

**Product Line-up Design based on Preference Measurement:  
A Case Study on TV industry**

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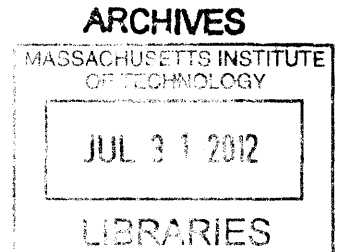
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**Key words:**

TV, consumer segmentation, conjoint analysis, preference measurement, product line-up

## 1. Abstract

Sony, in 2010, introduced innovative product line-up setting process for its TV, using the technique of market segmentation and conjoint analysis. This practice was expected to increase its sales compared to traditional vertical line-up, as academia has for long asserted that meeting specific needs of consumer groups in customized way with the most preferred combination of features identified through conjoint analysis is a way to bring the most willingness to pay from consumers. However, contrary to its estimate, Sony lost its market share significantly in 2010. In this thesis, I analyze how Sony actually came up with needs-based product line-up and check on whether there has been any problem in its process reflecting on the framework proposed by academia.

Consequently, three possible reasons to explain its failure were identified.

- The result of conjoint analysis should have been used in market segmentation
- Purchasing decision of TV is not made at the individual level
- Use of Meta attributes in conjoint analysis can be beneficial

In order to address the first issue, I recommend Sony to adopt a componential segmentation to execute both consumer segmentation and conjoint analysis, while for the second to consider the effect of group decision mechanism onto its conjoint analysis and to introduce consumer segmentation concept into the model of calculating group utility. Finally, in order to reflect Meta attributes in its conjoint analysis more properly, I propose that Sony should adopt prototype in preference measurement process, take business-oriented perspective in

product planning process, and prepare to reshuffle its product line-up from scratch. Those recommendations will ensure increase of the efficiency of preference-based product line-up setting in estimating market reaction.

## **2. Introduction**

Traditionally, consumer electronics manufacturers composed their product line-ups vertically. That means expensive TV has been released with all the brilliant features equipped, while inexpensive TV had only basic features. Accordingly, if new innovative technologies, i.e. huge sized LCD screen, were developed, it was a common practice to assign them into only high-end TVs during product line-up setting process. This kind of line-up design was based on the notion consumers would choose products by considering performance to price ratio only.

However, in 2010, Sony, one of leading TV manufacturers, designed product line-up based on preference measurement by using techniques of consumer segmentation and conjoint analysis, and eventually came up with not-vertical product line-up. It assumed that every consumer has different motivation behind making a final decision on purchasing and if certain product can meet specific needs for targeted group, it would lead to increase of its sales. Likewise, Sony denied the traditional product line-up setting practice by assigning some features that had been usually implanted only in expensive TV to not expensive one and vice versa. As a result, at the same price range, some TVs appealed its superb picture quality targeting people who cared about visual experience, while others appealed network functionality to technology-savvy people.

After adopting this new innovation in its product line-up, however, Sony lost its market share significantly in 2010 as shown in Table 1 below. This phenomenon contradicts the assertion from academia that consumer segmentation and conjoint analysis will bring the most

willingness to pay from consumers and maximize company's profit accordingly.

Q1 2010 Rank	Vendor	Q1 2010 Shipments	Q1 2010 Market Share	Q4 2009 Shipments	Q4 2009 Market Share	Percentage Change in Shipments
1	Samsung	1,149	18.0%	1,715	17.3%	-33.0%
2	Vizio	1,066	16.7%	1,844	18.5%	-42.2%
<b>3</b>	<b>Sony</b>	<b>722</b>	<b>11.3%</b>	<b>1,318</b>	<b>13.3%</b>	<b>-45.2%</b>
4	Sanyo	513	8.0%	401	4.0%	27.9%
5	LG Electronics	500	7.8%	793	8.0%	-36.9%
	Others	2,428	38.1%	3,870	38.9%	-37.3%
	Total	6,377.73	100.0%	9,942	100.0%	-35.8%

(Ranking by Unit Shipments in thousands)

**Table 1. U.S LCD-TV market share in the first quarter of 2010**

Likewise, in this thesis, I will investigate whether there was any problem in Sony's attempt to adopt preference-based product line-up setting and suggest how its practice can be improved in the future. In order for that, I will research on the recent academic work from marketing area on consumer segmentation and conjoint analysis to establish framework with which I will analyze Sony's case.

<sup>1</sup> <http://www.electronicadvocate.com/2009/11/17/samsung-regains-leadership-in-us-lcd-tv-market/>



### 3. Conjoint Analysis

#### 3.1. What is conjoint analysis?

Conjoint analysis is a technique that is used in market research area to predict consumers' preferences over product or service with certain features. First, set options of features, which have mutually exclusive and independent characteristics, which means if feature A is added by feature B in certain option, its total value to consumers is neither more or less than sum of values of each features, are shown to representatives of potential customers to survey their preferences on each option. Then preferences of respondents over those hypothetical products can be analyzed using statistical methods such as ordinary least squares (OLS) regression and polyhedral methods in order to come up with the contribution (= partworth or utilities) of each element (=feature) to the total preferences. Using those partworths, companies can calculate the total values for any combination of features and choose products that incur the most Willingness To Pay (WTP) of consumers to maximize their profits.

The basic idea is that total product value can be decided by the following formula.

$$V = \sum_i (A_i \times W_i)$$

**V (Value): Total value (preference) of the product/service**

**$A_i$  (Attribute): What product features do customers care about?**

**$W_i$  (Weight): How important certain features are considered?**

By asking consumers on their preferences on hypothetical products/services, one can obtain the value of V for each of combinations of features. Also,  $A_i$  can be decided by managerial

judgment, primary consumer data (i.e. focus groups, in-depth interviews and survey) or secondary consumer data (census data) before conjoint analysis is conducted. With those two values known, regression estimates can be used to discover the unknown value of  $W_i$  which is the weight for individual feature. This  $W_i$  is not the one consumers can precisely estimate, so conjoint analysis is the powerful tool with which those weights for various individual features can be predicted. Once, weights are decided, they can be input into the formula of total value above again and multiplied by specific known attributes,  $A_i$ , to estimate the total value (preference) of actual products.

For example, assume that a consumer wants to choose a TV. Out of several characteristics of TV, here I limit them only to three elements of picture quality, screen size and brand. In each of characteristics, it has only two levels, which mean picture quality is either good or average, size is either big or small and brand is well-known or unknown. Likewise, based on all the combinations of the three features,  $8 (= 2 \times 2 \times 2)$  different kinds of hypothetical TVs can be formulated. Then preferences for those hypothetical TVs can be asked to the sample of consumers. Here attribute ( $A_i$ ) 1 means better performance in each dimension while 0 inferior.

Preference	TV	Picture Quality	Size	Brand	Attribute Encoding		
					Picture Quality	Size	Brand
95	A	Good	Big	Well-Known	1	1	1
85	B	Good	Big	Unknown	1	1	0
70	C	Good	Small	Well-Known	1	0	1
55	D	Good	Small	Unknown	1	0	0
75	E	Average	Big	Well-Known	0	1	1
70	F	Average	Big	Unknown	0	1	0
40	G	Average	Small	Well-Known	0	0	1
10	H	Average	Small	Unknown	0	0	0

**Table 2. Example of conjoint analysis on TV**

Once preference is gathered through survey as shown in the most left column in the table 2 above by survey, the weight,  $W_i$  can be calculated by using regression analysis. Given preference as output and attributes as multiple inputs, we will come up with the best coefficients (weights) that minimize the regression error. The result for this example is as following.

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	22.5	6.846531969	3.2863353	0.030319669
Picture Quality	27.5	6.846531969	4.0166321	0.015908791
Size	37.5	6.846531969	5.4772256	0.005408479
Brand	15	6.846531969	2.1908902	0.093599021

**Table 3. Calculation of weight values in TV example**

Here higher value of coefficient means more important factor in consumer’s purchasing decision. For example, size is more important than picture quality in this example as coefficient of size (37.5) is bigger than the one of picture quality (27.5). With the coefficients (weights) decided, one can predict the market preference on actual products. For example, if a company with mediocre brand image wants to introduce TV with slightly above average picture quality and huge sized screen, its total value (preference) is likely to become 97. In this way, companies can choose the combination of products that are likely to be purchased the most in the market.

Preference	TV	Picture Quality	Size	Brand	Picture Quality	Size	Brand
97	I	Above Average	Biggest	Middle Position	0.8	1.2	0.5

**Table 4. Preference estimation of empirical TV in the example**

**3.2. Data Collection Methods**

There are many ways to survey consumers on their preferences on hypothetical products.

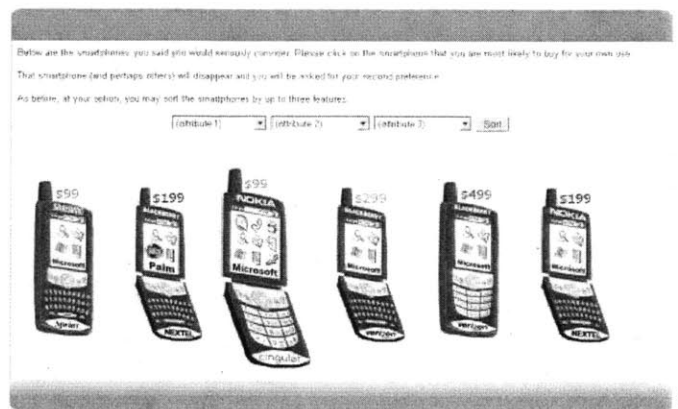
Here I will introduce what they are and what kinds of pros and cons exist for each type.

- Full-profile ratings

Full profile rating is a method that was used in chapter 3.1. After showing full ranges of combinations of features, which are often called profiles, surveyors ask respondents how much preference in number they have or how much in monetary value they are willing to pay for each of hypothetical products. The preferences are rated continuously and mostly hierarchical Bayes estimation and polyhedral methods are used for estimation, even though ordinary least squares (OLS) regression is accepted as in the example of previous sub-chapter.

- Full-profile rankings

Instead of continuous rating used in full-profile ratings, ranking method is used in full-profile ranking. Respondents are shown all the combinations of features and asked to “rank” each hypothetical product as shown in Figure 1 below. If certain product is ranked as 1, it is most preferred product. Monotonic regression, ranked-logit methods or linear programming are referred as most proper estimation methods.



<sup>2</sup> Hauser, J. R., "Note on Conjoint Analysis"

### **Figure 1. Example of full-profile rankings methods**

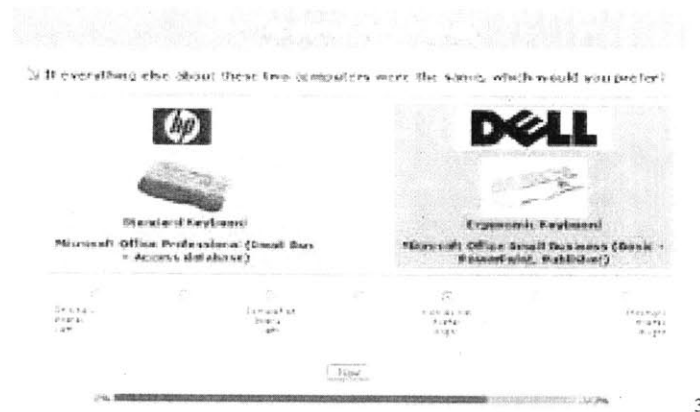
Both full profile ratings and rankings have some drawbacks. First, conjoint analysis based on full fraction design would require exponentially increasing number of options as the number of features (attributes) increases. That says if a company wants to experimentally obtain consumer's preference for 10 different kinds of features, it would require combinations of 1024 options. With this huge-scaled full factorial design of survey, consumers will often get distracted and the result will lose its validity as a result. Second, ratings or rankings do not reflect on the real situation where consumers make purchasing decision. Consumers often make choices between options, not artificially rating or ranking. This necessitates other types of conjoint analysis such as partial-profile tasks or choice-based conjoint analysis.

