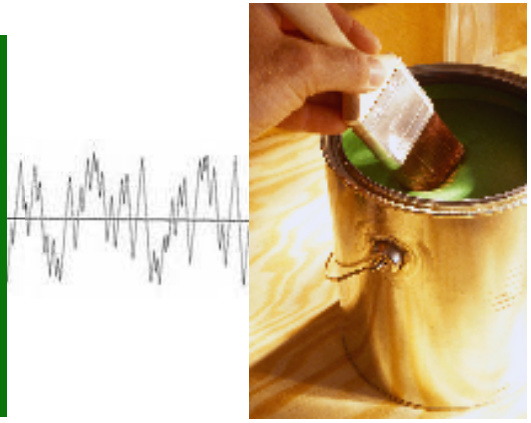


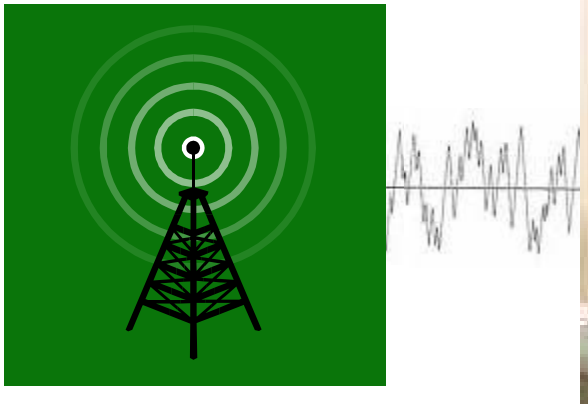
Electro-magnetic
propagation



Electro-magnetic
excitable luminous paint

True ambient lighting

What Supersystem components
could replace the Trimmed items?

