Innovation and Abductive Reasoning

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2017/12/17 Session “Sunday Abductive Reasoning and Creativity in the Context of Ba”
12:30 - 13:20, December 17, 2017
8-303/304/305 Waseda University, Tokyo
1. “Abduction”

2. Error in Christensen’s Argument

3. Role of “Abduction” for Innovation

4. Case Study: Innovation of Blue LEDs

5. General Theory for Innovation

6. Can “Abduction” Be Educated?
“Abduction” can be characterized as follows:

1. The surprising fact, \( S \), is observed.

2. If a hypothesis, \( P \), were true, the fact, \( S \), would be a matter of course.

3. Hence, there is reason to suspect that the hypothesis, \( P \), is true.

\[ \Rightarrow \text{The inferring process } S \rightarrow P: \text{“Abduction”} \]

Charles S. Pierce (1965):
Copernicus → Kepler → Newton

Copernicus’ heliocentric theory = Induction

Kepler’s abduction:
S= Brahe + Copernicus
P= Kepler’s three laws of planetary

Not only the planets but the whole universe move according to the same law.

Newton’s abduction:
S= Kepler’s three laws of planetary
P= the law of universal gravitation.

Not only the planets but the whole universe move according to the same law.
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"Disruptive Innovation" by Christensen

Hard disk drive

Performance
Sustaining innovation

Ferrite-oxide heads
Thin-film heads
Magneto-resistive heads

Areal Recording Density
(Millions of Megabits per Square Inch)

1,000
100
10
1

Year

8 inch 5.25 inch
3.5 inch

After "Innovator’s dilemma" by Christensen
“Disruptive Innovation” by Christensen

Performance demanded at the high end of the market

Def.1: Intentionally decrease the performance.
Def.2: Discover new market taking over the main.

After “Innovator’s dilemma” by Christensen
“Transistors were disruptive technologies relative to vacuum tubes. ...”

Introduction, P. xvii, The innovator’s dilemma.
Paradigm Disruptive Innovation

- Transistor (Vacuum tube)
- MOSFET (Transistor)
- HEMT (MOSFET)
- Blue LED / LD (all other LED / LD)

- Thin film head / MR head (Ferrite head)
- Smaller HD drive (Larger HD drive)
- Transistor (Vacuum tube)
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New Concept: Innovation Diagram !!!

Knowledge Embodiment (Development)

A (Technology)

Deduction

S (Existing Knowledge)

Abduction

P (Created knowledge)

Knowledge Creation (Research)

Soil
Soil Knowledge Creation (Research)

Knowledge Embodiment (Development)

A (Existing Technology)

Abduction

Deduction

A’ (Paradigm Sustaining Innovation)

Induction

S (Existing Knowledge)

P (Created Knowledge)

A* (Paradigm Disruptive Innovation)

ASPA* = Breakthrough Type 1

Field of Resonance

Soil

Knowledge Creation (Research)
Soil Knowledge Creation (Research)

Knowledge Embodiment (Development)

A (Existing Technology)

Abduction

Induction

Deduction

A' (Paradigm Sustaining Innovation)

S (Existing Knowledge)

P (Created Knowledge)

A* (Paradigm Disruptive Innovation)

ASPA* = Breakthrough Type 1

Field of Resonance

Soil

Knowledge Creation (Research)
Ptolemaios: Geocentric theory
Aristotle: geocentrism
Deduction: Astrology
Copernicus: heliocentric theory
Induction: Anti-thesis
Abduction: Astronomy
Abduction: Physics
Kepler: Three laws of planetary
Newton: the law of universal gravitation
Knowledge Creation (Research)
Knowledge Embodiment (Development)
Soil
Space technology
Copernicus → Kepler → Newton, again
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New generation semicond.

Bandgap and atomic distance for semiconductors.
Innovation diagram: Blue LEDs

- **Science (crystallography)**
  - Akasaki: Challenge to lattice-mismatched crystal growth (paradigm disruption). /1970s

- **Paradigm sustaining innovation**
  - Existing technology for LED (IR and red)
  - Nakamura: descend to the “Soil”. /1989

- **Knowledge embodiment**
  - ZnSe LED

- **Soil**
  - All major farms withdrew /1995-1997

- **Knowledge creation**
  - Akasaki: Challenge to p-type GaN growth. /1970s

- **Knowledge integration**

- **Innovation**
  - Nakamura et al.: Develop InGaN LED /1992
  - Shimizu et al.: Realize White LED /1996
  - Nakamura et al.: Integrate three.

- **Ogawa (CEO of Nichia Corp.): Decide to invest** /1993

- **Shimizu et al.: Realize White LED** /2020

- **By 2 flow method** /1990

- **Matsuoka et al.: Realize InGaN growth.** /1989
  - Challenge to p-type GaN growth.
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General Theory for Breakthrough

Knowledge Embodiment (Deduction) vs. Knowledge Creation (Abduction)

- **Type 0**: Road-mappable
- **Type 1**: Field of Resonance
- **Type 2**: Transience
- **Type 3**: Soil

- A (Existing Technology)
- A’ (Paradigm Sustaining Technology)
- A* (Paradigm Disruptive Technology)

Soil Knowledge Embodiment (Deduction)
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Can abduction be educated?

1. Abduction results in paradigm disruptive innovation.

2. Abduction is an individual act (not collective) because it is triggered by serendipity.

3. Mindset to seek abduction is equivalent to the desire of existence.

4. Abduction is disturbed by undifferentiated group work of undifferentiated individuals.

5. Abduction is encouraged by “Fields of Resonance” where differentiated individuals can make dialogs to chain inspirations.

6. Abduction is initiated by “discomfort” for existing knowledge/concept. Hence, abduction can happen only after completely learning the existing knowledge/concept, that is, only after making thorough deduction.
Zeami (1363-1443, co-founder of Noh 能) used “resemble”, “not resemble”, and “can resemble”.

“resemble = imitate”. All of beginners try their best to resemble/imitate.

“not resemble”. At a certain point, students can intentionally succeed in resembling the master, and then shift the phase of “not resemble”. For instance, women can behave as women although she does “not resemble”. Namely, “not resemble” is to abandon the intentional act. It is similar to mindlessness.

“can resemble”. While they continue “not resemble” as it is, suddenly “can resemble” happens. It is an unintentional and unexpected phenomenon.

Education toward “resemble” is, in fact, made to reverse toward “not resemble”. At times there, fresh language is born on the horizon without language.