#### **- Partial-profile tasks**

Partial-profile task is a type of conjoint analysis that fixes certain features at a given level, and only asks consumers their preferences on two hypothetical products with limited number of features. In this data collection type, the methods either to allocate different number of chips between two alternatives to show how much consumers prefer one to another (which is often called metric paired-comparison) or simply to express which option one prefer can be used. The preferences can be often analyzed using OLS, hierarchical Bayes, polyhedral methods or support vector machines.

#### **- Choice-based conjoint analysis**

This method is to ask respondents to choose one among two to four hypothetical products, which are called choice sets. Since it resembles the actual purchasing situation most accurately, it is recently gaining popularity in the industry.



**Figure 2. Example of choice based conjoint analysis**

Since consumers only show their decisions, not ratings or rankings in choice-based conjoint analysis, it has been impossible to obtain individual partworth using classic estimation methods such as logit models, probit models and polyhedral methods. However, recent development of hierarchical Bayes and machine learning methods enabled us to estimate individual utilities. Also, there are several ways to reduce the number of profiles. One of the most common experimental designs is called orthogonal fractional factorial design. It can be built by inputting same number of zeros and ones into the column of matrix. Then we can model the effect of each of utilities separately, and then predict the combined effects with the small number of profiles. For instance, 16 features only require 32 profiles in orthogonal partial fractional design as shown below.

P1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P2	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1
P3	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1
P4	0	0	0	1	1	0	0	0	1	1	1	1	1	1	0
P5	0	0	1	0	0	0	1	1	0	0	1	0	0	1	0
P6	0	0	1	0	1	0	1	1	0	0	1	1	1	0	1
P7	0	0	1	1	0	0	1	1	1	1	0	0	0	1	1
P8	0	0	1	1	1	0	1	1	1	1	0	1	1	0	1
P9	0	1	0	0	0	1	0	1	0	1	0	0	1	0	1
P10	0	1	0	0	1	1	0	1	0	1	0	1	0	1	1
P11	0	1	0	1	0	1	0	1	1	0	1	0	1	0	1
P12	0	1	0	1	1	1	0	1	1	0	1	1	0	1	1
P13	0	1	1	0	0	1	1	0	0	1	1	0	1	1	0
P14	0	1	1	0	1	1	1	0	0	1	1	1	0	0	1
P15	0	1	1	1	0	1	1	0	1	0	0	0	1	1	1
P16	0	1	1	1	1	1	1	0	1	0	0	1	0	0	0
P17	1	0	0	0	0	1	1	0	1	0	0	1	0	0	1
P18	1	0	0	0	1	1	1	0	1	0	0	0	1	1	1
P19	1	0	0	1	0	1	1	0	0	1	1	1	0	0	1
P20	1	0	0	1	1	1	1	0	0	1	1	0	1	1	0
P21	1	0	1	0	0	1	0	1	1	0	1	1	0	1	0
P22	1	0	1	0	1	1	0	1	1	0	1	0	1	0	1
P23	1	0	1	1	0	1	0	1	0	1	0	1	0	1	0
P24	1	0	1	1	1	1	0	1	0	1	0	0	1	0	0
P25	1	1	0	0	0	0	1	1	1	1	0	1	1	0	0
P26	1	1	0	0	1	0	1	1	1	1	0	0	0	1	0
P27	1	1	0	1	0	0	1	1	0	0	1	1	1	0	0
P28	1	1	0	1	1	0	1	1	0	0	1	0	0	1	0
P29	1	1	1	0	0	0	0	0	1	1	1	1	1	1	0
P30	1	1	1	0	1	0	0	0	1	1	1	0	0	0	1
P31	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1
P32	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1

Table 5. How to build orthogonal fractional factorial design from 32 profiles

### 3.3. Use of conjoint analysis in industry

According to the survey by Philippe Cattin and Dick R. Wittink, conjoint analysis is widely used by marketing professionals in the industry to predict the impact of product features on consumer preferences. They found that total number of 698 research projects in a decade or 70 projects per year have been completed by 17 research firms. This great number of use case indirectly explains conjoint analysis has shown its validity in practice. Among several product categories, consumer goods were the area where conjoint analysis was heavily used compared to industrial goods or government. The purpose for which conjoint analysis being

<sup>4</sup> Hauser, J. R., "Note on Conjoint Analysis"

used varied, from the evaluation of new product/service concepts, consideration of alternative communication campaigns to market segmentation. However, in projects where attributes are “soft”, not physical one, or attributes are too many, conjoint analysis is often avoided in the industry. Green and Srinivasan expected this phenomenon by mentioning that individuals would have difficulty in evaluating hypothetical products with more than six features at a time, because of information overload. Likewise, some respondents seemed to be using componential segmentation and hybrid models more increasingly when there are too many attributes.<sup>5</sup> Among different data collection procedures, full profile ranking was the most widely accepted method. However, as new algorithms to estimate the stimuli with the limited information and web-based adaptive conjoint analysis have been developed recently, choice-based conjoint analysis seem to be gaining its popularity in the industry. In order to ensure validity of their research, companies often conducted consistency check i.e. by inserting replication of the questions. Or, they would test the validity of their analysis by comparing actual and predicted preferences or computing a cross validated correlation.

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<sup>5</sup> Green, P. E. and Srinivasan, V. (1978). “Conjoint Analysis in Consumer Research: Issues and Outlook”, *Journal of Consumer Research*, 5 (September), 103-23



## 4. Market Segmentation

Smith mentioned success in planning marketing activities would require precise utilization of both product differentiation and market segmentation as components of marketing strategy.

He argued that viewing a heterogeneous market as a number of small homogeneous markets in response to differing product preferences, and meeting specific desires of consumers in more precise and customized way would be a winning strategy for a company. <sup>6</sup>

### 4.1. Categorization of Market Segmentation

Wind categorized four different methods of how market segmentation can be designed. <sup>7</sup>

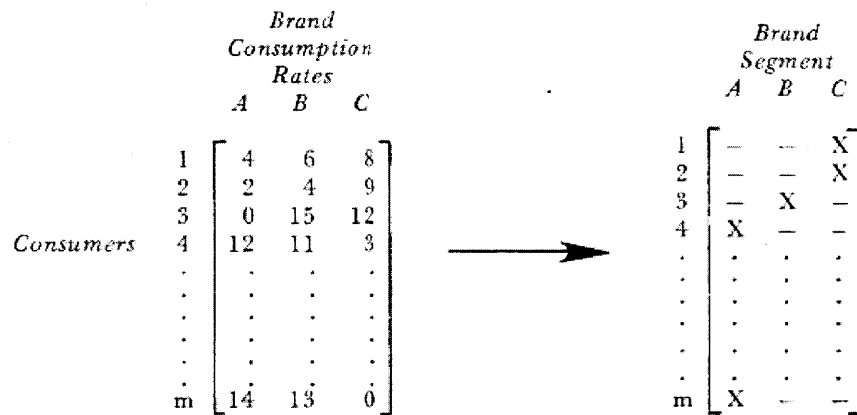
- A priori segmentation

Management decides on a basis for segmentation such as product-specific variable (i.e. brand, product usage) or customer characteristics (i.e. age, sex) before getting data on customers and formulating profiles using analytical procedures. For example, a company divides the consumer mass based on their preferences on brands, i.e. Samsung, Sony and LG. Then multiple discriminant analysis can be applied to identify possible different characteristic across different group. The following matrix shows how market can be segmented by a brand from the raw data of brand consumption rates in a priori segmentation.

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<sup>6</sup> Smith, W (1956). "Product Differentiation and Market Segmentation as Alternative Marketing Strategies", *Journal of Marketing*, 21 (July), 3-8

<sup>7</sup> Wind, Y. (1978), "Issues and Advances in Segmentation Research", *Journal of Marketing Research*, 15(August), 317-337



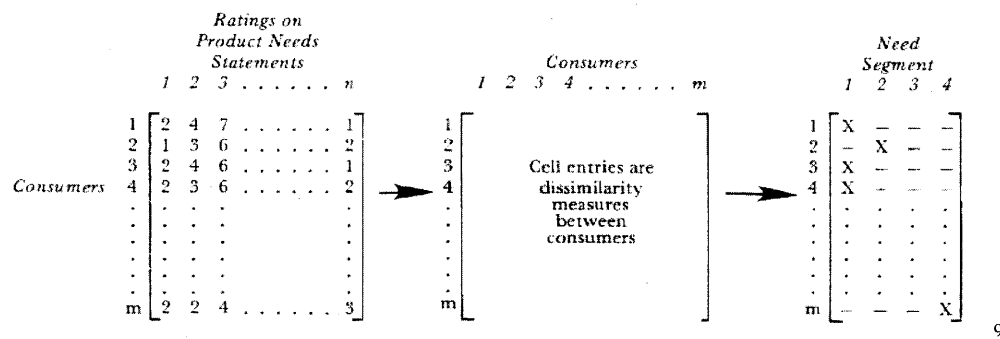
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**Figure 3. Mechanism to develop a priori segmentation**

- Clustering-based segmentation

Main difference of clustering-based segmentation from a priori segmentation is basis for segmentation (the number and type of segmentation) is decided after getting data on customers and then clustering of respondents on similarities on set of variables. One cannot decide how many segments will turn up and how big the size of each segment will become before conducting cluster analysis. In the following example, m consumers were surveyed on benefits sought for the product and then clustered first based on the degree of agreement of the need statement. Then multiple discriminant analysis were applied to check if various clusters have different characteristics in other dimensions such as brand preference, age and etc to eventually yield four simple need segments.

<sup>8</sup> Green, P. E., "A New Approach to Market Segmentation", Business Horizons, 20 (February), 61-73



**Figure 4. Mechanism to develop on clustering-based segmentation**

- Flexible segmentation

Flexible segmentation develops many alternative segments that two traditional segmentation methods could not cover by aggregating a group with similar preference on “hypothetical” products. This approach is based upon the conjoint analysis and computer simulation of consumer behaviors. The biggest difference between this approach and traditional methods is management team has flexibility of dividing and aggregating segmentation based on the utilities value that was identified by conjoint analysis. Then, information such as demographic characteristic and market share can be easily estimated using multiple discriminant analyses.

- Componential segmentation

The componential segmentation shifts a focus of market segmentation from how heterogeneous market is segmented to which group with certain characteristics such as demography, psychography, and benefits recognized for products will be most responsive to specific products. Especially, this approach is notable in that conjoint analysis is applied to not only selecting the features of the product, but also the propensities of

<sup>9</sup> Green, P. E., “A New Approach to Market Segmentation”, Business Horizons, 20 (February), 61-73

respondents. In other market segmentation methods, when conjoint analysis is applied, the utilities matrix identified by conjoint analysis can be served as input to validate the profiles set in case of a priori segmentation or as input to clustering program which would result in benefit segments in case of clustering-based segmentation.<sup>10</sup> However, in componential segmentation, the same utilities matrix can be applied to selecting of respondents. For example, in previous chapter of conjoint analysis, I discussed the eight types of TV by screen size, picture quality and brand, and identified stimuli for each attributes. With those stimuli, we can estimate how reactive certain group will be to specific type of TV. If factors that segment the total markets are geography (Americas, Europe and Asia), sex (Male and Female), marriage status (Single and married) and income level (High, Mid, and Low), then  $3 \times 2 \times 2 \times 3$  combinations of consumer profiles can be constituted. With orthogonal design, those combinations can be reduced up to 9. Then by carrying out conjoint analysis to each type of consumer profiles (i.e. single female with low income in Asia) with 8 hypothetical combinations, researchers can obtain data of  $9 \times 8$  matrix. Then with COSEG (componential segmentation) algorithm, one can decompose the matrix into individual parameter values for each of the 8 product features and each level of the 9 consumer profile characteristics. If Monte Carlo simulator is further used, we can estimate (1) for each respondent segment, the frequency of the first choices for certain hypothetical products (2) for each product combinations, the frequency of first choices across segments.<sup>11</sup> Likewise, componential segmentation is a strong framework to analyze both market segmentation and preference for product offerings at the same time.

