THE EVOLUTION MATRIX: NAVIGATING THE COMPETITIVE ADVANTAGE AND SUSTAINABILITY OF OUTSOURCING

by

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Submitted to the Alfred P. Sloan School of Management
In Partial Fulfillment of the Requirements for the Degree of

Masters of Science in the Management of Technology

at the

Massachusetts Institute of Technology

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THE EVOLUTION MATRIX: NAVIGATING THE COMPETITIVE ADVANTAGE AND SUSTAINABILITY OF OUTSOURCING

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Carl Joseph Chen

Submitted the Alfred P. Sloan School of Management on May 10, 2004 in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Management of Technology

ABSTRACT

The thesis addresses whether there is competitive advantage to outsourcing and whether outsourcing is sustainable. The reason, outsourcing (to foreign countries) has become an acerbic topic because the breadth of its impact has now reached all strata of society – from blue-collar to white-collar. Our answer is based upon the pooling of several analytical tools: Ricardian comparative advantage, game theory, system dynamics, Clockspeed and a new holistic framework developed for this topic, the Evolution Matrix. Together these tools represent an Evolution Trajectory that is representative of progress, which for the purpose of this thesis is interpreted as advances in technology and globalization. Thus, these tools are applied from a perspective that is grounded deep in history. In doing so we learn that outsourcing is a part of the trajectory theme.

A part of this trajectory theme is the global turnkey production network for the electronics industry. Its growth, abroad, and utilization by American electronics companies have a double-edged nature. This network has been a savior and potential source of competition. Our conclusion, outsourcing is a tactical tool. For companies, outsourcing may not aid a firm in its core competency quest. The competitive advantage of outsourcing is fleeting at best and outsourcing is sustainable only over the short-term. However, despite these risks, it will not fade away because of technology’s progress. The issue then is how best to navigate the outsourcing debate. To do this the manager must plot his company’s location and chart its trajectory within the competitive landscape. This is what the Evolution Matrix was developed for.

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ACKNOWLEDGEMENTS

This work and the memories that flows from it are dedicated to

my wife, Jocelyn, our parents,

my brother (Benjamin) & my sister (Charmine).

They are with me each step that I take in life.

Their love and unfailing support have helped make me the person that I am.

As I close this most remarkable and eventful chapter of my life at MIT,
the unfolding of many new and equally fruitful chapters has begun, with my new son –

Averell.

Godspeed to my brothers & sisters of MIT’s MOT Class of 2004.
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CHAPTER ONE
SETTING THE STAGE

1.1 Introduction

“Outsourcing” seems to have become an acerbic topic of late and I imagine it will remain a sensitive issue for some time to come. N. Gregory Mankiw, President Bush’s top economic advisor best revealed the storm behind the issue when he commented that sending U.S. service jobs abroad “is probably a plus for the economy in the long run.”\(^1\) Was the sturm und drang that followed this comment deserved? That of course would depend on the context, tone aside. And Mr. Mankiw’s context was that outsourcing would result in lower costs at home and that “[o]utsourcing is just a new way of doing international trade.”\(^2\) Yet the press had a field day and ignored what I consider the more far-reaching implication and error in the second comment, that outsourcing is a new way for conducting international trade. It is not as Mr. Mankiw says a new way of doing trade, outsourcing and way of trade being the operative words, new being the error. Outsourcing is an inevitable consequence of globalization, which is an inevitable consequence of the human species drive for ever greater interaction. This will be a recurring theme throughout the paper. Whatever your opinion though, the topic is divisive. And it will only continue growing so, especially during an election year with a major contender for the Presidency proposing potential legislation requiring U.S. companies to warn of job exports.\(^3\)

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\(^2\) Ibid.

Figure 1-1.

The purpose of this paper is not to argue for or against “outsourcing” nor is it an attempt to address the contentious issues surrounding it. I leave this for the politicians, corporate spin-doctors and peeved students. But Mankiw did strike close to what this paper is concerned with. This paper recognizes that outsourcing can be a powerful tool in any company’s arsenal of strategies. But as with any tool, it is only as useful as the thought that goes into using it.

The paper is my attempt to enrich the body of that thought by examining the issue of outsourcing from a perspective unlike that of other papers. My arguments and tools are derived from economics, game theory, system dynamics and the Clockspeed concept. The synthesis of these various disciplines will hopefully add a few more lumens to the manager’s outsourcing considerations, in light of potentially strong and ever shifting
externalities in the business world. The paper therefore takes a strategy level perspective to outsourcing. It is not a company level how to. Although we recognize that cost savings, access to markets, scarce resources and even knowledge may be outsourcing drivers the paper has more meaning for the reader who would examine outsourcing from a systemic level – diversifying complexity, production networks, divesting non-essential activities. Outsourcing is a means, a tool, like the concepts (frameworks) we will use. The ends have to do with the big picture thinking that is so much a part of the leadership training that is the Management of Technology Program.

Theme of the Paper

The theme of the paper is as follows. If technological innovation forces us to rethink production in our networked world then it pushes upon us the question of (1) when production is a strategic asset and when it is a commodity or within the context of this paper when is outsourcing a competitive advantage? This begs the question of (2) whether outsourcing is sustainable, not just from the cost perspective but also from asking how outsourcing can buffer uncertainty and address the problem of business cycles.

In addressing these two issues, I reply that what competitive advantage there is to outsourcing is fleeting. It is a consequence of a greater trajectory that cannot be halted. This trajectory is the result of our inimitable drive in creating greater interactions for the pursuit of ever larger and more complex non-zero sum games (win-win games). We call this the Evolutionary Trajectory (or Trajectory Theme). These games scale with technology at mind-boggling rates. Where we are headed on account of all this game playing is beyond anyone’s guess but one thing is for sure, the world is becoming an ever more networked place and outsourcing is a way that this network is weaving itself into the
fabric of our definition for globalization. So we treat the *Trajectory Theme* as one of the needles and outsourcing as one of the threads.

The reaction to this trend is not to stop something with so much momentum. The better response is to understand the trend and outsourcing’s role in it so one can better survive each successive wave of changes. So to get back to the two issues I raised just above, the “trend” will surface time and time again throughout this paper in the form of references to history. It is in a sense a warning to not leap for the branches without first having identified the trees.

**Course of the Paper – Methodology**

Hence, the course of the paper is as follows. Chapter One will set the stage. It opens by addressing contemporary reactions to outsourcing. But more than merely point out the obvious that job loss and paranoia go hand in hand, we try for a deeper systemic understanding of why accepting comparative advantage in its classical sense won’t suffice as an explanation for what is taking place. If you do so you may make the mistake of believing that there is a strategic comparative advantage to outsourcing when in fact such a strategy is not sustainable. Given enough time everything in the universe will reach stasis. But we are studying outsourcing so that we can in part minimize the impact it has for those who must bear its consequences.

The strategic manager must peer into the economic and logical argument that many leaders are too ready to accept. He must understand the caveats that cause the disruptions and which ignite the anxiety and tension for his employees. There is no *fait accompli* for the displaced if one can gain the proper perspective.
I want the reader to be reminded of the intellectual provenance that precedes any debate about outsourcing because I want to take a "back to fundamentals" perspective; thus, the discussion of comparative advantage in the Ricardian sense and the heavy flavor of history throughout this paper.

