J. Inf. Technol. Appl. Manag. 24(3): 107~123, September 2017
https://doi.org/10.21219/jitam.2017.24.3.107

ISSN 1598-6284 (Print)
ISSN 2508-1209 (Online)

An Integrative Framework of the Determinants for the Emergence of a Next-Generation Dominant Display

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Abstract

This study uses the concept of dominant design to identify the determinants for the emergence of a next-generation dominant electronic display. It employs multiple research methods with the participation of display experts, which combine case studies, an unstructured interview, and the Delphi method. The results show that based on technological innovation and market dominance, a next-generation dominant display is more likely to emerge as a result of technological competition between liquid crystal displays (LCDs) and organic light-emitting diodes (OLEDs). The findings emphasize that the importance of rapid technological innovation, including component and process innovations, and a competitive edge in manufacturing costs are important. The study sheds light on our understanding of dominance in an industry and market, and also provides strategic guidance for practitioners to establish a competitive strategy.

Keywords : Dominant Design, Determinant, Integrative Framework, Next-Generation Display, Multiple Research Methods

Received : 2017. 08. 11.　　Revised : 2017. 09. 15.　　Final Acceptance : 2017. 09. 21.

※ This paper is a modified and extended version of work published in the XXVII ISPIM Innovation Conference-Blending Tomorrow's Innovation Vintage, Porto, Portugal on 19-22 June 2016.

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1. Introduction

For most companies, it is critical to manage the core determinants that upset the balance of technological competition as well as to adopt the most promising alternative among different designs. Dominant designs, such as Sony's Walkman, JVC's Video Home System (VHS), Microsoft's operation system, are *de facto* standards based on market acceptance and competition [Gallagher and Park, 2002; Srinivasan et al., 2006; Schilling, 2010; Yoon et al., 2014]. Dominant designs are single architectures along a specific path of an industry or product category [Abernathy and Utterback, 1978; Suarez and Utterback, 1995; Christensen et al., 1998]. In the electronic display industry, the cathode ray tube (CRT) display became a standard for televisions (TVs) in the middle of the 20th century [Mentley, 2002; Nakagawa, 2003]. The liquid-crystal display (LCD) is the dominant design at present, and is ubiquitous in our lives [Luo et al., 2014]. Along with a significant decrease in the cost of thin film transistor (TFT)-LCD, strict consumer demands for improvements in image, color and viewing angle have brought about a wider applicability for LCD-based products [Hsiao et al., 2011].

However, LCD displays still face challenges from new displays, such as organic light-emitting diode (OLED) displays that have the potential to be dominant in next-generation displays. The reason for this is that OLED displays have technological strength in terms of their image quality, motion, contrast ratio, viewing angle, and more. In addition, since these have a thin layer of organic material that emits light when stimulated by electricity [Tseng et al., 2009], OLED displays have no corresponding back light unit (BLU) component [Coe-Sullivan, 2014]. Therefore, the OLED technology can be used in next-generation displays, such as flexible, wearable, and transparent displays. At present, LCD and OLED displays compete both with digital TVs, which have the highest revenue efficiency and in mobile displays for sales volume and product innovativeness. Their sponsors are currently competing to dominate the next-generation display industry, nurturing their technological strengths, progressing through technological evolution, and expanding the relevant markets.

Various determinants influence the advent of the dominant design in many different industries [Smith, 1996; Christensen et al., 1998; Schilling, 1998; Suarez, 2004; van de Kaa et al., 2011; Yoon et al., 2014, and related works]. Similarly, promising displays may not rely entirely on a single determinant to emerge as the dominant design. Eggers [2014] articulates that the continued evolution of LCD displays toward an emerging dominant design configuration was shaped by several events, including an increase in consumer value for color screens, plasma makers' abandonment for research and operation of plasma display panel (PDP) technology, the advent of TFT-LCD displays, and improved performance and reduced cost of LCD displays attained by applying amorphous silicon.

