# Examples in Liquid Crystal – Modelling Product Innovation

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## I. Introduction

In this ever transforming and evolving age of technological development and innovation there are an overwhelming number of products to which economic theory might be compared. I have selected the LCD (Liquid Crystal Display) Monitor as a test case due to its proliferation across global markets, the fiercely competitive industry it has spawned, and the clarity with which its economic evolution demonstrates changes in "tastes, growth, and innovation"[1]. I will provide a brief history of the LCD monitor while analyzing it through the lenses of Joseph Schumpeter's business cycles and Raymond Vernon's product cycles.

The technology behind the LCD monitor can be traced to experiments in the late 19th century, however in any similar derivative to its current form it was developed in the 1970s, first appearing on pocket calculators in 1973[2]. This presents an ideal example of both Schumpeter and Vernon's contrast between invention and innovation, inventions in LCD technology occurred as far back as the late 19th century, however there was only significant innovation with the technology after the late 1980s[3]. As Vernon appropriately predicts, "there is ordinarily a large gap between the knowledge of a scientific principle and the embodiment of the principle in a marketable product"[4]. The LCD display would then slowly grow from its introduction into the technology we are familiar with today, the LCD computer monitor, following the rough path laid out in Vernon's product cycle (see Table 1a), introduction, growth, maturity, and decline.

## II. Growth

The LCD monitor was initially released as a high priced luxury item (like most new computer peripherals) with only a few major brands producing it. The space saving aspects they

[1]Joseph A. Schumpeter, 1939. "BUSINESS CYCLES: A theoretical, historical and statistical analysis of the capitalist process". New York: McGraw-Hill Book Company. 82.
[2] Hirohisa Kawamoto, "The History of Liquid-Crystal Displays" *Proceedings of the IEEE*, 90 no. 4 (2005), 2.
[3] Schumpeter, 82.
[4] Joe Wilcox. "Will flat-panel monitors make nice stocking stuffers?" in CNET News [database online]. 2000 [cited 09/29 2009]. Available from http://news.cnet.com/2100-1040-247374.html.

provided, interested many business, this allowed for reasonably large initial sales while still maintaining high price points. This conforms to Vernon's product cycles model with the initial investors in the successful technology taking advantage of a market monopoly to turn high profits.

However, while Schumpeter's ideas that entrepreneurs make the most likely innovators[5], holds some relevance in the LCD case (numerous entrepreneurs contributed to the development process)[6], the main actors in the production of LCD monitor has been large firms from the beginning (such as Sharp's development of the LCD calculator), as their large research and development arms transformed LCD technology into a consumer product.

During its initial production and innovation period the LCD monitor was widely available in several different technological forms. They can be grouped into two categories: The first being TN monitors, the lowest quality (measured by such factors as colour depth, contrast, and viewing angle) and the cheapest to produce. The second group included S-PVA, P-MVA, and IPS based models which are superior to TN models in almost every category, though they are significantly more expensive to produce. Thus the low cost TN panel would lead to the "growth" of the consumer LCD monitor.

## III. Maturity

As the LCD monitor market became increasingly competitive, prices plummeted as did quality. While initially both categories of monitor were widely available, TN began to dominate the market as most consumers were unaware of any difference and it became increasingly difficult to find S-PVA, P-MVA, and IPS based models. The higher end models were phased out of production to their current state, where only enthusiasts and professionals in the graphic

[5] Schumpeter 92.
[6] Kawamoto, 84.

design or related industries purchase them. TN has become the standardized type of LCD monitor as "concern about production cost begins to take the place of concern about product characteristics"[7]. With the standardization of LCD monitors has come a highly competitive struggle to win over the consumer with features and modifications (such as height adjustable stands and built in webcams), "as competitors try to avoid the full brunt of standardization"[8].

Vernon states that the manufacturing of goods which require adherence to exacting specifications is more likely to occur in more developed areas. In today's markets LCD's are produced in many "developing" areas (primarily East Asia)[9], though these "developing" areas are a new brand of economy, that of which were only in their infancy as Vernon was writing. These technology specialized developing economies provided a development economy type neither Vernon nor Schumpeter had the chance to examine. Vernon does pay tribute to these developing producers citing both Taiwan and Japan having both "managed to developed significant overseas markets for standardized manufactured products"[10]; however, the general trend as LCD monitors have become standardized has conformed to his statement that, "if economies of scale are being fully exploited, the principal differences between any two locations are likely to be labour costs"[11]. Thus explaining why, for all practical measurements, no LCD monitors are produced in say, the United States.

