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Replacement Trend of New Mobile Products under Product Life Cycle Model

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Abstract: With the rapid development of science and technology, the Internet, a huge network connected by networks, has occupied most of our lives. The demand of mobile phones is getting higher than before because of the smart data era. However, the convenience of smart phones is apparently couple with rapid replacement of new types. Apple of the United States, Huawei of China and Samsung of South Korea are the three giants in the mobile phone industry appeal users all over the world. However, none of them will stay in the end users for more than a handful years since new versions are scheduled releasing every year. Based on the sales data from popular models of Apple, Huawei and Samsung in recent years and the product life cycle theory, the amount sold are compared and analyzed in this study from the aspects of self-replacement and brand replacement along with projection of the replacement trend of their new products. Finally, relevant suggestions are proposed for the breakthrough of new mobile phone products.

Keywords: Mobile Phone Products; New Product Replacement; Product Life Cycle

1. Introduction

Mobile phone industry is one of the most important industries to promote the development of China's national economy. With the popularity of smart phones, living habits of the majority has been deeply affected as well as life style imperceptibly. At present, the fierce competition of mobile phone entered white-hot stage and the ranking changes frequently (Tang, *et al.*, 2016).

According to the global smartphone sales data in 2020, Samsung and Apple remained top two in the market and a high market share altogether, among which Samsung occupied 20% of the market share in 2020 but with a decline of 14% compared to 2019 (Table 1). With Apple accounting for 16% of the market in 2020 and a 5% increase from previous year, the two brands remained strong in the market share. Wieser and Tröger (2018) identified three forms that were considered outdated, either related to the basic functionality of the phone, the replacement of the phone, or the social capabilities of the phone. The result shows that switching phones is not only based on a desire for a new phone, but is primarily based on a perception of obsolescence in existing phones. In the competitive environment, patent, R&D, launch of new technologies, new products and new markets have become a virtuous cycle in the mobile phone industry. Therefore, mobile phone companies should establish their own brand image, constantly improve the product design and functions of their smartphones, and provide competitive prices to improve customer satisfaction and customer loyalty.

The definition of new products can be carried out from three perspectives: enterprise, market and technology. For enterprises, the first production and sale of products are named new products; For the market, however, only the first product is entitled a new product; From the technical point of view, only in the product principle, structure, function and form have changed can be identified as a new product. Defined from the perspective of the concept of product integrity, new products in marketing include the first three components but pay more attention to consumers' feelings and recognition. The innovation and improvement of any part of the concept of product integrity can bring certain new feeling, satisfaction and benefits to consumers, which is relatively new or absolutely new products (Redda and Shezi, 2019).

Table 1. Worldwide smartphone shipments and growth.

	2019		2020		
Vendor	shipments (million)	Market share	Shipments (million)	Market share	Annual growth
Samsung	298.0	22%	255.6	20%	-14%
Apple	198.1	14%	207.1	16%	5%
Huawei*	240.60	18%	188.5	15%	-22%
Xiaomi	125.5	9%	149.6	12%	-4%
Oppo	120.2	9%	115.1	9%	-4%
Others	384.3	28%	348.9	28%	-9%
Total	1,366.7	100%	1,264.7	100%	-7%

* including Honor
Note: percentages may not add up to 100% due to rounding
Source: Canalys estimates (sell-in shipments), Smartphone Analysis, January 2021

New products refer to the new products developed and produced by adopting new technical principles and new design concepts, or the products which are significantly improved over the original products in some aspects such as structure, material and process to significantly improve the product performance or expand the use function. It includes both the new products identified by the relevant government departments and within the period of validity, also the new products developed by the enterprise itself which have not been identified by the relevant government departments and are within one year from the date of production. It reflects the output of science and technology and its direct contribution to economic growth.

New products are classified into incremental or derivative products, next generation or platform products, and breakthrough products. Incremental or derivative products are hybrids or enhancements of existing products requiring minimal changes in design or process, allowing for quick development, and involving fewer resources to develop new features or functions. They ensure near-term cash flows by maintaining current market share. Next generation or platform products represent new "system" solutions for customers, requiring more resources to develop and is the key to continued product revenue growth. Breakthrough products have the creation of new product categories as their core business requiring substantial design and process change and render existing products obsolete in long-term. Apple, Huawei, Samsung and other mobile phone companies constantly innovate and update their products to guarantee their new products the breakthrough ones.

The concept of Product Life Cycle, referred to as PLC, is to compare the sales history of a product to the life cycle of human beings, which should go through the stages of birth, growth, maturity, aging and death. In terms of products, that is to go through a stage of development, introduction, growth, maturity and decline. The first stage is product development period, including the idea of developing a product to the period of product manufacturing success. During this period, the product has not been sold and the company's investment continued to increase. The second stage is the introduction period that new products are coming on the market but the sales are slow. Due to the high cost of introducing products, initial profits from new products are usually low or negative but with few or no competitors in the market. The third stage is the growth period that products become quite famous with rapid growth in sales and significant increases in profits. However, due to the rapid growth of the market sales and profits, it is easy to attract more competitors. The fourth stage is the mature period where market growth trend slows down or becomes saturated. At this stage, the product has been accepted by most potential buyers and the profits gradually decline after reaching the peak. At the same time, the market competition is fierce and the company needs to invest a great deal of marketing expenses to maintain the product status. The fifth stage is recession that product sales decline significantly and profits fell sharply because of supplementary competitors in the market.

