FORECASTING : ITS ROLE AND VALUE FOR PLANNING AND STRATEGY

by

S. MAKRIDAKIS*

95/54/TM

* Research Professor of Decision Sciences and Information Systems, at INSEAD, Boulevard de Constance, Fontainebleau 77305 Cedex, France.

Printed at INSEAD, Fontainebleau, France

FORECASTING:
ITS ROLE AND VALUE FOR PLANNING AND STRATEGY

Spyros Makridakis
Research Professor, INSEAD

Abstract

Long-term predictions are indispensable for planning and strategy. Yet little is known about their value, their limitations or the most appropriate way of making and using them. This paper examines these issues and proposes two approaches to long-term forecasting while illustrating their use to planning and strategy. The first approach consists of identifying and extrapolating critical long term trends while assessing their impact on society and firms. The second approach studies the analogy of the industrial and information revolutions and the specific consequences of the five most important inventions of the industrial revolution in terms of the consequences of similar ones of the information revolution. The paper concludes by advocating that much needs to be done to integrate forecasting, on the one hand, and long-term planning and strategy on the other if we want to increase the ability of organizations to anticipate important forthcoming changes, as well as their consequences, and successfully adapt themselves to these changes and the opportunities as well as the dangers associated with them.

FORECASTING:
ITS ROLE AND VALUE FOR PLANNING AND STRATEGY

" ...and it is true that if foresight is not the whole of management at least it is an essential part of it."
Henri Fayol, 1916

Spyros Makridakis
Research Professor, INSEAD

The most important lesson we have learned in the field of forecasting over the last two decades is that models which best fit available data (such models will be, in everyday language, the equivalent of explaining as well as possible, after the fact, what has already happened in the past) are not necessarily the most accurate ones in predicting beyond this data. This paper demonstrates that such a lesson has serious implications for other areas and notably management which is still based on the notion that future success can be attained by imitating "excellent" companies or best practices, that is past success or the equivalent of model fitting. This paper argues that correctly recognizing emerging changes in the business environment and accurately predicting future ones are prerequisites for future success. Recognizing and predicting such changes brings forecasting to the forefront of management and ironically turns its biggest weakness (the fact that the best model fit does not guarantee the most accurate after the fact forecasts) into a much needed strength as recognizing and predicting changes is becoming one of the most critical factors for developing foresight, formulating corporate strategies, planning effectively and in general succeeding in business.

What Can We Learn from "Excellent" Companies?

The book *In Search of Excellence* was published in 1982. It became an instant success, selling millions of copies. Based on research conducted between 1961 and 1980, its authors, Tom Peters and Robert Waterman, identified 36 excellent companies and presented the factors that brought about their "success". The objective of the book and its intended value for other companies can be best captured by its subtitle, *Lessons from America's Best-Run Companies*. Could others have learned, however, from America's best?

Figure 1 shows the 1980 (the latest figures available when the study leading to the book was completed) price/earning ratios, in comparison to the average, of as many of the 36 "excellent" companies identified by Peters and Waterman for which published data was available, while Figure 2 shows the same ratios ten years after the book was published. Figure 1 reveals that in 1980 the price/earning ratios of the "excellent" companies were, with a couple of exceptions, well above the average. However, the opposite is true in Figure 2 which shows losses in eight of the 33 firms, three firms with practically zero earnings making the price/earning ratios meaningless (this means that one third of the once "excellent" firms had losses or close to zero earning -- an extremely high proportion). Finally, there are only three firms in Figure 2 whose price/earnings ratios are above average. In addition, two firms (Data General and Wang) found themselves in serious financial trouble that lead to chapter 11 bankruptcy proceedings.

Some people rightly argue that price/earning ratios reflect psychological factors as well as real financial performance and might not be the most appropriate way of drawing conclusions about the "excellent" firms identified in *In Search of Excellence: Lessons from America's Best-Run Companies.* To provide a more objective basis for comparisons, Figure 3 shows the average annual rate of return to investors (ROI) for the decade before the book was published while Figure 4 shows the same rates for the decade after.[1] Interestingly the "excellent" firms did not perform significantly above the average during the 1971/81 decade, at least as far as the return to investors was concerned (Figure 3) which proves that the selection for naming a firm "excellent" was based on the recent past. At the same time Figure 4 shows that they did considerably worse than average for the 1981/91 decade.

The obvious conclusion from the above discussion is that if the "excellent" companies could not even manage to stay average ten years later, how can they teach lessons to other firms? Figures 2 and 4 even suggest that there is a regression of the "excellent" firm to below average as it is highly unlikely that the results of Figures 2 and 4 are due to pure chance. In forecasting terms best fit does not guarantee the most accurate post-sample (that is, after the

[1] Taken from various issues of *Fortune.*

FIGURE 1

EXCELLENT COMPANIES: THEIR P/E RATIOS IN COMPARISON TO THOSE OF ALL FIRMS IN 1980

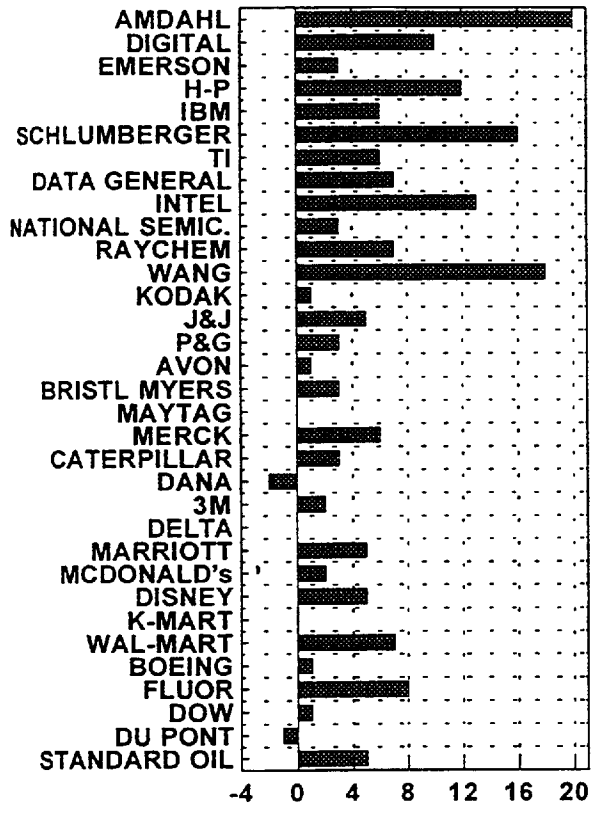


FIGURE 2

"EXCELLENT COMPANIES": THEIR P/E RATIOS IN COMPARISON TO THOSE OF ALL FIRMS IN 1992

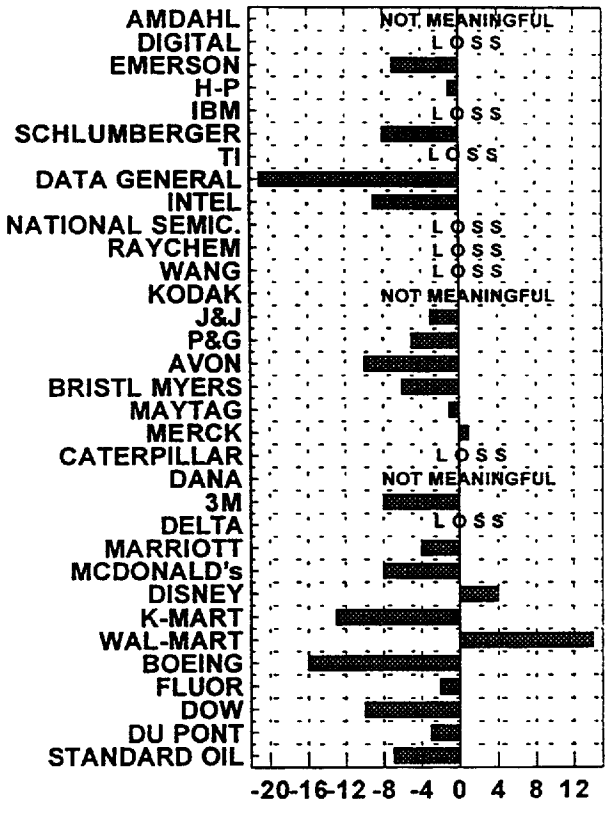


FIGURE 3

"EXCELLENT COMPANIES": THEIR RETURN TO INVESTORS IN COMPARISON TO FORTUNE's 500 MEDIAN

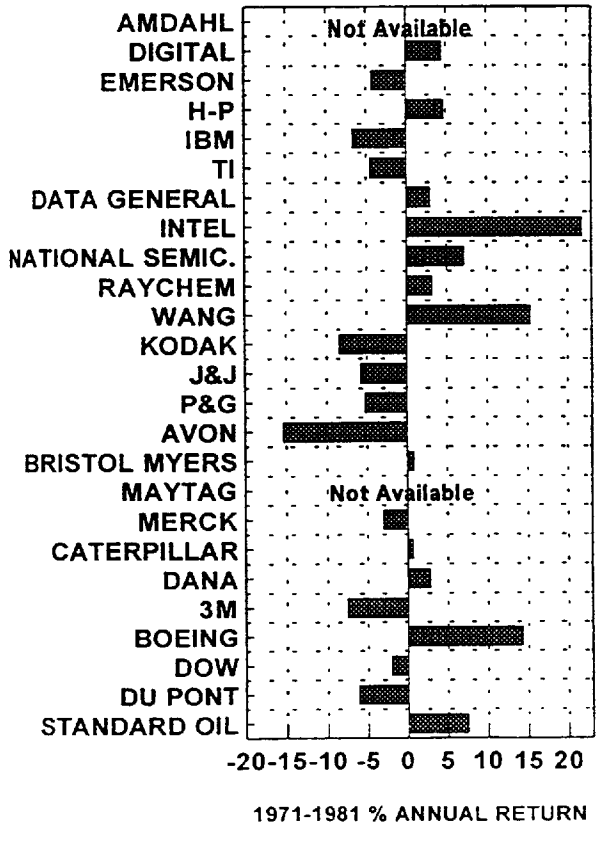
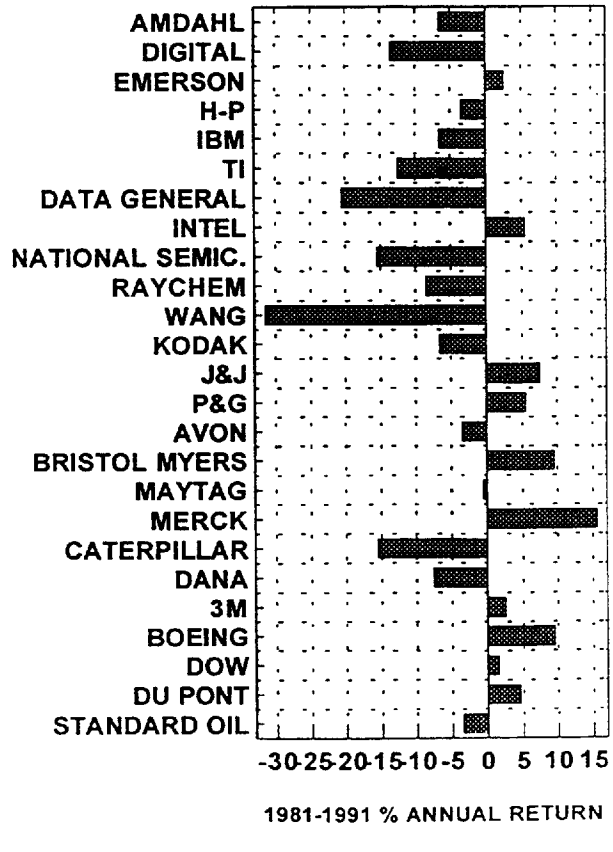


FIGURE 4

"EXCELLENT COMPANIES": THEIR RETURN TO INVESTORS IN COMPARISON TO FORTUNE's 500 MEDIAN



fact, or future) predictions. We can even argue that "success breeds its own failure" and that unless excellent firms make a conscious effort to overcome the "handicaps" (arrogance, the attitude 'we do not need to change since we are so successful', higher salaries and other costs related to "excellence") and avoid the complacency associated with excellence there is only one way: doing worse and going towards, or even below, the average.

The firms of *In Search of Excellence* are not the exception of successful and admired companies that found themselves getting into serious trouble. GM, Philips and IBM were considered textbook examples of best managed companies. Yet today they are thought of as dinosaurs unable to adapt to the changing business environment. The same was true of Digital Equipment, Siemens, Polaroid, Xerox and even Apple. Yet these firms have found themselves getting into serious difficulties, performing below average, a fact that can be seen in their stock prices which have declined considerably. At the same time other firms like Microsoft, Intel, Compaq or Virgin have become examples of successful companies and Wall Street favorites. The obvious challenge, therefore, is to discover future success stories and even more importantly help management to make their firms successful by helping them to predict forthcoming opportunities while avoiding future dangers.

What Can We Learn from Management Theories on Strategy?

