

Data Mining and Innovation Science

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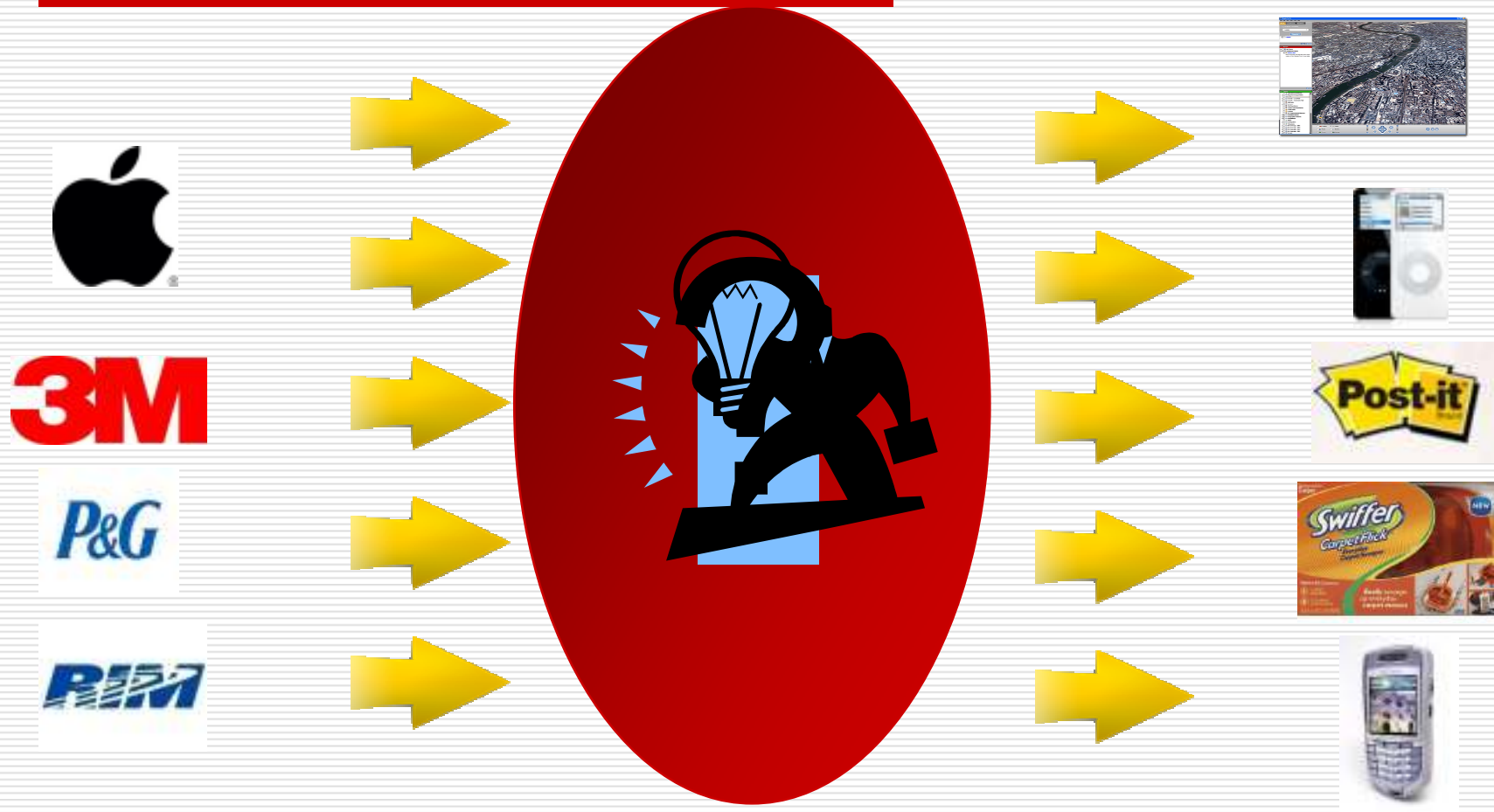
<http://www.icaen.uiowa.edu/~ankusiak>