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<sup>10</sup> Wind, Y. (1978), "Issues and Advances in Segmentation Research", *Journal of Marketing Research*, 15(August), 317-337

<sup>11</sup> Wind, Y. (1978), "Issues and Advances in Segmentation Research", *Journal of Marketing Research*, 15(August), 317-337

#### **4.2.    Levels of Segmentation**

Wind mentioned it is more “art” type question based on managerial discretion. However, general criteria for deciding whether to decompose segments further are segment stability and cost estimation of segmentation. It is known that segment stability can be checked by comparing the results with alternative clustering procedures. Also further segmentation issue can be decided in trade-off relationship between cost of managing segments and costs of inefficient segmentation. That means the cost of segmentation generally correlates with the number of levels since managing great variations of segments takes expense, while homogeneity within a segment by further segmentation leads to eradicate inefficiency of targeting average tastes in marketing strategy.

Whichever methods are used for market segmentation, marketers consider implication of segmentations of preference heterogeneity for (1) changing current segments, (2) accessing selected segments, and (3) evaluating whether the changes in consideration will incur additional profits when setting product line-ups.

## 5. Product line-up in TV industry

### 5.1. General Industry Trend

Traditionally, TV manufacturers have set up their product line-ups in a vertical manner as mentioned in introduction. That means there are flagship, volume zone and basic models, and flag ship model is always the most expensive one with all the innovative features implanted while the most inexpensive models come only with the basic functionalities. This vertical product line-up was based on the conception that line-ups which are simply recognizable by consumers are the best ways to appeal the values created by technology-driven innovation and to accumulate superior brand image in the consumer's perception.

For example, Appendix A shows how Samsung, one of leading manufacturers of TV, set up their products line-up in 2010. The row shows functionalities while column has series names. As we move along from left to right column, generally new features are likely to be added or some functionality is getting strengthened. Series 4 models are entry-type 720p models with basic connectivity and decent picture quality, while Series 5 models have increased resolution up to 1080p for a full high-definition TV experience. From Series 6 models, some significant performance such as 120Hz drive has been enhanced for smooth picture transition, while some trendy functionalities such as Ethernet connections for RSS downloads of weather, stock prices, news and sports scores has also been newly adopted. Likewise, the highest-end TV, in this case Series 9, has the most new functionalities. Also, in terms of technological performance, such as contrast ratio, consumer electronics manufacturers intentionally adjusted higher-end TV to the higher level in consideration of cannibalization problem from less profitable lower-end products.

It is also interesting to see that their products can be lined up vertically in a perspective of pricing. The Table 6 below shows MSRP (Manufacture Suggested Retail Price) of Samsung’s LCD TVs in 2010. While there are small overlaps of pricing zone between each series due to the pressure on cost increase from big LCD panel, each series has almost lower price than higher rank series. Conversely, as just shown in the naming of Series 4, 5, 6, 7, 8, 9, TV manufacturers industry-wise has targeted to establish vertical line up in terms of both features and price so far.

Series/Model	Estimated Selling Price	Size (inches)	Availability
UN55C9000	\$6,999.99	55	April 2010
UN46C9000	\$5,999.99	46	April 2010
UN65C8000	\$4,999.99	65	July 2010
UN55C8000	\$3,499.99	55	April 2010
UN46C8000	\$2,799.99	46	April 2010
UN55C7000	\$3,299.99	55	March 2010
UN46C7000	\$2,599.99	46	March 2010
UN40C7000	\$1,999.99	40	May 2010
UN55C6800	\$2,999.99	55	May 2010
UN46C6800	\$2,299.99	46	May 2010
UN65C6500	\$4,499.99	65	May 2010
UN55C6500	\$2,799.99	55	March 2010
UN46C6500	\$2,099.99	46	March 2010
UN40C6500	\$1,699.99	40	March 2010
UN32C6500	\$1,199.99	32	May 2010
UN60C6300	\$2,999.99	60	May 2010
UN55C6300	\$2,499.99	55	March 2010
UN46C6300	\$1,699.99	46	March 2010

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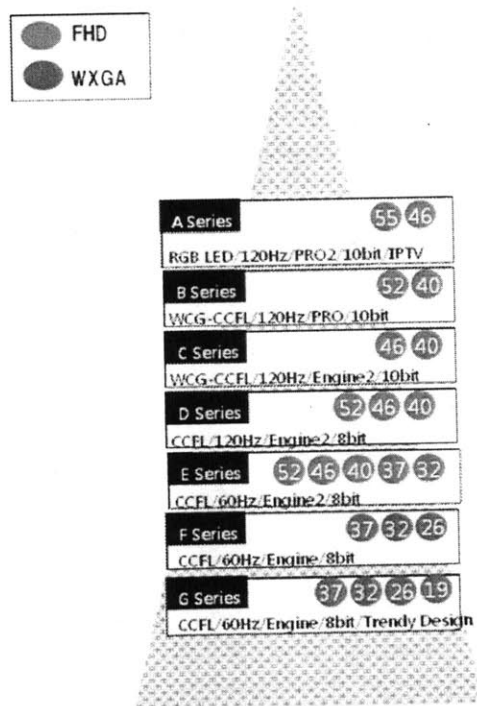
**Table 6. Example of vertical line-up: 2010 Samsung TV**

**5.2. Overview of Sony’s product line-up design based on preference measurement**

Here I want to introduce the case of Sony, one of leading TV manufacturers when it tried to diverge from traditional product line-up setting process and aggressively to adopt market segmentation and conjoint analysis in 2010. Due to confidentiality issue, some proprietary information will be hidden throughout the thesis.

<sup>12</sup> <http://trendsupdates.com/samsung-gives-an-insight-into-the-expensive-price-structure-for-its-3d-products/>

Like all the TV manufacturers in the world, Sony had set up its product line-up vertically in the domains of technological performance and pricing in the past. The Figure 5 below shows how Sony's LCD TV product line-up looked like in 2008. With the combinations of resolution, screen size, type of backlight, driving frequency, signal processor type, bandwidth of digital signal path and IPTV configuration, Sony introduced 21 different types of LCD TVs. While entry-level models inherited most of basic features from models in previous years, Sony strategically allocated innovative technologies such as LED backlight or 120Hz drive into its flagship models in order to appeal its frontier technology and establish strong brand image as a leading company. This was the typical "Winner takes all" type of product line-up practice in TV manufacturing industry.



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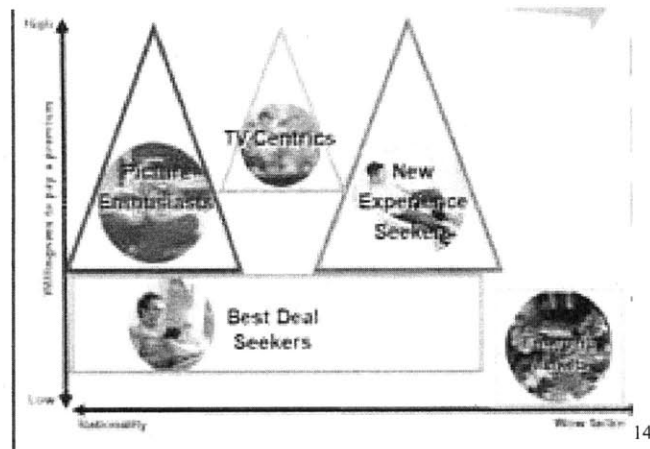
Figure 5. Sony's vertical line-up in 2008

However, in 2010 Sony introduced totally different configuration of product line-up of LCD

<sup>13</sup> Reconstructed based on <http://www.avsforum.com/avs-vb/showthread.php?t=971094>



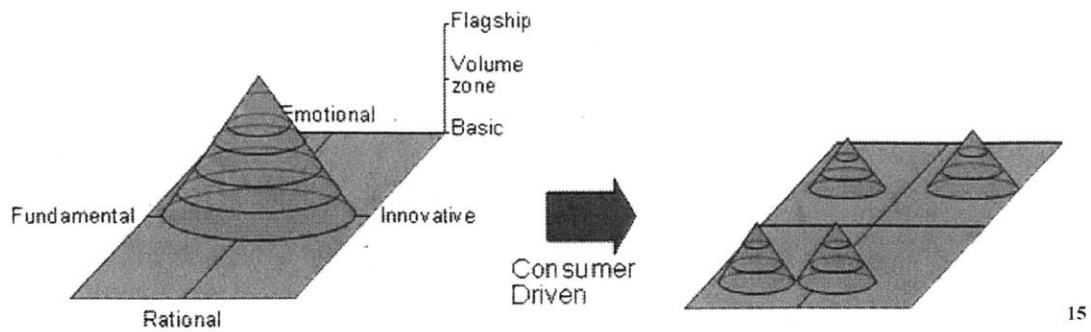
TV. First it noticed that the reasons for consumers to make purchase decisions on TV might be different case by case. Some might purchase TV, because of its superior picture quality, while some might be interested in certain TVs to try new experience with innovative features. Also, some people consume the “brand” based on the popularity of company’s name, while some may seek for the best deal under the same features. Likewise, Sony divided the total market of consumers based on the motivation behind purchasing behavior and located each segment in the perceptual map of price importance index (Willingness to pay a premium, Y axis) and brand preference (X axis) as shown below, identifying each of the group as Picture Enthusiasts, TV Centrics, New Experience Seekers, Best Deal Seekers and Emerging Markets.



**Figure 6. Needs-based consumer groups in perceptual map of price importance index and brand preference**

This new initiative was to compose product portfolio to meet specific market needs and customize the combination of features and pricing to different needs as shown in the illustration below. While traditional approach for line-up setting was more likely driven by development of new technologies, this movement was initiated by efforts to put “consumers’ tastes” at the highest priority.

<sup>14</sup> Sony’s internal resource



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**Figure 7. Shift from vertical line-up to product portfolio  
based on needs-based consumer segmentation**

### 5.3. Process of establishing TV line-up in Sony

In this subchapter, it will be explained how Sony actually came up with customer segmentation and consequently constructed product portfolio based on consumer segmentation and conjoint analysis on the various features.

#### 5.3.1. Segmenting consumer base and selecting target segments

First based on the criteria in consumers' purchasing decision, Sony divided total consumers to four different groups: Group1 (Company brand driven premium payers), Group2 (Product driven premium payers), Group3 (Optimizer) and Group 4 (Less involved and price sensitive buyers). Group 1 is a firm believer of Sony's prestigious brand and chooses Sony's product almost without question. Group 2 is the one who has loved Sony products' historic performance so far, so when they review products from several manufacturers, they naturally put Sony into consideration. Group 3 is a very rational consumer segment who tries to

<sup>15</sup> Sony's internal resource

maximize price to performance ratio among several options in the market, after researching on very detailed specification of the products. Finally, Group 4 makes purchasing decision solely based upon the price, generally ignorant of performance. Afterward, each group is further divided into subgroups in more detail as following.