2. Literature Review

The product life cycle theory was first proposed by Vernon (1966) that partly solves the Leontief Puzzle. Vernon divided the product life cycle into three stages, namely the initiation stage, the growth stage and the maturity stage. Wells (1968) further developed the product life cycle theory into five stages: introduction stage, growth stage, maturity stage, decline stage and extinction stage to analyze the trade of industrial finished products between countries. Product design changes may be required in each step of product life

cycle from its design to decline phase (Finger, 1975). Nowadays, numerous companies face shorter product life cycles, increasing the need to properly forecast demand for newly introduced products (Shivankar and Deivanathan, 2021). The death of a product is bound to lead to the emergence of new products and real new products will continue to extend the life of the product. The continuation of the new product life cycle is the performance of self-replacement of the product.

There have been various studies on the performance of smartphone. Tavani *et al*. (2022) demonstrated the performance of the iPhone for orientation and raster image data capture, being comparable to analog compass-clinometers and reflex/mirrorless cameras to reach the empirical results that iPhone's geo-location capabilities are acceptable for most field cases. Yan and Huang (2022) provided a comprehensive review of Huawei's practice in implementing open innovation as one of the most powerful key factors behind its rapid development and competitiveness in telecommunications equipment manufacturing. Atashfaraz *et al*. (2016) discussed the impact of electronic service innovation on brand equity, brand value and customer loyalty of Samsung International. One of their conclusions suggested that technology leadership has a direct impact on customer loyalty through leading-edge mechanism because the technology is marketed by a company ahead of the other competitors. As a result, Samsung should have unique technologies in the mobile phone market ahead of its competitors to retain their loyal customers and to add new loyal customers.

3. The Model

Product life cycle is a model that explains the route of a certain product through its useful life in an industry. Waris *et al*. (2016) has divided the life of a product in four stages constituting the life span of a product. The first stage is the introduction where the product is designed, manufactured and released to the market. The second stage is growth where sales increase due to increased market penetration and product improvements. The third stage is maturity where sales reach its peak and the cost of the product is reduced by scalability. The fourth stage is decline where sales begin to fall probably due to the introduction of new products or obsolescence. Figure 1 demonstrates the product life cycle through product sales rate, frequency of changes in product, and frequency of changes in process respectively.

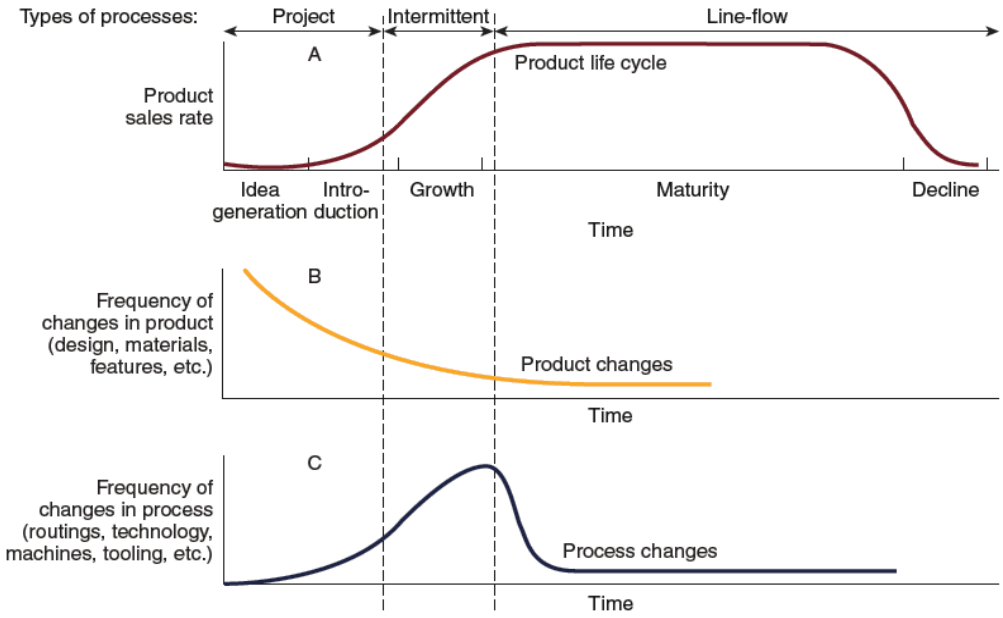

Figure 1. Product and process life cycles.