So beginning with the simple observation that none of what is taking place in terms of outsourcing is new, I engage in a discourse on economic comparative advantage and its conceptual child, Michael Porter's Diamond for the "Determinants of National Competitive Advantage." We apply Porter's Diamond to Taiwan as an example of how comparative advantage can be fleeting and disruptive to everyone, even the perceived winners.

Chapter Two introduces the game theory concept of non-zero sum games as the secret behind why outsourcing is inevitable and why it will only accelerate. Set within the framework of system dynamics and reinforcing loops we expose game theory as the propellant for globalization. Interaction for the accumulation of positive sums will only increase with the aid of technology. It happened in the past and it is not about to change anytime soon. So when we turn up the steam by adding more and better technology we are accelerating a self-reinforcing cycle of progress. Unfortunately, this self-reinforcing cycle spins more like a wobbly washing machine than it does a perfectly balanced wheel. These wobbles show up as oscillations in the supply chain. As companies attempt to tame these oscillations they may, for better or worse, decide to pass the problem elsewhere. Hence the oft rapid and ill thought out resort to outsourcing.

Chapter Three introduces the Evolution Matrix, a merger of the Clockspeed concept and the principles covered earlier - history, trajectory, non-zero sum dynamics and re-
enforcing systems. This tool is designed to aid the manager in gaining a firmer grip on understanding the effects from outsourcing. It also addresses two key concerns when outsourcing – the preservation of capability and capacity. The Matrix maps Clockspeed and evolution against capability and capacity as considerations when outsourcing. The manager can use this Matrix to gauge the potential negative impact on his business along what I call the Discontinuity Path. However, as with all models, the Evolution Matrix should not be treated as a mirror reflection of reality. There are caveats that go with it and these caveats largely stem from the use of models as a simplified approximation of our surroundings.

Chapter Four looks at the electronics industry and its international production network to examine whether production is still relevant in light of what I have hopefully reminded the reader of – the inevitable trajectory of systemic globalization in the digital age. We will look at the turnkey production network for the electronics industry and its interplay with the Evolution Matrix. I explain that this network is defined by technology standards and characterized by companies that can optimize these standards against the outsourcing company. Herein lays a potential trap that many managers are quick to fall into because of their misinterpretation of core advantage and failure to understand that developing nations have no interest in preserving intellectual property ("IP") rights. The potential outcome for any manager making an outsourcing decision without considering the issues presented herein is an acceleration of game dynamic effects and speeding up of the company along the Evolution Matrix’s Discontinuity Path.

Finally Chapter Six, wraps-up our paper with thoughts on the implications for what outsourcing, within the context of this work, means for the American manager.
Perhaps the uncertainties of competitive advantage and sustainability are too prosaic for managers who must hew quarterly earnings according to Wall Street’s behest. But what I do as a manager is focused through the lens of my interest in history and my curiosity for identifying relations among seemingly disparate yet interconnected problems. It is my hope that you share an interest in building sustainable organizations so the "generational" aspects of the two uncertainties and of the perspectives herein will be of greater application and meaning. The paper therefore follows a tone set by the following quote, "Speak with your grandparents and you can reach back a hundred years in history."  

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4 This is probably the most poignant thing said to me at MIT. James Utterback, Chair of the MIT Management of Technology Program, made the statement during a class session of course 15.353, “Research Themes in the Management of Technology.” This thesis has its origins in Professor Utterback’s class.
The “Storyboard” is essentially the roadmap for the thesis. It is the forest and the trees.
1.2 "The Structure of the World" Has Changed?

Before we delve any deeper let’s clarify something first. What’s the difference between outsourcing and offshoring? Without leaping straightaway into the paper let us just say for the time being that when a company engages in outsourcing it has decided that item “x” should be sourced from outside the organization, that is from a body the company has no management control over and no financial interest in. However when a firm is offshoring item “x” it is sourcing that item from a body that it may exercise some control over, both in terms of management and finance, and the source for item “x” is located in a foreign locale. Foreign locale, by the way, means another country. Now that we have this settled, let me establish the setting from which we will begin our examination of outsourcing.

First, the issue of outsourcing or offshoring cannot be studied in isolation and here’s why. The next time you walk into a Neiman Marcus and perchance some frippery such as a US$595 silver-trimmed leaf clipper catches your eye it may well be made by a craftsman in Bali, Indonesia, working in a factory owned by an ex-hippie from Canada. Mind you, we are not talking about native crafts; the artifact is a leaf clipper that the Queen Mother might find fit for Balmoral Castle. And that Canadian hippie turned businessman-hippie? He has his workers sitting tropical wood seats to a brass toilet destined for his luxury apartment in Manhattan. A Canadian, hippies, Neiman Marcus, leaf clippers and Bali, what is happening here? Nothing that has not happened before; this is probably the

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most basic example of trade on a global level. We just referred to it as “international” business in the past but the trend for literature seems to be in calling it globalization.

But if a leaf clipper of Western design produced in Bali for Neiman Marcus is too insignificant and outside your conception of an outsourced artifact then let us take Netgear Incorporated to illustrate my point further.

I recently bought a Netgear wireless router while upgrading my home’s IT system. Netgear is a popular branded manufacturer of networking equipment for home or small office use. The company was incorporated in the state of Delaware in 1996 but operates out of Santa Clara, California. In its most recent 10-K as filed with the Securities and Exchange Commission on March 5th of 2004, Netgear comments that production arrangements are with Taiwan based production contractors under Original Design and Manufacture ("ODM") or Original Equipment Manufacture ("OEM") contracts. All products are manufactured in Taiwan or in China and its manufacturers purchase all necessary parts and materials to produce complete, finished, goods. In addition, Netgear outsources all warehousing and distribution logistics and makes extensive use of outsourcing for technical support.\(^6\) As a matter of fact the people who answered my calls to Netgear tech-support were based in Bombay, India.\(^7\) How do I know this? I asked. You might try it next time, as a matter of curiosity. Clearly, Netgear is a global corporate citizen – based in the U.S. with production sourced from East Asia and after-sales support located in the Indian sub-continent.

Second, none of this is all that new. As the world becomes ever more interconnected globalization and technology are amplifying the impact of outsourcing. All


that fiber optic bandwidth that was laid during the Internet bubble is still around and the dark channels are gradually being lit. The Neiman Marcus leaf clipper from Bali is an example of the sort of cross-border exchange that has traditionally taken place, before the advent of jet travel and fiber optic communications. Modern transport and technology has escalated the effect and magnitude of outsourcing. Even Dell Computers had long ago outsourced everything but the marketing of its notebook computers to a handful of Taiwan based ODMs; while Apple Computers, long before Dell Computers, outsourced the manufacturing of virtually all its PCs (desktop and notebook) to Electronic Manufacturing Services ("EMS"); more on this hodge-podge of lexicon and acronyms later.