This paper uses the dominant design concept to identify the determinants of a next-generation dominant electronic display, and then proposes an integrative framework that includes internal and external factors of a display company. Suarez [2004], van de Kaa et al. [2011], and Yoon et al., [2014] emphasize the importance of a comprehensive framework that is used in the field of technology management in order to have a deeper understanding of dominance in an industry and market. However, since current frameworks are mainly established by a single case study and a meta-analysis, they are limited in applicability to specific industries or products. Therefore, this research employs multiple methods that combine the case study method, unstructured interviews, and the Delphi method, through the participation of display experts in each stage. This framework, based on empirical evidence, will complement the existing literature and help display firms adopt next-generation displays in spite of the exploratory nature of the methodologies.

The remainder of this paper is organized as follows. Section 2 reviews the literature related to a dominant design and the technological competition between LCDs and OLED displays. In Section 3, the proposed research design is demonstrated. Section 4 shows the results of the empirical work. Finally, Section 5 discusses the implications of the results and provides suggestions for further research.

2. Literature Review

2.1 Dominant Design Concept

In the field of industrial economics and technology management, many researchers have used a dominant design concept to study technological evolution and industrial innovation. Studies on dominant design are important since a firm that has a dominant design can shape and lead the evolution of the industry [Schilling, 2010]. That is, a dominant design significantly affects the firm's strategy and performance [Srinivasan et al., 2006].

Meanwhile, some studies have insisted that the dominant design is identical to a standard [e.g. Kartz and Shapiro, 1985; David and Greenstein, 1990]. The current literature on standards and dominant design is not very clear on the differences [Funk, 2003; Suarez, 2004; Gallagher, 2007]. Dominant designs are persistent architectures while standards are interface protocols and important elements of dominant designs [Gallagher, 2007]. Srinivasan et al. [2006] consider standards to be the technological specifications that are required for the proper functioning of products, and market acceptance is an integral aspect of dominant design that includes codified standards. They further elaborate that the dominant design often emerges from competition among several designs in the market. Since the technological competition between promising designs provides strategic importance for firms competing in the information and communication technology (ICT) industry [Soh, 2010], the dominant design may be closely linked to establishing a competition strategy [Anderson and Tushman, 1990].

In order to conceptualize the dominant design, this paper classifies theoretical streams into four viewpoints. Suarez [2004], Murmann and Frenken [2006], van de Kaa et al. [2011], and Yoon et al. [2014] insist that the literature related to the dominant design has been studied, along with four theoretical viewpoints. First, industrial economists [e.g. Abernathy and Utterback, 1978; Rosenbloom and Cusumano, 1987; Anderson and Tushman, 1990] focus on the dominance of architecture in a product category or an industry. They explain that the dominant design is a single architecture that dominates a product class [Abernathy and Utterback, 1978] or a specific path along the industrial hierarchy that establishes dominance among competing design paths [Suarez and Utterback, 1995]. In turn, industrial economics focuses on the dynamics of industries and the evolution of technology. Second, within network economics [e.g. Kartz and Shapiro, 1985; Farrell and Saloner, 1986], a different theoretical stream has been developed according to the concept related to network effects, an installed base, complementary assets, and so on. Arthur [1989] explains that the dominant design is affected by the numbers of each that are adopted at the time of choice since adoption according to market share determines not the next technology but rather the probability of each technology being chosen. Third, institutional theorists [e.g. Khazam and Mowery, 1994] emphasize that the advent of the dominant design is a conscious strategic objective of firm strategy by supporting the diffusion of their architecture and new technologies. Therefore, they highlight the role of firm or institutional strategy, such as licensing, pricing and marketing initiatives. Finally, researchers in the field of technology management [e.g. Suarez, 2004; Schilling, 2010; van de Kaa et al., 2011] define the dominant design as a de facto standard that usually takes 50% or more of the market share. A specific technological design achieves dominance when, one or both of the following cases occur : (a) the most closely competing alternative design abandons active competition; (b) a design achieves a clear market share advantage over alternative designs [Suarez, 2004]. Researchers in the field of Technology management demonstrate a dominant design as a de facto standard and integrate the determinants of organizational and environmental factors.