The vast majority of the profit has been removed from the market as margins have become slimmer and slimmer due to fierce brand competition and consumer taste, which has caused the vast majority of LCD monitor production to be focused on TN panels. The economic history of the LCD monitor continues to mirror Vernon's product cycle in that in the year 2000

[7] Vernon, 196.
[8] Vernon, 196.
[9] Raymond Vernon. "International investment and international trade in the product cycle." 1966. The Quarterly Journal of Economics 80, (2) (May): 203.
[10] Vernon, 205.
[11] Vernon, 198.

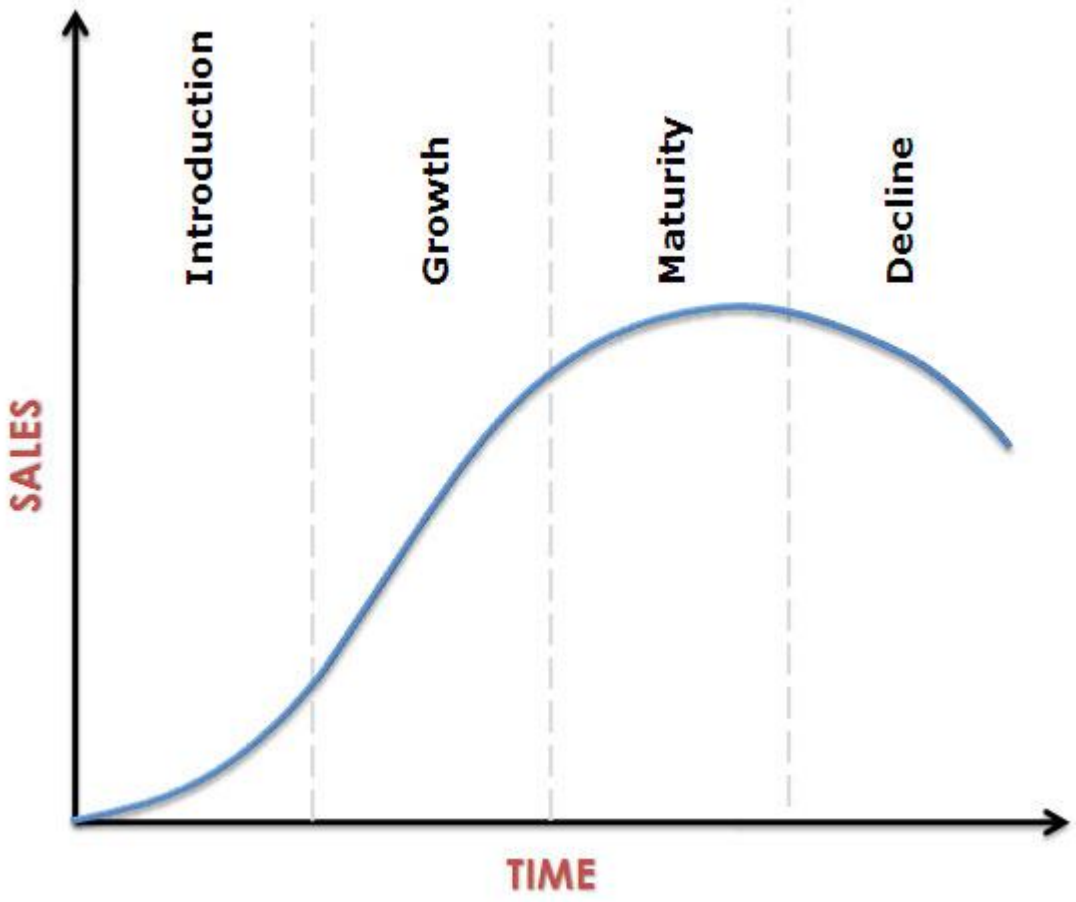
average LCD monitor prices hovered around $1000 USD[12], today they hover around $200USD forming the top of the maturity area of Vernon's cycle, an area of fierce competition, leading to a decline.

## IV. **Conclusion**

While the economic evolution of the LCD monitor can largely be explained using Vernon and Schumpeter's works, there remain aspects of the process that neither anticipated, particularly with regard to the role of entrepreneurs. Despite this, their theories do an excellent job predicting the product cycle of the LCD monitor, from its invention evolving into its innovation, to its high initial cost and profit margins, to its standardization and maturity, and we await its inevitable decline. The test case of the LCD monitor provides strong evidence that Schumpeter and Vernon have provided key tools in economic analysis, which, while not without their imperfections, are as valid today as they were at their development.

[12] Joe Wilcox. Will flat-panel monitors make nice stocking stuffers? in CNET News [database online]. 2000 [cited 09/29 2009]. Available from http://news.cnet.com/2100-1040-247374.html.

**Table 1a**



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