Corporate planning and strategy has become a popular management area since the early 1960s (Gilmore and Brandenburg, 1962; Ansoff, 1964) as the size of corporations as well as their complexity and competition were increasing. Although the early attempts concentrated on long range planning (Ackoff, 1970), later there was a shift towards corporate strategy (Ansoff, 1979; Lorange and Vancil, 1977; Malmlow, 1972; Steiner, 1979) as it was recognized that trends can change and unexpected events can occur rendering long range plans useless. Prominent among these methods and tools that became popular in the past, and which assumed that past patterns would also hold true in the future, were the Product Life Cycle Planning approach (Smith, 1980), the Portfolio Matrix of the BCG (The Boston Consulting Group, 1972), and Competitive Analysis (Porter, 1980). Porter, for instance, wrote in 1980:

> "Also, some firms persistently outperform others in terms of rate of return on invested capital. IBM's return has consistently exceeded that of other mainframe computer manufacturers, for example. General Motors has persistently outperformed Ford, Chrysler and AMC." (p.126-127)

Needless to say, 15 years after the book was published, IBM and GM have lost more than $40 billion between them while Chrysler has become the star of the automobile industry. Today Porter's statement seems outdated, if not ludicrous. Competitive analysis is useless unless the strength of **future** competition can be predicted. The same is true with the Portfolio Matrix (The Boston Consulting Group, 1970) and the PIMMS (Schoeffler et al., 1974) approach which assumed that the bigger the competitor and the higher his or her market share the more important his or her advantages (Wensley, 1982). Such thinking failed to see the bureaucratic disadvantages associated with bigness, or alternatively the value of being small and therefore more entrepreneurial and flexible (Kiechel, 1981). The recent excellent performance of smaller firms (e.g., Chrysler) and their ability to outperform their much bigger competitors (e.g., GM) point to the impossibility of drawing conclusions about the future by simply extrapolating what has worked well in the past. Again best model fit does not guarantee the most accurate predictions for the future. On the contrary, being different (Fierman, 1995) or even going against conventional wisdom like Sam Walton or Richard Branson may contribute more to future success than imitating the past success of excellent firms or following some alleged recipes that will improve a firm's fortunes.

Mintzberg (1994) in a recent book entitled *The Rise and Fall of Strategic Planning* concludes that "'strategic planning' did not work, that the form (the 'rationality' of planning) did not conform to the function (the needs of strategy making)" (p. 415). He also mentions the findings of a study conducted among Japanese firms (Hayashi, 1978) which show that Japanese firms distrust formal strategic planning which they use instead for "identifying major problems and for creating an atmosphere conducive to the development of creative ideas and hard work within the company" (p.217). Although Mintzberg's conclusions are not shared by everyone (Ansoff, H.I., 1994; Teck and Grinyer, 1994), we cannot assume today that tools and techniques available to everybody can automatically provide competitive advantages.

A survey of such management tools and techniques (Bain and Company and The Planning Forum, 1995) concludes that

> "no correlation exists between the number of tools used and satisfaction with financial results, while a very strong correlation exists between satisfaction with financial results and a company's ability to discover unexplored customer opportunities, build distinctive capabilities, exploit competitor vulnerabilities and effectively integrate these activities" (p. 10).

For planning, strategic or otherwise, to be successful, correct foresight based on realistic forecasting is indispensable. The problem is that the need and importance for such foresight/forecasting is not made explicit while the difficulties and uncertainty involved are ignored. In the Portfolio Matrix approach, for instance, a product is defined as a "star" when its industry is growing at a fast pace while it holds a small market share at present. The idea is, therefore, to invest in such a "star" to increase its market share, and production volume, and reduce costs through economies of scale and scope. Profits could, therefore, increase by being a high volume, low cost producer in a fast growing market. Such reasoning, however, assumes that one can predict high growth industries and that competitors will not attempt to also invest in their own "stars" as they could also predict these high growth industries-- in which case the result will be overcapacity, high competition and low profits, or losses, even in the case when such high growth industries can be correctly identified. Moreover, it assumes that economies of scale and scope outweigh the bureaucratic and other disadvantages associated with "bigness", which recent experience has shown to outweigh these economies.

But if "recipes" like those given in *In Search of Excellence* do not work and if economies of scale and scope provide no obvious advantages, it is by more correctly predicting and better understanding what will happen in the future that firms can gain competitive advantages. Thus, we are brought back to Fayol's (see epigraph at the beginning of this article) point about the importance of foresight which is reemphasized in a recent book by Hamel and Prahalad (1994) who wrote:

> "Today many companies seem to be convinced that foresight is the easy part, it's implementation that's the killer. We believe that creating industry foresight and achieving operational excellence are equally challenging tasks. Many times what are described as today's implementation failures are really yesterday's foresight failures in disguise" (p. 75).

Strategy, or at least a good part of it, must be based on foresight, or anticipation, which must in turn be based on some form of forecasting and a realistic assessment of the uncertainty involved in all types of future predictions. In addition, it must take into account competitive actions and reactions, another area requiring forecasting, and the learning and imitation as well as the attempt to guess and outsmart the strategies and actions of competition. On the other hand, the futility of any type of analytical strategy is that it is based on principles (tools and techniques) and assumptions well known to everyone. This makes it easy for competitors to predict the consequences of the actions of firms using these strategies and take steps to attempt to render them obsolete. Forecasting for strategic purposes must be, therefore, as accurate as possible but not obvious so that competitors can guess the strategic consequences of such forecasts. In addition, to be complete it must also cover competitive actions and reactions as a result of learning and imitation.

The remainder of this paper discusses the value, as well as the limits, of forecasting and its potential contribution to planning and strategy. At the short-term, operational level the role and contribution of forecasting towards planning is clear. Forecasts are "most likely value" -- our best estimates about the future. They are found by identifying and extrapolating established patterns and/or existing relationships. They are accurate as long as the future is a continuation of the past. If we think it will not be, judgment must be used to adjust the extrapolative forecasts. At the same time the uncertainty surrounding the forecasts is accepted **and** measured. Moreover, such an uncertainty is being incorporated into planning through the build-up of safety stocks or extra slack. In addition, higher flexibility, smaller production runs and just-in-time production are used in order to minimize the negative effects of inaccurate forecasts and the associated uncertainty in any effort to predict the future.

In the medium term, the role of forecasting for mostly budget planning is also well-defined although the uncertainty surrounding the forecasts is higher because of business cycles and unusual or unexpected events. Predictions about the medium term are based on the "average" of, say, past recessions or recoveries as well as an interpretation of the special circumstances surrounding each business cycle. Specialized economic agencies (OECD, Federal Reserve, IMF) and business publications (Wall Street Journal, Financial Times, Business Week, Economist, Fortune) provide, on a regular basis, medium-term economic and industry forecasts and the uncertainty associated with them. To deal practically with such uncertainty firms set aside financial and other reserves to weather for instance, recessions while, at the same time, they devise ways (e.g., subcontracting or outsourcing) to increase their flexibility and be able to more easily adjust in the case of worsening economic or other conditions.

In the long term the role of forecasting is less obvious, although its need and value for long-term planning and strategy is as critical as that of operational or budget planning. Long-term forecasts are needed to develop foresight of what is to come and evaluate the extent and directions of forthcoming changes as well as their impact. In addition, forecasting is indispensable for identifying potential opportunities as well as dangers in the business environment and appreciating the extent and impact of future uncertainty. This is where forecasting can provide real strategic benefits and where much can be done to improve its usefulness and relevance to executives. Correct foresight in predicting major forthcoming changes and identifying opportunities and dangers, as well as appreciating uncertainty realistically are areas of **common** interest between forecasters on the one hand and managers/strategists on the other -- requiring cooperation and joint work between the two. The recent interest in "Competing for the Future" (Hamel and Prahalad, 1994) also points in the same direction. The critical question is how correct forecasts about the long term can be made and how these forecasts can be effectively incorporated in order to develop a collective organizational foresight that can improve a firm's chances of future success.

Past vs Future Success

In 1984 John Opel, IBM's chairman, announced that the sales of his firm, $50 billion at the time, would double to $100 billion by 1990 while its profits would continue their exponential growth. Figure 5 shows IBM's sales between 1954 and 1984, the time of the announcement, while Figure 6 displays its profits. Extrapolating the historical growth of IBM's sales for 1990 results in $110 billion sales, $10 billion more than Opel's forecast which could, therefore, be considered conservative as it underestimated the straightforward extrapolation of IBM's past sales.

Based on such forecasts IBM hired more than 100,000 new personnel to be capable of providing its existing and new customers with the high quality service it was much acclaimed for and which constituted the foundations for its strong competitive advantage. However, things did not turn out as expected. Figures 7 and 8 show, in addition to the 1954 to 1984 era, IBM's sales and profits since 1984. In 1994, eleven years later, its sales were only $64 billion while it has incurred losses of more than $13 billion over the last four years. Moreover, its work force was, by the end of 1994, at about half its 1986/87 peak of 430,000.

Should a firm like IBM, renowned for its high calibre, professional management, have made such a monumental mistake in forecasting? IBM's management assumed that the business environment and IBM itself would **not** change during the following six years and felt, therefore, justified in extrapolating historical patterns and basing its overall strategy and expansion plans on the forecasts from such extrapolation. This belief, however, that best model fit guarantees the most accurate forecasts, is not a good business practice for three reasons. First, if nothing changes, the future will be deterministic, as straightforward extrapolation is trivial and can be done by everyone, including all of IBM's existing as well as new competitors who would also make plans to expand and take for themselves as high part of the growing pie as possible. But inevitably the lure of high growth and big profits creates overcapacity, intensifies competition and results in price wars that diminish profits or even bring losses. Second, yearly growth rates in the 15% to 20% range may be possible for a small or medium size company but become exceedingly difficult for a $50 billion giant (the

