Plasma TVs and Perceived Customer Benefits

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INTRODUCTION

A **plasma display panel (PDP)** is a type of flat panel display common to large TV displays (32 inches or larger). Many tiny cells between two panels of glass hold an inert mixture of noble gases. The gas in the cells is electrically turned into a plasma which then excites phosphors to emit light. Plasma displays should not be confused with LCDs, another lightweight flatscreen display using different technology. A plasma TV is a high definition alternative to the standard cathode ray televisions sold today. A plasma TV provides sharp images and vibrant colors. Quite often, a plasma TV is designed in a 16:9 ratio for wide screen movie formats, as opposed to the box-like 4:3 ratio of standard televisions.

One of the chief selling points of a plasma TV is a flat screen, which allows it to be mounted directly on a wall without a lot of clearance required. Investors in a plasma TV may also employ surround-sound theater speakers and high-end receivers to complete the feeling of luxury. Plasma televisions have become status symbols among technophiles and other wealthy consumers. Currently, prices of Plasma TVs range between Rs 50,000 to upwards of Rs. 4 lacs.

HISTORY

Plasma displays were first used in PLATO computer terminals. The monochrome plasma video display was co-invented in 1964 at the University of Illinois at Urbana-Champaign by Donald Bitzer, H. Gene Slottow, and graduate student Robert Willson for the PLATO Computer System. The original neon orange monochrome Digivue display panels built by glass producer Owens-Illinois were very popular in the early 1970s because they were rugged and needed neither memory nor circuitry to refresh the images. A long period of sales decline occurred in the late 1970s as semiconductor memory made CRT displays cheaper than the $2500 512x512 PLATO plasma displays. Nonetheless, the plasma displays' relatively large screen size and 1" thickness made them suitable for high-profile placement in lobbies and stock exchanges.

In the late-1960's, graduate student Larry F. Weber became interested in plasma displays and completed his PhD studies in this area at the University of Illinois. After his graduation in 1975, he joined the university as a research professor that began a period of 15 years of intensive research into plasma displays, filing 15 patents and eventually developing the sustainer power-saving circuit and color plasma panels. It is no exaggeration to say that one man working in the wilderness for 20 years kept plasma technology alive when semiconductor-backed CRT and LCD displays threatened to make them extinct.

Helping to spur development of the plasma video displays, Burroughs Corporation, a maker of adding machines and computers, developed the Panaplex display in the early 70's. The Panaplex display, generically referred to as a gas-discharge or gas-plasma display, uses the same technology as later plasma video displays, but began life as seven segment display for use in adding machines. They became popular for their bright orange luminous look and found nearly ubiquitous use in cash registers, calculators, pinball machines, aircraft avionics such as radios, navigational instruments, and stormscopes; test equipment such as frequency counters and multimeters; and generally anything that previously used nixie tube or numitron displays with a high digit-count throughout the late 1970s and into the 1990s. These displays remained popular until LEDs gained popularity because of their low-current draw and module-flexibility, but are still found in some applications where their high-brightness is desired, such as pinball machines and avionics. Pinball displays started with six- and seven-digit seven-segment displays and later evolved into 16-digit alphanumeric displays, and later into 128x32 dot-matrix displays in 1990, which are still used today.

In 1983, IBM introduced a 19-inch (48 cm) orange-on-black monochrome display (model 3290 'information panel') which was able to show up to four simultaneous IBM 3270 terminal sessions. Due to heavy competition from monochrome LCD displays, in 1987, IBM planned to shutter its factory in upstate New York. When Larry Weber heard about this, he felt that his dream of practical plasma displays had evaporated. Taking a big chance, he co-founded a startup company Plasmaco with Stephen Globus, as well as James Kehoe, who was the IBM plant manager, and bought the plant from IBM. Weber stayed in Urbana as CTO until 1990, then moved to upstate New York to provide hands-on direction to Plasmaco.