This paper extends the mobile phone product life cycle to the mobile phone family product life cycle. The ideal family product life cycle is shown in Figure 2 where the upgrading trend is the product family of a certain brand which is the integration of own product of different types. The product life cycle holds for individual mobile phone product as well as the mobile phone product family.

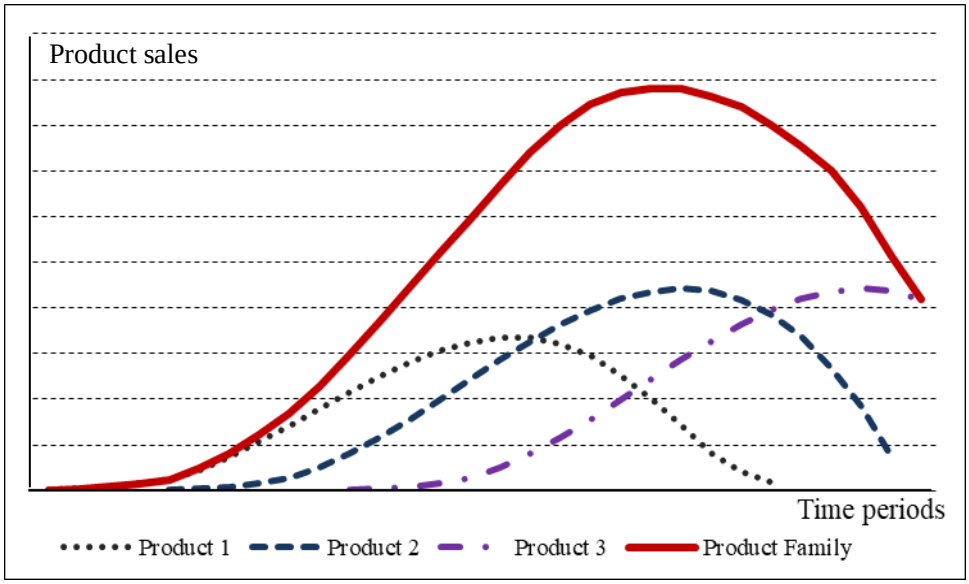

Figure 2. The theoretical family product life cycle.

4. Data source

4.1. The Apple Family Product Life Cycle

Apple has continuously introduced new products from the launch of iPhone1 in 2007 to that of iPhone11 and iPhone12 in 2021. In terms of the annual sales volume of the whole Apple family, the sales volume of iPhone was 1.39 million in 2007, 11.63 million in 2008, 20.73 million in 2009, 39.99 million in 2010, and 72.29 million in 2011 respectively. 2012 was a turning point of iPhone where sales reached 125.05 million units as sales began to break the 100 million mark. The sales volume of iPhone was 150.26 million in 2013, 169.22 million in 2014, 231.22 million in 2015, 211.88 million in 2016, 216.76 million in 2017 respectively, and it is estimated that the sales volume of iPhone in 2018 will not exceed 200 million. On a per-product basis, The iPhone came out with new models every year, but the leading seller was the iPhone6 series releasing in 2014. Surging demand for the iPhone6 helped Apple posted record results for the second consecutive quarter, making China Apple's second most important market after the United States. The company sold 61.2 million units of iPhone 6 and iPhone 6 Plus in the first three months of 2015 (Williams, 2015). In an era of rapid smartphone upgrades where the production time of a smartphone can range from a few months to a year or two, the iPhone6 has been on sale for five years (Figure 3).

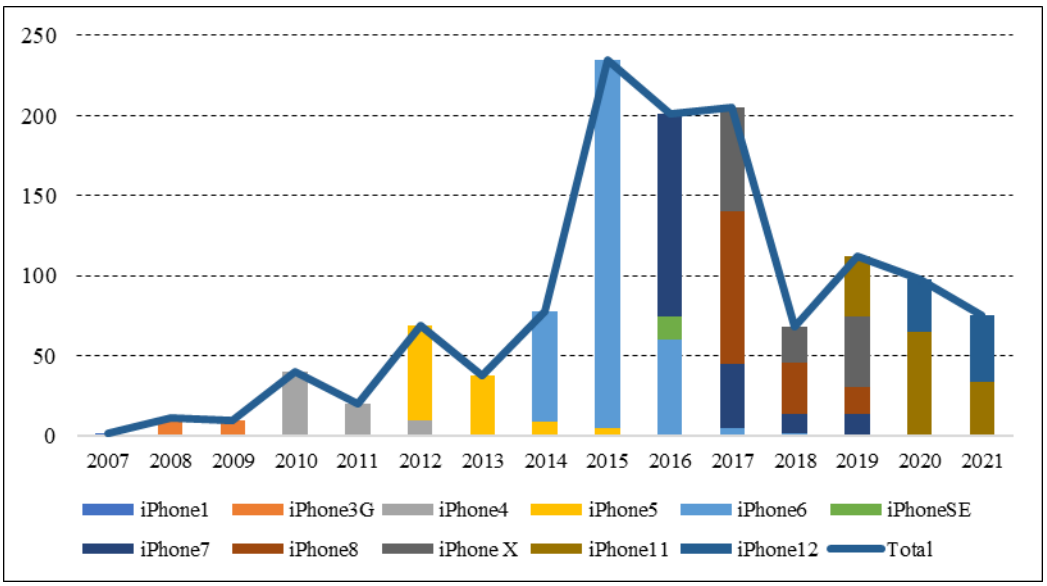

Figure 3. The Apple family product life cycle (Unit: Million).

