An Analysis of Competition for Standardization in the Japanese PDA Market: From the Perspective of Semi-Open Source Strategy

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Abstract

While it is an obvious fact that “compatibility” plays a key role in IT-product competition, results of analyses of the Japanese PDA market have revealed that, in addition to compatibility, “customizability” in platform development is also an important factor in competition for standardization. The primary objective of this paper is to verify the effects of customization-driven strategies on consumer behavior throughout product lifecycles. On the other hand, if a more customizable platform development system based on division of labor is adopted, the technological know-how tends to be diffused throughout the industry, which appears to make it difficult to maintain long-term technological advantages. The secondary objective of this paper is, therefore, to determine, through analyses based on patent information, how PalmOS created its technological advantages.

Keywords: Compatibility; Customizability; Open source; Product lifecycle; PDA market

1. Introduction

Standards indispensable to the establishment of networks tend to be monopolized and narrowed down to specific standards through regulations and competition, against a background of decreasing costs on the supply side or network externalities\textsuperscript{1} on the demand side. Particularly when no compatibility exists in competing standards, “excess inertia”\textsuperscript{2} and “excess momentum” may emerge, accelerating competition to an early end. In other words, once a corporation gains the upper hand in the platform competition, it tends to launch one product emphasizing compatibility with the platform after another, taking the so-called “enclosure strategy” to enhance its economies of scope and scale\textsuperscript{3}.

As profitability tends to decrease in perfect or unrestricted competition, companies tend to improve their profitability by setting entry barriers via the enclosure strategy or other means, creating imperfect competition. Particularly in the case of IT products, which are frequently comprised of multiple standards, compatibilities among standards tend to be an important factor in enclosure strategies. We can, however, observe certain cases that cannot be properly explained through only an enclosure strategy based on compatibilities of standards. One such case is the domestic PDA\textsuperscript{4} market, in which the share of WindowsCE, most effectively linked with Windows-based PCs and supposedly the most advantageous in terms of network externalities, retains only a small market share, particularly among personal users.

To explain this situation, the “open source strategy”\textsuperscript{5} is frequently mentioned. The analysis of Kurimoto & Kobayashi (2004) contends that PalmOS can effectively compete with Zaurus (which has long dominated the domestic electronic data book market) and WindowsCE (which attempts to increase its market share through data compatibility with PCs) because of its open source strategy. PalmOS has successfully structured its platform development system around a division of labor, standardizing the development environment and disclosing the source code\textsuperscript{6} to external complementary developers, including software developers and licensed manufacturers.

In addition, the analysis of Kurimoto & Kobayashi (2004) presents strategic variables in marketing, which the open source strategy attempts to improve. The market data utilized in the analysis was from the period 1998 through 2002, corresponding to the introductory and growth periods of the market. It is thus the first objective of this paper to verify whether these strategic variables continue to

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\textsuperscript{1} For more details about network externalities, please refer to Katz & Shapiro (1985, 1992, 1994) and Asaba (1998).
\textsuperscript{2} For more details about excess inertia, please refer to Farrell & Saloner (1985, 1986).
\textsuperscript{3} For more details about customer enclosure strategy in information technology, please refer to McFarlan (1984).
\textsuperscript{4} Personal Data Assistant.
\textsuperscript{5} For more details about open source strategy, please refer to Kokuryou (1999), Negoro & Itou (2003), and Annabelle & Cusumano (2002).
\textsuperscript{6} Offered to development users under the condition of NDA (Non-Disclosure Agreement).
function as the key drivers in maintaining each platform’s competitive advantage. If it is possible to grasp the effect of each variable on consumer behavior at each stage of a product’s life cycle, this information can be utilized as a framework for comprehending competitive strategies for not only PDAs but also IT products in general.

On the other hand, if a platform development system based on division of labor is established by enhancing the customizability of the platform, the technical know-how linked with the platform ends up being dissipated throughout the industry. It is thus crucial for Palm to consider how to maintain the technical advantages of the system long-term. Toward this end, a technical development strategy that can support its product development strategy will be the key. And it will be necessary to analyze the technical development capability of each platform and the technical relevance to complementary companies. However, this point is not sufficiently discussed in our previous study, “Kurimoto & Kobayashi.”

The objective of this paper is thus to reveal how PalmOS has established its superiority in the platform competition within the domestic personal-user market, not only by using market data to analyze consumer behavior but also by analyzing aspects of technical development surrounding the product development.