FIGURE 5

IBM's ACTUAL SALES: 1954-1984

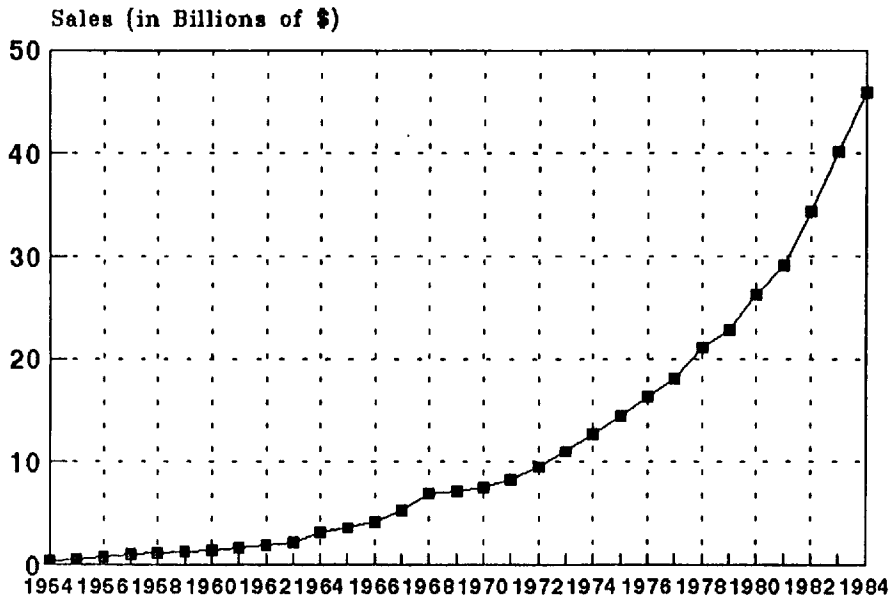


FIGURE 6

IBM's PROFITS: 1954-1984

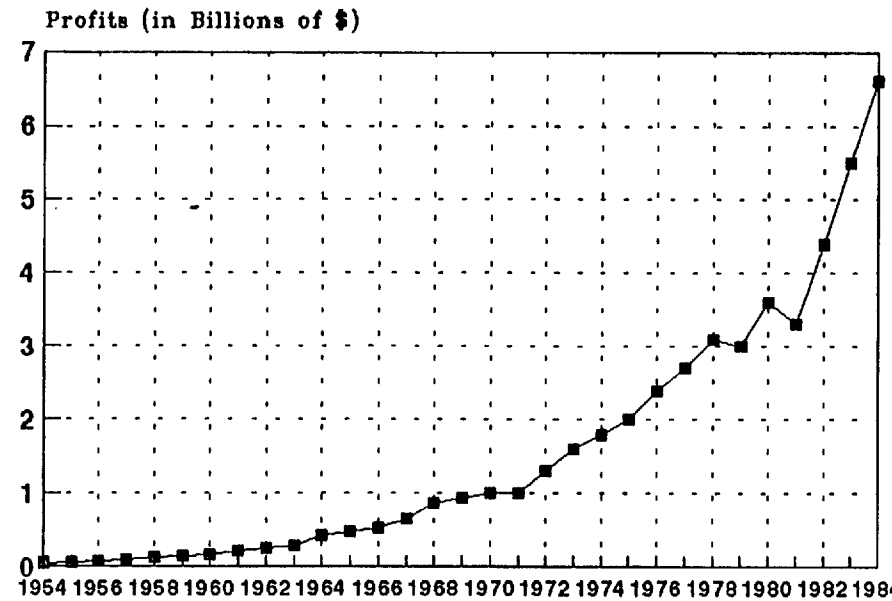


FIGURE 7

IBM: SALES AND 1984 FORECASTS

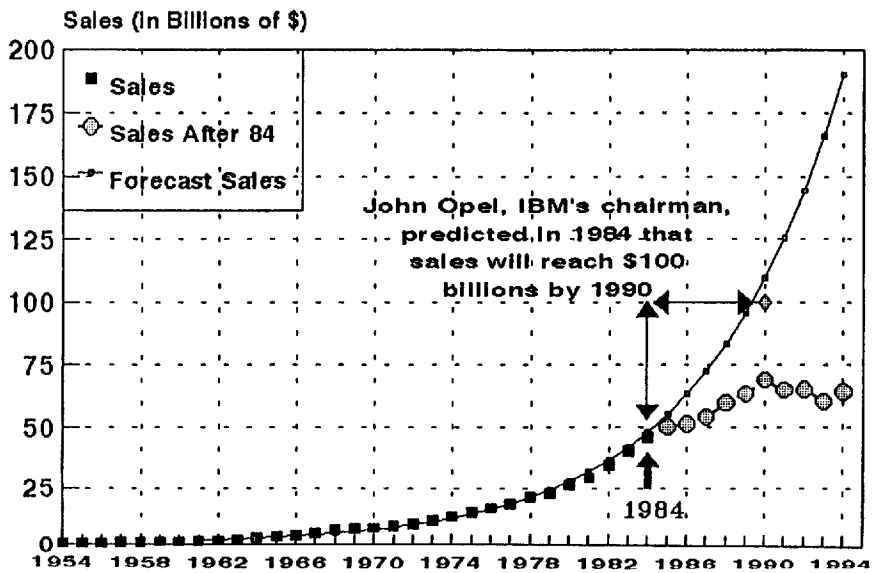
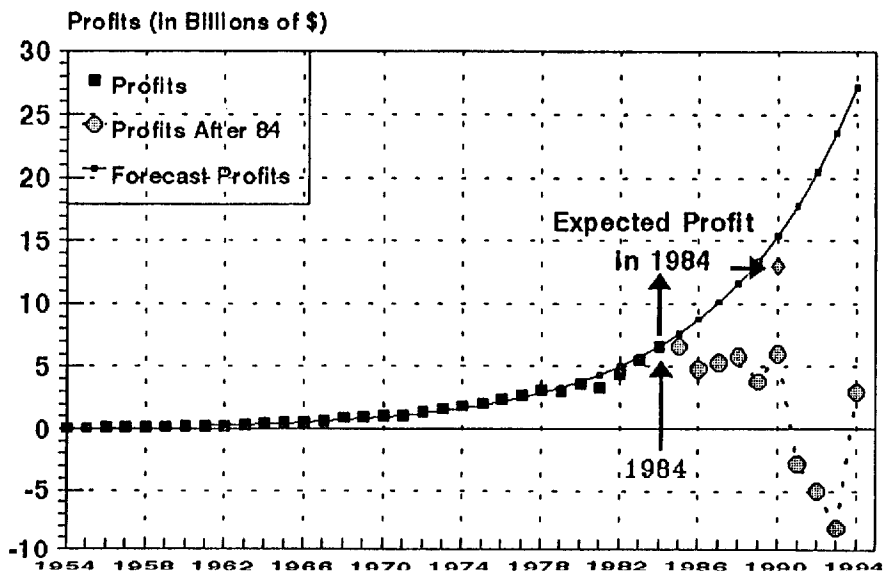


FIGURE 8

IBM: PROFITS AND 1984 FORECASTS



size of IBM in 1984) as a 16% growth meant an $8 billion yearly increase, more than the revenues of all but a few dozen of 1984's largest firms. Finally, even if IBM had managed to grow in revenues it would have been highly unlikely to have grown equally well in profits. John Opel and IBM ignored these simple forecasting principles and instead extrapolated established trends, not wanting to believe that such trends could change in the future. It would be interesting to see what would happen if a group of investors sued firms making forecasts like those of IBM which are based on erroneous principles without making explicit the danger and uncertainty associated with these forecasts.

History has shown that no large, bureaucratic firm has managed to maintain the growth in its profits at the level when it was smaller, more flexible and entrepreneurial. Bureaucracy and the associated diseconomies of scale inevitably take their toll. These types of historical observations seem to have held since modern firms appeared and are not likely to change as long as large firms do not fundamentally change the way they are organized and operate. IBM, and other large firms, cannot ignore these and similar historical observations if they are to avoid the dictum that "success breeds its own failure".

Major Changes in the Business Environment

Many firms and whole industries (e.g., steel and automobile) have found themselves in similar situations to IBM, being unable to recognize that the environment has or is about to change and realize that it does not suffice to continue doing well what has brought them success and high profits in the past. Table 1 summarizes the major changes in the business environment which have resulted in much stronger, and global, competition, more demanding customers, willing to only accept high value products/services, and fundamental shifts in the way firms are managed and operate. These changes have and will continue to fundamentally affect the business environment requiring a forward looking perspective as there is one certainty about the future: Firms are to expect continuous changes in the business environment. They must embrace, therefore, a new attitude that accepts that future success will be directly linked to correct foresight. To this end the role and value of forecasting is central in fulfilling two tasks: as accurate and relevant predictions as possible, **and** assessing the uncertainty of the

future as realistically as possible. As no planning or strategy is feasible without these two tasks, the role of forecasting is critical for the future success or failure of firms, making the cooperation of forecasters and strategists an absolute necessity.

Table 1: Major Changes in the Business Environment

TYPE OF CHANGE	YESTERDAY	TODAY	TOMORROW	CONSEQUENCES
MARKETS	Growing	Stagnant	Declining Except !!	
				Stronger, Global Competition
INDUSTRY BOUNDARIES	Well-Established	Falling Down	Non-Existant	
				More Demanding Customers
TECHNOLOGICAL CHANGES	Slow	Fast	Super-Fast	
				Fundamental Changes in Firms and Management
RULES OF GAME	Accepted	Disregarded	New/Changing	

Uncertainty in the Business Environment: Cycles vs Long-Term Trends

Figure 9 shows the monthly copper prices (in constant 1994 dollars), for 28 months. The downward trend is obvious. Constant prices were about \$5.5 at the beginning of the graph and \$2.5 at the end, a decrease of around 50%. Moreover, as the R^2 (a measure of how well the downward sloping exponential curve fits the historical data - the monthly copper prices) of the model (the negative exponential curve shown in Figure 9) is 0.974 we can feel pretty comfortable, according to prevalent statistical thinking, about extrapolating such a downward trend to future periods. Moreover, our uncertainty, based on these 28 data points, is very low as R^2 is close to 1 (1 indicates a perfect model or fit - the range of R^2 is from 0 to 1) and the variance of the model fitting errors is small. For instance, by extrapolating the trend of Figure 9 we arrive at a forecast for month 36 of \$2 a kilo while a pessimistic/optimistic (i.e. 95%) confidence interval around such a forecast is in the \$1.8 to \$2.2 range. Similarly, for month

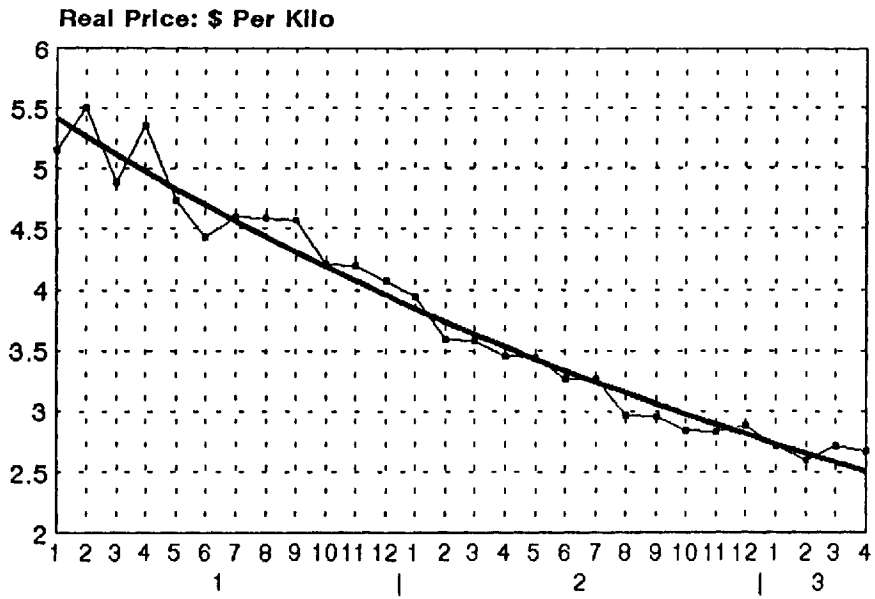


FIGURE 11
REAL 1994 YEARLY COPPER PRICES

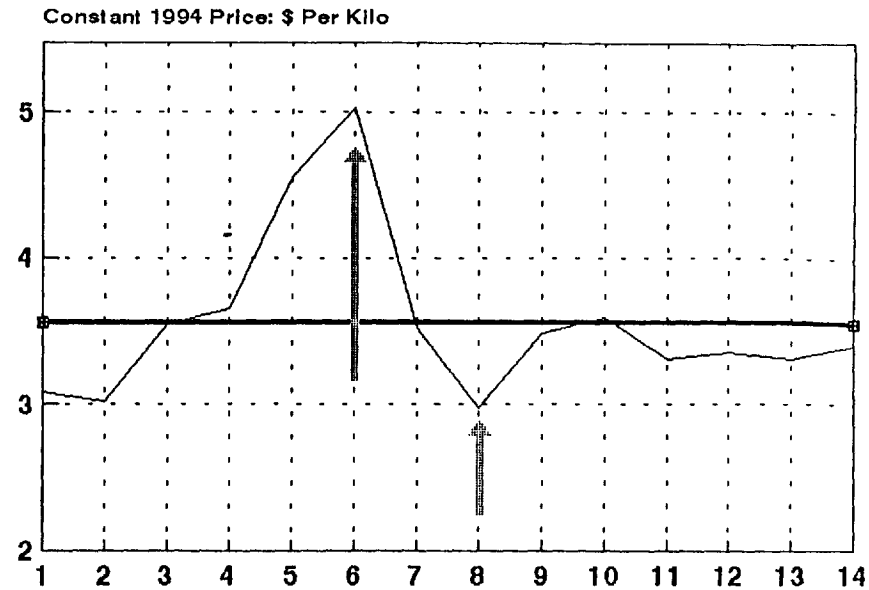
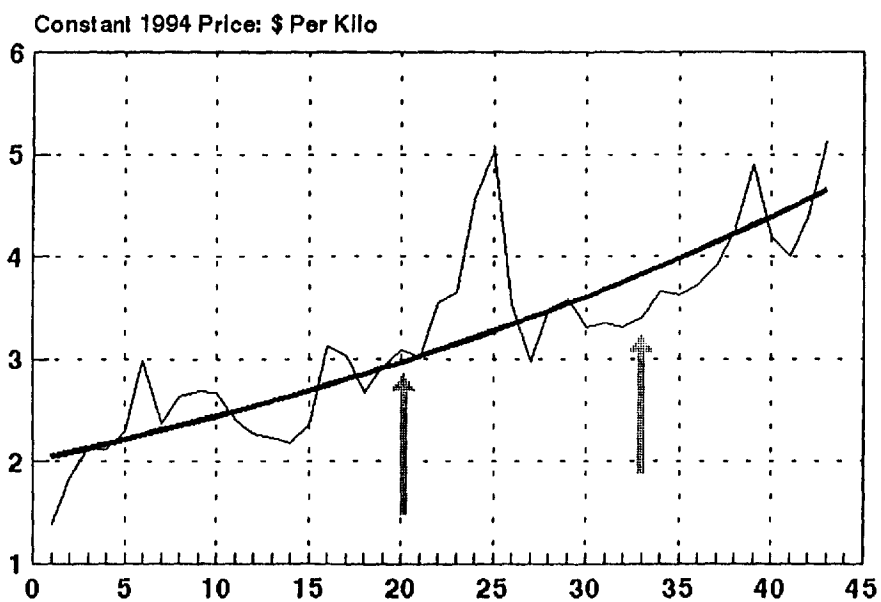
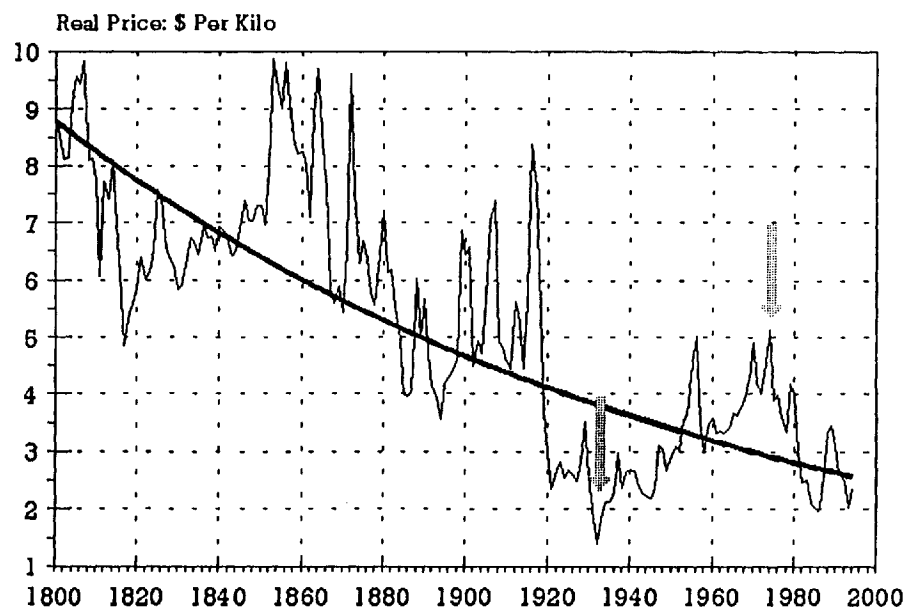


FIGURE 12
REAL COPPER PRICES IN CONSTANT 1994 $





48 the forecast is $1.42 with a pessimistic/optimistic confidence interval in the range of $1.28 to $1.57 a kilo.

