

# TRIZ for Better Competitiveness

## Part 2

TRIZ/Systematic Innovation Usage in Industry

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2010

# 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 Corp**



# 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

Coca-Cola

General Electric

Alian

British Petroleum

Siemens

Intel

Samsung

Airbus

# 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
- Largest Semi-Conductor Manufacturer
  - 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 – 3<sup>rd</sup> 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*
  - *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.

Both of these products deliver the same base function.

Which one provides the best value?



*function: entertains people*

# 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*

# Functional Analysis

- Component Analysis results in system evolution

*Components: motor, pump, drum*

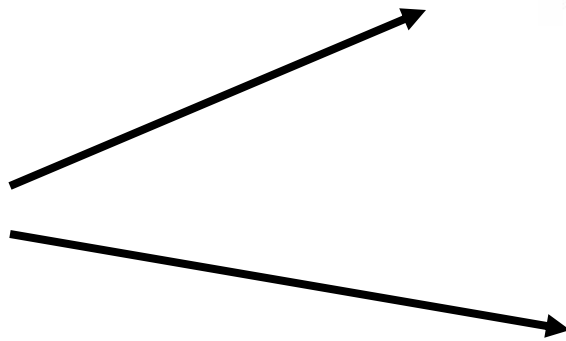


# Functional Analysis

- Function analysis results in system innovation

*System:* handheld cleaner, bleach pen

*System:* washer



*function:* removes dirt



*System:* no water ionizing washer

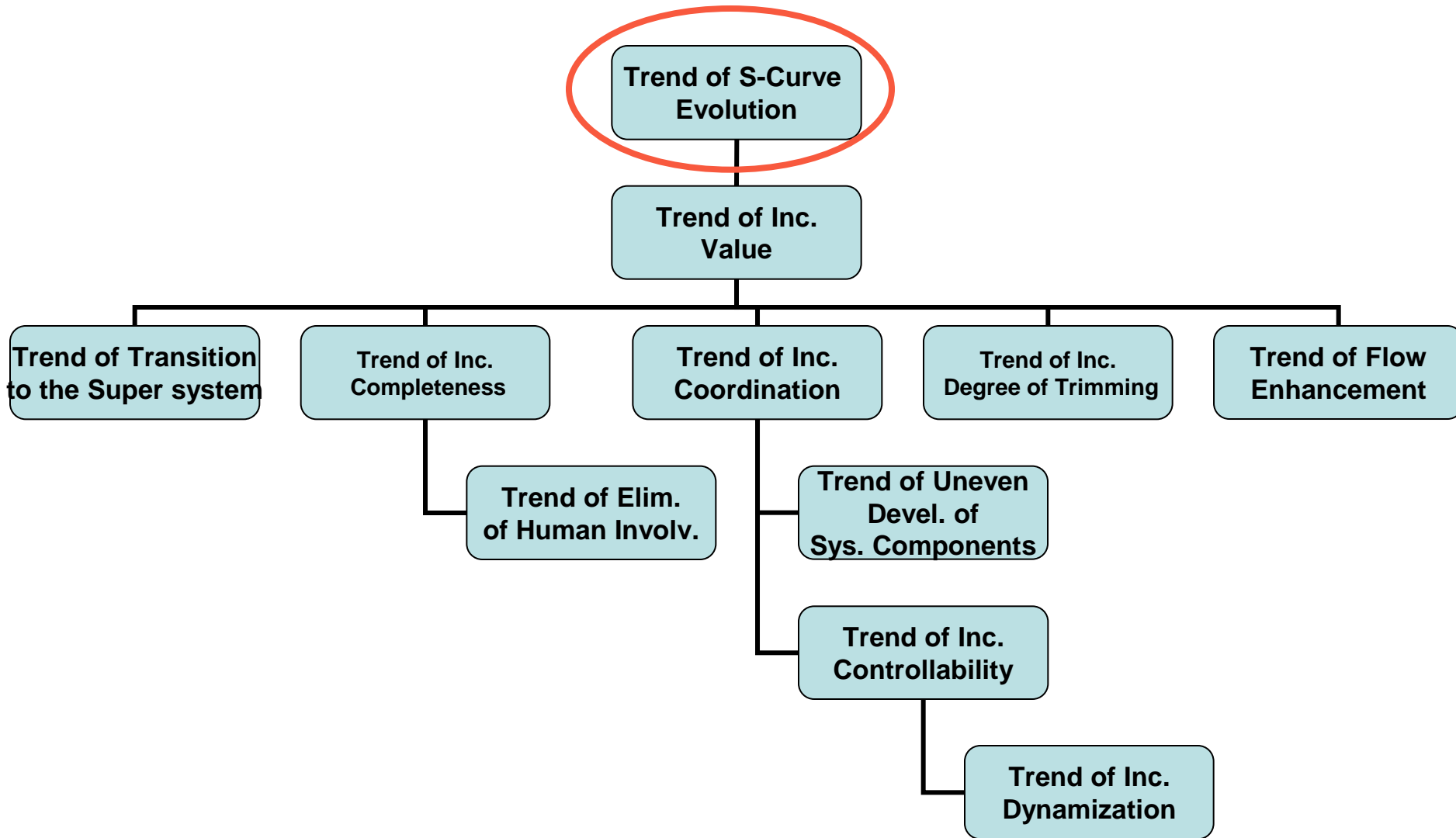


# Trends of System Evolution

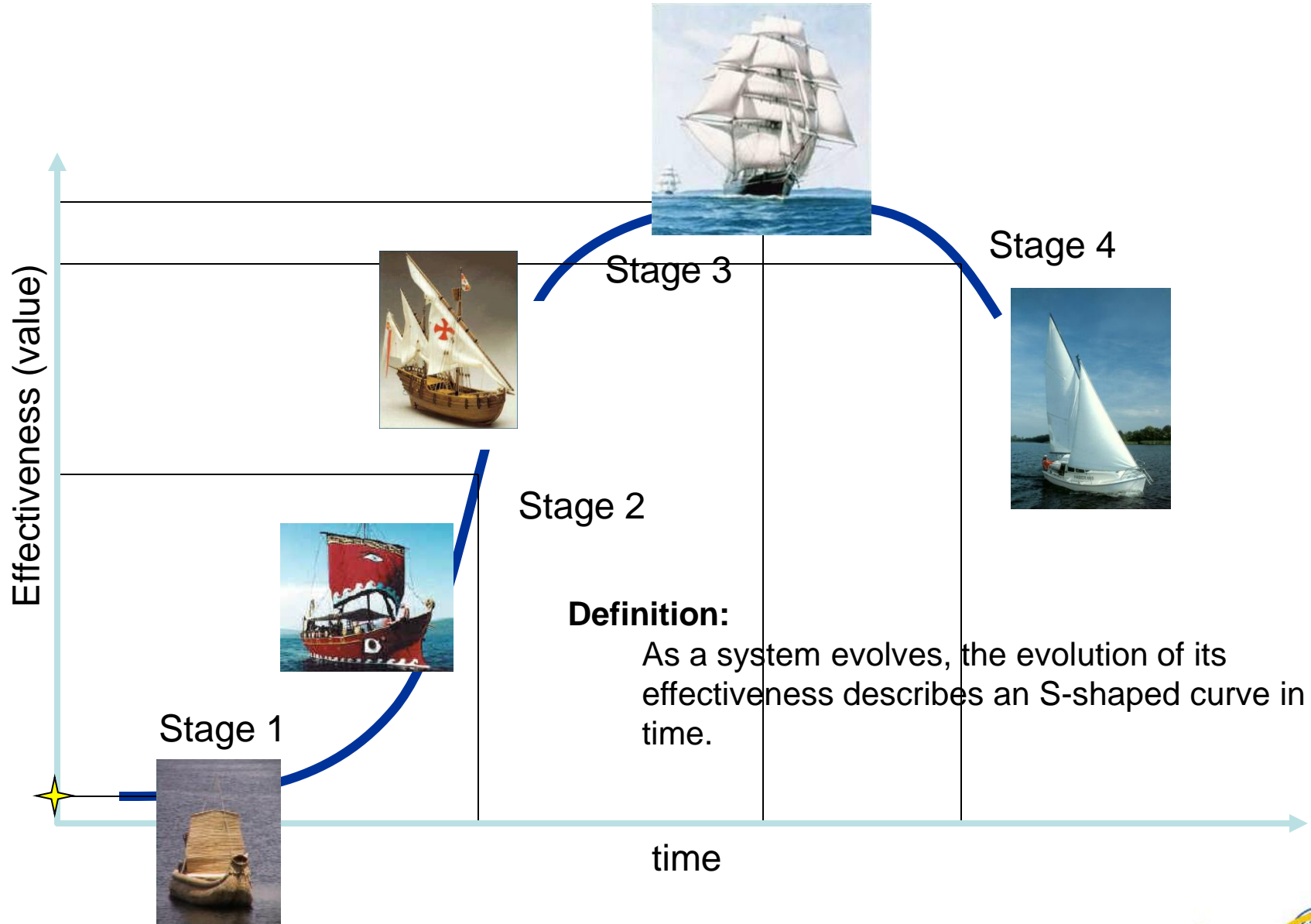
- Engineering systems (products) do not evolve randomly but rather according to objective trends.
  - The trends were established by statistical observations of a wide variety of technologies.
  - The trends can be used to predict future technologies and systems.



