Ph. D. Dissertation in Engineering

Peripheral Innovation in Technology Management

: From Phenomenon to Theory

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Abstract

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The locus of innovation can be found in either a product's core components (e.g., chemical composition in cosmetics) or peripheral components (e.g., makeup sponges in cosmetics). Most of the research on product innovation has focused on core components because changes and improvements in the peripheral components were believed to have only a minor effect on overall innovation. However, there is growing evidence that revolutionary products can be driven by innovating peripheral components. For example, Nintendo's Wii transformed the video game console industry by embedding motion–sensing technology into the controller—a peripheral component. Other than high–tech industries, peripheral innovation can be found even in mature industries. Teeth–whitening

strips and hydrogel masks are two representative examples. In each case, the peripheral component (i.e., the flexible plastic strip for teeth–whitening strips and the polymeric material for hydrogel masks), not the core component, was a primary driver for demand creation and differentiation.

In innovation literature, peripheral innovation has been neglected, despite the potential for creating market–changing products. Recognizing the lack of research on peripheral innovation, this dissertation aims to investigate the phenomenon of peripheral innovation and develop a theoretical framework for it. To this end, this thesis presents a rationale for the significance of peripheral innovation, refines the existing innovation framework to include peripheral innovation, and explores the systematic approach to implement a powerful peripheral innovation.

To demonstrate the potential of peripheral components as a source of creating powerful innovation, Chapter 2 illustrates peripheral innovation in practice. Focusing on the different methods of innovating peripheral components, this chapter shows that peripheral innovation can be implemented by (1) replacing the old materials, (2) modifying the prior forms, and/or (3) adding components to the existing product system.

Chapter 3 further analyzes peripheral innovation and places it in the technology management literature, based on the concept of complementarity and the hierarchical structure of product systems. Concentrating on the complementarities within a product, or the interrelated relationship between core and peripheral components, this chapter proposes a more refined innovation framework that can reflect the relation between core

and peripheral components. Building on the discussion and analysis in this chapter, three research propositions for powerful peripheral innovation are presented: (1) creating synergy between core and peripheral components may enhance the impact of peripheral innovation; (2) exploring the applicability of peripheral components to solve customer hassles from the beginning of the innovation process may enhance the impact of peripheral innovation; and (3) highlighting categorical attributes of peripheral components may enhance the impact of peripheral innovation.

The following two chapters investigate a specific peripheral innovation case in the cosmetics industry. In order to verify these research propositions, qualitative case studies were conducted on the cushion compacts invented by AmorePacific, Korea's top cosmetic firm. More specifically, research propositions 1 and 2 are verified in Chapter 4 by analyzing the new product development (NPD) process of AmorePacific's Air Cushion Sunblock, while proposition 3 is verified in Chapter 5 by examining the firm's marketing strategy for its overall cushion compacts.

AmorePacific's cushion compact is a radical innovation which created a significant competitive advantage through peripheral innovation. By integrating makeup sponges (i.e., peripheral components) with cosmetic emulsions (i.e., core components), cushion compacts offer an ingenious way to deliver makeup formula. Out of $4.8 billion of the consolidated revenue of AmorePacific Group in 2015, about 15% was generated from this single product category. Therefore, it is relevant to study the case of Air Cushion Sunblock and AmorePacific's overall marketing strategy for cushion compacts in

order to investigate how a powerful peripheral innovation can be achieved.

AmorePacific's Air Cushion Sunblock—the world's first cushion–type cosmetics providing UV protection, foundation makeup, and brightening skincare in one product—eliminated a number of customer hassles, when launched in 2008. In developing this innovative product, AmorePacific particularly concentrated on identifying structural constraints generated by the intrinsic characteristics of the core components; emulsions are easy to apply lightly but inconvenient to carry whereas balms are convenient to use but dull and heavy. Light texture, high portability, and convenience of use were conflicting benefits that were seemingly unable to be delivered by a single product. AmorePacific clearly understood the dilemma rooted in the core components and tenaciously sought to fix the problem in a creative way.

Inspired by a stamp pad made with an ink–saturated sponge–type material, AmorePacific realized that an emulsion sunblock could also be retained in a compact without leakage by using a porous sponge to control the fluidity of the emulsion. After a lengthy search for suitable materials and appropriate technologies, the company developed Air Cushion Sunblock, a multifunctional sunscreen that offered the benefits of liquid foundation (i.e., light and even application) and a makeup compact (i.e., portability and convenience of use). After the product launch, AmorePacific continuously endeavored to improve the key technologies for cushion compacts with a special attention to strengthening the synergy between the core and peripheral components. For example, the company strove to stabilize the filling operation and continuously upgraded the

sponges. All these research and development (R&D) efforts and technological improvements served as a firm foothold for the company to expand the cushion–related technologies to other brands and to release more advanced and diversified products.

Pursuing the product extension strategy aggressively from 2012, AmorePacific strategically repositioned cushion compacts from sunblock into foundation makeup. An analysis of user behavior suggested that they were perceived as a substitute for foundation or BB cream instead of sunblock. Repositioning the products based on user behavior dramatically enlarged the customer base for cushion compacts and eventually established them as a new makeup category. The product labeling strategy that highlighted the product's categorical attributes also contributed to the success of cushion compacts. As of May 2016, AmorePacific had 54 cushion–based product lines under 13 in–house brands. By consistently labeling the 54 product lines with the descriptive categorical cue word "Cushion," the firm succeeded in imprinting on consumers' minds the meaning of the word as a makeup product, not as a throw pillow in a conventional sense.

Derived from the case studies on AmorePacific's cushion compacts in Chapter 4 and Chapter 5, five principles that firms can follow to implement peripheral innovation are summarized in Chapter 6. First, identify customer hassles latent in the core components. Second, resolve these hassles by improving usability through peripheral components. Third, create synergy between the core and peripheral components. Fourth, eliminate cost burdens associated with changes to peripheral components. Finally, highlight the categorical attributes driven by peripheral components in communicating

the new concept and benefits of peripheral innovation.

The main theoretical contribution of this dissertation is the development of a typology for peripheral innovation. To the best of my knowledge, it is the first thesis that comprehensively analyzes the phenomenon of peripheral innovation and examines different methods of revolutionizing peripheral components to categorize them. This typology can function as a rationale for the significance of peripheral innovation hitherto neglected. This dissertation also contributes to the literature on complementarities, especially on complementary assets. While most research on complementary assets has primarily concentrated on the complementarities across the value chain, this dissertation expands the scope of inquiry beyond its traditional focus by addressing the interconnected and interdependent relationships between product components. Another important contribution of this dissertation is a more refined innovation framework that includes peripheral innovation. The approach of employing a hierarchical–systems perspective that reflects the locus of innovation offers a new perspective to help to recognize the potential significance of peripheral components, which has been largely neglected in the previous innovation literature.

Keywords: peripheral innovation, complementarity, hierarchical systems, usability, categorical differentiation

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Chapter 1. Introduction

1.1 Background

Every year, thousands of new products are launched to the market. However, not many of them prove to be successful. New products are estimated to fail at a rate of between 40% and 90% (Gourville, 2006). Radically new products as opposed to incrementally new ones tend to raise the chance of failure even more. Still, many companies stake their competitive advantage on continuous innovation as they believe that product innovation can have a significant impact on performance and create a firm foundation for its sustainable growth.

Generally, firms focus innovation on the core components of their products (e.g., chemical composition of cosmetics), believing that improvements in those elements offer the largest potential payoff. However, focusing on seemingly trivial elements, i.e., "peripheral components" of products can make significant difference as well. For example, AmorePacific, Korea's top cosmetic firm, generated a significant competitive advantage from just a single product category called "cushion compacts," which offer an ingenious and more convenient way to deliver liquid foundation by innovating peripheral components—makeup applicators such as sponges and puffs. Out of $4.8 billion of the consolidated revenue of AmorePacific Group in 2015, about 15% was generated from

cushion compacts alone.

As is clearly shown in AmorePacific's cushion compacts, peripheral innovation is driven by changes and improvements in the peripheral components of a product, not the core components. Peripheral innovation cases are commonplace, especially in product design or packaging. Examples include Tetra Pak's plastic–coated paper carton packages with various easy–to–open features, Yoplait's Go–Gurt, the first processed sweetened yogurt in a tube, or ergonomically–designed kitchen tools such as OXO Good Grips' swivel peeler. However, the scope of peripheral innovation is not limited to product design or packaging. Nintendo's Wii and Samsung's Galaxy Note are great examples to illustrate that peripheral innovation does not mean the simple changes in design or packaging.

The Wii revolutionized the video game console industry by embedding motion–sensing technology into the remote controller—a peripheral component. The simplicity of using familiar body motions to control the game enlarged the customer base, even attracting senior citizens to gaming. Likewise, the success of Galaxy Note smartphones, prior to the Galaxy Note 7, has been driven in part by the S Pen—again, a peripheral component that enables users to interact more easily with the main device[1].

Surely, peripheral innovation does not always guarantee a significant

[1] The Galaxy Note 7, the latest version of Samsung's Galaxy Note line, was permanently discontinued just two months after the product launch because the device had a tendency to spontaneously catch on fire. However, the previous Galaxy Note versions were popular premium smartphones or phablets, and the iconic stylus contributed to their success.

breakthrough. However, there is growing evidence that peripheral innovation can have a significant impact on the market, even in mature industries. A typical example is Procter & Gamble (P&G)'s Crest Whitestrips which combines whitening gel (i.e., the core component) with a teeth–adhering plastic strip (i.e., the peripheral component) to make teeth–whitening at home easier and more convenient. Before the introduction of Whitestrips in 2001, at–home whitening systems relied on a tray to deliver the product. The tray was inconvenient for a number of reasons: it had to be worn for two to three hours to be effective, excess gel could trickle out of the tray, and it required cleaning after every use. Whitestrips removed these hassles by replacing the trays with disposable strips, which reduced the required application time, eliminated excess gel, and changed the landscape of the at–home teeth–whitening market.

Just as Whitestrips revolutionized at–home teeth whitening, another peripheral innovation, hydrogel masks, has driven the rapid growth in the facial mask market in Korea. Traditional sheet masks are made of nonwoven fabrics. They were difficult to adhere to the face and couldn't prevent the embedded skincare ingredients (i.e., the core component) from evaporating. Furthermore, moving around while wearing the mask was difficult as the skincare ingredients oozed from the fabric. Hydrogel masks, by contrast, use translucent, elastic, jelly–like polymer substances, which adhere to the face without oozing, reducing evaporation and allowing customers to move around freely while wearing them. Since the launch of the first hydrogel masks in Korea in 2007, the masks have steadily gained popularity. In fact, driven largely by hydrogel mask products, it is

estimated that the facial mask market almost doubled in size in only three years, from $90 million in 2007 to about $170 million in 2010 (Hong, 2014).

By rethinking peripheral components, each of these products—AmorePacific's cushion compacts, Nintendo's Wii, Samsung's Galaxy Note, P&G's Whitestrips, and hydrogel masks—addressed customer hassles in a way that improved product usability and created demand. In each case, the peripheral component, not the core component, was a primary driver for demand creation and differentiation. Particularly in these blockbuster products, peripheral innovations succeeded because they directly addressed customer hassles—frustrations and complications that limited usability and, hence, the market for a given product. Slywotzky and Weber (2011) pointed out that identifying and eliminating such customer hassles is one of the secrets of creating demand. Therefore, it can be argued that peripheral innovation, if properly considered early on in the development process (i.e., at the idea generation phase or the concept development stage), can deliver a powerful competitive advantage.

It is a common misconception that improvements in peripheral components have little to do with the overall innovativeness of a product. However, the aforementioned cases of peripheral innovation in practice prove that this is not true. Considering all these examples, peripheral innovation deserves our attention. Observing and theorizing about the phenomenon of peripheral innovation would broaden the horizon of our knowledge of innovation and help us to explore new opportunities for inventions and ideas that have never been thought of when focusing only on core innovation.

1.2 Research Purpose and Outline

The objective of this dissertation is to illuminate the importance of peripheral innovation hitherto neglected and investigate how a powerful peripheral innovation can be achieved. So far, most of the research on product innovation has focused on core innovation. Although a few scholars have identified the potential of peripheral innovation, it has been largely eclipsed by core innovation and received little attention from academia. Recognizing the lack of studies on peripheral innovation, this dissertation aims to investigate the phenomenon of peripheral innovation and develop a theoretical framework for it. To this end, this dissertation presents a rationale for the importance of peripheral innovation, refines the existing innovation framework to include peripheral innovation, and explores the systematic approach to implement a powerful peripheral innovation.

For this purpose, qualitative case studies were conducted on the new product development (NPD) process of AmorePacific's Air Cushion Sunblock and the firm's marketing strategy for overall cushion compacts. AmorePacific's cushion compact is a radical innovation which created a significant competitive advantage by innovating peripheral components. It not only proved to be a commercial success but also established itself as a popular product category, changing the fundamental makeup routines of Korean consumers. Thus, an in–depth analysis on AmorePacific' NPD and marketing strategy for its unique products would deepen our understanding of peripheral innovation and help us to better grasp the key principles that make peripheral innovation competitive and

sustainable in the market.

The remainder of this dissertation consists of five chapters: analysis of peripheral innovation in practice, the literature review, two case studies of cushion compacts, and the overall conclusion. Chapter 2 defines peripheral innovation, proposes the typology, and provides relevant examples in order to demonstrate the potential of peripheral components as a source of creating powerful innovation. This comprehensive analysis of peripheral innovation in practice introduces the rationale behind the main argument of this dissertation—why the phenomenon of peripheral innovation should be given more attention.

Chapter 3 presents the theoretical background of peripheral innovation and how it fits into the technology management literature. This chapter reviews complementary assets, hierarchical product systems, and the role of peripheral technologies in technological evolution. Based on the concept of complementarity and the interdependent relationship between core and peripheral components within hierarchical product systems, a more refined innovation framework to include peripheral innovation is developed and three research propositions to achieve powerful peripheral innovation are formulated.

Then, the following two chapters investigate a specific peripheral innovation case in the cosmetics industry in Korea to verify the research propositions. Chapter 4 studies the NPD process of Air Cushion Sunblock, the world's first cushion–type cosmetics product utilizing a makeup sponge (i.e., the peripheral component) as its key delivery mechanism. While the main focus of this chapter is on the NPD process from a

technological perspective, Chapter 5 concentrates on AmorePacific's marketing strategy for cushion compacts in general and examines how they have been established as a new makeup category. Through this dual approach, this dissertation assesses peripheral innovation from both dimensions, technology and market.

Finally, Chapter 6 summarizes five principles that companies can follow in order to implement a powerful peripheral innovation and provides the academic contributions of this dissertation. Limitations and suggestions for future research are also presented in this chapter.

Chapter 2. Peripheral Innovation in Practice

2.1 Definition of Peripheral Innovation

Products are generally composed of subcomponents. For example, a chair can be broken down into several parts such as a seat, legs, a backrest, etc. The parts of a ceiling fan include blades, a motor, a remote control system, and so on. An airplane is a combination of numerous subsystems (e.g., the fuselage, wings, the empennage, the propulsion system, landing gears, etc.) that can be separated again into subcomponents: for instance, the propulsion system consists of the engine, propellers, propelling nozzles, and others while the engine itself can be decomposed further into many subcomponents.

Each component or subsystem of a product is of unequal importance in function or concept (Clark, 1985). Some are more essential or "core" to the product's intended function or its basic purpose. Clark (1985) noted that core subsystems have system–wide effects on the overall performance of products, arguing that "the choice of a core concept creates a set of given conditions with which other parameters must deal…[and] establishes the agenda for a product's technical development within a particular functional domain" (p. 243). In a similar vein, Murmann and Frenken (2006) focused on the number of functions or the service characteristics that will be affected by changes in the components. Borrowing from the biological concept of "pleiotropy," they

distinguished between core components (i.e., high–pleiotropy components) and peripheral components (i.e., low–pleiotropy components) based on how many functions these components can affect.

Subsystems are also different in their degree of centrality or interdependence. Tushman and Murmann (1998) and Tushman and Rosenkopf (1992) stated that core subsystems are tightly connected to other subsystems and peripheral subsystems are weakly connected to other subsystems. Gatignon, Tushman, Smith, and Anderson (2002) further elaborated on their definition by highlighting the interdependent nature between subsystems, adding that "core subsystems are…more interdependent with other subsystems…[while] peripheral subsystems are less interdependent with other subsystems" (p. 1106).

Meanwhile, Ma, Gill, and Jiang (2015) argued that optionality and detachability are two defining characteristics of peripheral components and used these features to distinguish between core and peripheral components. In their study, peripheral components are operationally defined as "components that offer discretionary utility and can be physically separated from the base product," and consequently "product components that are built into the base product, whether they serve essential or nonessential functions, are… not peripherals" (p. 310). Their definition is clearly contradictory to prior definitions, especially Gatignon et al.'s (2002) definition which emphasizes the interdependency between subsystems.

One major drawback of this approach (i.e., only focusing on the ability to operate

independently and separately) is that it is quite a restricted perspective. According to this definition, rear–view mirrors or windshield wipers, for instance, cannot be categorized as peripheral components because they are attached to an automobile—the base product. However, the same components can be classified as peripheral components in terms of prior researchers' definitions. Since Ma et al.'s (2015) operational definition of peripheral components makes the scope of our discussion too narrow, this dissertation decides to disregard their proposed criteria. Consequently, the relevant criteria to judge whether a subsystem is core or peripheral from the existing literature can be summarized as (1) its impact on the overall product performance and (2) the strength of the linkages between subsystems.

Gatignon et al. (2002) also argued that innovation can be assessed based on its locus—whether the technological alterations are made at the core components of a product or at the peripheral components. Then, peripheral innovation can be described as innovation which is driven by changes or improvements in peripheral components. Peripheral components can be defined as (1) those that are less associated with performance impact on the overall product, and/or (2) loosely coupled to other subsystems but (3) still necessary for the product to offer its full commercial value. The first and second conditions of peripheral components are based on the existing literature, while the third is introduced in this dissertation in order to clearly highlight the interdependency between core and peripheral components which is lacking in Ma et al.'s definition of peripheral components. Furthermore, it can help to distinguish the

interdependent relationship between components in a single product from the complementary relationship between a pair of complements.

In discussing peripheral innovation, it is important not to confuse the relationship between core and peripheral components (e.g., engines vs. rear–view mirrors for cars) with the relationship between different complementary products that can be used separately and independently (e.g., washers vs. dryers). The former relationship bears a similarity to the latter in that both are characterized by interdependence or interrelatedness. However, components and complements are basically two different things, especially from the perspective of commercial value to end customers. For example, the value of washers will be enhanced when they are used in conjunction with dryers. However, even if either of them is used alone, the commercial value will not be damaged. On the contrary, the commercial value of cars will be severely damaged if they are not equipped with peripheral components such as rear–view mirrors.

Another thing to note in considering peripheral innovation is that the importance of peripheral components in a new product system can change as a result of technological innovation (Table 1). For example, makeup sponges are peripheral components in most cosmetics. However, the specific sponges utilized in AmorePacific's cushion compacts are as equally important as makeup formula—the conventional core component. Likewise, while the seats in traditional movie theaters are nonessential to screen a film, the motion–enabled seats at 4DX movie theaters[2] are integral in supplying a variety of special effects

[2] The 4DX technology was developed in 2009 by CJ 4DPlex—a subsidiary of Korea's largest multiplex

such as seat motion, wind, and scents.

[Table 1] The dynamic nature of peripheral components

The relative status of peripheral components	**Illustrative examples of peripheral components in products**		
	Sponges	**Seats**	**Watchstraps**
I. Subordinate to Core	conventional compacts	Conventional movie theaters	conventional quartz watches
	↓	↓	↓
II. Equivalent to core	cushion compacts	4DX theaters	Swatch watches
			↓
III. Superior to core			smart watches (smart straps)

The technological innovation in the watch industry dramatically shows how a previous peripheral component can be completely transformed and finally can offer new benefits which are technologically superior to the core component. For centuries, the watch has remained pretty much the same from a technological perspective. It was basically a product developed through mechanical engineering. However, in the 1970s, Japanese companies started to introduce new technologies, including electric, electronic,

cinema chain, CJ CGV. By combining the traditional movie experience and the thrills of theme parks, 4DX offers a unique cinematic experience: the chairs which are equipped with motion simulators in sync with the storyline of movies help the audience to be more immersed in the movie's plot.

digital and quartz technology, to the watch movements—the core components of watches—and began to mass–produce cheap quartz watches, which seriously threatened the Swiss watchmakers characterized by a high standard of craftsmanship (Landes, 1983: Glasmeier, 1991).

Then, SMH (i.e., the current Swatch Group) revitalized the Swiss watch industry by revolutionizing cases and straps—once peripheral components. Through developing inexpensive plastic wrist watches featuring a variety of colorful styles and attractive designs, the company transformed the consumer perception of wrist watches from functional items into fashion accessories (Dell'Era, Marchesi, & Verganti, 2010) and changed the main battlefield of the watch industry from the movements to plastic cases (Tushman & Murmann, 1998).

The evolution of innovation in the watch industry does not stop here. As wearable technology develops, watch straps these days are utilized as a technology–embedded platform. For instance, Innomdle Lab, a spin–off startup of Samsung, recently developed SGNL, a smart strap which enables you to make phone calls with your fingertip. If you put your finger to your ear, conversations are transmitted from your wrist through your fingertip to your ear. This smart wristband is interchangeable even with the straps of traditional watches so that it can simply transform any watch into a "smart watch" just by replacing the old strap with SGNL. This is a representative example of how a once peripheral component can broaden the traditional boundary of what core components can offer so that their functionality becomes superior to that of the original core component.