Intelligent Systems
Laboratory

Outline

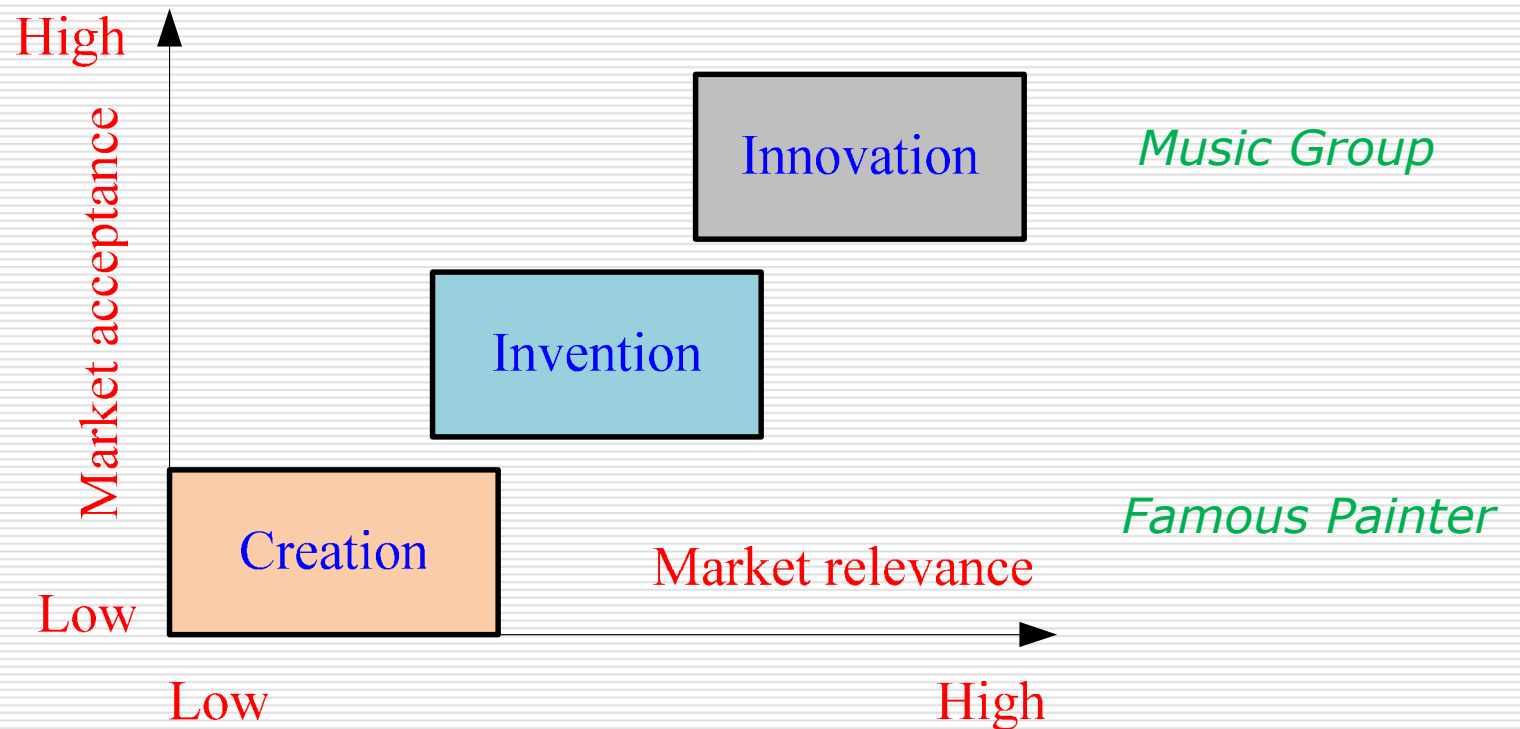
- Introduction
 - Creativity
 - Innovation practice
 - Data mining contributions to innovation science
 - Summary
-

What do They Have in Common?

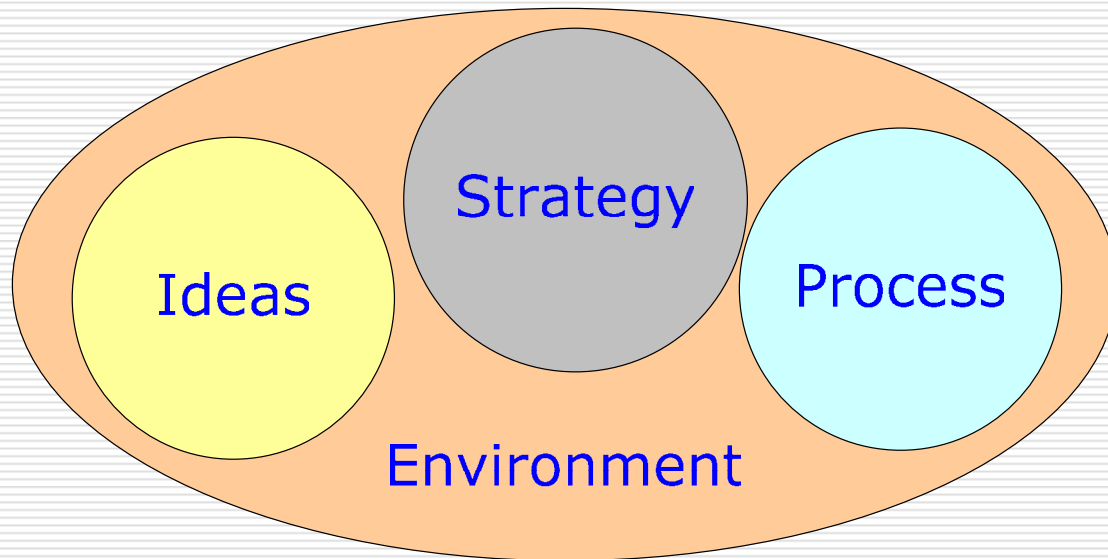


Innovation!!

