JOHN M. JORDAN

Information, Technology and Innovation

Resources for Growth in a Connected World

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John Wiley & Sons, Inc.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data

Jordan, John M.
Information, Technology, and Innovation : Resources for Growth in a Connected World / John M. Jordan.
pages cm
Includes index.
ISBN 978-1-118-15578-3 (hardback); ISBN 978-1-118-22598-1 (ebk);
ISBN 978-1-118-23930-8 (ebk); 978-1-118-26396-9 (ebk)
1. Technological innovations. 2. Information technology—Management. I. Title.
HD30.2.J673 2012
303.48'3—dc23

2011048573

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1

For Douglas, Phoebe, and Walker

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Preface

The Outer Banks of North Carolina is a chain of barrier islands located off the eastern shore of the state. Most famous for the Kitty Hawk dunes where the Wright Brothers first achieved powered flight, the Banks have a long, rich history. The pirate Edward "Blackbeard" Teach sailed out of Ocracoke Island, while the treacherous waters offshore have claimed dozens of ships over the centuries. In World War II, German submarines sunk merchant vessels there; divers recovered an Enigma decoder machine from one such German submarine in 1981. Merchant hunters once used massive shotgun-like weapons to down hundreds of duck and geese in a single outing on the 30-mile wide Pamlico Sound.

For hundreds of years, the Banks were remote and hard to get to; this quality, along with the wind and sand, was part of the appeal to the Wrights. The 1960s saw the beginning of a period of rapid growth and discovery by the outside world. Bridges and causeways replaced some of the ferries, world-record marlin were caught by Hatteras Island charter captains, and the rapid growth of such southeastern cities as Atlanta, Raleigh-Durham, Charlotte, and the Washington, DC area helped drive a rapid increase in tourism. Finally, the rise in such adventure sports as surfing, windsurfing, and kiteboarding coincided with the area's unique combination of wind and waves to draw international attention to the area. For all the snowboarder-like attitude, however, fishing—on the sound in a skiff, in the Gulf Stream from a 50-foot "battle wagon," or off the beach—was and remains a massive draw to the area.

Despite the modernization, the islands remain prone to hurricane damage. The fragile barrier islands are continually shifting and extreme storms can breach the thin islands. While the sunshine and miles of white sand beaches, many of them protected from development as part of a national seashore, exert their pull toward escape and relaxation, locals keep a close eye on the weather. Evacuation routes are clearly marked and frequently used. After one hurricane, renters were given flyers

asking them to be patient with storekeepers and restaurant waitstaff insofar as some of them had just lost their homes.

The Outer Banks is clearly a unique locale, a barrier island ecosystem with a rich history. Inspired by the Foxfire experiment in oral history begun by a Georgia English teacher in the 1960s, the local high school interviewed longtime residents for an excellent series of recollections. As recently as the 1990s, weather information was displayed in block letters, much like old IBM text-based PCs, on local cable television. Wireline telephone coverage was spotty: some calling cards worked better than others. The *New York Times*, Sunday or otherwise, was impossible to obtain. Renting a house involved a mimeographed list of options and a toll-free telephone call to a property management firm. Being removed from the rat race was part of the Banks' appeal.

The rapid growth of the Sun Belt, combined with the real estate bubble of 1995 to 2008, encouraged building and more building. Houses grew bigger. Pools became the norm, even for oceanfront houses. Real estate firms multiplied, and moved from mimeograph to black-and-white offset printing to thick, slick full-color catalogs. The *Washington Post* and Sunday *New York Times* infiltrated the islands, as did upscale restaurants. Cell phone service improved; high-speed Internet access became a routine feature of the rental properties.

As of 2011, the Outer Banks feels less isolated than ever before. Some property managers have dispensed with paper catalogs altogether, moving instead to online guides that feature Google Earth aerial imagery, video walk-throughs of the properties, and extensive photo galleries. The *New York Times*, the BBC, and Al Jazeera are all equally and easily available. Weather channels and resources have proliferated.

