

OPINION

Industrialist rebuts academic: Japan still relies on foreign science gains

By William C. Norris

Prof. Fumio Kodama is entirely correct in suggesting in his April 9 article in *The Japan Economic Journal* ("U.S. Call to Share Technology is Based on Faulty Premise") that slavish adherence to the so-called "linear model of technological innovation" in the only form of that model with which he is acquainted can sometimes lead to misleading results.

But surely the linear model in every form has demonstrated its validity to the extent that it underscores the inevitable science underpinnings of technological innovation. Where the narrowly-drawn linear model — and Prof. Kodama — go wrong is in not recognizing that the most relevant forms of the model have feedback loops. The linear model must be looked at in dynamic terms rather than purely static ones. Obviously, Prof. Kodama only knows it in its simplest form.

With respect to feedback loops, their application in later models of innovation more often than not represents an explicit acknowledgement that the needs of industry in pursuing technology development in any and all of its aspects often requires new technology or technique in order to be able to begin the initial innovation process. This should come as no surprise to Prof. Kodama; it is the way

William C. Norris is founder and chairman emeritus of Control Data Corp.

the process of innovation surely must be, especially where it breaks new ground with regard to technology or technique.

It is even true that occasionally a process of innovation will be held up awaiting the generation of science outcomes that turn out to be indispensable; even here the fundamental truths represented by the simplest linear model are not seriously challenged. At worst, such cases merely underscore that the simplest linear model requires elaboration to make it more accurately reflect reality; it also illustrates that sometimes even science responds directly to demand-pull forces even while it generally proceeds with limited regard for market considerations. In all scenarios, however, technology rests on science.

Prof. Kodama seems to have considerable difficulty in differentiating between science and technology. The examples he advances in an attempt to shoot down the linear theory of the process of technological innovation are, without exception, cases where the development and exploitation of technology awaits still other technological achievements, the necessity of which presumably was not foreseen when the particular innovation activity was undertaken. As noted above, that is the way the world is. But in no sense does anything Prof. Kodama offers, including his three examples, challenge one of the fundamental tenants of the linear model: Every technological innovation is bottomed upon one or more achievements in science. But for the generation of specific science outcomes, the tech-

nological innovation could not have become a reality.

Why should Prof. Kodama feel so uncomfortable in the face of this truth? One can only speculate that he wants the Japanese nation to be recognized as solely responsible for the innovations it generates and exploits in world markets. This is indeed a noble and legitimate objective. But with notable exceptions — and they are few — Japan continues to rely on other nations for the science outcomes which underlie their technological innovations.

And as a matter of pride it bothers Prof. Kodama that this is so; the hope is that it will also bother others in the *conscience* so that there will be a strong consensus develop to become more forthcoming in the sharing of the technology which Japan generates based upon the scientific achievements of others. At the same time, it would represent a step in the right direction if Japan would begin to shoulder more of the responsibility for financing efforts in science — the unavoidable front end of a process of technological innovation.

Until the Japanese are able and willing to share both their scientific achievements and their technology with others on an equitable basis, thus making international cooperation and competition work fully to the net benefit of all, the "technology friction" which Prof. Kodama has correctly identified as a major issue between Japan and the U.S. will continue — even intensify — and produce unwanted results for both countries.