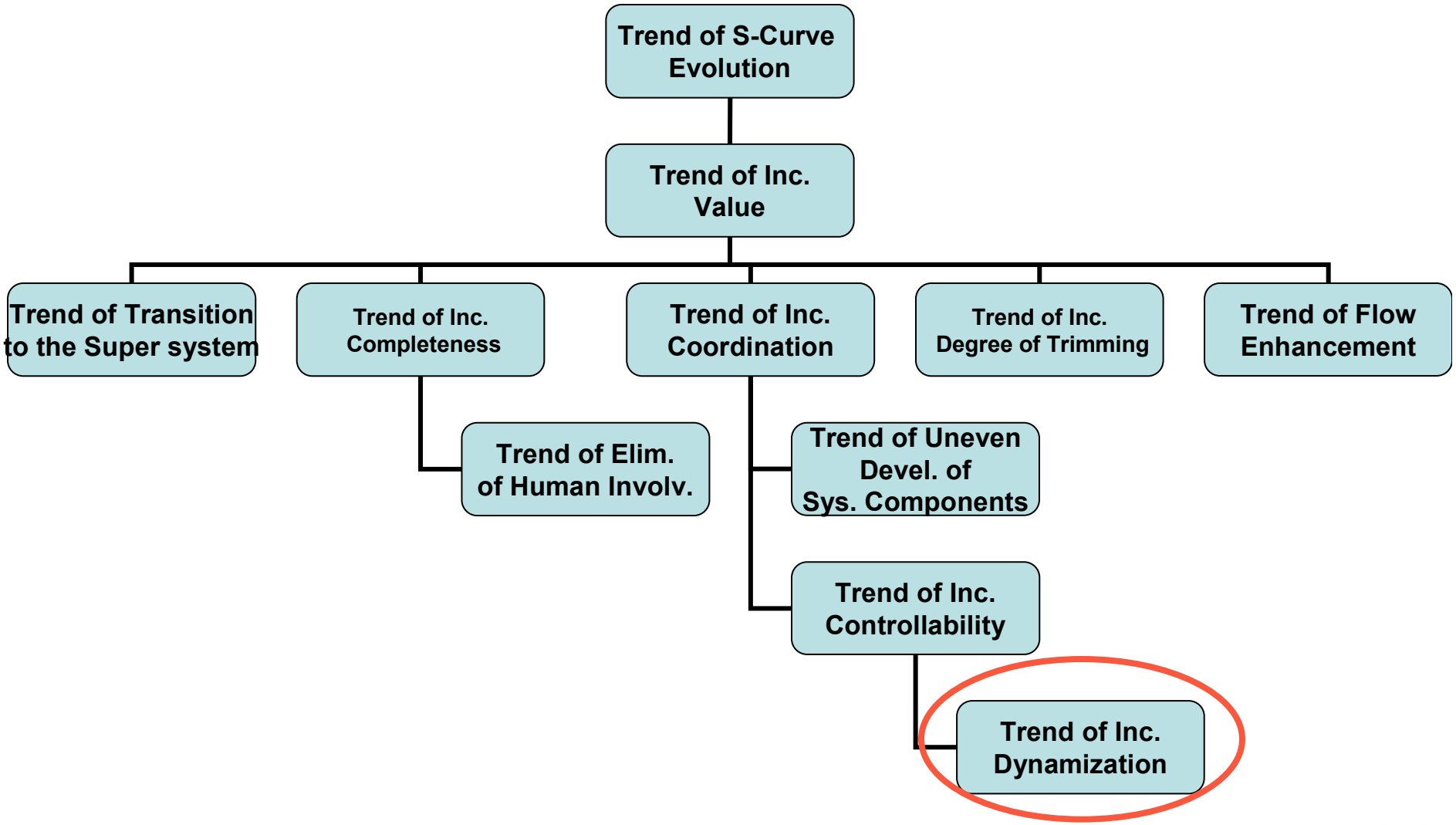


Electro-magnetic
propagation

Electro-magnetic
excitable luminous paint

True ambient lighting

Hierarchy of Trends



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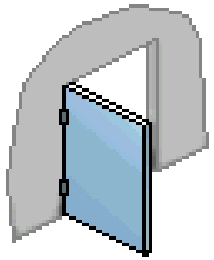
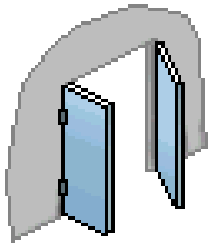
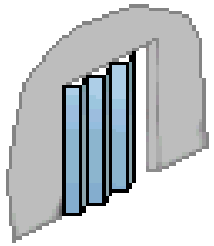
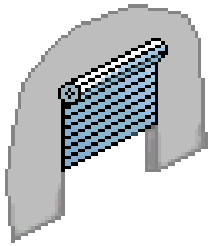
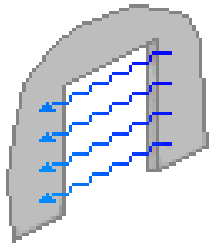
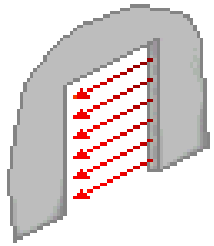
TRIZ Focus Areas