Figure 10 shows real copper prices for 14 years. Figure 10 indicates that copper prices are constant, not declining. Which of the two, Figure 9 or 10, is correct? According to the prevalent statistical thinking, Figure 9 is to be preferred to Figure 10. Its R^2 is 0.974 versus 0.007 for Figure 10. Moreover, the model implied in Figure 9 is based on 28 points while Figure 10 uses 14 points only. However, the prices shown in Figure 9 are monthly, and consist of a small part (that shown between the two arrows) of the yearly data displayed in Figure 10. Logic dictates, therefore, to set aside the traditional statistical thinking and instead conclude that real copper prices are constant.

Figure 11, which contains 43 years of data, suggests a different picture: increasing copper prices (the 14 yearly data of Figure 10 are simply the part shown between the two arrows of Figure 11). The R^2 of the data shown in Figure 11 is 0.743. What can a copper firm conclude from these graphs? As the highest R^2 is found in Figure 9, traditional statistical thinking dictates that the optimal model is the one that best fits past data, that is that shown in Figure 9. Logic dictates, however, that yearly data should be trusted more than monthly ones, irrespective of the value of R^2 -- meaning that the model of Figure 11 should be preferred.

But even if we assume that the best model is that related to Figure 11, can its increasing trend be used as the basis on which to make an important strategic investment decision for opening, say, a new copper mine that will cost more than $1 billion? After all, 43 years is a very long period (most executives complain that their data does not go back more than five to ten years) and the fit of the model shown in Figure 11 is pretty good -- its R^2 is 0.743. Our confidence, therefore, about extrapolating the exponential trend of copper prices to future years should be pretty good. (For example, its forecast for ten years later is $5.66 a kilo with a pessimistic/optimistic confidence interval of between $4.12 and $7.80 a kilo).

In real life, 43 years of data does not represent a long enough period to draw any conclusions about the long-term trend in copper prices. Long wave cycles, also called kondradieff, can last for more than 60 years. It is possible, therefore, that what seems to be an upward trend for 43 years is, in effect, the rising part of a kondradieff cycle. This is the case of the data shown in Figure 11 which includes the upward increase of the long-wave cycle that started in 1932 and ended in 1974. The full cycle that started in 1932 can be seen in Figure 12 which shows copper prices since 1800 (**an appropriate** starting time since the effects of the industrial revolution started at about this time) and which displays both an exponentially decreasing trend and many cycles of various durations and lengths (the 43 years of Figure 11 are simply the part of Figure 12, shown between the two arrows, from 1932 to 1974 -- it is not clear that the downward decline of such a cycle has ended as yet).

Even though the R^2 relating to Figure 12 is 0.618, smaller than the 0.743 of Figure 11, we will have to conclude that real copper prices are not increasing in the long run as Figure 11 suggests. On the contrary, they are decreasing in an exponential fashion. This means that Figures 9, 10 or 11 have no value for strategists apart from illustrating, beyond the slightest doubt, the dangers of making long-term forecasts without an appropriate starting period. In fact, any conclusion drawn from them can be highly misleading and must **not** be used for basing strategic, or other long-term decisions which require the accurate prediction of long-term copper prices on which to base, for instance, capital expansion plans. Such a conclusion implies a fundamental change in our approach to forecasting as well as its use for long-term planning and strategic decisions. Unless we are certain that we use the right starting period (as with Figure 12), we cannot be confident about our extrapolations or our ability to distinguish long-wave cycles from long-term trends.

Successful strategy and effective long-term planning (e.g., capital budgeting) require figuring out the implication of long trends and distinguishing such trends from the various cycles associated with them. As a matter of fact, the further the copper prices go away from the long-term trend, as is the case of the data shown in Figure 11, the higher the chance that there will be a regression towards, and possibly below, the long-term trend. This has happened in

Figure 12 which shows that copper prices, well above the long-term declining trend in 1974, have fallen below such a trend in 1993 and (part of) 1994. Based on Figure 12 we can forecast the long-term copper prices (in constant 1994 dollars) as $2.48 in the year 2000 and $2.40 in the year 2005, with pessimistic/optimistic ranges of $1.41 to $4.35 and $ 1.37 to $4.22 respectively.

Uncertainty in the Business Environment: Unusual and Unexpected Events

In addition to cycles of various durations and depths, unusual and unexpected (or little expected) events can also occur that add to the uncertainty of future predictions. The 1991 Gulf War, for instance, brought air travel to a standstill and caused huge losses to airlines and the travel industry as people, afraid of terrorist attacks, avoided or cancelled practically all travel abroad. Similarly, new competitors like the Japanese entering the US Automobile Industry when the conventional wisdom of that time was that such a move was bound to fail (Magaziner and Patinkin, 1989); new technologies like personal computers that substantially decreased the demand for mainframe ones because of their lower cost and versatility, including their user friendliness; and changes in consumer attitudes like the acceptance of superdiscount stores, warehouse clubs; or greater concerns about health or the environment as well as fads and fashions can and do bring unexpected consequences which firms must be capable of withstanding, or at least be capable of reacting as soon as possible.

Although it is not possible to plan for unusual events, or anticipate unexpected ones, the fact remains that such events will occur again and again in the future and some type of strategy must exist to deal with them once they have occurred. Contingency planning and mostly scenarios (Wack, 1985; Schoemaker, 1995) are possible ways of dealing with such events which require a fundamental change in executive thinking away from the reassuring belief that the future is an extrapolation of the past (the way John Opel of IBM predicted its sales in 1990) to accepting that it is impossible to eliminate future uncertainty. In such a case one of the most valuable aspects of forecasting is to facilitate learning to take place while that of strategy is to provide adequate responses (e.g., the necessary slack) so that the organization can smoothly adjust to temporary changes (e.g., in the case of war, or a competitive move) or

successfully adapt to permanent ones (e.g., new, improved technologies or fundamental changes in consumer tastes and attitudes). But whatever is done uncertainty cannot be ignored without devastating negative consequences.

Predicting the Long Term and Assessing the Uncertainty of Predictions

Can long-term forecasting be relevant and useful with the type of huge cycles, lasting for many decades, shown in Figure 12, or with the possibility of unusual and unexpected events? The answer is simple: we have no other choice. We must predict the future as accurately as possible and we must assess the uncertainty surrounding such predictions as realistically as we humanly can. Otherwise our planning and strategy will be neither realistic nor will they benefit from information that can be made available through forecasting.

Long-term forecasting is difficult **and** challenging for two reasons. First, the long-term future is not simply an extrapolation of the past because of technological and other changes. Second, humans, in their attempt to profit from and influence what will happen, can and do change the course of future events to achieve desired goals. The long-term future is not, therefore, predetermined and cannot be predicted except as it unfolds. In addition we, through our actions, can create such a future. The interesting and critical questions are how far ahead can we predict, how certain, or uncertain, are we about our prediction, and to what extent can we influence, and create, the future itself. In these cases the correct timing of our long-term predictions may be as, or even more critical as the accuracy of the predictions themselves (e.g., knowing **when** computers that can understand natural languages will become widespread and economical may be as, or even more important than predicting that such computers will become a reality before, say, 2015).

Long-term predictions must be possible, otherwise no foresight about the future can be developed and therefore no correct vision and appropriate strategies could be conceived. On the other hand, if these predictions are obvious and shared by many people they will be of little value for a specific firm. For instance, the strong growth in the PC market had been, and still is, known for a long time. This correct forecast, however, did not produce many benefits

except to a few companies precisely because all players have predicted the forthcoming boom in demand. Consequently, they increased their production, in anticipation of the growing demand, bringing overcapacity, strong competition and price wars that brought more bankruptcies than in other industries where their long-term forecasts turned out to be much less accurate.

Today, long-term forecasts point to a huge growth in the demand for telecommunications as transmission speeds are increasing and prices are falling (see section on Computers and Communications). What is not clear, however, is whether existing telephone networks, fiber optics networks, mobile or radio transmissions, cable TV networks, satellite transmissions, new fiber optics networks laid down by electric utilities, gas companies or rail firms, or some combination of the above will prevail and dominate the growing usage of telecommunications as the various players will be attempting to capture as big part of the growing pie as possible. Those who will profit most in the evolving battle will be those who can better predict what will happen and who make the right choices and investments in order to gain maximum competitive advantages -- hoping they will consequently keep them. Long-term forecasts are indispensable for developing the right foresight about the future, knowing well that some of the forecasts will be wrong, that the timing of others will be missed and that still other important developments will not be predicted in advance. Accepting these difficulties, there are two major approaches available for forecasting the long term which are elaborated next. They involve the extrapolation of long-term trends and the use of analogies. The implications of such forecasts can be consequently used to develop foresight, preferably in the form of scenarios, about the future and the strategies that will be required to move the organization in the desired directions.

LONG-TERM TRENDS

Although long-term trends can also change, it is not likely that they will do so because, by definition, they have been lasting for a very long time, being the outcome of our economic system of free competition. Such trends can, therefore, be extrapolated with a reasonable

degree of certainty unless we have reasons to believe that the present economic system will change in some fundamental manner.

The Long-Term Trends in Real Prices, Income and Buying Power

Most prices, when inflation is excluded, of standardized (commodity type) products or services decrease in the long run. The decrease started with agricultural products and has continued with practically all standardized products and services. Figure 13 displays real wheat prices since 1264 and clearly shows their considerable decrease since around 1800. Since then, real wheat prices have behaved very much like the copper ones shown in Figure 12. Both have been declining, in real terms, because supply has increased above demand (although population increased six-fold between 1800 and 1994, increasing demand considerably) forcing real prices to drop.

The long-term decrease in real prices necessitates the view that firms must continuously improve their productivity, through technological and/or organizational innovation, in order to be capable of decreasing their costs and real prices continuously -- this is at least true for firms producing standardized products/services.

In the long run, real income increases, although its increase is also characterized by cyclical fluctuations. Figure 17 shows real wages in England since 1264 and clearly indicates that real income has been increasing exponentially, first from around 1625 until 1725 under the impact of the agricultural revolution, and second since about 1800 under the impact of the industrial revolution. As real wages increase, so does real GNP or wealth. Figure 18 displays the real Gross National Product (GNP) of several countries, going as far back as reliable data has been available, which also shows a substantial increase over time.

The combined effect of diminishing constant prices and increasing real income improves people's buying power in an accelerated fashion, and results in more material possessions. For instance, Figure 19 shows, since 1264, the percentage of a day's wages needed to buy two kilos of wheat (about what is needed to feed an average family which used wheat as its major