Relationship Between Creation, Invention, and Innovation



Innovation: What is Needed?

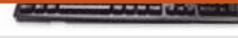


<http://www.getfuturethink.com>

Innovation: Many Ideas

Where to focus?

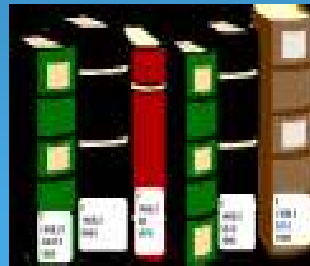
Incremental



Disruptive



Platform



Creativity in the Literature (1)

□ Creativity

- Book ***The Creating Brain: The Neuroscience of Genius*** by Nancy Andreasen, U of Iowa Professor of Psychiatry
 - Andreasen's Theory (Hypothesis): "Creative ideas appear spontaneously when people **are NOT** trying to be creative"
 - Example
 - Mozart who composed his music after a good meal and a walk, that would occasionally trigger a complete symphony
-

Creativity in the Literature (2)

□ Creativity

- Example 2
 - Friedrich Kekulé – German chemist who discovered the structure of benzene - entered a dreamlike state in which the form of benzene came to him in a brilliant flash
-

Creativity in the Literature (3)

□ Creativity

- Terrence Ketter – Professor of Psychiatry, Stanford U
 - Ketter's Theory (Hypothesis):
"Creativity is directly related to **mental instabilities**, because the brain uses its **negative emotion** to initiate a real or fictional solution to the problem"
 - What comes first creativity or the mood disorder?
 - Where does creativity comes from? [It is not known, Peggy Nopoulos, UI Professor of Psychiatry]
-

Innovation in Industry: SRI (1)

□ Innovativeness

■ Five disciplines:

1. "Assess each innovation for its value to the customers"

Look beyond cost and quality, e.g., into convenience and conscience

2. "Appoint a champion who is insanely committed to the project"

No champion, no project, no exception

A process

Innovation in Industry: SRI (2)

□ Innovativeness

■ Five disciplines:

3. “Building teams and doing so across the organizations”

Engelbart’s iterative approach was also applied on a larger scale by Google, which publishes beta versions of its products and feeds customer responses into development of these products

Innovation in Industry: Xerox

□ Combine Ideas

Xerox Corporation looks for intersection between ideas and combining them into next offering of products

Innovation in Industry: McDonald's

- McDonald's innovation team thinks it terms of "*back-casting*" – starting with an end-product and working backward towards the basic idea that is cost and technology feasible

Innovation in Industry

□ Take advantage of “gift economy”

Examples

- Wikipedia
- Linux operating system
- Firefox web browser
- Media sites: YouTube, Flickr