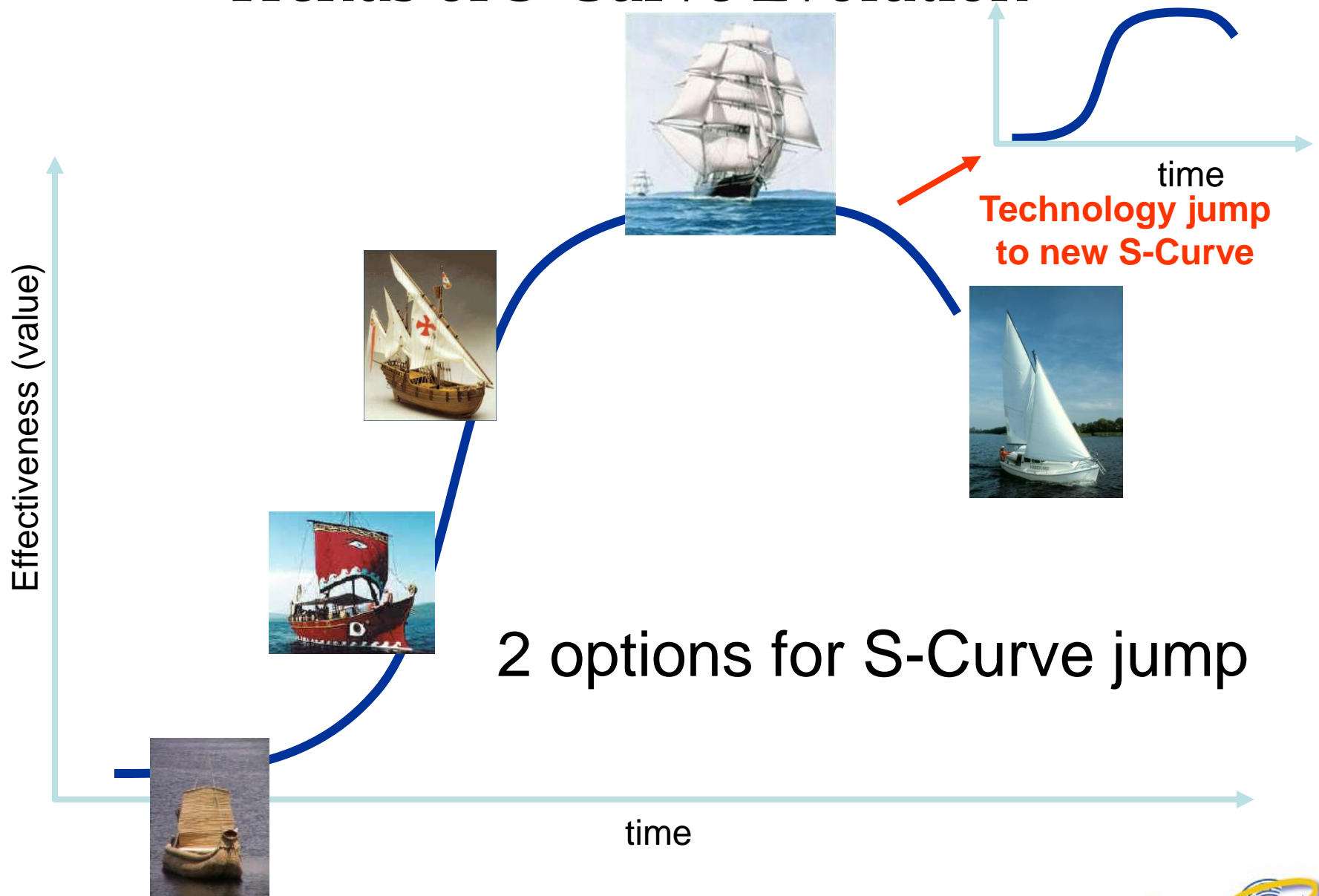
# Hierarchy of Trends



# Trends of S-Curve Evolution

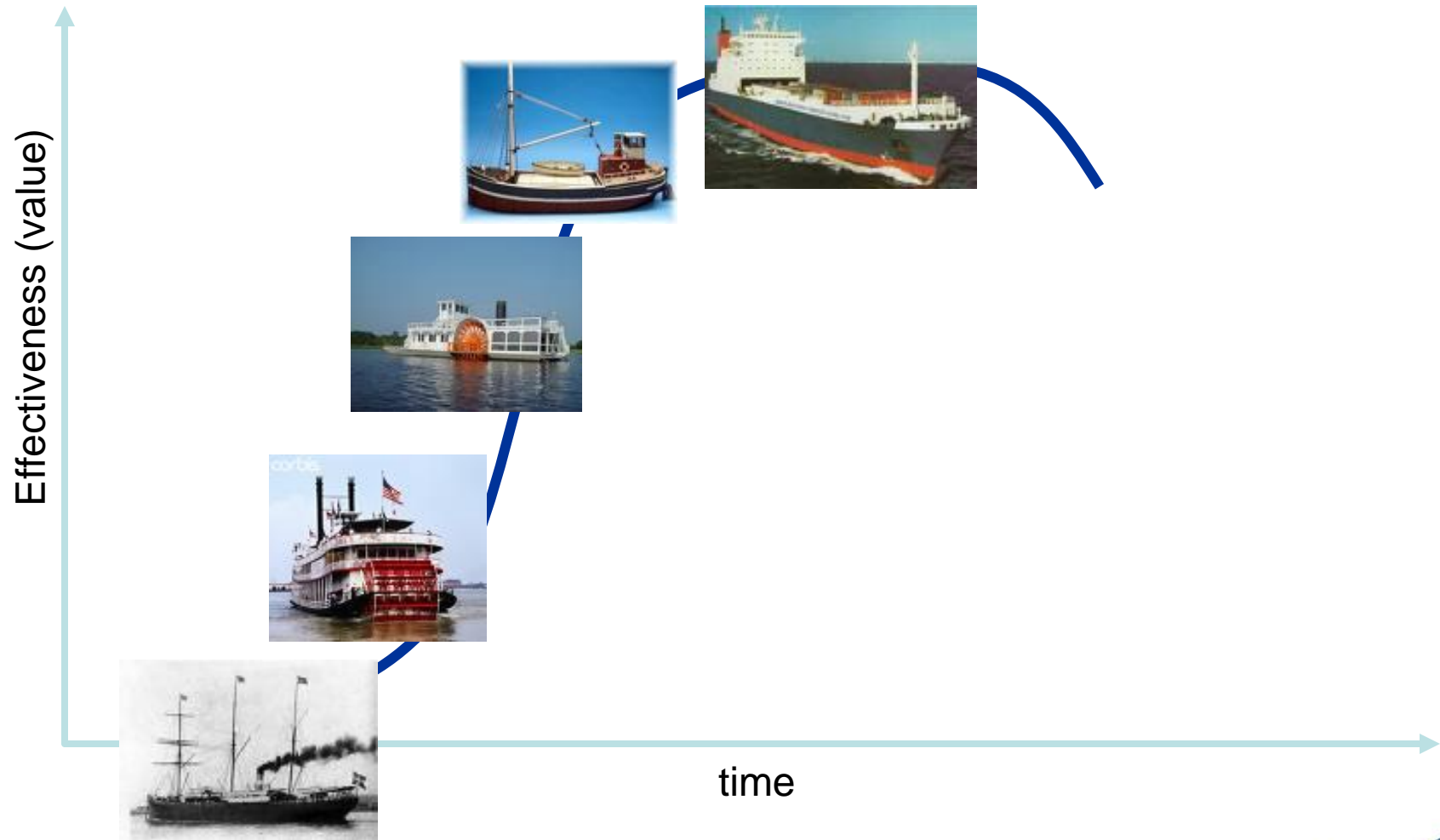


# Trends of S-Curve Evolution



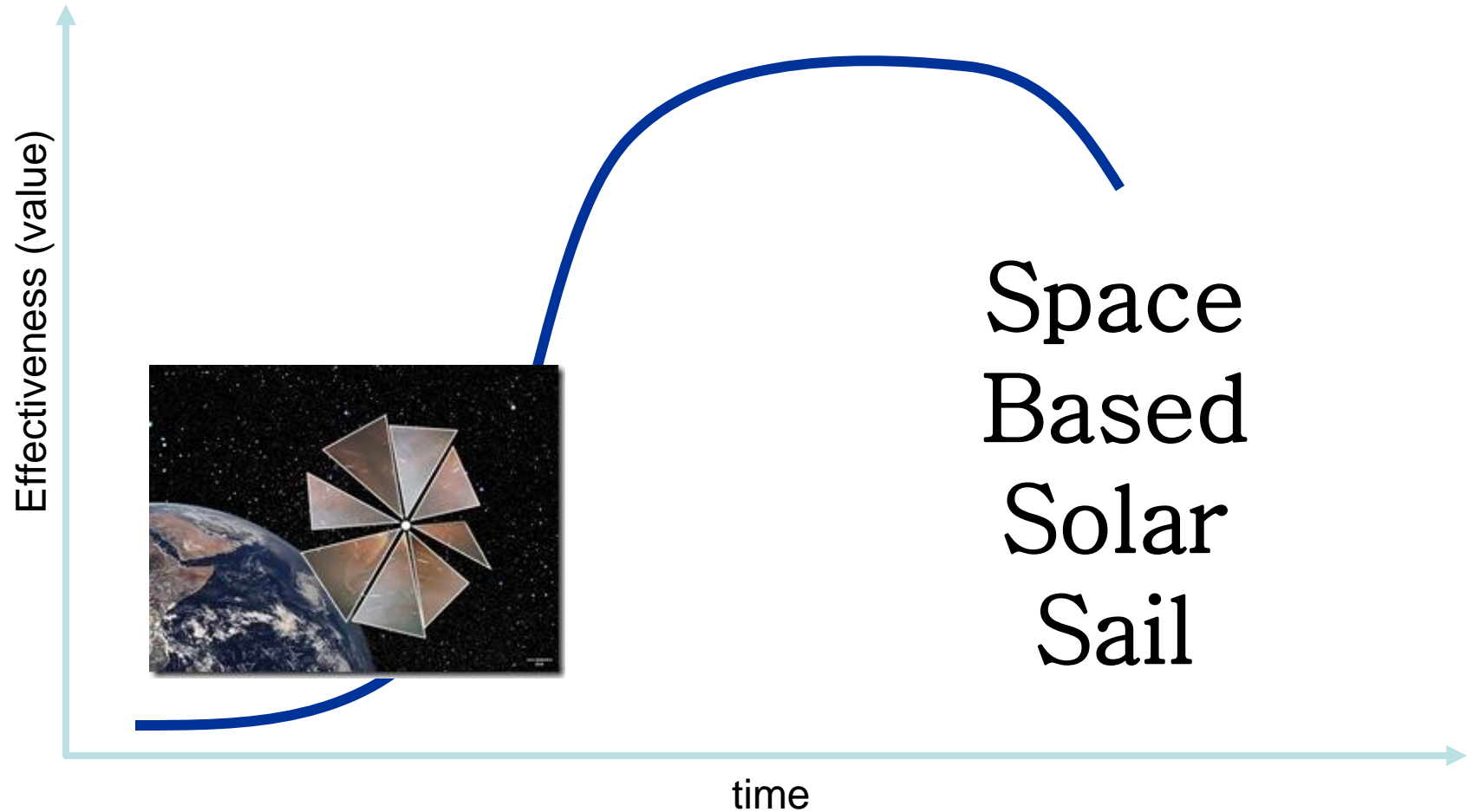
# Trends of S-Curve Evolution

New action principle for same use

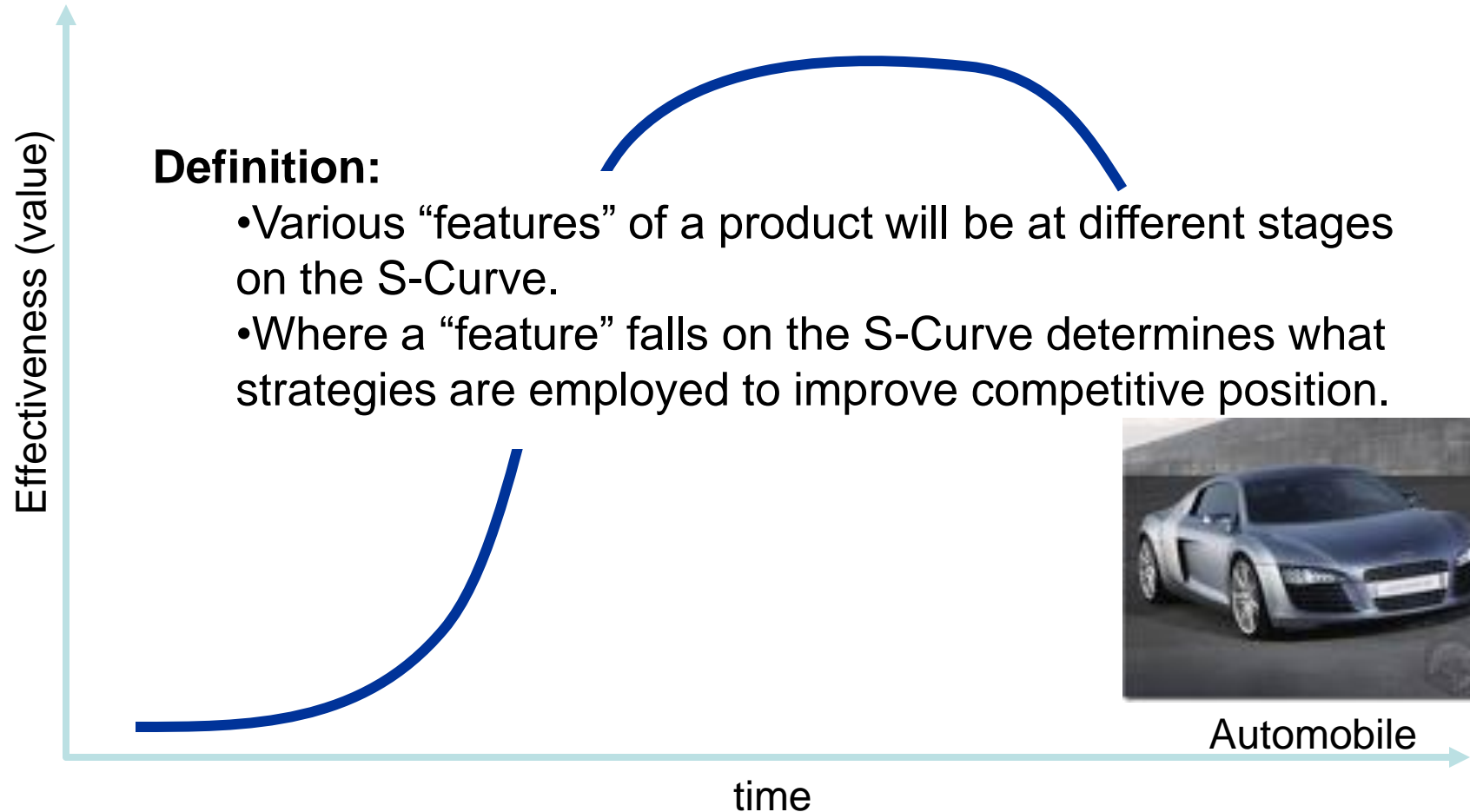