4.2. The Huawei Family Product Life Cycle

From 2004 to 2010, it took Huawei 6 years to sell 3 million units of mobile phones. After 2010, the sales volume of mobile phones increased from 3 million units to 240 million in only 10 years. Since 2016, Huawei's market sales have been increasing but the increasing share is mainly in the domestic market. In 2017, Huawei's total shipments reached 153 million. In 2018, Huawei's sales volume exceeded 200 million for the first time and reached 208 million, but it was still the third in the world. Figure 4 shows that Huawei has launched a wide range of products with certain new products sustaining a relatively short life cycle since only changes in its appearance or upgrading the performance was observed which failed in the definition of a real new products.

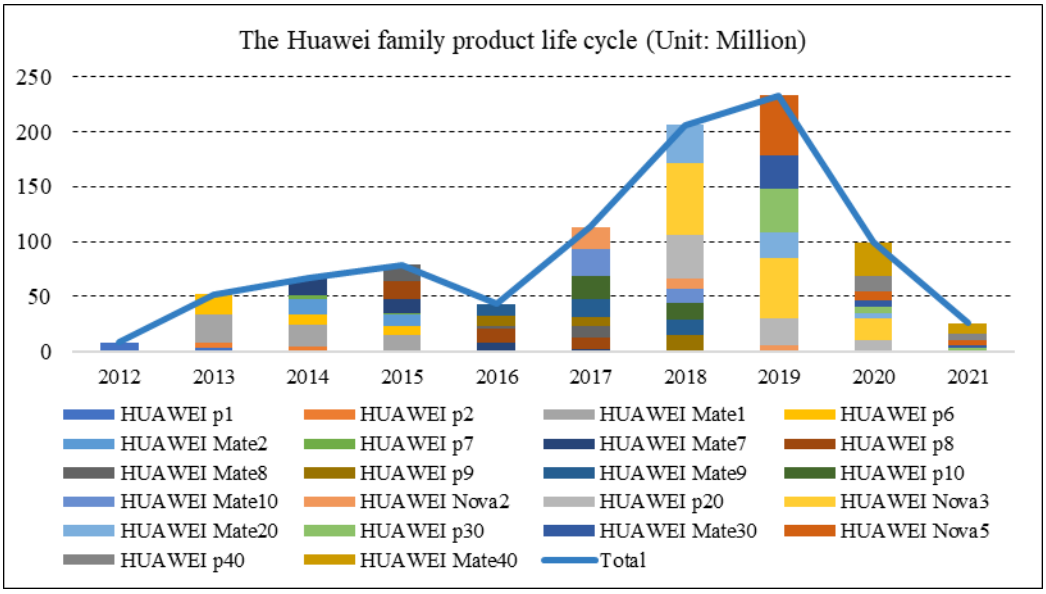

Figure 4. The Huawei family product life cycle (Unit: Million).

4.3. The Samsung Galaxy Family Product Life Cycle

Samsung Galaxy S series is not only a smart phone series, it is even synonymous with Android phone to some extent. In the beginning, however, Samsung Galaxy S didn't make a big splash. After slow growth in previous generations, it took off with the Galaxy S3 and S4 which even became the best-selling Android phone of all time. Samsung then refined the product line and soon made it into the top tier of Android phones (Figure 5).