This paper uses the dominant design as the de facto standard in order to study technological competition, technological innovation, and market dominance, based on the perspectives of industrial economics and technology management. Previous studies have identified several determinants of dominant design according to the above-mentioned theoretical streams and research subjects. Integrative approaches that have been developed for technology management have mainly categorized determinants into firm-level and external environmental factors of a company. This paper specifically sorted previous studies into an integrative framework that was applied by Suarez [2004] and van de Kaa et al. [2011] in order to identify comprehensive determinants (see <Table 1>). This attempt to construct an integrative framework will provide various perspectives and determinants of the dominant design and will prevent bias from falling on a single theoretical stream. Researchers and practitioners need to sort and manage determinants from an integrative viewpoint now that the dominant designs have been shaped by various factors [Lee et al., 1995; Suarez and Utterback, 1995; Ehrardt, 2004].

〈Table 1〉 Determinants for the Emergence of Dominant Design

Determinant		Source	Abernathy and Utterback (1978)	Farrell and Saloner (1986)	Rosenbloom and Cusumano (1987)	Khazam and Mowery (1994)	Lee et al. (1995)	Smith (1996)	Schilling (1998)	Ehrhardt (2004)	Suarez (2004)	Srinivasan et al. (2006)	Schilling (2010)	van de Kaa et al. (2011)
Firm-level Factors	Firm characteristics	Technological superiority	●		●		●		●		●		●	●
		Complementary assets and credibility					●			●	●		●	●
		Installed base		●				●	●	●	●		●	●
		R&D intensity							●	●		●		
		Financial resources and firm size						●		●	●			●
	Strategic characteristics	Entry timing			●		●	●	●		●		●	●
		Pricing	●	●		●			●	●	●			●
		Licensing policy		●		●		●			●			
		Marketing initiatives		●			●		●	●	●			●
Environ-mental factors	Market characteristics	Network effects and switching costs		●			●	●	●	●	●	●	●	●
		Regime of appropriability				●	●		●		●	●		●
		Availability of complementary goods		●					●		●			●
	Industrial characteristics	Interdependency within communities			●							●		●
		Strategic alliances						●		●				
		Regulation and institutional intervention					●	●	●		●		●	●

2.2 LCD versus OLED

For the display industry, the front industries consist of digital TV, laptop, and mobile device manufacturers, and these coexist and cooperate with rear industries that include materials, components, and equipments for manufacturing display panels. The display industry is the representative process industry for the ICT sectors, and there is a strong linkage between display-related industries in that materials and components determine the competitiveness of display panels in terms of quality and cost, which are significant parameters for the front industries [Chu et al., 2013]. Therefore, displays may be a keystone that decides the direction of the industry.

LCD displays previously achieved market dominance through continuous technological evolution to strengthen the fundamental technological characteristics (e.g. high resolution, low power consumption, and so on). However, they may have become a dominant design over PDP displays as a result of various determinants, not merely the technological strengths. Even though PDP displays possesses some advantages as emissive displays, such as good color saturation and a wide viewing angle [Mentley, 2002], the current dominant feature of LCD displays may be the circumstantial evidence that various determinants are more likely to affect the advent of the dominant design.

The LCD and OLED groups in academia and in industry argue whether LCD displays will continue to be dominant in the market or if OLED displays could become a mainstay in next-generation displays. The question of which will be the dominant design in future displays is a pressing matter. Although LCD displays have taken a leading role in the evolution and development of current displays, analysts and practitioners claim that OLED displays may be able to dominate the display industry in the future due to some evidence, including the technological strengths, as follows.

First, the maturity of the flat-panel display (FPD) market may leave the door open for industrial attention and for further development of OLED technologies, so technological innovation of OLED displays will ensure the competitiveness quality and cost of their panels. Active-matrix OLED (AMOLED) has gained an increasing amount of attention from display manufacturers as the FPD market matures and its revenue growth slows [DisplaySearch, 2014a]. Its technological innovation (e.g. the improvement in production yields of AMOLED mobile phone panels) is closing the manufacturing cost gap between AMOLED and TFT-LCD smartphone displays [DisplaySearch, 2014b]. Second, changes in consumer value for multimedia on mobile devices may increase the demand for displays with high specifications. OLED displays presently dominate the markets for high- end smartphones, tablets, and other portable display devices [Poor, 2014] because the color performance of mobile-OLED-displays provides a significant improvement over that of typical mobile-LCD-displays [Coe-Sullivan, 2014]. In addition, two major Korean manufactures are first movers in control of developing OLED displays and their related industries. Their commitments to OLED TVs are reassuring for the industry [Murano and Lemke, 2013], and these may meet market expectations for OLED displays to be dominant in next-generation displays.