# Trends of S-Curve Evolution

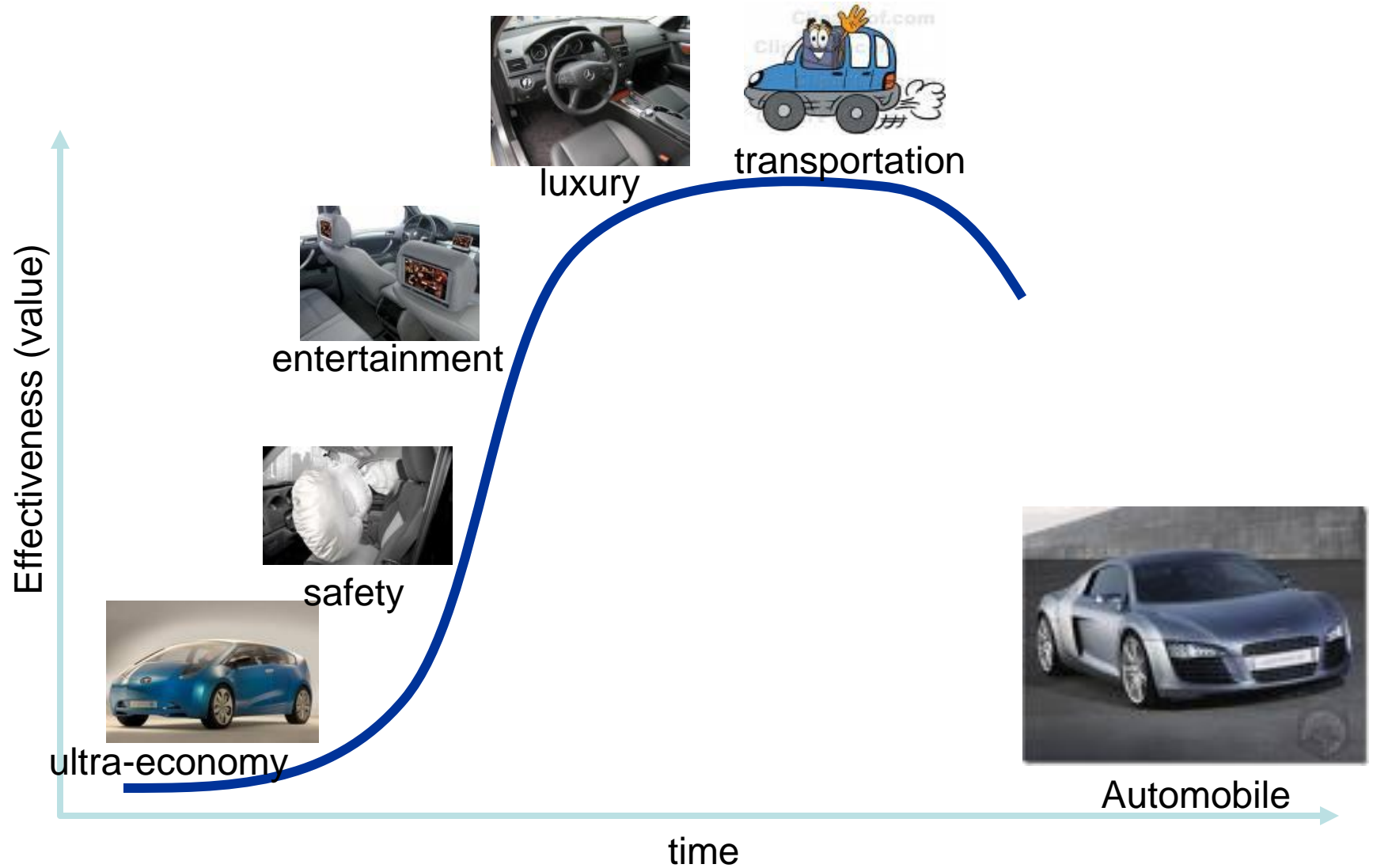
New use for same action principle



# Trends of S-Curve Evolution

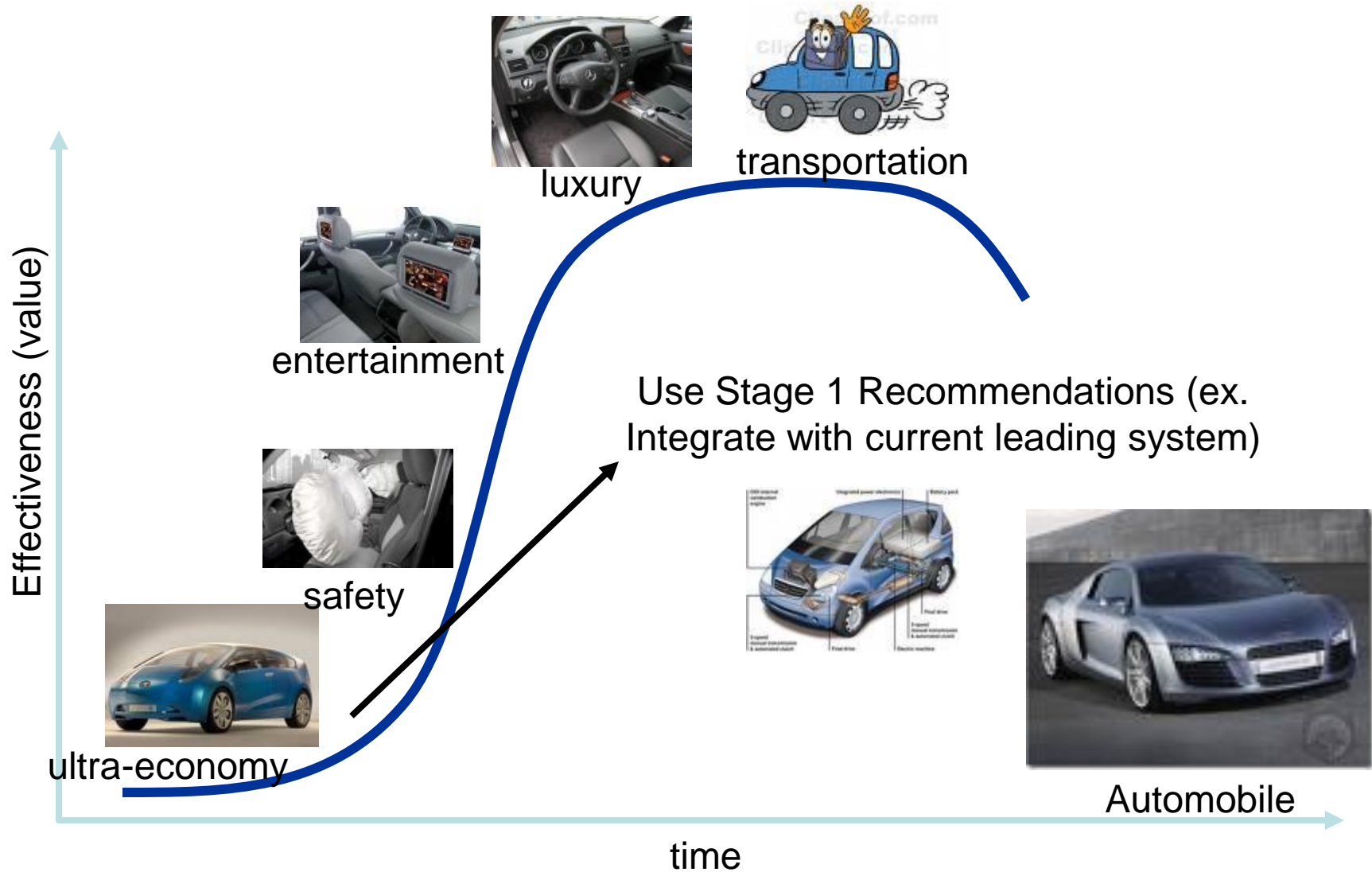


# Trends of S-Curve Evolution



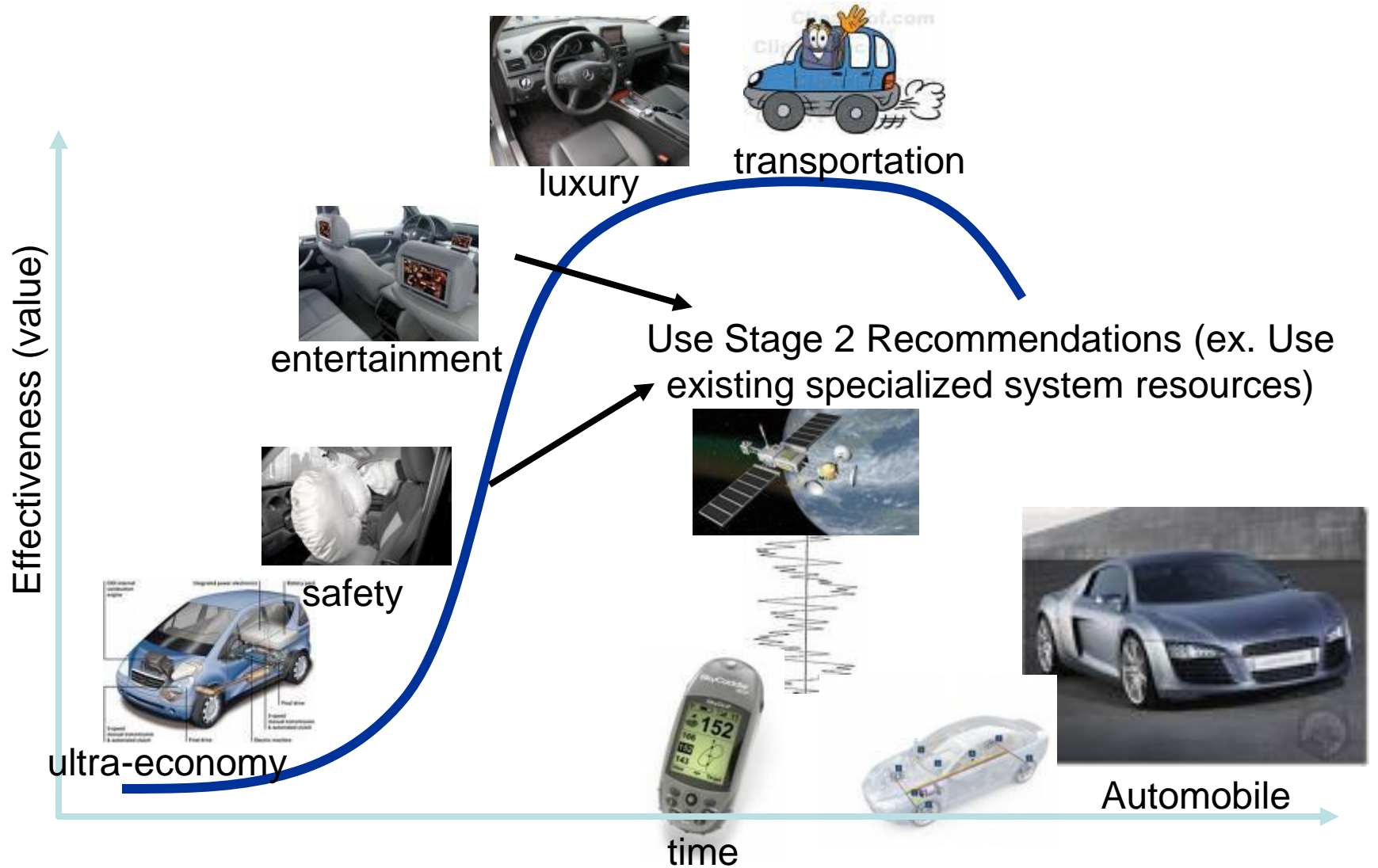


# Trends of S-Curve Evolution

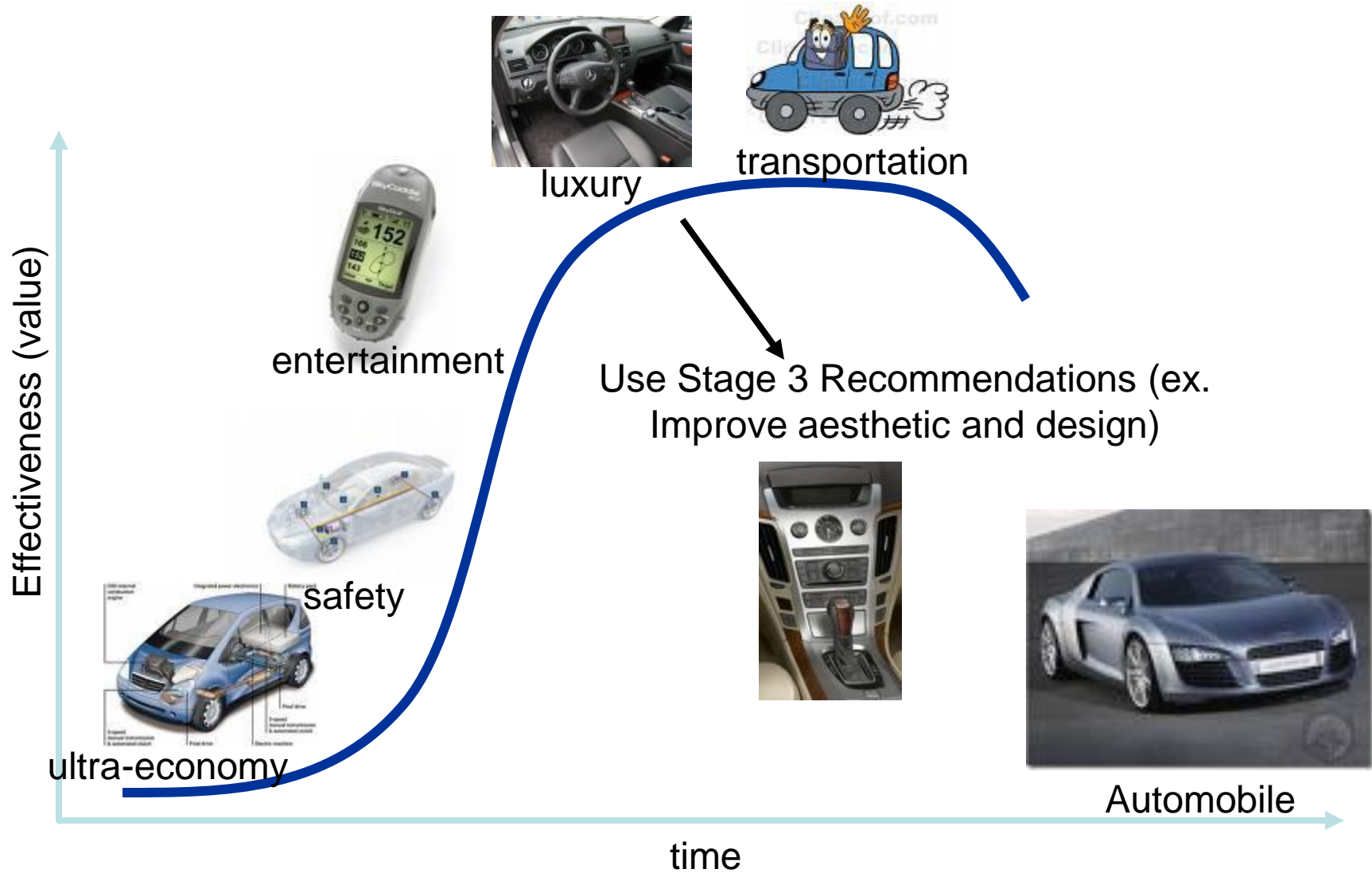