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In 1992, Fujitsu introduced the world's first 21-inch (53 cm) full-color display. It was a hybrid, based upon the plasma display created at the University of Illinois at Urbana-Champaign and NHK STRL, achieving superior brightness.

In 1994, facing certain death from an onslaught of color LCD displays, Weber demonstrated color plasma technology on the last day of an industry convention in San Jose. Panasonic was interested, and began a joint development project with Plasmaco, which led in 1996 to the purchase of Plasmaco, its color AC technology, and its American factory.

In 1997, Fujitsu introduced the first 42-inch (107 cm) plasma display; it had 852x480 resolution and was progressively scanned. Also in 1997, Philips introduced a 42-inch (107 cm) display, with 852x480 resolution. It was the only plasma to be displayed to the retail public in 4 Sears locations in the US. The price was $14,999 and included in-home installation. Later in 1997, Pioneer started selling their first plasma television to the public.

Screen sizes have increased since the introduction of plasma displays. The largest plasma video display in the world at the 2008 Consumer Electronics Show in Las Vegas, Nevada, U.S., North America was a 150-inch (381 cm) unit manufactured by Matsushita Electrical Industries (Panasonic) standing 6 ft (180 cm) tall by 11 ft (330 cm) wide.

Until the early 21st century, superior brightness, faster response time, greater color spectrum, and wider viewing angle of color plasma video displays, compared to LCD televisions, made them a popular display for HDTV flat panel displays. For a long time, it was widely believed that LCD technology was suited only to smaller sized televisions, and could not compete with plasma technology at larger sizes, particularly 40 inches (100 cm) and above. Improvements in VLSI fabrication technology have narrowed the technological gap. The lower weight, falling prices, and often lower electrical power consumption of LCDs make them competitive with plasma television sets. As of late 2006, analysts note that LCDs are overtaking plasmas, particularly in the important 40-inch (1.0 m) and above segment where plasma had previously enjoyed strong dominance. Another industry trend is the consolidation of manufacturers of plasma displays, with around fifty brands available but only five manufacturers. In the first quarter of 2008, a comparison of worldwide TV sales breaks down to 22.1 million for direct-view CRT, 21.1 million for LCD, 2.8 million for Plasma, and 124 thousand for rear-projection.

In 2004, Larry Weber retired, but as of 2008, he is back at work, looking for new ways to reduce the power consumption of plasma displays. If he is successful, plasma displays may once again start to take market share away from LCD displays.

GENERAL CHARACTERISTICS AND FUNCTIONAL DETAILS

'Plasma' is a scientific term referring to gases like neon and xenon which glow when exposed to an electrical field. Plasma is sometimes called the fourth state of matter, after liquids, solids and gases. Think of a neon sign or fluorescent light bulb to understand plasma as it applies here.

Televisions in general rely on thousands of small 'picture elements', abbreviated as pixels. With any color television, a bundle of three separate colors comprise one pixel, usually red, green and blue. By controlling the level of each color, all of the other colors of the spectrum can be produced in each pixel. The viewer is usually so far from the screen that the individual pixels blur into each other and the illusion of motion is created as they change color. This is true of any television system, plasma or otherwise.

In a plasma TV, the individual pixels are made from three tiny containers of an inert gas such as neon or xenon. There are literally hundreds of thousands of these tiny tubes on an average plasma TV screen. All of these individual pixels are sandwiched between two electrically-charged plates. Remember that plasma glows when exposed to an electrical current. A computer processing unit receives signals from a cable or broadcast antenna which tells it how to reassemble the entire picture hundreds of times per second.

The computer controls the electrical field down to individual pixels, allowing different combinations of colors to glow. The viewer is usually not aware of all the changes, because his or her brain is processing all of the information as a continuously moving image. Because a plasma TV screen contains quite a few more pixels than a standard television, the image is noticeably sharper. Each pixel combination can reproduce an exact hue, not a quick approximation. This means the colors are usually deeper and richer.