FIGURE 13
WHEAT PRICES IN CONSTANT 1993 £

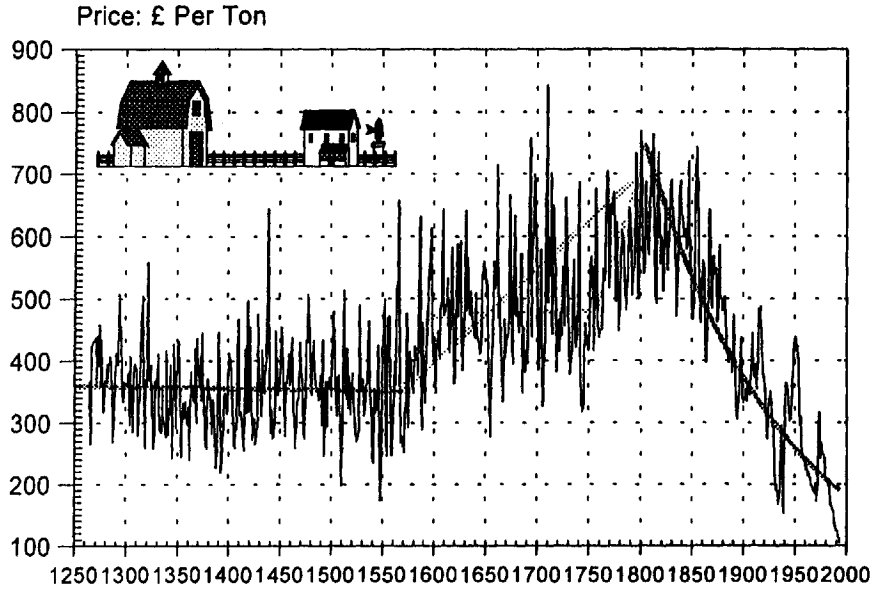


FIGURE 14
NAIL PRICES IN CONSTANT 1993 $

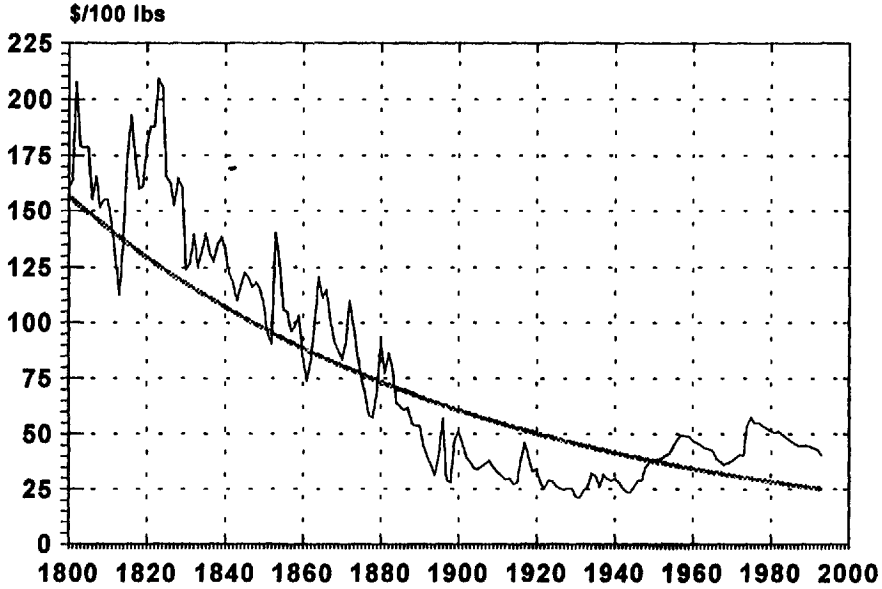


FIGURE 15
TELEPHONE COST: NEW YORK-SAN FRANCISCO

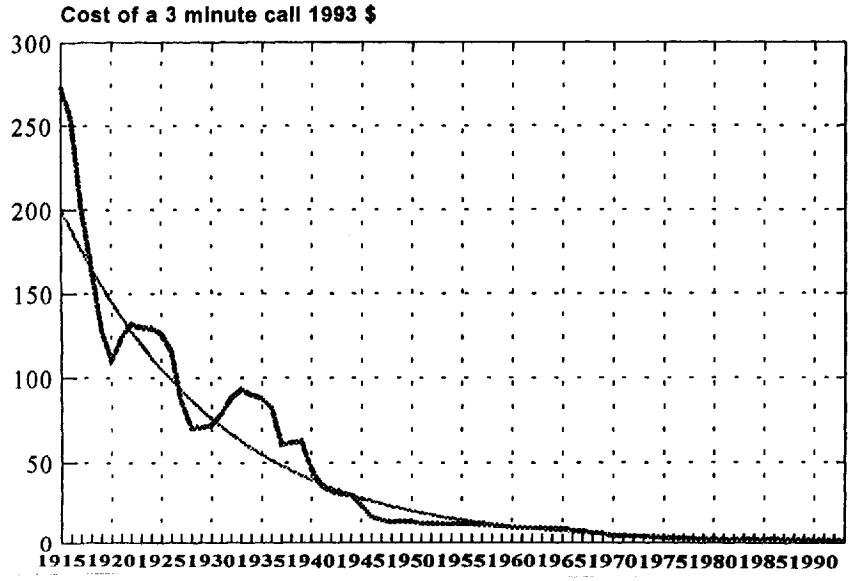


FIGURE 16
CONSTANT PRICE OF A DOZEN EGGS: USA

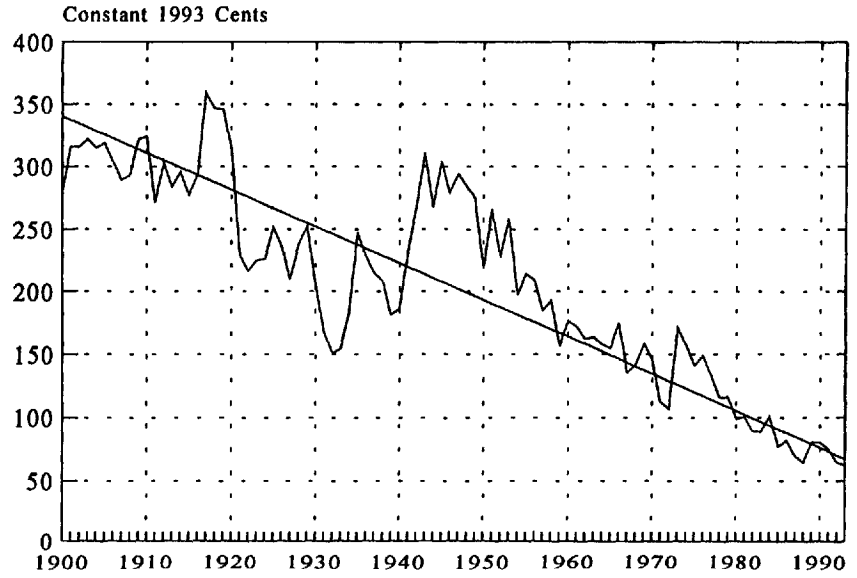
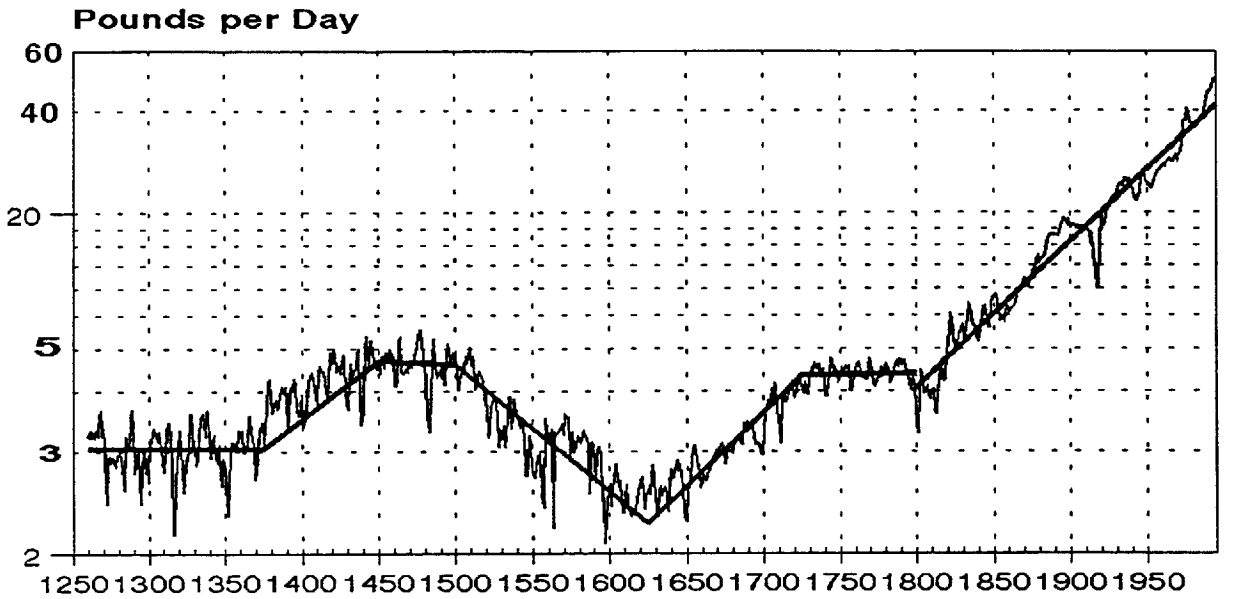


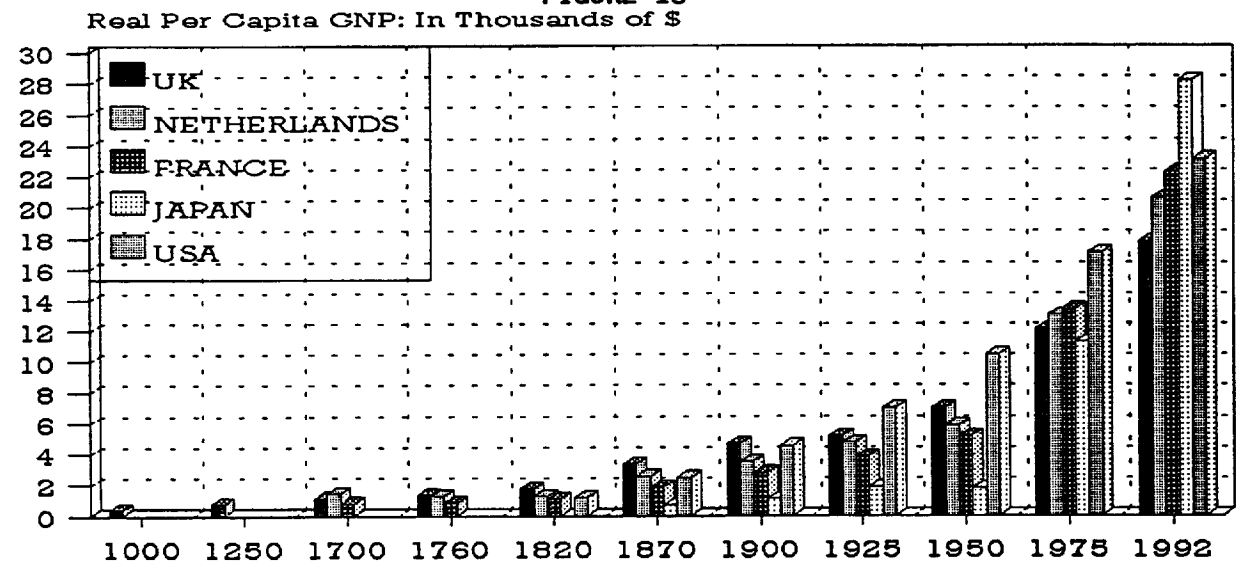
FIGURE 17

REAL DAILY WAGES IN £: ENGLAND



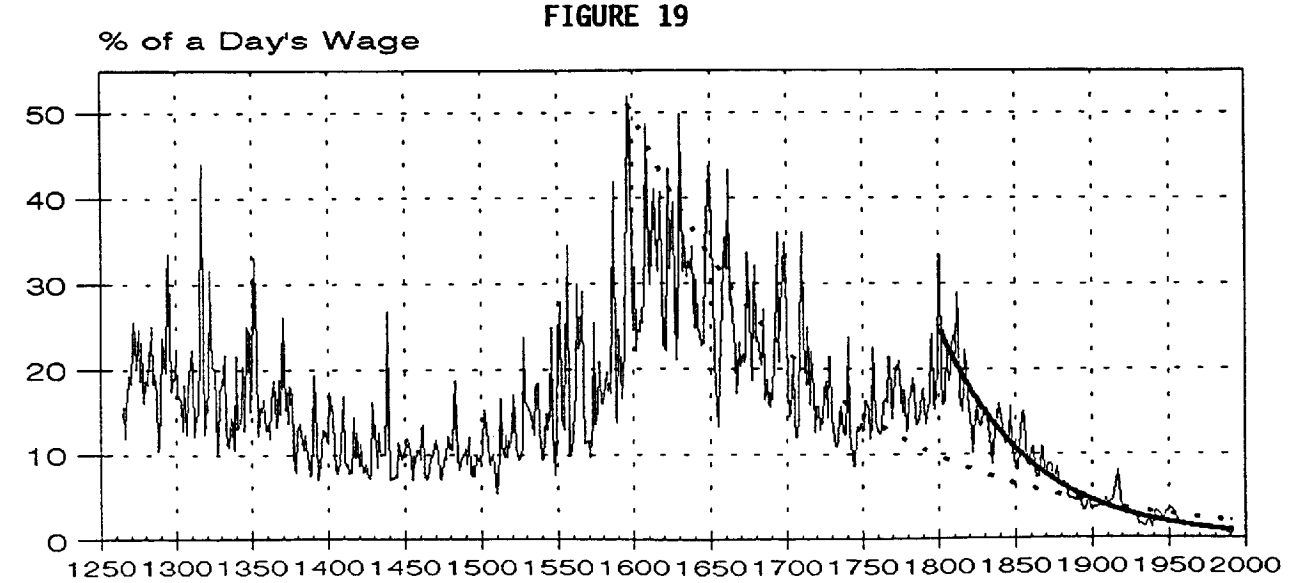
GNP: 'USA, JAPAN, FRANCE, HOLLAND AND UK

FIGURE 18



% OF A DAY's WAGE TO BUY TWO KILOS OF WHEAT

FIGURE 19



source of food) in England. Such a percentage has both decreased substantially and has been fluctuating much less around its long-term trend since about 1800. As buying power improves, the great majority of people in industrialized countries can buy all necessities required for living and also have a part of their income left for acquiring durable and luxury goods, or spend it on services, including entertainment, and housing. Today, practically all families in industrialized countries possess refrigerators, ovens and other electrical appliances while the great majority own telephones, TVs and cars. There is no doubt that in the future material possessions will increase even more as real prices will continue going down and real income will keep increasing. It is only a question of time before full material abundance will become widespread for the great majority of inhabitants of developed countries.

Cycles of Various Durations and Depths

The prices, income and buying power graphs displayed in Figures 12 to 19 exhibit strong deviations, some more than others, around the long-term trend. As it was mentioned, these deviations, or cycles, can last for many decades and present a considerable challenge for both forecasters and planners/strategists. Unfortunately, however, cycles cannot be predicted quantitatively, as their length and depth are not constant (this observation can be confirmed in Figures 12 to 19). As Slutsky (1937) has pointed out, cycles are the outcome of cumulative random errors of the following form:

$$Y_t = \Sigma e_t \qquad (1)$$

where e_t are independent, normally distributed error (i.e., random) terms, with a mean of zero and a constant variance. That is, expression (1) means adding up random happenings, or errors, over time and considering their cumulative impact.