Y. Benkler, *The Wealth of Networks*, Yale University Press, New Heaven, CT, 2006.

http://www.benkler.org/Benkler_Wealth_Of_Networks.pdf

Mass Customization and Innovation

History of Product Diversity

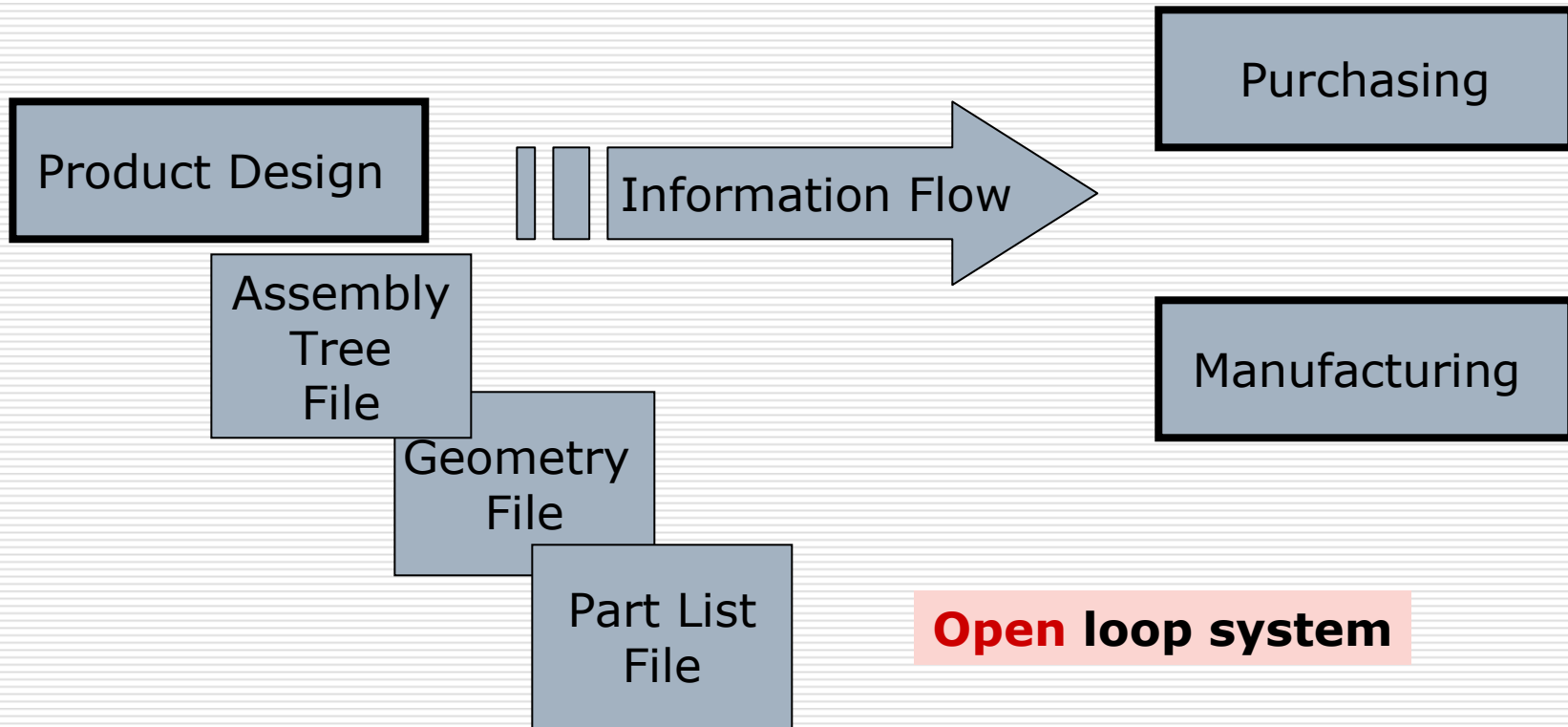
Example

Year	Car Model	No. of Models
1908	Ford T	1
1963	Renault 4	11
1971	Renault 16	6,000
1982	Renault 18	60,000
1989	Renault 25	120,000
1998	Peugeot 306	170,000