Cell phone coverage can extend up to 20 miles offshore. It's great for the fishing guides but just as useful for making the BlackBerry work. Wi-Fi in many rental houses makes tuning out an act of will rather than a default state of affairs. Anonymity becomes less common: A colleague of ours was on the same island as we were on a recent visit, a fact we discovered through Facebook. His page even told us what music he listened to while there.

Local retailers of everything from books to kiteboard gear to fishing tackle now ship worldwide from online storefronts. Fishing guides and restaurateurs look to Match.com for a social life, claiming that "It's hard to develop a relationship with people who are only here a week at a time." Political organizers have turned to the Web as court decisions to protect nesting birds and sea turtles have restricted beach access for fishing and other recreation. One of the main bridges connecting the islands is in need of substantial repairs, and there are online petitions and other resources devoted to that cause as well.

Relentless improvements in electronic connection have brought many changes to life on these islands. Personal safety during extreme weather, health care, and retail selection, particularly in the off season, have increased by a sizable extent. At the same time, the Outer Banks is no longer unique: In a highly connected world, anyplace can to a degree become everyplace. Getting CNN, and Twitter, and e-mail just as easily in an island paradise as in an airport Hilton also has consequences.

This book attempts to explore the intersection of our connecting technologies and our institutions, and the changes that come to business as a result. For a variety of reasons—not all of them related to the Internet—making a living, finding a partner, and other essential, defining pursuits are changing. Just as with life on the Banks, the changes are happening fast, but often invisibly, particularly for the young. The book began as an undergraduate class on global information technology strategy, an exercise in looking closely at the ways in which information and technology alter the business landscape. My objective is neither to be a cheerleader for IT nor to lament the lost glories of years gone by. Rather, I hope to identify both the imperative and the resources for still-deeper innovation as we extend the impact of the information revolution to more strata of society, more areas of the globe, and ultimately more workers.

This book's argument has five phases. First, some basic facts about technology, management, and economics are examined to set some context. The second section is concerned with how humans organize resources and do work in the changing landscape. Business model disruption and innovation is the focus of seven case studies in Section III. A number of particular technologies that can serve as innovation resources—building blocks, as it were—are discussed in Section IV. Finally, the last section sketches out five broad areas of rapid change in the foreseeable future.

Acknowledgments

Many people have contributed to this book with extraordinary intellectual generosity. It is a pleasure to thank as many of them as I can recall. To anyone I left out, my apologies.

Stu Abraham, Lawrence Baxter, Gary Bolles, Brian Geffert, Raghu Garud, Heather Jordan, Tom McGlaughlin, Dave Robertson, and Don Shemanski each read sections of the book and made helpful suggestions. My students, both current and former, have provided assistance with suggestions, corrections, and fresh insights: in particular, to Chao He, Amanda Hahnel, Jamie Joung, Terrence Kim, Tushar Shanker (who did wonderful work on the graphs), and Mike Waldhier, my sincere appreciation. In the heavy lifting department, Lee Erickson, Dave Hall, John Parkinson, Jamie Taylor, and Richard Weddle made substantial suggestions and/or edits after reading one or more versions of the complete manuscript. Each of you made this project better; where it has flaws, those are mine.

At John Wiley, Tim Burgard got a green light for the project and handed me off to the capable team of Stacey Rivera, Natasha Andrews-Noel and Helen Cho who made the production process feel smooth and positive.

Financial support came from the Smeal College of Business at Penn State, with thanks to my department chair, Gene Tyworth, and to Arvind Rangaswamy, our senior associate dean. Thanks also go to the College of Information Sciences and Technology, also at Penn State, for financial support granted by Dean David Hall.

SECTION I

Foundations

For all the breadth of today's technology and business landscape, a surprisingly small number of general principles underlie many patterns of behavior. These principles, however, derive from several areas of the social and behavioral sciences that are usually considered in parallel rather than jointly. At base, the paradox of information technology lies in how much more potential remains to be explored, particularly in the economic realm.