Is anxiety about outsourcing not a bad thing so long as it forces you to make the right choices? What exactly are its long-term consequences? Is outsourcing simply a new way of doing international trade, as Mankiw said? And is it probably a plus for the U.S. economy over the long run or are we on some sort of slippery slope from which those without the right skill sets will be left behind, permanently? As the chief executive of Infosys Technologies, an Indian outsourcing company, declared at the World Economic Forum, "Everything you can send down a wire is up for grabs." This sounds pretty intimidating and it probably wasn’t lost on Senator John Kerry’s campaign when it estimated that about one million jobs have moved overseas since President Bush took office. But though we are in the midst of an election year and though statistics may indicate that the U.S. economy is recovering, one thing that has long accompanied most recoveries appears to be ever farther from the horizon – jobs. As Steve Liesman, a

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8 Ibid, refer to FN 01.
business writer, noted in the Wall Street Journal, "It's taken longer and longer during the past three recessions: 28 months from the 1981 recession and 32 months from the 1991 downturn to reach the prior peak. Three years into the current downturn in employment levels, it will still take months more of above average job growth to get back to the prior peak. It may well take four years."

*Figure 1-3. GDP Trend – 2000 to 2004*

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*Figure 1-4. Unemployment Trend – 2000 to 2004*

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*Third,* the nature of the economic challenge appears to be fundamentally different this time and I think Carly Fiorina, chairman of Hewlett-Packard captured this argument

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13 Ibid.
best when she said; “Not only do our competitors have increasingly knowledgeable work forces, but they can compete for jobs that were once the sole province of the developed world… There is no job that is America’s God-given right anymore.” And so it seems, to all those transcriptionists, call center employees, programmers, etc., who have seen their jobs shifted elsewhere.

To recap, the issue of outsourcing cannot be studied in isolation. To do so would be misleading and myopic. If we want to understand then we need to delve into globalization and its historic roots. Thus, none of what is happening is new. But if none of what is happening is new then why does it seem that much worse this time around? The answer lines in the sharp disturbances that emanate from the increased adoption of technology. What follows, as will hopefully become apparent, is captured by a recent and apt statement by Craig R. Barrett, Intel’s chief executive, “The structure of the world has changed...”\textsuperscript{14} And it has changed in such a way that no geographic region can any longer lay claim to high-tech white collar jobs.

\textsuperscript{14} Ibid, refer to FN 09.
1.3 The Ricardian View – Comparative Advantage

Theories abound but one theory seems to have particular relevance as of late, and that is the theory from economics that tells us that trade between nations occurs because of differences – in productivity, taste, or economies of scale. What this theory is addressing is comparative advantage – you produce what you are most efficient at. If your country has a lot of resources then you “produce” those resources. If you’re country is great at making tiny things then you export intricate and expensive watches like the ones with “automatic” movements that the Swiss make or if your country is wealthy in terms of access to and availability of capital (I would add intellectual capital though the traditional theory does not account for it) then you produce capital intensive goods. This is comparative advantage in the classic sense.

What this has to do with outsourcing is that so much of the current debate about outsourcing revolves around the banter that companies are fleeing for cost friendly geographies that are better suited to doing what they are good at. But is this so unnatural?

That is the question-answer that many accept. And if we accept it cringing, we do so because it seems strange that the poor man’s comparative advantage in labor/price is at the same time a gain and a loss for the developed world. Why is this so and what are the potential fallouts that might chip away at outsourcing as a strategic advantage?

As we shall see, the typical proof for this question-answer, the theory of comparative advantage, has some debilitating caveats. These caveats are what the manager must understand because they provide the strategic insight into the tenuous nature of the competitive advantage derived from outsourcing. What follows will knit the insight we gain from this with our discourse that technology is carrying all of us on a trajectory
toward ever increasing globalization, even if that means there is a flight to overseas labor regardless of whether it is good or bad. This is the theme I raised in the introduction, recast.

**Comparative Advantage – The Caveats**

So let us begin the study and address comparative advantage by turning to any OPEC (Organization of Petroleum Exporting Countries) member as an example. The world may jealously look on at what their “black gold” can afford to OPEC members but up until a few years ago most of its constituents from the Middle East were simply living classical comparative advantage to its best and fullest. Would any of us have seriously expected someone in Qatar to farm legumes, in of all geographies a sea of sand? Similarly would anyone expect a farmer in Iowa to plant anything but his crop of corn? Sure, central Iowa has plenty of coal but translating that coal into something that a car can use is a pricey proposition. Both an Iowan and a Qatari are better off trading. This way everyone wins or is at least supposed to. That is what we are supposed to believe with outsourcing.

In fact there are several caveats to this. *First*, we assume that macro-economic policies will be used to keep people employed, to reach the theoretical unemployment rate of 5%. Even if you assume that long-term gains will more than offset short-term losses from the failure to do so, the consequence for not doing so is that the discounted net present value for missing the mark can be very costly, even greater than any expected long-

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15 Hugh Pope. “Saудis Try New Way to Fuel Economy: Going to Work.” *The Wall Street Journal Online*, April 1, 2004, available from Factiva, <http://www.factiva.com>, accessed April 1, 2004. Even the issue of jobs has reached the Saudis. In a somewhat distorted Malthusian irony population growth has whittled away the ability of the land to sustain the living standard that most Saudi's were accustomed to just a few short years ago. Apparently, local Saudis now seek after those very jobs that were sourced to imported foreign labor. As one interview subject in the article commented, “Saudis used to think that even a pilot was something lowly, like a chauffeur, and wouldn't let their daughters marry one. Now they're happy for their daughters to marry a flight attendant like me.” What goes around comes around.
term rewards. I think the Saudis are a case in point. When I visited Saudi Arabia for the first time in 2001 I was surprised to see how few businesses there were in manufacturing industrial equipment and the creation of intellectual capital. Subjects of the desert kingdom apparently had no incentive to work because subsidies from oil money were generous. Now, having failed to properly direct the economy towards more knowledge intensive industries the long term rewards for the kingdom and its ruling class may very well prove to be shallow in light of the problems they currently face. Today some 35% of Saudi men between the ages of 20 to 24 are unemployed.\textsuperscript{16} That figure exists within the backdrop of religious extremism as a key political issue for the region.\textsuperscript{17} Amidst this climate the Saudi’s have to figure out a way to make the spectacular leap to some semblance of a knowledge based economy before the oil literally runs dry or becomes too expensive to extract from tired and mismanaged fields.\textsuperscript{18}

Second, we assume that markets are perfect and that skill adjusted wages and capital returns are the same regardless of the industries for capital and labor. This is not the case. We know from the current debate over outsourcing that the concerns of displaced workers are about finding jobs that, at least, effectively pay no less than the jobs they were displaced from. As Rory Cowan, CEO of Lionbridge commented when speaking to the Management of Technology class of 2004 at the Massachusetts Institute of Technology (“MIT”), “Each transition concentrates skilled employment in increasingly higher skilled

\textsuperscript{16} Ibid.
people.”