2.2 Typology and Examples of Peripheral Innovation

It is true that many breakthrough innovations are driven by the improvements in the core components of a product. For example, the propulsion system is a core subsystem of aircrafts. Thus, whether airplanes are propeller planes or jet aircrafts, or whether they use piston engines or gas turbines is directly related to core innovation. Likewise, the evolution of the powertrain of automobiles from internal combustion engines to hybrid or battery–powered systems is a series of innovations characterized by changes in the core components of cars. The endless effort to improve the performance of the central processing unit (CPU) in the computer industry is also interpreted as core innovation activities. Considering the epoch–making advancements in these technology–driven industries, it is undeniable that core components are the main battlefields where most companies focus in order to make breakthroughs.

However, some product innovations, especially in the consumer goods industry, are mainly driven by a series of peripheral innovation. The facial sheet mask from the cosmetics industry is a prime example. Until the mid 2000s, most sheet masks in Korea were composed of cotton–based non–woven fabrics soaked in various hydrating ingredients. Then in 2007, peripheral innovation occurred: polymeric materials replaced the traditional cotton sheets. The change of the material used as the delivery mechanism led to the creation of hydrogel masks. This invention contributed to the rapid growth of the entire facial mask market in Korea. The technological evolution of sheet masks is still

ongoing. For example, a bio cellulose mask made from bacteria fermented with coconut water is now emerging as a new alternative to hydrogel masks or traditional sheet masks. The superior hydrophilic characteristic of bio cellulose enhances the fluid–holding capacity of the sheet material and the extremely fine fibers help the ingredients to penetrate deeply into the skin. Again, the focus of R&D is on the sheet material—the peripheral component. The conventional sheet masks are undergoing peripheral innovation as well. For instance, Estée Lauder recently introduced a foil–backed dual structure to its sheet masks: on top of the cotton sheet layer which holds the concentrated serum, a foil layer is added so that it can function as a protective barrier to keep the serum from evaporating and help it to penetrate much deeper and faster into the skin.

Similarly, the tampon market is also characterized by a chain of peripheral innovation. The first commercial tampons in the modern sense were developed by Tampax in 1936 when it introduced the patented applicators to the internal absorbents—the core components. Thanks to the "tube–within–a–tube" applicators made of cardboard, Tampax made a breakthrough in the feminine hygiene products market and remained the market leader for several decades. Then, in 1973, Playtex invented plastic applicators and created a new market segment. Since plastic applicators were much easier and more comfortable to insert than cardboard ones, Playtex quickly eroded the market share of Tampax. Tampax was later acquired by P&G in 1997, and after eight years, the company launched a new product called Tampax Pearl—plastic tampons characterized by a soft, rounded tip to help a smoother insertion, an anti–slip contoured grip to make it easier to

hold, and a uniquely braided string to capture any overflow. By modifying multiple aspects of the peripheral components, Tampax Pearl was able to regain its lost market share (Lafley & Charan, 2008).

These two examples demonstrate that even in a mature industry, market–changing innovation can be created through improving various characteristics of peripheral components. They also show that the common methods of innovating peripheral components can be roughly categorized into three groups: (1) replacing the old materials (e.g., substituting non–woven fabrics with polymeric materials or bio cellulose in facial sheet masks); (2) modifying the prior forms (e.g., designing the tip of the plastic tampon applicator in a more rounded shape); and (3) adding components to the existing product system (e.g., adding a foil layer to the conventional facial sheet masks). Each method is not mutually exclusive and can be mixed together. Given that the focus of this dissertation is to explore how to implement peripheral innovations in developing new products, this approach is useful because it highlights the specific methods of innovating the peripheral components (Table 2).

[Table 2] Key methods of innovating peripheral components

I. Substituting Materials	
Examples	**Description**
• Milk in carton packs (e.g., Tetra Pak)	Replaced the old glass bottles with plastic–coated paper carton packages in the mid–twentieth century.
• Instant cup noodles	Utilized a polystyrene cup as a packaging material, a cooker, and a bowl. Created a totally new product category in the instant noodle market.
• Vegetarian soft capsules for drugs or supplements	Substituted the gelatin made from by–products of animals with plant material. Better suited for those who have special needs such as dietary concerns or religious reasons.
• Plastic applicator tampons (e.g., Playtex)	Changed the cardboard materials used in applicators into plastic. Made tampons easier to insert.
• Hydrogel facial masks	Substituted non–woven fabrics with polymeric materials. Enhanced the product quality and usability.
II. Modifying Forms	
Examples	**Description**
• Sanitary pads with wings (e.g., P&G Always Plus)	Introduced winged structure to sanitary pads on the side. Offered additional protection for underwear.

[Table 2] Key methods of innovating peripheral components (continued)

II. Modifying Forms	
Examples	**Description**
• Easy–to–hold handles of cookware, toothbrushes, etc. (e.g., OXO Good Grip, Oral–B Squish Grip)	Larger than normal sized handles, specially designed for kids or users with arthritis, etc.
• Swatch's watch cases and straps	Transformed the perception of wristwatches from functional items into fashion accessories through developing inexpensive plastic wrist watches.
• SamSung AddWash	Introduced a "door within a door" design to front–loading washers. Allowed consumers to put extra laundry even after the wash cycle has started.
• Teeth–whitening strips (e.g., P&G Crest Whitestrips)	Replaced the tray with flexible plastic strips. Made teeth–whitening at home quick and easy.
• Tefal Ingenio, aka "Magic Hands"	Cookware with removable handles characterized by highly space–saving features.
III. Adding Components	
Examples	**Description**
• Sanitary pads with adhesive strips (e.g., Stayfree)	Introduced adhesive strips on the bottom of sanitary pads. Removed the necessity of wearing bulky belts.

[Table 2] Key methods of innovating peripheral components (continued)

III. Adding Components	
Examples	**Description**
• Six–pack carriers for glass bottles (e.g., Coca–Cola bottle carriers)	Coca–Cola's invention in 1923. Encouraged people to take glass bottles of Coca–Cola home and drink Coke more often.
• Cosmetic wipes	Combined facial cleanser with disposable fabrics. Simple and convenient solution to cleanse the face.
• Cushion compacts (e.g, AmorePacific's Air Cushion)	Integrated cosmetic formula with sponges. Enabled portability and light application at the same time.
• Treksta Zero–Tie	Hands–free, self–tying lacing system. Installed a specially–designed buckle at the heel of the shoes.
• Action camcorder accessories (e.g., GoPro)	Detachable equipment to help to get the most out of the action camera depending on the activity.
• Smart covers for mobile devices (e.g., Smart Cover for Apple's iPad)	Installed magnets on the plastic or leather cover. Enabled the auto–unlock feature.
• LG Friends for G5 (e.g., Hi–Fi Plus with B&O Play, CAM Plus)	Separate add–on modules for G5 smartphones. Enhanced the functionality of audio or camera.
• Stylus for phablets or tablets (e.g., S pen for Samsung's Galaxy Note, Apple Pencil for iPad Pro)	Highly responsive digital stylus. Enabled users to be engaged more interactively with the main device.

[Table 2] Key methods of innovating peripheral components (continued)

III. Adding Components	
Examples	**Description**
• AirPods for Apple devices	Wireless headphones that can activate Siri, a built–in intelligent system for Apple smartphones.
• Wii Remote for Nintendo Wii	Controllers equipped with the motion sensing capability to allow users to enjoy the game with physical movements.
• Innomdle Lab's SGNL	Interchangeable smart wristbands which enable wearers to make phone calls with their fingertips.
• Zepp's sensors	Detachable sensors to analyze players' swings. Utilized as smart tools for sports training in tennis, golf, baseball, etc.
• Babolat's Play Pure Drive	Smart tennis racket equipped with motion–detecting sensors at the bottom of the grip.
• 4DX movie theaters	Movie theaters equipped with motion–enabled seats synchronized with a variety of effects.
• In–vehicle Infotainment (IVI)	Integrated hardware/software systems to deliver audio/video entertainment as well as navigation.

2.2.1 Replacing Materials

One way of improving peripheral components is to change the materials used in the product. Substituting materials can improve the price/performance characteristics of products. A representative example is Tetra Pak's plastic–coated paper carton packaging, one of the greatest food innovations of the twentieth century. Until the mid–twentieth century, milk was generally supplied in glass bottles, the fragility of which made milk delivery cost–inefficient. During and after World War II, the manufacturing cost of glass bottles became prohibitively high because of a shortage of raw materials. Naturally, Tetra Pak's invention of the disposable paper cartons for liquid food products in 1952 instantly attracted great attention. Tetra Pak further developed its packaging technology, and about a decade later, launched Tetra Brik—the aseptic packages which made it possible to extend the shelf life of liquids and made the distribution extremely cost–efficient. Consequently, milk glass bottles were rapidly replaced by the superior paper cartons. Today, the carton packaging is used for a variety of beverages from juice to wine, thanks to its advantages (Tetra Pak, 2013).

Another breakthrough innovation in the food industry triggered by replacing the old materials was the creation of instant cup noodles. While Chicken Ramen—the world's first instant noodles invented in 1958—was an example of core innovation, Cup Noodles launched in 1971 was a peripheral innovation. The key to this innovation was a polystyrene cup—a peripheral component. The waterproof, upright container has three

different roles: (1) a packaging material; (2) a cooker; and (3) a bowl. The simplicity and convenience of Cup Noodles opened up a groundbreaking way for people to prepare, cook, and eat instant noodles in the same container. This peripheral innovation sparked the popularity of instant noodles around the world and created a totally different product category, i.e., cup–type noodles (World Instant Noodles Association, 2016).

Similarly, vegetarian soft capsules used in pharmaceutical products and supplements can also be regarded as a peripheral innovation achieved by substituting materials. Traditionally, gel capsules were generally made of gelatin manufactured from the collagen obtained from bovine or porcine organs or connective tissues. Although gelatin is the most common and inexpensive material for capsules, they may not be suited for some consumers, especially people with religious reasons or special dietary restrictions which forbid them to consume any products sourced from animals. Instead, vegetarian capsules made of plant cellulose provide a better alternative to those customers with special needs and are often deemed compatible with Halal and Kosher certifications (Mathur, 2015). Simply changing the previous material enabled the product to be tailored to specific consumer needs which had been previously ignored.

2.2.2 Modifying Forms

Modifying product forms is another popular way of creating technological innovation. The ingenious winged structure which P&G first introduced to Always Plus sanitary pads

in 1986 belongs to this type of peripheral innovation. The patented design of side extensions for panty protectors propelled P&G to the forefront of the feminine care market (Lafley & Charan, 2008). Although wings still remain as peripheral components of sanitary pads, which have nothing to do with the product's basic function (i.e. absorption of menstrual blood), they clearly made a powerful breakthrough by greatly improving product usability.

Another relevant example is Samsung's AddWash[3]—a washer which allows you to put forgotten laundry items into the drum even after the cycle has already started. Drum washing machines are generally front–loading washers, so it is hard to put extra laundry into them while they are in the wash cycle. However, the so–called "door within a door" design in AddWash (i.e., the additional window on the door) makes it easy to add extra items to the washer at any stage, eliminating the need to start all over again just because of forgotten laundry. Launched in September 2015, AddWash instantly became such a hit that it accounted for more than half of Samsung's entire drum washer sales within two months of its release (Kim, 2016). The change from the traditional door

[3] Samsung's AddWash becomes more interesting when it is compared to its competitor, LG's TWINWash which was launched around the same time. TWINWash achieved innovation through focusing on core parts of the washing machine—the SideKick pedestal washer, part of the TWINWash system. This compact–sized washer is supposed to be installed below the existing front–loading washer. Since it can be used on its own or at the same time with the front–loader above, extra laundry items can be added whenever you want, even after the cycle has started. The time–saving feature of SideKick is similar to AddWash, but the way of achieving it is totally different. While TWINWash is a core innovation, AddWash is a peripheral one. Both are receiving great responses from consumers and leading the premium segment of washers at home and abroad (Kim, 2016).

structure to the creative door design added an attractive functionality which was not possible without this innovative change.

Another good illustration of changing the previous structural form for innovation is the cookware of Tefal Ingenio, also known as “Tefal Magic Hands.” In 1996, Tefal launched the Ingenio collection, which features high quality cookware with removable handles—the peripheral components. The composition of components of Ingenio remains basically the same to that of conventional cookware, but the configuration of components can be changed flexibly by the detachability of the handles. The patented removable handles are designed to be freely attached and detached to the main utensils, and are even compatible across the different types of cookware such as frying pans, sauté pans, pots and woks. With the handles detached, the cookware becomes more easily stacked up, which makes the utensils extreme space–savers whether on the kitchen stove, in the cupboard, or in the dishwasher. The handles are still nonessential to perform the product’s basic function (i.e., cooking), but the revolutionary idea of making them detachable makes the cookware more easy–to–use, easy–to–clean, and easy–to–store, which attracts a lot of customers (Tefal, 2012).

2.2.3 Adding Components

Adding additional peripheral components to the existing product system can also drive a breakthrough innovation. Cosmetic wipes are the representative example of this type of

method. Facial cleansers are offered in a variety of forms such as creams, lotions, foams, gels, oils, water, and even wipes. Among different types of cleansers, cosmetic wipes may be the most convenient format of all. By employing a fabric as a medium to deliver the cleansing ingredients, cosmetic wipes function as a simple and convenient solution to cleanse the face and remove make–up. In the hustle and bustle of modern life, cosmetic wipes are gaining more and more popularity.

Sanitary pads with adhesive strips on the bottom also fit this category. Before Stayfree first invented an idea of introducing an adhesive underside to the sanitary pads in 1969, women had to wear a special girdle or a sanitary support belt, which was an unpleasant experience. The invention of adhesive strips which helped pads to stay in place on the underwear set a revolutionary milestone in the history of feminine hygiene products because it liberated women from the hassle of wearing the bulky belt. By the mid–1980s, sanitary belts completely disappeared and all sanitary pads were made to include adhesive strips (Stein & Kim, 2009). The small addition of a seemingly minor component completely replaced the traditional methods and accelerated the adoption of the innovation.

In the footwear industry, Treksta's Zero–Tie outdoor shoes occurred through introducing additional components. The Zero–Tie technology is claimed to be the world's first hands–free lacing system that does not require wearers to bend over to tie up shoelaces, which is especially convenient for those who are pregnant, suffer from knee arthritis, or have mobility issues. It is activated by a specially–designed buckle installed

at the heel of the shoes. You can tighten up your laces while you are standing up straight, just by simply sliding your foot backwards (Treksta, 2016). This additional component created a product that addressed a niche within the existing market.

Babolat's Play Pure Drive, Nintendo's Wii, and Apple's AirPods are good examples of peripheral innovation where digital technologies (e.g., motion–sensing technologies such as accelerometers) are newly incorporated in the peripheral subsystems. Integrated with digital technologies, the conventional devices—whether they are tennis rackets, remote controllers, or headphones—are transformed into intelligent smart devices, pioneering the new frontier of digital transformation.

Detachable peripheral subsystems or accessories can be also regarded as this type of peripheral innovation. For example, Apple's Smart Cover was introduced for the iPad 2 and the later versions of Apple devices. Unlike the old cover for the original iPad, the Smart Cover has interesting technological features: it turns the device on and off instantaneously whenever you open and close the cover, and it connects and aligns itself automatically to the main device when placed nearby. The key to this smart functionality is magnets. By simply installing magnets on the Smart Cover and into the iPad itself, Apple transformed the original iPad case into something more than a protective case.

The action camera accessories also belong to this category of peripheral innovation. Although action cameras themselves are a core subsystem for filming, they are designed to be attached to other equipment such as helmets, surfboards, or snowboards in order to capture the most immersive action footage. Without the right

accessories including mounts, clips, clamps, grips, and monopods, it would be hard to capture the exciting footage. In order to fully exploit the functionality of action cams, the support from accessories that are specifically designed for different purposes is required.

Adding peripheral components in a detachable way is not limited to the IT–related industry. The classic example includes the six–pack bottle carriers first invented by Coca–Cola in 1923. Although it is common nowadays to package beverages in six–packs, it was not the case in the past. According to the company's official website, "the idea of a carton that could help you carry six bottles of Coke at once was a huge breakthrough back in 1923, when Coca–Cola introduced it….The carrier helped encourage people to take bottles of Coca–Cola home and drink Coke more often…The carton was a relatively simple idea that really helped change our business" (Mooney, 2008). Since the packaging in six–pack was light enough to be carried by a housewife and eliminated the clumsiness of carrying individual glass bottles, the idea spread out to other beverages including beers and revolutionized the landscape of packaging in beverages.

In summary, this chapter examines the phenomenon of peripheral innovation in various industries and presents the three ways of implementing peripheral innovation. Each approach may have its own advantages and disadvantages which could vary depending on the industry. However, the aforementioned examples clearly demonstrate the potential of peripheral innovation, no matter what approach is taken. Even though the innovation of peripheral components can be easily seen in many industries, businesses and academics often fail to appreciate that peripheral innovation can be an avenue to

improve products in meaningful ways. In order to help address this misconception, the following chapter builds the theoretical foundation for peripheral innovation.

Chapter 3. Placing Peripheral Innovation in the Existing Literature

3.1 Complementarity

3.1.1 Complementary Assets

In traditional economic theory, the notion of complementarity is closely related to a negative cross–price elasticity of demand. From the perspective of standard price theory, complements can be defined as "two goods for which an increase in the price of one leads to a decrease in the quantity demanded of the other" (Pindyck & Rubinfeld, 2005, p. 23). Typical examples of complements are pancake mix and maple syrup or automobiles and gasoline. Each pair tends to be used together, so a decrease in the price of one increases the quantity demanded for another. For instance, if the price of gasoline increases, its consumption will fall and consequently cause the demand for automobiles to drop as well (Lieberman & Hall, 2004; Pindyck & Rubinfeld, 2005).

Milgrom and Roberts (1990) extended the concept of complementarity beyond the relationship between complementary products. By stating that "The defining characteristics of…complements is that if the levels of any subset of the activities are increased, then the marginal return to increases in any or all of the remaining activities

rises" (p. 514), they recognized the existence of complementarities in management practices in organizations. The presence of complementarities among two or more activities can create synergistic effects and extra gains (i.e., additional pay–offs generated by the combination of activities) as opposed to when they are in isolation (Miravete & Pernias, 2006; Battisti & Iona, 2009; Love & Roper, 2009). This means that increasing the level of any one of a pair of complementary activities raises the marginal benefits and consumption utility of the other. Therefore, focusing on the synergistic effects, complementarities between elements—be they components, products, or any kind of activities—can be described as complementary situations where the combination of elements yields greater value than the sum of the value derived from each element in isolation.

Researchers interested in technology dynamics have studied technological complementarities. Classical examples include the format war between Sony's Betamax and JVC's VHS in the home videocassette recorder (VCR) industry. "A VCR by itself is worthless. Users can employ it only in conjunction with a complementary product, the videocassette, that is designed to conform characteristics of contemporary information technologies, such as the personal computer (PC) and its software programs, compact disc (CD) players and discs, or TV receivers and broadcast signals" (Cusumano, Mylonadis, & Rosenbloom, 1992, p. 64). By analyzing the history of this well–known standardization rivalry, Cusumano et al. (1992) showed that JVC's strategic alignment with producers and distributors of complementary products (i.e. prerecorded

videocassette tapes) was the main reason why the late mover eventually won this battle, despite the technological inferiority of the VHS to the Betamax.

The notion of complementarity is not only relevant to the technological domains at the product level, but also for strategy making at the enterprise level. In the literature on innovation and business strategy, the concept of complementary assets was first introduced by Teece (1986). In his seminal work, Teece defined complementary assets as resources or capabilities that are required to profit from the core technological know–how needed to create a product or service. Typical examples of complementary assets include capabilities such as marketing, sales channels, after–sales support, distribution, competitive manufacturing facilities, and complementary technologies. He suggested that innovator firms need to have an access to complementary assets in order to capture the benefits from their innovations. He also stressed that complementary assets, particularly the ones that are hard to imitate, contribute to firms gaining sustainable competitive advantage.

Complementary assets can be divided into three categories: generic, specialized, and co–specialized. Generic complementary assets are general purpose assets that do not need to be customized to the innovation. Specialized complementary assets are characterized by unilateral dependence between the innovation and the complementary asset while co–specialized ones exhibit a bilateral dependence (Teece, 1986, p. 289). Among these different types of complementary assets, specialized (and co–specialized) complementary assets have been primarily in the spotlight of academia because these

assets are generally valuable and hard to imitate and therefore can serve as a source of competitive advantage (Barney, 1991).

Empirical support for the importance of complementary assets has been found in a number of studies (e.g., Mitchell, 1989, 1991; Tripsas, 1997, Powell & Dent–Micallef, 1997). For example, Mitchell (1989), in his study of the medical diagnostic imaging industry in the US, showed that the ownership of industry–specialized supporting assets can enhance the probability of incumbent firms entering a new subfield. Likewise, Tripsas (1997) illustrated through her detailed analysis of the typesetter industry that the possession of specialized complementary assets may significantly contribute to an incumbent securing the market leadership, despite technological discontinuities. Scholars also have highlighted that complementary assets should be combined within and across companies. Grandori (1997) argued that complementarities are a central driver for interfirm coordination and alliance formation. While distinguishing between explorative technological alliances and exploitative commercial alliances, researchers argued that the main purpose of the exploitative commercial alliances is to leverage specialized complementary assets (e.g., a powerful brand, a strong reputation, well–trained salesforce, knowledge of international markets, etc.) possessed by candidate partners (Rothaermel, 2001; Colombo, Grilli, & Piva, 2006).

