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# Forecasting change - 3 Paradigms stalked

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### Paradigms follow law-like relationships

Paradigms follow certain law-like relationships. These law-like relationships are based on analysing numerical data on the growth of several paradigms, major and minor.

### **Proposition 1**

### Paradigms follow predictable growth patterns.

The recurring pattern of most growth phenomena is a bell shaped curve known as the *logistic curve* (See Exhibit 1). This curve resembles the familiar normal probability curve. (For a mathematical description of this curve, see Exhibit 1.)



This logistic curve may be applied to a number of growth phenomena. For example, their use grew very slowly at first when cars were first introduced (Birth). This was followed by accelerating growth (Growth), and then by a stable growth period (Maturity). The rate of growth then declined (Decline) and then stagnated (Death).

### The cumulative logistic curve (The S-Curve)



While the logistic curve describes the growth pattern of many phenomena, it is subject to fluctuations along the way. We can smooth out these fluctuations by simply presenting the data cumulatively. When we create a cumulative graph of the logistic life cycle curve, we arrive at what is known as the S-curve (Exhibit 2).

# Application of S-curves shows that

- Deaths from AIDS have already peaked.
- Fatal car accidents will increase by 20% in the 1990s.
- No more than one nuclear accident will occur in a 5-year period during the 1990s.

We can consider the S-curve to be a law-like relationship describing growth phenomena. Paradigms, being growth phenomena, follow the cumulative logistic curve. This law-like relationship enables us to forecast the growth and decline of a paradigm.

Modis (1992) identifies a wide variety of events which follow the S-curve. Exhibit 4 shows a few examples of growth phenomenon for which the S-curve holds.

In reality, the S-curve appears to hold for practically all paradigm growth situations, making it a law-like relationship. (For a few examples of S-curve charts see Exhibit 3).

The application of the S-curve (Modis 1992) leads to several interesting conclusions such as:

- Deaths from AIDS have already peaked. Death from AIDs will never account for more than 1% of all deaths in the U.S
- Fatal car accidents will increase by 20% in the 1990s.
- No more than one nuclear accident will occur in a 5-year period during the 1990s.

# **Exhibit 3: The Ubiquitious S-Curve**

The S-curve appears to describe a variety of growth phenomena (Modis 1992). A partial list of events which follow the s-curve is given below:

- Population of cars (Marchetti 1983
- Total mileage of railway in the U.S. (Lotka, 1925; Modis 1992)
- Birthrate of U.S. woman
- Population of rabbits
- Acquisition of children's vocabulary
- Western Hemisphere exploration
- Sales of Digital Minicomputer Vax 11/750 (Modis 1992a)
- Oil discoveries
- Oil production
- Number of compositions by Mozart, Schuman, Brahms
- Number of publications by Einstein, Hemingway, Marquez
- Number of American Nobel Prize winners
- U.S. transport infrastructure - Canals, Railways, Roads
- Growth of Supermarkets
- Number of Gothic Cathedrals

# **Proposition 2**

# When we substitute a new paradigm for an old one, we may also be substituting a new behaviour for an old one.

Many new paradigms are substitutes for old paradigms. A new paradigm in variably grows at the expense of an old one. When a new paradigm comes into being, it might look as though the old pattern has disappeared. However, there are some underlying constants. These are maintained through substitution. For example, over the years, letter writing has declined but this decline was compensated for by an increase in phone calls. Exhibit 4 shows more examples of new paradigms growing at the expense of old ones. Consequently, a difference between the present and the past may simply mean that it may be more apparent than real. For instance, the permanent job loss in many organizations (such as IBM and General Motors) may appear to indicate that jobs are being lost permanently in our society. But it may instead be that jobs are growing in other areas or in industries that did not exist about 20 years ago. If we fail to see this (i.e. not understand the constant), we may not be properly prepared to deal with the situation. We may find ourselves faced with high unemployment on the one hand and not enough qualified people to fill a large number of positions elsewhere.

### Substitution charts show

- Gender equality in the executive ranks is likely to be achieved by the year 2000.
- Renewable energy has almost completely been replaced by fossil based energy.
- Information workers will continue to expand at the expense of manual workers.
- Conventional mail as a medium of communication will continue to diminish in importance.

