Objective Laws Of System Evolution

Systems Evolve in Predictable Ways
Systems Never Remain Static

Propeller
Pushes
Vessel
Water
Lifts / Positions
Propels
Materials / People
Transports

Sails
Pushes
Vessel
Water
Lifts / Positions
Transports

Wind
Pushes
Vessel
Water
Lifts / Positions
Materials / People
Transports

Propeller
Pushes
Vessel
Water
Lifts / Positions
Transports

Materials / People
Systems Change at all levels

Super System

System

Sub System
If two systems have the same function, but use different effects (physical phenomena) to deliver the main function, we will call them different systems.
Different Propulsion Systems
Same Function but Different Effects (Steam Powered and Wind Powered)

Same Propulsion System
Same Function and Same Effect (Oars)
What Stages Occur Between Effects?

- Light gas
- Lifts
- Payload
- Wing
- Lifts
- Payload
- Propellant
- Lifts
- Payload
Law of Stages

How systems grow up
Stage 1: Determining the Parts and Where They Go
Stage 2: Removing the Bad Marks

Fuel Tanks become supporting structure
Booster can be added or removed depending upon payload.

= Make Adjustable
Stage 4: Introducing Feedback
Stage 5: Transition To New Effect
The Effect is Still Present but...

Combine with Super-system

Macro to Micro
(Make use of Bulk Properties)

Ionic Drive Engine
uses bulk properties of Plasma
Time For a New Effect?

↓ Has the system become very specialized?

↓ Has the system reached the point of diminishing return?

↓ Is automatic feedback used to perform the main function?

↓ Must multiple conflicts be resolved for improvement?
Level of invention

1. No resolution of contradiction

2. Resolves contradiction with small change

3. Resolves contradiction with a major change. Uses technology from same field

4. Resolves contradiction. Complete change in Effect. Usually a technology from another field.

5. Fundamental Effect. Has ability to change the super-system to which it belongs.
Law of Increasing Ideality

\[
\text{Ideality} = \frac{\text{Index of Useful Functions}}{\text{Index of Harmful Functions}}
\]

More functions done better

Less Harmful Functions (Includes $ \times \text{Time Weight and Harmful Interactions}$)
Ideality Exercise

Based upon the laws of ideality, what should happen to this lawn mower?
Law of Shortening Energy Paths

- Transmissions paths are shortened and eventually eliminated.
- Energy transformations are reduced and finally eliminated.
- Muscle and control signals use the same field.

What should happen to this automobile transmission?
Law of Non-Uniform System Development

- System parts are improved in “fits and spurts”
- When one part is improved, other parts may be harmed.
- System improvement is slowed by increasing conflicts.
- When one part improves, other parts may appear worse by comparison.
- System Takes on Subsystem improvements and Effects

- Engine Bleed Valve

Engine efficiencies improve as temperatures increase. What effect will this have on an attached valve?
Law of Transition from Macro to micro

Functions performed at the macro-level are eventually performed at the micro level where the bulk properties are controlled by a field.
Lines of Evolution
Field

= Fundamental fields in physics which can be combined to form Effects

Fields used in Buoyancy

Gravity
Pressure

Move
Buoyancy

Liquid
<table>
<thead>
<tr>
<th><strong>Elastic Force</strong></th>
<th><strong>Gravity</strong></th>
<th><strong>Friction</strong></th>
<th><strong>Adhesive</strong></th>
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<tr>
<td>Internal and external</td>
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<tr>
<th><strong>Centrifugal Force</strong></th>
<th><strong>Inertia of Bodies</strong> (note direction)</th>
<th><strong>Coriolis Force</strong></th>
<th><strong>Bouyant force</strong></th>
<th><strong>Hydrostatic pressure</strong></th>
<th><strong>Jet Pressure</strong></th>
<th><strong>Surface Tension</strong></th>
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<th><strong>Oder &amp; Taste</strong></th>
<th><strong>Diffusion</strong></th>
<th><strong>Osmosis</strong></th>
<th><strong>Chemical Fields</strong></th>
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<th><strong>Sound</strong></th>
<th><strong>Vibrations &amp; Oscillations</strong></th>
<th><strong>Ultrasound</strong></th>
<th><strong>Waves</strong></th>
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<th><strong>Electric Discharges</strong> (Corona)</th>
<th><strong>Current</strong></th>
<th><strong>Eddie Currents</strong> (internal and skin)</th>
<th><strong>Particle Beams</strong></th>
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<th><strong>Thermal Heating</strong></th>
<th><strong>Thermal Shocks</strong></th>
<th><strong>Nuclear Forces</strong></th>
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<th><strong>Magnetic</strong></th>
<th><strong>Information</strong></th>
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<th><strong>Radio Waves</strong></th>
<th><strong>Micro waves</strong></th>
<th><strong>Infrared</strong></th>
<th><strong>Light (Coherent &amp; light Pressure)</strong></th>
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Lines of Evolution
States and Fields

Solid
Liquid
Gas
Field
Not Existing
Lines of Evolution
Dimension

- Point
- 1-Dim
- 2-Dim
- 3-Dim
Lines of Evolution
Path

Linear

Curved in Plane

Curved out of Plane
Lines of Evolution
Dynamization

Fixed
Joint
Multiple Joints
Flexible
Lines of Evolution

Control

Fixed

Dynamized

Increased Dynamization (Continuous, Multiple)

Feedback
Lines of Evolution
Continuity of Variability

Invariant

Stepwise Variable

Continuously Variable
Lines of Evolution
Oscillations

Continuous
Pulsed
Oscillating
Resonating
Standing Wave
Lines of Evolution
Surface Structure

Smooth
Protrusions
Roughness
Activated Surface
Lines of Evolution

Voids

Monolith  Cavity  Voids  Capillary Structures  Dynamized Pores
Lines of Evolution
Segmentation

Monolith
Parts
Powders Mist
Mixed Media
Lines of Evolution

Mediators

Rocket Nozzle

No Separation

Separator

Separator made from Existing Objects

Separator Made From Voids
Lines of Evolution

Double Multiply Group
(Same) (Biased) (Different) (Opposite)

Combine Interact

Consolidate

Mono-System
Bi-System
Interacting
Mono-System (Fully Consolidated)
Lines of Evolution

Double Multiply Group
Mono-system

Homogeneous Bi-system
Combine and Partially Consolidated

Mono-System (Fully Consolidated)
Lines of Evolution

Mono-system

Homogeneous Poly-system

Combined and Partially Consolidated

Mono-System (Fully Consolidated)

Double Multiply Group

(Same) (Biased) (Different) (Opposite)

Combine Interact

Consolidate
Double Multiply Group

Bi-System (Biased)

(Same) (Biased) (Different) (Opposite)

Combine Interact

Mono-System (Fully Consolidated)

Combined and Partially Consolidated

Biased System (Biased)
Bi-System

Combined and Partially Consolidated

Mono-System (Fully Consolidated)
Double Multiply Group

Lines of Evolution

(Same)
(Biased)
(Different)
(Opposite)

Combine
Interact

Mono-System

Mono-System
(Fully Consolidated)

Multiplied and Interacting