3. Research Design

In today's fast-paced technology-driven environment, attempts to explore a submerged dominant design and to investigate its determinants are required rather than extrapolation from past trends and facts. Many studies on dominant design have been criticized for being conducted 'ex-post' [Tushman and Anderson, 1986; Suarez, 2004], which may be in fact a controversial issue. Studies on the ex-post performance and implications of a dominant design have mainly been conducted using empirical research [e.g. Khazam and Mowery, 1994; Suarez and Utterback, 1995; Christensen et al., 1998; Schilling, 2002; Srinivasan et al., 2006; Soh, 2010]. Meanwhile, Suarez [2004] emphasizes the usefulness of the 'ex-ante' dynamics for the dominant design, and Choi et al. [2008] and Lee et al. [2011] present the core variables for next-generation dominant designs based on ex-ante simulations.

This paper suggests a research process that provides an integrative framework for identifying the determinants that are more important for promising displays. That is, this framework is not a prescriptive tool but offers a strategic guidance to establish a competition strategy. For this, this work conducted multiple methods that strived to ensure validity and reliability through the participation of external display experts as follows. First, on the basis of a literature review and case studies, this paper conducted unstructured interviews to examine the determinants of a dominant display. This work concentrates on data triangulation [Patton, 2002; Yin, 2009] in order to establish the construct validity and the converging lines of research. As shown in the references of this study, this work collected useful evidence from publications, research papers in academic journals, articles and reports from leading display market research firms and magazines, and news items from display manufacturers' web sites. After this paper had derived the determinants from the above-mentioned evidence, unstructured interviews were conducted. In particular, the interviews were conducted with two display experts, and each has more than ten years of experience in the field. These interviews were completed as face-to-face discussions five times from November 3rd, 2015 to December 6th, 2015 without imposing limitations on the interview format (e.g. questionnaire and minutes).

The Delphi method is defined as a social research technique that obtains a reliable opinion from a group of experts [Landeta, 2006]. The specific use of the Delphi method in this research establishes the validity of the determinants to construct an integrative framework. It is critical to have a dependable expert group in order to obtain successful results from the Delphi survey [Mitchell and McGoldrick, 1994]. To invite experts for this work, this research requested the cooperation of members from major display firms' forums and academic and industrial experts by telephone or e-mail through the support and advice of the experts in the interviews as key informants. This work assembled a panel suitable for the research, having 6 experts in corporate R&D, 5 in product planning, 7 in consulting, including media, and 6 in academic and research institutions. Their experience comprises an average of about 13 years in their fields. This work also conducted an on-line survey containing a semi-structured questionnaire that included open-ended questions and fixed-alternative questions using a five-point Likert scale. The reason for this was to ensure convenience in the response submission as well as the anonymity of the participants while reducing the negative effects of further interaction. The survey was initially conducted from June 10th, 2016 to July 31th, 2016.

4. Results

4.1 Unstructured Interviews

The purpose of this work serves to examine the determinants found in the relevant literature. After the experts reviewed the determinants in <Table 1> and discussed the changes in the display industry, they provided feedback on the extant determinants (see <Table 2>). Since a single display maker uses several display technologies (e.g. OLED technology for smartphones and TFT-LCD technology for laptops), this work excluded determinants associated with a single firm's characteristics, such as the 'financial resources and firm size', 'licensing policy', and 'marketing initiatives' in <Table 1> in accordance with the experts' consensus. These determinants can be important regarding the market share of sponsors that use specific display technologies. However, the purpose of this study is to identify all determinants that influence which is the most promising among the display alternatives.

The 'availability of complementary goods' was also not selected in that there were non-existent complementary goods for displays. The fundamental reason for this is that the electronic display is the visual processing part that links users and devices, containing information that stimulates human vision [Mentley, 2002; Lee et al., 2008]. First, the display functions not as an individual product but as a generic part that is physically equipped with various products [Whitney, 1988]. Since complementary goods are needed to maximize the utility of a promising product [Teece, 1986; Gallagher and Park, 2002], there may be no complementary goods for the display itself. Second, different display technologies are inherent in similarly shaped display panels, and there is little difference between complementary goods for display devices (e.g. LCD-based and PDP-based TVs of the same size).