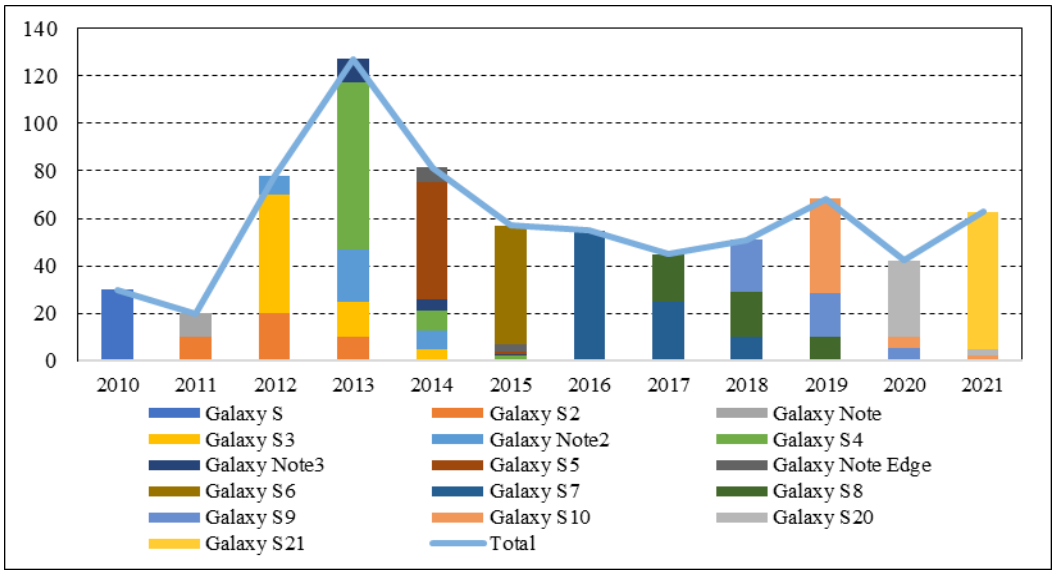

Figure 5. The Samsung family product life cycle (Unit: Million).

4.4. Future Trend Analysis

The future trend of family product life cycle can be estimated from Fourier and Gaussian forecasting equations:

$$F(t) = a_0 + a_1*cos(t*w) + b_1*sin(t*w) + a_2*cos(2*t*w) + b_2*sin(2*t*w) \quad (1)$$

$$G(t) = a_1*exp(-((t-b_1)/c_1)\text{^}2) + a_2*exp(-((t-b_2)/c_2)\text{^}2) \quad (2)$$

where a_i, b_i , c_i (i = 0, 1, …, 2) and w are the estimated coefficients; t is the time period of product life cycle. Equations F2 and G2 represent i =2 and F6 for i = 6.

In the product life cycle, Apple's new product seems to have only experienced three stages: growth stage, maturity stage and decline stage. The reason for the popularity of Apple's new product can be comprehended from the perspective of consumers' stickiness consumption, flaunty psychology and high price pursuit. From the perspective of brand, the product life cycle of Apple family has gone through four stages: introduction stage, growth stage, maturity stage and decline stage. 2007-2011 is the introduction stage, 2012-2014 is the growth stage, and 2015-2017 is the maturity stage (Figure 6). The sales volume of Apple family peaked in 2016, and showed an overall trend of decline after 2018. However, its recession depends on Apple's subsequent performance. Every iPhone launch has a devout following and the leading adopters prefer truly new products over upgraded ones because they don't see the advantages of using an upgraded version of an already widely adopted product. Therefore, only by constantly launching new products and developing performance different from the old products can Apple captures the hearts of consumers and improve its brand advantage (Arruda-Filho and Lennon, 2011).

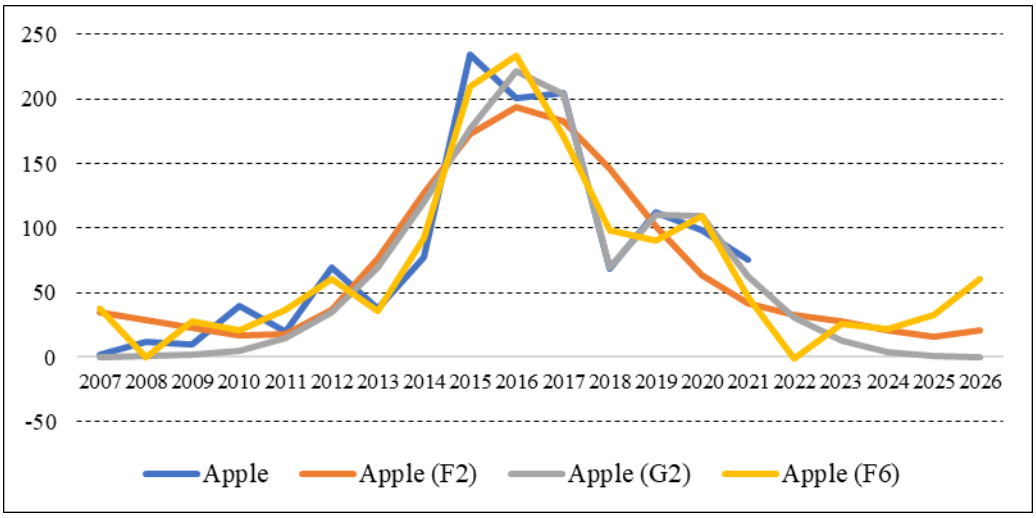

Figure 6. Actual and forecasting for Apple family product life cycle.

Huawei family product life cycle has experienced difficulties in recent years because of the increasingly tense on the macro environment of international economic situation. The United States took increasingly strict technology blockade to Chinese enterprises that caused serious negative impact on the development of domestic telecommunications equipment companies (Guo, 2021). Figure 7 shows that Huawei's family product life cycle has the highest sales in 2019 as the mature stage, representing a bright development prospects. However, since Huawei is the emerging markets' backwardness high-tech enterprises, domestic environment and the accumulation of technology R&D is far behind the western developed countries. In order to improve the innovation ability, Huawei needs to obtain external technology licensing and technical cooperation through open innovation strategy (Wu, 2021). Only by constantly developing high-quality new products can Huawei be competitive in the international market. Obviously the patriotic psychology of consumers has also brought good sales volume to Huawei.