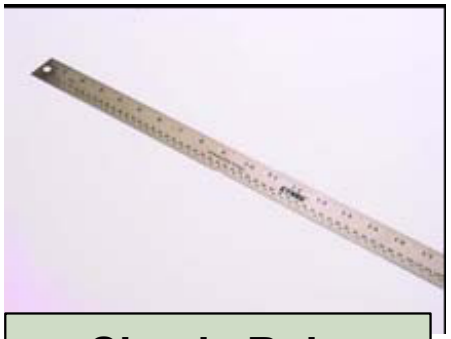
- *Trend of Increasing Dynamization*

rigid	single joint	multi-joint	elastic	liquid or gas	field
					
Single-leaf	Two-leaf	Accordion door	Roll-up door	Air curtain	Light lock

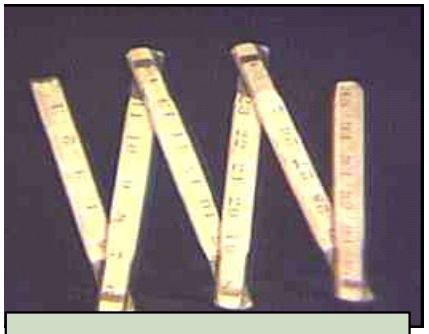
TRIZ Focus Areas

- *Trend of Increasing Dynamization*

rigid → single joint → multi-joint → elastic → liquid or gas → field



Simple Ruler



Folding Ruler

Measuring Tape

Laser Ruler

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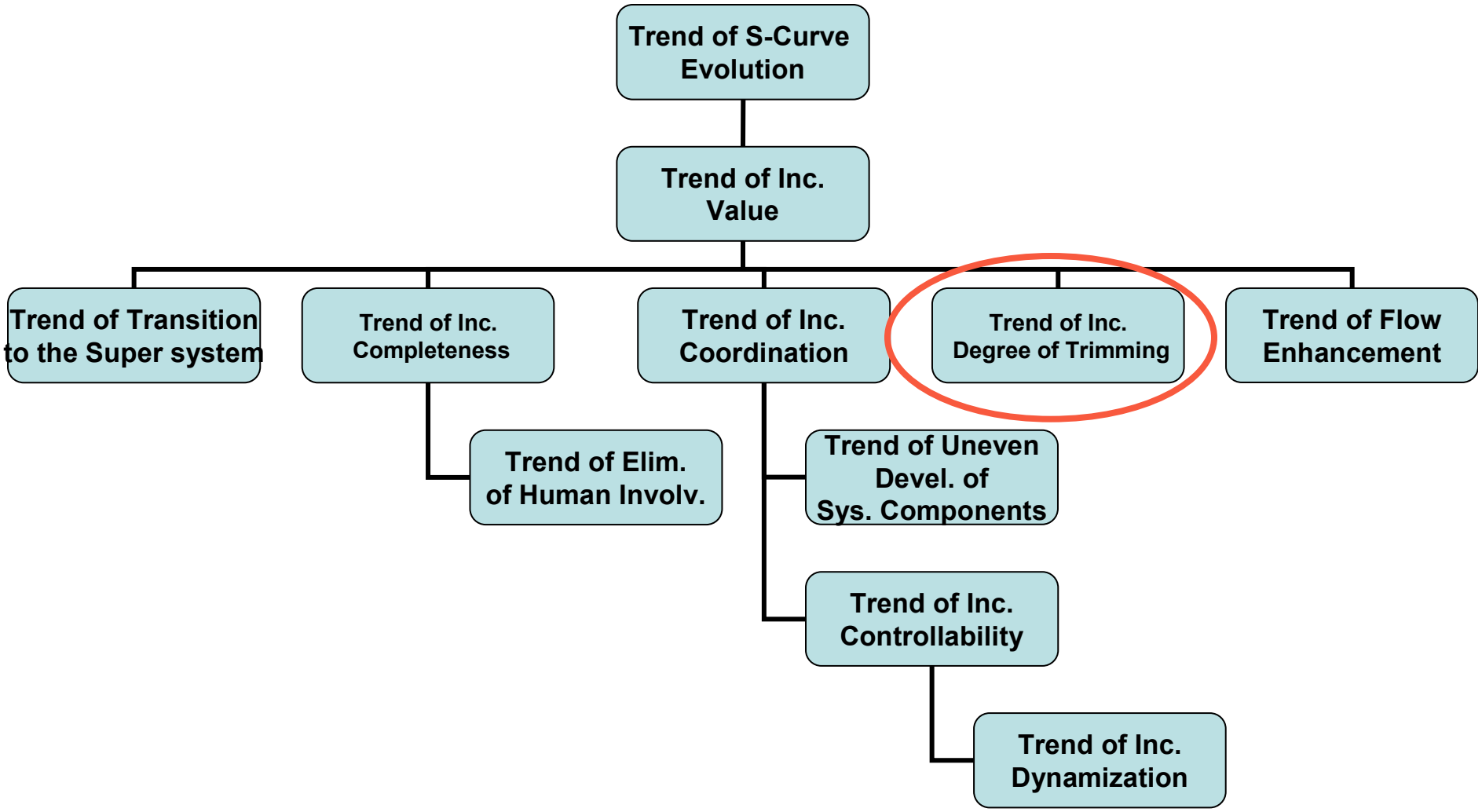
Hierarchy of Trends