2. Analysis of Consumer Behavior

In Japan, market launches of Zaurus, WindowsCE, and PalmOS were officially announced around 1997, but the full-scale growth of the market became palpable around 2000, when domestic manufacturers started licensed production of PalmOS devices. Figure 1 indicates the number of units sold in the entire domestic market, compiled from monthly POS data at domestic mass merchandisers, which were provided by BCN.

![Figure 1. Total Number of Units Sold in the Personal-user Market](http://www.bcn.jp/)

The analysis of Kurimoto & Kobayashi suggests that the effectiveness of product variations presented by each platform will be the key drivers in maintaining each platform’s competitive advantage. It clearly indicates an overall tendency for significant fluctuations in the number of units of new products sold at launch. Furthermore, in 2002, the general trend of sales expansion subsided and the fluctuations in sales caused by newly launched products were magnified, both of which may suggest a saturated state in the market.

According to Gartner Japan (2003), while the market for corporate customers is expected to expand in and after 2004, demand in the consumer market will slowly trend downward following its 2002 peak, resulting in the overall market being led by demand for replacements instead of new purchases. These findings are consistent with the interpretation of Figure 1, compiled from newly acquired POS data—regarded as highly reliable sampling data. Using this data, market share, as determined by the cumulative number of units sold per platform, has been compiled in a graph.

The results indicate that the market share of WindowsCE continued to decline in and after 2000, when PalmOS was introduced in the Japanese market, and this trend is still observable in 2004 (Figure 2). In estimating the monthly number of sales by platform (Sales), the analysis of Kurimoto & Kobayashi suggests that the effectiveness of product variations presented by each platform (Vari) and average sales prices (Price) can function as effective explanatory variables. We will next examine how these variables have changed in recent years.

2.1 Product Variation

Figure 3 shows the development of product variation in the market. As is apparent in this figure, the market can be classified as the “growth period.” The period up to 1999 Q3, characterized by a rapid increase in product variations, can be classified as the “introductory period,” and the period from 1999 Q4 to the end of 2001, in which growth peaked, can be classified as the “growth period.”

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7 Compiled from the monthly sales data (from October 1998 through March 2004) of major domestic PC outlets (569 outlets of 13 companies) provided by BCN. In the following pages, this is the data that has been used unless otherwise specified. For more details about this

8 In this paper, Zaurus devices equipped with the proprietary OS of Sharp and Zaurus devices equipped with Linux are treated as different platforms, as their compatibility is rather limited.


10 For more details about product life cycles, please refer to Levitt (1965) and Day (1981).
The period from 2002 to 2003 Q2, in which increases in product variations were no longer observed, can be classified as the “maturity period,” with the period after 2003 Q3 as the “decline period.” In general, as little information is available to select standards in the introductory period when full-scale launches of products are initiated, consumers tend to use product variation among different platforms as a reference indicator for comparing respective market shares.

As a result, product variation functions as a network externality, stimulating consumption behaviors in favor of specific platforms. Platform manufacturers thus find it crucial to increase the number of product variations equipped with their own standards as quickly as possible, and frequently use supplies from OEMs for that purpose. In these situations, for OEM suppliers to which the OS is supplied for OEM operations, how much information is necessary for hardware development, including the OS source code, can be obtained from the original developer, and how freely the OS can be customized, will be crucial points in competition among standards. This is because adopting a platform in which product specifications can be flexibly modified by utilizing such information can be advantageous for OEM suppliers in differentiating their product models, a necessary step to enhance product variation.

2.2 Sales Prices

Next, Figure 4 indicates the development of the average sales prices in the market. The sales price average of about 60,000 yen in 1998 dropped by half in five years, to 30,000 yen in 2005, probably due to price competition among models equipped with WindowsCE. Looking into different platforms, while the prices of the units equipped with PalmOS in the introductory period were about 30,000 yen, which is almost the same level as at present, the average price of those with WindowsCE were about 60,000 yen in the same period, causing a significant price difference and raising the average sales price for the entire market during the introductory period.

These price differences between platforms may be caused by the facts that WindowsCE requires high-performance hardware and that PalmOS has adopted an open specification strategy.

The open specification strategy adopted by PalmOS is designed to minimize the memory capacity required to boot the OS in order to expand the number of possible hardware configurations. However, as more domestic manufacturers utilizing OEMs entered the market, pushing the market up to the growth stage, the sales prices of the units equipped with WindowsCE requiring high hardware performance started to decline, along with the unit price of memory. And, in and after 2002, when the market was regarded as being in its maturity period, manufacturers focused their efforts on product differentiation. Prices, which had tended to decline at launches of new models, remained around 30,000 yen, allowing for a respite in the price competition.

