

The mechanism of a changeover of leading position in the computer industry

– Approach from business model transition point of view –

Hideki NAKAMURA (Tokyo University of Science)
M417704@ed.tus.ac.jp

Keywords: business model, supply chain, computer industry

1. Introduction

The computer industry has grown very rapidly in both the market size and the number of computers manufactured. In course of 70 year history since 1946, the winning business model of the industry has changed multiple times. With this change, the leading position has taken over by another company several times. Why the leaders were taken over by their followers even with their advantages of resources and their market insight? What made followers able to catch up and take over the leaders? I would like to approach the mechanism of taking over the leading position in this report.

2. About the industry

The modern computer industry has started since 1946 with release of ENIAC in US. This first generation computer used vacuum tubes and had program based on cables and switches. ENIAC was one-off computer and number of first generation computers produced per model was limited.

In 1950s, second generation computers were developed using transistors. This technology made it possible to produce multiple units per model. For example, first model of UNIVAC series, UNIVAC I, had 47 units produced. In the later model of second generation computers the number of units produced per model increased such as IBM 1400 series was produced more than 100,000 units. Another feature of the second generation computer is that program was based on the software. In case of IBM 700/7000 series, their program was FORTRAN which was the first software program. This enabled to carry legacy program to new computer when replaced. Or to copy the programs to other computers.

In 1960s, third generation computers using integrated circuits (IC) were developed. IBM 360 series is one of the typical third generation computers which was the first computer to have modular design. Modular structure allowed to split the development and the manufacturing by modules which enabled horizontal division by each module.

In 1970s, fourth generation computers using microprocessors or large scale integration

(LSI) were introduced to the market. Typical fourth generation computers are so called minicomputers, microcomputers or personal computers. These computers were mass produced in much larger scale compared with the previous generations. In this generation, the combination of Intel CPU and Microsoft Windows OS became the de facto standard. This combination was called “Wintel”. This became the platform of personal computers and lower the entry barrier to the market for followers. This platform also made it possible to outsource manufacturing to EMS as OEM or ODM. Thus the market is very competitive in the fourth generation until now.

Table 1 shows the summary of the computer generations and their characteristics which are important for this study.

Table 1 Generation of Computers and their Characteristics

	1 st Generation	2 nd Generation	3 rd Generation	4 th Generation
Year	1946-1950s	1950s-1960s	1960s-1970s	1970s- present
Technical aspect	Vacuum tube	Transistor	IC	LSI-VLSI
Supply chain model	One-off production	Mass production by IBM Insourcing model	IBM introduced design rule for modularization Division of production in the industry. Delivery to end customers. Outsourcing components	Large size mass production with division of production in the industry. OEM and ODM model introduced. VMI(vendor managed inventory)
Leading company	N/A (universities and government)	IBM	IBM, DEC	Servers: IBM, HP, Dell PC: IBM, Compaq, HP, Dell, Lenovo Smartphones: Apple, Samsung
Typical models	ENIAC, EDVAC	UNIVAC, IBM 700/7000 series	IBM 360 series, DEC PDP series	Micro and personal computers
Remark		46 to 100k units production size Program introduced : FORTRAN	Software is backward compatible Components were made in house Modular design introduced	Specialized manufactures for components. E.g. CPU, OS, HDD De facto standard of Microsoft, Intel Smile curve in profit EMS become white box manufactures for servers
Information flow	Knowledge accumulated in products	Knowledge accumulated in a company (manufacture) Learning by doing : Invisible asset	Knowledge diffused from original company to industry wide	Early stage: Knowledge diffused into EMS Later stage: Knowledge accumulated in EMS

3. Earlier studies

In the earlier study of disruptive innovation by Christensen (1997) showed that the follower company will take over the leaders disruptively. This occurs when the market is keep improving the quality level. Leader’s products become over quality and the follower’s products reach the acceptable level. Then the leading position will be taken over by the follower. But the mechanism behind this take over was not clearly explained.

Chesbrough (2006) explained about how multiple companies cooperate to make innovation by using open innovation theory. But these earlier studies cannot clearly explain the mechanism of the leading companies’ take over. And I feel that a holistic approach is necessary to explain the phenomena.

Baldwin and Clark (2000) explained about the modularity by studying the mechanism of “design rules” of IBM System 360. This was the first computer to introduce the design

rule and modularized the computer. This modularization led the industry to Wintel platform and to the highly competitive market in the fourth generation computer era.