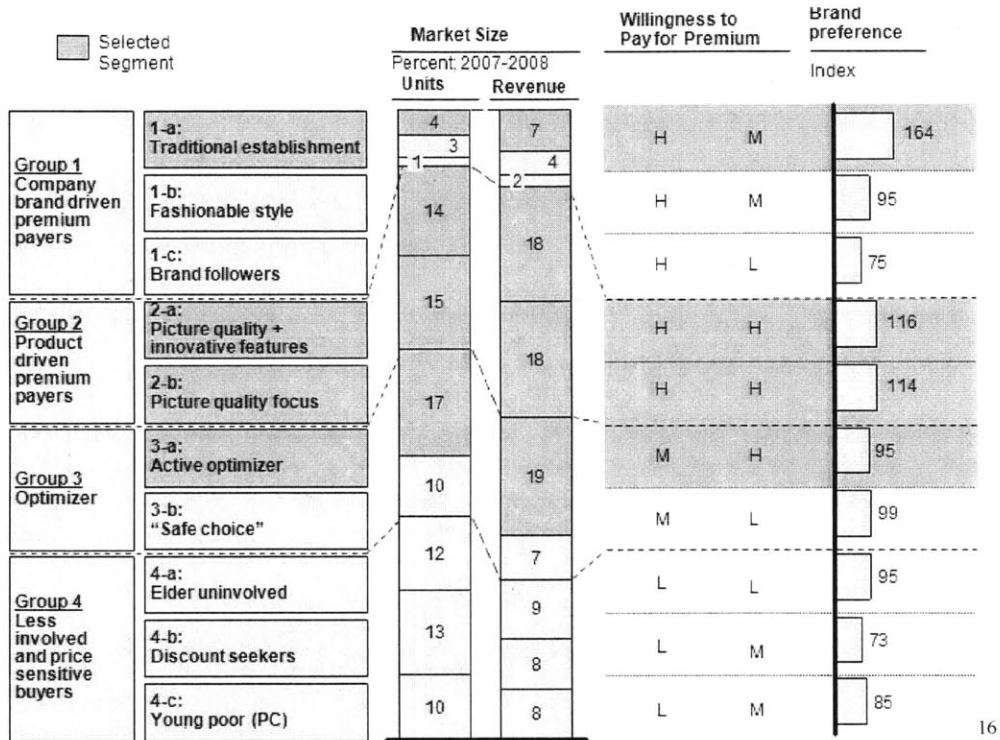


Figure 8. Detailed consumer segmentation of TV market

Group 1: A (Traditional Establishment), B (Fashion Style), C (Brand Followers)

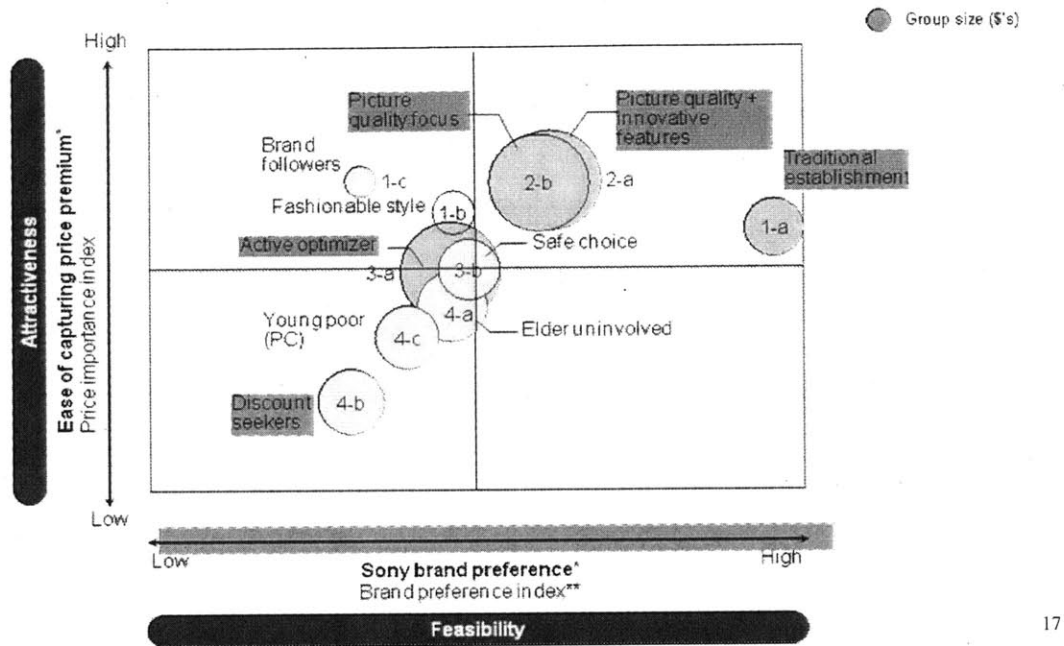
Group 2: A (Picture Quality + Innovative Features), B (Picture Quality Focus)

Group 3: A (Active Optimizer), B (Safe Choice)

Group 4: A (Elder Uninvolved), B (Discount Seekers), C (Young Poor: PC user)

<sup>16</sup> Sony's internal resource

Based on this detailed segmentation above, perceptual map in Figure 6 could become more detailed as following.



**Figure 9. Perceptual Map of Detailed Consumer Segmentation**

Among all those segments, Sony strategically chose categories in upper right portion of the perceptual map. This was because given Sony's financial crunch, it wanted to increase its profitability by introducing products that can capture price premium. Also, since Sony has cherished leading position for a long time and accumulated a strong brand image, it planned to select consumer layers that are receptive to brand power. Once those decision rules are made, Sony estimated market size based on the market research data and chose the biggest four subgroups, traditional establishment, picture quality + innovative features, picture quality focus and active optimizer, which had great potential to incur huge revenue.

### 5.3.2. Analyzing characteristics of target subgroups and establishing product concepts

<sup>17</sup> Sony's internal resource

After consumer segmentation and choice of target, Sony analyzed the characteristics to brainstorm basic concepts of TV for each group.

- Traditional Establishment

#### Characteristics

This subgroup is mainly composed of over mid-age people who prefer to have a TV with big screen size for family use. Since they are quite risk-averse and conservative, they are often reluctant to challenge new brands and inclined toward traditional brands. Even though it is true they have tendency to look for product information hard, in general they cannot fully understand the usefulness of new technologies. Likewise, they are characterized to enjoy “owning” good television.

#### Guideline

In the model targeting this group, it is desirable to have superior functions to ones in the basic models. Also, technologies implemented into TVs should outperform competitors', even though too innovative features are not necessarily essential. More than anything else, it is assumed to be important to utilize brand power of Sony in this category.

#### Product Concepts

In every aspect, the model for this consumer segment should have technological performance at least equal to the lower-end models. Especially, given that consumers are not technology-savvy people, ease of use should be aggressively appealed. Also, design should have image of luxury or grandness to appeal to senior people with great purchasing power. Likewise, the model for this segment can be considered as the highest

model in traditional pyramid-like vertical product line-up.

- Picture Quality + Innovative Features

Characteristics

This group also has preference on somewhat large-sized screen. To some degree, they pursue good picture quality, but have little knowledge on innovative video processing algorithms or display technologies to improve picture quality of TV. Foremost, they will look for new features or trendy design which they can easily understand the value of.

Guideline

For this group, it is most important to promote “technology branding” by implanting easy-to-appeal new features into the TV, while having good picture quality or good design is also desirable without question.

Product Concepts

Up-to-date technologies with evident value addition are the most important factor in this product. Also image of “Newness” or “Uniqueness”, rather than “Luxury” should be attached to the product by design.

- Picture Quality Focus

Characteristics

This group thinks good picture quality as the most important factor when deciding on TVs and they have good knowledge on picture quality improvement technologies.

Especially, they search for evaluation report on certain TV written by the professional critics or renowned amateur opinion leaders, and try to understand their perspectives before making any purchasing decision. Compared to Picture Quality + Innovative Features, this group is insensitive to the eye-catching or trendy functionalities.

### Guideline

Building a product with superior quantitative metrics on picture quality, i.e. superb contrast ratio or fast response time, is the most important.

### Product Concepts

It is recommended to adopt the LCD panel that most critics agree the best platform to design TVs with great picture quality. Also, TVs in which detailed settings for picture quality can be configured by consumers themselves are recommended. In terms of design, splendid color that distracts viewing experience should be discouraged.

- Active Optimizer

### Characteristics

This group also has inclination to prefer bigger size of screen, but to some degree, they are sensitive to price change. In other words, when they purchase TV, they try to find TV with the most number of functionalities within their budget limit, after making a comparison among several products from different manufacturers in the same price zone. Meanwhile they prefer to have practical features whose value can be easily identified, such as input/output terminal counts.

### Guideline

It is most important to suppress the cost of goods by implementing technologies that have been already proven in the market and are thus able to enjoy economies of scale. Also, in designing a product, applicability of common modules across different models or adaptability of previously designed platforms would be the most important issues.

### Product Concepts

Main functions that are easily checked by consumers on the shop, i.e. functions that are supposed to be written on the specification such as Appendix A, should be all implemented. Especially, among all the innovative technologies, the practical ones which are likely to be used often by users, i.e. remote controller that controls other types of electronics products, should be emphasized.

#### 5.3.1. Narrowing down technological options for conjoint analysis

Before conducting conjoint analysis, Sony narrowed down the features to be asked to sample consumers into 12 options. There were many internal innovative ideas potential to be implemented to new TVs at that time, but managerial team used their own discretion to limit the number in order to exercise full factorial conjoint analysis. The followings are the features that a sample of consumers was asked how much preference they have during conjoint analysis.

- 240Hz vs. 120Hz vs. 60Hz

Generally, TV shows 60 frames of static picture per second to make objects seem to move smoothly. However, as more interpolated frames are put between frames, images can



become smoother. This kind of technology was called Motionflow in Sony and it was to improve picture clarity in fast moving scenes and reduce motion blur. It is known that as the more frames are added, i.e. 240 frames/s, the more picture quality improves.

- 2 million:1 vs. 50k:1 vs. 50000:1

The contrast ratio is a property that can be defined as the ratio of the luminance of the brightest color (white) to that of the darkest color (black). As this ratio goes up, consumers can see the objective more clearly. For example, stars in dark sky can be watched better if contrast ratio of TV is higher.

- Auto-picture adjust

Auto-picture adjust is a feature that automatically adjust the picture quality to the best level regardless of situation where TVs are located. For example, in a rural area, the transmittance of broadcasting signal can be easily distracted by noise signal, because there is long distance between transmitter and receiver (TV). In this case, TV automatically checks the status (noise level) of receiving signal and makes an automatic adjustment on the video signal level.

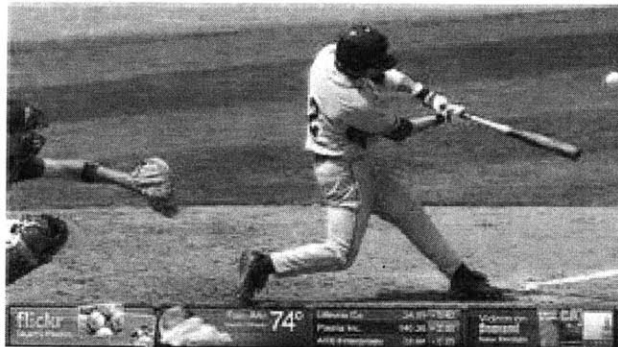
- IPTV

IPTV is the acronym for Internet Protocol television (IPTV). It is the platform where IP based signal can be received from computer network. This technology enables users to access Internet as they do through PC and creates significant opportunities to make TV viewing experience more interactive and personalized.