2.3 Product Newness (Average Sales Period)

We have so far looked primarily into competition between different standards. However, in competition within a specific standard, among products which have adopted the same platform, we can observe situations that cannot be properly explained by the product variation and sales prices we have discussed so far. In Figure 5, which indicates the number of units sold and sales prices for the market launch of a typical model (PEG-NR70V) in the Japanese market, nearly the entire number of units sold

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11 For more details about open specification strategy, please refer to Kurimoto & Kobayashi (2004).
were sold in the few months following the market launch, which cannot be properly explained by looking at sales prices alone. Looking at the number of units sold decreasing immediately after the product launch and continuing to decline with time, it can be surmised that product newness is an important factor for consumers when they compare products.

The product newness we have just observed may be a significant factor in competition within a standard, in which products that have adopted the same platform are compared. Conversely, how can competition within a standard cantering on product newness affect competition between different standards? As indicated in Figure 6, which plots the average sales periods at different points in time for the entire market, the average sales period generally trends upward from the introductory period to the maturity period, suggesting the “maturing” of the market in terms of product structure. Platform manufacturers may consider it desirable that products complying with their own standards be comprised of relatively new products, with shorter sales periods compared with those based on competing standards. However, as the analysis of Kurimoto & Kobayashi does not consider the effects of competition within a standard on competition between standards, it is necessary to conduct a new analysis by establishing an improved model in this regard.\footnote{For more details about the establishment of indicators for technological development capabilities, please refer to Griliches (1990), OECD (1994) and Pavitt (1985).}

Figure 6. Average Sales Periods

2.4 Regression Analysis

In addition to product variation (Vari) and product price (Price), which are conventionally thought to affect consumers’ platform selection behaviors, product newness (Time) was included in order to formulate the explanatory variables for the number of units sold for the major platforms (PalmOS, WindowsCE, Zaurus, and Zaurus (Linux)) to produce the “1.1” formula. In order to understand how the effects of these strategic variables may differ with the inclusion of product lifecycle as a consideration, the platform-specific variables derived from the POS data have been classified into the four product lifecycle types observed in Figure 3 in order to conduct a regression analysis. The results are indicated in Table 1. For each variable, the positive/negative sign of a coefficient corresponds to that assumed in advance.

\[ S = \alpha V^p P^T S^e \] (1.1)

Then, looking at the beta coefficient of each variable, when the effects of these variables on the number of units sold are compared, we can surmise that product variation strongly affected the number of units sold in the introductory period, that sales prices had stronger effects in the growth period, that the effect of the number of units sold in the previous period dwindles and product variation gains the momentum again in the maturity period, and that strategic variables, which can be properly addressed at the product development phase, cannot exert any strong influence in the last decline period. These facts indicate that, in platform competition, sales prices had decisive effects only in the growth period, and that product variation and product newness had consistent effects throughout product lifecycle.

So how can these variables be improved? Focusing on product newness, which has been newly introduced in this paper, we can assume that it is largely dependent on the technical development capability of each platform manufacturer. This is because OS upgrades for functional improvements can provide a good occasion for OEM suppliers to renovate their product lineups. We will next attempt to establish indicators for the technological development

<table>
<thead>
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<th>Variable</th>
<th>T</th>
<th>Beta</th>
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</thead>
<tbody>
<tr>
<td>Sales,1</td>
<td>6.31</td>
<td>0.533</td>
</tr>
<tr>
<td>Vari</td>
<td>5.40</td>
<td>0.469</td>
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<td>-0.251</td>
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<tr>
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<tr>
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<tr>
<td>Vari</td>
<td>2.58</td>
<td>0.238</td>
</tr>
<tr>
<td>Time</td>
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<tr>
<td>Price</td>
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<td>-0.528</td>
</tr>
<tr>
<td>Cons</td>
<td>5.40</td>
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Table 1. Regression Results for Different Periods

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</tr>
</thead>
<tbody>
<tr>
<td>Sales,1</td>
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</tr>
<tr>
<td>Vari</td>
<td>6.73</td>
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<td>Time</td>
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<tr>
<td>Price</td>
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</tr>
<tr>
<td>Cons</td>
<td>4.01</td>
<td></td>
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<table>
<thead>
<tr>
<th>Variable</th>
<th>T</th>
<th>Beta</th>
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<td>0.615</td>
</tr>
<tr>
<td>Vari</td>
<td>3.19</td>
<td>0.326</td>
</tr>
<tr>
<td>Time</td>
<td>-1.03</td>
<td>-0.112</td>
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<tr>
<td>Price</td>
<td>-0.60</td>
<td>-0.066</td>
</tr>
<tr>
<td>Cons</td>
<td>0.22</td>
<td></td>
</tr>
</tbody>
</table>
capabilities of different platform manufacturers, utilizing patent information disclosed by the U.S. Patent Office to conduct analysis concerning how technological development supports product development activities. This is because the method of establishing indicators for technological development capabilities of industries and enterprises through patent registration information has been attempted by Griliches (1990) and other researchers and can be recognized as appropriate for clarifying technical innovation trends in the industry.