Figure 20 shows four graphs generated by expression (1). Figure 20(a), 20(b) and 20(c) were selected from a total of ten tries to illustrate extreme cases of applying equation (1). Figure 20(d) includes two graphs. One displays the cycles of copper prices (the difference between the actual copper prices and their long-term trend from Figure 12) and the other displays the

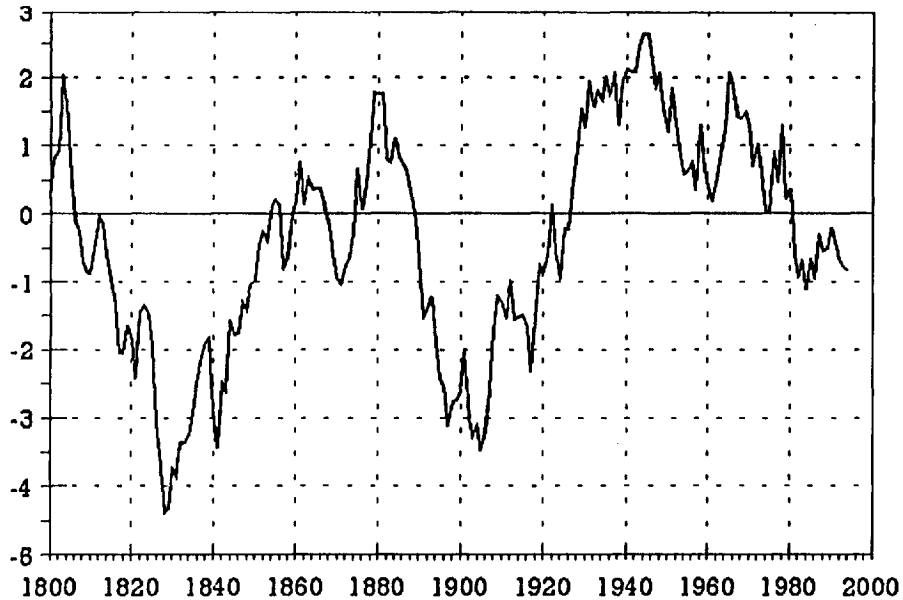


FIGURE 20(c)
A GENERATED SERIES THROUGH A RANDOM WALK

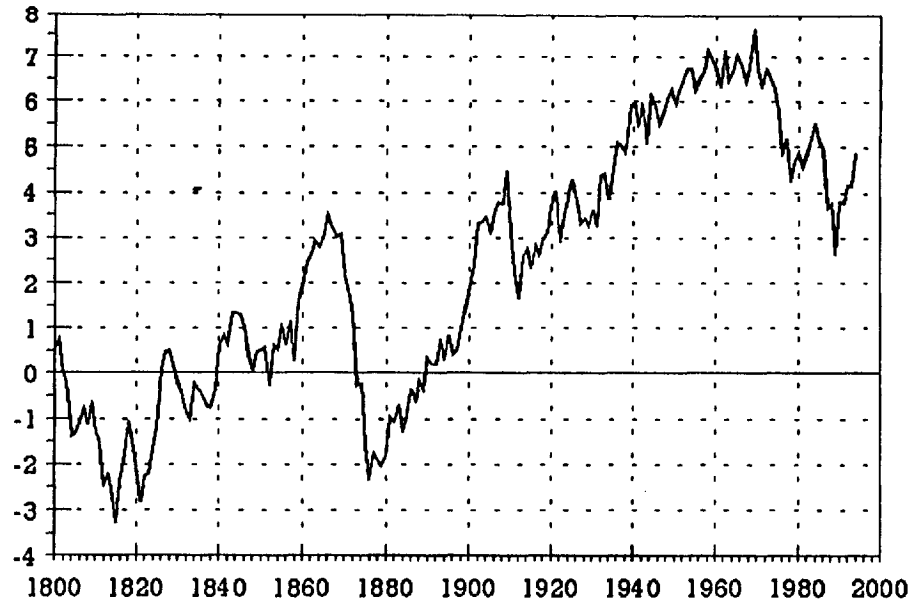
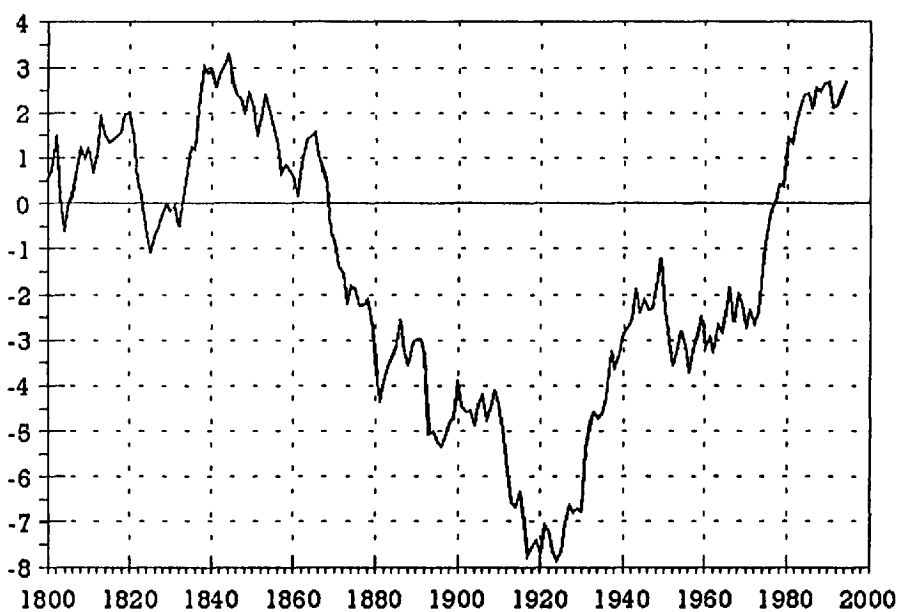
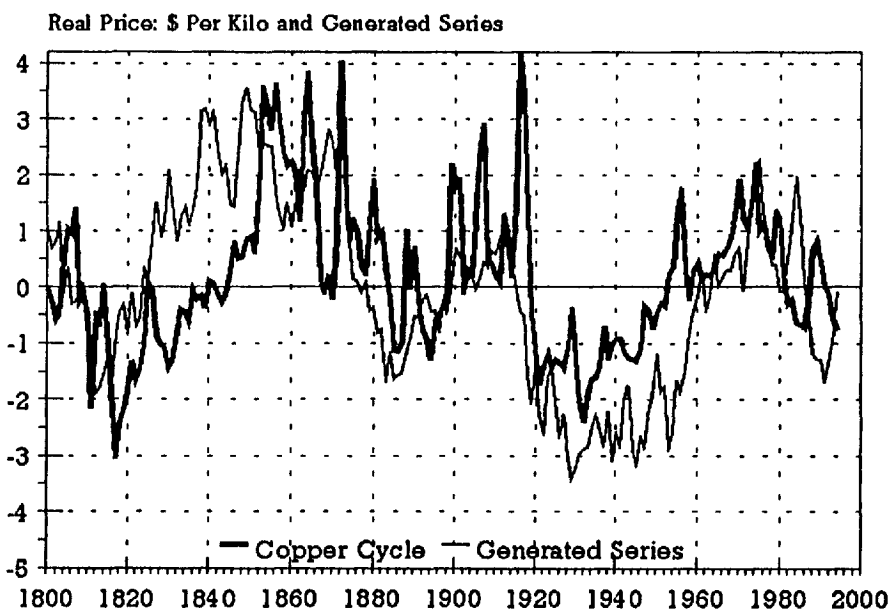


FIGURE 20(d)
CYCLES IN REAL COPPER PRICES AND A RANDOM WALK





series, among ten ones generated by expression (1), that has the highest correlation to the copper price cycles found from Figure 12. The obvious resemblance between the copper price cycles and the series generated through expression (1) in Figure 20(d) is striking, proving that copper cycles are the outcome of random forces whose influence is being accumulated over time. The shapes of the curves in Figure 20 suggest that the cumulative effect of random fluctuations can result in strong cyclical patterns that can make us believe, in an illusory manner (Langer, 1975), that there are underlying factors behind them when there is nothing more than chance happenings whose effect cumulates over time.

Y_t, as presented by equation (1), is called a random walk and it is characterized by our inability to predict its next turning point. Many economic and business series behave like random walks, making the most appropriate forecast, for any future value of $\hat{Y}_t$, the latest actual value available, or

$$\hat{Y}_{t+i} = Y_t \qquad (2)$$

Expression (2) means that the best forecast for the future, say, the Dow Jones Industrial Average is today's value of Dow Jones.

Figure 20(d) suggests that copper prices, once the long-term trend has been excluded, are random walks which cannot be predicted, unless additional non-quantitative information is available (e.g., inside information about capacity utilization rates, the power of cartels to limit production, etc.). The random walk character of economic and business series explains the conclusions (Fildes and Makridakis, 1994) of why sophisticated models, which identify and extrapolate short and medium-term trends, are not more accurate than methods which assume no trend (e.g., single exponential smoothing) or which slow down its continuation (e.g., damped exponential smoothing).

The fact that cycles are random walks increases the uncertainty in long range planning and necessitates taking into account such uncertainty when formulating strategies for firms. Like

chaos theory in physics (Gleick, 1987) random walks as expressed in (1) indicate that random forces, and their cumulative effects, are often responsible for huge cyclical swings which are not therefore predictable as they can be the outcome of some initial insignificant perturbations (the butterfly effect).

The Long-Term Trends in Population, and Wealth Inequalities

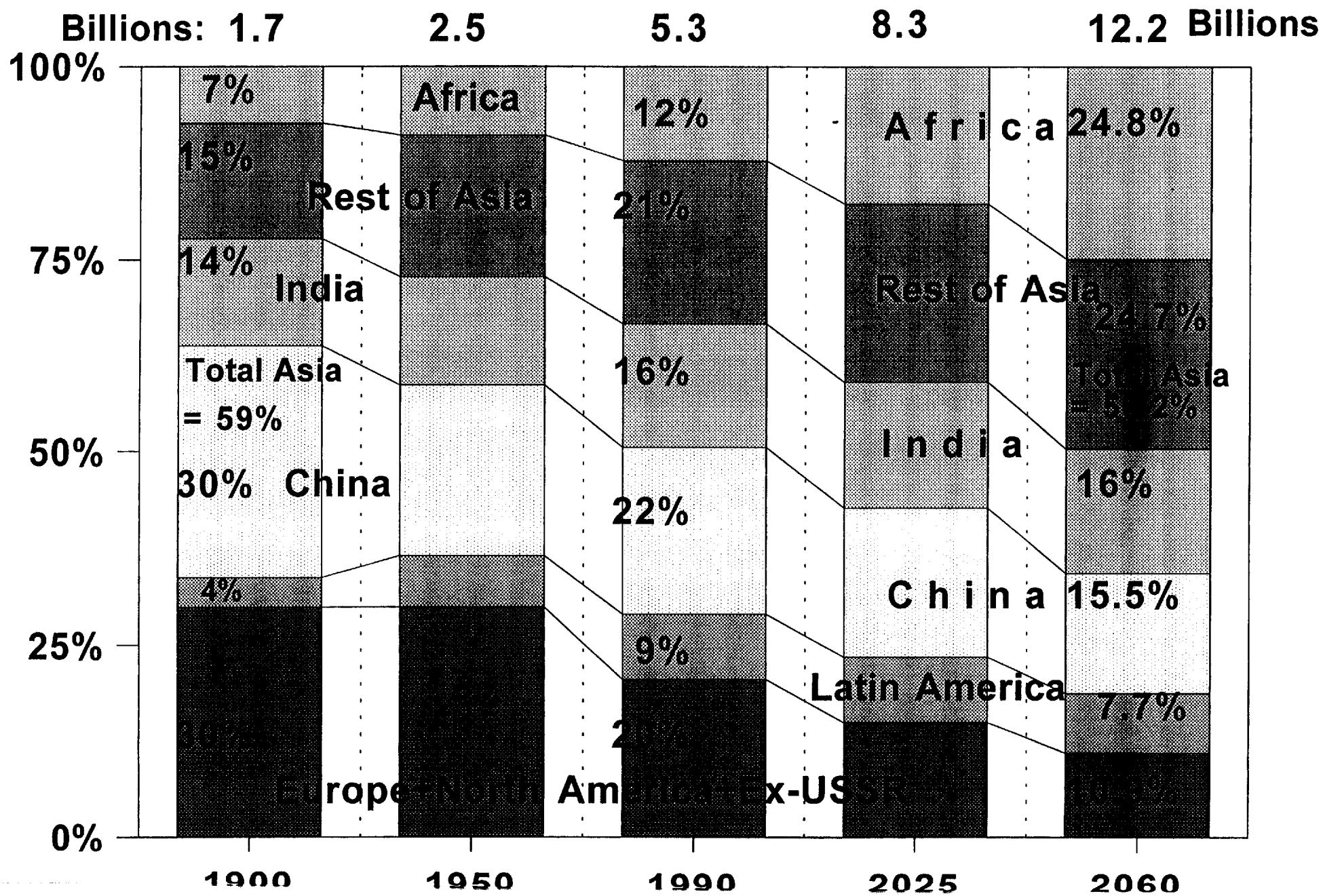
Human population has grown exponentially since homo sapiens appeared 50,000 years ago. However, absolute growth had been small until about 700 BC when the population of earth stood at about 200 million. Since then it has been increasing at an exponential rate which accelerated from the fifteenth century onwards when the population was about 375 million. The population doubled in 1740, and again in 1875 and 1955 when it stood at about 3 billion. It is expected to double to 6 billion people before the end of this century and to double again to 12 billion by the year 2060.

Population growth in developed nations has slowed down since the 1970s, or has even become negative in certain countries, while that of the developing world is still growing at a fast pace. If the population growth of the developing nations follows the same pattern of slowing down as that of developed ones, then it is estimated that the population of earth will stabilize around the year 2060 at more than 12 billion, more than double today's population size of about 5.5 billion. Sustaining a population of more than 12 billion does not seem as difficult as it was thought a few decades ago (e.g., see *The Limits to Growth*, 1972). Agricultural and manufacturing production can support an even bigger population size. Instead, serious problems are bound to come from the growing regional differences in the population size, the wealth inequality between the rich and the poor, and the social and environmental (pollution, solid waste, deforestation) problems associated with high consumption levels as well as differences and inequalities.