What is anyone to do with a 50 year-old mainframe engineer whose job can be done by someone in India? What is he to retrain for and who will pay for it? As Cowan said, “You can’t just wake up one day and decide neurosurgery! That’s the ticket!” The frightening thing for these people is that it appears as if globalization is creating new equilibrium in wages, one in which given similar skill sets some people are getting pulled out of poverty and into a living standard that is markedly different and better while others suffer a downgrade in living standards.

### Table 1-1. Balance of Trade, US.

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<td>Goods</td>
<td>-482.9</td>
<td>-549.4</td>
<td>13.8%</td>
</tr>
<tr>
<td>Services</td>
<td>64.8</td>
<td>60.0</td>
<td>-7.4%</td>
</tr>
<tr>
<td>Total</td>
<td>-418.1</td>
<td>-489.4</td>
<td>17.1%</td>
</tr>
<tr>
<td>Pacific Rim Total</td>
<td>-214.9</td>
<td>-230.0</td>
<td>7.0%</td>
</tr>
<tr>
<td>China</td>
<td>-103.1</td>
<td>-124.0</td>
<td>20.3%</td>
</tr>
<tr>
<td>Japan</td>
<td>-70.0</td>
<td>-66.0</td>
<td>-5.7%</td>
</tr>
<tr>
<td>NAFTA Total</td>
<td>-85.3</td>
<td>-95.0</td>
<td>11.4%</td>
</tr>
<tr>
<td>Canada</td>
<td>-48.2</td>
<td>-54.4</td>
<td>12.9%</td>
</tr>
<tr>
<td>Mexico</td>
<td>-37.1</td>
<td>-40.6</td>
<td>9.4%</td>
</tr>
<tr>
<td>Western Europe</td>
<td>-88.9</td>
<td>-101.3</td>
<td>13.9%</td>
</tr>
<tr>
<td>South/Central America</td>
<td>-18.0</td>
<td>-26.8</td>
<td>48.9%</td>
</tr>
<tr>
<td>OPEC</td>
<td>-34.4</td>
<td>-51.0</td>
<td>48.3%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>-26.7</td>
<td>-31.6</td>
<td>18.4%</td>
</tr>
<tr>
<td>Mineral Fuels</td>
<td>-104.2</td>
<td>-141.9</td>
<td>36.2%</td>
</tr>
<tr>
<td>Agricultural Commodities</td>
<td>11.1</td>
<td>12.1</td>
<td>9.0%</td>
</tr>
<tr>
<td>Manufacturing Trade Balance</td>
<td>-429.7</td>
<td>-470.6</td>
<td>9.5%</td>
</tr>
<tr>
<td>Advanced Technology Products</td>
<td>-16.6</td>
<td>-27.4</td>
<td>65.1%</td>
</tr>
</tbody>
</table>

*Note: Figures selected for illustrative purposes. They do not necessarily sum up.*

*Source: US Census Bureau*

Third, the theory implicitly assumes that currency values will change to maintain a rough balance in exports and imports. This certainly has not happened, for the U.S. economy. As Lester Thurow notes, “[F]or two decades [U.S.] imports have vastly

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19 Roary Cowan. Presentation to the Management of Technology Program (MIT), Cambridge, MA, April 1, 2004. The transition Rory Cowan speaks of concerns the transition from one principle industry that is driving economic growth to another, for example, from mainframe computers to mini’s to PCs.

20 Ibid, refer to FN 09.
exceeded exports... [and] for two decades those losing jobs to trade have been far larger in number than those directly gaining jobs from trade.”\textsuperscript{21} The numbers can be quite staggering, consider that from 2002 to 2003 the U.S. accumulated nearly one trillion dollars of deficit in its balance of payment.

Also the theory implicitly assumes that the jobs gained are no worse than those lost. Professor Thurow observes that, “Wages paid in import competing industries (industries where imports exceed exports such as autos) are higher than the wages paid in exporting industries (industries where exports exceed imports such as agriculture) and higher than those paid in the sectors that neither export nor import any significant fraction of their output.”\textsuperscript{22}

If this is indeed the case, then American workers are right to be worried and given the wealth of media reports feeding the maelstrom of debate surrounding outsourcing I would agree with Professor Thurow. If we accept this then what seems surprising at first should not be.\textsuperscript{23} Service jobs that aren’t traded pay the lowest in the economy and as I stated earlier if someone in India or China can and is willing to do the same work for less then wages do not reflect underlying productivity, as the theory assumes. In short, your nation’s GNP may not increase in an open trading regime, especially if you are importing more than you are exporting and your export industries are not as productive as your import industries.

\textsuperscript{22} Ibid. I have a great deal to thank Professor Thurow for his time, guidance and willingness to speak with me at length (Cambridge, MA, March 2, 2004). This section of the thesis would not be possible without the unpublished work cited in FN 21 and Professor Thurow’s guidance.
\textsuperscript{23} On March 6\textsuperscript{th} of 2004, when I ran a search on the Wall Street Journal Online (“WSJ Online”) using the query “outsourcing” I pulled up more articles than my PC’s screen had room for. Many of the articles touched upon the loss of jobs to outsourcing. Running the same search on any other major newspaper (e.g., the New York Times or Washington Post) or any major periodical such as BusinessWeek yields similar results. Thus, though my methodology is very crude, I would agree with Professor Thurow – why are we surprised?
Fourth and finally, let us go back to our Iowa & Qatar example and assume a reversal in the focus of their economic activity, such that Iowa is gasifying coal and using it to power, among other things, autos and those in Qatar are raising Iowa oceans of corn. As soon as the two places start trading based on what we would off-hand assume to be their respective “comparative advantage” the unfortunate souls doing the “wrong” thing would begin losing their jobs. And any capital expenditures made in plying the “wrong” trade would soon lose any value.

Of course there is a transition period during which things may very well get worse for many before they get any better, for hopefully many more. However, since the costs come early and the gains from trade come sometime later, it is not without the realm of possibility for the net present value of short term costs to exceed the net present value of the promised future gains from trade. And even if the costs come out in favor of opening to trade what would be the time horizon involved? The benefits may trickle in at such a rate that though your overall net present value for opening up is positive, you have to discount using so many years and use such a low rate of return that you test the patience of even those who would be willing to give “it” a try.

But let us assume that there are winners and losers and that overall, for society as a whole, there are more winners than losers. How will the losers be compensated? Are they to wait for the new wealth to trickle down to them? Seriously, who would have that patience when you are on the proverbial end of the shaft? We are not just talking about giving away a few pennies here and do not misconstrue me as taking sides; this is human nature we are talking about. How many people would be willing to do the compensating on their own accord and given that there probably won’t be too many volunteering, what
kind of government imposed mediation would people be willing to put up with, higher taxes? There are sure to be plenty of arguments for not redistributing wealth and I am certainly not one who would want to be subject to it – I will admit to this – but if the equilibrium means greater wealth but in fewer people then axiomatically the people of Iowa and Qatar are better off not trading with each other.

Remember, it is currently April 2004. We are in the midst of an election year and the arguments from both sides are quite compelling. Allow me the gross simplification of saying the arguments boil down to: (1) the long term effects are sure to outweigh the short term losses, though they may be painful for some and (2) we have got to slow things down, there must be some way to minimize the pain.\(^{24}\) I can agree with both and disagree with both or agree with one and not the other but if that is too Zen for you and it should be because it can be for me as well (for I am that conflicted businessman and human being) then the following may only serve to complicate matters.