For the past several decades, however, most studies on complementary assets have highlighted the non–technological dimension of complementarities. In proposing the dynamic capabilities framework, Teece, Pisano, and Shuen (1997) clearly differentiated

technological assets from complementary assets and argued that the latter assets typically lie downstream. Specifically, Helfat and Lieberman (2002) listed finance, marketing, sales, distribution, logistics, and customer service as examples of complementary assets. Rothaermel and Hill (2005) also treated complementary assets as downstream, market–related activities and considered upstream technological competencies as core assets. Likewise, Fischer and Henkel (2013) focused only on marketing, sales and service activities in exploring the interaction between complementary assets and patents.

In many studies, it has been found that technological capabilities are essential to new product and process developments (e.g., Nelson, 1982; Calantone & di Benedetto, 1988; Roth & Jackson, 1995; Bierly & Chakrabarti, 1996), and critical to the success of new products (e.g., Montoya–Weiss & Calantone, 1994; Song & Parry, 1997). In today's world, technology is becoming more and more complex in nature. As the technology life cycle is getting shorter and the speed of technological development is getting faster, the paradigm for innovation has been shifting from an in–house development model to an open innovation model (Chesbrough, 2003). Consequently, many firms are utilizing technological alliances (Vanhaverbeke, 2006; Neyens, Faems, & Sels, 2010) and technological M&As (Ahuja & Katila, 2001; Sleuwaegen & Valentini, 2006) as strategic tools for innovation. Accordingly, the importance of complementary technologies is increasing. Based on patent analysis in the pharmaceutical, chemical, and electronics industries, Makri, Hitt, and Lane (2010) demonstrated that complementary technologies contribute to the post–merger innovation performance in high–tech, knowledge–intensive

industries by fostering better quality and more novel inventions. Thus, in studying innovation, more attention should be given to the technological aspect of complementary assets, i.e., complementary technologies.

However, in the extant strategy literature, the significance of complementary technologies in the innovation process has not been fully recognized (Teece, 2006). Although Teece (1986) included complementary technologies as one of the complementary assets, they were mentioned briefly and not investigated in detail. Since then, the discussion of complementary assets has been limited primarily to the downstream value chain activities for commercialization. Put differently, complementary technologies per se have not received much attention from academia as most of the discussion and analysis on complementarities has focused on the organizational complementarities for commercialization. Considering the growing importance of technology in innovation, due attention should be given to the complementarities within the upstream level (e.g., R&D) of the value chain where the actual technological product development activities occur.

3.1.2 Complementarities in Innovation Frameworks

The concept of complementarity is closely related to interconnectedness or interdependence. If two (or more) elements have complementarities, this means that they are interconnected with and dependent on each other. Noticing the interdependent nature

of complementarities, Dierickx and Cool (1989) elaborated on the interconnectedness of assets and Christensen (1995) discussed the inter–asset specificity. Thus, in order to exactly understand complementarities, we should pay attention to the interaction and interrelated relationships between elements.

[Table 3] Abernathy and Clark's (1985) transilience map

Market/Customer Linkage	Technology/Production	
	Conserve existing competence	Disrupt existing competence
Conserve existing linkages	Incremental innovation	Modular innovation
Disrupt existing linkages	Architectural innovation	Radical innovation

Abernathy and Clark (1985) developed an innovation framework based on the interconnected assets (Table 3). They divided firms' resources and capabilities required for innovation into two domains—technology/production and marketing—and proposed a framework that classifies innovations by whether the existing competence is strengthened or disrupted by technological changes. In so doing, they introduced the concept of transilience—"[the] capacity [of an innovation] to influence the firm's existing resources, skills and knowledge" (Abernathy and Clark, 1985, p. 5). According to the transilience map that they proposed, technological innovation can be categorized into four types—architectural, revolutionary, niche, and regular innovation. Based on Tushman and

Anderson's (1986) terminology, the first two types of innovations can be classified as "competence–destroying" innovation that makes firms' existing competence obsolete and requires new knowledge or expertise, while the last two types can be regarded as "competence–enhancing" innovation that reinforce the existing competence.

Whereas Abernathy and Clark (1985) noticed the interdependent nature of firms' assets across different functions, Henderson and Clark (1990) zeroed in on the interconnectedness that exists within technological product systems. Technologies can be viewed as systems of interlocking design configurations. Focusing on the linkages between different subsystems (i.e., product components), Henderson and Clark (1990) investigated the dynamic interaction between components and the linking mechanism and developed their own innovation framework. In their influential paper, they classified innovations based on two dimensions—an innovation's impact on the firms' existing "component knowledge" and "architectural knowledge." The former determines core design concepts while the latter determines the configuration of the product system, or product architecture—"the scheme by which the function of a product is allocated to physical components" (Ulrich, 1995, p. 419). Depending on which type of knowledge is affected and to what extent, innovations can be categorized into four different types: incremental, modular, architectural[4], or radical innovations (Table 4).

[4] The meaning of the technical term "architectural innovation" should not be confused. Abernathy and Clark (1985) used the term to refer to a competence–destroying innovation that disrupts the firm's existing competence in both technology and marketing. In Henderson and Clark's (1990) innovation framework, however, it signifies modification of the product architecture by improving the linkages between product components without changing the components themselves.

[Table 4] Henderson and Clark's (1990) innovation framework

Linkage between	Core concepts	
core concepts and components	Reinforced	Overturned
Unchanged	Incremental innovation	Modular innovation
Changed	Architectural innovation	Radical innovation

According to their typology, incremental innovations build on the existing technological knowledge of product components while modular innovations fundamentally change the exiting component knowledge. Both types of innovations do not change the traditional product architecture. Meanwhile, radical innovations transform both the product architecture and the technological knowledge of components whereas architectural innovations change the linking mechanism among key product components but leave the underlying component knowledge untouched.

Through an in–depth analysis of the semiconductor photolithographic alignment equipment industry, Henderson and Clark (1990) demonstrated that architectural innovation can offer firms the opportunity to gain significant competitive advantage in the market. Ulrich (1995) also argued that in developing products, there are a multitude of possibilities in connecting different subsystems to construct the product architecture which can serve as a main driver of firms' performance. "For example, both front–wheel–drive cars and rear–wheel–drive cars employ similar component technologies, but the components interact within the two automobile architectures in quite different ways"

(Christensen & Rosenbloom, 1995, p. 235).

3.2 Hierarchical Systems Perspective

3.2.1 Hierarchical Structure of Product Systems

Although Henderson and Clark (1990) developed a useful innovation framework by noticing the complementarity or interconnected relationships inherent in technological products, they overlooked one important aspect—the hierarchical structure of product systems. Simon (1962) pointed out that most entities in nature—be they physical, biological, social, technological, or otherwise—can be viewed as a complex hierarchical system "that is composed of interrelated subsystems, each of the latter being in turn hierarchic in structure until we reach some lowest level of elementary subsystem" (p. 468). It is then logical to consider products or services as a bundle of nested subsystems or components that are hierarchically positioned and connected to each other through interdependent linking mechanisms (Alexander, 1964; Clark, 1985; Henderson & Clark, 1990; Sanchez & Mahoney, 1996; Meyer & Seliger, 1998; Baldwin & Clark, 2000).

Conceptualizing technology as hierarchical systems, Tushman and Rosenkopf (1992) classified products, based on the degree of complexity, into four categories: non–assembled products, simple assembled products, closed assembled systems, and open assembled systems. Non–assembled products include aluminum, paper, steel, or springs.

Since they have no separable components, they are created by multiple sub–processes that are sequentially interlinked. Simple assembled products are composed of distinct subsystems. For example, guns are made up of barrels, locks, and stocks, etc. Assembled systems are much more complex due to the interdependency of the linkages or interfaces between individual subsystems or modules. Depending on whether the set of subsystems has a clear boundary or not, assembled systems can be divided into two classes—closed vs. open. Closed assembled systems include watches, bicycles, and automobiles while telephone networks, railroad systems, and power systems exemplify open assembled systems (Tushman & Rosenkopf, 1992, pp. 325–331).

Building on Tushman and Rosenkopf's (1992) typology of technological artifacts, some researchers have proposed the notion of complex product systems (CoPS) to specifically refer to the engineering–intensive characteristics of assembled systems (Hobday, 1998; Miller, Hobday, Leroux–Demers, & Olleros, 1995; Hobday, Rush, & Tidd, 2000; Brusoni, Prencipe, & Pavitt 2001). These researchers define CoPS as multi–component products characterized by multi–technology. They mostly correspond to the open assembled systems, "the most complex form of technological systems"(Tushman & Rosenkopf, 1992, p. 333). A high degree of precision and customization is often required to produce CoPS. Consequently, the technological evolution of CoPS does not follow the traditional innovation model characterized by the natural selection and variation process of the market in the early stage of innovation (Miller et al. 1995).

Scholars have also noted that there are two kinds of hierarchies: a control

hierarchy and a controlled (or inclusionary) hierarchy (Wilson, 1969; Mesarovic, Macko, & Takahara, 1970; Murmann & Frenken, 2006). While the controlled hierarchical system is primarily composed of functional or physical components to be controlled, the control hierarchical system is a combination of rules or coordination principles that control the system. According to Mesarovic et al. (1970), control hierarchies can be roughly divided into two layers—local decision units and coordinator units: the former controls the specific components to achieve local goals, the latter coordinates multiple subsystems and addresses higher–level goals which affect much broader portions of the system. The local decision units are subordinate to coordinator units, and the coordinators to other coordinators, which results in a multilevel hierarchical architecture.

This dual approach may not seem to be of much use when considering simple products because the local decision units in control hierarchies generally correspond to the functional subsystems that are to be controlled. That is why most literature in organizational theory does not distinguish between the controlled/control hierarchies. However, in the context of complex systems, the local decision units are often not neatly coupled with the specific subsystems. Rather, they often extend the boundaries between subsystems to make complex decisions (Lee & Berente, 2012). Therefore, it can be argued that the dual–hierarchy perspective is more useful to understand the complicated and interrelated decision making process of complex systems, or CoPS.

The hierarchical systems perspective has an important implication for assessing innovation because “a modular innovation at one level in the hierarchy can clearly be an

architectural or radical innovation at a lower level in the hierarchy (Murmann & Frenken, 2006, p. 938). Since the trajectories of technological evolution can be observed at each level of the system hierarchy, a discontinuous development at a lower level subsystem may translate into incremental development at the higher level (Rosenkopf & Nerkar, 1999).

3.2.2 Core–Peripheral Relations in Hierarchical Systems

Clark (1985) argued that numerous components of a system are of unequal importance in function or concept, adding that an element located at the top of the functional hierarchical domain dominates all other components. He defined such an element as a "core" concept, and the parts dominated as "subsidiary" parameters. By identifying unequal significance between components, he recognized that some subsystems are more essential to the product and can have a system–wide effect. In a table lamp, for example, a light bulb and the power source are central subsystems while a lamp shade is a peripheral component. In airplanes, jet engines are essential subsystems while the in–flight entertainment (IFE) system is clearly peripheral. Although IFE may be quite important in terms of customer satisfaction, the airplane can absolutely fly without it, but not without engines. Likewise, a table lamp without a lampshade will certainly perform its intended function of giving light.

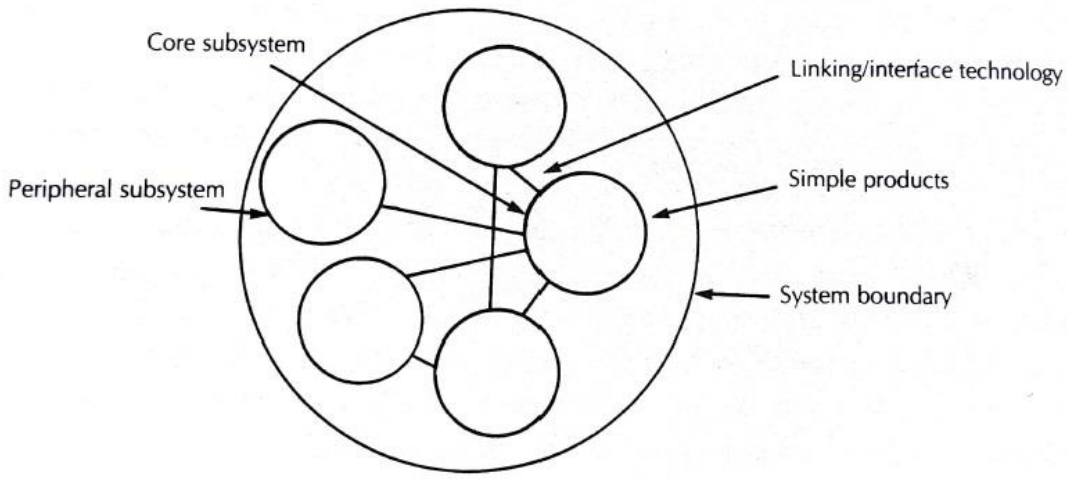
Tushman and Rosenkopf (1992) and Tushman and Murmann (1998) further

investigated the internal structure of the hierarchical system and differentiated between "core" and "peripheral" subsystems (or components) based on the linkages between subsystems (Figure 1). Noticing the interdependency between product subsystems, or put differently, the complementarities embedded in product systems, they argued that the more internal linkages a component has, the more central it becomes to the product system.

Although researchers have pointed out the distinction between core and peripheral components at the subsystem level, most literature on innovation has failed to distinguish between these two (Ma et al., 2015), analyzing the effects of innovation at the product rather than component level. "For example, Myers and Marquis' (1969) pioneering work on innovation characteristics defined incremental and radical at the product level (e.g., printers). More recently, Green et al. (1995) developed multiple dimensions for radical/incremental, but apply these dimensions to product characteristics. Similarly, with few exceptions (e.g., Rogenkopf and Nerkar 1999), patent data have been extensively used to assess the degree of innovation at the product or invention level of analysis (e.g., Podolny and Stuart 1995, Flemming 2001)" (Gatignon et al., 2002, p. 1107).

The failure to discriminate between core and peripheral components within products also causes the confusion about the unit of analysis. Many researchers have primarily focused on core components while arguing that they have studied product innovation. For example, Tushman and Anderson (1986) and Anderson and Tushman (1990) all collected data on the core components and used them to discuss the product as

a whole. In short, previous literature neither distinguished between core and peripheral components, nor paid attention to the latter as much as to the former. Consequently, research on innovation driven by peripheral components is lacking.



[Figure 1] Illustration of the relation between core and peripheral subsystems

Source: Adapted from Tushman & Rosenkopf (1992)

The lack of literature focusing on peripheral subsystems or components is primarily because changes in peripheral components have been thought of as minor improvements that can have only a limited effect on the product system (Tushman & Murmann, 1998; Gatignon et al., 2002). Furthermore, peripheral subsystems or components are often regarded as product accessories or auxiliary devices attached to the main products (Kahn, 2001), as is evident in common phrases such as “computer peripherals” or “peripheral devices.” Due to this add–on characteristic of peripheral

subsystems, designing them is usually considered as an activity that happens in the later stage of the product development process, after the core design concept is finalized in the early stage of the process (Ulrich & Eppinger, 1995; Golish, Besterfield–Sacre, & Shuman, 2008). For instance, Golish et al. (2008) divided the technology development process into five stages—conceptualization, design and development, prototype testing, production, and lifecycle management—and suggested that peripheral innovations should be considered only in prototype testing. Given less priority in the product development process, peripheral components have been often deemed as nonessential or trivial, which also explains the deficiency of academic literature on them.

The relation between core and peripheral components is not static. Rather, it can change over time as technology develops. What is a core subsystem this year may not remain central to the performance of a product next year. Likewise, what is peripheral today may no longer be trivial for the product's function. The history of watches exemplifies how peripheral components can increase in importance while core components lose their significance. Until the mid–twentieth century, springs had been core subsystems for mechanical watches, but when the quartz movements system was introduced, they no longer remained core to the product and became peripheral. After quartz movements became prevalent, the Swatch Group changed the rules of the game in the low–cost watch market by treating the cases—once peripheral components—as core components. Swatch's injection–molded plastic cases caused system–wide effects to other components and linking mechanisms (Tushman & Murmann, 1998).

Another good example showing the dynamic core–peripheral relation can be found in aircraft engine control systems. Until the 1970s, the most critical component of the engine control system was the hydromechanical engine control unit that was operated by a pilot using a power lever or manual throttle. Back then, the hydromechanical engine control unit was big and heavy and composed of thousands of component parts. Operating the control unit was extremely demanding because pilots had to regulate the fuel flow manually throughout the entire flight. However, the continuous evolution of aviation technology and the introduction of jet engines have transformed this hydromechanics–based engine control unit into an analog electronic system, and eventually a digital system. Digital electronics was not only able to cope with the complex control requirements of jet engines, but also better integrated with other systems such as avionics and enhanced flexibility. In the aircraft engine control system, hydromechanical components are no longer regarded as a central subsystem as they were four decades ago. In contrast, software—once a peripheral component—is now considered as the most important element of the engine control system (Prencipe, 2000, pp. 899–901).

As was clearly shown in Prencipe (2000), the application of digital electronics to control systems has system–level effects. The transformational potential of digital control systems blurs the traditional boundaries between subsystems by linking different subsystems previously separated from each other. In particular, digital control systems nowadays often act as a core integrative system for CoPS such as automobiles and

airplanes by dramatically expanding the breadth and depth of their automated control (Hobday 1998), and perform boundary–spanning roles between different components across the overall product system (Franklin, Powell, & Workman, 1998). Furthermore, they can create an integrative "control" hierarchy in CoPS that further extends its reach and coordinates multiple subsystems within the complex architecture.

When digital technologies are incorporated into a system, they can not only improve its performance but also create numerous new applications. Intelligent sensors, smart software solutions, and high–performance integrated circuits can extend the range and scope of their control, integrate different subsystems in a more creative and efficient way, and inspire novel applications that were not possible in the past. Through these new applications, it becomes much easier for peripheral components to go beyond the periphery of the system and move to the center of the system and function as its core.

Considering the boundary–spanning characteristics of digital technologies, it is logical to question whether the changes or improvements in the peripheral components necessarily have minor or trivial impacts on the entire system. When coupled with digital technologies, the potential of peripheral components can dramatically improve. It is highly likely that digital technologies will continue to rearrange existing hierarchical structures and cause changes in the relations between core and peripheral components.

In order to reflect the status change among components during the evolution of technology, Lee and Berente (2013) subdivided the classes of core components into "preceding core" components (i.e., components that were central to the product

architecture, especially before the emergence of a dominant design) and "subsequent core" components (i.e., components that were formerly peripheral but evolved into core components after the dominant design). The dynamic nature of the core–peripheral relation within hierarchical systems suggests that we should neither limit our attention to core subsystems nor neglect the potential of peripheral ones when we pursue innovations.

3.3 Technological Evolution

3.3.1 Cyclic Innovation Models

Researchers who have noticed the core–peripheral relation between components in hierarchical systems have consistently argued that firms tend to focus on core subsystems in the early stage of product innovation in order to fix the core design concept, and focus on improvements in peripheral subsystems in the later stage of development (e.g., Clark 1985; Ulrich & Eppinger, 1995; Tushman & Murmann, 1998; Murman & Frenken, 2006). The sequential nature of the technological development process bears some resemblance to the cyclical model of technological evolution.

Utterback and Abernathy (1975) and Abernathy and Utterback (1978) proposed a stepwise process of technological evolution. Their descriptive model can be summarized as a transition from a "fluid" period of technological development to a "transitional" stage, and eventually to a "specific" phase. In the initial state, a radical product innovation

emerges, focusing on product performance requirements. In the middle stage, process innovation and incremental innovation occur, emphasizing product variation and differentiation. Finally, in the mature stage of technological innovation, process innovation is emphasized for cost reduction in order to make high–volume production efficient.

Another seminal work with a cyclical perspective for technological evolution is the study by Anderson and Tushman (1990). Their model features an evolutionary process where a technological discontinuity[5] initiates an era of ferment that is punctuated by the emergence of a dominant design[6], followed by a period of incremental technical change that is, in turn, broken by another technological discontinuity. In the early stage of new technological products (i.e., an era of ferment), multiple theories co–exist, with no single

[5] The definitions of technological discontinuities vary among scholars. "Some authors define technological discontinuities in terms of competence changes, others as physical product or process changes, while some define technological discontinuities as changes in the price/performance level" (Ehrnberg, 1995, p. 438).

[6] The concept of a dominant design was pioneered by Abernathy (1978) and Abernathy and Utterback (1978). In their evolutionary model, they explain that a dominant design emerges during the middle (i.e., transitional) stage when the focus of technological innovation shifts from radical to incremental product innovation. A dominant design is not a de jure standard that is officially or legally enforced as an industry standard by the government or authorities. Rather, it is a de facto standard in the market. Although there is no definite yardstick to judge when a single variant or process architecture actually becomes dominant, the market concentration ratio—fifty percent or more of the market—is used as a useful criterion (Schilling, 2005). Dominant designs have been studied in a wide range of industries. For example, automobiles (Abernathy, 1978), glass/cement/minicomputers (Anderson & Tushman, 1990), VCRs (Cusumano et al., 1992), typewriters/electronic calculators/TVs (Suarez & Utterback, 1995), mainframe computers (Iansiti & Khanna, 1995), microprocessors (Wade, 1995, 1996), flight simulators (Miller et al., 1995), disk drives (Christensen, Suarez, & Utterback, 1998), and so on. Although the concept of dominant designs was originally conceived at the product level, it is also applied to a "sub–product" level (Tushman & Murmann, 1998; Murmann & Frenken, 2006).

generally accepted industry standard. Thus, firms in this stage fiercely compete with each other, especially in the domain of product concept designs. After a dominant design emerges, however, the focus of competition shifts from product design to cost effectiveness through economies of scale, and a myriad of process innovations ensue. In the later stage (i.e., an era of incremental change), the product architecture remains stable, at least until the subsequent technological discontinuity happens. To sum up, the emergence of a dominant design marks a watershed between an era of ferment and an era of incremental change, and the period between two technological discontinuities is regarded as a technology cycle.