Traditional Design

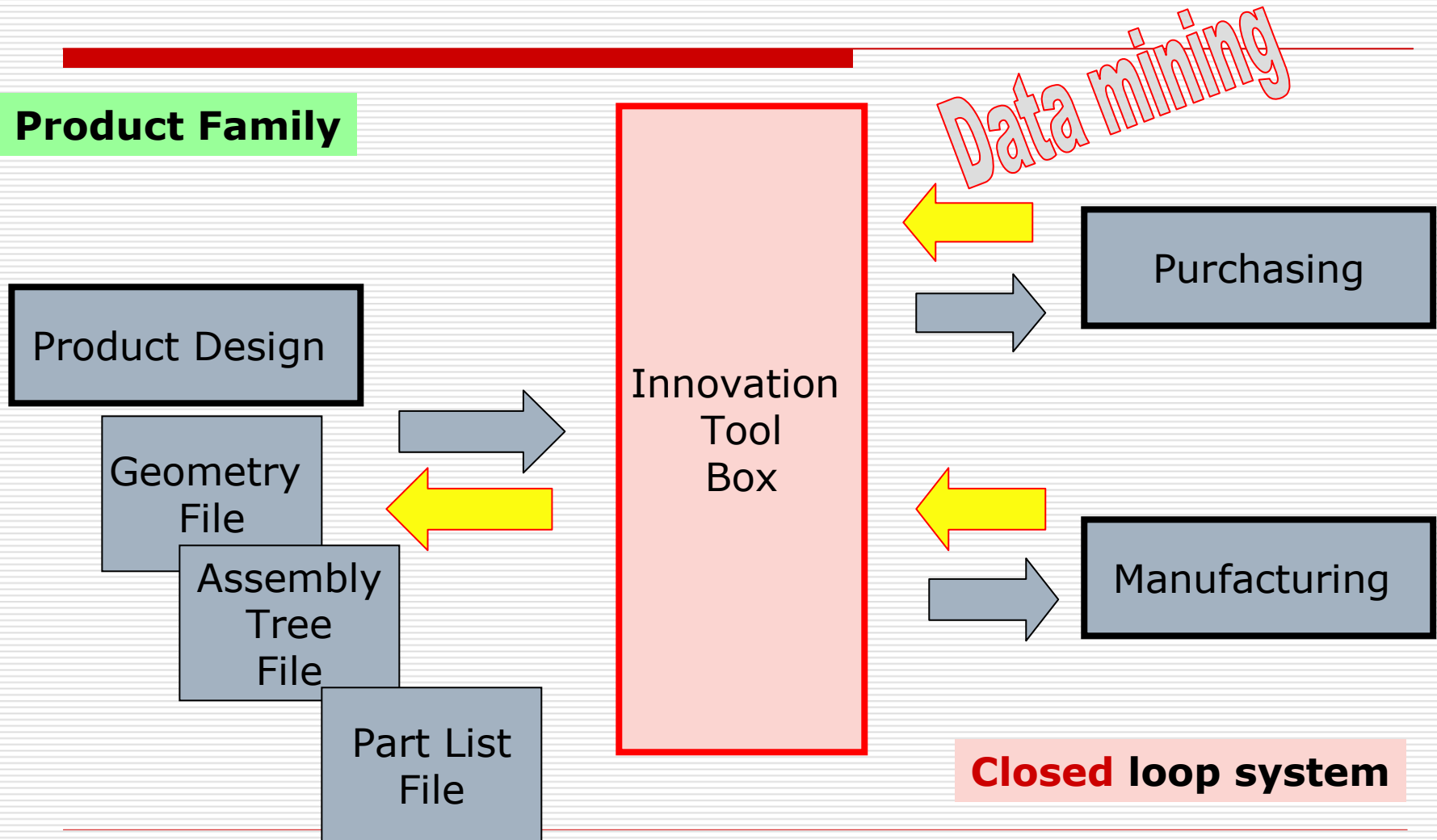
Product Family

Data trail



Innovation-Inspired Design

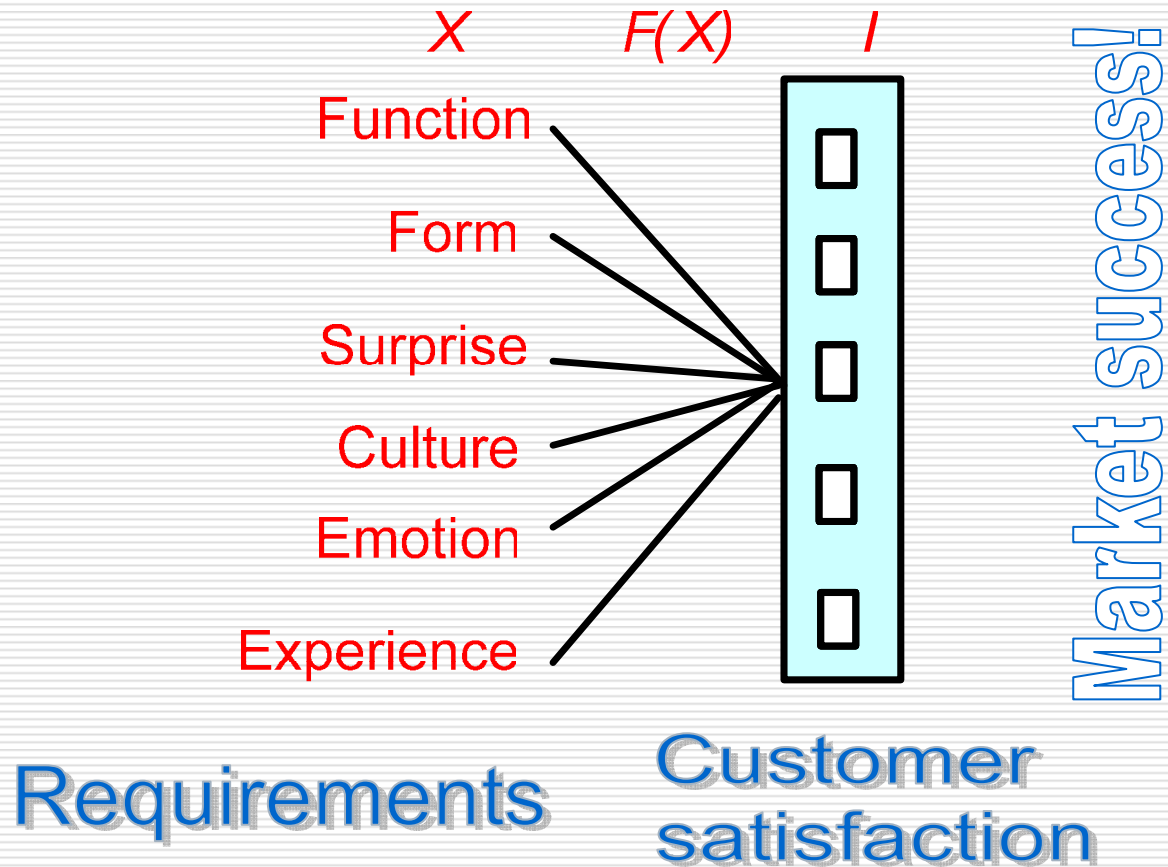
Product Family



Modeling Innovation

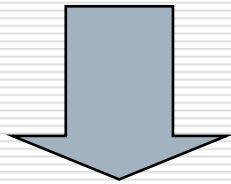
Innovation Science

Attribute classes



Requirements: Multi-dimensional Origin

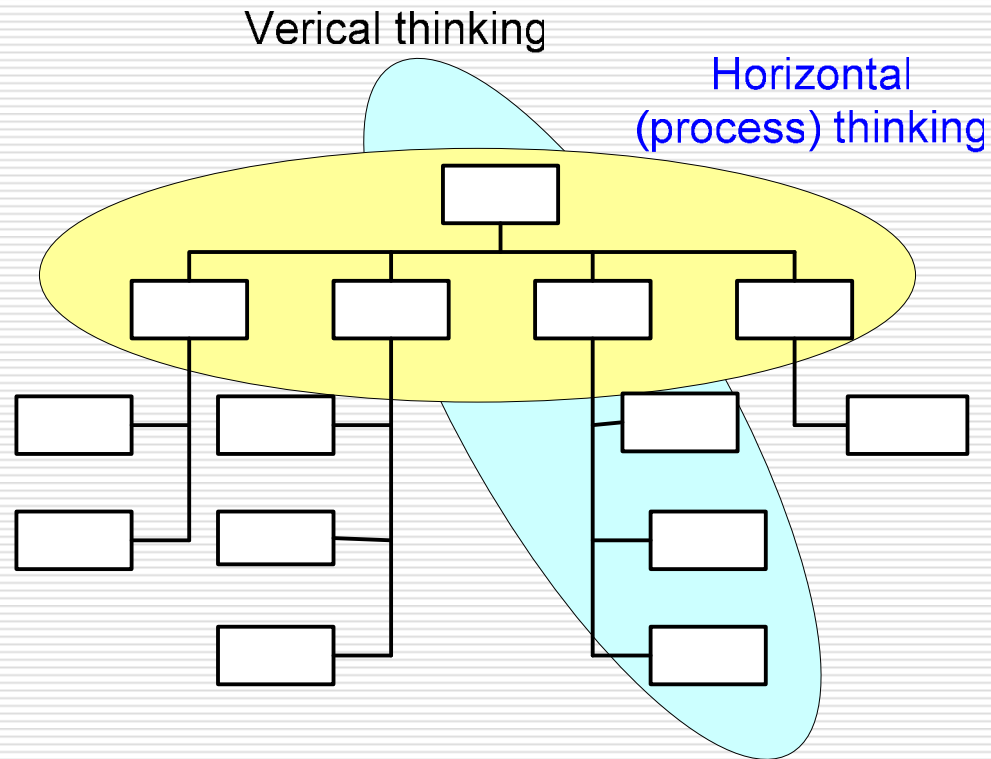
- Customer induced
- Expert induced
- Product life-cycle induced
- Cyber-world induced



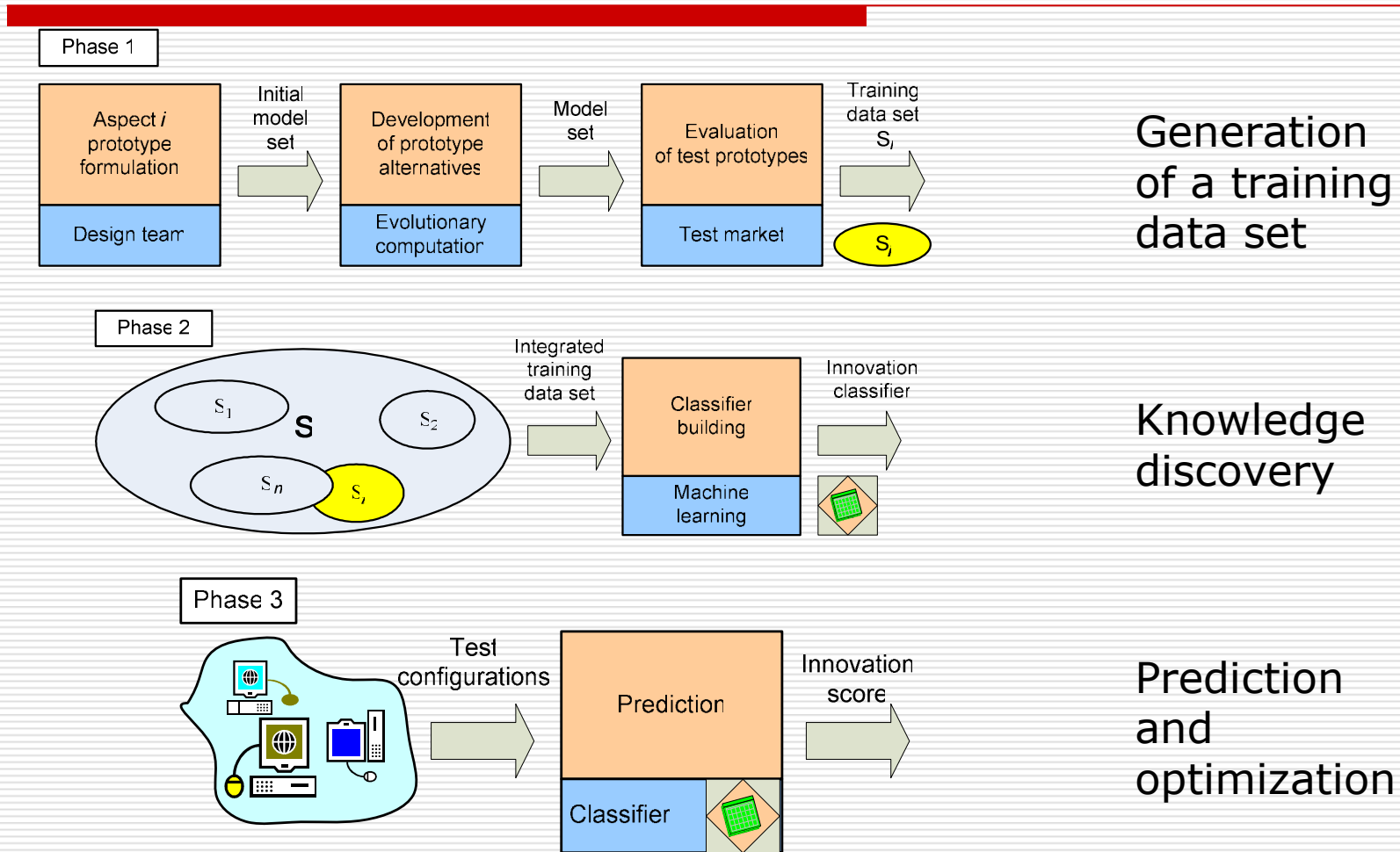
- Requirements driven
-

After All

Innovation: Process thinking



Innovation: A Data Mining Solution



Challenges

- Data availability
 - Industry struggle with embracing the concept of gift economy
 - Benefits from customers' input
 - vs
 - Potential losses from revealing
 - Lack of experience
 - Computational experience with mass customization data
-

Conclusions ⁽¹⁾

- ❑ No single “one-size fits all” innovation methodology on the horizon
 - ❑ Diverse products, systems, and services call for different innovation approaches
-

Conclusions (2)

- ❑ Increasing role of data
 - ❑ Data could potentially drive innovation
 - ❑ Data mining and evolutionary computation key to innovation
-

Innovation

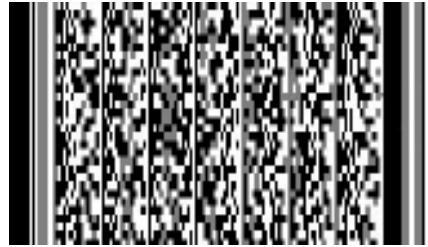
Case Studies

Case Study 1: Process Invention

```
<firstName>Melinda</firstName>  
<middleInitial>B.</middleInitial>  
<lastName>Jones</lastName>  
<address1>22 2nd St. </address1>  
<address2>Apt. 312B</address2>  
<city>Chicago</city>  
<state>IL</state>  
<zipCode>42050</zipCode>
```

