Cinderella Becomes A Princess

Instructive Stories

Conventional wisdom in the main advanced industrial countries (AIC) asserts that industrial development starts with scientific and engineering research. Only research can produce new products and advanced production processes and these are the only route to an industrially competitive economy. This argument postulates the familiar cycle of the birth, life, decline and eventual death of a product. The product itself is continuously changed in answer to market wants and needs (not necessarily the same thing) and to competitive challenges. Its costs are driven down by process improvements. This is the competitive way in AIC.

This concept of industrial development integrates science, engineering, design and marketing under the control of the entrepreneurial company and has served the economies of the AIC very well. It is probably unrivalled and irreplaceable for the firms involved in complex finished products such as automobiles, aircraft, measuring and control systems, chemical plant and other production equipment systems. These firms can conveniently be called "Main equipment producers" (MEP). Once the industrial sectors of competing countries have reached a comparable and advanced level, there is no other way for their MEP to retain their position. But it has to be noted that "science" and even engineering research, although integrated into the firm's operations and intellectual effort, play but a small role in these processes. The success of a MEP firm depends upon its ability to translate research into saleable, profitable goods and services. This requires a management system which is flexible, dynamic and highly professional. It must be able to appreciate and to respond to the changes in technical, commercial, financial and social cultures that affect business. The board sets the strategy of the firm, but above all it must practise and instil into all its people the culture of doing everything properly - "perfect first time and every time". Engineers who have good ideas but are indifferent to their implementation and to the rigour of the details are not engineers. They cannot rise above being merely "men with ideas"; these ideas, for lack of attention in their essentials, will not succeed.

The life cycle of products and processes has been much studied, discussed and written about, especially by management consultants, Business Schools and theoreticians and self-styled intellectuals. This is perfectly understandable. The innovation processes in applied natural sciences, engineering and their industrial manifestations are a part of the whole spectrum of the curiosity and intellectual processes of mankind, in the arts as well as in science. It is not unnatural for them to have received so much attention. Intellectuals like to study intellectuals in other fields even if they have no personal experience of such work and therefore cannot do it. We have to remember the aphorism, "he who can, does, he who cannot teaches, and if he cannot teach he writes about it, and if he is a bad journalist he becomes the Minister." However it seems that this attention may in certain circumstances absorb the full attention of intelligent people who may have the best interests of their industry, economy and country at heart. In so doing, "science" and research become almost an article of religious faith which requires ritual expenditure of money and people on a vast scale and often without analysis of any benefits that might flow therefrom. It seems 'obvious' that the more that is spent on support for scientists and researchers the better will be the economy of the country. People who advocate this policy overlook the simple fact that much more is needed

to satisfy those interests than an emphasis on 'science', on research and on development as it is normally understood. Not only is there little correlation between science and economic wealth but even if there were, one has to remember an old axiom amongst statisticians - "Correlation does not necessarily imply causation". A Danish statistician showed some years ago a correlation between the arrival of storks for their nesting period with a rise in the human birth rate.

Scientific effort by itself will not automatically provide wealth. Wealth is created by the efforts of people who have devoted themselves successfully to the processes mentioned above. Both good science and good industrial performance depend on a common culture which allows them to interact. For example, Japanese science and Japanese laboratory instrumentation are both excellent; the scientists ask for advanced instruments and the producers respond. It is an upward spiral; each advance is based upon the last contribution from their partner. Once a certain level of wealth in an organisation or a nation is achieved then a corresponding level of expenditure on science and on untargeted research can be afforded.

Support for untargeted research in a sense is like support for a leisure class. It has first to be afforded and earned. Three years ago I asked the Scientific Adviser to the Prime Minister of Japan how they managed to persuade the electorate to pay for so much research into, for example, radio astronomy. He replied, "We are now so rich that we can afford to treat pure science as an art form and as part of our contribution to world culture. The Japanese people are curious about the origins of the human race and of our world and they need no encouragement to vote money for such work." There is hardly another country in the world where such an answer could be sincerely produced. And there is not another country which could afford it. (There is no space here to describe the ways that Japan has achieved its position in the world not only of pure science but in its application within the economy.)

Like much of the life of the leisured classes, much of the research in every country, especially that funded by Governments, is economically unproductive. This is because, unlike work done in private firms such as the MEP, the Government systems, for example in Great Britain and in Russia, do not evaluate the work for which they provide funds. Pure research is a tax on the nation rather than its life support system. It is therefore up to those who run the affairs of the nation to see that Government funding for research is properly accounted for and subject to professional and objective evaluation.