If we match technology cycles to the core–peripheral relations in hierarchical systems, we can posit that eras of ferment are mainly characterized by innovations in the core components while eras of incremental change feature innovations in the peripheral components. Despite abundant literature on technological discontinuities and dominant designs, most research has focused on innovative activities happening in eras of ferment. This is primarily because eras of incremental change have been regarded as relatively stable as opposed to eras of ferment, which are characterized by intense competition among contending products for an industry standard (Dokko, Nigam, & Rosenkopf, 2012). This disproportionate attention is closely related to the lack of research on innovations driven by changes in peripheral subsystems. Since most of the academic attention has been directed to innovations in the core subsystems in the eras of ferment, innovations in the peripheral subsystems have been underappreciated.

However, a few studies have recently shown that eras of incremental change can actually be quite dynamic and not as stable as previously thought (e.g., Funk, 2009; Dokko et al., 2012; Lee & Berente 2013). For example, Lee and Berente (2013) demonstrated through an in–depth analysis of US patents for automotive emission control systems that improvements in what was once peripheral greatly contribute to strengthening the system's overall performance over time. This implies that the role of peripheral subsystems, contrary to conventional wisdom, may not be trivial during the process of technological evolution.

3.3.2 Peripheral Technologies' Role in Technological Shifts

Stressing the importance of complementary technologies, Teece (2006) stated that they "are implicitly thought of as belonging to private sector firms located somewhere in the marketplace" (p. 1139) and held up roads and service stations for cars as examples of complementary technologies. With these examples, he regarded complementary technologies as something related to the supporting infrastructure for the focal innovation (e.g., airports for airplanes, harbors for ships, etc.). However, he also explained that better batteries for electric vehicles (EVs) or low cost flash memories for digital cameras are complementary innovations driven by complementary technologies. This suggests that he recognized the existence of complementarities within technological products as well. Examples such as batteries for EVs and flash memories for digital cameras signify the

complementarities between the suppliers of components and focal firms integrating these components in the upstream level of the value chain. On the contrary, examples such as roads and service stations for cars refer to the complementary assets existing in the downstream. Although Teece (2006) described all of the aforementioned examples as complementary technologies, they are two different kinds of complementary technologies from a value chain perspective. For clarity, this dissertation refers to the complementary technologies within the same products in the upstream as peripheral technologies in order to distinguish them from complementary technologies across the different levels of the value chain.

Analyzing multi–technology firms' technological competencies, Granstrand, Patel, and Pavitt (1997) illustrated how Ericsson successfully responded to technological change by utilizing its peripheral technologies. Until the 1950s, Ericsson had concentrated on a narrow range of core technologies (electro–mechanical switching and cable transmission technologies). However, in the next four decades, Ericsson continued to diversify its technological competencies into computerized digital switching, and combined its switching technology with the radio transmission technology that had long been treated as peripheral to Ericsson. As a result, Ericsson successfully entered into the cellular mobile communications market when encountering the technological shift from landline telephone systems to mobile telephony (Granstrand et al., 1997, p. 14). Their research shows the importance of peripheral technologies, especially in a period of technological shifts.

Clark (1985) recognized the importance of peripheral subsystems (i.e., subsidiary parameters), although he mainly emphasized the significant impact of core subsystems on innovation. He pointed out that innovations driven by "a new agenda for subsidiary parameters…may occur within lower order concepts and yet have significant impact…[and] destroy the value of established commitments and competence, and call forth new skills and resources" (Clark, 1985, p. 249). His statement implies that the changes in peripheral subsystems may trigger competence–destroying innovation, or new technological discontinuities that will initiate another technology cycle. The technological evolution of the automotive industry will be a case in point for this argument.

In terms of the powertrain of a car, gasoline–powered automobiles have remained the dominant design in the market for almost a hundred years. However, in the early twentieth century, gasoline engines were the least–preferred option. In 1900, about 40% of the automobiles in the United States were steam–powered, 38% were electric cars, and the remaining 22% were gasoline–fueled vehicles (Möser, 2002). One of the major drawbacks of the internal combustion engine was its inconvenient starting system. Up until the early twentieth century, people had to rely on hand cranks to start gasoline–powered automobiles. They had to manually rotate the crank attached to the front of the car which was an incredible nuisance and quite dangerous. This inconvenience acted as one of the main hurdles preventing the diffusion of gasoline–fueled cars.

However, this problem was fixed when Charles F. Kettering, one of the greatest engineers of the twentieth century, invented an electrical starting motor in 1911 and

revolutionized automotive electrical systems. Before Kettering developed electric self–starters, the use of electrical technology in automobiles had been limited to the ignition system. Kettering focused on this peripheral technology, utilized it to replace the old starters (i.e., hand cranks), and made cars much easier and safer to operate, which greatly enhanced the utility and appeal of gasoline–powered vehicles and assured that the internal combustion engines became the dominant design of the powertrain system over batteries or steam–based engines (Leslie, 1983; Lerner, 2012).

Since then, the core technologies in the car industry have long been mechanical or hydraulic engineering. However, in today's cars, these technologies are no longer the source of innovations. Analysts estimate that more than 80% of all automotive innovation today originates from electronics (Leen & Heffernan, 2002; Broy, Krüger, Pretschner, & Salzmann, 2007). From the perspective of technological evolution, this shift is noteworthy. Until the 1960s, the only electronics applied to automobiles were limited to a few subsystems including car radios, alternators, and voltage regulators. Clearly, electronic engineering was a peripheral technology for the car industry. In the 1970s, however, electronic fuel injection technology was introduced to automobiles, which ignited the development of automotive electronics (Chong, 2011; Fleming, 2015). Electronic systems in cars have replaced the previous mechanical and hydraulic systems and applications. The development of in–vehicle networks such as the controlled area network (CAN), local interconnect network (LIN), and media–oriented systems transport (MOST) are good examples. Consequently, the dependency of dynamic driving control

systems on electronics keeps growing (Leen & Heffernan, 2002). Today, the cost of electronics in automotive vehicles is estimated to account for about 40% of the total manufacturing cost (Credit Suisse, 2014).

The past several decades have witnessed drastic changes in the number and sophistication of automotive electronics. One of the most distinctive technology–driven trends in the car industry nowadays is autonomous driving. Many industry players and experts expect that autonomous driving technology will eventually transform a vehicle into a "moving office." Although there might be different projections about how fast autonomous vehicles will be adopted and what the automotive industry will look like in 10 to 20 years[7], it seems obvious that autonomous driving technology will be the next big thing in the auto industry—another technological discontinuity to engender a major disruption. To fully realize autonomous driving in the future, the advanced driver–assistance system (ADAS), an integrated system of various automotive electronics (e.g., electronic blind spot detection, crash avoidance, parking assistance, adaptive cruise control, etc.), will be the key stepping stone to trigger the next technological discontinuity in the car industry (McKinsey, 2016).

In short, innovations in the modern car industry are driven by electronics and software engineering—once peripheral technologies. These technologies will expedite the

[7] For example, McKinsey (2016) forecasts that fully autonomous vehicles are likely to be commercially available by 2020, and by 2030, will account for up to 15% of the new–vehicle market share worldwide under a high–disruption scenario. Oliver Wyman (2015) also predicts that by 2035, semi– and fully autonomous cars will account for 35% of global auto production under the high–penetration scenario.

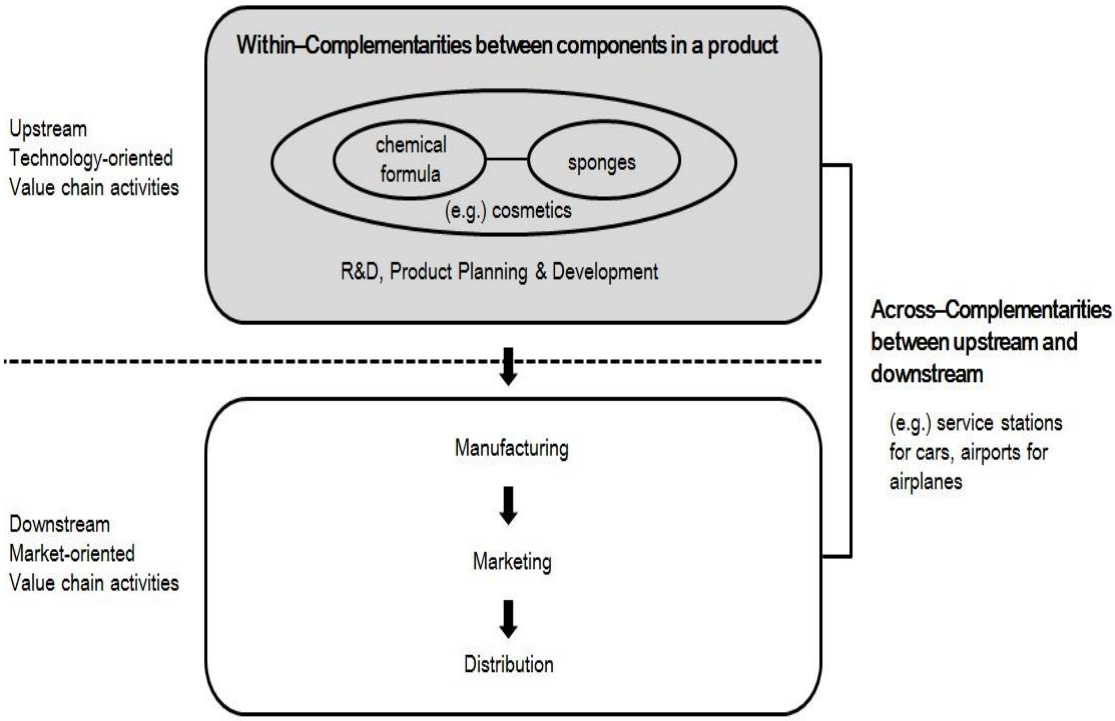
arrival of connected cars that provide seamless Internet connectivity. Considering the technological evolution in the car industry, it can be argued that peripheral technologies can function as a trigger to initiate technological discontinuities.

3.4 Conceptual Framework and Research Propositions

Most of extant research on complementary assets has primarily focused on the downstream value chain activities for commercialization and has not fully recognized the complementarities in the upstream level (e.g., R&D, product development, etc.). In order to fill the void of relevant research on the upstream level where the actual product development activities occur, this dissertation focuses on the complementarities within a product, more specifically the interconnected relationship between core and peripheral components (Figure 2). For a comprehensive understanding of complementarities during the product innovation process, they should be analyzed within the same level of the value chain (i.e., within–complementarities between components in a product) as well as the different levels across the value chain (i.e., across–complementarities between the upstream and the downstream of the value chain).

Many scholars have viewed products as a hierarchically structured entity that is composed of different levels of interconnected subsystems (Rosenberg, 1976; Hughes, 1983; Rosenkopf & Nerkar, 1999; Murmann & Frenken, 2006). It is also presumed that a product system is a hierarchical structure (Simon, 1962; Clark, 1985), which consists of

core and peripheral components (Thusman & Rosenkopf, 1992; Tushman & Murmann, 1998; Gatignon et al., 2002; Murmann & Frenken, 2006). Thus, it is fair to argue that the complementarities or interdependent relationships within a product system originate from the linking mechanism between core and peripheral components.



* The shaded area is the focus of this dissertation.

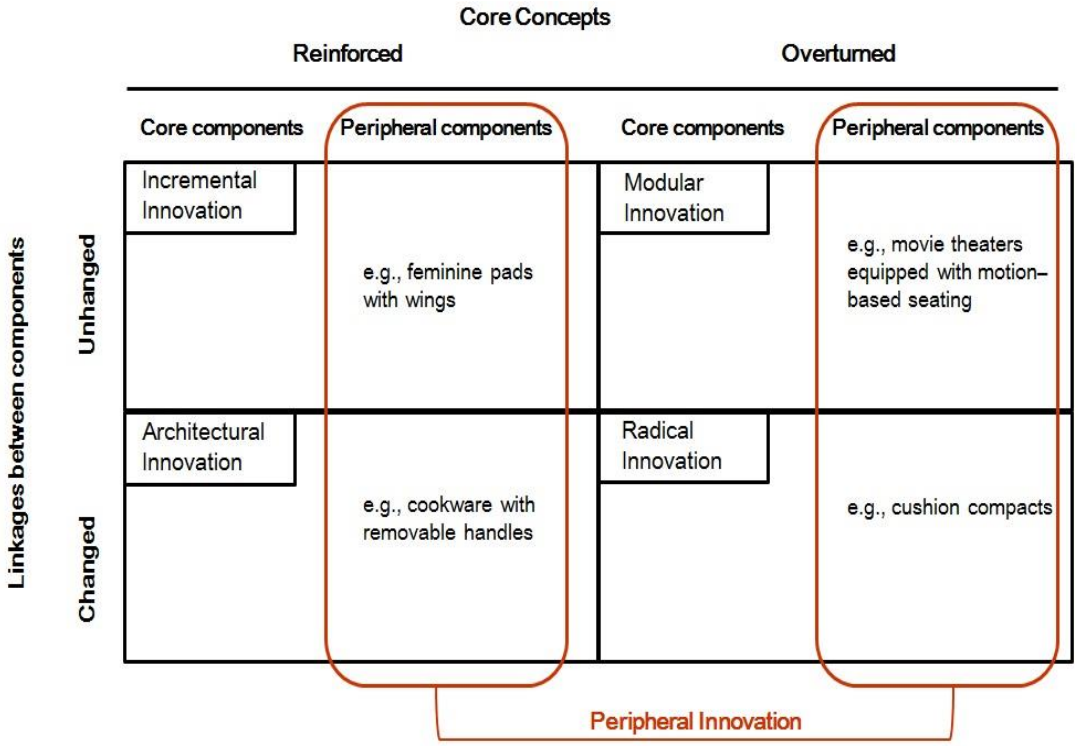
[Figure 2] Schema of complementarities from a value chain perspective

In evaluating innovation, it is important to investigate the locus of innovation—whether technological changes and improvements occur at the central subsystem that is

essential to the product's primary function or at the peripheral subsystem that is not integral to the product's intended function (Gatignon et al., 2002; Ma et al., 2015). Put differently, incorporating the distinction between core and peripheral components into the innovation framework is integral for an in–depth understanding of the characteristics of technological innovation.

Therefore, this dissertation proposes to refine Henderson and Clark's (1990) innovation framework by adding an additional dimension that separates core and peripheral components (Figure 3). Despite its usefulness, Henderson and Clark's original framework failed to address the distinction between core and peripheral components. Although they highlighted the importance of the product architecture, they only focused on the product's core components, core design concepts, and the relationships between core components (Tushman & Murmann, 1998). By limiting their attention only to the core parts, they overlooked the role of peripheral components in innovation. In order to analyze complementarities within products, a more refined approach that reflects the relation between core and peripheral components is required.

According to the refined framework, peripheral innovation can also be categorized into four types of innovation—incremental, architectural, modular, and radical innovation—depending on the innovation's impact on subsystems and the linkages. Although changes in peripheral subsystems have been believed to have a minor or even negligible effect on products, the existence of examples that show powerful breakthroughs through peripheral innovation requires us to address its hidden potential.



[Figure 3] Refinement of Henderson and Clark's (1990) innovation framework to include peripheral innovation

Different components—be they core or peripheral—are connected to each other through linking mechanisms, which are as crucial to the product's performance as are the product's components themselves (Henderson & Clark, 1990; Tushman & Murmann, 1998). In fact, it is the interdependence between components that influences the evolution of products (Hughes, 1983). Therefore, it can be assumed that making the interconnected linkages between core and peripheral components more efficient and effective is important to the success of product innovation. It can be further assumed that when peripheral components become more closely intertwined with core components through

reconfiguring the existing product architecture, the peripheral components can create a synergistic effect with the core components. Then, the potential impact triggered by the peripheral components may increase to the extent of having system–wide effects on the entire product system. Based on this reasoning, this dissertation presents the following proposition:

Proposition 1: Creating synergy between core and peripheral components may enhance the impact of peripheral innovation.

Peripheral innovations have been mostly relegated to afterthoughts or add–ons (Kahn, 2001; Golish et al., 2008), which leads to the common misconception that they are innately insignificant. However, recent evidence for powerful peripheral innovation such as cushion compacts casts new light on their true potential as a source of competitive advantage. Slywotzky and Weber (2011) argued that understanding customer hassles—"the array of frustrations, inconveniences, complications, and potential disasters lurking in most customer experiences" (p. 59)—and solving them can become a great way to create demand. Obviously, recognizing these hassles serves as a way of generating new ideas for innovation in the early stage of the NPD process. The decision on product architecture—how different physical components or subsystems are integrated into a whole product—is also made early on in the innovation process, and is closely connected to firms' overall performance (Ulrich, 1995). This suggests that peripheral components, if

properly considered from the outset of the development process and incorporated into the product architecture to fix the hassles, can deliver a powerful competitive advantage. Based on this reasoning, the dissertation suggests the following proposition:

Proposition 2: Exploring the applicability of peripheral components to solve customer hassles from the beginning of the innovation process may enhance the impact of peripheral innovation.

When customers encounter new products in the market, they attempt to categorize them for product evaluation (Ozanne, Brucks, & Grewal, 1992; Olshavsky & Spreng, 1996). Categories are described through the use of category labels (Moreau, Markman, & Lehman, 2001; Navis & Glynn, 2010). Category labels are the central features of categorization (Mervis & Rosch, 1981) and play a critical role in stabilizing the conceptual systems of new products and establishing new categories (Rosa, Porac, Runser–Spanjol, & Saxon, 1999). Ha, Park, and Ahn (2009) empirically proved that emphasizing categorical attributes can even eclipse the attraction effect[8], showing that categorical differentiation can influence consumers' product choice decisions. Goode, Dahl, and Moreau (2013) also argued that providing an accurate, diagnostic brand name

[8] The concept of the attraction effect was first introduced by Huber, Payne, and Puto (1982), which can be described as "an inferior product's ability to increase the attractiveness of another alternative when the inferior product is added to the original choice set" (Ratneshwar, Schocker, & Stewart, 1987, p. 520). Although powerful, the attraction effect can be mitigated when a unique categorical feature is introduced (Ha et al., 2009).

is important for the success of innovations, because a non–descriptive brand name does not help consumers much when perceiving the newness of an innovation. These studies show that naming and positioning a new product are important to properly convey its new concept and benefits, implying the effectiveness of categorical differentiation in communication strategy. Since peripheral innovation is driven by peripheral components that have long been regarded as insignificant elements, it is essential to effectively communicate the new features that the peripheral components offer by providing proper category information or cues. Thus, the following proposition can be developed:

Proposition 3: Highlighting categorical attributes of peripheral components may enhance the impact of peripheral innovation.

The following two chapters investigate a specific peripheral innovation case in the cosmetics industry in Korea to verify the research propositions. More specifically, Chapter 4 studies the NPD process of AmorePacific's Air Cushion Sunblock while Chapter 5 concentrates on AmorePacific's marketing strategy of cushion compacts in general (Table 5).

[Table 5] Research propositions for successful peripheral innovation

Domains of Innovation Activities	
I. Product Development	**II. Product Marketing**
(P1) Create synergy between core and peripheral components (P2) Explore the applicability of peripheral components from the beginning	(P3) Highlight categorical attributes of peripheral components
(To be verified in Chapter 4)	(To be verified in Chapter 5)

Chapter 4. NPD Process of AmorePacific's Air Cushion Sunblock[9]

4.1 Introduction

The Korean cosmetics industry has been rapidly growing for the past several years despite the prolonged economic downturn. In 2015, the beauty and personal care industry in South Korea managed to grow by 6%, which was more than two times higher than the country's GDP growth rate (Euromonitor, 2016). In recent years, cosmetics exports have also increased dramatically. According to the Korea Customs Service (KCS), cosmetics shipments have expanded by more than three times in the past five years, eventually recording $2.45 billion in 2015. The largest importer was China, which accounted for about 40% of the total exports. This is quite a remarkable performance given the fact that many of the traditional manufacturing industries in Korea are struggling to survive the worldwide economic downturn.

Contributing to the stellar performance of the recent cosmetics industry in Korea, AmorePacific has evolved from a domestic cosmetics firm into a global player and led the growth of the entire industry. According to Lee, Lin, and Kim (2015), AmorePacific

[9] An earlier version of Chapter 4 was published in Research–Technology Management, vol. 59, issue 4, under the title, "The Power of Peripheral Innovation."

showed the biggest increase (161.1%) in market capitalization among the 15 largest cosmetics companies in the world, over a one–year period from March 16, 2014 to March 16, 2015. Until 2013, AmorePacific was not even included in the list of the top 10 companies on the Korea Composite Stock Price Index (KOSPI). However, as of October 31, 2016, AmorePacific stood at No. 10 in terms of market capitalization. In 2016, the company ranked 21st on Forbes' annual list of the World's 100 Most Innovative Companies, climbing up by 7 positions from 28th in the previous year.

One of the key reasons that the company was included on the Forbes' list is its innovative cushion technology which has enabled AmorePacific to create a totally new product category in the global cosmetics market. In 2008, AmorePacific's premium brand IOPE developed an innovative product called Air Cushion Sunblock, the world's first multifunctional cushion–type cosmetics providing UV protection, foundation makeup, and brightening skincare in one product. Air Cushion Sunblock was a radical innovation, which revolutionizes both the components of the conventional products and the existing product architecture. The most remarkable feature of Air Cushion Sunblock lies in the ability to offer cross–category benefits. By integrating a sponge with a cosmetic formula, thus controlling the fluidity of emulsion within a compact case, Air Cushion Sunblock succeeded in offering both features—portability and light application—which were previously thought as incompatible features that could not be embodied in one product. Consequently, Air Cushion Sunblock was able to greatly facilitate usability as compared to traditional tube–formatted sunscreen products.