Actual figures support this model. Since 1984 'knowledge workers have increased in numbers while manufacturing production workers have decreased (see Beck 1992).

- Exhibit 4 charts are freehand versions of substitution data. For the actual curves, refer to the sources listed.
- The principle of substitution can be observed whenever a technological paradigm changes. (For more examples such as railways replacing canals, roads replacing railways and airways replacing roads, refer to Nakeicenovic in Ausubel and Herman (ed.) 1988.)

Basic human needs such as the need to move from Place A to Place B or to communicate with others remain the same. When new paradigms emerge, they don't change the underlying needs, but only the way these needs are fulfilled. Substitution charts show that the new paradigms grow at the expense of the old.

By combining the growth/decline patterns of two paradigms, these charts also enable us to predict the future. For instance, substitution charts tell us that:

- Gender equality in the executive ranks is likely to be achieve by the year 2000.
- Renewable energy has almost completely been replaced by fossil based energy.
- Information workers will continue to expand at the expense of manual workers.
- Conventional mail as a medium of communication will continue to diminish in importance.

**Exhibit 4:** New paradigms usually fill the same basic human needs - but in a different format. In general, new paradigms act as substitutes for the old paradigms.



# **Examining the changes**

An examination of the current paradigms from different areas of human endeavour shows another interesting pattern. Current paradigms have reached their ceiling either in terms of what those paradigms can achieve or in terms of what people expect of those paradigms. Such ceilings are evident in areas such as manufacturing, food production, research and development, transportation, infrastructure and communication.

As a result, no major meaningful progress within the old paradigms is possible or even desirable. To move ahead we need new paradigms.

This will be explored in greater detail in the next issue of Imprints (November 1993).

For a list of references cited in this article please see below.

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# **BOOKS IN BRIEF Books on becoming numerate**

We live in the information age. Any one can now access an enormous quantity of information. The advent of 'personal digital assistants' (such as the Apple Newton) makes information access virtually limitless. Attention shifts from 'how to get information' to 'what to do with the information once one has access to it'.

We can ask specialists to interpret numbers for us. The only catch is that many such interpretations are wrong. While our culture has traditionally emphasized literacy, it has failed to emphasize numeracy-the ability to understand and interpret numbers. There is a stigma attached to being illiterate but there is no stigma to being innumerate.

In the information age, we cannot afford to depend on someone else to tell us what numbers mean. To thrive in the new economy we need numeracy, in addition to literacy.

Here are two entertaining books on numeracy.

# '99 44/100 pure' numeracy

200% of Nothing by A.K. Dewdney. Published by John Wiley & Sons, Toronto. 1993. \$27.95, 182 pages.

- When you read that 'Ivory Soap is 99 44/100% pure' do you wonder what it actully means?
- If 30 out of 35 people who drowned last year in boating accidents were not wearing life jackets, would it persuade you to wear one when you go boating?
- You are thinking about someone you haven't thought of in a while. The phone rings. The person calling is the one you were thinking about. It is not the first time this has happened. Why doesn't this offer evidence of telepathy?
- If underlit streets have less than one crime per street while well-lit streets have 3 crimes per street, would you conclude that underlit streets are generally safer?

If any of the above examples puzzle you, make you uncomfortable or leave you confused, you may want to read this little book to understand how numbers are constantly being misused.

200% of nothing is clearly written and fun to read. Marketing and advertising professionals will find the examples particularly interesting and relevant. It may even make some of us uncomfortable.

# The price of innumeracy

Innumeracy: Mathematical Illiteracy and Its Consequences. by John Allen Paulos. Published by Vantage Books, NY 1990.

This is probably the first major book on numeracy to be published in North America. It illustrates a number of common fallacies in mathematical reasoning. While many examples appear slightly contrived, the book nevertheless is a good guide to numeracy.

Pseudo-scientific reasoning is currently a growth industry. How does one evaluate the 'scientific' evidence provided by people from Freudians to parapsychologists? Paulos provides a number of examples of pseudo-scientific reasoning. While his examples may not make us experts in identifying the misuse of scientific reasoning, they will make us question the numbers we are presented with.

Numeracy is not optional but is an essential skill for the information age. For those who are interested, these two books are a good starting point.

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