As shown in <Table 2>, this work derived new determinants from display cases and confirmed them with the experts. The 'speed of technological innovation' and 'technological generality' within the newly proposed technological factors and 'governmental assistance' within environmental factors were extracted from this work. In particular, the reasons for considering technological factors as a new factor to understand the emergence of the dominant display are as follows. First, since the display industry is considered to be a technology-intensive in-

<Table 2> A Proposed Framework Examined by Unstructured Interviews

		Extant Determinant	New Determinant	Modified Determinant
Technological Factors	Technological superiority	●		
	Speed of technological innovation		●	
	Technological generality		●	
Firm-level Factors	Complementary assets and credibility	●		
	Installed base	●		
	R&D intensity	●		
	Entry timing	●		
	Pricing (component)	●		
Environmental Factors	Network effects and switching costs	●		
	Regime of appropriability	●		
	Eco-friendly regulations			●
	Solidarity with front and rear industries			●
	Strategic alliances	●		
	Governmental assistance		●	

dustry, technological factors may affect the overall processes of determining the dominant design. Also, efforts that employ corporate strategy alone would not be sufficient to overcome technological limitations. Second, they refer to innovative elements [van de Kaa et al., 2011; Yoon et al., 2014] and not only achieve technological superiority, but also increase the chance of becoming the dominant design [Christensen et al., 1998]. Finally, technological differences between LCD and OLED displays are manifested in their evolutionary trajectory and competition no less than essential differences between LCD and PDP displays. Some researchers [e.g. Lee et al., 1995; Ehrhardt, 2004] have also classified technological factors as distinguishable from strategic maneuvering (firm-level factors).

'Regulation and institutional intervention' and 'interdependency within communities' were modified into 'eco-friendly regulation' and 'solidarity with front and rear industries' according to situations in the display industry, respectively. The perceived harmfulness of a display's backlight unit (BLU) is considered to be the main cause of environmental problems. For example, light-emitting diode (LED) BLUs are used as a light source in many LCD displays because of their exclusion of mercury and other toxic chemicals [Lo et al., 2009]. Due to the characteristics of the process industry, 'solidarity with front and rear industries' may be closely connected to the competitiveness of display panels : materials and components in rear industries may affect the quality and cost of display panels, and devices in front industries may determine the demand.

4.2 Delphi Method

This work refines the determinants within the proposed framework in <Table 2> and provides

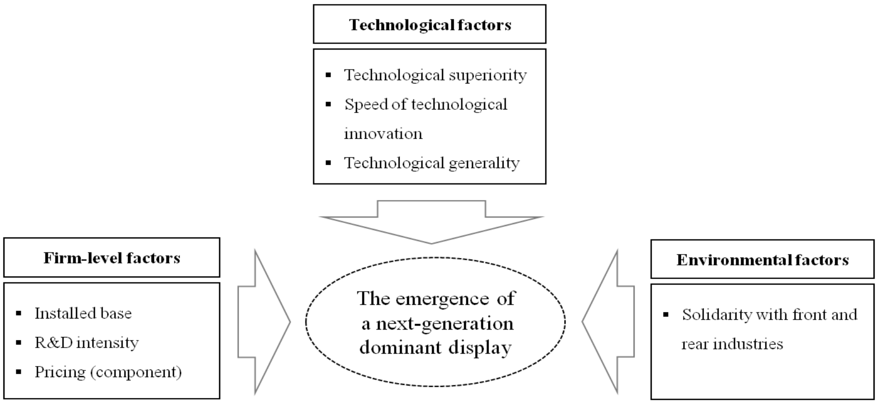
〈Table 3〉 Results of Content Validity and Consensus for an Integrative Framework