According to Tushman and Rosenkopf's (1992) typology of products, cosmetics products belong to the category of simple assembled products, for which dimensions of merits are easily measured. Unlike complex products such as automobiles and airplanes which are inextricably related to social, political, and institutional changes, the technological evolution of simple products is relatively unaffected by sociopolitical factors. Since the sociopolitical aspect of technological change is beyond the scope of this dissertation, studying cosmetics is appropriate as it reflects mainly the aspect of the technological progress. In addition, cosmetics are at the mature stage in terms of the industry life cycle. Therefore, investigating a case of radical innovation created in cosmetics can help us to grasp how peripheral components can be utilized to make breakthroughs, even in a mature, competitive industry.

Unfortunately, existing innovation models that mainly focus on core innovations provide little insight into peripheral innovations. There is as yet no framework or approach for structuring a peripheral innovation process. As a first step toward developing such a framework, this chapter analyzes the NPD process of AmorePacific's Air Cushion Sunblock to investigate how an innovative product driven primarily by technological changes in peripheral components can create competitive advantage.

4.2 Methodology

Case study research involves examining a phenomenon in its natural setting. Among

different research strategies including experiments, surveys, or archival analyses, case studies are especially appropriate for research in new topic areas, where the main purpose of the research is to understand the “how” or the “why” that concerns a contemporary set of events, and the objective is to gain insights for building a theory (Eisenhardt, 1989; Yin, 2003). Since the objective of this dissertation is to explore peripheral innovation which has been neglected and to derive a systematic approach for successful peripheral innovation, a qualitative case study was conducted to investigate AmorePacific’s Air Cushion Sunblock.

The primary source of data was a series of semi–structured interviews with senior executives and managers in R&D and marketing who were involved in the Air Cushion Sunblock development project. From July to August in 2015, a total of six interviews were conducted, each of which lasted an average of 80 minutes. The interviews asked about how the cushions were created, how opportunities were identified, what key technologies were involved, what challenges were encountered and how they were overcome, etc. All the interviews were recorded and transcribed.

Prior to the interviews, secondary data gathered from newspapers, magazines, patents, and the company’s official website were examined, as well as internal materials provided by AmorePacific, such as market research data and in–house newsletters. These secondary data suggested directions for interview questions and facilitated further comments and clarifications during the course of the interviews.

The interview transcripts were read through several times to identify common

themes by looking for high–frequency words and phrases (e.g., “customer hassles,” “usability”) and examining the context of their use. For example, when “customer hassles” appeared in a transcript, the associated content was typically concerned with the structural constraints of core components, and paragraphs containing the word “usability” generally focused on peripheral components. Each of these ideas was analyzed from the perspective of the innovation locus—whether they were focused on core or peripheral components. Finally, in order to maximize the reliability of our analysis, a preliminary draft of the report was subjected to review by interviewees and others at AmorePacific.

4.3 Case Analysis

4.3.1 Start with a Core Innovation Project

Air Cushion Sunblock, AmorePacific’s first cushion compact, was created to compete with White X–II Plus Sun Balm released by LG Household and Healthcare (LG H&H), Korea’s number two beauty company. Prior to the launch of White X–II Plus Sun Balm in 2006, most sunscreens in Korea were in the form of emulsions contained in tubes. The emulsions were sticky, thus inconvenient for consumers as they had to wash their hands after using the products. To solve this problem, LG H&H’s premium brand ISA KNOX developed the first balm–type sunblock in Korea that could be applied with an accompanying puff which liberated consumers from the routine of washing their hands

after using sunscreens[10]. Thanks to its novelty and convenience, White X–II Plus Sun Balm became a hit, recording a sales revenue of about $13 million within 10 months of its release.

Motivated by the White X–II Plus Sun Balm's success, AmorePacific set forth to develop its own balm–type sunblock in January 2007 to compete with LG H&H's product. Among the many brands of AmorePacific, IOPE took the initiative as it was comparable to ISA KNOX in terms of the brand concept, target group, pricing, and distribution channels. The main objective of this project was to launch the product as soon as possible in order to restore the company's competitiveness in the sunscreen market. At that time, balm–type sunscreens were already a proven success. Given that AmorePacific was a latecomer in this niche, time–to–market was particularly important.

Researchers and marketers worked closely together under AmorePacific's established brand manager system, in which a brand manager is responsible for developing the overall marketing strategy for a new product, from planning to promotion (Hwang, 2004). The team planned to develop a differentiated balm–type product by adding supplemental features, such as cooling effects. With this in mind, team members focused on studying ingredients and compositions of balms—the core component.

By June 2007, AmorePacific succeeded in developing a balm–type sunblock of its own. However, IOPE did not launch the product. As a latecomer in the balm–type

[10] LG H&H also developed Korea's first solid powder–type sunblock in 2008 under the auspices of its luxury brand OHUI.

sunscreen market, it presumed that adding supplemental features was not enough to beat White X–II Plus Sun Balm. Researchers and marketers started again to work on how to fundamentally outdo the competitor product and eventually identified the gap between consumer needs and product offerings of balm–type sunscreens.

Consumers wanted a sunscreen that was easy to carry and apply lightly to the skin without the hassle of washing their hands after use. However, these were conflicting values. For portability, a compact case with a mirror is the best option among various cosmetic containers. Thus, the balm format is suitable because emulsions run the risk of leakage when packed in a compact. However, one of the weaknesses of the balm is that due to its oily feature, dust tends to cling to its surface as it is used. Furthermore, balms are innately difficult to apply evenly and lightly to the skin as they leave a relatively matte or dull finish as compared to emulsions. Therefore, emulsions are preferred to balms for light texture.

In short, there were significant structural constraints embedded in the balm formula and clear trade–offs between conflicting consumer needs—customer hassles caused by the intrinsic characteristics of the core components. Although the accompanying puff made balms efficient to use, the intrinsic limitations of the oily formula led to less than satisfactory results on the skin. In short, balm–type sunscreens were problematic from a usability perspective. Given these inherent limitations, the development team reasoned that improvements in the balm formula itself would not significantly increase customer value, no matter how many supplemental features were

added. Concluding that a fundamentally different solution was required to address the customer hassles that came with the balm format and create meaningful value, the company decided on a different approach.

4.3.2 Shift toward a Peripheral Innovation

AmorePacific realigned its objectives to create a sunblock that is easy to carry and apply lightly to the skin and makes it unnecessary for consumers to wash their hands after using the product. The company especially sought to resolve two contradictory consumer needs—the desire for portability and clean application and the desire for even and light application. The joint team from marketing and R&D engaged in numerous brainstorming sessions to seek solutions. The main objective was to ameliorate usability deficits in core components. At this point, the deadline was tight—management wanted a new product by February 2008, because new products in the sunscreen category are usually launched in spring. Given this time constraint, technological improvements in the core components seemed unlikely. Thus, the team began to investigate the possibilities of mitigating the usability deficits in core components through peripheral components—specifically, applicators such as sponges and puffs.

Ultimately, the team arrived at a creative solution inspired by stamp pads which are made with ink–saturated materials. AmorePacific realized that an emulsion sunblock could also be retained in a compact without leakage by using a porous sponge to control

the fluidity of the emulsion. This solution mitigated the trade–offs between equally desirable but mutually exclusive consumer desires, by allowing an emulsion product to be packaged as a compact and used without soiling the hands. Combining an emulsion with a sponge and delivering it through a puff creates synergy and brings value to customers.

The key to maximize that synergy was to find the right materials for applicators and to wholly integrate the emulsion with the sponge. Although developing water–in–oil emulsions with low viscosity was important, the key challenge was to find the ideal sponge material. The sponge had to be able to hold a sufficient amount of emulsion at a size small enough to fit into a compact case. The de facto standard amount for sunscreens in Korea was 30 grams, so providing a smaller amount might limit the perceived value of the product. The key indicator for a material's suitability, then, was its absorptiveness. The material also had to control the fluidity of the emulsion: the liquid should not flow out of the sponge when it was not in use, but had to ooze out of it easily when pressed on by a puff. Researchers conducted experiments to find a material that fit these criteria. Careful examination revealed that users tended to feel most satisfied, when they put on makeup, with the amount of emulsion per application in the range of 0.3 to 0.5 grams. After approximately 3,600 tests with approximately 200 material samples, polyurethane foam, generally utilized inside powder puffs, was identified as the optimal choice.

Additionally, the company needed to develop filling techniques for this new product to facilitate production. In general, the techniques involved in cosmetics production can be divided into manufacturing and filling (Knowlton & Pearce, 1993).

Manufacturing techniques (e.g., liquid/solid mixing, miscible/immiscible–liquid mixing, etc.) are closely related to the core components and generally perceived as more important and more complex than filling techniques. However, cushion compacts require a more sophisticated filling technique than the usual practice of simply injecting the cosmetic into a container, and the filling technique is central to the eventual usability of the product. Specifically, the sponge must be saturated with the optimal amount of emulsion as homogeneously as possible. Thus, the product quality will be damaged if emulsions are not evenly absorbed throughout the sponge or if they leak during use because of overfilling.

The problem was that no such filling techniques existed. During the initial prototype testing, the product developers dipped the sponges into the emulsions one by one by hand. Producing the Air Cushion Sunblock at scale required a new filling technique and equipment, both of which have been patented by AmorePacific. This technique provided a minimum of 12 grams of emulsion, well below the de facto standard amount of 30 grams. Instead of investing more time and money to develop advanced filling techniques that would increase the amount of emulsion per sponge, AmorePacific decided to launch the product as it was. Given the novelty of the product, the management believed that it would be better to verify consumer demand by launching the product with an included refill, for a total of 24 grams of product per purchase, than to delay the launch to reach the preferred emulsion amount. Additionally, through testing numerous prototypes, they developed a dual airtight container that effectively prevented

vaporization and leakage of liquid so that an emulsion–saturated sponge could be safely stored in hermetic packaging.

A series of experiments were also conducted to find a suitable material for a puff applicator. Researchers discovered that a puff composed of a microporous material would enable the application of emulsion most evenly and lightly to the skin, while minimizing excessive absorption of emulsion from the sponge. Through deliberation, they selected wet–type polyurethane featuring homogenous continuous microporous foam, which had been utilized mainly as a material for eye–shadow tips in Korea. They found that due to its superior permeability and water–absorption capacity, wet–type polyurethane enabled an emulsion to permeate into its microscopic pores when pressed onto a moistened sponge and to be discharged instantly when pressed onto the face. Thus, an emulsion can be applied to the face in a thinner layer because it breaks down into small–sized particles when transferring from the puff to the skin.

The problem was the high cost. The wet–type polyurethane foam was nearly five times more expensive than synthetic latex, the most common material used for putting on makeup. It was the high cost that had limited the use of wet–type polyurethane to point makeup puffs (e.g., eye–shadow tips) where only a small amount of the material was needed. AmorePacific's development team overcame this issue by creating a three–layered design for the puff: an expensive wet–type polyurethane was used only for the bottom layer, a cheap polyurethane was utilized in the central layer, and a waterproof polyurethane film was put on the top. This ingenious approach reduced the cost of the

applicator to an acceptable level. In March 2008, IOPE finally launched Air Cushion Sunblock, an innovative multifunctional sunscreen which offered both the benefits of liquid foundation (i.e. light texture) and a compact case (i.e. portability and convenience of use).

4.3.3 Upgrade after Product Launch

Even after launching Air Cushion Sunblock, AmorePacific continued to improve the key technologies for cushion compacts. For example, the sponge materials have been constantly upgraded. Initially, polyester–based polyurethane foam was used. However, this was replaced by polyether–based polyurethane foam in 2011 as researchers learned that polyether foam has a larger cell structure and more resistance to humidity than polyester foam. By substituting the old polyurethane foam, AmorePacific could improve the durability of the sponge. AmorePacific also introduced the reticulation process to polyether foam to form a netlike open cell structure, which would enable liquid foundation to permeate the sponge more homogenously and to be discharged appropriately in each use. Furthermore, AmorePacific modified the internal composition of the sponge from a single layer to a multilayer structure. Each layer differed in thickness, pore number and size, allowing the multilayer foam to discharge liquid foundation more uniformly. With this structural modification, AmorePacific could solve the problematic issue of continued use resulting in a decrease in the amount of liquid

foundation being discharged. The most recent technological improvement in sponges is related to the sponge–shaping technology. In 2016, AmorePacific developed a new sponge production technique to make an embossed pattern (a honeycomb shape) on the sponge surface, which improves its ability to discharge the amount of liquid foundation evenly throughout the product's lifespan.

The design and structure of the container also went through improvements over time. When Air Cushion Sunblock was first launched in 2008, its outer compact case, i.e., the exterior structure of the dual container, had a diameter of 8 centimeters. However, in 2010, AmorePacific renewed its product design, reducing its diameter to 7.4 centimeters and removing the bottom so that the base of the inner case (directly containing the liquid–soaked sponge) was exposed to the naked eye. In so doing, AmorePacific made the product lighter and sleeker. Furthermore, the effectiveness of the sunscreen was improved from SPF 40 and PA ++ in 2008 to SPF 50 and PA +++ in 2010. During the same period, the company strove to stabilize the filling operation and finally succeeded in improving the quality of operation: in the beginning, the maximum guaranteed amount of emulsion per sponge was only 12 grams but was later increased to 15 grams, thanks to the technological improvements in filling techniques acquired through two years of trial and error. All of these improvements provided a strong foundation for the company to expand cushion–related technologies into other brands and more advanced and diversified products (Table 6).

[Table 6] Key technological milestones of Air Cushion Sunblock

Year	Description
2008	Developed multifunctional cushion–type sunblock (SPF 40, PA ++)
2009	Introduced sweat–proof function
2010	Increased amount of emulsion per sponge (12 grams → 15 grams) and UV protection function (SPF 50, PA +++). Modified the packaging design.
2011	Modified sponge material to improve durability

4.4 Research Findings

Generally, the technological entry barriers in Korea's cosmetic industry are low: if one company develops a popular product, then similar products from competitors tend to enter the market several months later or within a year of the original product's release. However, the case of cushion products was different. It took four years and five months after the launch of Air Cushion Sunblock for the first similar products to be released by LG H&G, the biggest rival of AmorePacific. This delayed market entry can be explained by the fact that Air Cushion Sunblock was created by peripheral innovation.

While most cosmetic companies traditionally concentrated on core technological know–how (e.g. cosmetic formula and manufacturing techniques), AmorePacific focused on peripheral technologies that other competitors had overlooked such as technological knowledge of sponges/puffs and filling techniques. In the traditional cosmetics industry,

filling operations are generally treated as less significant than manufacturing operations, thus they are a comparatively underdeveloped area in cosmetics production. However, AmorePacific expanded its effort to include the development of filling techniques. The company even invented the specialized equipment for filling operations and had it patented (Table 7).

[Table 7] AmorePacific's patented cushion–related technology

Year	I. Cosmetic formulas
2008	Developed low viscous water–in–oil emulsion with pigments dispersed in the inner phase to give soft light texture and high makeup coverage
2009	Enhanced the sweat–proof functionality of sunblock
	Developed spherical–shaped micro–TiO_2 to improve UV protection without raising viscosity
	II. Sponges
2008	Developed emulsion–saturated sponge utilizing polyurethane foam in a compact case
2011	Replaced polyester–based polyurethane foam with polyether–based foam in a reticulated structure to improve durability and absorption/discharging efficiency
2013	Introduced a multilayered structure enabling uniform emulsion discharge throughout use
	III. Filling techniques
2008	Developed an apparatus to saturate sponges with low viscous emulsion
2011	Automated the entire manufacturing process to maintain uniform quality of products

The peripheral technologies for cushion compacts, i.e., the technological knowledge on sponges and special filling techniques resulted in maximizing the synergy between the core and the peripheral components. The product quality—the synergy between the core and the peripheral component would be damaged if the filling operation failed to evenly saturate the sponge with the optimal amount of emulsion or if the emulsion leaked during use. These peripheral technologies were competence–destroying in nature, which was evident by the fact that it took almost two years for AmorePacific to stabilize its filling operation. Since cushion compacts required such new capabilities, the company was not able to exploit its existing technological knowledge. Rather, they had to start R&D from scratch and explore the new technological domain which functioned as a high entry barrier against competitors and played a large role in delaying its rivals from quickly entering the emerging cushion market.

It is essential to create synergy between the core and peripheral components in order for peripheral innovation to become a commercial success. Conventionally, core and peripheral components of cosmetics were physically separated: a sponge did not contain any cosmetic formula, for instance. AmorePacific's Air Cushion Sunblock changed this practice by combining the core with the peripheral component and making them inseparable. AmorePacific strove to maximize the synergy between the core and peripheral components by constantly improving and strengthening the ties between them. As a result, AmorePacific fixed the trade–offs, created new demand, seized an opportunity, and gained a competitive edge.

Although AmorePacific did not structure a formalized process specifically geared toward peripheral innovation, the way that the company changed the direction of its innovation efforts—beginning with core innovation, then shifting its attention to peripheral innovation, and continuing to upgrade the peripheral components after product launch—suggest a possible approach to implementing peripheral innovation more systematically.

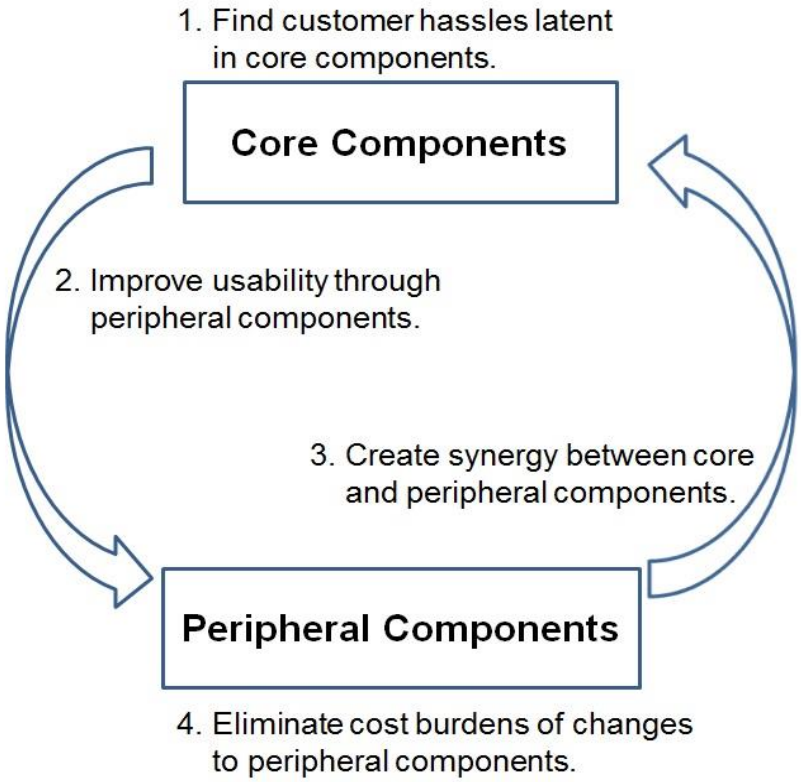
Analysis of the case shows that the innovation process for Air Cushion Sunblock evolved in four steps: identify hassles, improve usability, create synergy, and control costs. First, AmorePacific defined the structural constraints of core components that created customer hassles. Then, the company tried to resolve these hassles and improve usability through peripheral components. Next, AmorePacific strove to create synergy and enhance customer value by strengthening the linkage between the core and peripheral components. Additionally, the company developed a creative idea to minimize the cost of the puffs and thus make the product competitive with offerings already on the market (Table 8). This four–step process represents a good foundation from which to develop a systematic approach to peripheral innovation.

[Table 8] AmorePacific's innovation process for Air Cushion Sunblock

		Step	Context
Consumer need: A product that (1) is easy to carry, (2) applies lightly and evenly, and (3) applies neatly, with no need to wash hands after use		I. Identify hassles	Define structural constraints embedded in core components.
			• Emulsions are good for light texture, but bad for portability. Balms are portable but too heavy in texture.
		II. Improve usability	Create solutions to address customer hassles.
			• Sponges can control fluidity of emulsions, making them portable.
		III. Create synergy	Develop technology to strengthen the linkage between components.
			• Test multiple materials to identify the optimal material in terms of absorbency and durability. • Develop filling techniques and production facilities.
		IV. Control costs	Address and minimize cost burdens associated with peripheral components.
			• A multilayered structure was adopted to minimize the cost of puffs.

4.5 Discussion

Although Air Cushion Sunblock was not the intentional outcome of a structured process for peripheral innovation, it does represent a very successful peripheral innovation. Based on the four–step development process of AmorePacific's Air Cushion Sunblock, a more generalized approach for successfully implementing peripheral innovation can be derived (Figure 4).



[Figure 4] A four–step process for peripheral innovation

1) Find customer hassles latent in the core components.

The importance of understanding customers in peripheral innovation cannot be emphasized enough. In implementing peripheral innovation, need–finding should be the starting point. Design thinking, a human–centered methodology to problem solving, offers one approach that starts with empathizing with the user and identifying user needs (Brown, 2008; Seidel & Fixson, 2013; Liedtka, 2014). Need–finding may also be deployed in NPD more generally, but in peripheral innovation, focus should be placed on the complete hierarchical system of the product and the interactions between the core and peripheral components. Innovators should not only observe user behavior and experience, but also investigate the structural constraints embedded in the core components and the customer hassles these constraints create. AmorePacific pursued this principle in seeking to address the customer hassles created by the inherent limitations of the balm format and decided to overcome the problems through exploring a different approach.