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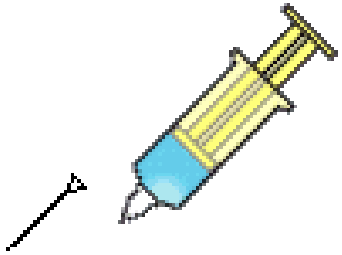
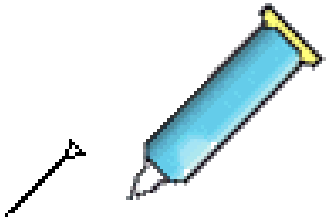
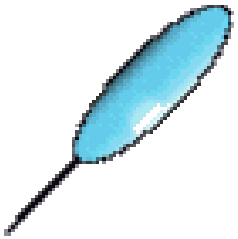
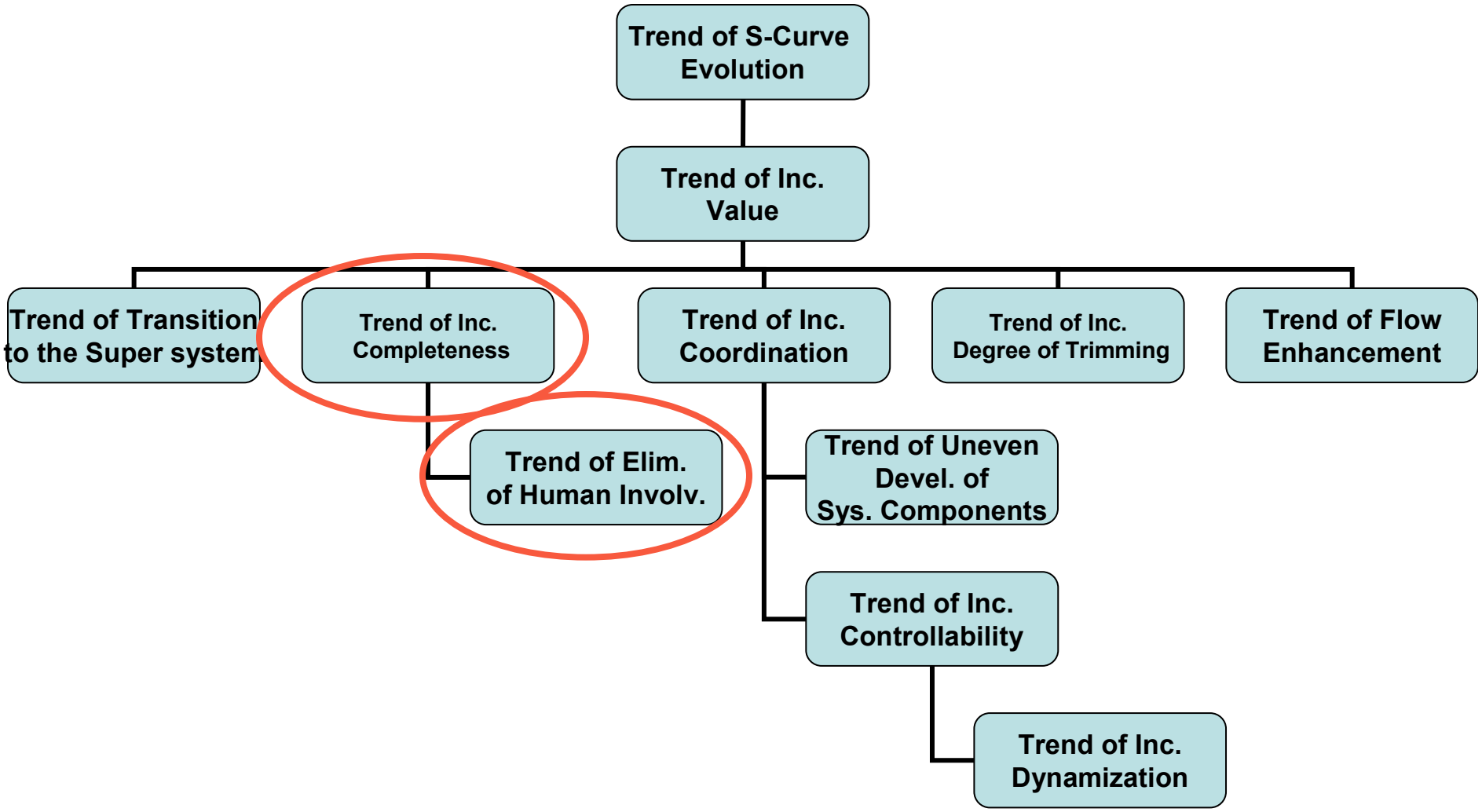
TRIZ Focus Areas