**Technology as the “Other” Factor**

Comparative advantage as it was formulated and as it is frequently used today does not consider the impact of technology. Robert Torrens wrote about comparative advantage in his *Essay on the External Corn Trade* (1815)\(^ {25}\) and David Ricardo popularized it in his book *On the Principles of Political Economy and Taxation* (1817);\(^ {26}\) the dates would suggest why technology is not considered in the theory as we know it. But as we all know ideas are not static, they evolve. But I think many on both sides of the debate do not give


enough attention to the effects of changes in technology in light of comparative advantage. The literature tends to simply jump from technology to jobs lost without something in between or at best it may imply that technology is not static. Technology through the lens of the comparative advantage framework should be treated as moveable.

Also when technology is made part of the public debate on trade, the antagonist or protagonist is usually implying a "product cycle" perspective. This cycle usually has the first world as the engine and the third world as the caboose, with the first world improving in productivity with each advance in technology and the third world following along in the path of once new technologies. This assumption is just wrong because technology itself makes it wrong. Technology is not and cannot be fixed. Once the magic genie is out it does not go back into the bottle and like water it tends to move towards the path of least resistance. At any given point in time a technical change could take place which transforms an entire industry; businesses would be disrupted and forced to move what were once first world jobs to third world locations. We all know the examples, why hire a web designer in San Francisco to code web-pages when you can have someone do it for far less in China? Why not push out the skull-drudgery of preparing taxes to someone in Chennai, India? Heck, why not farm out commodity legal research as well? India has a common law system thanks to the English. This way the sun would never set on your practice. Modern telecommunications simply makes the world a smaller place and in doing so it is contributing to the displacement of many people from their accustomed income stream.

What moves in classical comparative advantage is the output; the factors of production (capital, labor and natural resources) are not moveable. Yet, for example,

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technology today has helped integrate and make possible the world’s capital markets. According to figures available from the Japanese Bankers Association website, in 2002 each Japanese banking institution, on a daily basis, cleared and settled roughly US$880 million in foreign exchange from both its internal and global capital markets.\(^{28}\) Technology also helps reconfigure global supply chains as new communications and transportation technologies allow for ever more elaborate supply chain design. Imagine how much smoother Wal-Mart’s operations could run if the shelves in its stores could inventory what and how much was on them and notify the supplier of an impending shortage?\(^{29}\) With the aid of technology, goods and money flow across borders and systems with seeming impunity. Even if regional attempts to erect artificial legal barriers are established to stop the necessary management or engineering skills from flowing to where capital and resources can be best put to use, one could still circumvent the restrictions within a wired world. Knowledge capital would still flow to where the profit is. Recall the chip designers mentioned above? These engineers make natural resource endowments all but moot in today’s world economy. A nation like Taiwan has no natural resources, yet it is able to create enough man made comparative advantage to rank the tiny Pacific island of 23 million as the world’s 15\(^{th}\) largest trading nation and 6\(^{th}\) most competitive country.\(^{30}\)

What is being said here is that knowledge, especially management knowledge, should be treated along with capital, labor, natural resources and technology as a production factor. Having the know how to put the other four factors to their most

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\(^{28}\) Japanese Bankers Association, “Foreign Exchange Yen Clearing System (Gaikoku-kawase Yen Kessai-Seido Koukandaka),” Japanese Bankers Association website, [no date is available for this spreadsheet], <http://www.zenginkyo.or.jp/>, accessed April 4, 2004. Spreadsheet was first given to me by my MOT classmate Yasushi Iguchi, of the Tokyo-Mitsubishi Bank.


efficient use and having the right skills to market and distribute the resulting products is at the heart of comparative advantage in today's world. This is not to say that management skill is equivalent to competitive advantage. Actually, given how freely people can travel and how easily data can be transmitted, whether that data be a design or management concept, it is all but impossible to have a competitive advantage in management skill.

Thus, if as in the case of Taiwan, we do not consider natural resources as a factor of production (imagine that they are not part of the economic equation) when considering comparative advantage then we can also lay aside geographic location as a restriction. In this case, everyone would have access to the same production opportunities and the same potential efficiency frontier, and this means the factors of production would flow to the most advantageous locations. The current dilemma Taiwan is facing in terms of its trade with China serves as an excellent example of this point. The excerpt that follows is from an interview with a Taiwan based executive from the electronics industry. It highlights the extent to which comparative advantage can readily shift.

_Q. How many of your top clients have located production facilities in China?_

A. "I don’t have one client that hasn’t relocated a production facility or that doesn’t have a customer with a production facility in China."

_What do you think are the primary reasons for your clients in locating facilities in China?_

A. "The American consumer, he’s the most spoiled consumer anywhere. For most major Taiwan electronics companies the U.S. is the key market. So we go to China to preserve prices for the American consumer because each quarter we're asked to cost down. At first, we really didn’t go for the
large market. Personally, I think many would have been happy making 3% to 7% net margins on the millions and millions of things Americans buy from us each year… There is power behind large quantities. But to get back to your question, yes. The China market is attractive but it’s not as easy to crack as everyone thinks. We have an advantage but those advantages aren’t anything that a determined Western company can’t buy. It might just cost them more and take them a bit longer to learn how to manage.”

Q. So what is the scale of the migration? There’s been a lot of press in the U.S. about losing white collar jobs to China and India. Do you think companies should be worried about losing their core competencies?

A. “I don’t see why any reasonable American business manager or any manager would want to keep those low level white collar jobs. If they are better done elsewhere for a competitive price you should do so. People should not be concerned with the rest of the world catching up with the rest of us. We’ll have more and better business to conduct… If you’re asking about IP I don’t think the U.S. is going to suffer from outsourcing but for a place like Taiwan that has just industrialized that’s a different issue. We have a lot of management skill but we don’t have the competitive capability to develop leading edge products like Japan or the U.S., for some limited areas we do but not across the board. Think about it, our whole economy is export driven. We went from farmers to factory managers not from farmers to inventors and then factory managers. We received and then bought our
initial technical and managerial know-how and we’ve been adding to it and refining it ever since. Our managers are probably some of the best in the world in recognizing plant efficiency… However, these skills can be passed on quite easily. Time is the only real obstacle. So we Taiwanese should be very worried. Management skills are soft skills. No one has yet to come up with solid guidance on what that should be replaced with.”

Q. When I read U.S. papers, many from the pro-outsourcing camp say that workers can be retrained or that workers will take on better jobs. Seems like the Taiwanese need to move up the food chain also.

A. “We are aware of that however it is easier said than done. Taiwan is a nation of small and medium sized businesses. That means there are not just money issues but coordination issues between the companies that comprise any industry.”

Q. I asked you earlier about the scale of the migration of Taiwan companies to China. Is it possible for you to give me a sense of it in terms of shear numbers, of companies or people? From your answer earlier the migration seems very large.