When the economy of a country is run down and everything requires massive investment in order to bring to a satisfactory condition the condition of the people, the infrastructure and indeed the very means of creating wealth, then we have to make drastic choices, to invest what resources we have into the most urgent channels in order to achieve those objectives. Support for a leisured class, whether scientific or absentee landowners, cannot be high on the agenda. This is the case in the fSU and was the case after the Second World War in Japan and western Europe as well as in the countries which we will examine now.

The Industrial Rise Of The Four Dragons

There are other ways than a reliance on "science" to raise the performance of a firm and also of a nation, as can be seen from a study of the rise of the newly emerging countries, for example South Korea, Taiwan, Hongkong and Singapore. More recently their example has been followed by Thailand, Malaysia, Indonesia and the

Republic of China itself. Until well after the end of the Second World War these countries were in every way third world; emerging from a colonial past, and years of devastation and military occupation, with a low standard of living, peasants eking out a subsistence living, cottage industries, a poor standard of education and poor health conditions. They came very late into the world of industrial development. Now they are vibrant economies, challenging Japan and supplying advanced and complex products, some of which are now of their own design, as well as electronic components of world class. Science played only a small role and then only far down the road of industrial development.

Their industrial development started with the manufacture of components for foreign MEP firms. Working as sub-contractors helped them to understand the requirements of world class MEPs, using their drawings, subjected to their quality assurance systems, having to deliver to rigorous schedules and maintaining consistent prices. Initially many firms had to import special components and materials unavailable locally. They offer low cost as well as manufacture and then assembly of foreign designed goods through dedicated factory cultures. They learn from their partners modern product design and production processes and sooner or later commercial skills including overseas marketing. They use these lessons and experience to their own purposes. Simultaneously with this industrial development, based upon mundane rather than innovative and romantic development, these countries developed an education system which provides a work force of almost 100% literacy as well as fully competitive mathematicians, computer programmers, scientists and engineers. In this way the local firms progressed from sub contractors to innovative performers in their own right on the world stage. Local firms both buy and sell licences and also invest in overseas acquisitions in AICs. This is especially true in electronics. Their exports are largely directed to USA but also to Japan.

It is essential when building a competence in new fields to work with advanced and intelligent customers from whom one can learn; but such local firms nowadays also sell to less advanced countries. The best firms in these countries of the Pacific Rim have the latest production equipment; the factories are often run by people, from several nations, with an up to date commercial, technical and operational culture. As a result they can attract investment from international as well as local sources. They form not only essential partners for the MEPs in AICs but also present a growing threat to the smaller and sub-contracting companies in AICs in Japan as well as western Europe and USA. They are already respected competitors to Japan, of which Korea was a colony until 1945 and from which it is determined to take some markets.

Science & The FSU

Official figures show that 70% of all qualified scientists and engineers and of the total expenditure on research and development in the USSR was devoted to military purposes. Experienced western engineers give a high assessment to the functional performance of the general run of Soviet military hardware and of the computer driven command systems that belong with them. However, even the hardware itself suffers from severe weaknesses: much of the equipment is considered to be hazardous to their own soldiers; so much so that the Bundeswehr rejected most of the equipment that came to them with the unification of the Volksarmee. Secondly, the weakest aspects are exactly those that are commonly called "high technology", namely electronics and electrical hardware. Thirdly and most important in the

context of this article is that excellent scientific and basic engineering concepts are translated very badly into actual hardware. This is the fault of the Command system itself. It dooms to failure the best efforts of highly intelligent and professional engineers who may have set out with high ideals and intentions. The military industrial complex (MIC) itself is the best of the old soviet industry and sadly its weaknesses are not recognised by the present governmental leadership. There is space here only to mention the key points; to analyse them in detail takes a lot of paper. Separation of functions and therefore of responsibility, excessive size of research, design and manufacturing organisations, an absence of a proper culture of industrial management even in production, general poor standard and specification of engineering materials, a lack of concern for cost reduction and a lack of understanding especially at the factory level of relations with customers, in modern parlance "marketing". The last two defects are shared with the defence industries of the west, which is why so many of them in the West were simply closed rather than adapted to civilian purposes.