- *Trend of Increasing Degree of Trimming*

complete system	merged system	partially trimmed	fully trimmed
 Glass syringe	 Plastic syringe	 Tube syringe	 Needle syringe

Hierarchy of Trends



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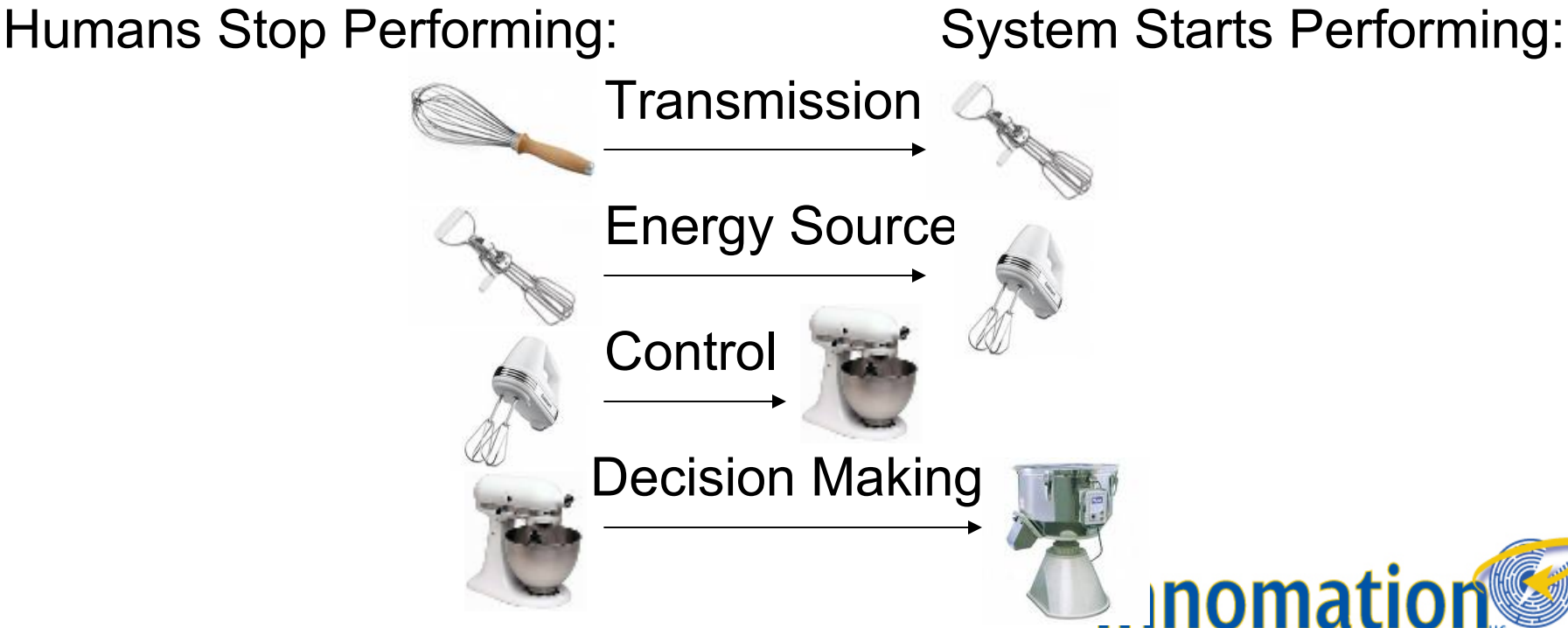
Trend of Decreasing Human Involvement & Increasing System Completeness

- As an eng. sys. evolves the number of system functions performed by humans decrease.
- A decrease in human involvement leads to an increase in system completeness.



