Teh Industrial Research Manager's New Job

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To say that the research manager's job has changed is one of the more redundant statements that one can make — at least in circles which are engaged in research in industry. Journals on research management abound in articles on the changing research environment, and meetings on subjects relating to research management under the new constraints have been held in considerable numbers.

As a result, it is almost impossible now to say anything really new on this subject. The following notes therefore can hardly claim much originality ; rather, they are to be regarded as an interpretation of the current industrial research scene, as seen by a person who has, for the past 16 years, been directing research projects in physics.

The Historical Perspective

The interpretation of what we are witnessing now will, of course, be much easier at a later date, when we can place the events into historical perspective. I believe later historians will say that the year 1969 was the point in time when a number of things relating to science, technology, and society changed almost explosively. Many expressions of people's general dissatisfaction with almost all aspects of technology suddenly became visible, and the environmental movement rapidly gained momentum. Fairly soon, it became clear that the scientist would be facing difficulties to which he was not accustomed. One now has the impression that the 20 or 30 years prior to that point in time were a truly golden age for those who had committed their lives to the fascinating job of closely coupling science to technology, an age that probably will not return during our lifetimes.

External Reasons for the Change

It is probably no coincidence that 1969 was also the year of the first moon landing which marked an admirable success of what doubtlessly is the greatest technological undertaking imaginable. It is quite possible that many people subconsciously felt that technology had gone as far as it could and should, and that attention should now be turned to other things. But there remains a total confusion on what these "things" are, or should be. Zero growth is advocated simultaneously with a request for higher wages and shorter working hours, a total contradiction, of course.

I believe one of the deeper reasons for what we are witnessing is the imbalance between economic and rational goals and activities on one side, and cultural and spiritual thinking on the other. Innovation in the arts has largely been repressed by innovation in science and technology — an imbalance which does not even remotely have a precedent in history. Dennis Gabor has said : "Our present civilisation is based materially on the solid foundation of scientific technology, spiritually on practically nothing." This, in my view, is an admirable description of one of the worst ills of the present age.

Internal Reasons

What I have described can be called a set of external reasons for the change — I mean external to the process of scientific and technological innovation and the community which handles it. I also see a set of reasons which can be called internal and which have to do with the fact that the process of technological innovation itself has changed.

Not long ago, we used to say that the great technological breakthroughs all came from the basic sciences, and indeed there are many examples of this ; the most brilliant among them are nylon, transistors, and nuclear energy. These three developments have their roots in truly creative scientific work based on profound insight ; their end-effect has been a tremendous impact on society, and they have also been the basis for great business success. Accordingly, the incentive for companies to engage in the basic sciences has been strong — there was a direct profit incentive to make oneself a contributing member of the scientific community. I believe this has been overdone, at least to a certain extent. The belief that scientific research is the key to business success has, perhaps, gone slightly too far. The basic sciences have brought us much less fundamental technological innovation in the past ten years than in the previous two decades, at least in electrical and mechanical engineering. It seems to me that the front of science and the front of technology, which for a while have been so wonderfully close together, are moving apart again, and that this separation is not a temporary move, but rather that the situation from 1940 to 1960 was exceptional and will not occur again soon.

The Driving Force behind Technological Innovation

This means that the driving force behind innovation in technology may also change. We can distinguish between the *push from research* and the *pull from the market.* Transistors have certainly been brought about by the push from research : the market did not ask for transistors, because it did not know they were possible. The same holds for lasers. But I believe in future the pull from the market will gain importance as compared with the push from research. In view of the strength and universal presence of the environmental movement we should perhaps replace the term "pull from the market" by "pull from society-at-large". It is quite clear that future research programmes will be heavily influenced by environmental movements and environmental legislation.

What does this mean to the Research Manager ?

As I have said in the beginning, the research director's life has changed, and this has become a truism. However, the answer to the question "How should he respond to the changing environment?" is less trivial. I believe his response must lie much more in the *selection* than in the *conduction* of the research projects. In selecting his research projects from among all those proposals that seem desirable, feasible and useful, the research director must, more than hitherto, take into account not only the company's long-term needs but also those of society-at-large — but not the immediate, emotionally expressed needs ; this would lead to bad mistakes ; humans are unpredictable, and emotions can change as rapidly as they have arrived. He must attempt to foresee what the world is going to look like 5, 10 and more years from now, and this is difficult indeed.

As far as the **conduction** of research projects is concerned, I am quite convinced that nothing has changed and that the rules of good research management established over the past decades in those companies that have been the great contributors to technological innovation remain as

valid as ever. I will try to summarize these rules into what I call **the eight commandments of industrial research management :**

1. The choice of the right people is indispensable to success, and the ability of the research manager to recognize these men at an early moment in their careers is an invaluable asset.
2. The established rules of scientific work that are so successfully practised at the best universities are valid also in the industrial research environment :

Know what you are looking for—acquaint yourself with the state of the art — formulate your question carefully — do more thinking than measuring — interact with theory. Or, in other words : Make the right experiment at the right time and draw the right conclusions from your observations.

3. The research centre is the window to the scientific community. It is the channel through which the corporation communicates with the worldwide scientific establishment, and this window must be kept open.
4. In each research project, never lose the economic goal — the goal which will be a contribution to business success — out of sight.
5. In guiding research staff members, try to strike a balance between individual freedom and collective guidance.
6. Assure strong exchange coupling between all departments of a research centre. The centre should not disintegrate into several blocks that do not communicate with each other.
7. Translating scientific results into technology is *the most difficult part of research management.* It requires more attention than anything else. Accordingly, *close coupling between science and engineering* should be the guiding rule of a research centre. It is difficult to justify science projects that are completely decoupled from the technological side of the house.
8. Finally, close rapport between research management and company management is vital. We must recognize that the *key to the solution of some of industry's greatest problems of the day is not to be found in research, but in overall company strategy.* The failure of some good industrial research laboratories can be attributed to a breakdown of this contact : Research management failed to understand changing attitudes at the top, and, conversely, company management, in revising its goals did not recognize existing strengths in research that could well have been utilised beneficially. Today more than ever, it is essential that company strategic planning and research planning must be regarded as one single, integrated process, and not as two separate processes that are coupled together only when they are completed.

The window to the scientific community: John Bardeen visiting an industrial research laboratory.