2) Investigate possibilities for improving usability through peripheral components.

Usability is regarded as a key consideration in designing new products, and a critical factor in consumer's product choice (Mack & Sharples, 2009). Rogers (1962, 1995) offered five innovation characteristics that affect the rate of adoption of an innovation: relative advantage, compatibility, complexity, trialability, and observability. All of these attributes do not seem to be of the same importance. Tornatsky and Klein (1982) showed that relative advantage, compatibility, and complexity are the attributes that are

consistently significant in predicting customers' purchase behavior, based on the meta–analysis on innovation characteristics. It is noteworthy that these three attributes which are perceived as more central than others are all closely related to the notion of usability. First, complexity is the complete opposite of ease of use or usability, by definition. Second, compatibility can be defined as "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 1995, p. 224). It can be argued that compatible products congruent with customers' existing knowledge structures are easier to use than incompatible ones, which shows a close connection between compatibility and usability. Finally, relative advantage is the concept closely related to the perceived usefulness. Many studies have proved that innovations perceived as easier to use are considered as more useful (Gong, Xu, & Yu, 2004; King & He, 2006)—again, a close relationship between usefulness, or relative advantage in a broad sense, and usability.

The concept of usability encompasses both the efficiency and effectiveness of use (Shackel, 1984) and the degree of user satisfaction (ISO, 1998). Han, Yun, Kim, and Kwahk (2000) pointed out that product usability is affected by the characteristics of all of the product components. Prior research on category adoption and diffusion suggests that usability is an important determinant of product adoption (Rogers, 1995; Babbar, Behara, & White, 2002). Improving usability is one way to eliminate customer hassles. Customer hassles, especially those caused by the structural constraints of core components, can be solved either by technological breakthroughs in the core or by innovation in the

peripheral components. Most companies tend to only focus on the first approach, but it is important to recognize that using peripheral components can be an equally viable solution to overcome the customer hassles. Peripheral components can be designed to address the hassles created by structural constraints. Put differently, looking at structural constraints and usability deficits can suggest where peripheral innovation may yield competitive advantage.

This idea was not lost on AmorePacific. The company clearly understood the importance of usability in innovation and improved it by aggressively attempting to create hassle–free solutions. At first, the company focused its attention on the cosmetic formula—the core component. However, the development team recognized that the trade–offs inherent in contradictory consumer needs could not be solved by technological improvements only in that core component. Rather than obsessing about innovating core components, AmorePacific broadened their approach into the peripheral components, resolved a persistent usability challenge through them, and finally created a breakthrough product. In short, AmorePacific did not fail to appreciate the potential value of makeup applicators and turned its attention toward the peripheral components—a shift that resulted in a truly innovative product.

3) Create synergy between the core and peripheral components.

Peripheral innovations become powerful when they are inextricably linked to the core components of the product in a way that makes the product as a whole more useful, more

usable, and more innovative. Once a solution is identified, prototyping and experimentation are required to explore how the concepts for peripheral components interact with the core product components. This stage is in some ways analogous to the last stage of the design thinking process, which Liedtka (2014) divided into three stages—data gathering about user needs, idea generation, and testing. The difference between the testing stage in design thinking and this stage in peripheral innovation is that in peripheral innovation particular attention should be given to the linkages between the core and peripheral components. As Henderson and Clark (1990) pointed out, even seemingly minor innovations can significantly affect existing markets if they reshape a product's architecture—the ways in which its components are integrated. The key to the success of Air Cushion Sunblock is the linkage of the product components—that is, the way in which the emulsion product works with the sponge and puff applicator. Taken together, these various elements create an entirely new product in a category that appeared to have matured. The synergy generated through the right linking mechanism can magnify the impact of peripheral innovation. As compared to traditional human–centered design methods, which do not often lead to radical innovation (Norman & Verganti, 2014), a more calibrated approach in testing prototypes, with a specific focus on the synergy between components, will increase the likelihood of breakthrough innovation at the product level.

4) Minimize the cost associated with changes to peripheral components.

In creating innovation, costs must be minimized. Cost inefficiency may hinder the feasibility of innovation and offset the potential benefits. Thus, to be sustainable in the market, peripheral innovations must deliver enough value to allow the company to recoup their costs and generate a profit. An innovation that is too expensive to produce will not survive in the market, even if it represents a huge improvement in usability or eliminates significant consumer hassles. Therefore, it is important to explore—and minimize—the cost impact of a peripheral innovation.

Among the four–step process of the framework, the third step is arguably the most important stage to maximize the impact of peripheral innovation. In order to make the most of the potential of peripheral components, firms should utilize not only the peripheral components themselves but also the linkages connected to the core components as both can have an impact on overall product performance. Through improving the linkages between core and peripheral components, the development of Air Cushion Sunblock shows that the peripheral components can positively affect the core components and leverage the basic, core function of the latter, thus creating synergy to help maximize the overall impact of innovation.

Furthermore, AmorePacific's experience also demonstrates that systematic consideration of peripheral innovation from the conceptualization phase can lead to breakthroughs. AmorePacific explored the possibilities of peripheral components as a

source of innovation from the beginning, not the later stages of the development process, despite the tendency for companies to treat peripheral innovation as an afterthought. Through the joint brainstorming sessions between researchers and marketers, which were facilitated under the brand manager system, the creative idea was derived. The idea was realized through numerous prototyping tests and experimentations. In short, keeping a clear focus on the hierarchy of product components from the beginning of the innovation process will help to reveal opportunities presented by peripheral innovation and allow NPD teams to exploit those opportunities when they emerge.

Chapter 5. Categorical Differentiation of AmorePacific's Cushion Compacts[11]

5.1 Introduction

According to Gourville's (2006) typology for innovation[12], AmorePacific's cushion compacts can be categorized as smash hits that can capture value from innovations most easily by minimizing the need for consumers to change while maximizing product change. The outer appearance of cushion compacts looks very similar to the conventional compact–type cosmetics. Using a compact for makeup is very familiar to consumers, which requires minimal behavior change. However, the key mechanism of utilizing sponges for makeup is an entirely unique concept, which is a technological leap that offers great value.

TNS Korea's survey conducted in 2015 showed that 75% of Korean women responded that they had purchased a cushion compact at least once, and 57% of them answered that they currently use cushion compacts. This category of product has the second highest widespread use after BB Cream, a popular base makeup product. The

[11] An earlier version of Chapter 5 was published in the Korean Business Education Review, vol. 31, issue 4, under the title, "Categorical Differentiation Strategy of AmorePacific's Cushion Foundation."

[12] Gourville (2006) classified innovations into four types—easy sells, sure failures, long hauls, and smash hits—based on the extent of the changes the innovations embody along two dimensions: degree of product change involved and degree of behavior change required.

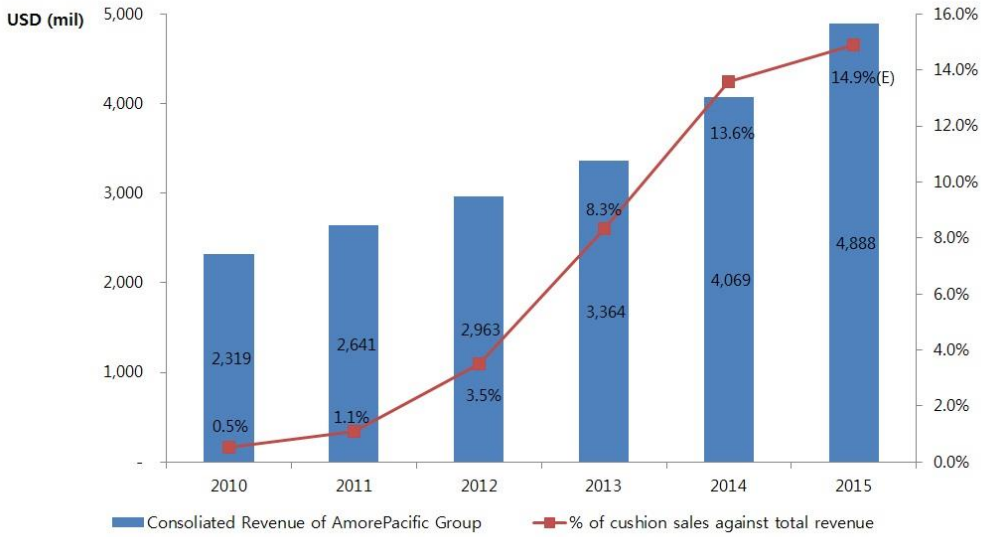
research also showed that the use of cushion compacts reduced the average number of makeup products that consumers used from 2.2 to 1.7 items, and shortened the average time spent on base makeup from 13 to 7 minutes. This is mainly because cushion compacts are multi–functional products which have sunscreen, foundation, and skincare benefits all together in just one product (AmorePacific, 2015).

Since AmorePacific first launched its proprietary cushion compacts in 2008, it has sold more than 100 million units of cushion compacts at home and abroad (AmorePacific, 2016). The company sold more than 33 million units of cushion compacts in 2015 alone, which means that almost one cushion was sold every second. The phenomenal success was attributed to AmorePacific's product extension and diversification strategy for cushion compacts. After four years since the launch of Air Cushion Sunblock, the company started to apply its cushion technologies that had been restricted to the IOPE brand alone to other in–house brands such as HERA and LANEIGE. Since then, the company has been continuously developing a variety of cushion compacts to meet customer demands for a more diversified range. As of May 2016, AmorePacific had 54 cushion–based product lines, sold under the 13 brands, with different ingredients and benefits.

Through this expansion, the sales of cushion compacts dramatically increased. For example, the total sales revenue of AmorePacific's cushion compacts in 2012, as compared to the previous year when only IOPE had released cushion compacts, reached $102 million, a year–on–year growth rate of 257%. In 2015, AmorePacific Group

recorded $4.8 billion of the consolidated revenue, about 15% of which was generated from cushion compacts alone (Figure 5).

AmorePacific also has made efforts to increase the global presence of its cushion compacts which have been rewarded. Between 2012 and 2015, the cushion sales form the overseas market increased at a compounded annual growth rate (CAGR) of 44%, which is a remarkable progress considering a CAGR of 6% from 2008 to 2012. In 2015, the company signed a memorandum of understanding with Parfums Christian Dior, a French cosmetic company, to provide Dior with cushion technologies. AmorePacific plans to leverage this partnership to increase brand awareness in Europe and North America.



[Figure 5] AmorePacific's cushion compact sales against consolidated revenue

AmorePacific's well–planned product extension and diversification strategy for cushion compacts has enabled the firm to create a new market category. If AmorePacific had limited the production of cushions only to IOPE, the cushion compacts might not have achieved such success. Thus, the aim of the study in this chapter is to investigate AmorePacific's overall marketing strategy for cushion compacts. The analysis on how an innovative cosmetic product characterized by smart sponges evolves into a new market category will offer key insights for making peripheral innovation competitive and sustainable in the market.

5.2 Methodology

The primary source of data was a series of semi–structured interviews with senior executives and managers in R&D and marketing in AmorePacific who were involved in the Air Cushion Sunblock development project and executed the product extensions of cushion compacts into other brands. From July 2015 to May 2016, a total of eleven interviews were conducted, each of which lasted an average of 80 minutes. The interview questions were mainly about what the rationale behind the expansion strategies of cushion compacts across brands was, how product differentiation was achieved, how the product category was labeled, and how the cushion compacts were positioned, etc. All the interviews were recorded and transcribed. Prior to the interviews, secondary data gathered from newspapers, magazines, patents, and the company's official website were examined,

as well as internal materials provided by AmorePacific, such as market research data and in–house newsletters. These secondary data suggested directions for interview questions and facilitated further comments and clarifications during the course of the interviews.

5.3 Case Analysis

5.3.1 Sales Promotion through Home Shopping Channels

While AmorePacific was developing its first cushion–type cosmetics, one of the most difficult challenges that marketers were faced with was how to name the new product. Since it was a kind of product that had never existed before, IOPE brand managers were debating the most suitable name for this innovative product. While brainstorming, marketers put forward many ideas and suggestions to come up with the best name to clearly communicate the concept and benefits of the new product to consumers. Among many candidates such as “Air Pad,” “Air Touch,” “Sun Pad,” and various other similar names, they finally settled with “Air Cushion.” Although there were concerns that Air Cushion might be associated with Nike’s Air Jordan basketball shoes, or decorative throw pillows for couch, they believed that it was the most self–explanatory name that could represent the product’s key features such as even and light application. Then, they added “Sunblock” to it as an informative cue to help consumers understand the product more clearly.

Finalizing the naming, AmorePacific released the first cushion–type cosmetic product in March 2008. Initially, the company distributed Air Cushion Sunblock through hypermarkets and ARITAUM[13], the firm's franchised cosmetic specialty stores, as these two channels are the primary distribution retailers of IOPE. However, the sales were somewhat dismal at first, mainly because of the product's radical novelty. Unlike the competing product of LG H&H which only modified the type of sunscreen formula from emulsion to balm, Air Cushion Sunblock incorporated the sponge into the product, which was very different from conventional cosmetics. AmorePacific reasoned that in order to boost the sales of this innovative product, consumers first needed to be educated about its concept and appropriate use.

Finally, in June 2008, AmorePacific decided to sell Air Cushion Sunblock on TV. It was an unprecedented decision in that it was the first time in the history of IOPE to sell a brand–new product through home shopping channels from the beginning. Although IOPE intermittently utilized home shopping channels for product sales, its main purpose was to dispose of inventories of existing products. Customarily, new products tended to be sold through IOPE's primary distribution channels, i.e., ARITAUM and hypermarkets. However, AmorePacific presumed that it would be worth exploring different channels where the innovative concept and new benefits of Air Cushion Sunblock could be explained and demonstrated in detail by show hosts and professional guests on TV.

This strategic decision turned out to be a great success. Home shopping channels

[13] As of September 2015, AmorePacific ran 1,330 ARITAUM retailers nationwide.

proved to be an effective medium to clearly communicate to consumers Air Cushion Sunblock's value propositions—multifunctional features, ease of use, and even and light application coupled with portability that were once thought as incompatible benefits. Exploring different sales channels resulted in a boost to the sales of Air Cushion Sunblock. In order to promote its product, AmorePacific used home shopping channels in 2008 for a total of 16 times, and about 37% of its total sales in that year were generated via these channels. The format proved that it has ability to hold viewers' attention for long enough to fully appreciate the innovative features of Air Cushion Sunblock. As a result, home shopping channels effectively motivated consumers to purchase a product that they would have otherwise underappreciated. In short, TV home shopping channels functioned not only as a main sales channel for the product but also as an effective tool for advertising and promotion.

5.3.2 Product Extension into Other Brands

AmorePacific released the cushion products from only the IOPE brand until 2011. As a premium brand, IOPE usually targeted customers purchasing medium–priced products through ARITUAM and hypermarkets. This meant that the majority of customers who purchased high–priced cosmetic products were still unfamiliar with Air Cushion Sunblock, as high–end cosmetics products in Korea were primarily sold through the well–developed door–to–door sales network—about 20% of the entire cosmetics

distribution channels in the country—and department stores.

AmorePacific, with about 36,600 door–to–door saleswomen called “Amore Counselors,” held a dominant position with more than an 80% share of the total retail revenue in the door–to–door channel of the Korean cosmetics market. As early as 2003, AmorePacific introduced the digital door–to–door sales system that enabled saleswomen to have access to the latest data and check the real–time inventory through a firm–supplied PDA, which helped them to easily schedule visits to deliver orders and improve reordering. AmorePacific further enhanced salesforce automation by providing them with customized sales apps for smartphones and mobile card readers to streamline the sales process and operations. The top management team expected that the sales of cushion compacts would further increase if they diversified distribution channels by launching distinct cushions in other in–house brands. They believed that AmorePacific’s strong door–to–door sales network coupled with its own specialty stores would enable cushions to expand more effectively and quickly throughout the entire range of the market.

With the intent of extending cushion products to other brands, AmorePacific decided to reposition cushion compacts from sunblocks to foundation makeup. The company initially positioned its cushion product as a sunblock by clearly providing a categorical cue word and settling on the name “Air Cushion Sunblock.” However, when the company decided to extend products to other brands, the company conducted research on user behavior and observed that most customers were still using sunblock even when they were using Air Cushion Sunblock. This implied that cushion compacts were

perceived as a substitute for foundation or BB (Blemish Balm or Beauty Balm) cream instead of sunblock. This realization led AmorePacific to repositioning cushion compacts from a sunblock that has the functionality of a base makeup to a foundation makeup that has the functionality of a sunblock. In so doing, AmorePacific aimed to enlarge their customer base to users of foundations, BB creams, and powder compacts.

In order to effectively reposition the product and expand into the high–end market, a luxury brand more traditionally associated with makeup was required. Consequently, AmorePacific's luxury brand HERA was selected. In terms of brand equity, IOPE was originally a strong brand in basic skin care while HERA had a reputation as a state–of–the–art color makeup brand in Korea. Thus, HERA had a clear advantage in leveraging brand equity for repositioning. Considering its influential brand ambassadors including power bloggers for cosmetics in Korea, HERA was ideal to rapidly spread cushion foundation throughout all segments of the market. Another reason HERA was selected was that its distribution channels (mainly department stores and door–to–door channels) were different from those of IOPE, which would minimize the cannibalization that might arise with expansion.

As the underlying makeup trend in the Korean cosmetics market was shifting from heavy makeup to a more natural, moisturizing base, HERA catered to consumers' needs by developing a distinct cushion foundation focusing on the prevailing trend. HERA named its own version of cushion as UV Mist Cushion, influenced by the behavioral trend among professional makeup artists to constantly use a facial mist to

leave a dewy skin with a watery glow. In order to provide a larger variety of foundation coverage and colors, HERA released seven different kinds of cushions with strong moisturizing properties. With this more diverse offering, AmorePacific was set to reposition the product as a foundation makeup. To increase consumers' awareness of the new product, HERA strongly emphasized the functional benefits of the cushion, which would enable consumers to put on makeup as lightly as possible, just as a makeup artist would do for them. HERA also produced TV commercials for its cushion products every year starting from 2013, positioning them as the flagship makeup product of HERA.

With HERA focused on domestic market expansion, LANEIGE, the most globalized brand of AmorePacific, pioneered the global market for cushions. Following its entry into Hong Kong and China in 2002, LANEIGE had already expanded its presence into more than 10 countries including Singapore, Malaysia, and Vietnam. Specifically, LANEIGE was perceived in most Asian countries as a cosmetics brand spearheading "K–Beauty" trends, part of the "Korean Wave" phenomenon. Thus, LANEIGE was positioned to capitalize on its brand reputation accumulated over the years in the Asian market to expand cushions.

LANEIGE utilized the concept of BB cream for its cushion to make the most of its popularity across Asia. In 2012, LANEIGE launched its own cushion products under the name of Snow BB Soothing Cushion.[14] LANEIGE noticed the deeply rooted desire among Asian consumer for skin–whitening so that they added an indicative cue word

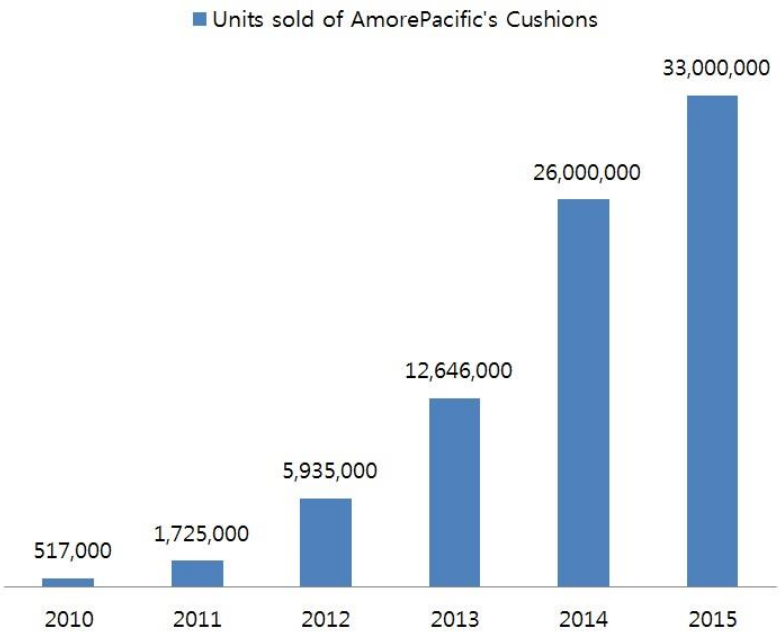
[14] The product name was later simplified to BB Cushion.

“Snow” to the product label in order to emphasize its brightening function. Snow BB Soothing Cushion was first introduced in Singapore in January 2012, followed by Malaysia, Thailand, and Vietnam in March, and finally Taiwan in April, all prior to its release in Korea in May. Even TV commercials featuring LANEIGE cushion products were first broadcasted overseas before Korea, starting in China and Indonesia in 2014 and then Korea in 2015.

Starting with HERA and LANEIGE in 2012, AmorePacific kept applying cushion technologies to most of their brands and launched distinctive cushion products for each brand in stages. More specifically, other than IOPE, HERA, and LANEIGE, the company also released cushion compacts for VERITE, LIRIKOS in 2012; AMOREPACIFIC, SULWHASOO, ESPOIR, ETUDE HOUSE in 2013; and INNISFREE, MAMONDE, PRIMERA, HANYUL in 2014.

All of this product extension would not have been possible without improvements in the filling techniques and manufacturing capacity of AmorePacific. In 2008, AmorePacific developed specialized filling equipment to saturate sponges with emulsion. However, productivity was initially low because the steps other than saturation such as fixing sponges into containers were still done manually. The dual air–tight container specially designed for cushion compacts was another cost driver. Consequently, the operating margin of early Air Cushion Sunblock products was about one–third of that of traditional sunscreens. Another challenge was to stabilize the filling operation within a predetermined error range which required a considerable amount of time.