3. Analysis of Patent Information

Figure 7 indicates the yearly totals for registered patents concerning PDAs. The analysis of Comanor & Scherer (1969), which analyzed the correlation between new product development and the number of patent applications, indicates that changes in technological development tend to be more accurately reflected by the everyday information contained in patent applications rather than the patents themselves. Taking this into account, Figure 7 seems to suggest that PDA-related technological development grew active around 1994, dwindled in 1996, then was reinvigorated in 1998 when the market reached its introductory period. That revitalization continued through 2000.

Next, in order to compare the technological development capabilities of the three major platform manufacturers (Palm, Microsoft, and Sharp), the number of PDA-related patents held by each company has been tabulated (hereafter referred to as “SPC”). The result indicates that Microsoft holds the largest number of relevant patents As Microsoft has developed multiple IT-product platforms aside from the PDA, and Sharp carries out technological development within Japan, it may be difficult to simply compare the SPC figures of the three companies; but the differences as indicated in Table 2 can be observed concerning the patents in which “PDA” is specified as a possible area of application.

However, as this tabulation method includes patents that may not lead to actual PDA product developments, it cannot accurately reflect the technological development capabilities directly linked with PDA development at the three companies. When only the patents specified as applicable to PDAs in the summaries of patent applications (ABST) are counted as “directly related technologies,” the superiority of Microsoft to Palm is reversed in terms of the SPC figures, as indicated in Table 2; that is, Palm can be regarded as superior in technological development capabilities directly linked with PDAs.

In addition, Albert (1991) points out that the “importance” and “expandability” of patented technologies held by a company can be more accurately reflected in indicators if the information on how often a certain patent is quoted in other patents can be utilized as a weight. In this regard, Trajtenberg (1990) reports that the number of registered patents weighted in accordance with the number of quotes with the formula indicated as “1.2” (WPC) is more appropriate than SPC as an indicator of the technological development capability of a company.

$$WPC = \sum_{i=1}^{n} (1 + C_i)$$  \hspace{1cm} (1.2)

Where “n,” indicates the number of patents issued by a company in the year, “t,” “Ci” indicates the number of quotes made so far for the patent, “i.” Based on this formula, “1.2,” the WPC figures for directly related technologies have been calculated from the information contained in the patents applied for by the three companies. The results confirm the superiority of Palm (Table 2). Putting these data together, when the three companies involved with development of PDA platforms are compared, Palm can be viewed as successful in the development of the most important and expandable PDA-related technologies.

Table 2. Number of Patent Registrations

<table>
<thead>
<tr>
<th>Company</th>
<th>SPC Technologies</th>
<th>SPC Related Technologies</th>
<th>WPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm</td>
<td>126 (33%)</td>
<td>44 (70%)</td>
<td>272 (65%)</td>
</tr>
<tr>
<td>Microsoft</td>
<td>230 (60%)</td>
<td>17 (27%)</td>
<td>111 (27%)</td>
</tr>
<tr>
<td>Sharp</td>
<td>30 (7%)</td>
<td>2 (3%)</td>
<td>35 (8%)</td>
</tr>
</tbody>
</table>

13 For the registered patents, the annual numbers of patents described as applicable to “PDA” or “Handheld Computer” disclosed in “http://www.uspto.gov/” were counted for each year (as of August 17, 2004).
14 Search Formula (ex.): AN/microsoft and (handheld or PDA) and computer.
15 The aggregated figures for Palm include the number of applications by 3Com until the Palm section was separated as an independent entity (September 13, 1999) (as of August 17, 2004).
16 For more details, please refer to Albert (1991) and Worcester Polytechnic Institute (1988).
Although we have determined the number of cases in which a particular patent has been quoted to calculate the WPC figures, existing patents are usually quoted when applying for a new patent in order to clarify its uniqueness by indicating its relevance with regard to existing technologies, and to justify the case for the patent being applied for. In other words, the same numbers of quotes may imply different meanings in terms of product development, whether most of the quotes are made under different patents within the same company or under patents of competitors or complementary companies. We thus looked into directly relevant technologies owned by Palm and Microsoft, both of which are relatively frequently quoted, examined how they are quoted, and classified the quoting entities as the owners of the original patent, complementary entities, or entities developing competing platforms. The results are as indicated in Table 3.