Patent Analysis and Circumvention

Patent Criteria:

1.) Novelty – new, does not exist, must be novel word wide

2.) Usefulness – can not patent useless stuff

3.) Non-obvious – the idea must not be obvious to an average specialist in the related discipline

Patent Analysis and Circumvention

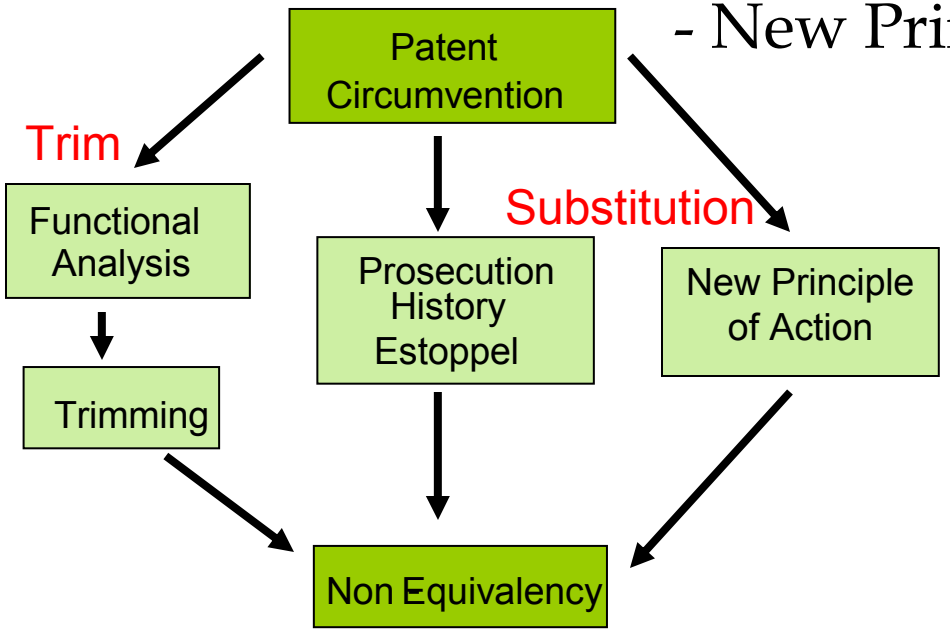
Patent Criteria:

1.) Novelty – new, does not exist, must be novel word wide.

- Patents focus on Components not Functionality.
- To make a patent novel:
  - Change the Components and retain its Functionality
  - Insure the patent is *Non-Equivalent*

Patent Analysis and Circumvention

- To make a patent novel, change its Components but retain its Functionality
  - Trim
  - Substitute
    - *Prosecution History Estoppel* can avoid *Doctrine of Equivalence*
    - New Principle of Operation (Action)



Patent Circumvention Example

Trimming

- 2007 TomTom Patent - GPS with built in video camera

Component:	GPS		Video Camera		Video GPS
		+		=	
Function:	information		live images		graphics overlay on live image

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Patent Circumvention Example

Trimming

- 2007 TomTom Patent - GPS with built in video camera

Component:	GPS		Video Camera		Video GPS
		+		=	
Function:	information		live images		graphics overlay on live image

1.) Trim a component

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Patent Circumvention Example

Trimming

- 2007 TomTom Patent - GPS with built in video camera

Component:	GPS		Windshield w/ plasma tech.		Headsup GPS
		+		=	
Function:	information		live images		graphics overlay on live image

1.) Trim a component

2.) Replace the functionality

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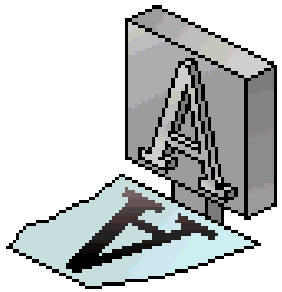
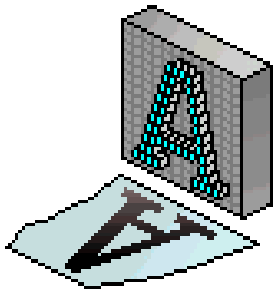
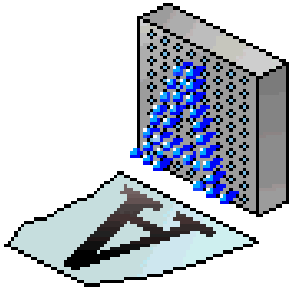
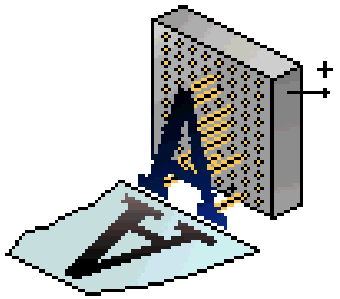
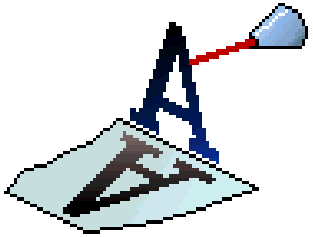
Patent Circumvention Example

New Principle of Action

Principles of action will follow a Trend Line

Function: Printing

Trend: Dynamization

monolith	segmented monolith	liquid, powder	gas, plasma	field
 Letter printer	 Matrix printer	 Jet printer	 Ion printer	 Laser

Each advancement in printing has been a new Principle of Action thus creating a patentable device.