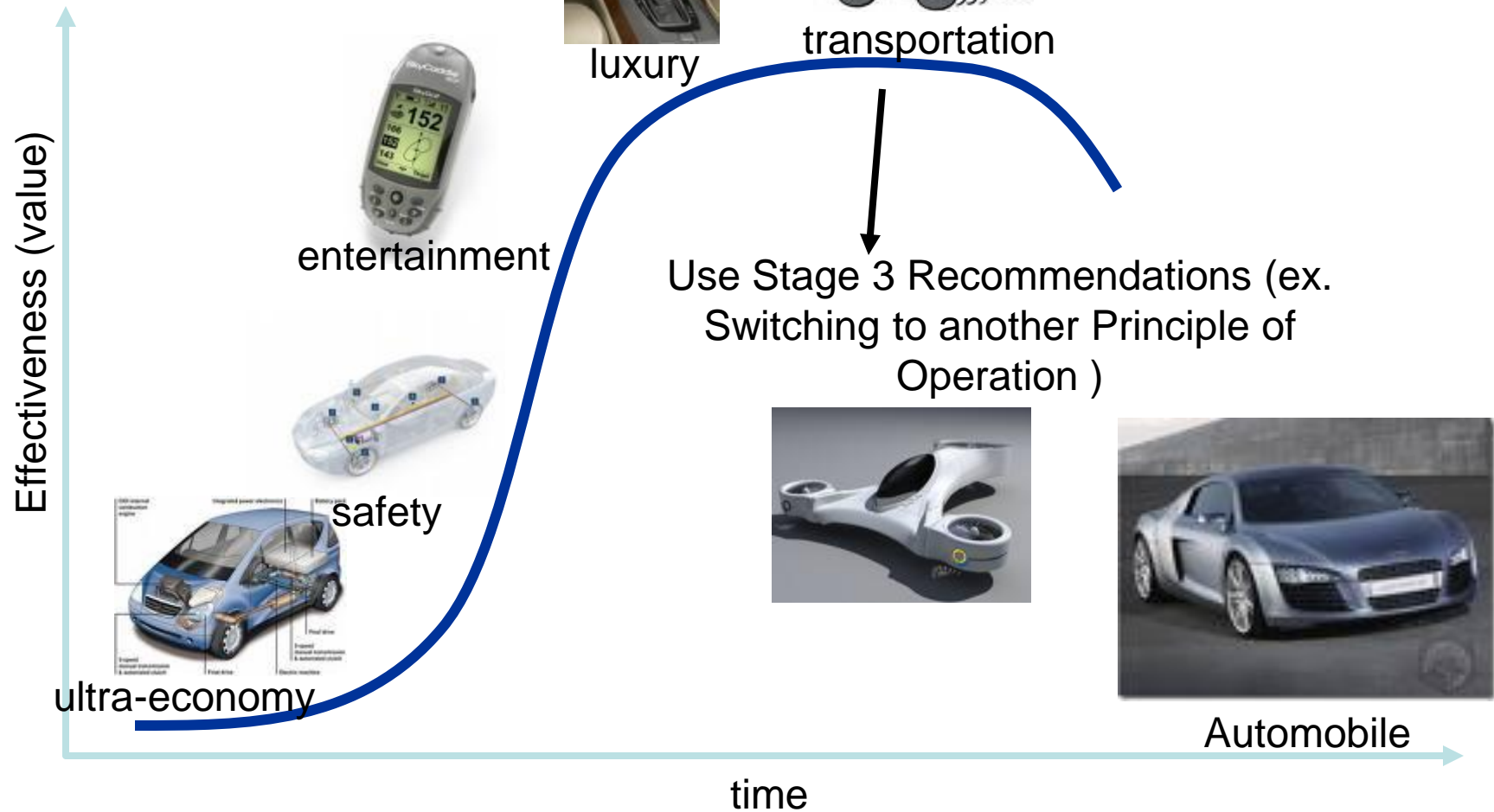
# Trends of S-Curve Evolution



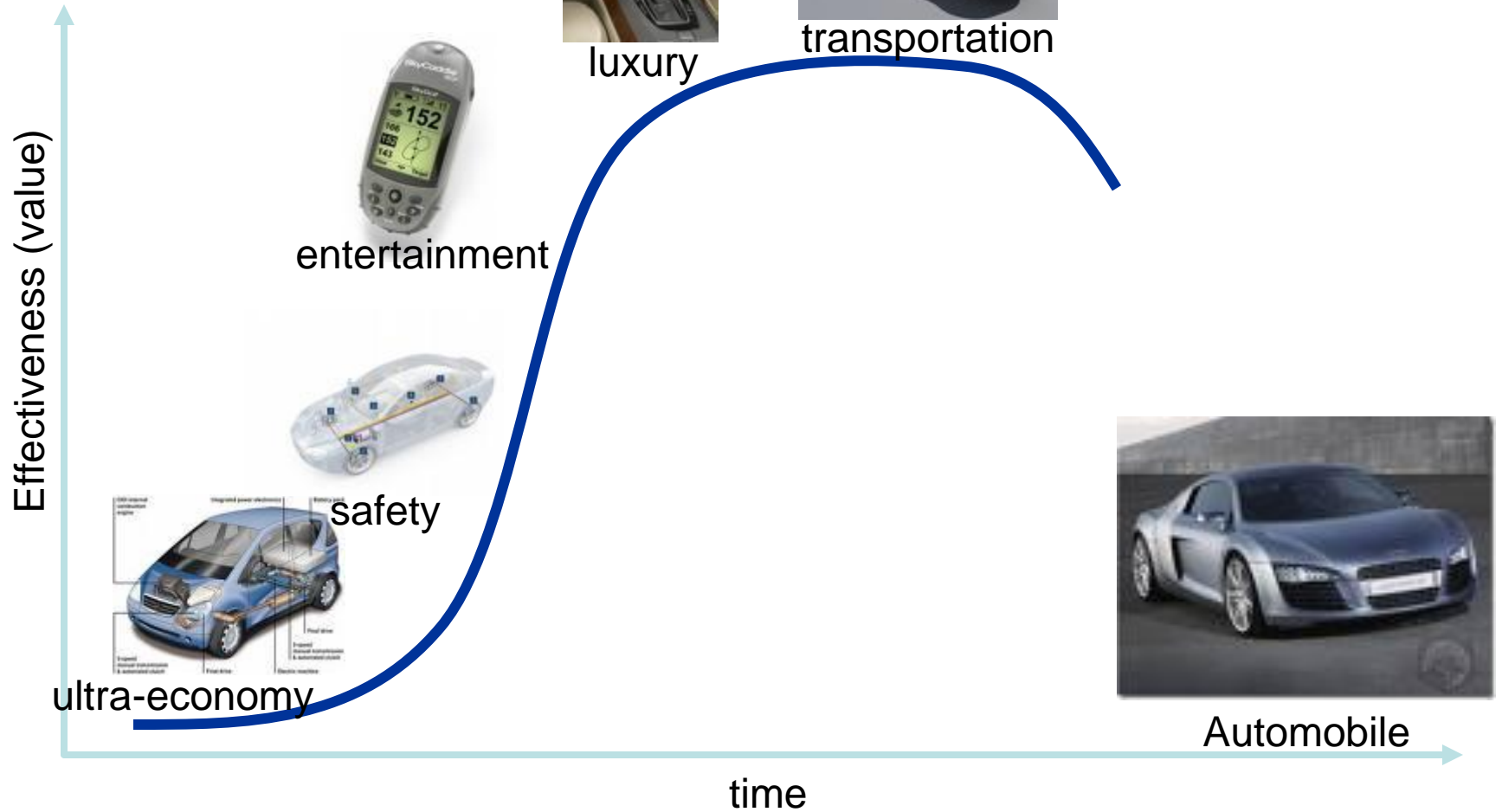
# Trends of S-Curve Evolution



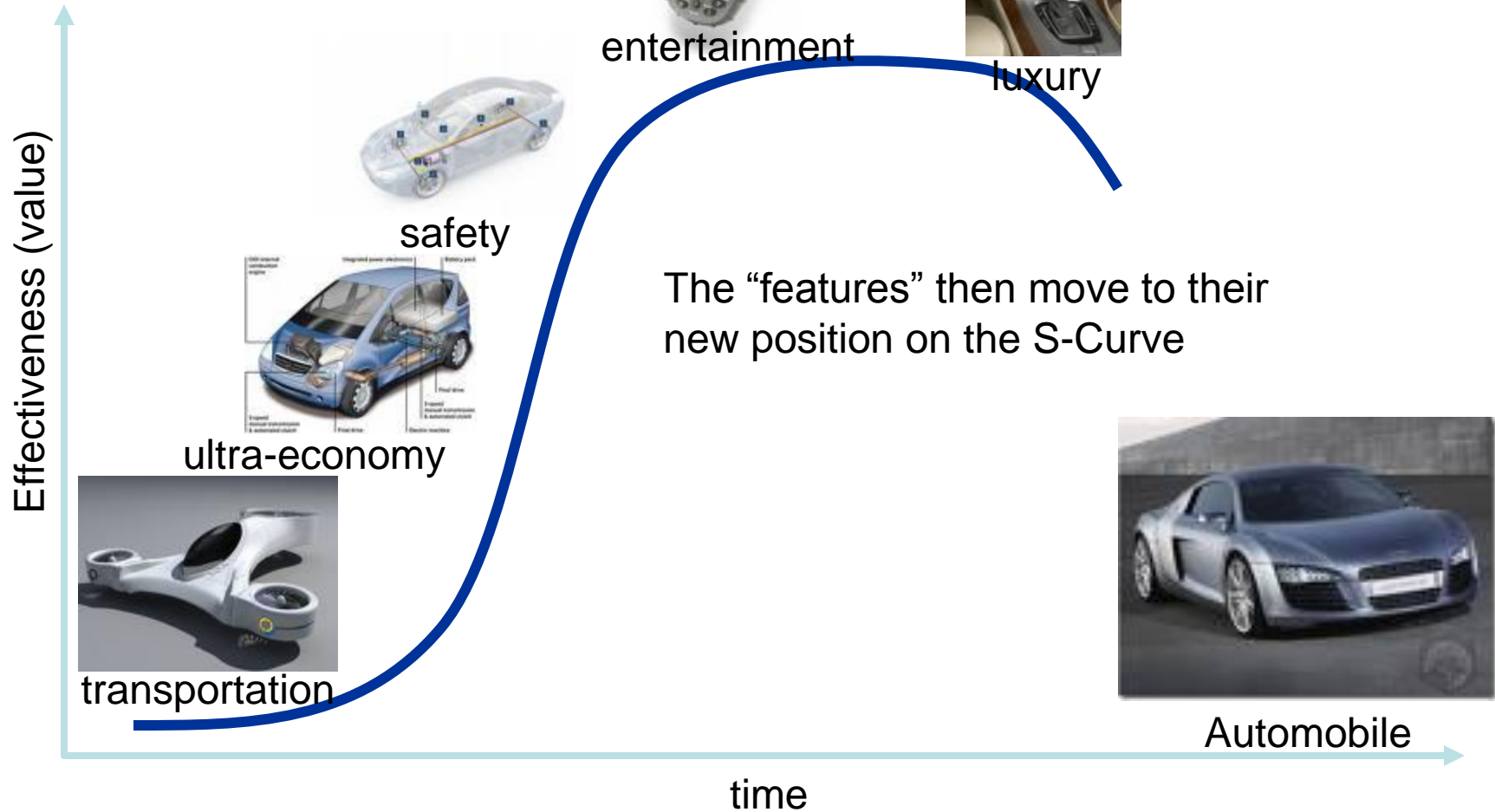
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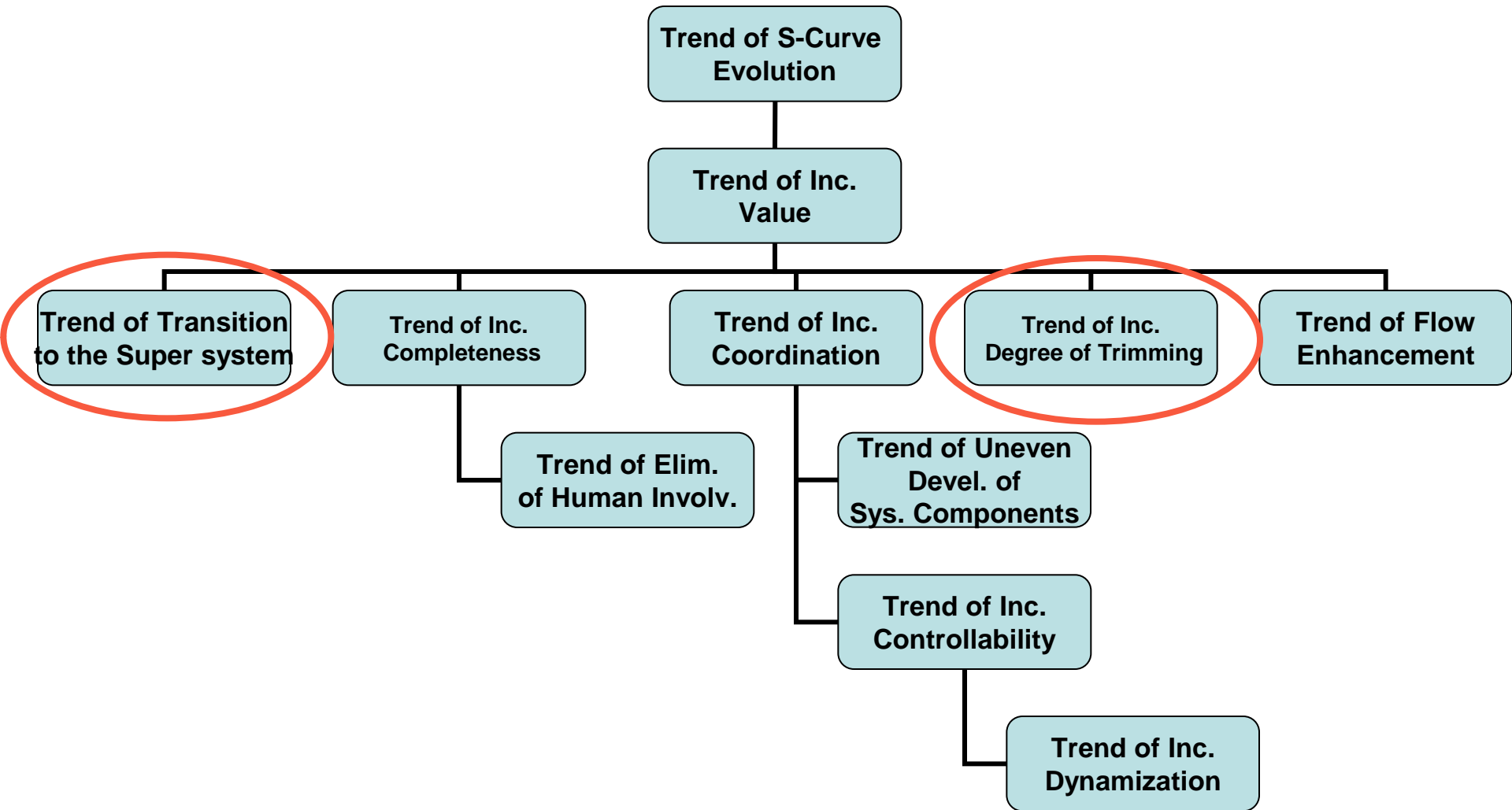
