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A Second Lease on Life for Technological Forecasting

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Teachers of forecasting techniques invariably discuss the Delphi method. A poignant introduction to teaching this method is the following classroom experiment. Take a very thin piece of paper, such as a single layer of a Kleenex tissue, and in front of the students' eyes fold it in half, and then in half again, and again, seven or eight times. Then pointing at the thickness of the folded tissue—barely thicker than a quarter of an inch—ask the students to estimate the thickness of 40 foldings. Discard the largest and the smallest estimates as "outliers" and average the remaining estimates. You will end up with a number between five inches and three yards, more than nine times out of ten, even if one of the students already knows the right answer, which is close to 100,000 miles, that is, halfway to the moon!

And yet modern large-scale forecasting efforts, such as the UK's Foresight Programmes, are centered on the Delphi method. What happened to all the elaborate technological-forecasting techniques? Cueing technological forecasting to Kondratieff's wave, Harold Linstone concluded that technological forecasting has already completed a life cycle, and now finds itself in a low-activity period.

Invoking Kondratieff's wave here as a tool for deeper understanding is acceptable. Today Kondratieff is no longer the discredited maverick economist he used to be during earlier decades of this century. The publication of such books as *The Great Depression of 1990* [1], the stock-market crash of 1987, and the persistent worldwide economic crisis of the early 1990s have triggered a comeback for Kondratieff's wave. Strangely enough, it is thanks to technological forecasting itself that the comeback enjoyed respectability. Marchetti's work in the 1980s using logistic functions contributed to Kondratieff's revival [2]. This time Kondratieff's wave was established more objectively via the study of physical rather than econometric variables. Later, a new book appeared by Kondratieff himself—published by his followers—in a respectable French publishing house [3].

One quantitative determination of Kondratieff's economic wave stipulates that worldwide economy went through a boom with apogee in 1968, went through nadirs in 1940 and again in 1996, and is due for another zenith in 2024 [4]. These peaks and

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valleys are centered on the designated dates but are rather broad. What is felt more sharply in society are the periods of growth and recession, for example, the 1950s and the 1980s respectively.

An analysis of growth-cycle phases using the four seasons as a metaphor defines as summer the high-growth period around the mid-point of the growth process, and as winter the low-growth period one finds at the end and at the beginning of the process. Spring is then the period between winter and summer, characterized by a progressively rising growth rate, and fall is the time between summer and winter, when the rate of growth continuously declines. This metaphor serves more than just as a mnemonic device or a poetic image. It can be a key to understanding and decision making [5].

Our familiarity with mechanisms and behaviors associated with nature's four seasons can shed light and guide us through decision about business issues and other social endeavors. For example, the low creativity observed during a summer is only partially due to the heat in the weather. New undertakings are mainly disfavored because the living is easy and there is no reason to look for change. In contrast, animals (such as foxes and sparrows) are known to become entrepreneurial in the winter. There is wisdom encoded in nature's seasonal patterns and behaviors. For example, fall is the most appropriate time to sow the seeds for the next crop. Winter is the chaotic time that follows a decline or a catastrophe, when mutations abound (in nature), and reorganization, segmentation, and fundamental changes take place (in society). Spring is time for learning and investments, whereas in summer the profits are high, and unification and bureaucracy emerge.

The rampant mutations and changes that take place during the winter season concord with the chaotic character of this time period. In fact, the state of chaos theoretically begins when we enter the last third of fall and extends though the first third of spring, see Fig. 1. Death occurs naturally only in winter. The end of the Office of Technology Assessment in 1995 is an example of such a death, the end of Communism is another. Taking the life span of the Soviet Union as dotted with an 80-year-long life cycle implies a 20-year-long winter season centered on 1997. The fall of the Berlin Wall can be seen as one large fluctuation of the winter chaos. In this metaphor, the end of the Russian winter should not be expected before 2010.

In contrast, the unification of western Europe signifies stability and maturity. The appearance of the Euro dollar is evidence of summer-like seasons for European currencies. A similarly fair-weather season trait was the appearance of this Journal, together with several books on technological forecasting in the late 1960s, see Fig. 1 in the Introduction. These publications constitute *par excellence* a bureaucratic type of activity. But we should not see here the bad connotation often associated with this word. Bureaucracy aims at process management, and becomes essential when things work like a clock.

The early days of forecasting activities (spring season for technological forecasting) must be positioned in the 1950s when significant investments were directed into the development of forecasting methodologies, see, for example, think tanks like RAND. On the other hand, during the fall season (the 1980s) we witnessed the revival of Kondratieff, the emergence of the science of chaos, and the popularity of Shell's multiple scenario playing. Could these be the "seeds" for the next "crop" of technological forecasting?