CHAPTER 1

Introduction

If you watch exponential change for long enough, the effects grow beyond comprehension. In the late 1990s the technology analyst George Gilder was fond of telling the story of "the second half of the chessboard." Here is one version:

> *The emperor of China was so excited about the invention of chess that he offered the inventor anything he wanted in the kingdom. The inventor thought for a moment and said, "One grain of rice, Your Majesty." "One grain of rice?" the puzzled emperor asked. "Yes, one grain of rice on the first square, two grains of rice on the second square, four grains of rice on the third square, and so on through the 64 squares on the chessboard." The emperor readily granted that seemingly modest request. Of course, there are two possible outcomes to this story. One is that the emperor goes bankrupt because 2 to the 64th power grains of rice equals 18 million trillion grains of rice, which would cover the entire surface of the earth with rice fields two times over.*[1]

The story highlights one of the critical facts of contemporary life: Improvements in digital technologies are possible at scales never experienced in previous domains. As a 2005 advertisement from Intel pointed out, if air travel since 1978 had improved at the pace of Moore's law of microprocessor price/performance (one of Gilder's doubling technologies), a flight from New York to Paris would cost about a penny and take less than one second. Cognitively, physically, and collectively, humanity has no background in mastering change at this scale. Yet it has become the expectation; the list later in this chapter should be persuasive.

Given the changes of the past 40 years—the personal computer, the Internet, Global Positioning Systems (GPS), cell phones, and smartphones—it's not hyperbole to refer to a technological revolution. This book explores the consequences of this revolution, particularly but not exclusively for business. The overriding argument is straightforward:

- Computing and communications technologies change how people view and understand the world, and how they relate to each other.
- Not only the Internet but also such technologies as search, GPS, MP3 file compression, and general-purpose computing create substantial value for their users, often at low or zero cost. Online price comparison engines are an obvious example.
- Even though they create enormous value for their users, however, those technologies do not create large numbers of jobs in western economies. At a time when manufacturing is receding in importance, information industries are not yet filling the gap in employment as economic theory would predict.
- Reconciling these three traits will require major innovations going forward. New kinds of warfare and crime will require changes to law and behavior, the entire notion of privacy is in need of reinvention, and getting computers to generate millions of jobs may be the most pressing task of all. The tool kit of current technologies is an extremely rich resource.

Cognition

Let's take a step back. Every past technological innovation over the past 300-plus years has augmented humanity's domination over the physical world. Steam, electricity, internal combustion engines, and jet propulsion provided power. Industrial chemistry provided new fertilizers, dyes, and medicines. Steel, plastics, and other materials could be formed into skyscrapers, household and industrial items, and clothing. Mass production, line and staff organization, the limited liability corporation, and self-service were among many managerial innovations that enhanced companies' ability to organize resources and bring offerings to market.

The current revolution is different. Computing and communications augment not muscles but our brain and our sociability: Rather than expanding control over the physical world, the Internet and the smartphone can combine to make people more informed and cognitively enhanced, if not wiser. Text messaging, Twitter, LinkedIn, and Facebook allow us to maintain both "strong" and "weak" social ties—each of which matters, albeit in different ways—in new ways and at new scales. Like every technology, the tools are

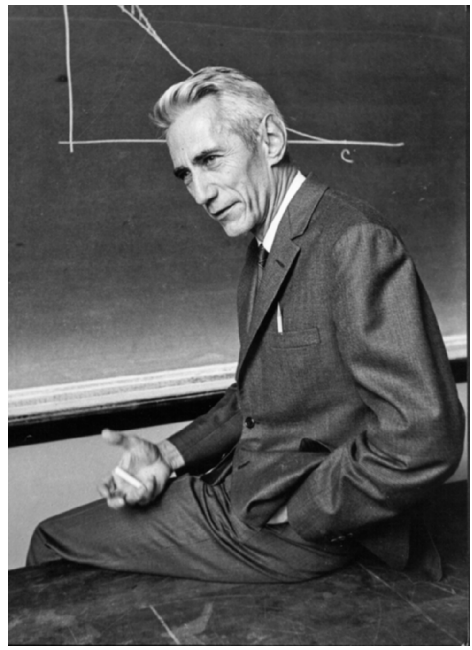

FIGURE 1.1 Claude Elwood Shannon, 1916–2001
Source: Courtesy MIT Museum.