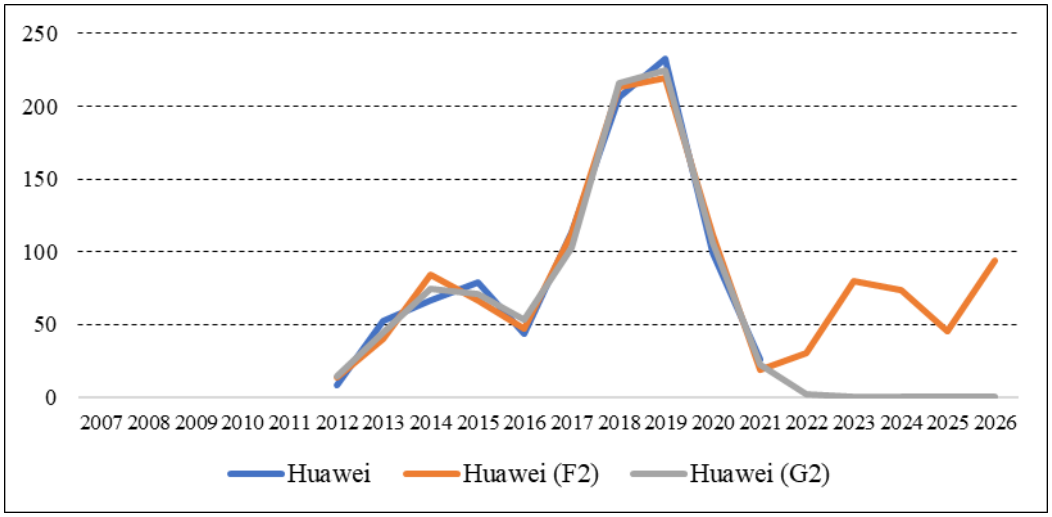

Figure 7. Actual and forecasting for Huawei family product life cycle.

In South Korea, the brand is the most important attribute of smartphone and Apple is the strongest in brand loyalty (Kim et al.,2020). Whether or not consumers who are currently owners of Apple smartphones continue to maintain the same brand in their next purchasing depends not only on their brand loyalty but also on the satisfaction of their leading peers who currently own the Apple. On the other hand, Samsung's brand loyalty is lower than that of Apple, but the brand interest is the highest among others (Figure 8). Additionally, in all smartphone brands, satisfaction with smartphone brands owned by leading peers has a significant impact on consumers' interest.

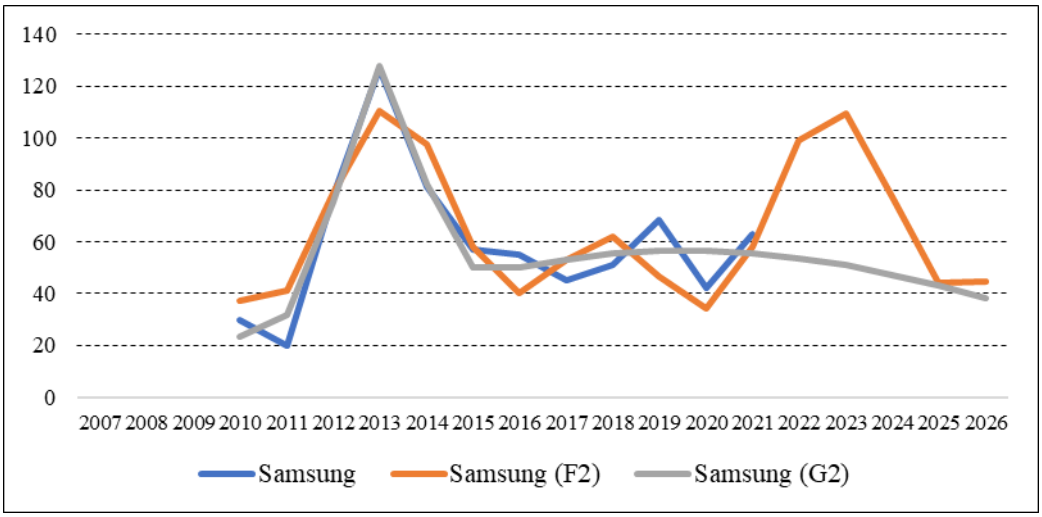

Figure 8. Actual and forecasting for Samsung family product life cycle.

Fourier forecasting of family product life cycles for three brands are shown in Figure 9. Apple entered the market first, began to grow in 2011, and reached a peak in 2016 before recession. The impact of COVID-19 epidemic has strictly obstructed the growth of iPhone sales in recent years.

Samsung entered the market in 2010 and reached the peak in 2013 along with the growth of Apple. However, it experienced a very short maturity period and rapidly recession after the peak. A stable but low sales volume has been observed for a long time, which was caused by the release of Samsung Galaxy Note7 since there have been more than three dozen explosions and fires caused by defective batteries worldwide. So far, Samsung has not really been recognized as an innovative company. For example, the company has never launched a new category of products which gives investors the impression that it's always a copycat.