A. “No other people in history have taken to improving themselves on the scale of the Chinese. The great thing too is they are doing it with other people’s money. Taiwan companies have invested more than US$100 billion in China and we have, I think, more than 250,000 Taiwanese living in Shanghai alone. If I am not incorrect, that’s about the same amount the
U.S. has invested in Mexico since NAFTA.\textsuperscript{31}

The interview raises several powerful questions that we will eventually address but for this section of the paper it serves to illustrate the flow of production to locations that provide the leanest cost given unequal factor prices. For Taiwan, China’s absolute cost and not comparative advantage is driving trade. In this event, the concern for Taiwan is that over the long run, as in the natural world when two items in different energy states are placed against each other, an equilibrium balance will be reached. For the purpose of the ongoing discussion in comparative advantage, this would be called “factor price equalization,” which for many is a scary thought. What it translates into is that for Chinese and Indians, since they have more distance to cover in terms of catching up to our living standards they appear to be disproportionately enjoying greater change from higher wages and returns on investment. This is a good thing, for them. For those in the developed world the opposite seems to hold true. Since we have less distance to go in achieving an ever finer degree of quality in our lives, the cries from the displaced seem to overwhelm any incremental gain.

Eventually returns from each factor of production would equalize. Compensation for varying labor skill sets between those in “rich” places and those in “poor” places would stabilize – overall wages would go up for the latter group and down for the prior group – while workers with “specialized” skills in both places would see their wages increase since these workers are always in shorter supply. Thus, countries would be rich or poor because of their aggregate supply of skills, technology and capital and not because of prices paid to individuals.

\textsuperscript{31} Taiwan Interview Participant 1, interview by author, Cambridge, MA, April 2, 2004.
Factor price equalization is usually overlooked in the debate about outsourcing. As a matter of fact, I think out of all the research for this paper I can only count Professor Thurow, Professor Henry Weil (a system dynamics guru) and one newspaper ever mentioning factor price equalization. Nonetheless, considering the contribution of technology in enabling the movement of factors ignoring it seems to be a mistake because the compensation that was mentioned earlier could escalate very rapidly from agreeable levels to levels that would ignite heavy and heated debate.\(^\text{32}\)

Thus in our world the better question to ask, taking note of what we have covered so far, is how much will move as opposed to what will move. To know the former we must understand what the “transition costs” and “coordination costs” might be. Some of these costs are easily understood per prior experience and market rates for the mundane – utilities, insurance, rent, etc… The hardest costs to value however are those associated with matters like “soft skills” – the value of face to face meetings and the informal exchange of nuances that can take place when people are physically proximate. There is a lot to be said for being located where your customer is at. I don’t imagine Bollywood challenging Hollywood anytime soon and neither do I see Hollywood vacating for Bollywood anytime soon. There are simply some factors that are location specific, such as the American moviegoer and the credibility she can attach to a blockbuster movie because such moviegoers are what constitute American culture. And then there is the weather, that crisp Mediterranean breeze and just right sunshine that the “stars” are simply loath to separate from. They would probably all wilt under the humidity and scorching heat of Bombay. But maybe soon this won’t be a problem if as in the movie Simone a tired movie

\(^{32}\)Ibid, refer to FN 24. This article proved to be a good gauge of current concerns. It is an interview with Ron Hira, chair of the career and workforce policy committee for IEEE-USA.
executive could actually seduce the world with a computer simulation of unbelievable sex appeal and faultless talent.\textsuperscript{33} Maybe then, the producer would finally get the last laugh; who needs temperamental actors or actresses who demand outrageous treatment and travel in entourages if you can not tell the difference between a simulation and the genuine prima-dona?

Finally there is another observation that Lester Thurow makes and that I find interesting. For me, it ties into what my mother has to say about my years as an investment banker in Hong Kong. Like Professor Thurow, she is of the generation that Tom Brokaw aptly calls the \textit{Greatest Generation}. I would tend to think that this generation worked harder than any other; yet my mother would remind me that it seems as if young people today are working longer hours for what only seems to be more pay. As a matter of fact she once informed me that given the hours my colleagues and I were working she doubted whether the pressure and take home pay matched that of her dental hygienist's – her dental hygienist is in Taiwan. Well, what she has observed but not formalized is that, as Professor Thurow comments, gains from modern productivity can be distributed in two ways: (1) prices can fall to the benefit of consumers or (2) prices can remain constant and the increased returns to more efficiently employed factors of production can flow to those who supply it. "Empirically after WWII most of the increases in productivity showed up as higher factor returns rather than lower prices. But starting in the mid-1990s the proportions seemed to have reversed themselves... Much of this shift can be traced to globalization and the downward price pressures from cheaper imports."\textsuperscript{34} In this event benefits flow unevenly in favor of consumers who may not


necessarily be workers, whereas workers are all consumers. Certainly, those who are wealthy enough to stay unemployed for long periods of time (such as Hollywood’s “stars”) along with the elderly and youths would fit the former billing. They get to enjoy the lower prices without having to add back to the economy. So the *real* income share of workers goes down but that of whomever graces the cover of *Variety* magazine goes up. Would you opt for lower prices or higher wages because in our theoretical world, if trade is the root of lower prices then maybe those who remain gainfully employed would have been better off had there not been a shift in the avenue by which productivity gains are distributed.

We wince at such options because the theoretical implications that we have been discussing are consequences for theoretical worlds built to simulate what we find important in our real world. When theory and reality crosses the ripples can sometimes be painful, as it was for Truman in the *Truman Show*, when he realizes that he has spent his entire life living in the set to put all other sets to shame and that what he knows of his world and himself has been manufactured for a TV program.\(^\text{35}\)

What can we conclude from the above discussion? For one, the American worker is not alone in his concern about outsourcing. If it is any consolation the inhabitants of Taiwan seem to face a stronger challenge. Recall the Taiwanese business executive’s worries? The impressive gains that Taiwan has achieved since the aftermath of the Second World War were made possible by trade and strong management talent.\(^\text{36}\) Yet the Taiwanese, in what sounds oddly familiar, must also worry about moveable factors of production and shifting advantages to cheaper destinations, namely China.


\(^\text{36}\) Ibid, refer to FN 30.
Second, accepting the age old definition of comparative advantage as the raison d’etre for outsourcing may lead you to overlook some of the potential big-picture fallout that will affect you at home and dampen the advantages to outsourcing. The caveats to the Ricardian view of comparative advantage warn us of the many important issues: transition periods, compensation, the effects of technology, misapplication of a product cycle perspective, failure to consider the interplay of knowledge, factor price equalization and even pricing. Nothing is free, especially for the socially responsible manager. Worse, turning to outsourcing for fixes may mean that your company will always be on the move looking for cheaper labor factor. With technological progress confidently moving forward, the horizon for any advantage could be short lived, as the Taiwan executive explained. Only the most shortsighted of managers would not think of how this might disturb his corporation’s legacy.

Third, if we are going to digest the above we need our discussion to be grounded in an example. We will use Taiwan for this purpose. It is a place that one prominent Washingtonian and interview participant referred to as “another American state.”37 And although Taiwan is a country and not a company, its size and corporate nature, make it an excellent study subject for strategy level thinking because it is a great example of the force behind technology and what a country can do to leverage technology as a factor.