Patent Circumvention Example

New Principle of Action

Component: Sewing Machine

Function: Join *material*

Current Action Principle

Thread Stitching

New Action Principle

Micro Rivets

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Patent Circumvention Example

New Principle of Action

Component: Food Mixer

Function: Mixes

Current Action Principle

Mechanical Stirring

New Action Principle

Mechanical Vibration

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References

- Some graphics are from Gen 3 Partners MATRIZ Level 3 training materials.

- Patent Analysis/Circumvention information is based on material from Dr. Sergei Ikovenko

Backup

- What is TRIZ?

TRIZ

Teoriya Resheniya Izobreatatelskikh Zadatch

Теория Решения Изобретательских Задач

Theory of Inventive Problem Solving

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What is TRIZ?

- TRIZ is a Russian acronym that stands for Teoriya Resheniya Izobreatatelskikh Zadatch. The English translation is "The Theory of Inventive Problem Solving." The TRIZ methodology was conceptualized and developed by Genrich Altshuller and his colleagues beginning in 1946 in the former USSR. His process involved reviewing hundreds of thousands of patents to understand how engineering systems evolved over time. Particular attention was paid to understanding how innovation was harnessed to solve difficult engineering problems in novel ways. Fundamentally, the objective of TRIZ is to discover how inventors invent. The development of TRIZ as an international science of creativity continues and has so far spanned over 60 years and encompassed the analysis of some three million patents. Elemental to the process is the understanding of how engineering system contradictions can be sufficed without the use of compromise.

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What is TRIZ?

- The TRIZ analytical tool set is designed to refine and sharpen a single problem. The concepts and methodologies are part of the public domain.
  - **Prediction Trends (Trends of Engineering System Evolution) –** Statistically proven directions of Engineering System development that describes the natural transitions of Engineering Systems from one state to another. These directions are statistically true for all categories of Engineering System.
  - **Inventive Principles (Principles) –** A problem solving tool that provides generalized recommendations for modifying a system to solve a problem formulated as an Engineering or Physical Contradiction (an Inventive Principle is an abstract model of the solution to the problem). Only 40 principles were defined by an analysis of all 40,000 "innovative" patents originally analyzed by Altshuller.
  - **Standard Inventive Solutions** – a set of 76 typical solutions, in the form of Substance-Field (Su-Filed) Models, to typical problems that are also expressed in the form of Su-Filed Models.
    - **Substance-Field Analysis** – a part of Standard Inventive Solution application that models a problem and potential solutions in the form of a substance-filed interaction (also used in the ARIZ analysis process)
  - **ARIZ** - A problem solving tool that transforms a complex engineering situation into a well defined model of the problem, which can be solved effectively using a wide spectrum of TRIZ tools.