There are two conditions to secure a second lease on life. Timing is one of them. The seeds must be put in the ground during the fall of the first cycle. The "seeds" mentioned in the previous paragraph satisfy this requirement. But good timing is a

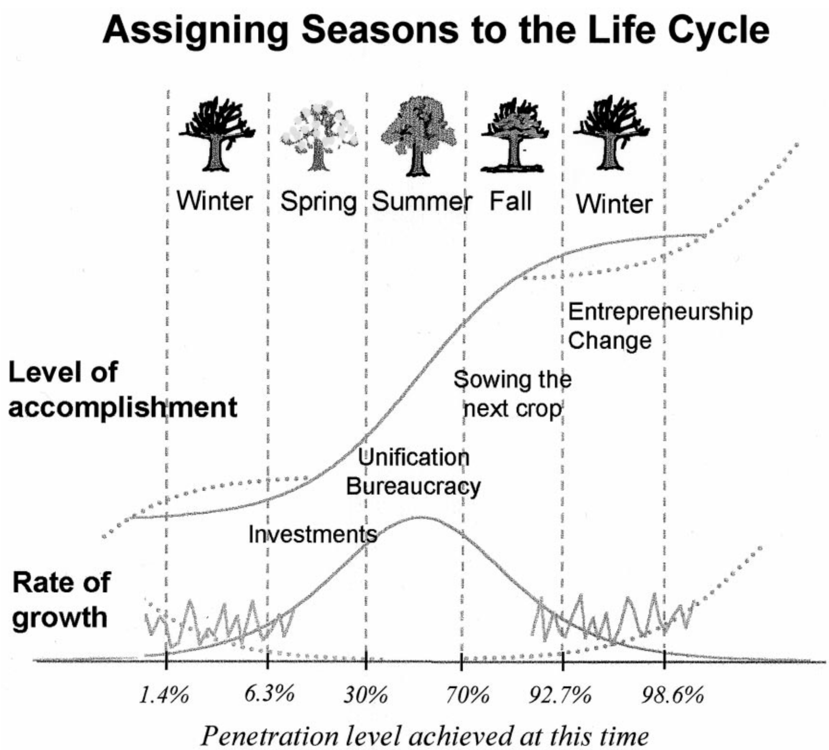

Fig. 1. Assigning seasons to the life cycle (i.e., segmentation of a life cycle into four seasons).

necessary not a sufficient condition. We saw that with Mozart's attempt for a second lease on life. His composition of the *Dissonant Quartet* in 1785 was timely. It took place during the fall of Mozart's creativity curve [5]. But the new "species" was not gifted for survival (it was rejected by the music audience). The learning curve of music lovers of that time could not accommodate the kind of music that became acceptable only with Bartók, more than 150 years later.

There is, however, a timely "seed" that seems rather promising as a new generation of technological-forecasting activities: biology-related studies. The bio/genetic sciences have been penetrating our lives in a ubiquitous way for many years now. They constitute the most popular field of study in Universities. Whether it is in the form of simple logistic curves, or in the more sophisticated Volterra-Lotka equations, biological models have also found their way into social, commercial, industrial, and even financial applications. Genetics and evolutionary theory are now sufficiently engrained in the public mind for advertisers to make use of them wrote *The Economist* in its first issue of 1999. Two car manufacturers in Europe, BMW and Renault, base their latest marketing campaigns on such genetic images as DNA sequences and double helices. It was mentioned earlier that even Kondratieff's revival benefited from logistic fits on growth patterns.

Bio sciences could provide the substrate for the next growth cycle of technological forecasting. They already have a good track record in the field, beginning with the celebrated Fisher-Pry model in 1971 [6], and ending with the "Genetic Re-Engineering of Corporations" in 1997 [7]. Consequently one can conclude that biotechnological forecasting has grown beyond infant mortality. It also has more growth potential than scenario planning, elaborate Delphi techniques, and chaos studies. As the shine of chaos wore off, it evolved toward complexity, looking at a bigger picture, paying attention to the law of competition, and incorporating admixtures from biology and ecology. At this point the entire stock market can in principle be modeled as an ecosystem [8].

In all this, what will happen to *Technological Forecasting and Social Change*? The Journal celebrates its 30th anniversary this year, completing a generation cycle, perhaps not unrelated to a cycle of its prime mover, the Editor-in-Chief, Harold Linstone. When the time comes for a new Editor-in-Chief, the Journal will be traversing a winter season, if for no other reason, the importance of the change (fundamental changes take place winters). Good timing dictates that now is the time to search for the "seed." But to ensure a second lease on life for the Journal, the newcomer should be of no lesser caliber than his or her predecessor.

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