# Trends of S-Curve Evolution



# Trends of S-Curve Evolution



# Hierarchy of Trends





# Trends of Engineering System Evolution (TESE)

Past → Present → Future

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

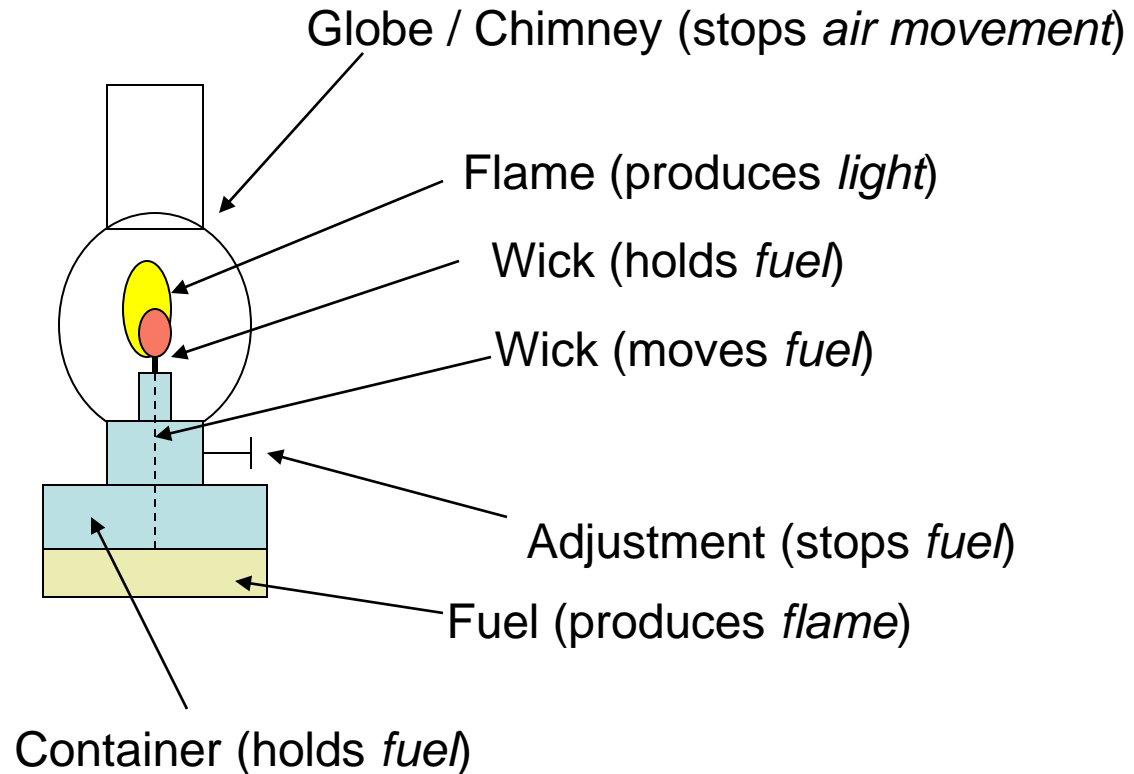
TESE describe how technologies have typically developed in the past