The main drawback of a plasma TV system is vulnerability to damage. If a hard object strikes the screen, hundreds of individual gas-filled tubes instantly lose their ability to glow. Replacing all of those elements is a time-consuming and expensive process, if it can be done at all. It may take several years before a noticeable change in picture quality, but the cumulative effects are similar to what happens in neon and fluorescent lighting-eventually, the gas inside the tube will begin to flicker instead of burning steadily.

Plasma displays are bright (1000 lux or higher for the module), have a wide color gamut, and can be produced in fairly large sizes, up to 381 cm (150 inches) diagonally. They have a very low-luminance “dark-room” black level compared to the lighter grey of the unilluminated parts of an LCD screen. The display panel is only about 6 cm (2.5 inches) thick, while the total thickness, including electronics, is less than 10 cm (4 inches). Plasma displays use as much power per square meter as a CRT or an AMLCD television. Power consumption varies greatly with picture content, with bright scenes drawing significantly more power than darker ones, as is also true of CRTs. Nominal power rating is typically 400 watts for a 50-inch (127 cm) screen. Post-2006 models consume 220 to 310 watts for a 50-inch (127 cm) display when set to cinema mode. Most screens are set to ‘shop’ mode by default, which draws at least twice the power (around 500-700 watts) of a ‘home’ setting of less extreme brightness.

The lifetime of the latest generation of plasma displays is estimated at 100,000 hours of actual display time, or 27 years at 10 hours per day. This is the estimated time over which maximum picture brightness degrades to half the original value, not catastrophic failure.

Competing displays include the CRT, OLED, AMLCD, DLP, SED-TV, and field emission flat panel displays. Advantages of plasma display technology are that a large, very thin screen can be produced, and that the image is very bright and has a wide viewing angle. The viewing angle characteristics of plasma displays and flat-face CRTs are essentially the same, topping all LCD displays, which have a reduced viewing angle in at least one direction.

OBJECTIVES OF THE STUDY

“To determine the underlying benefits consumers seek from the purchase of a Plasma TV set”.

RESEARCH METHODOLOGY

The study was conducted in the city of Lucknow in December 2008.First of all, through focus group interviews, the underlying benefits that consumers seek from the purchase of a Plasma TV set were sought to be identified. Three focus group interviews were conducted (until the results started getting repetitive); each consisting of ten members and lasting an hour.The members were from diverse backgrounds. Based on the results of these focus group interviews, a questionnaire was designed. It was pre-tested among the thirty members of the three focus groups and refined. The questionnaire finally consisted of six statements and the respondents were asked to indicate their degree of agreement with these on a seven point scale (1=strongly disagree, 7= strongly agree).It was administered to two hundred and fifty people. Finally, two hundred and ten questionnaires were chosen for the study.

The statements were:

Q1: It is important to buy a TV set that has a good picture quality.

Q2: I like a TV that looks good.

Q3: A TV should have a wide viewing angle.

Q4: I prefer a TV that elevates my status.

Q5: Prevention of strain on the eyes is not an important consideration in buying a TV.

Q6: The most important consideration in buying a TV set is that others should get impressed.

ANALYSIS, RESULTS AND DISCUSSION

The data were captured in a spreadsheet and transported to a software statistical package (SPSS 10.0).The correlation matrix constructed from the data is shown.

CORRELATIONS

		Q1	Q2	Q3	Q4	Q5	Q6
Q1	Pearson Correlation	1.000	-.053	.873	-.086	-.858	.004
Q2	Pearson Correlation	-.053	1.000	-.155	.572	.020	.640
Q3	Pearson Correlation	.873	-.155	1.000	-.248	-.778	-.018
Q4	Pearson Correlation	-.086	.572	-.248	1.000	-.007	.640
Q5	Pearson Correlation	-.858	.020	-.778	-.007	1.000	-.136
Q6	Pearson Correlation	.004	.640	-.018	.640	-.136	1.000

There are relatively high correlations among Q1,Q2 and Q5.We would expect these variables to correlate with the same set of factors. Likewise, there are relatively high correlations among Q2; Q4 and Q6.These variables may also be expected to correlate with the same factors. The results of the factor analysis are shown below.

KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.660**
Bartlett's Test of Sphericity	Approx. Chi-Square	111.314
	df	15
	Sig.	.000

COMMUNALITIES

	Initial	Extraction
Q1	1.000	.926
Q2	1.000	.723
Q3	1.000	.894
Q4	1.000	.739
Q5	1.000	.878
Q6	1.000	.790

Extraction Method: Principal Component Analysis.

TOTAL VARIANCE EXPLAINED

	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.731	45.520	45.520	2.731	45.520	45.520	2.688	44.802	44.802
2	2.218	36.969	82.488	2.218	36.969	82.488	2.261	37.687	82.488
3	.442	7.360	89.848						
4	.341	5.688	95.536						
5	.183	3.044	98.580						
6	8.521E-02	1.420	100.000						

Extraction Method: Principal Component Analysis.

COMPONENT MATRIX

	Component	
	1	2
Q1	.928	.253
Q2	-.301	.795
Q3	.936	.131
Q4	-.342	.789
Q5	-.869	-.351
Q6	-.177	.871

Extraction Method: Principal Component Analysis.
a 2 components extracted.

REPRODUCED CORRELATIONS

		Q1	Q2	Q3	Q4	Q5	Q6
Reproduced Correlation	Q1	.926	-7.761E-02	.902	-.117	-.895	5.662E-02
	Q2	-7.761E-02	.723	-.177	.730	-1.788E-02	.746
	Q3	.902	-.177	.894	-.217	-.859	-5.134E-02
	Q4	-.117	.730	-.217	.739	1.999E-02	.748
	Q5	-.895	-1.788E-02	-.859	1.999E-02	.878	.152
	Q6	5.662E-02	.746	-5.134E-02	.748	-.152	.790
Residual	Q1		2.440E-02	-2.915E-02	3.115E-02	3.770E-02	-5.245E-02
	Q2	2.440E-02		2.224E-02	-.158	3.763E-02	-.105
	Q3	-2.915E-02	2.224E-02		-3.127E-02	8.138E-02	3.327E-02
	Q4	3.115E-02	-.158	-3.127E-02		-2.657E-02	-.107
	Q5	3.770E-02	3.763E-02	8.138E-02	-2.657E-02		1.574E-02
	Q6	-5.245E-02	-.105	3.327E-02	-.107	1.574E-02	

Extraction Method: Principal Component Analysis.
a Residuals are computed between observed and reproduced correlations. There are 5 (33.0%) non-redundant residuals with absolute values > 0.05.
b Reproduced communalities.

ROTATED COMPONENT MATRIX

	Component	
	1	2
Q1	.962	-2.663E-02
Q2	-5.721E-02	.848
Q3	.934	-.146
Q4	-9.832E-02	.854
Q5	-.933	-8.401E-02
Q6	8.337E-02	.885

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 3 iterations.

COMPONENT TRANSFORMATION MATRIX

Component	1	2
1	.957	-.290
2	.290	.957

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

COMPONENT SCORE COEFFICIENT MATRIX

	Component	
	1	2
Q1	.358	.011
Q2	-.001	.375
Q3	.345	-.043
Q4	-.017	.377
Q5	-.350	-.059
Q6	.052	.395

Extraction Method: Principal Component Analysis. Rotation Method:
Varimax with Kaiser Normalization.

COMPONENT SCORE COVARIANCE MATRIX

Component	1	2
1	1.000	.000
2	.000	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

The null hypothesis that the population correlation matrix is an identity matrix is rejected by the Bartlett's test of sphericity. The approximate chi square statistic is 111.314 with 15 degrees of freedom which is significant at the 0.05 level. The value of the Kaiser-Meyer-Olkin (KMO) statistic (0.660) is also large (it should be greater than 0.5). Thus, factor analysis is an appropriate technique for analysing the correlation matrix.