value neutral and also have a dark side; they can be used to exercise forms of control such as bullying, stalking, surveillance, and behavioral tracking. After about 30 years—the IBM Personal Computer (PC) launched in 1981—this revolution is still too new to reflect on very well, and is of a different sort from its predecessors, making comparisons* only minimally useful.

For a brief moment let us consider the "information" piece of "information technology" (IT), the trigger to that cognitive enhancement. Claude Shannon, the little-known patron saint of the information age (see Figure 1.1), conceived of information mathematically; his fundamental insights gave rise to developments ranging from digital circuit design to the blackjack method popularized in the movie *21*. Shannon made key discoveries, of obvious importance to cryptography but also to telephone engineering, concerning the mathematical relationships between signals and noise. He also disconnected information as it would be understood in the computer age from human uses of it: Meaning was "irrelevant to the

*When Al Gore called the Internet the "Information Superhighway" in 1978, it was a perfect example of this disconnect.

engineering problem."[2] This tension between information as engineers see it and information that people generate and absorb is one of the defining dynamics of the era. It is expressed in the Facebook privacy debate, Google's treatment of copyrighted texts, and even hedge funds that mine Twitter data and invest accordingly. Equally important, however, these technologies allow groups to form that can collectively create meaning; the editorial backstory behind every Wikipedia entry, collected with as much rigor as the entry itself, stands as an unprecedented history of meaning-making.

The information revolution has several important side effects. First, it stresses a nation's education system: Unlike twentieth-century factories, many information-driven jobs require higher skills than many members of the workforce can demonstrate. Finland's leadership positions in education and high technology are related. Second, the benefits of information flow disproportionately to people who are in a position to understand information. As the economist Tyler Cowen points out, "a lot of the Internet's biggest benefits are distributed in proportion to our cognitive abilities to exploit them."[3] This observation is true at the individual and collective level. Hence India, with a strong technical university system, has been able to capitalize on the past 20 years in ways that its neighbor Pakistan has not.

Innovation

Much more tangibly, this revolution is different in another regard: It has yet to generate very many jobs, particularly in first-world markets. In a way, it may be becoming clear that there is no free lunch. The Internet has created substantial value for consumers: free music, both illegal and now legal. Free news and other information such as weather. Free search engines. Price transparency. Self-service travel reservations and check-in, stock trades, and driver's license renewals. But the massive consumer surplus created by the Internet comes at some cost: of jobs, shareholder dividends, and tax revenues formerly paid by winners in less efficient markets.[4]

In contrast to a broad economic ecosystem created by the automobile industry—repair shops, drive-in and drive-through restaurants, road-builders, parking lots, dealerships, parts suppliers, and final assembly plants—the headcount at the core of the information industry is strikingly small and doesn't extend out very far. Apple, the most valuable company by market capitalization in the world in 2011, employs roughly 50,000 people, more than half of whom work in the retail operation. Compare Apple's 25,000 nonretail workers to the industrial era, when headcounts at IBM, General Motors, and General Electric all topped 400,000 at one time or another. In addition, the jobs that are created tend to be in a very narrow window of technical and managerial skill. Contrast the hiring at

Microsoft or Facebook to the automobile industry, which in addition to the best and the brightest could also give jobs to semiskilled laborers, tollbooth collectors, used-car salesmen, and low-level managers. That reality of small workforces (along with outsourcing deals and offshore contract manufacturing), high skill requirements, and the frequent need for extensive education may become another legacy of the information age.