As a result the MIC is basically unprofitable, financially bankrupt, has contributed largely to the destruction of local ecology. It produced almost all the electronics and household equipment made in USSR, but its inadequate performance in design and manufacture led to poor quality, low reliability and low value for money. As a result the fSU is flooded with foreign engineered products which sell at higher prices than they command in their home territories.

It is essential that the MIC regains its home market and begins to sell civilian products abroad, not just to the third world. Russia cannot continue to survive by selling raw materials and importing technology on the present scale. Basic, raw materials continue to occupy about 70% of all Russian exports; engineered products only 2.5%. The figures show that engineered products occupy about 30% of world trade.

A drive to achieve better export figures for technical, civilian products requires no "science" nor research. Improved industrial performance depends upon: better understanding of market requirements, better and more responsive design, attention to quality in its totality, attention to detail, a proper culture of factory management, understanding of how to serve distributors, agents and customers, a proper humility and an understanding of how a competitive market economy works.

Science and research has had little useful impact on the national life and economy of the USSR and of Russia since 1985. Its extraction industries, air, rail and pipeline transport systems are inefficient and dangerous. A comparison between the Soviet and Alaskan oil pipelines is instructive. The Soviet specification for steel pipes is the same as those of the West but the losses of oil through breakages is many times higher. This is due to: the use of inappropriate welding techniques which work well in ideal, factory conditions but not in the field; inadequate internal and external anti-corrosion and other protection coatings and coverings; careless, totally inadequate systems of supporting the pipes, especially in areas subject to shifting soil and to earthquakes. The demands for speed and the separation of responsibilities which are typical of soviet and post-soviet command managements bear a heavy responsibility for failures and the losses to the economy, human life and damage to the environment.

Lada cars provide another instructive lesson. The basic design of the car and factory that makes it are Italian. Two things limit its sale on western markets - failure to keep up with competition in design features and its low quality of

manufacture. Lada UK, the importers, stated in December 1995 that the carburettors usually contain swarf and other metal residues from cutting operations in the factory; as a result Lada UK routinely give them to a British specialist firm to bring them to an operational standard. Secondly, the paintwork so often contains foreign bodies mixed with the paint that many cars have to be stripped and 23 hours spent in repainting. Regularly, non-essential components fall off the car. As a result British customers are turning to competitors away from Lada.

One sees no contribution of decades of soviet research in the design and performance of vehicles. There are many research papers that claim to solve many advanced problems, for example in the 'ride' and suspension system and in multi wheel steering. Such papers may be fun to write but they are irrelevant when compared with the fact that the performance and manufactured quality of existing vehicles are so poor. Is it not easier and more fun to write papers about future advances than to tackle present problems? The tragedy for the Russians is that the future never comes. To produce another example, the fuel efficiency of engines in current production for cars and aircraft is far below that of the foreign competition. Russian aero engines have a much shorter life between major overhauls.

My own observation of the "clean rooms" in weapons' electronics factories of the fSU is that they are a sham; this lack contributes to the high rejection rate of PCBs and other components. In comparison, for example, Toshiba report that every 1% of reworked rejects costs the equivalent of 5% of net profit; their reject rates of TV sets in Britain is now down to about 2%; general Directors in fSU factories report figures about an order of magnitude higher. Western agricultural specialists report that soviet seed, farming methods and equipment do not accord with the conditions on the farms that they have examined and, in some cases, run. When they import, for example, British seed and equipment and apply British husbandry techniques the output has risen by more than 3 times in two seasons. What were the famed Institutes of Biology etc in the USSR doing all those years?

The standard of building, furniture and household and office equipment for ordinary people, in contrast to that of the 'high-ups' and for foreigners, of the telephone system as well as of toilets and the basic utilities is not that of an advanced country. These aspects of life reflect of course the under investment in them for decades - due to the over-investment in the military but also in other things deemed to be prestigious such as "science", the arts and space which was of course primarily intended for military purposes. But they also fail to demonstrate any contribution from "science" and research. They remain of a low standard. To bring them up to west European standards, as the Russian people deserve, requires not science but the devoted attention of good engineers and craftsmen led by good managers with sensible directives. Experience in Britain after 1945 suggests that the job may take a very long time. British science was then, as it is now, of world class but much of its manufacturing industry was uncompetitive for very similar reasons that we observe in Russia today; these are largely those of organisation and mentality of management and work force rather than of equipment and investment.

Disclaimer

The views expressed are those of the
Author and not necessarily those of the
UK Ministry of Defence