Determinant		Mean	Standard Deviation	CVR	COV	IQR	Evaluation
Technological Factors	Technological superiority	4.174	0.388	1.000	0.093	0	Retention
	Speed of technological innovation	4.217	0.671	0.739	0.159	1	Retention
	Technological generality	4.130	0.626	0.739	0.151	1	Retention
Firm-level Factors	Complementary assets and credibility	3.609	0.583	0.130	0.162	1	Cut-off
	Installed base	4.174	0.717	0.826	0.172	1	Retention
	R&D intensity	4.217	0.518	0.913	0.123	1	Retention
	Entry timing	3.739	0.915	0.304	0.245	1	Cut-off
	Pricing (component)	4.174	0.887	0.565	0.212	1	Retention
Environmental Factors	Network effects and switching cost	3.652	0.647	0.304	0.177	1	Cut-off
	Regime of appropriability	3.739	0.541	0.391	0.145	1	Cut-off
	Eco-friendly regulations	3.217	0.850	-0.217	0.264	1	Cut-off
	Solidarity with front and rear industries	4.043	0.638	0.826	0.158	0	Retention
	Strategic alliances	3.217	0.795	-0.304	0.247	1	Cut-off
	Governmental assistance	3.217	0.600	-0.391	0.186	1	Cut-off

evidence to analyze the priorities between the determinants that have been retained. Above all, most experts consider LCD displays to be the current dominant design and henceforth OLED displays will emerge as next-generation displays. However, it is hard to predict the emergence time of the OLED display as a next-generation dominant display. Based on the distribution of years that experts predicted, the emergence time is in the broad range of 2017 to 2022. Thus, this prediction can lead to an incorrect conclusion due to individual deviations. Some experts explained that complementary technologies, such as a quantum dot (QD), for LCD displays could sustain their dominance in the display industry. QD-enhanced LCD displays have an improved performance of color gamut and response time over current LCD displays [Luo et al., 2014]. Even though the dominance of LCD displays continues, OLED displays will rise to dominance-at least until the next big technology comes along [Perry, 2013].

The following indicators can establish statistical robustness for content validity and consensus. The content validity ratio (CVR) [Lawshe, 1975] is an indicator to evaluate whether a determinant corresponds with the situation and the facts of an OLED display. According to the number on the panel, the minimum value of CVR is 0.42 (24 experts) [Lawshe, 1975, p. 568].

As shown in <Table 3>, seven determinants were eliminated due to having CVRs of less than 0.42. Eventually, seven determinants were retained within the framework for next-generation displays. That is, the panel reached the same conclusion that these determinants were suitable for the emergence of a next-generation dominant display.

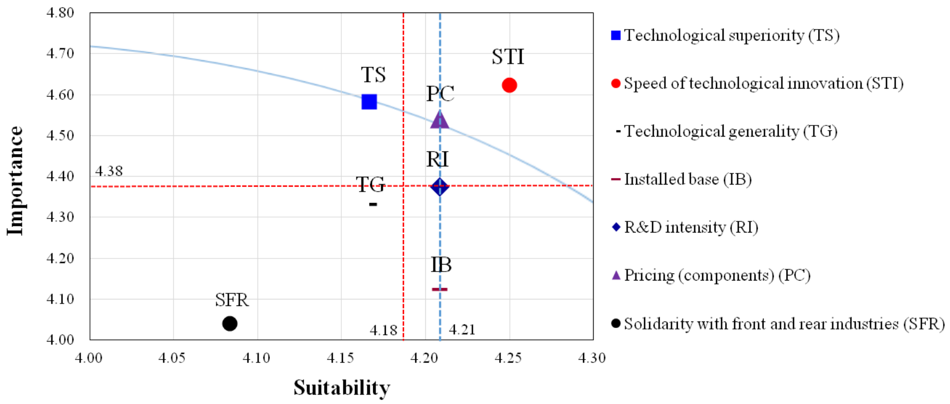


〈Figure 1〉 Integrative Framework for the Emergence of a Next-Generation Dominant Display

In parallel, the consensus (i.e. the group response stability for this work) was measured by the inter-quartile ratio (IQR) and coefficient of variation (COV) [English and Kernan, 1976]. An IQR of 1 or less was found to indicate a suitable consensus for the five-point Likert scale [von der Gracht, 2012]. Since a COV of less than 0.5 has a good degree of consensus and does not require an additional round [Dajani et al., 1979], the Delphi process was completed in accordance with the results of the COV in <Table 3> Consequently, these statistical procedures based on the consensus of the group of display experts indicate that this framework can be utilized as an ex-ante framework for a next-generation dominant display (see <Figure 1>).