After a period of trial and error, the company finally overcame these challenges and built a mass production facility specifically designed for cushions. With this enhanced manufacturing capability, AmorePacific was able to sell 517,000 units of cushions in 2010. Furthermore, in 2011, the company started to automate the entire cushion manufacturing process. Thanks to the automation, AmorePacific could minimize the use of human labor and increase productivity. As a result, the sales volume of Air Cushion Sunblock dramatically jumped to more than 1.7 million units, which was more than triple that of 2010 (Figure 6).



[Figure 6] AmorePacific's cushion compact sales in units

The SCM capability was enhanced just in time to contribute to establishing

cushions as a mainstream category in foundation makeup. In 2012, AmorePacific opened "Beauty Campus," the company's main SCM center which had automated production lines for high–speed mass production and cell production lines for flexible manufacturing. At the Beauty Campus, warehouses and distribution bases on a large scale were integrated, enabling the firm to respond quickly and accurately to any order via logistics solutions such as the digital picking cart (DPC) and digital picking systems (DPS). With this innovation, AmorePacific could respond quickly to the market and deliver products directly to retail stores without an intermediary distribution agent. The synergy between the automated mass–production facility and advanced distribution capabilities enabled AmorePacific to rapidly expand the product lines throughout their diverse brands.

5.3.3 Diversification of Product Portfolio

While AmorePacific was extending cushion products across brands, the company also continuously renewed and diversified cushion products by releasing product sublines. Through this continuous effort, the company strategically sought to establish cushion products as a new product category in the base makeup market.

For example, IOPE improved the previous Air Cushion Sunblock in 2012, and divided it into three different product lines—Natural, Cover, and Shimmer. The Natural line focused on Air Cushion Sunblock's basic offerings that help to express a natural skin–tone while the Cover line emphasized the foundation feature of covering facial

blemishes and flaws. The Shimmer line highlighted the product's ability to create a glowing complexion. In 2013, IOPE eliminated the term "Sunblock" from the original product label and simplified it to "Air Cushion." At the same time, IOPE additionally got anti–aging functionality approval from the MFDS (Ministry of Food and Drug Safety) so that all Air Cushion products had triple functionality: UV protection, brightening, and anti–aging. In this way, IOPE strengthened the base–makeup features in its cushion products while successfully solidifying its core brand identity as a functional cosmetics leader. In 2016, IOPE reformed the product lines again and reorganized them into four sublines—Natural Glow, Intense Cover, Moisture Lasting, and Matte Longwear. Furthermore, it developed its own color matrix for foundation based on skin tone as well as brightness and offered five color choices for each of its Air Cushion product lines. Previously, brightness was the only criteria that IOPE considered when it decided the foundation color options. IOPE systemized the foundation color offerings in order to effectively meet the growing needs of consumers who wished to select the most suitable foundation color for their skin tone. In the future, IOPE plans to double the number of color choices for Air Cushion products to ten.

AmorePacific also strove to tailor its marketing strategy for cushions to the characteristics and unique brand identity of each brand. For example, as the foremost functional skincare brand and the pioneer of the cushion market, IOPE opened an Air Cushion pop–up store in Myeong–Dong, one of the busiest places and primary shopping districts in Seoul. It was the first time in the company's 70–year history that

AmorePacific temporarily ran a flagship–like store that focused on a single product category. In the pop–up store, consumers could see the entire development history and the evolution process of Air Cushion products and test a variety of IOPE cushion products for sale. The timing was important as IOPE had entered into the Chinese market only one month before the store opened in July 2015. This was a strategic decision that IOPE made in order to appeal to Chinese tourists, who account for a large percentage of the visitors to Myeong–Dong. Advertising through the pop–up store that IOPE is the originator of cushion products, IOPE could better reach Chinese consumers who prefer to buy products that were made by the original company as opposed to similar products from rival companies.

Another example of aligning brand identity with the marketing strategy for cushion compacts was the product customization of LANEIGE. Noticing the specific consumer needs of different countries, LANEIGE started to expand its product lines in 2013. For instance, LANEIGE launched BB Cushion Pore Control for consumers in hot, humid areas of Southeast Asia and BB Cushion Antiaging for consumers in extremely cold and dry areas of China. In short, LANEIGE tailored cushion products to customers in specific regions. Another notable feature of LANEIGE's cushion products is that they offer the greatest number of color options among AmorePacific's brands since they aim to reach global consumers of different races; LANEIGE had nine color options for its cushion products as of May 2016. For instance, it not only provides foundation shade No. 21 and No. 23, the two most popular colors for Asian consumers, but also offers No. 11

for Caucasians, No. 33 and No. 35 for Hispanics, and No. 37 for African–Americans.

LANEIGE also ran a multi–country campaign called “LANEIGE Beauty Road,” which visited seven cities in four Asian countries (Thailand, Singapore, Malaysia, and China) to promote cushion products. AmorePacific’s professional makeup artists toured each country and performed makeup demonstrations in front of the local consumers. Although there had been marketing campaigns held overseas, it was the first time to run a campaign that spanned across multiple countries with the sole purpose of promoting a single product category. The 2015 LANEIGE Beauty Road campaign lasted for about six weeks and attracted a total turnout of 250,000 people in four different countries.

In the case of HERA, it diversified its product lines through repeatedly renewing its products and aggressively marketed the product both through TV commercials and print advertisements. It also collaborated with famous designers and artists to launch limited editions of cushions with unique packaging, which was aligned with its luxury brand identity. Overall, while expanding the reach of their cushion products, each of AmorePacific’s brands intended to take advantage of its unique brand equity when implementing a marketing strategy.

Furthermore, AmorePacific started to expand its makeup product portfolio of cushions beyond base makeup products. From 2014, the company started to introduce its proprietary cushion technologies to a variety of point–makeup products. For example, HERA launched Cushion Liner (eyeliners) in March 2014, LANEIGE released Watery Cushion Concealer in April 2014, and IOPE introduced Air Cushion Blush in May 2014.

Especially, LANEIGE was the most aggressive in utilizing cushion technologies in products other than base makeup. After introducing the cushion concealer product, LANEIGE kept diversifying its cushion makeup portfolio by releasing Cushion Highlighter in 2015 and Sparkling Body Cushion in 2016.

This proactive product extension and diversification was a highly involved process that occurred over several years and focused on adapting cushion technologies to meet consumer's needs, while embracing the unique identity of each of AmorePacific's brands. As a result, the company successfully created a whole new demand for cushion products that continuously grew. Thanks to the different concepts, benefits, and distribution channels of each product, the company effectively minimized cannibalization while accelerating the growth of the market. As of May 2016, AmorePacific has 54 cushion product lines in 13 different brands (Table 9).

[Table 9] AmorePacific's cushion compact portfolio

	Brand (Launch Year)	Product Name	Product Lines (Color Options)
Luxury	HERA (2012)	UV Mist Cushion	Cover, Nude, Long–Stay, Ultra Moisture (2–4)
		Age Reverse Cushion	(6)
		Cushion Liner	(3)
	LIRIKOS (2012)	Marine UV Water Cushion	Natural, Long–Lasting (2)
		Marine Collagen Cushion	Basic, Moisture (2)
		Clarifying Glow Cushion	(2)
	AMOREPACIFIC (2013)	Treatment CC Cushion	Natural, Cover (2)
		Anti–Aging CC Cushion	Natural, Cover (3)
		Sun Protection Cushion	(2)
	SULWHASOO (2013)	Perfecting Cushion	Basic, Brightening (6–7)
	PRIMERA (2014)	Watery CC Cushion	(2)
		Baby Sun Cushion	(–)
		Skin Relief Daily Sun Cushion	(–)
Premium	IOPE (2008)	Air Cushion	Natural Glow, Intense Cover, Moisture Lasting, Matte–Longwear (5)

[Table 9] AmorePacific's cushion compact portfolio (continued)

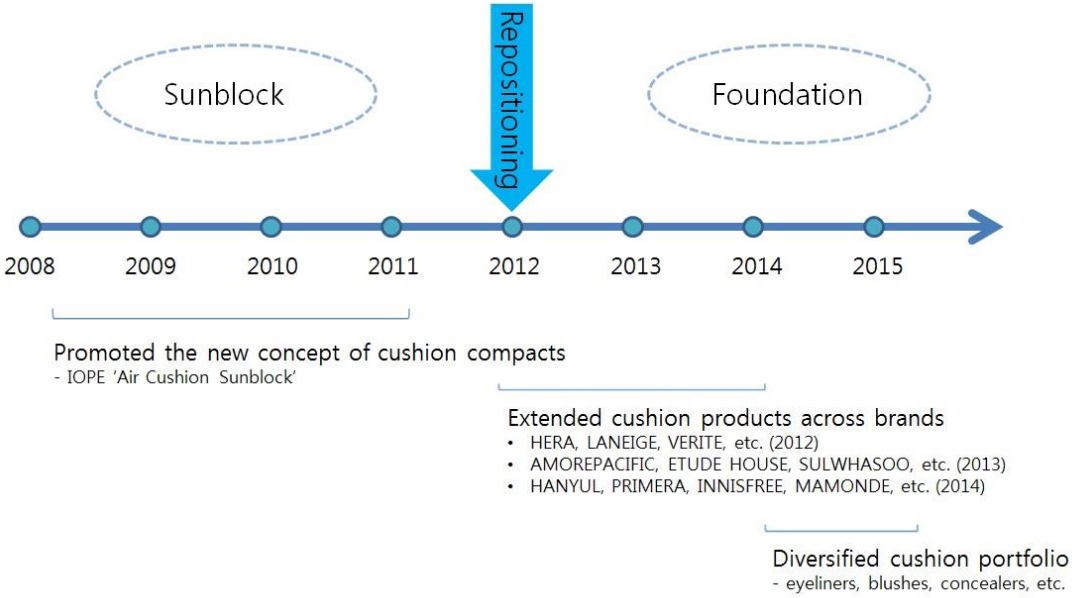
	Brand (Launch Year)	Product Name	Product Lines (Color Options)
Premium	IOPE (2008)	Man Air Cushion	(1)
		Air Cushion Blush	(2)
	LANEIGE (2012)	BB Cushion	Whitening, Pore–Control, Anti–Aging (5)
		Watery Cushion Concealer	(3)
		Cushion Highlighter	(1)
	VERITE (2012)	Aurora Cover Cushion	(2)
	HANYUL (2014)	Kwangchae Cushion Cover	(2)
	MAMONDE (2014)	Brightening BB Cushion	(2)
		Skin Change Cushion	(3)
		Cover Powder Cushion	(3)
		Moisture Mask Cushion	(3)
Mass	ESPOIR (2013)	Nude Cushion	Original, Dewy (5)
		Pro–Tailor Cushion	Basic, EX (5–8)
	ETUDE House (2013)	Any Cushion	Basic, Magic, Proof, Moist, Pearl Aura (2–4)
	INNISFREE (2014)	Water–Glow Cushion	(3)
		Longwear Cushion	(5)
		Ample Intense Cushion	Natural, Cover (3)
		My Cushion	Long–Wear Cover, Water–Fit, Ample Moisture (4)

5.4 Research Findings

After AmorePacific proved cushion compacts as a viable product category, other companies, both domestic and abroad, followed suit and launched their own cushion products. However, AmorePacific still has the widest variety of product lines and the largest production capacities for cushion compacts (AmorePacific, 2016). Each product line of AmorePacific's cushion compacts differs in terms of color range, main ingredients (e.g., plant extract, medicinal herbs, etc.), and primary skincare functions (e.g., anti–aging, brightening, moisturizing, pore–control, etc.). Despite the differences among the 54 product lines, the basic functionality and delivery mechanism of cushion compacts are exactly the same. Whether it is IOPE's Air Cushion, HERA's UV Mist Cushion, or LANEIGE's BB Cushion, all of them are multifunctional cosmetic products offering sun protection, foundation makeup, and basic skincare. Although the word "Sunblock" was originally included in the product name, Air Cushion Sunblock still offered foundation features from the beginning of its launch. In short, from a technological point of view, all cushion compacts of AmorePacific are basically similar products.

The real driving force behind AmorePacific's successful product extension and diversification can be attributed to its strategic marketing initiatives. In the beginning, AmorePacific concentrated on informing consumers about the novel concept of its innovative product. Then, when AmorePacific was finally equipped with the necessary complementary assets for commercialization, the company decided to extend its cushion

technologies to other brands while repositioning cushion compacts from sunscreen to foundation. AmorePacific's product extension and diversification strategy was accompanied by a product labeling strategy that consistently highlighted categorical attributes, which aided in establishing cushion compacts as a new product category (Figure 7).



[Figure 7] AmorePacific's marketing strategy for cushion compacts

1) Educating consumers about the new product benefits

When AmorePacific first launched its cushion compact, the major benefit of Air Cushion Sunblock was its superior usability. The product could achieve portability and light application at the same time, which had previously been seen as incompatible benefits.

However, the delivery mechanism of the product—integrating sponges with makeup formula—was such a new idea that it might have negatively influenced consumers' perception of the product. In order to overcome this challenge, AmorePacific utilized TV home shopping channels so that consumers would better understand the innovativeness of the product.

About four months after the product launch under its premium brand IOPE, the firm made an unprecedented decision to use TV home shopping channels to promote the brand–new product. Although TV shopping channels were generally not the main distribution channels for AmorePacific's premium brands such as IOPE, the company concluded that consumers should be educated about the new product's concept through live product demonstrations and explanations from beauty experts, in order to help them to properly grasp its value.

This decision was timely and effective from the perspective of schema congruity for product evaluation. Mandler and Parker (1976) defined schema as "an internal structure, developed through experience with the world, which organizes incoming information relative to previous experience" (p. 39). When people are presented with an unfamiliar product that is incongruent with the existing schema, they have difficulty in easily placing the product within the existing categories and properly understanding the product's characteristics (Meyers–Levy & Tybout, 1989). The demonstrations shown on home shopping channels helped consumers to place Air Cushion Sunblock within the sunscreen category, despite the fact that sunblocks were traditionally not contained in

compact cases. Furthermore, the detailed explanations offered by the show hosts about the additional benefits of cushion compacts motivated consumers to purchase the product. Given the fact that the initial performance of Air Cushion Sunblock prior to selling it on TV was mediocre, this strategic decision contributed greatly to boosting up the sales.

2) Repositioning products based on user behavior

The decision as to how to position a product is often one of the most important strategic decisions for a firm or brand because the product position is central to customer's perception and choice–decisions (Kotler & Armstrong, 1994). Aaker and Shansby (1982) divided the process of developing a positioning strategy into six steps: "(1) identify the competitors; (2) determine how the competitors are perceived and evaluated; (3) determine the competitors' positions; (4) analyze the customers; (5) select the position; (6) monitor the position" (p. 59). They argued that once a certain positioning strategy is selected, the company should continuously monitor the position over time and modify it to respond to changes in the market. It is important for firms to recognize that a positioning strategy is not a permanent decision, especially if the product is highly innovative; AmorePacific understood this principle and adeptly adjusted the position of cushion compacts.

Although Air Cushion Sunblock was a multifunctional product offering foundation features from the beginning, it was positioned as a sunblock because it was developed to compete against LG H&H's balm–type sunscreen products. However, when

AmorePacific decided to eventually pursue the product extension strategy, the company modified the position of its cushion compacts—not by its competitor's products as they had from the start, but by product users. The analysis of user behavior showed that consumers actually perceived cushion compacts as foundation even though the product had been presented by the company as a sunblock. Consequently, AmorePacific repositioned cushion compacts as base makeup products, which greatly contributed to the fast increase in demand for cushion compacts. With this repositioning, the company was able to rapidly expand its customer base and, as sales continued to increase, cushion compacts eventually established themselves as a new makeup category.

3) Emphasizing categorical attributes in labeling products

New products may be either congruent or incongruent with the existing product schema. Really new products, or radical innovations, generally defy straightforward classification in terms of the existing schema (Gregan–Paxton & John, 1997). When consumers confront the challenge of building new knowledge structures to understand these radical innovations, they deal with them by either restructuring the existing schema or developing an entirely new one (Mandler, 1982). Thus, it is important to offer relevant category information to consumers in order to help them to properly evaluate innovative products.

Prior to the launch of its first cushion compact in 2008, AmorePacific made an effort to come up with the best product label to effectively represent the new concept and

the appropriate use of its innovative product. Through brainstorming, marketers decided to combine the two words “air” and “cushion” together: the former was to describe the functional benefits of the new product while the latter was to represent the categorical features. While pursuing the product extension of cushion compacts, AmorePacific consistently applied the categorical cue to every product across all brands: for example, UV Mist Cushion in HERA, BB Cushion in LANEIGE, Perfecting Cushion in SULWHASOO, etc. Despite starting with different descriptive words (e.g., UV Mist, BB, Perfecting, etc.), each of them contains the word “Cushion” in its product label. This labeling strategy helped to differentiate cushion compacts from traditional foundation makeup products and also created an entirely new product label that consumers could easily recognize in products across diverse brands. In doing so, the term quickly spread and was successfully established as a dominant product category label in the market.

5.5 Discussion

Technological capabilities are absolutely critical to the success of new products (Montoya–Weiss & Calantone, 1994; Song & Parry, 1997). However, the synergy between product technology capability and marketing capability is also essential to new products’ commercial success (Cooper & Kleinschmidt, 1987). In his excellent paper, Teece (1986) emphasized that the successful commercialization of innovation requires core technological know–how to be utilized in conjunction with complementary assets

such as manufacturing and marketing capabilities. He argued that, without these complementary assets, innovators would be outperformed by followers or imitators and eventually would fail to secure the lion's share of profits from the technological innovation.

The significance of complementary assets is not limited to core innovations, but also holds true for peripheral innovation, which is evident in the case of AmorePacific's cushion compacts. The high–speed, automated, mass production facilities specially designed for cushion compacts provided a firm foundation for the company to expand cushions into other brands. Furthermore, AmorePacific's unparalleled distribution channels (e.g., door–to–door sales network, ARITAUM, etc.) and state–of–the art SCM capability (e.g., DPS, DPC, etc.) supported the rapid diffusion of cushion compacts. Thanks to these complementary assets, AmorePacific has continued to maintain its leadership position in the cushion market.

On top of these complementary assets, strategic marketing with a clear focus on categorical differentiation has been critical for cushion compacts to be established as a new product category. Extant research has shown the significance of categorization in the evolution of new industries (Rosa et al., 1999). When faced with a really new product, consumers confront the challenge of building new knowledge structures to understand it (Moreau et al., 2001). If consumers fail to categorize an innovative product with certainty, a product's newness may be underappreciated and product evaluations will be negatively affected (Goode et al., 2013).

Bertini, Ofek, and Ariely (2009) demonstrated that add–on features of a product (e.g., tripods or carrying cases for a digital camera) can affect consumer product evaluations positively, if they offer new benefits rather than simply upgrade an existing feature of the product. In a broad sense, the add–on features may correspond to the peripheral components of a product system. Based on Bertini et al.'s (2009) findings, it can be argued that peripheral components introducing new benefits can lead consumers to evaluate the new product more favorably. Therefore, it can be further argued that if marketers clearly communicate to consumers the new product's additional benefits driven by the changes in the peripheral components, it may improve the consumers' perception of the product.

In educating consumers about the concept of a radically new product, marketers have an opportunity to influence how consumers construct the representations of the product (Olshavsky & Spreng, 1996). Highlighting categorical attributes of a new product can be a good way to communicate the product's benefits and characteristics (Ha et al., 2009; Kim, 2013). This type of communication strategy for categorical differentiation can be found in the case of Samsung's light–emitting diode (LED) TVs. From a technological point of view, LED TVs are basically the same as liquid crystal display (LCD) TVs since both use liquid–crystal displays as a screen to produce images. The main difference between these two lies in the backlighting units (BLU). While traditional LCD TVs utilize cold cathode fluorescent lamps (CCFL) behind the screen, LED TVs use light–emitting diodes for the backlight instead. When Samsung developed LED TVs in 2009,

they stressed the categorical attribute of the BLU which successfully caused consumers to perceive them as a totally new product category different from LCD TVs, contributing to the creation of new demand (Kim, 2013, p. 315).

In the process of categorization, category labels play a critical role as they help to describe the basic characteristics of categories (Navis & Glynn, 2010). Thus, one of the most effective ways to accentuate categorical attributes can be labeling product categories. Suarez and Grodal (2015) argued that a firm's labeling strategy can have significant performance implications for products in a nascent industry. They further explained that successful category labels should be novel enough to draw the attention of consumers, but at the same time sound familiar enough to convey the intended purpose of a new product. They held up "snowboard" as an example of a successful category label that strikes the right balance between familiarity and novelty. They argued that the label "snowboard," which was introduced by Burton Snowboards in the 1970s, led the firm to dominate the emerging snowboard industry, despite the fact that it did not invent the product and jumped into the market as a latecomer[15].

In naming the first cushion compact, AmorePacific was farsighted enough to think

[15] The first commercially available snowboard was known as "snurfer," which Sherman Poppen developed in the 1960s. The word was coined by combining two words—snow and surfer to describe surfing down a snowy hill. When Poppen patented his idea in 1966, he explained his new product as a "surf–type snow ski." Unfortunately, the label was too novel to stick and his "snurfer" products did not have much appeal to consumers as it sounded so unfamiliar that people did not link the label to the intended purpose of the product. On the other hand, the compound word "snowboard" was a success since it clearly connected two familiar items "snow" and "board." As a result, the term was quickly adopted, became the dominant product category label, and brought a commercial success to Burton Snowboards (Suarez & Grodal, 2015, p. 27).

of growing its innovative product into a new market category—a cushion–type cosmetics. While pursuing product extension and diversification for cushion compacts, AmorePacific has labelled products consistently with the categorical cue so that categorical attributes represented by peripheral components could be clearly communicated to customers. Despite the product's radical newness, the term "Cushion" effectively conveyed its unique concept, which was instrumental for AmorePacific to establish cushion compacts as a new makeup category and pioneer the cushion–type cosmetics market.