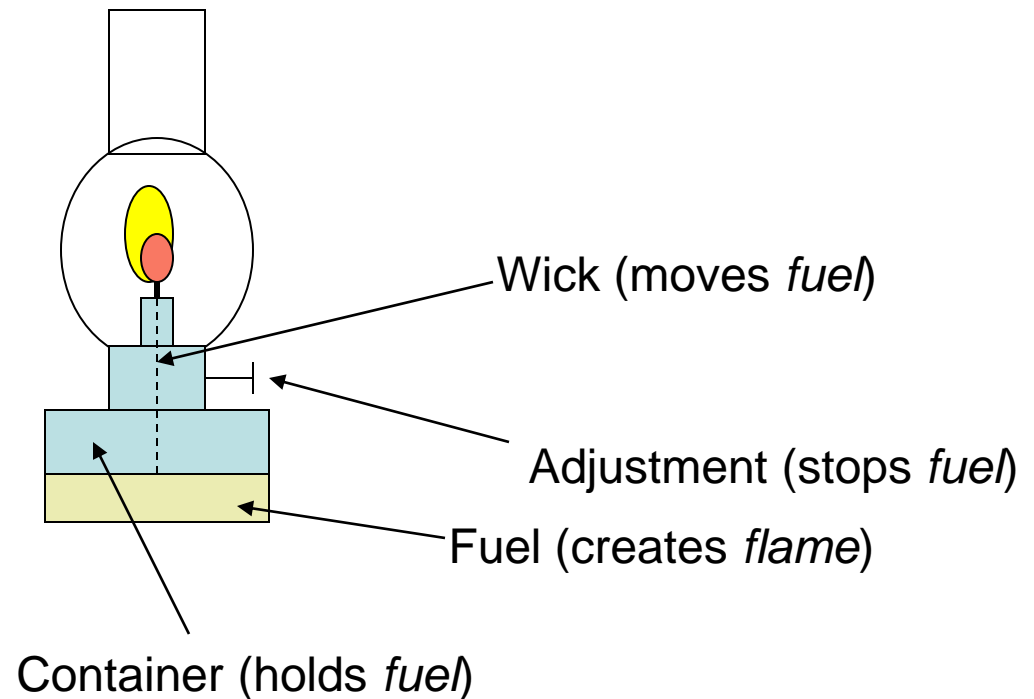


# Illumination Function Example

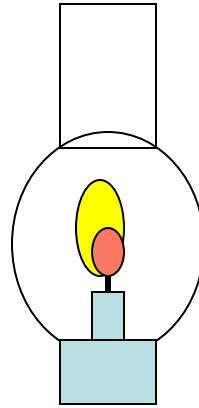
TESE describe how technologies have typically developed in the past



# Trim functions and transition them to the Supersystem



# Trim functions and transition them to the Supersystem



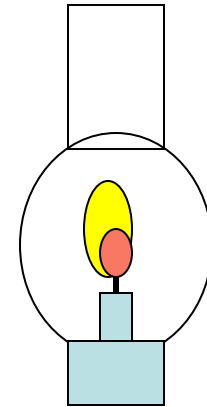
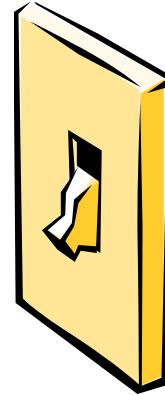
Wick (moves *fuel*)

Adjustment (stops *fuel*)

Fuel (creates *flame*)

Container (holds *fuel*)

# Trim functions and transition them to the super-system

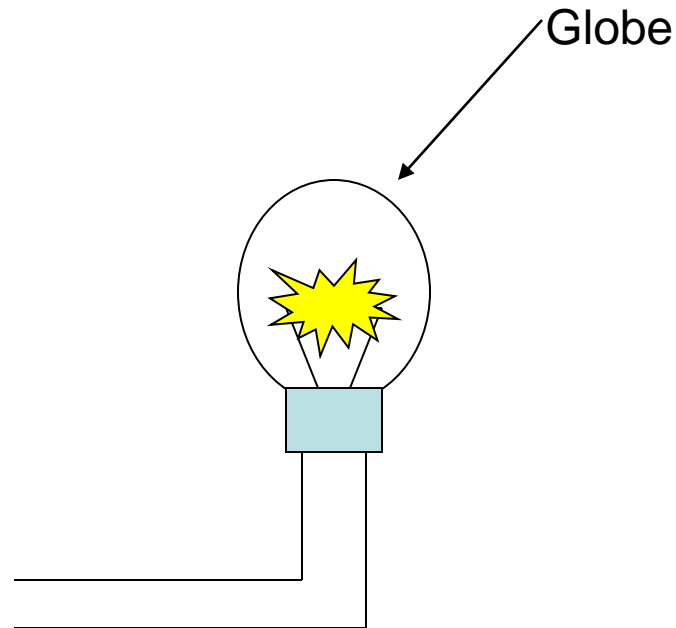


Container (holds *fuel*)  
Wick (moves *fuel*)  
Fuel (creates *flame*)

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.

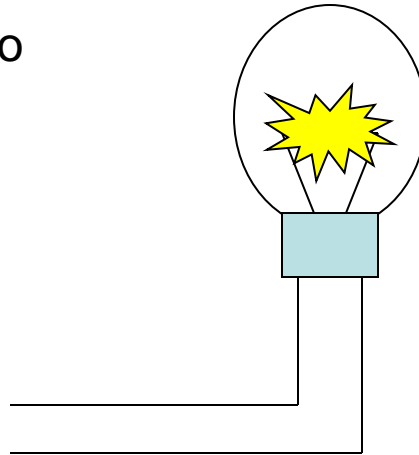


# Illumination Function Example

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

What are some problems with this engineering system?

What can be Trimmed to the Supersystem?



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

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

# Illumination Function Example

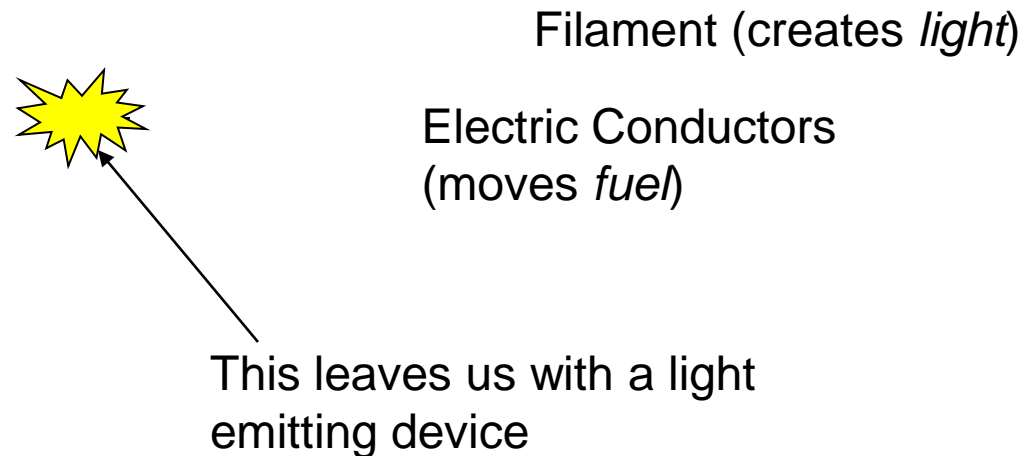
TESE can be used to predict how technologies will develop in the future



This leaves us with a light emitting device

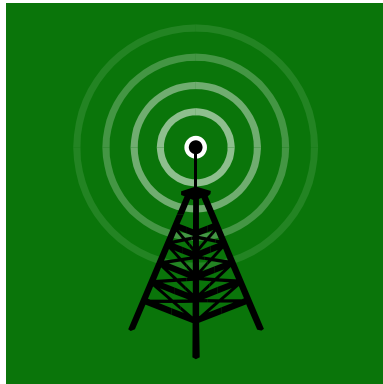
# Illumination Function Example

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





What Supersystem components  
could replace the Trimmed items?

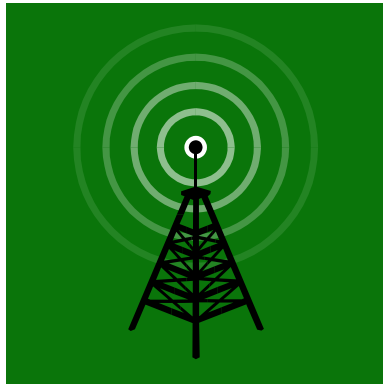


Electric Conductors  
(moves *fuel*)



Filament (creates *light*)

What Supersystem components  
could replace the Trimmed items?



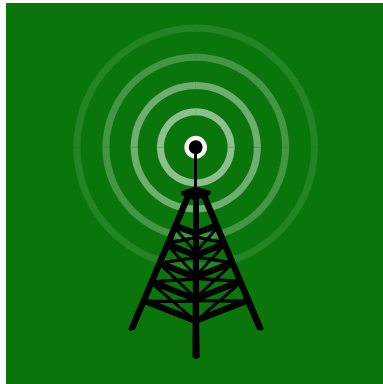
Electro-magnetic  
propagation



Electro-magnetic  
excitable luminous paint

True ambient lighting

What Supersystem components  
could replace the Trimmed items?