The path for our analysis will be framed within a slightly modified version of the “Diamond of National Advantage” tool as first used by Michael Porter and which itself is built on the work of Ricardo’s theory of comparative advantage, as discussed above.38 By the end of this exercise, it is hoped that we will have taken the reader one step closer to

37 Former White House Counsel, interview by author, Washington DC, March 5, 2004.
exposing the mercurial nature of comparative advantage to arrive at a richer understanding of the strategic thought that must go into an outsourcing decision. The next section will therefore take the treatment of comparative advantage that we have covered and apply the discussion concepts, using a modified Porter’s Diamond. The modification was made largely to account for the unique combination of Taiwan’s low population but high industrial achievement.
1.3.1 Porter’s Diamond & Taiwan, Case Example

Taiwan is a textbook example of what a nation can achieve when it must create its own competitive advantage. Slightly smaller than Maryland and Delaware combined, what natural resources Taiwan has goes by the way of small deposits of coal, natural gas, limestone, marble and asbestos.39 Roughly 24% of the island is arable land, most of it along a sliver that abuts the Taiwan Strait which courses by the western half of the island; the rest of the island’s geography is dominated by large rugged mountains, including peaks no less grand than Japan’s Mount Fuji. These run along the spine of Taiwan.40 Last year Taiwan ranked third among nations in foreign reserves with more than US$200 billion, despite a population that is less than that of Texas.41 Much of the reserves can be credited to the export of information technology goods of which the communications, PC systems, and electronics industries recorded sales in excess of US$142.2bn during 2003.42

Underlying this success is a variety of attributes that help explain Taiwan’s rise. By examining Taiwan through a modified framework adopted from Porter’s Diamond we will answer how a small island has been able to leverage a man-made comparative advantage (technology) into a competitive foil. This will set the stage for our study in later sections of the global production network (for the electronics industry) and what a firm might do to keep itself from being disconnected. Again Taiwan will resurface due to its central role in creating this global production network.

40 Ibid.
Our modified version of Porter's diamond removes one of the four attributes in his model – the demand condition. As the model originally stands the key attributes that a nation must fulfill in securing a competitive footing among other nations are: (1) factor conditions, (2) demand conditions, (3) related & supporting industries, and (4) firm, strategy, structure and rivalry. Each will be covered in turn as we move throughout this section, including the explanation of why "demand conditions" does not fit our study.

As mentioned earlier, "Factor Conditions" – labor, land, natural resources and capital infrastructure – will determine the flow of trade. But when you possess none of these, then technology becomes the pearl of great price and primary objective in factor development. Luckily for the people on Taiwan the military government that fled there from China, the Kuomintang, inherited from the colonial Japanese a solid infrastructure for education. Indeed, much to the credit of the Japanese, transportation, communication and education infrastructure was brought up to reflect in part Japan’s national standards. This enabled Taiwan to rank as one of the world’s top producers of agricultural products by the end of the 1930’s – something that could not have been achieved without proper development.43 The conditions for excellence in education continued such that by 2001 Taiwan’s literacy rate was in excess of 95% and its tertiary educational institutions were awarding, yearly, to students of the sciences and engineering: 528 doctorates, 7,692 master’s degrees and 35,446 bachelor’s degrees.44

43 Frank S.T. Hsiao, and Mei-Chu Hsiao, “Taiwan in the Global Economy – Past Present and Future,” University of Colorado Boulder, Department of Economics, Working Paper Online, [no record locators given], <http://www.colorado.edu/Economics/mcguire/workingpapers/>, accessed April 18, 2004. According the Professor Hsiao’s research, by the end of the 1930’s Taiwan ranked 3rd in production of bananas and canned pineapples, 4th in sugar and sweet potatoes, 6th in tea, 10th in rice and peanuts, and 13th in salt. Unfortunately, much of this product was to be used in fueling Japan’s expansionist ambitions throughout Asia.
The education system sustains this prodigious output through heavy national spending on overall education from kindergarten through the university level. In 2001, the last year for which comprehensive data is available from Taiwan, spending on education per high school student was actually greater than that of the United States – 23% as compared to 20%, respectively. If as Porter suggests, that sustained and heavy investment is required to support competitive advantage then I would gather that Taiwan adequately fits this bill in terms of preserving its technological competence through education. Already Taiwan builds an estimated 80% of the world’s notebook computers for major international brand names like IBM and Toshiba and Taiwanese firms control the production of more than three-quarters of the world’s motherboard manufacturing.

Further, the world’s top two contract chip foundries, Taiwan Semiconductor Manufacturing Company (“TSMC”) and United Microelectronics Company (“UMC”),

<table>
<thead>
<tr>
<th>School Year 2001</th>
<th>Enrollment</th>
<th>Spending (NT$ '000)</th>
<th>Spending Per Pupil</th>
</tr>
</thead>
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<td>Elementary</td>
<td>1,925,491</td>
<td>179,802,868</td>
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<td>Junior High</td>
<td>935,738</td>
<td>87,363,870</td>
<td>2,667.53</td>
</tr>
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<td>High School</td>
<td>370,980</td>
<td>54,506,081</td>
<td>4,197.85</td>
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<tr>
<td>University</td>
<td>780,384</td>
<td>184,856,770</td>
<td>6,767.98</td>
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<th>GDP/Capita - Purchasing Power Parity</th>
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<tbody>
<tr>
<td>Taiwan</td>
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<tr>
<td>USA</td>
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<table>
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<tr>
<th>Spending per Pupil as % of GDP/Capita - Purchasing Power Parity</th>
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<tbody>
<tr>
<td>Taiwan</td>
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<tr>
<td>USA</td>
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45 Ibid, refer to FN 39. GDP measurements were taken from the CIA Factbook covering the USA and Taiwan.
which created the concept of global outsourcing for semiconductor chip fabrication are based in Taiwan.

*Figure 1-5. Determinants of National Competitive Advantage, Michael Porter*

As Porter defined, "Competitive advantage results from the presence of world-class institutions."⁴⁸ And though we leaped in faith by suggesting that education provides the sustenance for and impetus behind technology as a factor condition, there are certainly few direct variables that would flow into the technology factor and explain Taiwan’s pre-eminence in developing this portion of Porter’s Diamond. I am borrowing a few thoughts from Ms. Jane Linder, Senior Research Fellow at the Accenture Institute for Strategic Change, when I say this. I wholly concur in the opinion that a solid public education program is the only way to maintain competitive advantage over the long run. After all, as in the case of Taiwan, it did have to build and sustain its comparative advantage in the production of information technology products, cheap labor does not solve everything. It just gets you started; the surest road to a modern future and one that Taiwan paved is to endow your citizens with the right skills.