Huawei entered the market in 2012 and its sales volume was in a slump at the starting point. It reached the peak in 2018 and 2019 but sales volume has not made a breakthrough in recent years. The reason is that Huawei cannot purchase some parts from the United States due to disputes between Huawei and the United States. On the other hand, Huawei is separated from Honor, which accounts for about 40% of Huawei's

mobile phone sales and inevitably resulting decline in revenue. However, Huawei launches new products frequently and the life cycle of new products is quite short, which results paying less attention to study what is real innovation.

Fourier forecasting in Figure 9 for three family product life cycles show that Apple is like to continuously decline after 2022, Samsung will reach another low peak in 2023 and decline thereafter, and Huawei might embrace an increase in sales in the year of 2025.

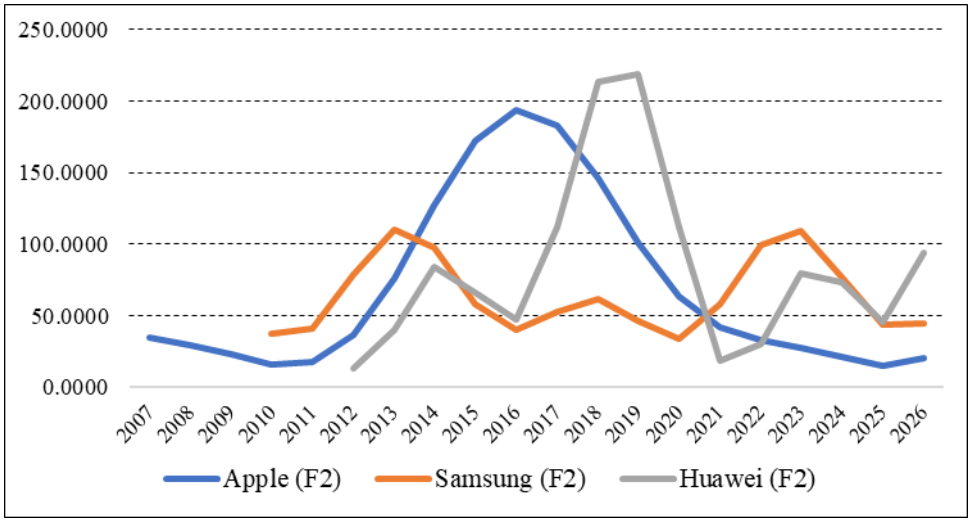

Figure 9. Fourier Forecasting for three family product life cycles.

Gaussian forecasting family product life cycles for three brands are shown in Figure 10. Unlike Fourier forecasting, Apple peaked in 2016 and then entered a brief decline. It rebounded in 2018 and reached another peak in 2019 and 2020, a peak nowhere near that of 2016. The reason is that from 2019, iPhone released the new iOS13 system, which brought the dark mode because of the cancellation of the 3D-touch button. Of course, usage rate of this function was not high, but some consumers responded that using the button can be a crash. With the removal of the 3D-touch button, consumers' expectation for the iPhone11 increased and sales of the iPhone11 soared. The Gaussian forecasting of family product life cycles for Samsung and Huawei is similar to that of Fourier, but the forecasting for Apple and Huawei are close to zero after 2024. Therefore, it is reasonable applying Fourier forecasting for three family product life cycles.

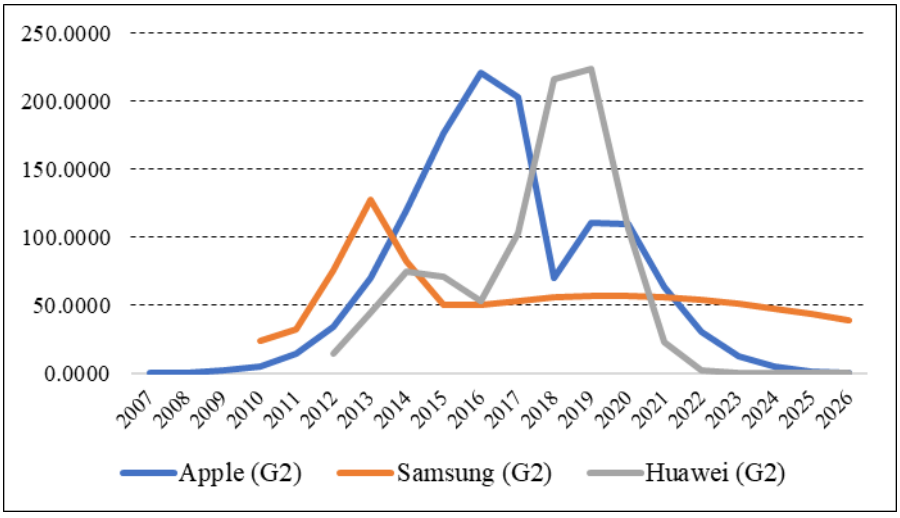

Figure 10. Gaussian Forecasting for three family product life cycles.