- Widget

Widget is personalized information displayer on the side of TV screen. As shown below,

consumers can configure the boxes that show information such as weather, news update and stock price as they want. This technology was made possible after Internet could be connected to TV and other information than broadcasting video/audio signal can be delivered to TV.



**Figure 10. Example of Widget**

- 2-HDMI

HDMI stands for High-Definition Multimedia Interface. Through HDMI terminal, digital signal can be delivered from external video signal transmitters such as DVD player, camera and video game consoles to TV. Since the signal integrity through HDMI is superior to one through other types of connections such as S-Video, composite video or component video which have been used traditionally, recently consumer electronics aggressively lead consumers to switch their video equipments to the ones with HDMI compatible. More HDMI input terminals in TV means TV can be connected with more video players with good picture quality assured.

- 0.5 inch thinness

One of advantage of recent HDTV over traditional CRT TV is its thinness. However,

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<sup>18</sup> <http://www.sizlopedia.com/2008/08/22/yahoo-connected-tv-to-bring-web-widgets-to-tv/>

recently as new backlight technologies such as LED backlight has been developed, LCD TV could become much thinner up to the level of 0.5 inch. This slimness can give consumers satisfaction with its beautiful design and enable them to hang TVs on the wall easily.

- Pausing (15min.)

Pausing is a feature that pauses real-time broadcasting for some time, so that users can continue to watch it without losing any contents when they should be away from TV. This feature can be implemented by implanting storage system into TV as a buffer that holds some amount of broadcasting video data. Users can bring the data back on to TV screen when they want to keep watching the contents.

- 2-box wireless

There are usually two types of TV: all-in-one type and separate type. While all-in-one type can be hard to be hung on the wall because of its thickness, separate type has advantage in that thin display part can be almost attached to the wall when separate set-up box part with significant number of electronic modules in is put somewhere on the floor. However, this separate type requires some kind of connection between display and set-up box, which makes TV aesthetically undesirable. In that sense, wireless communication between two parts of display and set-up box in separate type can provide consumers better looking TV, getting rid of unnecessary cables.

- Recording (6 Hrs.)

Recording is almost the same feature as pausing except the fact that it can record longer contents with bigger hard disk in capacity. Likewise, consumers can record whole

contents of a program when they cannot watch on-air contents and watch them whenever they want to.

- Built-in Wi-Fi

Built-in Wi-Fi offers consumers the advantage of removing ugly connection of Ethernet for IPTV functionality. Likewise, even though the TV is hung on the wall, consumers do not need to see complicated cables for Internet connection. This feature can be implemented by building in Wi-Fi receiver into TV.

- Multi-view + Gyro RC

Multi-view technology on remote controller is for consumers to view some kind of information about TV, i.e. Menu user interface, on the display of remote controller. Also Gyro remote controller can transform the movement of the remote controller into electric signal, so that users can control TV not only by pushing button on the remote controller, but also moving itself in the air. This technology can be felt as user-friendly among consumers and it is often used in the video console game such as Nintendo's Wii.

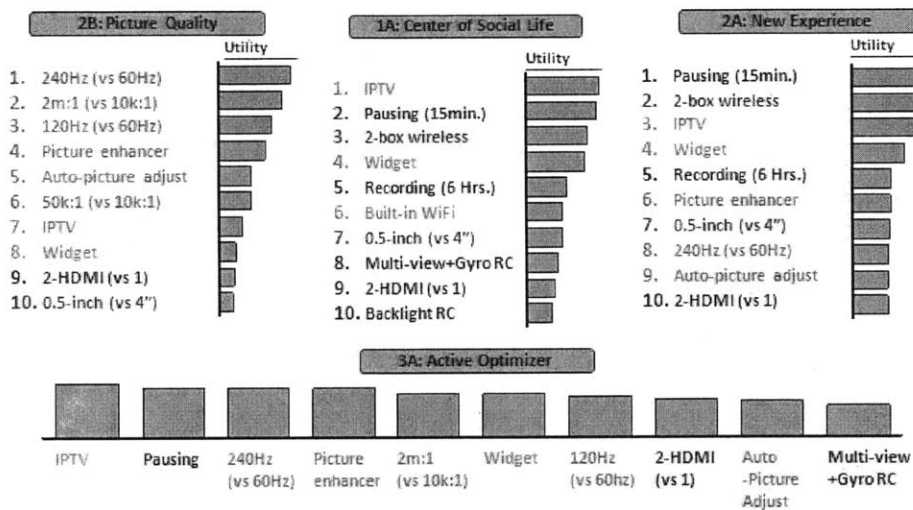
### 5.3.2. Carrying out conjoint analysis

To each of segments identified by consumer segmentation, surveys of preferences on new technologies were carried out. The type of conjoint analysis was full-profile ranking in which consumers are requested to rank 12 features by order. As shown below by the result, each group had different utilities for different features. For example, Picture Quality group showed high utilities to technologies that can improve picture quality such as Motionflow, high contrast ratio, and auto picture adjustment function. Meanwhile, New

Experience group who was expected to put more focus on trendy technologies in the analysis of characteristics of target subgroups met Sony’s expectation by preferring drastically innovative features such as Pausing or IPTV to picture quality improving technologies.

### FEATURE PREFERENCE by SEGMENTATION

THERE ARE CLEAR SKEW IN FEATURE PREFERENCE AMONG THE SEGMENTS



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Figure 11. Result of conjoint analysis for each consumer group

As a result of this product line-up setting process based on preference measurement, Sony could analyze which new features are worth to be implemented in order to catch specific consumers’ attention. Final line-up introduced in the market in 2010 is shown in Appendix B.

<sup>19</sup> Sony’s internal resource

## **6. Analysis on the case of TV line-up setting process**

In this chapter, several hypotheses to explain why Sony's TV line-up based upon preference measurement failed to estimate market reaction will be proposed.

### **6.1. The result of conjoint analysis should have been used in market segmentation**

I argue that Sony should have employed the result of conjoint analysis in the consumer segmentation to divide the market into clusters with homogeneous tastes more precisely. In the case, it first segmented market based on the logical analysis of consumers' purchasing behavior and then carried out conjoint analysis to figure out the best combination of product features for each of target consumer groups. However, its attempt to confirm the validity of its initial consumer segmentation only with skewed preference for features does not seem enough to ensure homogeneity within the group. Especially if Sony eventually planned to conduct conjoint analysis to introduce the best-fit composition of products for each segment, I propose it could have first carried out conjoint analysis on general population and then used the preference data of consumers both to segment the market and to design the most proper products with the limited amount of additional efforts. Likewise, the order of market segmentation and conjoint analysis should have been opposite and the scope of conjoint analysis being applied to should have been broader in practice for more valid product line-up setting.

#### **6.1.1. Merits in Using Conjoint Analysis in Consumer Segmentation**

As noted in chapter 3, the result of conjoint analysis is already being widely used to identify market segmentation. This is because conjoint analysis can provide good quantitative platform to divide the market more accurately, as the analysis algorithms for grouping consumers based on its preference and connecting it with other characteristics have been developed.

In the paper of “Conjoint Analysis in Consumer Research: Issues and Outlook”, Green and Srinivasan identified the value of consumer segmentation using conjoint analysis. They insisted that consumer segmentation based on importance (preference discovered by conjoint analysis), not predicted preferences as in the case of Sony, would be more valid in many applications.<sup>20</sup> Green and Krieger also confirmed the limitation of a priori segmentation based on intuition or logical analysis by mentioning a priori segmentation using ancillary variables or the observed choice frequencies does not guarantee different preferences and price sensitivities among different segments.<sup>21</sup> Furthermore, Wittink and Montgomery experimented on the validity of individual and segment based preference model in estimating market share, and obtained higher predictive validity for individual-based preference models than for segment-based.<sup>22</sup> This necessitates surveys on preference in the conjoint analysis to be done at the individual level before segmenting the market into several groups. In summary, academia strongly recommends segmenting market in a quantitative manner, possibly using conjoint analysis to individual sample in order to ensure homogeneity within the segmented group.

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<sup>20</sup> Green, P. E. and Srinivasan, V. (1978). “Conjoint Analysis in Consumer Research: Issues and Outlook”, *Journal of Consumer Research*, 5 (September), 103-23.

<sup>21</sup> Desarbo, W. S., Ramaswamy, V. and Cohen, S. H. (1995), “Market Segmentation with Choice-Based Conjoint Analysis”, *Marketing Letters*, 137-147

<sup>22</sup> Wittink, D. R. and Montgomery, D. B. (1979), “Predictive Validity of Trade-off Analysis for Alternative Segmentation Schemes”, Chicago: American Marketing Association, 68-73

### 6.1.2. Lack of Quantitative Approach in Sony's case

If quantitative analysis were to be applied to consumer segmentation as academia recommended, contrary to logical analysis in Sony's case, the preferences can be utilized as predictor variables in a multiple discriminant analysis in a place where market has already been divided into a set of groups on the basis of some other criterion in case of a priori segmentation. Also, in clustering-based segmentation, one can apply cluster analysis to segment total group into the ones with similar preferences for certain attributes and cross-tabulate the clusters against various background variables. However, Sony missed any of those steps to use preference data to segment the market or even to validate its initial consumer segmentation in a statistical manner. Also, its use of conjoint analysis was limited only to identifying features in product line-up design process afterward.

Then it is to be questioned whether lack of quantitative approach in Sony's consumer segmentation really led to some kind of heterogeneity within a group and I believe the answer is very positive. For example, it can be discovered that IPTV technology is liked by almost all different groups except picture quality focused group in Sony's conjoint analysis. IPTV is an innovative technology that can transform the concept of TV experience from passively watching the contents to actively choosing what viewers want to see and how they interact with broadcasters. Likewise, in general, it is expected that traditional establishment group who is strongly affected by company's brand and who is not very much technology-savvy according to Sony's definition is not necessarily expected to have much interest in such an innovative technology. However, according to research result on preference by Sony, IPTV was ranked as No. 1 for traditional establishment group. I suspect this phenomenon might have occurred because either some people who were identified as traditional establishment



might belong to other categories, i.e. Picture Quality + Innovative Features group, or more importantly some other motivations than brand-based purchasing might have existed within this group. Likewise, I believe there was lack of validity in consumer segmentation in Sony's case and it was caused by purely depending on logical analysis.

### 6.1.3. Effect of Heterogeneity in Consumer Segment

Desarbo illustrated result of inefficient market segmentation, especially when there exists heterogeneity in the segmented consumer base, and potential cost followed in his work of "Representing Heterogeneity in Consumer Response Models". According to him, if the independent attribute is only price with the dependent variable being probability of purchase, and two market segments with same size have exactly opposite characteristics regarding price (i.e. one has upward sloping utility function while the other has downward), the market in aggregate may seem indifferent to price since its aggregate utility function will become flat. However, in market segment one, actually members utilize price as a proxy for quality and wish to buy the highest quality goods, offering a company great opportunity to increase the revenue by pricing its product at higher level. For another market segment which is highly sensitive to price, lowering price would bring great revenue increase in the opposite manner. Likewise, structural heterogeneity within the segmented group caused by misinterpretation of the real effects of independent criteria on separate groups can easily hurt potential sales. In a same manner, lack of homogeneity in Sony's consumer segmentation has possibly led to inefficient marketing strategies for each group and lagging sales of its products accordingly.

