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NOT EITHER/OR: RESEARCH IN PASTEUR'S QUADRANT

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ABSTRACT

This paper suggests that when we debate binary choices for IS research, such as rigor/relevance or theory/practice, we constrain our vision and limit the impact of our efforts. An alternative viewpoint considers research in a two-dimensional space based on motivation, enabling us to envision research that seeks both *understanding* and *practical use*. The paper reviews the historical precedence in the U.S. for the unidimensional view of research, presents examples of the recursive relationship between scientific and technical progress, and concludes with implications for focusing on research in the "both-and" quadrant.

The discussion on relevance of information systems and information technology research has been going on for as long as I can remember. The discussion can be helpful—it sharpens our view of the MIS field and raises provocative issues—but often we tend to frame the issues in a limited way. By debating choices such as rigor/relevance, theory/practice, basic/applied and similar either/or propositions, we accept a dichotomous universe within which we view our efforts. Such distinctions can be useful in retrospect when one wants to discern differences between approaches or when one wants to categorize a report or project as part of a meta-analysis of research efforts, but there is no *a priori* requirement for us to accept this limited viewpoint of how we operate as researchers. Indeed, doing so constrains our vision and limits our impact. Instead of either/or, we can choose both-and. These two options reflect two different underlying mental models of research.

The either/or model buys into the notion of a linear, unidimensional research space or continuum along which one must choose an operating point. The extremes provide the boundaries along this continuum. Even if one argues for "balance" between the choices [rigor/relevance, theory/practice, basic/applied], we still are limiting ourselves to a point on a line.

What is our foundation for such a notion? In the US, we can point to Vannevar Bush, who articulated the rationale for an investment in science in his 1940s report to the President on postwar research. The argument is simply that an investment in basic research leads to new knowledge. This knowledge is then used as the basis for applied research, the results of which lead to development, and development yields new products and useful applications, thus yielding national economic benefits. This linear, pipeline model decouples basic research and technology; research is placed on the continuum between the extremes of "pure" or "basic" research and applied technology.

There is another way to view research efforts that is more encompassing and, I would argue, provides a viewpoint on research and an approach to knowledge creation that is more robust and has a greater impact. The "both-and" viewpoint is presented by the late Donald Stokes in

Pasteur's Quadrant: Basic Science and Technological Innovation . Stokes points to Pasteur's work as a model of need-driven (or use-driven) research that was done carefully (good science) but was motivated by specific needs. Pasteur's fundamental scientific work was motivated by practical needs. Examples range from industrial production of alcohol from beets (he accepted such a problem, and presumably support, from a Lille industrialist), to agricultural production (problem posed by the minister of agriculture), to the spread of rabies (motivated by a mother whose child was bitten by a rabid dog). In pursuing solutions to practical problems, Pasteur had to develop technology (to conduct his experiments) in order to gain his understanding of the physical and biological processes that were at the core of the problems. His scientific work that demonstrated the bacterial foundation for disease led to changes in milk processing and major changes in health care practice. But the widespread public health impacts, as significant as they continue to be, were stimulated by more prosaic and mundane problems.

Stokes points out that this interplay of science and technology in Pasteur's case is not unique, and the history of science and technology abounds with similar stories. Kelvin's physics research, for example, was "inspired by a deeply industrial view of the needs of the Empire."[2]