In the past 50 years, computers have become ubiquitous in American businesses and in many global ones. IT has contributed to increases in efficiency and productivity through a wide variety of mechanisms, whether self-service Web sites, automated teller machines, or gas pumps; improved decision making supported by data analysis and planning software; or robotics on assembly lines. The challenge now is to move beyond optimization of *known* processes. In order to generate new jobs—most of the old ones aren't coming back—the economy needs to utilize the computing and communications resources to do *new* things: cure suffering and disease with new approaches, teach with new pedagogy, and create new forms of value. Rather than optimization, in short, the technology revolution demands breakthroughs in innovation, which as we will see is concerned with more than just patents.

There are of course winners in the business arena. But in the long run, the companies that can operate at a sufficiently high level of innovation and efficiency to win in brutally transparent and/or low-margin markets are a minority: Amazon, Apple, Caterpillar, eBay, Facebook, and Google are familiar names on a reasonably short list. Even Dell, HP, Microsoft, and Yahoo, leaders just a few years ago, are struggling to regain competitive swagger. Others of yesterday's leaders have tumbled from the top rank: Merrill Lynch was bought; General Motors and Chrysler each declared bankruptcy. Arthur Andersen, Lehman Brothers, and Nortel are gone completely. How could decline happen so quickly?

Given our era's place in the history of technology, it appears that structural changes to work and economics are occurring. To set some context, consider how mechanization changed American agriculture after 1900. Because they allowed fewer people to till the land, tractors and other machines drove increased farm size and migration of spare laborers to cities. Manufacturing replaced agriculture at the core of the economy. Beginning in 1960, computers helped optimize manufacturing. Coincident with the rise of enterprise and then personal computing, services replaced manufacturing as the main employer and value generator in the U.S. economy. In short, *innovation could be to information what mechanization was to agriculture: the agent of its marginalization and the gateway to a new economic era.*

How IT relates to this shift from manufacturing to services and, potentially, a new wave of innovation is still not well understood; to take one example, as Michael Mandel argued in *Bloomberg Businessweek*, a

shortfall of innovation helps explain the misplaced optimism that contributed to the financial crises of the past years.[5] But rather than merely incant that "innovation is good," I believe that the structure of economic history has certain limits, and computers' propensity for optimization may be encountering one such limit. It takes people to innovate, however, and identifying both the need as well as the capabilities and resources necessary for them to do so may be a partial path out of the structural economic stagnation in which we find ourselves.

Consider Dell, which achieved industry leadership in the 1990s through optimization of inventory control, demand creation, and the matching of the two. The 2000s have treated the company less well. Apple, which like Dell boasts extremely high levels of supply chain performance, has separated itself from the PC industry through its relentless innovation. Seeing Apple pull away with the stunning success of the iPhone, Google in turn mobilized the Android smartphone platform through a different, but similarly effective, series of technical and organizational innovations. In contrast to Apple and Google, optimizers like Dell are suffering, and unsuccessful innovators including Nokia are making desperate attempts to compete. Successful innovation is no longer a matter of building better mousetraps, however: The biggest winners are the companies that can innovate at the level of systems, or platforms.

The Macro Picture

At the risk of missing some important nuances, three broad issues—globalization, the shift from manufacturing to services, and stagnant middle-class wage growth—need to be considered in tandem with the technology and associated business changes that serve as the primary focus of this book. It should be noted at the outset that coincidence does not imply causation: To assert that the rise of the information era happened in the same period as a transition from manufacturing to services should not be taken to say one caused the other. In fact, some other dynamic may have caused both. That said, powerful forces need to be acknowledged before analyzing the technology sector by itself. We have more to say about each of the topics in the coming chapters.

Globalization

The rise of globalization (regardless of how it is defined) and the rapid diffusion of the Internet and mobile phones are neatly aligned in time, taking off around 1989. Figure 1.2 shows one effort to measure globalization, building on three factors: Economic, social, and political inputs all inform this index, which was created by KOF, a Swiss think tank.[6] These