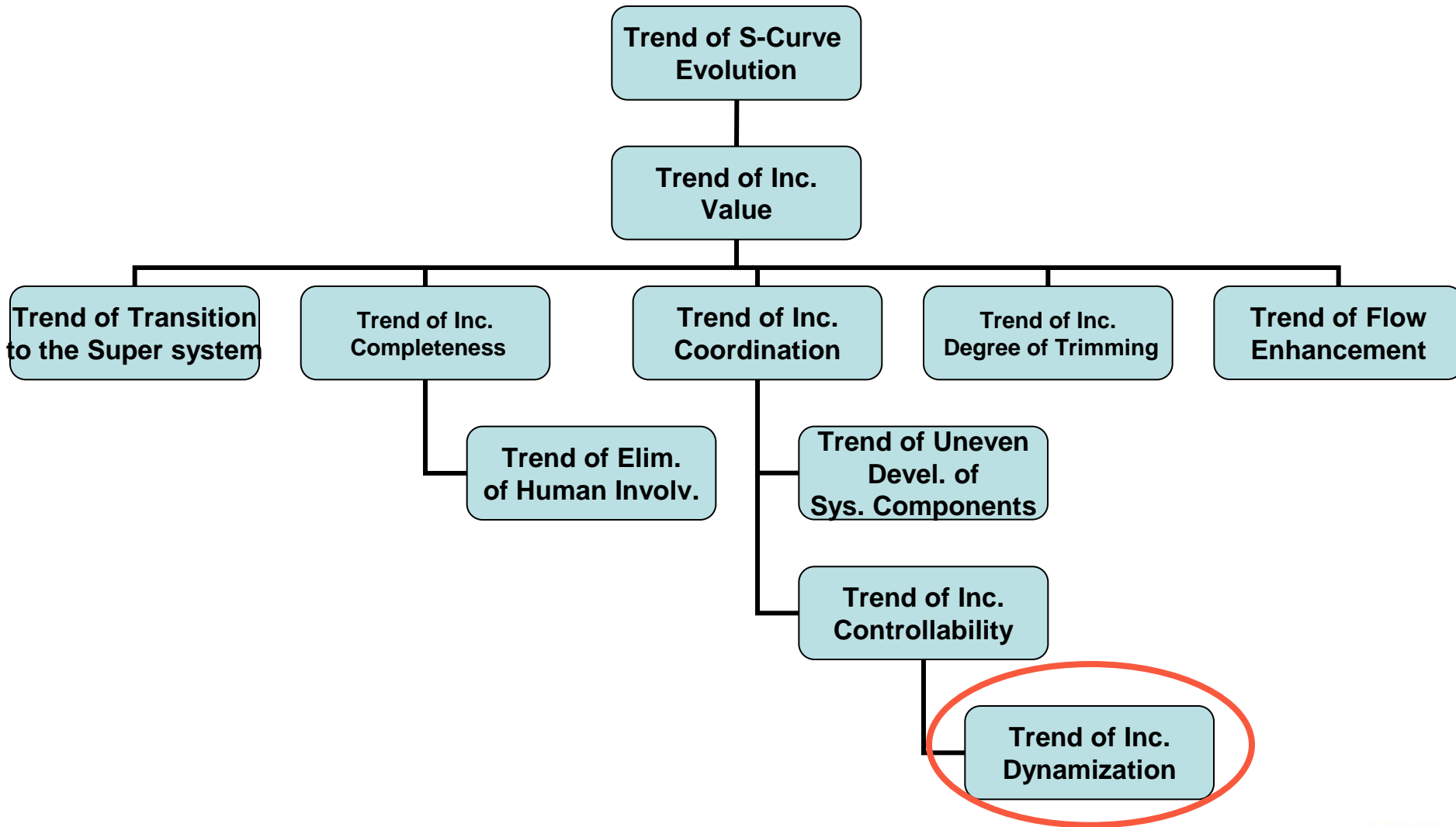
Electro-magnetic  
propagation



Electro-magnetic  
excitable luminous paint

True ambient lighting

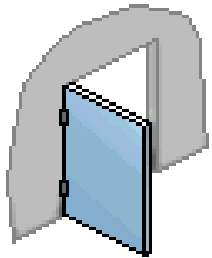
# Hierarchy of Trends



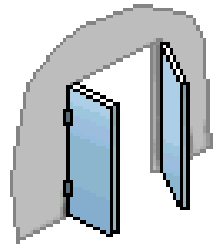
# TRIZ Focus Areas

- *Trend of Increasing Dynamization*

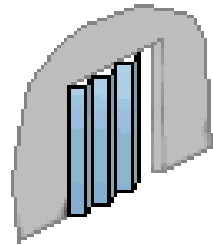
rigid      single joint      multi-joint      elastic      liquid or gas      field



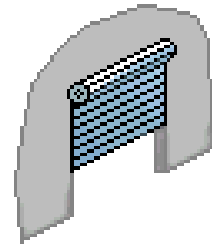
Single-leaf



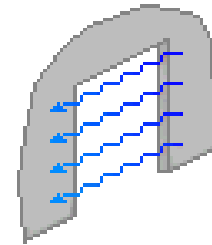
Two-leaf



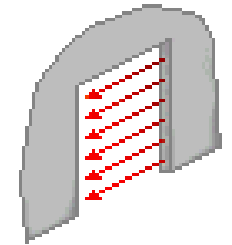
Accordion door



Roll-up door



Air curtain



Light lock

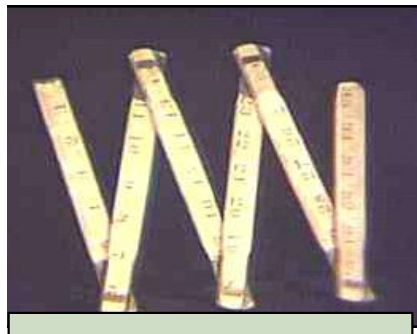
# TRIZ Focus Areas

- *Trend of Increasing Dynamization*

rigid      single joint      multi-joint      elastic      liquid or gas      field



**Simple Ruler**



**Folding Ruler**

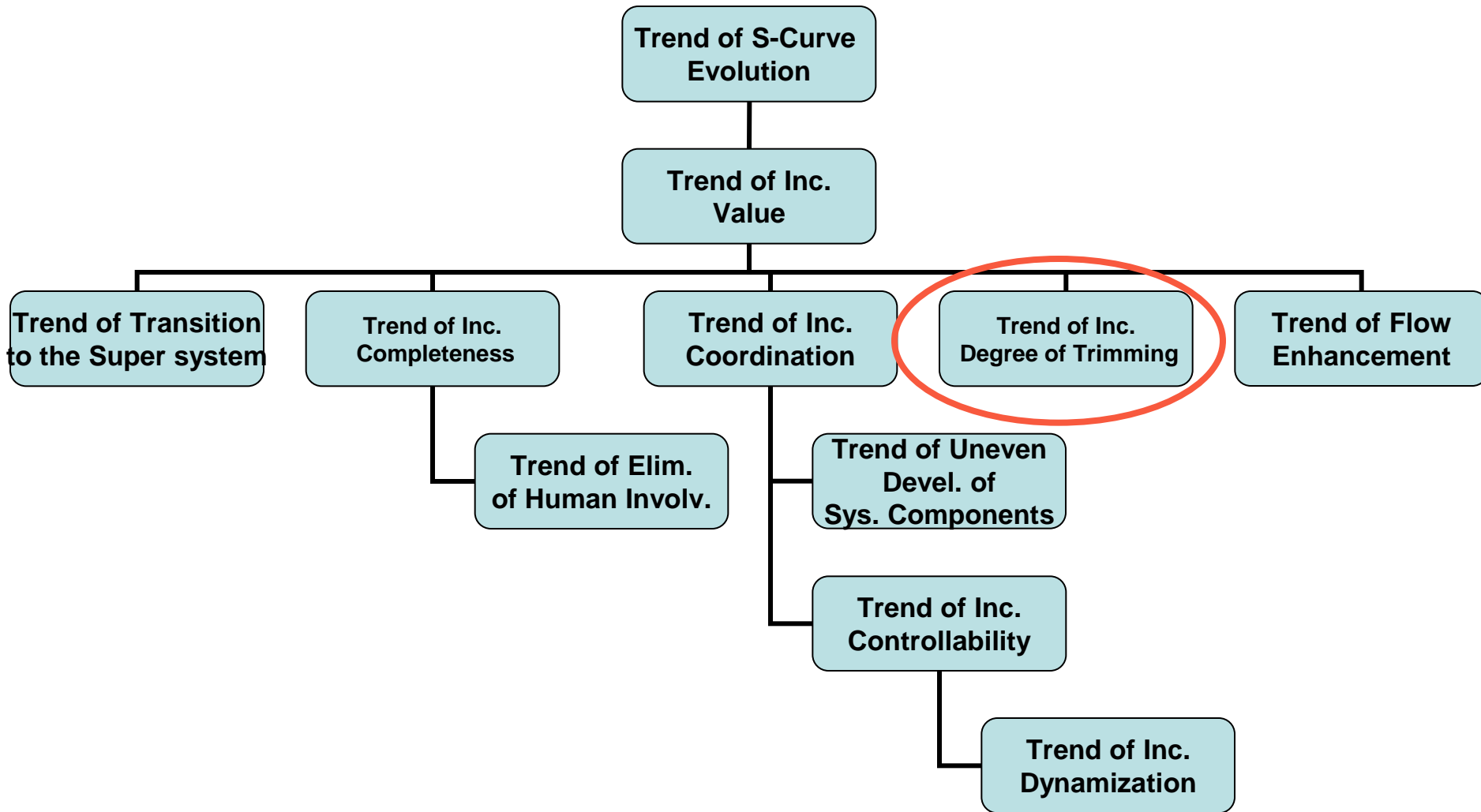


**Measuring Tape**



**Laser Ruler**

# Hierarchy of Trends



# TRIZ Focus Areas

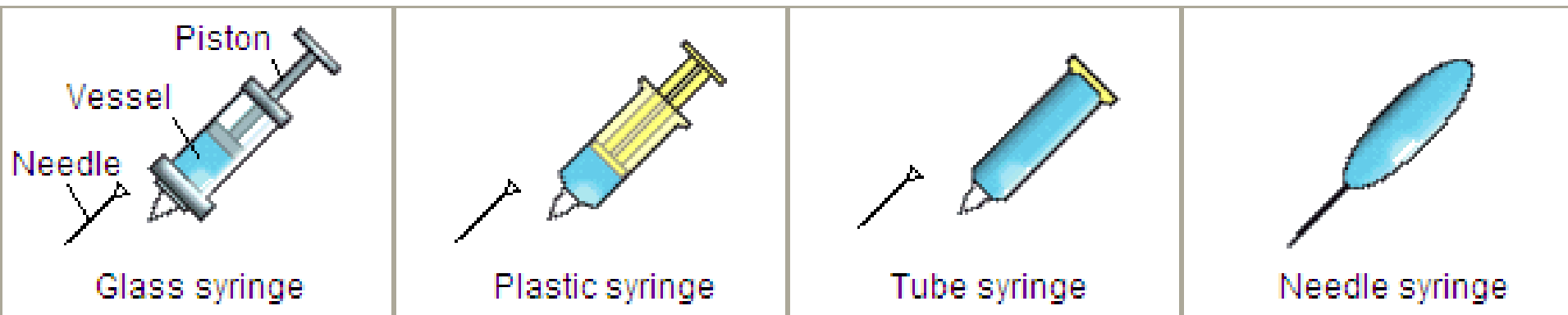
- *Trend of Increasing Degree of Trimming*