⁴⁸ Ibid, refer to FN 38, p. 78.
“Demand Conditions,” which sit opposite factor conditions, literally means “home” demand. And supposedly, the more sophisticated and demanding the buyer’s are in a nation, the greater the impact of home demand in prompting companies to deliver the innovative solutions that make a particular product or service the standard of measure for all others. This of course leads me to the one problem I have with Porter’s Diamond − Taiwan only has 22 million inhabitants. To paraphrase one senior member in Taiwan’s government, “Taiwan must export. Our internal market is simply too small… [I]t would be better to have a larger internal market to develop a national car… Dollar for dollar a PDA is of more value per gram than an auto. [W]e have no useful proximity to any large market that is important for large and expensive goods… China’s market is large but it is not an open market and it was not available when Taiwan was industrializing… [S]o we make things that have great value for their weight.”49

The short of it is, whether the exports are agricultural products – as would have been the case in the 1930’s – or the IT doo-dads that we are accustomed to, Taiwan simply does not have the critical mass in population to develop the appropriate character in home-demand. Yes, Porter does remind us that population size is not as important as the nature of home-demand. But as the government official opined, the population is small and must depend on exports, and for some markets like autos there won’t even be a chance to innovate based on demand characteristics because the industry cannot even gain traction. However, excluding “demand conditions” does not cripple the model. Rather, the logic of it is quite acceptable. If you are a recipient of outsourcing projects, businesses are looking to your firm to fulfill a need because you can do it by consuming fewer resources. These

49 Former Taiwan government official, dinner with author and Mr. James Ziglar, Sr., Taipei, Taiwan, January 2002.
last words are key – fewer resources – because when companies outsource, they often do so for capacity issues. As a senior manager of global sourcing for Germany’s largest tire maker commented, “We look to supplement our capacity. We have better knowledge…[w]e look to outside capacity to manage changes in demand.”

But something else must have been a catalyst for Taiwan and it is not just demand coming from the rest of the world. Response to tough challenges as posed by sharp consumers must be exogenous for Taiwan but the competition that such exogenous demands incite can be quite an internal matter.

“Related & Supporting” industries picks up cleanly where demand conditions leaves off. Related and supporting industries is that part of the framework that argues a determinant of national advantage is the presence of related and supporting industries that are internationally competitive. There are not only downstream and upstream effects but also innovation and upgrading are simplified by proximity – short lines of communication, quick and constant flow of information and an ongoing exchange of ideas and innovations.

The best example for such microcosm effects is the Hsinchu Science Park in Hsinchu Taiwan. Situated within 580 hectares are an industrial zone, a residential zone and a recreational area. There are also two universities that concentrate on the technical sciences and engineering, the National Tsing Hua University and National Chiao Tung University, with a combined total of more than 15,000 students and 1,300 professors. Some of the schools therein concentrate on such fields as computer science, electrical engineering, nuclear science, life science and management science. Also, within a stones throw is the Industrial Technology Research Institute (“ITRI”) that includes 12 research facilities for aerospace, chemicals, computing, communications, energy and renewable

resources, machinery, medical devices, and nanotechnology … and three national laboratories. Collectively, the centers for higher science employ more than 6,000 researchers and in concert with the two universities have been responsible for more than 50 of Taiwan’s most respected start-ups, including TSMC and UMC.\footnote{Hsinchu Science Park Taiwan, “Science Based Industrial Park,” Hsinchu Science Park Taiwan website, <http://www.sipa.gov.tw/seconde/indus-e/indus-e.htm#Anchor01>, accessed March 10, 2004.}

Within this park resides what may be one of the largest concentrations of technical minds: 1,223 Ph.D.s, 19,338 Masters and 23,162 Bachelors of Science graduates.\footnote{Hsinchu Science Park Taiwan, “Statistics Yearly,” Hsinchu Science Park Taiwan website, <http://www.sipa.gov.tw/en/report-3.html>, accessed March 10, 2004. NTS to USS conversion based on NTS35.0/US$1.0.} These individuals are in addition to those in the academic or research institutes and, as of 2003, work in 406 different technology related businesses.\footnote{Ibid.} Total revenues for these companies in 2003 was US$24.5bn and though the patents may seem low given the concentration of technologists, calling the science park a science park is perhaps a misnomer since the revenue figure clearly indicates that this park has a definite business orientation.\footnote{Ibid.}

<table>
<thead>
<tr>
<th>2003, Year End</th>
<th>No. of Companies</th>
<th>Employees</th>
<th>Sales</th>
<th>Invested Capital</th>
<th>No. of Patents Approved, 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integrated Circuits</strong></td>
<td>151</td>
<td>61,281</td>
<td>16,093,571,429</td>
<td>21,495,314,286</td>
<td>577</td>
</tr>
<tr>
<td><strong>Computers &amp; Peripherals</strong></td>
<td>58</td>
<td>12,286</td>
<td>3,850,600,000</td>
<td>1,818,085,714</td>
<td>23</td>
</tr>
<tr>
<td><strong>Telecom</strong></td>
<td>57</td>
<td>6,912</td>
<td>1,613,114,286</td>
<td>932,885,714</td>
<td>166</td>
</tr>
<tr>
<td><strong>Opto Electronics</strong></td>
<td>69</td>
<td>19,348</td>
<td>2,695,285,714</td>
<td>3,824,457,143</td>
<td>29</td>
</tr>
<tr>
<td><strong>Precision Machinery &amp; Materials</strong></td>
<td>31</td>
<td>948</td>
<td>165,400,000</td>
<td>153,971,429</td>
<td>2</td>
</tr>
<tr>
<td><strong>Biotechnology</strong></td>
<td>40</td>
<td>823</td>
<td>52,600,000</td>
<td>131,028,571</td>
<td>2,688</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>406</td>
<td>101,598</td>
<td>24,470,571,429</td>
<td>28,355,742,857</td>
<td>3,485</td>
</tr>
</tbody>
</table>

To expound on the last comment, Singapore government academics studying the Hsinchu Science Park write:

“Although it lags behind in the capabilities to develop cutting edge technology, Hsinchu is generally regarded as a key player in the...
manufacturing of new semi-conductor and other electronic technologies. Firms located in Hsinchu are among the top manufacturers of personal computer related systems and components. It has developed strong links with Silicon Valley, effectively becoming part of the latter's global network. These linkages extend to cross-border investment flows, key manufacturing partnerships between Taiwanese and U.S. firms, and the transfer of entrepreneurial talent and management practices from Silicon Valley into Taiwan. In 1988, 109 of the 272 companies in the Hsinchu district were founded by Taiwanese entrepreneurs who have had ... experience in the United States."\(^5^6\)

This passage was from a Singapore government study that was part of an effort to emulate the agglomeration effects of Hsinchu to create a copy in Singapore. It clearly indicates the extent to which the effect of related and supporting industries has been successfully woven into the economic fabric of Taiwan and it raises the interesting observation that these related and supporting industries are associated with a wider global production network.

Finally, "Firm Strategy, Structure & Rivalry" has to do with how national circumstances and context create tendencies in how companies are formed, organized and managed. As one of my Japanese colleagues from Toshiba observed of Taiwan companies, "They resemble Japanese companies in feel but they move much faster, like American

companies. How does one explain a statement like this? For all its pliability it somehow captures the essence of “Firm Strategy, Structure & Rivalry” as having to do with culture and national character, which are soft issues. What can be said of “Firm Strategy, