

# Creating Candidate Technologies for Disruptive Innovation

## 4 Practical R&D strategies

Dan YU

Chang Chieh HANG

Division of Engineering and Technology Management

yudan@nus.edu.sg



# Literature review 1

## **Definition** (Govindarajan and Kopalle, SMJ, 2006)

- inferior on the attributes that mainstream customers value;
- offer new values propositions to attract a new customer segment or the more price sensitive mainstream market;
- sold at a lower price and
- the market penetration goes from niche to mainstream.

## **Finer categorization** (Markides, JPIM, 2006)

- disruptive technological innovation: Inkjet printer, transistor radio
- disruptive business model innovation: discount department stores, online educations.

## Literature review 2

**Both literature and practice underestimates roles played by technology and product at least in a technological DI.**

Academic literature focused on the management challenges and business models in disruptive innovation, assuming that the suitable technology or product is simple and readily available. Few discussion on technology dimension of DI (Yu and Hang, PICMET08).

Industrial firms tend to invest their R&D of new scientific/engineering discoveries from a sustaining point of view as they could readily appreciate the eventual market potential. Even firms proactively create emerging technologies which may be disruptive to the core business, a new problem that bootstrapping a new business with considerable investment on the new disruptive technology will come (*Maccormack and Herman, Harvard Business case on Intel research, 2005*).

Based on existing products, no need to start from scratch

## Literature Review 3


Certain technologies are inherently have weaknesses in the conventional application domain, and could create disruptive opportunities in new application domains if explored purposefully, ex. Fuzzy logic, digital imaging.

DT sometimes risky and technologically challenging (Schmidt and Druehl, JPIM, 2008).

Although important and challenging, creation of disruptive technologies or products candidates from purposeful R&D to provide additional technology options (Boer, 2002; Rouse and Boff, 2004) was rare and needs to be promoted.

Two recent attempts in the literature to propose systematic approaches to create disruptive products. (Kostoff *et.al.* 2004; Walsh, 2004). However, fail to observe the nature, so gap still there.

|  |  |   |   |  |                                   |                                       |   |
|--|--|---|---|--|-----------------------------------|---------------------------------------|---|
| <i>Conditions of Disruptive technological innovation</i> | <b>Transistor Radio</b>                    | <b>2.5 inch Hard Disk Drive</b>             | <b>Automatic External Defibrillator</b>   | <i>Simplified Tank Gauging machine</i>   | <b>Wii</b>                        | <b>Centrino</b>                       | <b>War games</b>  |
| <i>Low end or new market disruption</i>                  | new market                                 | new market                                  | new market  | low end  | new market                        | new market                            | low end   |
| <i>Disruptee</i>   | floor-standing TVs and radios              | 3.5 inch Hard Disk Drive                    | MED   | Traditional Tank Gauging machine   | PS3 and Xbox360                   | Pentium series                        | military training devices                                       |
| <i>Niche market</i>                                      | American teenagers who likes rock 'n' roll | Laptop application                          | public and home application   | China, for non professional operation  | females & seniors                 | Portable PC                           | recruit soldier   |
| <i>Mainstream market</i>                                 | Adult customers of home audio equipments   | Enterprise solution and desktop application | hospitals non-acute care and non-treatment areas, and emergency service               | US and EU, for professional operation  | 18-49 male                        | Desktop PC or scientific calculation  | Various military training programs                              |
| <i>key performance</i>                                   | Sound quality and Reliability              | Capacity, data transfer rate                | VF detection capability, time required for energy shock, variety of therapies offered | Tank Gauging capability; In-tank leak testing; Automated calibration of tank chart | Processing speed, graphics, sound | Processing speed                      | network playability, local scenario storage and graphic quality |
| <i>New value proposition</i>                             | pocketability, power consumption           | small size, light weight                    | ease of usage, increase survival rate, significant cost reduction                     | input and Display, small size  | user-friendly interface           | battery life and wireless application | Significant cost reduction                                      |
| <i>unit cost compared with existing product</i>          | lower                                      | lower                                       | lower   | lower  | lower                             | lower                                 | Lower   |

| When Wii was first introduced in Nov, 2006. | SonyStation 3  | Xbox360  | Wii   | Comparison  |
|---|--|--|---|---|
|   |  |  |   |  |
| <b>Central Processing Units</b>             | Cell processor, powerPC-based core @3.2GHz*1   | Xbox360 processor, powerPC-based core @3.2GHz*3  | Broadway processor, powerPC-based core @729 MHz   | Wii inferior  |
| <b>Memory</b>                               | 256MB GDDR3 VRAM @700MHz, 256MB XDR Main RAM @3.2GHz   | 512MB of 700MHz GDDR3 RAM,10 MB of embedded DRAM   | 88 MB main memory, 3 MB embedded GPU texture memory and framebuffer   | Wii inferior  |
| <b>Graphic Processing Units</b>             | 550MHz NVIDIA  | 500MHz Ati   | 243MHz Ati  | Wii inferior  |
| <b>Storage</b>                              | Detachable 2.5" HDD slot x 1   | Removable HDD 20G, 12x dual-layer DVD-ROM  | 512 MB built-in NAND flash memory   | Wii inferior  |
| <b>Audio</b>                                | 7.1 Dolby Digital surround sound   | Dolby Digital surround sound   | Stereo sound  | Wii inferior  |
| <b>Video</b>                                | HDTV resolutions from 480i up to 1080p   | Supported at 16:9, 720p and 1080i, anti-aliasing. Standard-definition and high-definition video output supported | 480p (PAL/NTSC), 480i (NTSC) or 576i (PAL/SECAM), standard 4:3 and 16:9 anamorphic widescreen                                     | Wii inferior  |
| <b>Online capabilities</b>                  | free online games, online service for purchase downloadable games and chat with friends in the network and browse web with PS3 | access to voice chatting and text message, get challenge with other gamers online                                | not available, but can purchase games, get news and weather updates and browse the internet with the Wii on Nintendo U.S. website | Wii inferior  |
| <b>System Floating Point Performance</b>    | 2 TFLOPS   | 1 TFLOPS   |   | Wii inferior  |
| <b>Controller</b>                           | Wireless Controller  | Wireless Controller support (up to 4)  | sensing wireless controller   | Wii Superior  |

| Cases                     | R&D Strategies  |                |              |                                      |
|---------------------------|-----------------|----------------|--------------|--------------------------------------|
|                           | Miniaturization | Simplification | Augmentation | Exploitation for another Application |
| Transistor Radio          | √               |                |              |                                      |
| 2.5 inch Drive            |                 |                |              |                                      |
| Wii                       |                 |                |              |                                      |
| Intel                     |                 |                |              |                                      |
| Simple Game Machine       |                 |                |              |                                      |
| War Games                 |                 |                |              | √                                    |
| Auto. Ext. Defibrillators |                 | √              |              |                                      |

**Exploitation**  
 Apart from the widely acknowledged strategy as to fight back, incumbents could also think of new applications and markets to reposition their existing products. Exploitation for another application strategy encourages incumbent firms to reposition their products targeting another application, because performance overshoot in one market may indicate an opportunity in another battle field.

# Generalization with another 30 cases



| Examples                                   |                          | Choices of Strategies |                |              |                                      |
|--|--------------------------|-----------------------|----------------|--------------|--------------------------------------|
| Disruptive Product                         | Mainstream Product       | Miniaturization       | Simplification | Augmentation | Exploitation for another application |
| 3.5 inch HDD                               | 5.25 inch HDD            | ✓                     |                |              |                                      |
| Hydraulically actuated excavator           | Cable-actuated excavator |                       |                |              | ✓                                    |
| RISC microprocessors                       | Normal CPUs              |                       | ✓              |              |                                      |
| .....                                      | .....                    |                       |                |              |                                      |
| Ultrasound                                 | X-ray                    |                       |                |              |                                      |
| Frequency (X among 30 disruptive products) |                          | 11                    | 19             | 3            | 8                                    |

# Implication of the generalization



## **Miniaturization**-Second most frequently used, 36.7%;

With technology advances in areas such as microelectronics, nanotechnologies, and optimization of architecture designs, firms are recommended to miniaturize their products into compact and portable disruptive products to tap in potential growth opportunity.

## **Simplification**-Most frequently used, 63.3%;

As there exist many high-end sustaining technologies, firms could proactively simplify them to create potentially disruptive technologies.

Univ. and RIs have found a lot of difficulties in directly transferring their high-end technologies to SMEs (Campo, 1999). Simplification strategy provides a possible channel if the Unvi/RI proactively simplify their high-end technologies, in consultation with the SMEs to help them create appropriate disruptive products.

## **Augmentation**-least frequently used, 10%;

Be more acceptable to incumbent companies as it does not entail the classical disruptive route of abandoning or challenging a sustaining technology. Nintendo and Intel demonstrate incumbents' possibility to realize such an R&D strategy.

## **Exploitation for another application**-under-utilized, 26.7%

Open the door to leverage on sustaining progress of certain established products which has already created affordable, high-tech components.

The potential disruptee could position their high-end products or some components in new market to avoid dethronement.

## Summary

Technology do play a key role at least in technological disruptive innovations, yet received very limited coverage.

It is a necessity to study empirically how to create potential disruptive products. Our strategies are developed based on existing products and no need to start from scratch.

4 R&D strategies proposed including miniaturization, simplification, augmentation and exploitation of another application.

The general applicability of these strategies was further tested using another 30 technological disruptive innovations. The frequencies of their utilization were also compiled and the implications studied.