### 6.1.4. Application of Conjoint Analysis to Consumer Segmentation

Next question would be what the most proper way is to apply the result of quantitative analysis into product line-up setting in order to reflect on consumers' preference more precisely. Here I want to suggest the use of componential segmentation as introduced in chapter 4. Unlike traditional methods such as a priori or post hoc segmentation, componential segmentation reduces the necessity of further analysis of data on top of conjoint analysis, which is beneficial to practitioners with limited resources. Also, componential segmentation could be a better method than traditional ones in estimating preference on specific products by specific groups and market reaction more precisely, since it decomposes individual response to come up with "component" contributions of either person or offering, utilizing the result of conjoint analysis, while traditional approaches just compose groups with similar characteristics.<sup>23</sup> Finally, through componential segmentation, marketers can effectively validate their segmentation. COSEG algorithm which is adopted in componential segmentation, can first verify how segmentable the market is. By checking segmentability index, a measure of how large the interaction between criteria, one can estimate certain product offerings are truly interrelated with some characteristics of the respondents. If Sony assumed interconnection between the above-average age and big screen size in traditional establishment group as identified in concept generation process, it could have been easily validated by checking whether segmentability index was high in COSEG algorithm of componential segmentation.

However, there might be some caveats related with componential segmentation. First, it divides the market highly specifically, so data points for conjoint analysis can swell rapidly with the full factorial design. Even though orthogonal design is used, it may not be feasible to find the survey targets who meet specific profiles. However, Green mentioned non-

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<sup>23</sup> Green, P. E., "A New Approach to Market Segmentation", *Business Horizons*, 20 (February), 61-73

orthogonal design of respondents would be still effective with slightly lower statistical validity.<sup>24</sup> Also, he insisted that by leaving intentionally a relatively small number of responses for internal cross validation and comparing the prediction with the result, one can compensate the drawbacks of componential segmentation, difficulty in dealing with lots of data points for conjoint analysis. Truly, effective validation on consumer segmentation using the result of conjoint analysis in the form of componential segmentation could have prevented Sony from hypothetically dividing consumer base based on instincts and missing the process of checking the validity of consumer segmentation with any kind of statistically effective manners.

## **6.2. Purchasing decision is not made at the individual level**

Conjoint analysis inherently assumes each of individuals is the unit who makes a purchasing decision. This assumption let marketers believe average of individual preferences represents the actual purchasing behavior of total population in the market. However, as we closely look into the real purchasing situation of TV, one of good examples of products which are commonly purchased and consumed by a group of people, i.e. family, it is notable not everyone has the same amount of authority or influence on the actual purchasing decision. This means that some people who showed enough intent to buy a TV based upon personal preference during survey for conjoint analysis, might not attempt to move into actual purchasing under the influence by other family members or any other types of interaction. This chapter will show how purchasing decision for TV is made in the context of family and propose a better practical way to increase preciseness of conjoint analysis reflecting upon group-based purchasing decision pattern.

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<sup>24</sup> Green, P. E., "A New Approach to Market Segmentation", *Business Horizons*, 20 (February), 61-73

6.2.1. Group-based purchasing decision of TV

According to Jacobs Media, about half of the purchasing decision for big-ticket items in the household, i.e. TV, does not follow individual preference as shown in the survey result below.

Often times, family members are willing to give up their opinions or compromise their decisions under the influence by other members with greater influence.

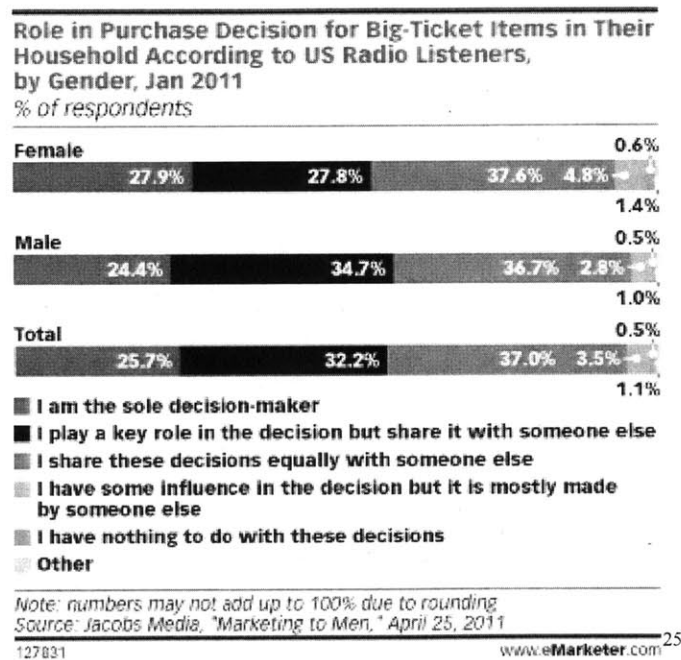


Figure 12. Role in purchase decision for big-ticket items by gender in the family

This phenomenon is especially true for TV products, since TV has become a platform that almost all the family members share and each of them might have crystallized preference for

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[http://www.google.co.kr/imgres?q=127831+emarketer.com&hl=ko&newwindow=1&sa=X&qscrl=1&nord=1&rlz=1T4GGLL\\_koUS360US360&biw=949&bih=503&tbn=isch&prmd=ivns&tbnid=kQyjoC-Y5Q35OM:&imgrefurl=http://www.facebook.com/TheChatHerGroup&docid=ULnYIW1kM5TX3M&w=90&h=90&ei=RZpDTp3kPMmemQWi\\_bTZCQ&zoom=1&iact=rc&dur=197&page=1&tbnh=78&tbnw=78&start=0&ndsp=8&ved=1t:429,r:0,s:0&tx=53&ty=45](http://www.google.co.kr/imgres?q=127831+emarketer.com&hl=ko&newwindow=1&sa=X&qscrl=1&nord=1&rlz=1T4GGLL_koUS360US360&biw=949&bih=503&tbn=isch&prmd=ivns&tbnid=kQyjoC-Y5Q35OM:&imgrefurl=http://www.facebook.com/TheChatHerGroup&docid=ULnYIW1kM5TX3M&w=90&h=90&ei=RZpDTp3kPMmemQWi_bTZCQ&zoom=1&iact=rc&dur=197&page=1&tbnh=78&tbnw=78&start=0&ndsp=8&ved=1t:429,r:0,s:0&tx=53&ty=45)

from their past experience. Likewise, compared to automobile or family vacation plan, TV showed much higher percentage of purchasing pattern decided jointly, not individually, among family members.<sup>26</sup> Likewise, it would be hard to estimate actual purchasing behavior of TV with the result of conjoint analysis on individuals, since they will go through lots of interactions with their family members before turning their intention into purchasing.

In addition to this kind of personal use, purchase of TV for industrial use often involves sophisticated power structure in the organization which seriously affects the result of final purchasing. For example, procurement department in hotel would have much more authority on deciding which TV to buy than bell boys would. Likewise, this gives us reasons why marketers need to be considerate on choosing samples for conjoint analysis.

#### 6.2.2. Introduction of joint decision onto conjoint analysis

In academia, there have been some studies regarding how to reflect the effect of joint decision on conjoint analysis. For example, Lakshman Krishnamurthi, in his paper of "Conjoint models of family decision making", identified three types of modeling methods. First one is called an equal weighting model which is a simple average of individual members' partworths. This modeling is being generally used in practice as in the Sony's case, because its model is the simplest and there are more products that are purchased on individual base than by group. However, for the products of which purchasing decision is made after severe interaction within the group, he introduced a relative influence and a conflict resolution model. While the former reflects differential influence among players in the group, the latter gives all the weight to the individual with the greatest segment utility difference.

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<sup>26</sup> Douglas, P. S and Wind, Y. (1978), "Examining Family Role and Authority Patterns: Two Methodological Issues", *Journal of Marriage and the Family*, February, 35-47

In more detail, both models use the weighted average sum formula to calculate joint utility function as following

$$b''_{p(k)} = \sum_{i=1}^N r_i * b_{ip(k)}$$

( $b''_{p(k)}$ : Joint Utility Function,  $b_{ip(k)}$ : Individual Parthworth)

In a relative influence model, one can estimate  $r_i$  by either directly asking group members how much influence each member will have on the final decision or indirectly deriving it from past work with more weights given to the individuals who had individual utility closer to joint one. Meanwhile, conflict resolution model is based on the notion that the final purchasing decision will stand to the individual who gains relatively the most when the individual with less to lose gives up his preference. Likewise, for instance, individual A gains more by taking attribute X than individual B, only individual A's utility function will be included in estimating joint utility function, since individual B is willing to yield to individual A to solve conflicts.

### 6.2.3. Practical adaptation of model

Seemingly logical, two modeling methods introduced above are hard to be adopted in actual practice. Direct methods in a relative influence model will often require marketers of additional work of quantifying relationship in the family in every case, and its relativity on the scale by the respondents may introduce errors into the model. Also, indirect methods has pitfall in a sense that case-by-case data for different external environments such as culture is difficult to be accumulated in a timely manner and dynamic change in relationship in a family over time can be neglected. Furthermore, conflict resolution model does not necessarily

reflect on the actual decision rule, since consumers are not conscious of marginal utility of one attribute over another when they solve a conflict.

Given this kind of limitation on resources of budget, time and efforts, here I want to suggest one adaptation to current models in calculating weighting factors to individual utilities:

Introduction of consumer segmentation concept in calculating group utility function.

Marketers can segment the family into a number of categories with similarities and then apply different fixed weighting factor for the each category. By doing this, they can decrease the workload for estimating weighting factor for each family in a customized manner or flexibly adjust the value reflecting on dynamic change since the data required is much less.

For example, if we limit our target respondents only to two categories, husbands and wives, we can categorize their relationship and its effect on purchasing behavior by asking some simple questions and apply different weighting factors to utilities of individual in truncated group. This approach not only will increase preciseness of conjoint analysis on the product purchased by a group compared to equal weighting model, but also will make customized methods more efficient to carry out in the actual situation.

#### 6.2.4. Other types of interactions to consider

So far I only mentioned interaction within a group, especially a family. However, as consumers can access to more sources of information than ever, final purchasing decision fluctuates even more after they decided their preference during survey. For instance, according to market research data on TV market in Japan by MyVoice, 9.4% of respondents replied they put importance on evaluation report by professionals or existing users on the Web when making purchasing decisions and 5.3% of them changed their minds after listening

to sales clerks' recommendation.<sup>27</sup> One of the ways to control those kinds of deviation based upon the interaction is to let respondents on conjoint analysis know all the possible information in the market before their preference is figured out. However, the fact not all people will go through interaction with other types of information and the volume of data to show to respondents are immense make it necessary to segment consumers by the degree of potential interaction and apply pre-quantified weighted factor to better estimate the market demand for the products, as in the argument for the family.

As shown so far, interaction within a family and an organization or with any type of information might distort market estimation from individual conjoint analysis. This is especially true for the products such as TV which are heavily purchased by jointly-made decision. Likewise, I argue that Sony should have considered the effect of group decision onto its conjoint analysis and one of good methods in both practicality and effectiveness is to introduce consumer segmentation concept into the model of weighted sum of individual utility.

### **6.3. Use of Meta Attributes in Conjoint Analysis can be beneficial**

#### 6.3.1. Rise of Meta Attributes in Conjoint Analysis

Traditionally, practitioners have used physical modules or functions as units of attributes for conjoint analysis. If a product for the survey is a cell phone, for example, generally preference on battery life, display resolution, CPU speed and reception efficiency are to be asked to respondents. This was because those kinds of parameters are easy to be quantified

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<sup>27</sup> <http://www.myvoice.co.jp/biz/surveys/14806/index.html>



and thus consumers can show their preference easily in an objective manner. Also, since they are closely related with engineering configurations, the advantage that different engineering options can be implemented into the system flexibly during product design or production phase was also one of the reasons behind this practice.

