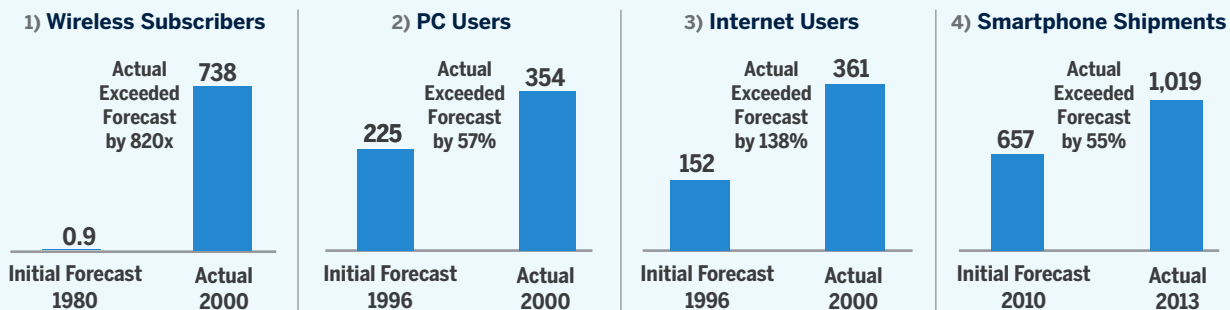


Echoes of the Past in Emerging Technologies

Forecasting the long-term market potential of emerging technologies is inherently challenging due to the limited information available in their early stages. These innovations can be difficult to understand fully until their transformative potential becomes clearer over time. By observing initial projections and actual outcomes of major innovations over the past few decades, we uncover patterns that reveal why early forecasts tend to miss the mark—and how investors can better evaluate today's nascent technologies.

Technological Progress Is Hard to Forecast Early On (Units in Millions)



Source: 1) *The Economist* 10/7/99 – “Cutting the Cord” and World Bank 2024. 2-4) Morgan Stanley Research and Alger.¹

- The charts above illustrate how initial growth projections often underestimated the rapid pace of adoption for the following technologies:
 - Wireless Subscribers:** In 1980, AT&T commissioned consulting firm McKinsey & Company to forecast global cell-phone use by 2000. The prediction—900,000 subscribers—was off by a factor of over 800x, as the actual figure reached 738 million.² While McKinsey accounted for the high data costs and bulky cell-phones with minimal battery life in 1980, they failed to anticipate advancements in mobile networks and affordable devices.
 - Personal Computer (PC) Users:** In 1996, Wall Street analysts projected there would be 225 million PC users worldwide by 2000. However, the actual number of global PC users reached 354 million—57% higher than their initial forecast.³ Analysts seemingly underestimated the PC's potential as it became an essential tool for consumers and enterprises due to falling hardware costs, improved interfaces, and expanding software ecosystems, revolutionizing the way people worked, learned, and communicated.
 - Internet Users:** Analysts in 1996 estimated 152 million global internet users by 2000, but the actual figure soared to 361 million—138% higher than initial estimates.⁴ This growth was fueled by the rise of internet service providers, affordable modems, and emerging web browsers, which integrated the internet into daily life.
 - Smartphone Shipments:** In 2010, industry estimates projected global smartphone shipments would reach 657 million by 2013. The actual figure exceeded expectations, hitting 1.02 billion—55% higher than initial estimates—driven by advances in hardware and innovative applications like ride-sharing and social media.⁵
- We believe these historical examples highlight a recurring theme: the long-term impact of emerging technologies is often underestimated because investors fail to account for innovative breakthroughs that drive rapid adoption. Investor skepticism typically stems from limited use cases and high upfront costs, but as companies innovate, adoption accelerates—often propelled by network effects that bring these technologies into the mainstream (see [Accelerating Adoption](#)). As investors consider the rise of emerging technologies such as artificial intelligence (AI), autonomous vehicles, robotics, and cell-based therapeutics, history reminds us to remain open to the transformative potential of innovation over the long term.

^{1,3,4,5} Morgan Stanley Research, Global Technology, North America, (2024), Morgan Stanley AI Guidebook: Fourth Edition, January 23, 2024.

² The Economist 10/7/99 – “Cutting the Cord”. World Bank Group, Mobile cellular subscriptions - World: 1975-2023, (2024).

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