After determining that factor analysis is an appropriate technique for analyzing the data, **the principal components analysis method** was selected. This approach considers the total variance in the data.

After that, only factors with eigen values greater than 1.0 are retained, the other factors are not included in the model. An eigen value represents the amount of variance associated with the factor. Hence, only factors with a variance greater than 1.0 are included. Factors with variance less than 1.0 are no better than a single variable, because due to standardization, each variable has a variance of 1.0.

In the table we see that the eigenvalue greater than 1.0 results in two factors being extracted. Also, from the cumulative percentage of variance accounted for, we see that the first two factors account for 82.49 percent of the variance, and the gain achieved in going to three factors is marginal. Thus, two factors appear to be reasonable in this situation.

The second column under "Communalities" in the table gives relevant information after the desired numbers of factors have been extracted. The communalities for the variables under 'Extraction' are different than under 'Initial' because all the variances associated with the variables are not explained unless all the factors are retained. The "Extraction Sums of Squared Loadings" give the variances associated with the factors that are retained .It can be noted that they are the same as under 'Initial Eigenvalues'. This is always the case in principal components analysis. The first factor accounts for (2.371/6) x100 or 45.52 percent of the variance of the six variables. Likewise, the second factor accounts for (2.218/6)x100 or 36.969 percent of the variance.

An important output from factor analysis is the factor matrix. The factor matrix contains the coefficients used to express the standardized variables in terms of the factors. These coefficients, the factor loadings, represent the correlations between the factors and the variables. A coefficient with a large absolute value indicates that the factor and the variables are closely related. The coefficients of the factor matrix can be used to interpret the factors.

Although the initial or unrotated factor matrix indicates the relationship between the factors and individual variables, it seldom results in factors that can be interpreted, because the factors are correlated with many variables. Therefore, through rotation, the factor matrix is transformed into a simpler one that is easier to interpret. Here we adopt the **varimax procedure** for rotation which is an **orthogonal rotation method** (the axes are maintained at right angles) that minimizes the number of variables with high loadings on a factor, thereby enhancing the interpretability of factors. In the table we see that whereas five variables are correlated with factor 1 in the unrotated matrix, only variables Q1, Q3, and Q5 correlate with factor 1 after rotation. Hence, this factor may be labeled a quality benefit factor. It may be noted that a negative coefficient for a negative variable (Q5) leads to a positive interpretation that prevention of strain on the eyes is important .The remaining variables Q2, Q4, and Q6, correlate highly with factor 2.Thus, factor 2 may be labeled as a social benefit factor. Furthermore, no variable correlates highly with both the factors.

One could summarize it by stating that consumers appear to seek two major kinds of benefits from a Plasma TV set: quality benefits and social benefits.

MARKETING IMPLICATIONS

Plasma TV set manufacturers should emphasise on two major benefits in their communication to the consumers: quality benefits and social benefits.

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The Consumer Products Division is a pioneer, offering healthier dietary options to the consumers. The product range comprises **Sugar Free Gold**– India's No.1 sweetener with a market share of over 70%, **Sugar Free Natura**– a zero calorie sucralose based sugar substitute, **Sugar Free D'lite**– a low calorie healthy drink and **Nutralite**– a premium cholesterol-free table spread.

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Source: *www.zyduscadila.com*

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- New Molecular Entities
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Source: www.zyduscadila.com

Notes:

1. Board of Directors of Cadila Healthcare Limited (Cadila Healthcare) and Carnation Nutra –Analogue Foods Limited (Carnation) at their meetings held on July 4, 2008 have approved the modalities of the composite scheme of arrangement for restructuring of the Consumer Products Division of Cadila Healthcare. The Boards have approved the demerger of the Consumer Products Division of Cadila Healthcare into Carnation, which is a subsidiary of Cadila Healthcare and the merger of Zydus Hospital and Medical Research Pvt. Ltd. (ZHMRPL) with Cadila Healthcare.

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