- Tags (such as XML)
- Organized data
- Enter once and transfer into any system

+



- 2D Barcode
- Securely transport data
- Paper and/or digital

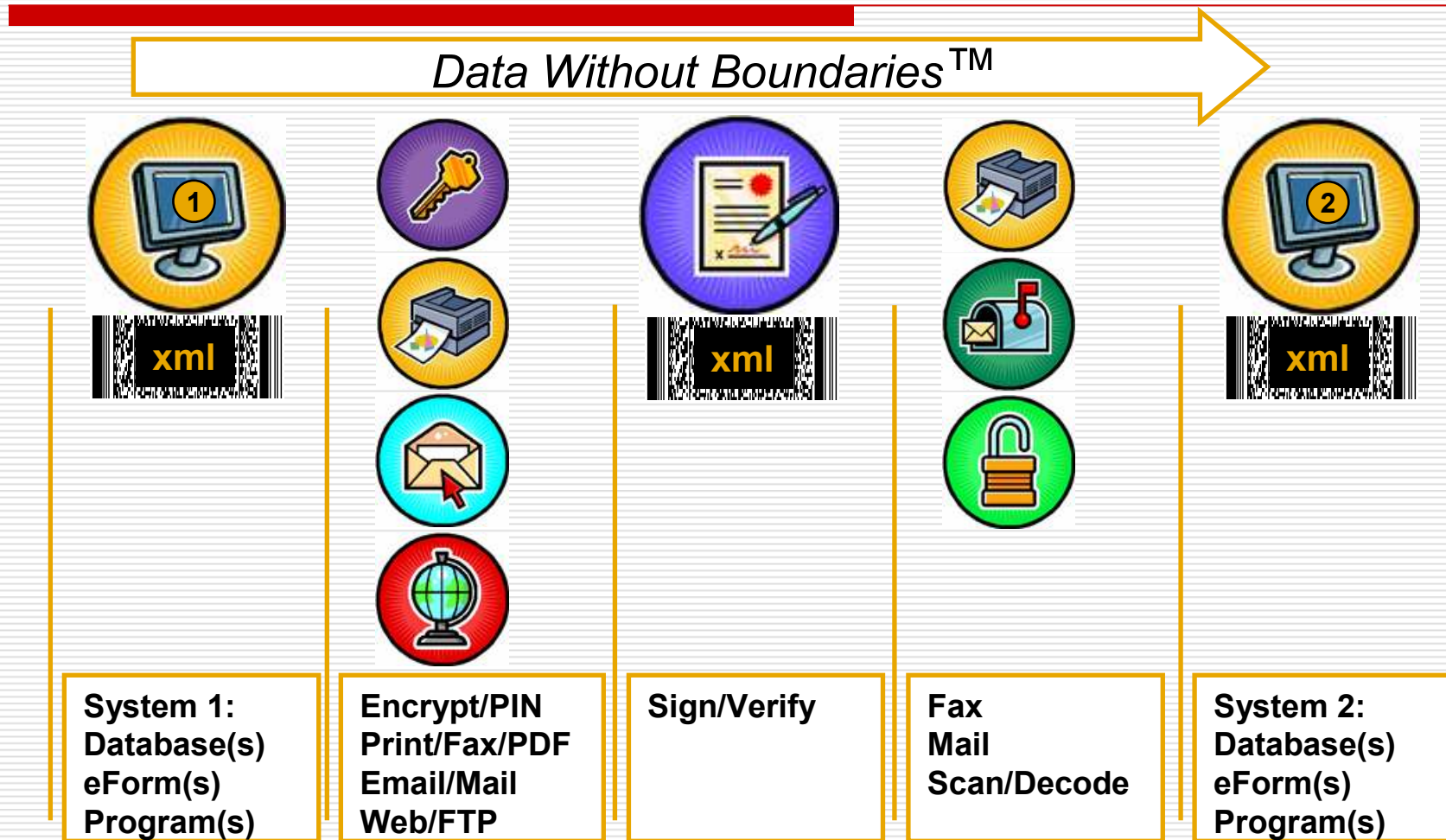
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*Data Without
Boundaries™*

- Move data b/t paper and digital form seamlessly
- Accurate, secure, efficient
- Patented

**United States Patent Nos. 6,764,009 and 7,070,103
and other pending patents**

Moving Data Between Disparate Systems



No manual re-entry No keystroke errors No reformatting

Case Study 2: General Electric

1996 – Third wave: Selecting Leaders

Imperial Germany

	Smart	Stupid
Eager	General staff ↑	Out
Lazy	Force them →	Troops

Karl von Clausewitz, 1830

General Electric

	Achievers	Non-achievers
Believers	Teach and stretch ←	Motivate and train ↓
Non-believers	Out	Do not hire

Jack Welch, 2000

Case Study 3: Different Types of Innovation

Organization Innovation

□ Dell Corporation

- Driver: Process innovation (e.g., manufacturing, supply chain, warranty service)
- Success: Largest computer producer

□ Apple Corporation

- Driver: Product innovation (+ lately process innovation)
- Success: Survived fierce competition despite strategic business errors

□ Gateway Corporation

- Drivers: Product and process innovation
 - Success: Limited market share
-

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-

Conclusions ⁽²⁾

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