4. Objective of this report

In this report, I would like to describe the transition of the technology between each computer generation and how these transitions drove the changes in the business models by using the case study method. And how this business model transition is related to the takeover of leading company position in the industry. Especially focusing on 1) how the followers compete with the leaders and 2) why the leaders cannot defend the attack from the followers. I will try to explain the mechanism of the changeover from the above 2 points.

5. Transition of the business model in the computer industry

The transition of the computer generation also changed the typical business models in the industry. Figure 1 shows the transition of the business models. In the first and the second generation computers were developed and manufactured within one firm. In the third generation when IBM System 360 introduced the modularization, it enabled horizontal division to develop and to produce modularized components individually from the entire system development. Since then, supplying components from dedicated component manufactures became possible and common. Then the outsourcing part of the virtual divided value chain made the progress as shown in the figure 1. This is the one of the factor in the changeover which will be discussed in this study.

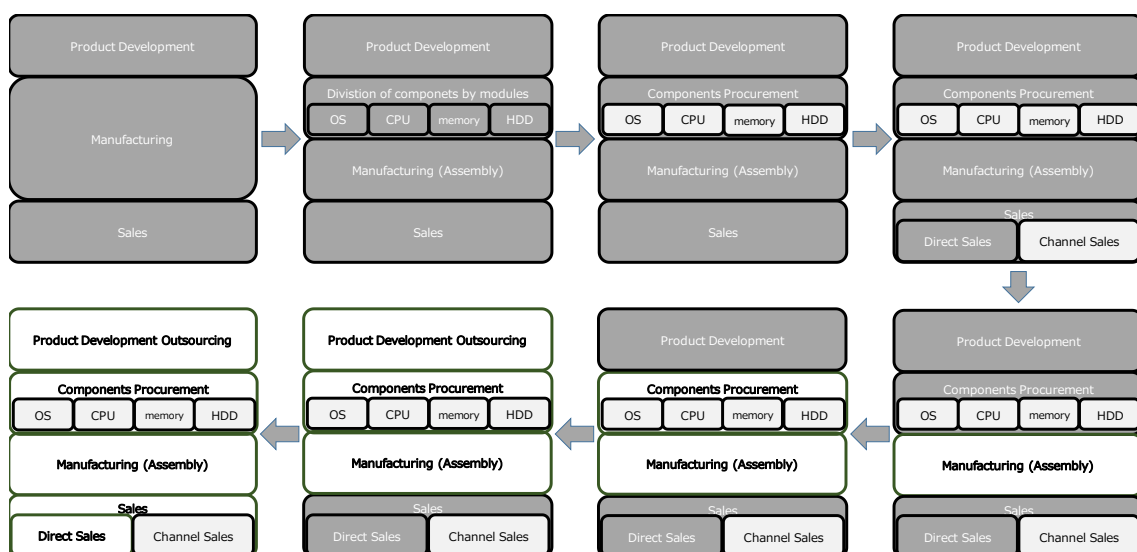


Figure 1 Transition of Business Models

6. Conclusion and implication

In this study, I've tried to explain the mechanism of the changeover of the leading position in the computer industry by using the transition of the business models.

The latest competition for the leading position is between EMS and the branded manufactures. In the course of outsourcing, the invisible asset has accumulated in the EMS making them capable to compete with the branded manufactures. And also tried to explain the relationship between these players since their relationship is not only the competitors but also customers and suppliers. This limited the move of the players and influenced the competition.

This study has approached from the business models from the value chain point of view. There are some other possible vision angles such as cash flow, relationship with suppliers and customers and so on. It is expected for further study from these angles to give the entire picture of the changeover of the leading position in the computer industry.

It is also expected for the further study to apply the theory to other industries, for example electronic appliances, mobile phones. And find the conditions when the theory works and when not.

References

- Baldwin Carliss Y., & Clark Kim B. 2000. *Design Rules: The Power of Modularity*. The MIT Press
Ando Haruhiko 2004 Toyo Keizai Shinpou-sha (Japanese translation)
- Ceruzzi Paul E. 2003. *A History of Modern Computing 2nd Edition*. The MIT Press
Uda Osamu, & Takahashi Kiyomi 2008 Mirai-sha (Japanese translation)
- Chesbrough Henry W. 2003. *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press
Omae Kenichi 2004 Sanno-dai Shuppanbu (Japanese translation)
- Christensen Clayton M. 1997. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. McGraw Hill
Izuhara Yumi 2001 Shouei-sha (Japanese translation)