However, recently academia raised up their voices to dispute whether setting up attributes for conjoint analysis only with physical characteristics is proper. For example, Tybout and Hauser have discovered that subjective consumer perception as well as objective physical attributes explains why consumers consume products.<sup>28</sup> Also, Luo et al showed some negative effects of designing products solely based upon preference for physical attributes through an example of chair. They explained if conjoint analysis is conducted only with the physical attribute of price and results showed high purchase intention of respondents on expensive one, marketers will naturally strive to manufacture luxurious chairs, while consumers actually only had correlated subjective perception between durability and price, and wanted to purchase “durable” chairs, not “luxurious” one.<sup>29</sup> Likewise, focusing on physical characteristics can potentially distort actual preference on the products, without catching truly-wanted subjective characteristics. Later, Netzer et al summarized the advantage of utilizing soft aspects in products, so called “Meta Attributes”, in conjoint analysis. They argued that using dimensions such as goals and needs, which are true motivation for purchasing, can make preference measurement as a more natural process with more precise result. Also, they mentioned Meta attributes would ensure better stability over

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<sup>28</sup> Tybout, A. M. and Hauser, J. R. (1981), “A Marketing Audit Using a Conceptual Model of Consumer Behavior: Application and Evaluation”, *Journal of Marketing*, Vol. 45, No. 3, 82-101

<sup>29</sup> Luo, L., Kannan, P. K. & Ratchford, B.T. (2007), “Incorporating Subjective Characteristics in Product Design and Evaluations”, *Journal of Marketing Research*, Vol 45, No. 2, 182-194

time than physical attributes.<sup>30</sup> In summary, recent research works insist that using Meta attributes in preference measurement combined with physical attributes can greatly increase the effectiveness of conjoint analysis.

### 6.3.2. Extraction of Meta Attributes

As mentioned in the previous sub-chapter, however, in industry Meta attributes are still not broadly accepted, even though it has been proven to include Meta attributes in conjoint analysis can improve the ability of forecasting market reaction through many empirical cases. This is because Meta attributes are hard to be set, since it is somewhat abstract to be contained in the human words. Also, most of time certain feature has multiple Meta attributes in nature, so it is difficult to estimate what was consumer's true motivation behind the consumption of the features with the past sales history of products.

In order to address this issue, academia recently started to suggest various ways. For instance, factor analysis, which is a statistical methods to describe variability of observed factors in response to unobserved latent variables (=factors), has been introduced, but its validity is still problematic. Also, De Bruyn et al. showed a potential that high-level ask-once question with tree-based methods can be utilized to come up with Meta attributes in recommendation agents.<sup>31</sup> In any case, objective methods to identify the true subjective perception behind purchasing have a way to reach perfect level and it is one of the reasons why practitioners are still hesitant to adopt it in their conjoint analyses.

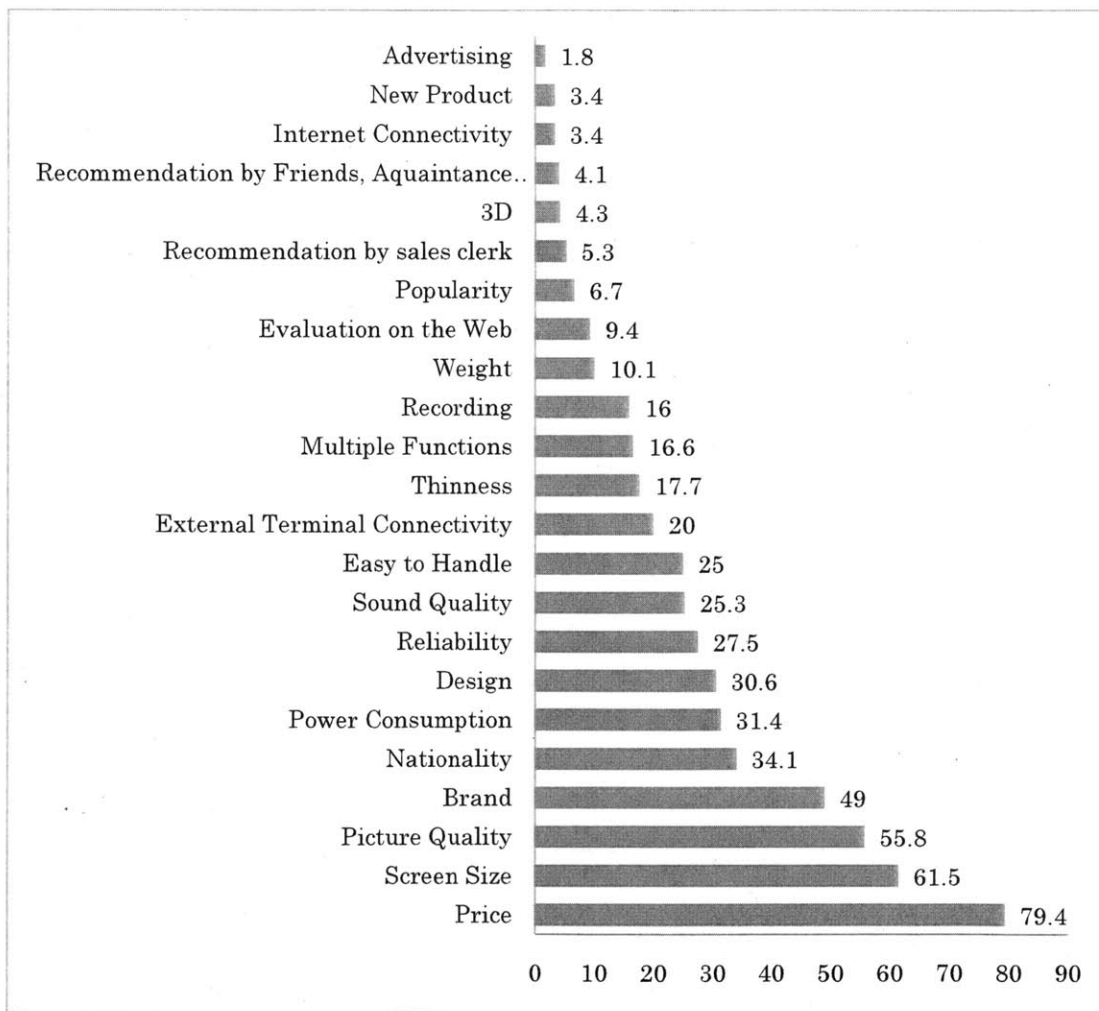
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<sup>30</sup> Netzer, O. et al (2008), "Beyond Conjoint Analysis: Advances in Preference Measurement", Market Letter, 19, 337-354

<sup>31</sup> De Bruyn, A., Liechty, J. C., Huizingh, E. K. R. E., & Lilien, G. L. (2008), "Offering online recommendations with minimum customer input through conjoint-based decision aids", Marketing Science

### 6.3.3. Reflecting on Sony Case in terms of Meta attributes

Here I want to check on whether physical attributes used in conjoint analysis in Sony's case was properly set in reflection of true goals or motivation behind the purchase of TV and suggest better ways to improve its effectiveness. Rather than criticizing the fact Sony did not include Meta attributes themselves in a conjoint analysis model, here I will analyze whether Meta attributes it identified through product concept building phase or the market requested of were properly reflected on physical attributes set in conjoint analysis.



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**Figure 13. Importance Index in influencing purchasing decision of TV**

<sup>32</sup> <http://www.myvoice.co.jp/biz/surveys/14806/index.html>

The above is a market research data gathered by MyVoice, regarding which aspects consumers put emphasis on when making a purchasing decision of TV. The number is percentile of respondents who mentioned yes to the each category. Based on this data, I identified what are the true motivators (goals) of customers behind consuming TV as following. Those six Meta attributes below are based on qualitative analysis, not on quantitative one such as factor analysis.

Meta Attributes	Items
Satisfaction from Low Expense	Price
	Power Consumption
Good Watching Experience	Screen Size
	Picture Quality
	Sound Quality
Sense of Superiority(or Safety) by owning	Brand
	Evaluation on the Web
	Popularity
	Recommendation by sales clerk
	Recommendation by Friends, Acquaintance and Family
Aesthetic Value	Design
	Thinness
Comfort	Reliability
	Easy to Handle
	Weight
New Experience (Sense of Coolness)	3D
	New Product
	Internet Connectivity
	Multiple Functions
	Recording
	External Terminal Connectivity

**Table 7. Extraction of Meta attributes from physical attributes**

It is noticeable that most of Meta attributes identified here were touched upon through product concept building phase in Sony. However, when Sony set up the attributes for

conjoint analysis, they were lopsided toward only part of those Meta attributes such as New Experience and Good watching experience as summarized below.

Meta Attributes	Attributes for Sony's Conjoint Analysis
Satisfaction from Low Expense	
Good Watching Experience	240Hz vs. 120Hz vs. 60Hz
	2 million:1 vs. 50k:1 vs. 50000:1
	Auto-picture adjust
Sense of superiority(or Safety) by owning	
Aesthetic Value	0.5 inch thinness
Comfort	
New Experience (Sense of Coolness)	IPTV
	Widget
	Pausing
	Recording
	Multi-view + Gyro RC
	2-box wireless
	Built-in Wi-Fi
	2 HDMI

**Table 8. Connection of Sony’s attributes in conjoint analysis with Meta attributes**

Based upon this analysis, it can be discovered that Sony’ attributes for conjoint analysis failed to cover all the Meta attributes requested from the market. (Note on gray area in the table above) Especially, the important factors in a view of consumer’s eyes such as satisfaction from low expense or comfort according to market research data were missing in conjoint analysis, even though it can greatly influence purchasing decision.

Then the question would be what led Sony miss some important Meta attributes in its conjoint analysis even though it succeeded to uncover all of them in product concept building phase? One possible reason can be some of attributes were difficult to be quantified. For

example, comfort or aesthetic value is difficult to set in different levels for the survey and subjective perception of respondents would vary person by person. Also, Sony's product planning only focused on engineering aspects, since market oriented levers such as price were out of scope. Finally, those attributes were set based upon very conservative viewpoints, in a sense that only new attributes that had not been implemented in the existing products were included in the survey. This attempt is thought to be based upon risk-averse notion that product line-up setting was a process to augment existing one with newly developed features, not to totally reshuffle it.

By those reasons, I want to make three recommendations to Sony in order to measure Meta attributes more effectively and thus reduce the deviation of market reaction from estimation.

- **Use prototypes to measure soft aspects of products during conjoint analysis**

As mentioned before, it is understandable some of subjective perception is hard to measure through conjoint analysis, even though it is sometimes the most influential to final purchasing decision. In this case, as Luo et al. recommended in his paper of "Incorporating Subjective Characteristics in Product Design and Evaluations", utilizing the combinations of prototypes to capture Meta attributes would be highly beneficial. Some arguments against this recommendation would be possible, because of cost increase. However, given that consumer electronics are already going through several phases of building prototypes to validate its engineering performance, adding some variations in its prototypes would only add the cost marginally. Especially, in a situation where lots of subjective aspects explain most of purchasing motivation of consumers according to market research, using prototypes during preference measurement process will only prohibit huge loss from market failure due to missing subjective perception properly

reflected on the products.

- **Include business levers as well as engineering options in the conjoint analysis**

It is not too much to say that Sony's new product planning process was around how to assign new "Technological" features into its product line-ups. Business levers such as price were decided afterward by cost estimation of the system and competitive situation. However, as shown in market research, a lot of levers that can be controlled in business side, not engineering side, were main factors to affect market behavior. Likewise, it will be fair to say including those non-engineering factors also into conjoint analysis will enhance its validity to estimate consumer's goal behind purchasing.

- **Be ready to reshuffle whole product line-up to meet consumer's demand**

Sony's product line-up setting was based upon conservative viewpoints in a sense that only new features were on the table, while leaving characteristics of existing products as it was. However, as long as its initial motivation to change the paradigm of product planning process was to meet different consumer needs, it would have been more effective if it challenged to reconsider its product line-up from the scratch and sometimes throw away a perception that existing one is somewhat valid. Mediocre innovation may have not been enough to reach its goal.