Figure 21 shows the percentage of population living in various countries/regions over time. These percentages confirm the substantial relative increase in the population of developing countries and the corresponding decrease in that of developed ones. In 1950 Europe, North

WORLD POPULATION

FIGURE 21



America and the ex-USSR constituted 30% of the world population. In 1990 it stood at 20% and it is expected to drop to below 11% by the year 2060, when the world population is expected to stabilize. At the same time the percentage of Africa will go from 7% in 1900 to close to an estimated 25% in 2060.

Another trend is the income distribution between developed and third world countries which is widening. Today, the top seven richest countries in the world with about 12% of the population hold two thirds of the world's GNP. The USA alone with 4.7% of the world population generates 25.8% of the global wealth. Its average yearly growth rate of about 3.1% was $183 billion in 1993, a number which exceeds the total GNP of the 37 poorest countries in the world which have a per capita GNP of less than $550 a year. Moreover, this 3.1% yearly increase of $183 billion is higher than the total GNP of India with a population of 885 million people. Worst of all, the gap between the rich and poor will continue to increase if left to its own, encouraging crime, pollution, illegal immigration and social unrest. If the poor see no opportunities and chances for advancement by following the established rules imposed upon them by the rich nations, they will search for alternatives including cultivating and selling drugs, deforesting the Amazon and other forests, polluting the environment, resorting to crime, or illegally entering countries where they can find work.

When long-term population trends are extrapolated they show that expansion is bound to shift to the developing countries of the third world and in particular those of South and South East Asia which, in addition to the high population growth, are developing economically at a fast pace. The population of China and India alone will, by the year 2015, be 2.7 billion, more than twice as much as the combined population of Europe, North America and Japan. Moreover, the inhabitants of developing countries own few material possessions, at present guaranteeing a huge demand from household appliances and cars to computers and medical equipment. The only difficulty will, of course, be that they will need enough income to be able to afford these products. However, if history is a guide, developing countries will improve their economies and achieve a take-off as today's developed nations have done since the beginning of this century. There are encouraging signs with many Asian countries that

such an economic take-off is well under way. This means that European, North American and Japanese firms will be obliged to operate in developing countries if they want to grow and through their investment and managerial know-how contribute to a faster economic growth for these developing nations. In such a case an important role for forecasting will be to accurately predict the countries and the timing of their take-off to help firms to formulate strategies and make appropriate investments to operate in such countries.

The Implications of Extrapolating Long-Term Trends

Table 2 shows the effects of a 1% decline in real prices, a 2.8% increase in the Index of Industrial Production (IIP), a 1.8% increase in the per capita GNP and the corresponding improvement in buying power. These percentages are close to the historical averages that have prevailed in developed countries since around 1800. In addition it shows the population of the earth assuming that its growth in developing countries will follow the same pattern as that of developed ones. Table 3 shows the same variables except for prices which are assumed to decline by an average of 2% a year (it is more difficult to estimate the price declines as they will be affected by the forthcoming technologies of the information revolution) instead of the 1% used in Table 2.

The effects of the cumulative growth are phenomenal. Buying power, 6 in 1890, becomes 100 in 1990, 133 in 2000, 200 in 2015, and 1608 in 2090, that is 16 times higher than in 1990 and 260 higher than in 1890. When average price decreases are assumed to be 2% (see Table 3), the effects are even more spectacular as buying power will be 146 in 2000, 260 in 2015 and 4577 in 2090 -- more than a 45-fold increase in a mere 100 years. If the trends shown in Table 2 or 3 continue, excluding unforeseen disasters, we are about to enter into an era of full material abundance where the buying of goods and services, at least the standardized ones for people living in developed countries, will be done with a very small percentage of our income. The obvious implications of this are that people will easily own everything they need and will be looking for **new** products and in particular **additional** services on which to spend their increasing real revenue. In such an environment the biggest challenge for firms will be to identify and quickly bring to market **novel** products and provide **extra** services to satisfy the

TABLE 2

HE CUMULATIVE EFFECT OF GROWTH RATES: rices =-1%, Per Capita IIP=2.8%, GNP=1.8%

Assuming that the growth of the population of developing countries ill follow the same pattern as that of developed ones)

	1890	1990	2000	2015	2050	2090
(Index of indus- al Production)	6	100	132	200	524	1582
al GNP	17	100	120	156	292	595
al Prices	270	100	90	78	55	37
ying Power	6	100	133	200	530	1608
rth Population	30	100	120	145	240	250
er 65:Developed	4 %	12 %	14 %	17 %	24 %	24%
er 65:Developing	2 %	4 %	5 %	6 %	14 %	21%

TABLE 3

HE CUMULATIVE EFFECT OF GROWTH RATES: rices =-2%, Per Capita IIP=2.8%, GNP=1.8%

Assuming that the growth of the population of developing countries ill follow the same pattern as that of developed ones)

	1890	1990	2000	2015	2050	2090
(Index of indus- al Production)	6	100	132	200	524	1582
al GNP	17	100	120	156	292	595
al Prices	725	100	82	60	30	13
ying Power	2	100	146	260	973	4577
rth Population	30	100	120	145	240	250
er 65:Developed	4 %	12 %	14 %	17 %	24 %	24%
er 65:Developing	2 %	4 %	5 %	6 %	14 %	21%

needs of consumers who already own practically everything they may want. Furthermore, this challenge will have to be met on top of falling prices which will require continuous productivity improvements to be able to survive. Success and high profits will then have to come from technological or other innovations, and from using these innovations to open **new** markets and satisfy **new** customer needs, as practically all existing ones will have already been saturated. Success will therefore require forecasting to identify **emerging or future technologies** and/or **needs or markets** rather than from past success or imitating like *In Search of Excellence* what others have been doing well.

Another implication from Table 2 or 3 is the ecological effects of increased production and high material consumption which will, by the year 2015, be double their 1990 level if established trends continue. Unless serious efforts and coordinated steps are taken to reverse established trends and move towards a green revolution, the quality of life might go down due to too much pollution, including solid waste disposal, and similar environmental problems. This will be true, in particular since large numbers of people in third world countries will be eager to taste the fruits of industrialization with lesser concern about ecological consequences which they feel is a luxury for the rich of the developed nations.

Tables 2 and 3 highlight the opportunities (high buying power, big increases in demand in developing nations), concerns (need for continuous productivity improvements and innovation/creativity), and problems (pollution, social conflict between the rich and poor, a graying population in developed countries) which could be turned into business opportunities (e.g., eliminating pollution, or caring for the old). Executives will have to study these and similar trends carefully and debate alternative scenarios of how they will affect their specific industry and firms. It is through such a debate that a collective organizational foresight can be developed which will serve as the basis for formulating appropriate strategies and preparing their firms to anticipate and exploit forthcoming opportunities while staying clear of the dangers lying ahead.

ANALOGIES

Extrapolating long-term trends is limited by the fact that in many instances no, or little historical information is available -- not to mention data series going back to 1800. In such cases analogies can be used which, as the name implies, allow forecasting by making predictions based on similar situations for which past data, or accumulated experience is available. Analogies are used in the short term for forecasting the implications of special events or competitive actions based on similar past ones. They are also used in the medium term for assessing the length and depth of, say, recessions by relating the current recession to all post World War II ones. Similarly, they are utilized in the longer term to predict the sales of new products or services based upon the past demand of similar ones. In this section the approach of analogies will be applied to assess the impact of Computers and Communications (C&C), what is referred to as the information revolution, and their implications for society and firms. In addition, the analogy between the five most important inventions of the industrial revolution and their corresponding forthcoming ones of the information revolution are explored.

The Information vs The Industrial Revolution

The arrival of the information revolution has been heralded since the late sixties. However, all predictions about the profound changes it will bring have **not** materialized as yet. Even today there are widespread complaints that white-collar productivity has not improved (Roach, 1991) even though there have been huge advancements and substantial investments in C&C, the backbones of the information revolution. There is, therefore, a justified concern as to what will happen and what firms should do to prepare themselves for the information revolution. The critical question is whether or not the information revolution is on target and the exact timing that it will start providing significant benefits and far-reaching changes similar to those of the industrial revolution.

Our experience of long-term forecasts has demonstrated three phases. Predictions over the very long term are accurate, even though they do not have much value as the timing of their arrival is not specified. Few people will have trouble, for instance, predicting that robots will,

during some time in the future, perform all repetitive and routine tasks or that humans will land on Mars or other planets. Back in 1260, for instance, Roger Bacon predicted:

> "Machines may be made by which the largest ships, with only one man steering them, will be moved faster than if they were filled with rowers; wagons may be built which move with incredible speed and without the aid of beasts; flying machines can be constructed in which a man ... may beat the air with wings like a bird ... machines will make it possible to go to the bottom of the seas".

Similarly, Leonardo Da Vinci, Francis Bacon, H.G. Wells and Aldous Huxley have made some quite accurate predictions but without specifying the time that they will be invented or when they can be exploited to produce economically useful results.

In the second phase, when a new invention first appears, few people are capable of believing its value and the extent to which it can and will affect us. For example, at the beginning of the century few could predict the potential importance and widespread usage of cars, electrical appliances, telephones, radios, televisions and so forth -- including some of the most knowledgeable experts. Even in the early 1950s the chairman of IBM was predicting a maximum demand for computers of no more than 100 (there are several hundred million today) while the president of Intel was forecasting, more accurately, a maximum demand for 50,000 personal computers (there are close to 100 million today). Somehow we, humans, underestimate considerably the usage of new technologies and their ability to bring huge changes to all aspects of our lives and work. We cannot envision that things can be done in radical and different ways through brand new technologies, probably because we do not wish to consider the threats implied by the changes that these new technologies are capable of bringing.

Finally, once the new technology has started spreading euphoria prevails together with overoptimism about its value and the changes it will bring. Scientists associated with the new technology, firms, or individuals attempting to sell it, and technology zealots overpredict the timing and the benefits that the new technology will bring. Proponents of robots predicted,

for instance, that they would be used to do **all** repetitive and routine tasks by the end of this century while those of computers forecast that they would be capable of speaking natural languages and exhibiting artificial intelligence by now. It is important, therefore, not to be unduly influenced by the overpessimism of disbelievers or the overoptimism of proponents of new technologies. This is where analogies can play a significant role in helping us assess forthcoming technologies and predict when their value and benefits will start becoming practical and economical. For instance, Table 4 shows the analogous events of the industrial and information revolutions in an attempt to increase our understanding and our ability to more accurately predict the changes that will be brought by the forthcoming information revolution.

Newcomen developed the first workable steam engine in 1707. It took more than 200 years before Henry Ford used such an invention for the purpose of building a practical and useful car that the majority of people could afford to buy. Furthermore, it took another half a century before cars could substantially change our mode of life by permitting people to move to the suburbs and by allowing them to decide where they would work and do their shopping -- rather than being obliged to work or shop in a place close to their homes. Similarly, it took more than 90 years between the time electricity was invented and its widespread use by firms to substantially improve productivity. It has been estimated that it took more than 20 years at the beginning of our century before the considerable investments in electricity paid off (David, 1993). It cannot be expected, therefore, that computers will produce immediate results. After all, they were invented half a century ago and they are still used mainly as number crunchers, text editors, data banks and in general for doing more efficiently tasks done without computers beforehand (the same was true of engines and electricity before the mid 1920s). If the technological developments in C&C continue, and if the analogies displayed in Table 4 are valid, we will be entering by the end of this century, or the beginning of the next, into a period where major productivity improvements from C&C will be achieved. By 2015 the information revolution should have provided firms with as much productivity improvement as those of the industrial revolution today. The information revolution is, therefore, on target if the analogy shown in Table 4 will hold.

TABLE 4

FROM STEAM ENGINES TO UNATTENDED FACTORIES AND FROM THE ENIAC COMPUTER TO EXPERT SYSTEMS

MECHANICAL POWER		COMPUTER POWER	
1712	Newcomen's Steam Engine	1946	ENIAC Computer
1784	Watt's Double Action Steam Engine	1950s	IBM's Business Computers
1830	Electricity	1971	Time Sharing
1876	Otto's Internal Combustion Engine	1973	Microprocessor
1914	Continuous Production Line	1970s	Electronic Data Processing (EDP)
1890	Cars	1977	Apple's Computer
1901	Electricity in Homes	1980s	Computers with Modems
1919	" in 1/3 of "	1993	Personal Computer in 1/3 of Homes
	Widespread Use of:		Widespread Use of:
1950s	Electrical Appliances	200?	Computers/Communications
1960s	Cars	200?	Tele-Services/Shopping
1970s	Long Distance Telephones		Tele-Work
200?	Unattended Factories	200?	Expert Systems

The biggest change as the information revolution takes off will be in the way people communicate with each other, shop and obtain services, entertain themselves and work. All these tasks can be done through computers and communications opening up the possibility, for those who want to take it, of a tele-society where work, education, shopping and, of course, entertainment can be done from the comfort of one's home. Going towards a tele-society is bound to bring fundamental changes in the way firms are organized, managed and run. Information could be shared and meetings could be held over computer networks among people who will not have to be physically present in the same location in order to see, talk, exchange information or interact face-to-face with each other. Through information superhighways consumers could buy, or get whatever service they need by being connected to a network like the Internet. Such a network, in addition to all its other advantages, would also allow the perfect dissemination of information about prices, quality, delivery time etc., as well as the widest freedom of choice as it would include vendors or service firms from all around the world. Furthermore, consumers will be able to check on-line consumer reports to obtain whatever additional information they want about the product/service they wish to buy and custom order their choices. The consequences can be enormous, requiring the most careful consideration of their impact on firms. An analogy of what perfect dissemination of information can do to profits is the airline industry. Through reservation systems everyone who wants to travel can find the best deal in a minimal amount of time, thus obliging airline companies to match the lowest price, if they do not want to lose customers, and by doing so reduce their profits or even incur huge losses. In addition to buying goods/services globally, people could also work from their home, if they so wish, and obtain whatever entertainment (concerts, videos, plays, music, sports, games, etc) they might wish from anywhere in the world. The implications are obviously far-reaching, although it may take some time before their full impact becomes widespread.