Achieving successful peripheral innovation requires complementary assets as well as technological capabilities. Particularly, strategic marketing capabilities are necessary to make peripheral innovations competitive and sustainable in the market. The key is to ensure that the benefits newly introduced by peripheral components should be clearly communicated to consumers. Particularly, if you are launching a radically new product in a nascent industry, getting the category labeling right is critical. Highlighting the categorical attributes driven by peripheral components as part of the product differentiation strategy may contribute to accelerating the adoption of peripheral innovation.

Chapter 6. Conclusion

6.1 Summary and Contributions

The primary goal of product innovation is to create competitive advantage. Generally, firms are too often preoccupied with innovating core components and fail to notice the potential of innovation in peripheral components to create breakthrough products, competitive differentiation, and significant market value. On closer examination, however, there are numerous powerful innovation cases driven by peripheral components. AmorePacific's cushion compact is a typical example of radical innovation which transforms the product components as well as its existing architecture, demonstrating that peripheral components can function as a main driver for breakthrough innovation and the key to sustained market leadership.

AmorePacific took a different path when confronted with competition from LG H&H's new product that had resolved a specific customer hassle. It is noteworthy that AmorePacific was late to identify the customer hassle, the fact that users needed to wash their hands after using emulsion–type sunscreen in a tube format. Instead, it was LG H&H that first addressed the customer hassle through developing the balm–type sunblock, an innovation which was created by changing the core components (i.e., the chemical formula). Additionally, LG H&H released Korea's first solid powder–type sunblock,

which was driven by core innovation as well. Still, the company dismissed the hidden potential of peripheral components to improve the delivery mechanism and missed an opportunity for further innovation. On the contrary, AmorePacific launched the world's first cushion foundation by innovating peripheral components that had been largely ignored or regarded as insignificant. The consequences of these two different approaches were remarkable. Both products of LG H&H waned in popularity after a brief fad while AmorePacific's cushion compacts became a tremendous success and evolved into an entirely new product category.

The in–depth analysis of the NPD process of AmorePacific's Air Cushion Sunblock in Chapter 4 of this dissertation showed that the integral factors to maximize the impact of peripheral innovation are the creation of synergy between core and peripheral components and the early consideration of peripheral components during the innovation process. Moreover, the comprehensive investigation of AmorePacific's marketing strategy for cushion compacts in Chapter 5 showed that the complementary assets for commercialization may strengthen the sustainability of peripheral innovation and emphasizing the categorical attributes of the peripheral components may enhance the impact of peripheral innovation. Based on these research findings, this dissertation suggests five principles that companies can take to implement peripheral innovation. First, find the customer hassles latent in the core components. Second, address those pain points by improving usability through peripheral components. Third, create synergy between the core and peripheral components. Fourth, eliminate cost burdens associated

with changes to peripheral components. Finally, highlight the categorical attributes driven by peripheral components in communicating the new concept and benefits of peripheral innovation (Table 10).

[Table 10] Key principles for successful peripheral innovation

Five principles to implement powerful peripheral innovation
1. Find customer hassles latent in the core components
2. Address those pain points by improving usability through peripheral components
3. Create synergy between the core and peripheral components
4. Eliminate cost burdens associated changes to peripheral components
5. Highlight the categorical attributes driven by peripheral components

Clearly, innovating peripheral components will not always lead to a breakthrough success. However, it does present opportunities to build competitive advantage. The case of AmorePacific's cushion compacts proves that a dominant product category can be created through innovation focusing on the peripheral components of a product. Moreover, it clearly demonstrates that peripheral innovation can yield meaningful value, given a systematic approach and a clear focus.

The main theoretical contribution of this dissertation is the development of a typology for peripheral innovation. To the best of my knowledge, it is the first thesis that comprehensively analyzes the phenomenon of peripheral innovation in many industries,

examines different methods of revolutionizing peripheral components, enumerates relevant examples of peripheral innovation in detail, and categorizes them based on the methods employed in achieving peripheral innovation. This typology can function as a counterargument to the popular belief that major breakthroughs are usually achieved by core innovation. Accordingly, it can serve as a firm foothold to demonstrate that powerful product innovation can actually be driven by changes and improvements in the peripheral components.

This dissertation also contributes to the literature on complementarities, especially on complementary assets. Most research on complementary assets has primarily concentrated on the market–oriented downstream activities of the value chain such as marketing and distribution and largely neglected their role in the technology–oriented upstream level such as R&D and product planning. This dissertation differs from prior research in that it expands the scope of inquiry beyond its traditional focus and explores the complementarities that exist within technological products. Focusing on the interconnected and interdependent relationships between product components contributes to a more balanced and comprehensive understanding of complementarities along the entire value chain.

Another important contribution of this dissertation is a more refined innovation framework to include peripheral innovation, based on the work of Henderson and Clark (1990), through a hierarchical–systems lens that can reflect the locus of innovation. This approach offers a new perspective that allows us to better understand the product

architecture, identify the distinction between core and peripheral components, and recognize the potential significance of peripheral components, which has been largely neglected in the previous innovation literature.

The real merit of peripheral innovation has not been appreciated properly in the technology development process. It is time to recognize its true worth and rethink how to manage peripheral innovation. In fact, overlooking the potential of innovation in peripheral components can lead companies to missing opportunities for significant breakthrough innovations that can deliver value over the long term. I believe that the findings derived from this dissertation can serve as a meaningful insight for researchers, marketing managers and other business practitioners when developing their new products to gain a competitive edge in the market.

6.2 Limitations and Future Research

A limitation of this dissertation arises from the fact that both case studies presented in Chapters 4 and 5 are single–case designs. Each case study investigates a specific product (or product category) invented by a single firm in a particular industry. Therefore, its narrow focus may affect the generalizability of the research findings. However, given the lack of prior research on peripheral innovation, a product/industry–specific analysis was required in order to discover the systematic approach to implementing peripheral innovation. The single–case design is appropriate when the case is a representative or

typical example (Yin, 2003). AmorePacific is a representative cosmetics firm in Korea, and cushion compacts including Air Cushion Sunblock developed by AmorePacific are typical examples of peripheral innovation. Thus, focusing on a single product category seems a sensible approach in the still nascent research area of peripheral innovation. Yet, similar studies in different industries which have varying degrees of technological, competitive, and regulatory conditions are necessary in order to overcome the issue of generalizability of the results.

Furthermore, the two case studies conducted in this dissertation deal with a radical innovation case, one of four types of peripheral innovation explained in Chapter 3. Thus, future research should address whether the research findings from this thesis are still relevant to the other innovation types such as incremental, architectural, or modular innovation. In a similar vein, among the three ways of innovating peripheral components presented in Chapter 2—replacing old materials, modifying prior forms, or adding additional components, cushion compacts were invented mainly through the last method—introducing peripheral components (i.e., makeup sponges) that integrate with the existing core components (i.e., cosmetic emulsions). Therefore, whether the key principles for successful peripheral innovation derived from the case studies of this dissertation are still pertinent to other peripheral innovation cases should be further analyzed as well. Moreover, in implementing peripheral innovation, the most efficient and effective method of changing the peripheral components can vary depending on the industry and a firm's capabilities and resources. Future studies can address this issue by

assessing the impact of each method of peripheral innovation under different conditions so that they can offer suggestions to maximize the potential of peripheral innovation in different cases.

Future studies of peripheral innovation failures would also be useful to deepen our understanding of peripheral innovation. This dissertation concentrates on a successful case because the main purpose of this study is to highlight the fact that peripheral innovation can make a powerful breakthrough and serve as a sustainable competitive advantage. Although the research findings of this dissertation provide meaningful insights on peripheral innovation, a careful investigation of the causes of failures may also provide strategic implications for implementing peripheral innovation more effectively while minimizing potential risks.

Analyzing consumer behavior when consumers are actually faced with a specific peripheral innovation could be beneficial as well. Some peripheral innovations that are perceived as extraordinary from a technological point of view often do not result in a commercial success as expected. The G5, LG's latest flagship smartphone, is a prime example. When it was unveiled at the Mobile World Congress in Barcelona in February 2016, it was highly praised for an innovative modular feature: the bottom part of the phone is designed to be removable so that it can be swapped for separate add–on modules that improve audio or camera capabilities. However, the sales of the G5 turned out to be dismal, contrary to the expectation of the company as well as the media. Therefore, it would be of use to examine LG's product strategy characterized by modular mobile

accessories from the perspective of peripheral innovation and consumer behavior.

Lastly, an interesting issue that has not been fully covered in this dissertation relates to the intra–organizational processes leading to peripheral innovation. Since peripheral components have long been mistakenly regarded as nonessential elements in the product development process, the idea of utilizing them as key drivers for breakthrough innovation may be vulnerable to internal opposition and may be easily disregarded. For example, the core departments of R&D may not give due consideration to peripheral components that are unfamiliar to their existing core technological know–how and instead may insist just on improving the core components. Likewise, the idea for peripheral innovation may be supported by lower managers but not by senior managers, thus the idea could never see the light of day. Future research focusing on the interlocking activities of managers at different levels and their decision–making processes in the organization may offer the opportunity to discover the strategic process to promote peripheral innovation in an organization.

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국문초록

제품 혁신은 제품을 구성하는 부품 중 혁신이 어디에서 일어났는지에 따라 크게 두 가지로 나눠볼 수 있다. 즉, 혁신이 제품의 기본 기능을 수행하는 데 필수적인 핵심 부품(예: 화장품의 경우 제조 성분)에서 일어난 것인지, 혹은 제품 본연의 기능과는 큰 관련이 없는 주변 부품(예: 화장품의 경우 스펀지)에서 일어난 것인지에 따라 핵심부 혁신(core innovation)과 주변부 혁신(peripheral innovation)으로 구분할 수 있다. 혁신과 관련된 기존 연구들은 대부분 핵심 부품에서 일어나는 혁신 활동에만 초점을 맞춰왔다. 주변 부품에서 발생하는 혁신의 경우 전체 제품의 성능 향상에 끼치는 영향력이 미미할 것이라고 여겨져 왔기 때문이다. 그러나 실제 우리 주변을 살펴보면, 비핵심적인 부품을 변화시키거나 개선함으로써 강력한 혁신을 창조한 사례들을 쉽게 찾아볼 수 있다. 닌텐도의 게임기 위(Wii)가 전형적 예다. 전통적인 비디오 게임 콘솔 시장에 일대 변혁을 불러일으킨 Wii는 핵심 부품인 콘솔 기기가 아니라 주변 부품인 원격 조종장치에 동작 감지 센서를 접목시킴으로써 혁신을 만들어 냈다. 치아미백용 패치나 하이드로겔 마스크는 성숙 단계에 접어든 산업에서 발생한 주변부 혁신의 대표 사례다. 두 제품 모두 치아미백이나 스킨케어 성분과 같은 핵심 부품이 아닌, 플라스틱 패치와 겔 타입 시트라는 비본질적 요소(주변 부품)에 집중해 혁신을 창조했다.

지금까지 주변부 혁신은 그 잠재력에도 불구하고 핵심부 혁신에 비해

학계의 큰 관심을 받지 못했다. 본 논문은 이 같은 연구 공백에 주목, 주변부 혁신 현상에 대한 종합적 분석과 체계적 이론화 작업을 통해 주변부 혁신에 대한 학계와 실무자들의 관심을 높이고자 한다. 이를 위해 지금까지 간과됐던 주변부 혁신의 중요성을 조명하고, 혁신 원천으로서 주변 부품의 잠재력을 반영할 수 있는 보다 세분화된 혁신 분석틀을 제시하며, 강력한 주변부 혁신을 창조해 낼 수 있는 방법이 무엇인지에 대해 연구하고자 한다.

이를 위해 본 연구 2장에서는 실제 산업 현장에서 발생하고 있는 주변부 혁신 현상에 대해 종합적으로 분석한다. 구체적으로, 주변부 혁신에 대한 개념 정의와 함께 주변부 혁신의 특징에 대해 논하고, 주변 부품을 변화시키는 방식에 따라 주변부 혁신을 크게 (1) 재료 대체, (2) 형태 변형, (3) 부품 추가라는 세 가지 방식으로 유형화해 다양한 사례를 제시한다.

3장에서는 2장에서의 논의를 바탕으로 주변부 혁신에 대한 이론적 토대를 구축하기 위해 기술경영 및 혁신 분야 관련 문헌들을 고찰한다. 특히 상호보완성 및 제품의 위계적 시스템과 관련된 기존 문헌에 근거해 제품 안에 존재하는 하위 부품들 간의 상호보완적, 상호의존적 관계성을 분석한다. 구체적으로, 상호보완성의 개념을 기초로 한 보완적 자산(complementary assets) 관련 기존 연구가 대부분 가치사슬의 하류(downstream) 부문 활동(예: 마케팅)에 집중돼 있어 상대적으로 상류(upstream) 부문 활동(예: R&D)에 대한 연구가 부족함을 지적하고, 핵심 부품과 주변 부품으로 이루어진 제품의 구조적 특성을 반영하지 못한 기존 혁신 분석틀의 문제점을 논한다. 이러한 관점을 토대로 혁신활동의 가치사슬 전반에 걸쳐 존재하는

상호보완성의 개념 및 보다 정교화된 혁신 분석틀을 제시하고, 강력한 주변부 혁신을 추구하기 위한 연구 명제 세 가지를 다음과 같이 제안한다. (1) 핵심 부품과 주변 부품 간 시너지 창출이 주변부 혁신의 영향력을 증대시킬 수 있다. (2) 혁신 프로세스 초기 단계에서 고객 고충(customer hassles) 해결을 위한 주변 부품 활용이 주변부 혁신의 영향력을 증대시킬 수 있다. (3) 주변 부품에 의해 드러나는 범주적 속성을 강조하는 커뮤니케이션 전략이 주변부 혁신의 영향력을 증대시킬 수 있다.

4장과 5장에서는 특정한 주변부 혁신 케이스에 대한 사례 연구를 통해 3장에서 제시한 연구 명제를 증명한다. 구체적으로, 4장에서 한국의 대표적 화장품 기업인 아모레퍼시픽(AmorePacific)의 에어쿠션 선블록(Air Cushion Sunblock) 신제품 개발 과정을 분석해 명제 (1)과 (2)를 증명하고, 5장에서 아모레퍼시픽의 쿠션 콤팩트(cushion compact) 제품 전반에 걸친 마케팅 전략을 분석해 명제 (3)을 증명한다.

아모레퍼시픽이 발명한 쿠션 콤팩트는 주변부 혁신을 통해 강력한 경쟁 우위를 창출해 낸 급진적 혁신 사례다. 자외선 차단, 메이크업 파운데이션, 미백 등 여러 기능의 화장품 유화액을 스펀지에 함침(含浸)시켜 휴대하기 편한 콤팩트 케이스에 담은 제품으로, 오랫동안 화장품 부자재로 여겨져 왔던 주변 부품인 스펀지가 혁신의 주된 원동력이다. 아모레퍼시픽은 2015년 한 해 동안에만 총 3300만 개의 쿠션 콤팩트를 팔았다. 같은 해 쿠션 콤팩트가 아모레퍼시픽그룹 전체 매출액(연결기준 5조6612억 원)에서 차지하는 비중은 약 15%에 달한다. 그만큼 쿠션 콤팩트가 아모레퍼시픽 내에서

차지하는 위상은 매우 높다. 따라서, 최초의 쿠션 콤팩트 제품인 에어쿠션 선블록 신제품 개발 과정과 쿠션 콤팩트 제품 전반에 걸친 아모레퍼시픽의 마케팅 전략을 살펴보는 것은 본 논문의 연구 목적에 적합하다.

아모레퍼시픽이 자사 프리미엄 화장품 브랜드 아이오페(IOPE)를 통해 2008년 처음으로 출시한 에어쿠션 선블록은 기존 자외선 차단제를 사용할 때 소비자들이 겪게 되는 여러 가지 고객 고충을 해결했다. 이전까지 한국 화장품 시장에서 자외선 차단제는 유화액 형태로 튜브에 담겨 있는 제품이 대부분이었다. 이 경우 제품을 피부에 고르게 펴 바르기엔 좋지만 손으로 직접 발라야 하기 때문에 끈적이는 내용물이 손에 묻어 사용 후에는 항상 손을 씻어야 하는 불편함이 있었다. 2006년 경쟁사인 LG생활건강이 손 대신 퍼프를 사용해 바를 수 있는 연고 형태의 선블록을 국내 최초로 개발했다. 그러나 연고 형태도 문제가 있었다. 사용 후 손을 씻을 필요가 없다는 건 장점이지만, 제형 특성상 유화액에 비해 가볍고 균일하게 바르기 어려웠다.

아모레퍼시픽은 이처럼 화장품 제형의 고유한 특성에서 비롯된 구조적 제약조건에서 기인한 고객 고충에 주목했다. 그리고, 가볍고 균일하게 바를 수 있으면서 제품을 사용할 때마다 손을 씻을 필요가 없어 휴대하고 다니며 자주 덧바를 수 있도록 사용 용이성을 극대화할 수 있는 방법이 무엇일지에 대해 고민했다. 계속된 브레인스토밍을 통해 유화액을 스펀지와 결합시켜 콤팩트에 담아보자는 창의적 아이디어가 도출됐다. 마치 잉크를 머금은 패드를 스탬프로 눌러 종이에 찍듯이, 액상 자외선 차단제를 머금은 스펀지를 퍼프로 눌러 얼굴에 찍어 바를 수 있게 해 보자는 발상이었다. 이 아이디어를

실제로 구현하기 위해 아모레퍼시픽은 총 200여 종의 스펀지 재질을 확보하고 화장품 성분을 가장 효과적으로 흡수시키는 재질이 무엇인지 찾기 위해 총 3600여 회의 실험을 진행했다. 또한, 비용 부담을 최소화하면서도 제품 전달 효과를 극대화하기 위해 3중 구조 형태로 퍼프를 제작하는 등의 노력을 기울였다. 그 결과 발림성과 휴대성이라는 두 가지 효능을 동시에 제공하는 에어쿠션 선블록이 탄생할 수 있었다.

2008년 에어쿠션 선블록 출시 이후에도 아모레퍼시픽은 핵심 부품과 주변 부품 간 시너지를 강화하기 위해 계속 노력했다. 즉, 화장품 주성분(핵심 부품)이 스펀지(주변 부품)에 최대한 균일하게 스며들고, 그 스펀지를 퍼프(주변 부품)로 눌렀을 때 적당량의 화장품 성분이 묻어날 수 있도록 하기 위해 충진 기술을 고도화해 나갔다. 쿠션 화장품 제조에 특화된 특수 장비를 개발하는 것은 물론 대량 생산 및 자동화 시스템도 지속적으로 확충해 나갔다.

아모레퍼시픽은 또한 2012년부터 아이오페 외에 헤라(HERA), 라네즈(LANEIGE) 등 자사 다른 브랜드에서도 쿠션 화장품을 출시하기 시작했다. 특히, 에어쿠션 선블록 출시 초기 자외선 차단제로 포지셔닝했던 쿠션 화장품을 소비자들의 사용 행태 분석에 기초해 파운데이션으로 리포지셔닝함으로써 고객군을 확대하는 데 성공했다. 지속적인 제품 확장 및 다각화 전략의 결과 2016년 5월 기준 아모레퍼시픽은 자사의 총 13개 화장품 브랜드에서 54개 쿠션 콤팩트 제품을 판매하고 있다. 54개 제품 모두 주요 성분이나 특장점이 조금씩 다르지만, 제품명은 하나같이 ‘OO 쿠션’의

형태를 취하고 있다. 이처럼 아모레퍼시픽은 주변 부품(스펀지)에 의해 드러나는 범주적 속성을 제품 카테고리 라벨에 부각시키는 커뮤니케이션 전략을 통해 쿠션이라는 혁신적 제품을 새로운 메이크업 카테고리로 확립할 수 있었다.

아모레퍼시픽 에어쿠션 선블록 개발 과정 및 쿠션 콤팩트 마케팅 전략에 대한 심층 분석을 토대로, 강력한 주변부 혁신의 수행을 위해 기업 현장에서 적용해 볼 수 있는 원칙은 다음과 같다. 첫째, 핵심 부품의 구조적 한계로 인해 야기되는 고객 고충을 파악하라. 둘째, 주변 부품의 활용을 통해 사용 용이성을 높임으로써 고객 불편을 해결하라. 셋째, 핵심 부품과 주변 부품 간 시너지를 창출하라. 넷째, 주변 부품의 변화·개선 과정에서 수반되는 비용을 최소화하라. 다섯째, 주변 부품으로 인해 드러나는 범주적 속성을 부각시켜 커뮤니케이션 하라.

본 연구는 지금까지 학계에서 간과해 왔던 주변부 혁신 현상을 기술경영 이론을 토대로 체계화하려 했다는 점에서 학문적 의의가 있다. 구체적으로, 주변부 혁신을 체계적으로 유형화했고, 상호보완성과 관련된 기존 혁신 연구의 초점을 가치사슬의 상류단계로까지 확대시켰으며, 핵심 부품과 주변 부품으로 이루어진 제품의 구조적 특성을 기존 혁신 분석틀에 반영해 보다 정교화된 모델을 제시했다는 점에서 가치가 있다.

주요어: 주변부 혁신, 상호보완성, 위계적 시스템, 사용 용이성, 범주적 차별화

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