complete system

merged system

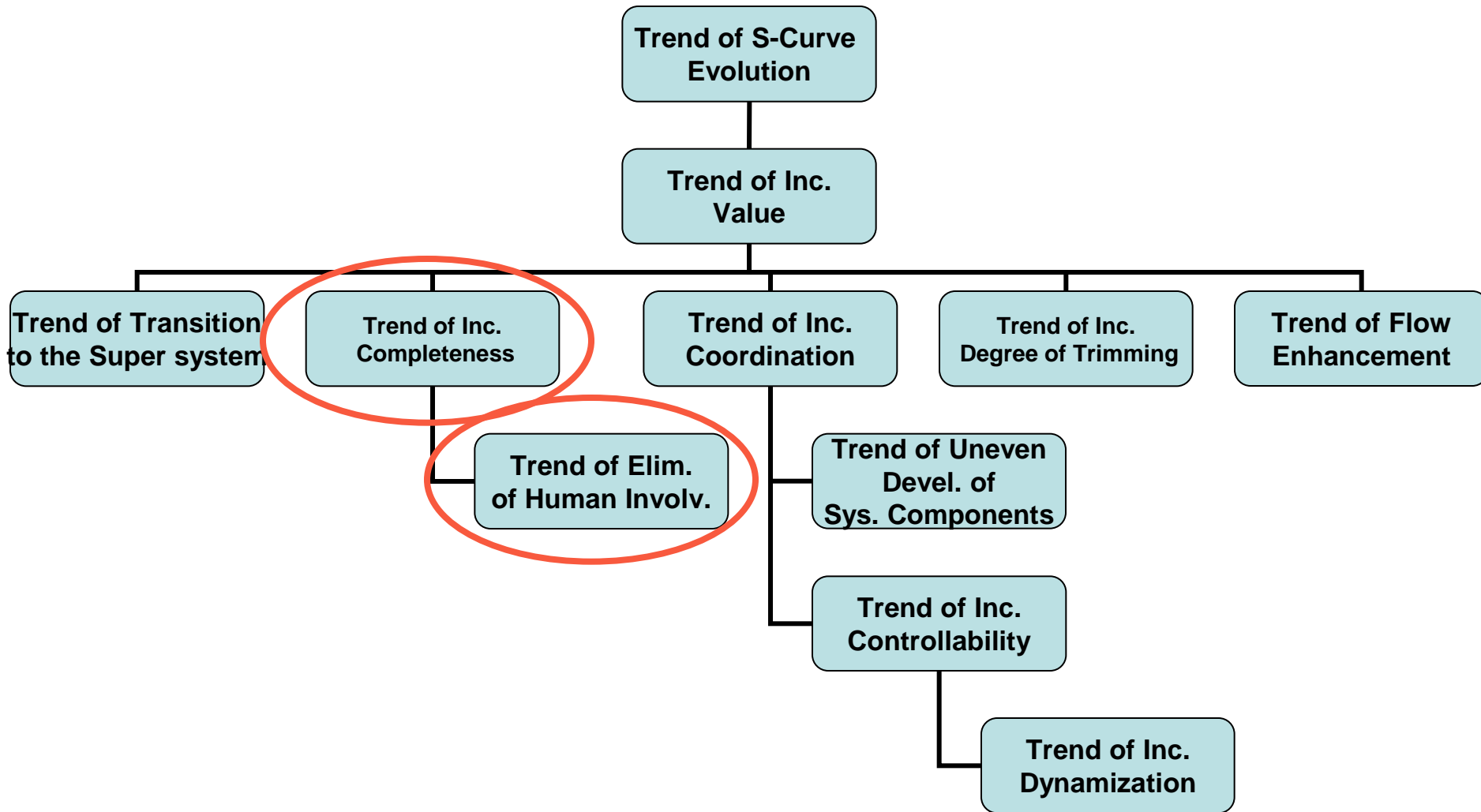
partially trimmed

fully trimmed





# Hierarchy of Trends

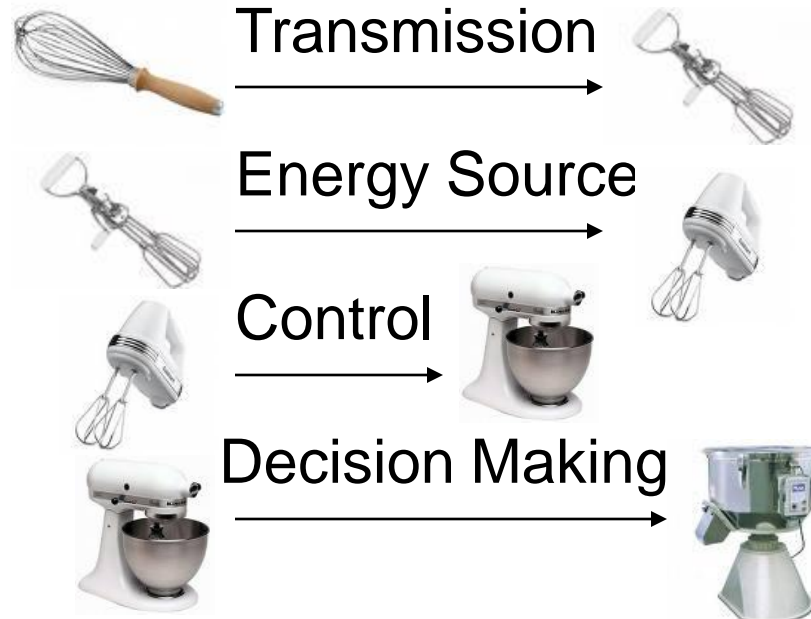


# Trend of Decreasing Human Involvement & Increasing System Completeness

- 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.

Humans Stop Performing:

System Starts Performing:



# 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:

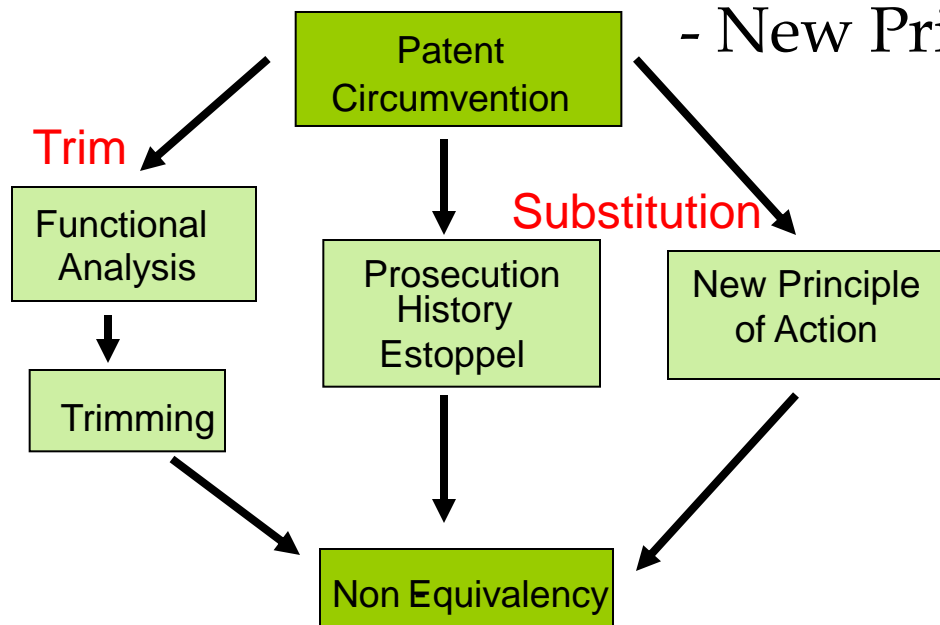
1.) Novelty – new, does not exist, must be novel word wide.

- 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



# Patent Circumvention Example

## Trimming

- 2007 TomTom Patent - GPS with built in video camera



### 1.) Trim a component





# Patent Circumvention Example

## New Principle of Action

Principles of action will follow a Trend Line

*Function:* Printing

*Trend:* Dynamization

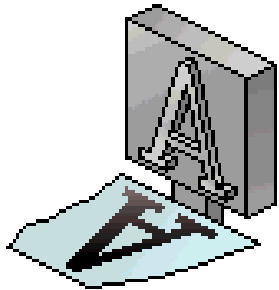
monolith

segmented  
monolith

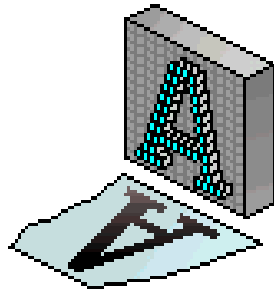
liquid, powder

gas, plasma

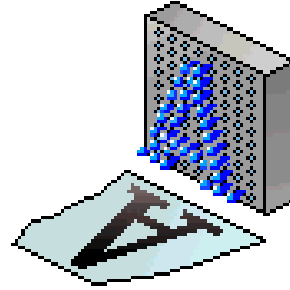
field



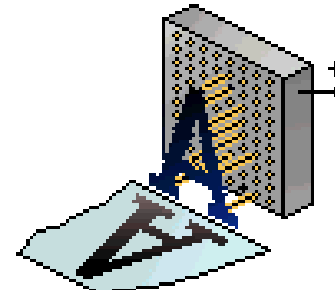
Letter printer



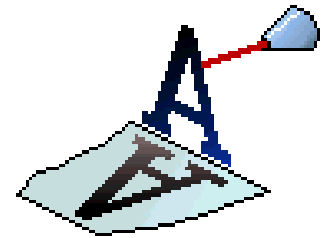
Matrix printer



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



# Patent Circumvention Example

## New Principle of Action



**Component:** Food Mixer

**Function:** Mixes

### **Current Action Principle**

Mechanical Stirring



### **New Action Principle**

Mechanical Vibration



# Contact Information

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## **Innomation Corp**

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505-206-3401

InnomationCorp.com



# 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**

# 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.



# 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.

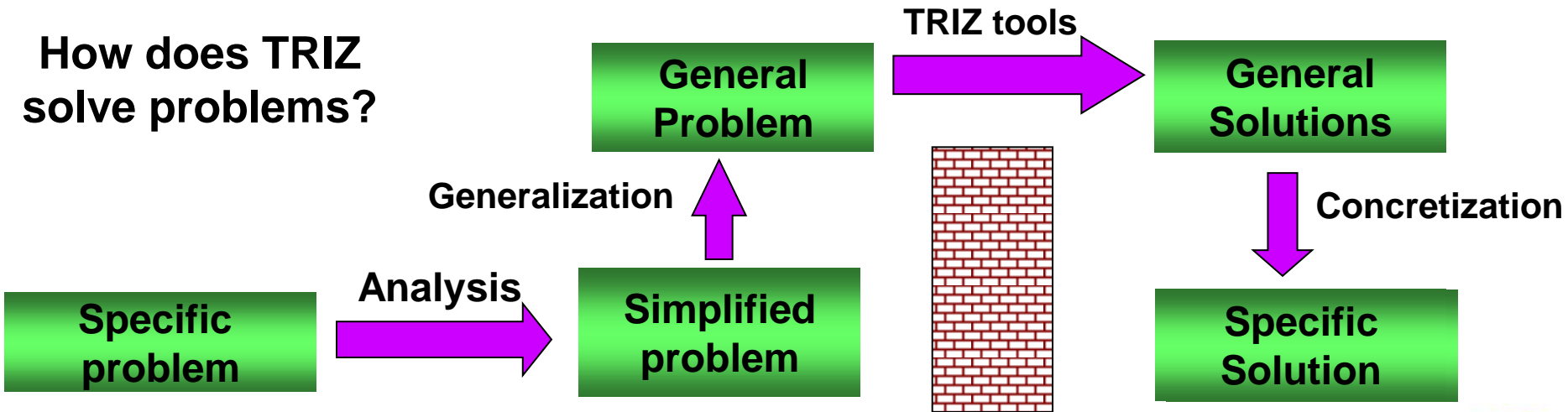
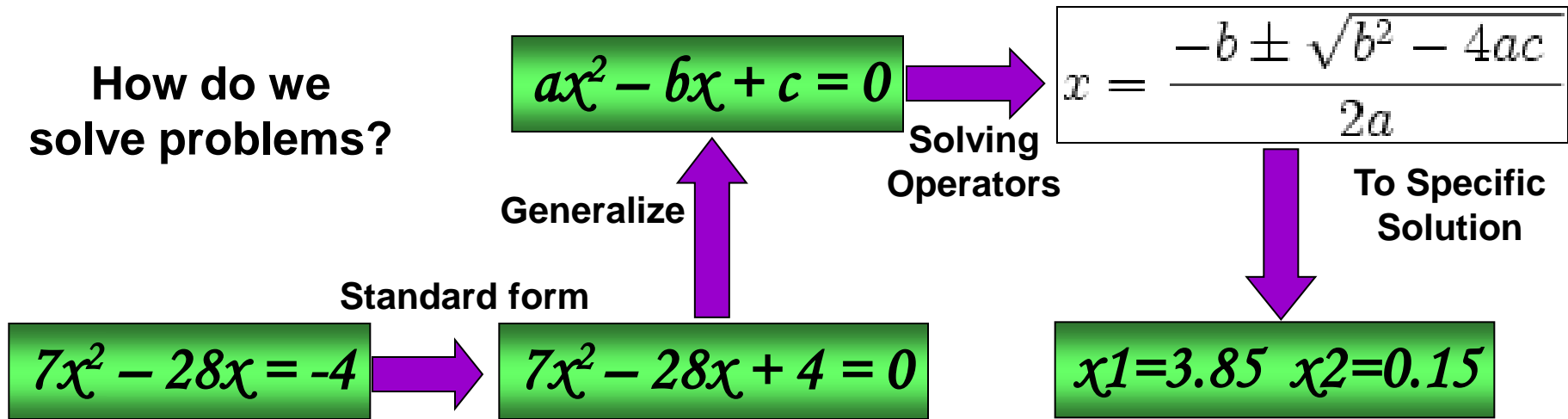
Just as in other disciplines, TRIZ provides multiple ways to model problems and solutions as well as providing tools to help with the transition from problem to solution modeling.

### 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 <sub>2</sub> O
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?



# Contact Information

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