The Five Major Inventions of the Industrial Revolution and Their Analogous Ones of the Information Revolution

Table 5 shows the five most important technologies of the industrial revolution. Each of them contributed significantly in changing the way people lived and the organization, management and running of firms. Electricity brought mechanical power everywhere, whether in factories or homes, and allowed the effective use of power tools wherever they were needed. Moreover, batteries allow the usage of all kinds of appliances in places with no electricity. Electrical appliances, in particular those for home use, freed women from household work, thus giving them the opportunity of entering the labor market. Cars provided people with mobility and unlimited freedom to go wherever they wanted and whenever they wanted in a comfortable and speedy way. Furthermore, cars permitted people to move away from cities, where the majority of the jobs were located, to the suburbs, and go to shop far away from their homes in search of bargains. Telephones allowed people to talk to relatives or friends, obtain information or services, or do business from their homes or offices with others not physically present next to them. As long distance calls became cheaper and cheaper, communications over telephone wires (both regular and mobile) became more and more popular affecting both consumers and firms. Faxes augmented the value of telephones as they allowed the transmission of text and pictures. Television, finally, brought entertainment to every home, reducing the need to physically go out and, through cable/satellite and VCR, increased the choice of what one could watch tremendously.

The five technologies shown in Table 5 have achieved practically 100% penetration rate in most developed countries. The obvious reason is that people want them and are willing to pay to obtain them. Once luxuries, they have become necessities. Today they are considered as utilities that practically all families possess. It is interesting to consider the analogous technologies of the information revolution once it has come into full swing. In doing so it must be remembered that very few people could imagine as late as the early 1920s the widespread use of the five inventions listed in Table 5, or their far-reaching economic and social impact.

Table 5: Five Inventions of the Industrial Revolution that have Contributed to the Most Significant Changes in our Lives

- Electricity
  - Plugs everywhere
  - Batteries
- Electrical Appliances
  - Wide choices
  - Programmable
  - Rechargeable
- Automobiles
  - Greater Choice
  - Better Quality
  - Greater Safety
- Telephones
  - Cordless
  - Mobile
  - Faxes
- Television
  - Remote Control
  - Cable and Satellite
  - VCR

Electricity: Computer networks will take computer power everywhere so that everybody can use it whenever and wherever he or she wishes. Portable notebook, or smaller size computers can be connected to these networks allowing unlimited access to a great number and variety of services. Information can, therefore, become instantly available whenever and wherever it is needed the same way that electricity is today.

Electrical Appliances: Software and groupware will become easy to use providing high value in ways that are not clear yet as the importance of electrical appliances was not obvious in the past. As they will be available via computer networks they can be used anywhere, increasing their usefulness and value. As electrical appliances permit us to do a great variety of tasks, so will software and groupware, for all aspects relating to information and its processing.

Automobiles: Of the five technologies of the industrial revolution shown in Table 5, cars are the most problematic. Their success has clogged up roads, made parking in popular places impossible and has increased pollution. Computers and telecommunication networks can provide an alternative by permitting people to work, shop or obtain services and entertain themselves wherever they wish, including in their own homes. Instead of the physical freedom of choice that cars allow us, because they let us go anywhere at anytime, C&C will permit us to achieve similar results but without having to physically move. We can have person-to-person interaction (e.g., through teleconferencing, or tele-work/buying) without having to be there physically ourselves.

Telephones: Computers and modern telecommunications augment the voice transmission capabilities of telephones in many ways. These include images (photos or video) and music as well as the possibility of multiple connections involving several/many parties. This would include the simultaneous transmission of voice, music, data and images, what is now called multimedia, simultaneously to more than two users located anywhere in the world. As all information can be digitalized, computers will provide unlimited possibilities for all sorts of communications. Information superhighways will permit cheap teleconferencing over personal computers that will allow the customized buying of products directly from any manufacturer anywhere in the world, the obtaining of any kind of service, or the completion of work by people far away.

Television: As the information superhighways will allow the carrying of images, music, sound, data and any other type of information (news, magazines, newspapers, teaching material, etc.) to any home, the possibilities can become limitless, not only for entertainment, but also for all kinds of related leisure activities, from reading a rare book to viewing the entire work of Picasso or seeing any concert or theater play, current or old, anywhere in the world. In addition, the integration of communications and computers will permit a high degree of interactivity and customization of exactly what one wants and when he or she wants it.

Information Revolution: Implications

If current technological trends continue, by the beginning of the next century unattended factories using robots and digitalized manufacturing will be common, further reducing the number of blue-collar workers. Moreover, the appropriate use of C&C in offices and service firms will do for the repetitive white-collar jobs what machines have done for the blue-collar ones since the beginning of 1800. Finally, C&C will do for the buying of goods and the obtaining of services what computer and telephone lines have already done for airline and other reservations: open up a global market place where information is instantly disseminated and where consumers themselves can directly get what they want by possessing a personal computer which is connected, through a modem, to a network. By doing so they can avoid all intermediaries and obtain from anywhere in the world any kind of customized product or personalized service they may wish. These are big changes as they could affect all aspects of buying/selling and the way that firms are organized and run. Virtual corporations, horizontal companies, firms without offices, widespread teleworking and similar possibilities must be considered by top management and their implications debated.

The analogy of the industrial and the information revolutions as well as those of electricity, appliances, automobiles, telephone or television can provide a useful starting point for predicting the extent of the changes to come, while avoiding the bias of under-estimating the extent of forthcoming changes as did the famous French economist Say who wrote in 1828:

> "No machine will ever be able to perform what even the worst of horses can - the service of carrying people and goods through the bustle and throng of a great city". p. 170.

Long-term forecasting requires, therefore an open mind so that a realistic and accurate picture of what is to come can be formed, debated and once crystallized used to develop foresight which is , in turn, indispensable for planning for the long term and formulating realistic strategies to anticipate forthcoming major changes and prepare organizations to adapt to such changes as painlessly and successfully as possible.

Conclusions

Human history has shown a clear tendency towards achieving more with less effort, doing more interesting and challenging tasks, having more free time to spend as one wishes, living longer and healthier lives, in addition to being able to feed, clothe and shelter ourselves as well as possible. These objectives are natural, and part of our intelligence and purposeful behavior. They are built into our economic, social, cultural and political systems. They are related and bring what we can call "progress" to our human civilization. Given the structure of our economic system and people's needs, objectives and expectations we can assume, with a reasonable degree of certainty, that the long-term trends described in this paper will continue into the future with all the implications discussed in this paper. Another challenge for firms is to figure out the implications of the forthcoming information revolution. This paper has argued that this can only be done by studying the analogy between the industrial and information revolutions and that of the major inventions of the former to gain a better idea of the timing and of what the latter is likely to bring. In addition to the long-term trends and analogies, two critical strategic concerns are first, the length and extent of deviations around the long-term trends, as some of these deviations can last for many decades and result in considerable fluctuations away from the trend, and second, when the specific technologies of the information revolution will start providing considerable economic advantages to firms that will be using them

The role of forecasting is critical in developing a body of knowledge to help executives in their task of developing as effective foresight about the future as possible. It is the belief of this author that forecasters and strategists will have to work closely together to bring success to tomorrow's firms. In such a collaborative effort, forecasters must concentrate their efforts on identifying long-term trends and appropriate analogies affecting the entire economy as well as specific industries. Strategists, on the other hand, must consider the implications of trends/analogies and how they can be used to develop foresight as well as find ways of exploiting the opportunities while minimizing the dangers from forthcoming changes.

REFERENCES

Ackoff, R.L., (1970) *A Concept of Corporate Planning*, John Wiley and Sons, New York.

Ansoff, H.I., (1964) "A Quasi-Analytical Approach of the Business Strategy Problem." *Management Technology*, **IV**, pp. 67-77.

Ansoff, H.I., (1965) *Corporate Strategy*, McGraw-Hill, New York.

Ansoff, H.I., (1979) *Strategic Management*, Macmillan, London.

Ansoff, H.I., (1994) "Comment on Henry Mintzberg's Rethinking Strategic Planning", *Long Range Planning*, **27**, 3, pp. 31-32.

Bain & Company and The Planning Forum (1995), *Management Tools and Techniques: An Executive's Guide, 1995*, Bain & Company, Boston.

The Boston Consulting Group, (1970) "Perspectives on Experience and Perspectives on Strategy", The Boston Consulting Group, 1972.

Corcoran, E., (1991) "Calculating Reality", *Scientific American*, January 1991, pp. 74-83.

David, P., (1993) "Investment in Electricity and Payoffs", *Stanford Working Paper.*

Dhalla, N.K., and Yuspeh, S., (1976) "Forget the Product Life Cycle Concept", *Harvard Business Review*, **54**, pp. 102-112.

Fierman, J., (1995) "Winning Ideas from Maverick Managers", *Fortune*, January 6, pp. 40-48.

Fildes, R. and Makridakis, S., (1994) "The Impact of Empirical Accuracy Studies on Time Series Analysis and Forecasting", *INSEAD Working Paper.*

Fortune Articles (various issues).

Giffard, P., (1989) *La Fin du Cheval*, Armand Colin, Paris.

Gilmore, F.F., and Brandenburg, R.G. (1962) "Anatomy of Corporate Planning", *Harvard Business Review* (November-December), pp. 61-69.

Gleick, J., (1987) *Chaos: Making a New Science*, Viking, New York.

Hamel, G., and Prahalad, C.K., (1994) *Competing for the Future: Breakthrough Strategies for Seizing Control of your Industry and Creating the Markets of Tomorrow*, Harvard Business School Press, Boston 1994.

Hayashi, K., (1978) "Corporate Planning Practices in Japanese Multinationals", *Academy of Management Journal*, **XXI**, 2, pp. 211-226.

Keyes, R.W., (1993) "The Future of the Transistor", *Scientific American*, June 1993, pp. 40-46.

Kiechel, W., (1981) "The Decline of the Experience Curve", *Fortune*, October 1981, pp. 139-146.

Langer, E.J., (1975) "The Illusion of Control," *J. Personality and Social Psychology*, **32**, 2, pp. 311-328.

Lorange, P., and Vancil, R.F., (1977) *Strategic Planning Systems*, Prentice-Hall, Englewood Cliffs, NJ.

Magaziner, I., and Patinkin, M., (1989) *The Silent War: Inside the Global Business Battles Shaping America's Future*, Random House, New York.

Malmlow, E.G., (1972) "Corporate Strategic Planning in Practice", *Long Range Planning*, **V**, 3, pp. 2-9.

Meadows, D.H., (1972) "The Limits to Growth; a report for the club of Rome's project on the predicament of mankind", Universe Books, New York.

Mintzberg, H., (1994) "The Rise and Fall of Strategic Planning", Prentice Hall, UK.

Peters, T.J., and Waterman, R.H., (1982) "In Search of Excellence: Lessons from America's Best-Run Companies", Harper & Row, New York.

Porter, M.E., (1980) *"Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York.

Roach, S.S., (1991) "Services Under Siege - The Restructuring Imperative", *Harvard Business Review*, September - October.

Roach, S.S., (1988) "Technology and the Services Sector: The Hidden Competitive Challenge", *Technological Forecasting and Social Change*, **34**, 4.

Say, J-B., (1828) *Cours complet d'économie politique.*

Schoeffler, S., Buzzell, R.D., and Heany, D.F., (1974) "Impact of Strategic Planning on Profit Performance", *Harvard Business Review*, **52**, pp. 137-145.

Schoemaker, P.J.H., (1995) "Scenario Planning: A Tool for Strategic Thinking", *Sloan Management Review*, Winter, pp. 25-39.

Slutsky, E., (1937) "The Summation of Random Causes as the Source of Cyclic Processes", *Econometrica*, **5**, pp 105-146.

Smith, Ward C., (1980) "Product Life-Cycle Strategy: How to Stay on the Growth Curve," *Management Review*, a publication of American Management Association, January 1980.

Steiner, G.A., (1979) *Strategic Planning: What Every Manager Must Know*, Free Press, New York.

Stix, G., (1991) "Domesticating Cyberspace", *Scientific American*, pp. 84-92.

Teck, F.C., and Grinyer, P.H., (1994) *Organizing Strategy: Sun Tzu Business Warcraft*, Butterworth-Heinemann, Singapore.

Wack, P., (1985) "Scenarios: Uncharted Waters Ahead", *Harvard Business Review*, **55**, pp. 73-89.

Weiser, M., (1991) "The Computer for the 21st Century", *Scientific American*, September 1991, 66-75.

Wensley, R., (1982) "PIMMS and BCG: New Horizons or False Dawn", *Strategic Management Journal*, **3**, pp. 147-158.