5. Conclusion

Based on the product life cycle theory, this paper analyzes the new product replacement trend of Apple, Huawei and Samsung, and concludes that the replacement of new products includes self-replacement and

brand family replacement. The self-replacement trend of Apple's new products is relatively regular, among which iPhone6 series has the longest life cycle so far. The replacement trend of the family peaked in 2016, and then showed a gradual decline. The frequency of self-replacement of Huawei's new products is too fast, resulting in a very short product life cycle. The development trend of the whole family peaks in 2018 and 2019, with great fluctuation, but gradually tends to pick up in recent years. The self-replacement of Samsung's new products is also too frequent, and the development trend of the family has not made a greater breakthrough since its peak in 2013. The results conclude that self-replacement is critical to the family product life cycle to maintain the mature period. However, the new products of self-replacement ought to be the breakthrough innovation that can truly sustain the life cycle.

To sum up, customization and the innovation of e-services have direct impact on brand equity, which along with technology leadership that create direct impact on customer loyalty (Waris and Szczerbicki, 2016). Apple might consider lowering the price of new products and the threshold for consumers to purchase iPhone for sales increase. Focusing on other products, such as Mac laptops and iPods, during a downturn and giving the iPhone a cooling off period might lead to better sales before the next release of a new iPhone. Huawei, however, should pay more attention to the research of innovation rather than blindly launching new products that changes the appearance or upgrade the system to maintain a longer product life cycle. It is also true for Samsung along with quality improvement of new products to make a greater breakthrough in sales.

References

1. Arruda-Filho, E. J. M., & Lennon, M. M. (2011). How iPhone Innovators Changed Their Consumption in IDay2: Hedonic Post or Brand Devotion. International Journal of Information Management, 31(6): 524-532
2. Atashfaraz, M., Hossein, M., & Abadi, H. S. (2016). Impact of E-Service Innovation on Brand Equality and Customer Loyalty in Samsung International Corporation. Procedia Economics and Finance, 36: 327-335.
3. Finger, J. (1975). A New View of the Product Cycle Theory. Review of World Economics, 111(1): 79-99.
4. Guo, Y. L. (2021). Huawei Company Development Strategy Research (Unpublished Master's Thesis). Beijing: Beijing University of Posts and Telecommunications.
5. Kim, J. H., Lee, H. J., & Lee, J. G. (2020). Smartphone Preferences and Brand Loyalty: A Discrete Choice Model Reflecting the Reference Point and Peer Effect. Journal of Retailing and Consumer Services, 52: 101907.
6. Redda, E. H., & Shezi, N. E. (2019). Antecedents of Customer Satisfaction and Brand Loyalty of Smartphones among Generation Y Students. Polish Journal of Management Studies, 20(2): 441-453.
7. Shivankar, S. D., & Deivanathan, R. (2021). Product Design Change Propagation in Automotive Supply Chain Considering Product Life Cycle. CIRP Journal of Manufacturing Science and Technology, 35(1): 390-399.
8. Tang, H. L., Zhang, C. Q., Du, B. Y., Chen, Y. J., & Dong, Z. Y. (2016). An Analysis of the Influence of Electronic Product Upgrading on College Students in the Internet Era-Taking iPhone as an Example. Modern Business, 9: 169-170.
9. Tavani, S., Billi, A., Corradetti, A., Mercuri, M., Bosman, A., Cuffaro, M., Seers, T., & Carminati, E. (2022). Smartphone Assisted Fieldwork: Towards the Digital Transition of Geoscience Fieldwork Using LiDAR-equipped iPhones. Earth-Science Reviews, 227: 103929.
10. Vernon, R. (1966). International Investment and International Trade in the Product Cycle. The Quarterly Journal of Economics, 80(2): 190-207.
11. Waris, M. M., Sanin, C., & Szczerbicki, E. (2016). Smart Innovation Management in Product Life Cycle. Information Systems Architecture and Technology, 429: 183-192.
12. Wells, L. T. J. (1968). A Product Life Cycle for International Trade? The Journal of Marketing, 32(3): 1-6.
13. Wieser, H., & Tröger, N. (2018). Exploring the Inner Loops of the Circular Economy: Replacement, Repair, and Reuse of Mobile Phones in Austria. Journal of Cleaner Production, 172: 3042-3055.
14. Williams, M. (2015). iPhone6 Sales in China Lead to Another Record Apple Quarter. Macworld, July: 9-9.
15. Wu, Q. Q. (2021). Research on the Mode of Enterprise Reverse Innovation-Taking Huawei Technologies Co., LTD as an Example. Modern Business, 32: 22-24.
16. Yan, X., & Huang, M. Y. (2020). Leveraging University Research within The Context of Open Innovation: The Case of HUAWEI. Telecommunications Policy, 46(2): 101956.

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