Accordingly, if Sony could set the physical attributes properly to reflect on true goals of consumers and measure soft aspects of consumer response effectively, the result at the market could have not deviated much from its estimation based upon conjoint analysis. Aggressive adoption of prototype in preference measurement phase, abandoning engineering-oriented perspective in product planning process, and being ready to reshuffle its product line-up in

some case would be concrete guidelines to increase the validity of preference-based product line-up setting in estimating market response.



## 7. Conclusion

Sony's failure to bring the most of willing to pay from consumers even with applying sophisticated methods of consumer segmentation and conjoint analysis was caused by the lack of ability to execute those techniques more properly. Consumer segmentation was not in line with academia's recommendation in a sense that it was not based upon any kind of quantitative analysis such as conjoint analysis and it only utilized logical analysis. Meanwhile, conjoint analysis has some deficiency in integrating group-based purchasing behavior of TV into calculating utility function, thus its estimation on market response deviated from its expectation based upon conjoint analysis. Also, soft aspects of products or true goals of consuming TV was not included as attributes in the conjoint analysis, and Sony's practice remained at the level to confirm skewed interests in newly-developed physical technologies only for different consumer segments.

Likewise, in order to improve its efficiency in meeting consumers' true needs through product line-up, I mainly recommended Sony three different measures. First, for market segmentation, use a componential segmentation to select the features of the product as well as to estimate the propensities of respondents. This change will not accompany additional efforts from current practice as its result is used in both consumer segmentation and conjoint analysis, only increasing its preciseness in estimating market reaction. Second, I recommend Sony to consider TV's purchasing decision is made after interaction in a group and likewise to reflect this situation in calculating utility in its conjoint model. Under the limitation of resource in industry, applying the concept of market segmentation in deriving weighted factor for individual utilities will be beneficial. Finally, I suggest Sony include Meta attributes combined with physical attributes in its conjoint analysis. If it is in a situation where Meta

attributes cannot be easily identified, aligning goals of purchasing with the physical attributes in conjoint analysis will help increase its validity. Specifically, using prototypes, taking business-oriented posture during product planning process and challenging itself with totally innovative line-up will be helpful tactics to find true motivation behind consumer's purchasing during preference-based product line-up design process.

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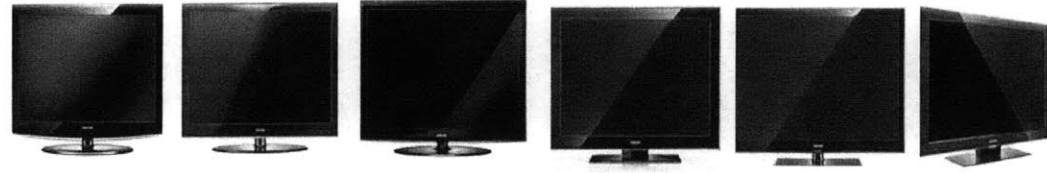
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Appendix

A

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chart.jpg



	4 Series		5 Series		6 Series		7 Series	8 Series		9 Series	
Television Model	LNXX4450	LNXX4530	LNXX4540	LNXX4550	LNXX4630	LNXX4650	LNXX4750	LNXX4850	LNXX4860	LNXX4950	Television Model
Resolution	720p	1080p*	1080p*	1080p	1080p	1080p	1080p*	1080p	1080p	1080p	Resolution
Dynamic Contrast	10,000*	20,000:1*	35,000:1*	30,000:1*	40,000:1	50,000:1*	50,000:1	50,000:1	50,000:1	2,000,000:1	Dynamic Contrast
120 Hz Auto Motion Plus	No	No	No	No	Yes	Yes*	Yes	Yes	Yes	Yes	120 Hz Auto Motion Plus
Screen	Semi-Matte	Semi-Matte	Glossy	Semi-Matte	Semi-Matte	Glossy*	Glossy	Glossy	Glossy	Glossy	Screen
LED Backlighting	No	No	No	No	No	No	No	No	No	No	LED Backlighting
Response Time	6ms*	5ms	5ms*	5ms*	4ms	4ms*	4ms	4ms	4ms	4ms	Response Time
Internal Memory	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Internal Memory
Infolink (RSS)	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Infolink (RSS)
Wiselink	No	No	No	Yes	Yes	Yes*	Yes Pro**	Yes Pro**	Yes Pro**	Yes Pro**	Wiselink
USB	No	USB 2.0	USB 2.0	USB 2.0	USB 2.0	USB 2.0*	USB 2.0	USB 2.0	USB 2.0	USB 2.0	USB
DNLA Certified	No	No	No	No	No	No	Yes	Yes	Yes	Yes	DNLA Certified
Touch of Color	No	No	No	No	Yes Red	Yes Red	Yes Red	Yes Rose	Yes Blue	Yes Grey	Touch of Color
Subwoofer	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Subwoofer
HDMI Inputs	3	3	3	3	3	4*	4	4	4	4	HDMI Inputs
Component Inputs	2	2	2	2	2	2	2	2	2	2	Component Inputs
Composite Inputs	2	2	2	2	2	2	2	2	2	2	Composite Inputs
RF Inputs	1	1	1	1	1	1	1	1	1	1	RF Inputs
Swivel Base	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Swivel Base
Screen Thickness	3.8"	3.6"	3.6"	3.6"	3.5"	3.5"	3.4"	1.9"	1.9"	N/A	Screen Thickness
Sizes Available	19", 22", 26", 32", 37", 40"	37", 40", 46", 52"	31", 40", 46", 52"	32", 37", 40", 46", 52"	40", 46", 52"	19", 22", 32", 40", 46", 52"	40", 46", 52"	46", 52"	46", 52"	46", 55"	Sizes Available

\*may vary if size is smaller than 40"

\*\* Wiselink Pro allows to play AVI/DivX/Mpeg4(Movies) where as regular Wiselink can not

The 650 has a curved bottom versus 7.0, 8.5 have flat bottom

DNLA allows you to stream video to TV from PC with software, Wireless support sold separately

**B**

<http://www.flatpanelhd.com/article.php?subaction=showfull&id=1265975930>

Sony 2010 line-up	60"	52"	46"	40"	37"	32"	26"	22"
Signature LX900	X	X		X				
Cinematic HX900		X	X					
Cinematic HX800			2.000	1.600				
Cinematic HX700			1.880	1.350				
Presence NX800		2.800		1.880				
Presence NX700			2.150	1.600				
Essential EX700	3.200	2.150	1.750	1.350		1.050		
Essential EX600				1.200		850		
Essential EX500		2.150	1.450	1.050	950	850		
Essential EX40B				1.050		950		
Essential EX400			1.200	850	800	750		
Essential EX300						600	540	470

Series	HX700	HX800	HX900	NX500	NX700	NX800	LX900
Backlight	CCFL	Dynamic Edge LED	Intell. Dyn. LED	CCFL	Edge LED	Edge LED	Edge LED
Resolution	Full HD	Full HD	Full HD	Full HD	Full HD	Full HD	Full HD
Tuner	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C
Picture Engine	BE3	BE3	BE3	BE2	BE3	BE3	BE3
Motionflow	200 Hz	200 Hz Pro	200 Hz Pro		100 Hz	200 Hz	200 Hz Pro
Contrast ratio	Standard	Over 1,000,000:1	Over 1,000,000:1	Standard	Over 1,000,000:1	Over 1,000,000:1	Over 1,000,000:1
High-quality panel	Deep Black panel	Deep Black panel	OptiContrast panel		Deep Black Panel	Deep Black panel	OptiContrast panel
Intelligent picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture
Intelligent Image Enh.			Intell. Image Enh				
Integrated player							
HDMI	4 HDMI	4 HDMI	4 HDMI	4 HDMI	4 HDMI	4 HDMI	4 HDMI
Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync
Audio return channel	ARC	ARC	ARC		ARC	ARC	ARC
S-Master amplifier	S-Master	S-Master	S-Master		S-Master	S-Master	S-Master
S-Force Front Surround	S-Force	S-Force	S-Force		S-Force	S-Force	S-Force
3D		3D Ready	3D Ready				3D integrated
WiFi	WiFi accy	WiFi accy	WiFi accy		WiFi integrated	WiFi integrated	WiFi integrated
DLNA	DLNA video	DLNA video	DLNA video		DLNA video	DLNA video	DLNA video
Favourites	Favourites	Favourites	Favourites		Favourites	Favourites	Favourites
Bravia Internet Video	Internet Video	Internet Video	Internet Video		Internet Video	Internet Video	Internet Video
Bravia Internet Widgets					Widgets	Widgets	Widgets
Auto picture adjust	Ambience + light	Ambience + light	Ambience + light	Light	Light	Light	Ambience + light
Presence sensor							BRAVIA Eye
Energy Saving Switch	Energy Switch	Energy Switch	Energy Switch		Energy Switch	Energy Switch	Energy Switch
USB	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo
USB DivX SD playback	DivX	DivX	DivX	DivX			DivX
Common Interface	CI+	CI+	CI+	CI+	CI+	CI+	CI+
Remote	Normal	Normal	Multi	Entry	Multi	Multi	Multi
Design	Monolithic	Alu bar	Monolithic	Monolithic	Monolithic	Monolithic	Monolithic



Series	EX200	EX200	EX300	EX400	EX302	EX402	EX408	EX500	EX600	EX700
Backlight	CCFL	CCFL	CCFL	CCFL	CCFL	CCFL	CCFL	CCFL	Edge LED	Edge LED
Resolution	WXGA	WXGA	WXGA	Full HD	WXGA	Full HD	Full HD	Full HD	Full HD	Full HD
Tuner	MPEG4-T	MPEG4-T	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C	MPEG4-T/C
Picture Engine			BE2	BE2	BE2	BE2	BE3	BE3	BE2	BE3
Motionflow								100 Hz		100 Hz
Contrast ratio	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Over 1,000,000:1	Over 1,000,000:1
High-quality panel										
Intelligent picture			Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture	Intell. picture
Intelligent Image Enh.										
Integrated player		DVD					Blu-ray			
HDMI	1 HDMI	1 HDMI	2 HDMI	2 HDMI	4 HDMI	4 HDMI	3 HDMI	4 HDMI	4 HDMI	4 HDMI
Bravia Sync			Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync	Bravia Sync
Audio return channel							ARC	ARC		ARC
S-Master amplifier							S-Master	S-Master		S-Master
S-Force Front Surround							S-Force	S-Force		S-Force
3D										
WiFi							WiFi accy	WiFi accy		WiFi accy
DLNA							DLNA video	DLNA video		DLNA video
Favourites							Favourites	Favourites		Favourites
Bravia Internet Video							Internet Video	Internet Video		Internet Video
Bravia Internet Widgets										
Auto picture adjust			Light sensor	Light sensor	Light sensor	Light sensor	Ambience + light	Ambience + light	Light sensor	Ambience + light
Presence sensor										Presence sensor
Energy Saving Switch										Energy Switch
USB	Music/Photo	Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo	Video/Music/Photo
USB DivX HD playback			DivX	DivX	DivX	DivX	DivX	DivX	DivX	DivX
Common Interface	CI	CI	CI+	CI+	CI+	CI+	CI+	CI+	CI+	CI+
Remote	Entry	Entry	Entry	Entry	Entry	Entry	Entry	Normal	Normal	Normal
Design	Black or white	Piano	Piano	Piano	Silver inlay	Gun metallic inlay	Gun metallic inlay	Alu bar	Alu bar	Alu bar

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