**Table 3. Numbers of Other Patents in which the Proprietary Patents are Quoted**

<table>
<thead>
<tr>
<th></th>
<th>Own</th>
<th>Competitor</th>
<th>Complementary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm</td>
<td>47 (32%)</td>
<td>9 (6%)</td>
<td>90 (62%)</td>
</tr>
<tr>
<td>Microsoft</td>
<td>8 (21%)</td>
<td>4 (10%)</td>
<td>27 (69%)</td>
</tr>
</tbody>
</table>

The result indicates that about 30% of the total quotes in applied patents are made by Palm itself, whereas Microsoft makes about 20% of its own quotes. In other words, while technologies developed by Microsoft tend to be referenced mainly by external complementary entities, such as hardware and software companies within the industry, Palm technologies are relatively more frequently quoted by internal developers, although external quotes are not few, which indicates a tendency to enhance technical areas close to the existing technologies developed in-house. Although it may be difficult to determine which technological development styles are superior in platform competition, the different directions taken by these companies are apparent; the technological development style of Microsoft can be regarded as “technological diffusion,” while that of Palm can be termed “technological integration.”

**4. Conclusion**

This paper is intended to determine standard competition factors in the PDA market by analyzing consumer behaviors and technological developments in the market. The improved point made in this paper is that the variable indicating product newness has been established as an explanatory variable for the number of units sold for a platform, so that the effects of competition within a standard on competition between standards can be properly considered in the regression analysis based on long-term market data. It has thus been revealed when the strategic variables for product development, such as “Vari,” “Price,” and “Time,” can effectively function in product lifecycles. In short, there is no specific variable that can strongly affect competition between different standards throughout product lifecycles, but product variation and product newness have sustainable effects on the number of units sold, except for during the decline period. Platform manufacturers and OEM suppliers should pay proper attention to this point.

Furthermore, this paper has revealed, through analyses of patent information, that, while Palm is considered to have taken the platform development strategy based on division of labor, which can be easily customized to improve the strategic variables in line with product lifecycles, it was not because the technological development capability of Palm alone was insufficient. In other words, judging from the WPC figures weighted by numbers of quotes made by other entities, the superiority of PalmOS is evident over the other platforms.

In addition, judging from the quotation relationships concerning different patents, it has also been revealed that the technological development of Palm is characterized by its trend toward technological integration. However, while Palm integrates and consolidates its in-house technological base to compete with Microsoft, its real advantages may have been derived from the fact that it has adopted the development method based on division of labor by actively disclosing the source codes of products already put into the market to external developers.

Based on the above discussions, we may place the PDA-related platform strategies on dual axes of “customizability” and “compatibility,” and obtain an overview of the strategic positioning of each platform, as shown in Figure 8. This figure illustrates that, in order to compete against the “enclosure strategy” led by a strong initiative of Microsoft (WindowsCE) and supported by the high compatibility with other complementary platforms, the “open source strategy,” which is superior both in customizability and compatibility, may seem to be a viable option, at least as a concept.

![Figure 8. Platform Strategy Classifications](image-url)
However, as can be seen in business operations based on Linux, it is difficult for a particular enterprise to internalize the technological know-how for sustaining the profitability while simultaneously maintaining both of these dual axes at high levels. This open-source approach may seem to be inappropriate for business markets. In fact, Sharp has adopted Linux for its basic PDA platform designs to make its terminals more network-compatible than Zaurus, which has long been developed with its proprietarily technology. This move has, on the other hand, decreased the portion of its proprietary technology in platform development, making it difficult to enhance development through the OEM-based division of labor with external parties, and forcing Sharp to take the conventional consolidated development style.

Here, we can witness the effectiveness of the “Semi-open source strategy,” which may be a stand-alone type with low compatibility with complementary platforms, but attempts to improve the strategic variables likely to affect consumer behavior from a product development perspective by emphasizing the technologies of complementary developers and enhancing customizability. In this case, technological development through division of labor with external developers will be required, necessitating disclosure of technologies through technical tie-ups, and maintenance of technological development capabilities to establish core in-house value. With this in mind, it can be concluded that Palm is in an advantageous position in platform competition because it has taken the semi-open source strategy and, at the same time, has pursued technological developments in a technologically integrated format.

References