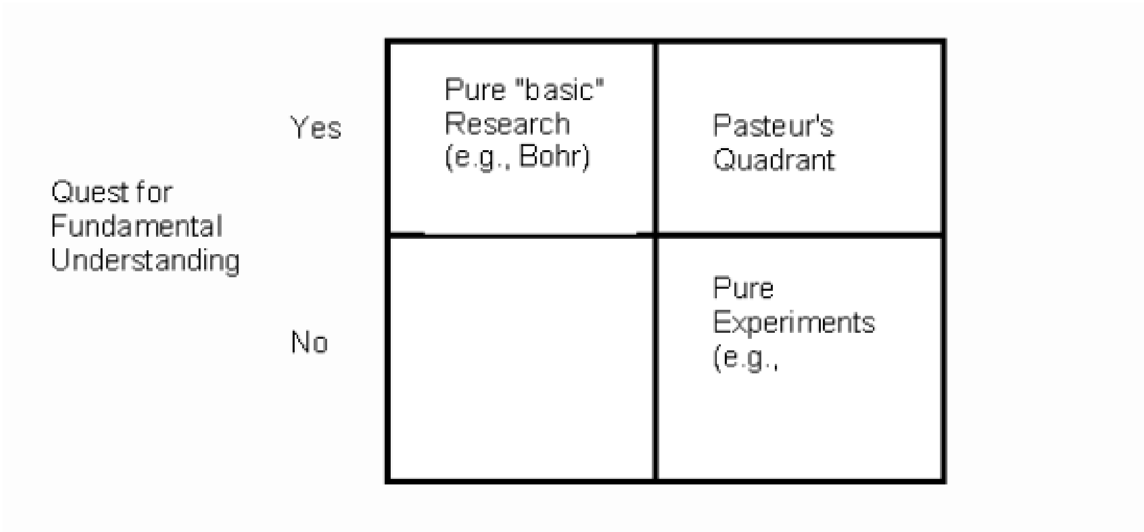
The history of the Michaelson-Morley experiment[3] (on what now is the Case Western Reserve campus), demonstrates a similar interplay between technology (control) and science (understanding). In this case, the required collaboration between the scientists and Warner Swayze—an industrial firm that built telescopes and, in this case, provided adjusting screws for the mirrors used in the experiment—at times was contentious. The scientists required more precision than the currently available telescope adjusting screws, and their demands challenged the company to improve their technology. Only when the precision improved sufficiently were the scientists able to proceed with their fundamental research. Their results later became the empirical evidence for Einstein's theory of relativity, but an immediate outcome (in addition to the empirical science) was improved precision for the adjustment of telescopes.[4]

Science (to gain understanding) and technology (to control) always have this close recursive relationship. However, the relationship, and the learning that arises from it, is more evident when the interplay takes place in a single research program or endeavor (as with the Pasteur and the Michelson-Morley efforts).

The relationship, some argue, is typified in models of learning. For example, Kolb's learning cycle model,a synthesis of work by Dewey, Piaget, and others, includes conceptual abstractions, active experimentation, concrete experience (empirical data), and reflective observation [Kolb 1984]. Theory is instrumental for learning, whether it emerges from reflective observation of empirical data or it precedes active experiments.

What does this mean for our field of IS research? If we are to view our research work as positioned in "Pasteur's Quadrant" in a two-dimensional space of "quest for understanding" and "considerations of practical use" (Figure 1), we simultaneously will be pursuing *both* good science, which leads to new understanding, *and* practical solutions to critical problems.

Are we taking this view? Perhaps not explicitly, but there are some instances in which we are gaining both fundamental understanding and practical solutions. Two come to mind, and I'm sure readers can name many more: Bob Zmud's collaboration with SIM through the Advanced Practices Council stimulates research on practical issues and prods us to reflect on our abstract models of technology adoption and management; Richard Boland's SPIDER is a practical research tool, developed as a means to improve our understanding of how executives make decisions.



Considerations for Practical Use?
(adapted from Stokes [1997])

Figure 1. Simplified Space of Research Types, Classified by Motivation

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The implications of focusing more on Pasteur's quadrant are that we will direct our energy toward significant practical problems and use our research efforts and creativity to develop the understandings that lead to solutions. There is no shortage of these significant problems (e.g, how to deal with information overload; methods for designing systems when the goals, technology, and stakeholders are in flux; how we manage information ownership when we are in a super-connected world; etc.). I'd find much more satisfaction in wrestling with these issues than in debating at what point in a unidimensional space we should be doing research.

END NOTES

[1]Bush's argument shaped much of how the US thought about investment in basic research. His views and the underlying US philosophy that government should not get involved in commercial enterprises contributed to a US science policy that since WWII focused on so-called "basic research." Over the last 25 years, for example, the percentage of total US federal research dollars devoted to basic research ranged from 60 to 70 percent, according to the National Science Foundation Surveys.

[2] Stokes [1997] attributes the view to Smith and Wise [19989]

[3] The Michelson-Morley experiment was an effort to demonstrate that the speed of light when measured in the direction of the turning earth (i.e., with the hypothesized "ether") was different than when measured orthogonal to this direction. The result, of course, was that there was no detectable difference in speed.

[4] Personal communication—from an informal discussion with a history of technology researcher whose name has been forgotten.

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