In order to develop a strategic guidance, this work used a modified importance-performance analysis (IPA) to analyze the priorities between the determinants within the framework. The IPA measures respondents' perceived degree of importance and performance using a Likert scale and then classifies those attributes into four strategic quadrants. However, the traditional lagging indices need to be modified due to the IPA's usage for post-evaluation. In the case of the importance, this work assessed how important a determinant would be for the emergence of a next-generation dominant display. Meanwhile, it was difficult to assess the direct performance (or satisfaction) for each determinant within this framework in advance, so this survey measured the extent of the suitability of the determinants to influence a next-generation dominant display's appearance.

After the evaluation for the importance and suitability of all determinants by the panel, this work matched up the importance with the suitability of the retained determinants, as shown in <Figure 2>. Considering the sum of the importance and suitability, the 'speed of technological innovation' (STI) exhibits the highest priority while the rank of 'solidarity with front and rear industries' (SFR) is the lowest. 'Pricing (components)' (PC), 'R&D intensity' (RI) and 'installed base' (IB) are directly comparable in their importance because each figure is identical for suitability (4.21). However, it is impossible to compare the 'technological superiority' (TS) and PC on the offset curve due to the equivalent sums of importance and suitability.



〈Figure 2〉 Results of a Priority Analysis among the Retained Determinants

5. Conclusions

This study suggests that promising electronic displays are influenced by technological, organizational, and environmental determinants and that a next-generation dominant display will emerge as a result of technological competition, technological evolution, and market dominance. Most experts that participated in this research believe that LCD displays take a leading position as the current dominant design in the FPD industry and OLED displays are more likely to emerge as a next-generation dominant display. In addition, the results emphasize that display makers should devote their resources to rapid technological innovation and create a competitive edge in manufacturing costs for market dominance so that they gains a dominant position in the display industry.

This study also highlights the usefulness of the dominant design concept and extends the understanding of industrial standards, technology selection, and technological innovation. An attempt is made to develop an integrative framework of the determinants for the emergence of a next-generation dominant design, a new classification according to technological factors, and additional novel determinants in the display industry. The approach of this study, which combines literature review and empirical evidence, would improve and complement the frameworks in current studies on dominant design. This approach will also contribute to existing methodologies for integrating different factors by using expert networking.

The results of results provide the following practical implications and considerations. First, the 'speed of technological innovation' with the highest priority signifies that display makers should simultaneously accelerate component and process innovations rather than innovation in the current dominant display only. Component innovation may induce rapid improvement in performance by overcoming technological inferiority, and process innovation can build a foundation for cost advantage and improvement in the manufacturing yield rate. Therefore, the acceleration of these innovations for next-generation displays can be the innovative trigger. Second, since a dominant design is a *de facto* standard based on market acceptance and competition, the importance of 'pricing (component)' implies that cost leadership is critical for a larger initial market share. That is, market dominance, arising from cost leadership, which is directly related to various applications and broad demands, is more important than direct demand in front industries and R&D investments of display firms to maintain their technological advantage and subsequently, to secure new markets. In summary, practitioners might understand the fundamental technological characteristics of the display to ensure faster technological innovation and competitiveness in their display quality and cost by cooperating with other firms in front and rear industries.

Despite the exploratory nature of the methodologies used, such as unstructured interviews and the Delphi method, multiple methods with the corresponding experts are beneficial to assess a next-generation dominant design. The proposed framework of this paper also enables managers to identify core determinants that are more likely to prevail over the competition. This approach can be useful for managers in planning their competitive strategy in other ICT industries, as well as in the post-FPD age.

This study however, has the following limitations. The cross-sectional method employed presents difficulties in predicting variations in the importance of the determinants. In addition, experts in only the Korean electronic display industry were consulted, and therefore, the panel's responses to the unstructured interviews and the subsequent results of the Delphi method may not represent a geographically diverse sample, even though Korean display companies lead the global display industry with advanced technologies. Therefore, further research that considers longitudinal approaches with international experts might be required to establish a causal relationship.

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