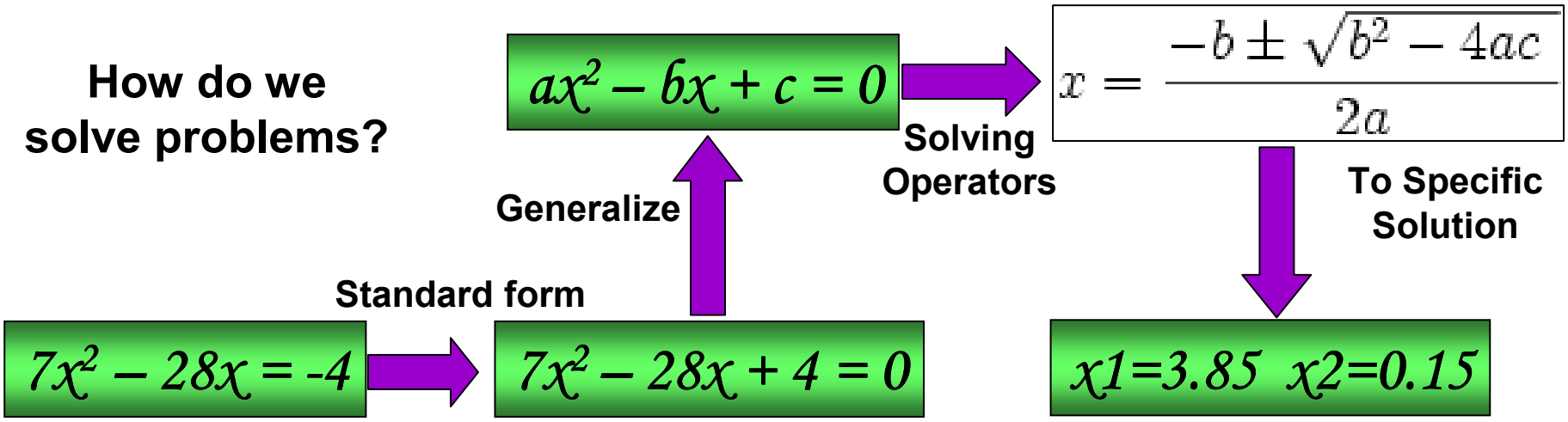
Just as in other disciplines, TRIZ provides multiple ways to model problems and solutions as well as providing tools to help with the transition from problem to solution modeling.

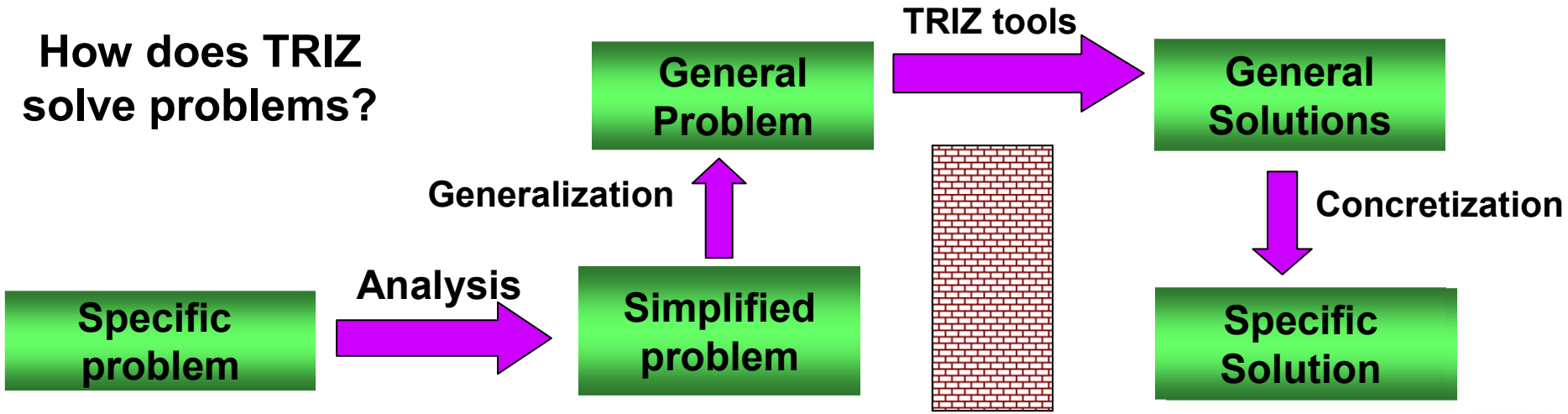
Some TRIZ Tools and How They Compare to Other Disciplines

Discipline	Model of Problem	Tool	Model of Solution
Math	10 X 20	Multiplication Chart	200
Chemistry	HCl + NaOH	Chemistry	NaCl + H_2O
TRIZ	Engineering Contradiction	Altshuller's Matrix	Inventive Principles
TRIZ	Su-Field	76 Standard Solutions	Specific Standard Inventive Solution
TRIZ	Physical Contradiction	Separation, Satisfaction, Bypass Algorithms	Inventive Principles
TRIZ	Physical Contradiction	Library of Effects	Specific Effect
TRIZ	Functional Model	Library of Effects	Specific Effect

TRIZ statistically based family of principles and strategies
Enable engineers to identify solution paths of technical problems

How Does TRIZ Work?





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