dominant market position rather than to encourage the creation of revolutionary products and services. But innovation was a much different affair at AT&T, which espoused a corporate ethos of universal service—and especially at Bell Labs, which adhered to a management philosophy calculated to attract some of the world's best scientists and engineers to work in an industrial lab. A healthy percentage of the costs of R&D were built right into the calling-rate base. Thus assured of steady financing, lab managers could afford to take the long view and pursue breakthrough technologies that might not pay off for a dozen years or more but might ultimately be of enormous value to society. AT&T's patient capital and secure cash flows allowed the company to take the substantial risks involved in attempting sustained innovation across a broad technology front.

The transistor is perhaps the best example of that process. AT&T's managers recognized the long-range need for a solid-state amplifier and switch during the 1930s, but it wasn't until 1947 that John Bardeen, Walter Brattain, and William Shockley invented the device. And it took another 15 years or so of technology development before transistors began to assume their modern form. Bell Labs and Western Electric fostered almost all the subsequent innovations this transformation required: purifying silicon, growing large crystals of this semiconductor material, diffusing layers of impurities into the crystals, patterning the layers using a protective oxide surface layer, and so on.

During the 1960s, Fairchild Semiconductor and Texas Instruments adapted many of these technologies to develop the microchip, whose manufacture now adds more than a trillion dollars per decade to the global economy. These smaller, less-robust companies could never have pursued the many different innovations that made their core product possible. But they were exquisitely poised to drink from the rich technology stream flowing from Bell Labs and Western Electric.

Only a large corporation such as AT&T—or others like General Electric and IBM—could ever afford to support the sustained, multidisciplinary, mission-oriented R&D efforts needed for these innovations without worrying too much about the short-term impact on the bottom line. And it was crucial that this work be accomplished in a pragmatic industrial setting, with a long-range goal of delivering better goods and services—an ethos that hardly exists in government or university laboratories.

Such farsighted institutions, performing basic research and development...

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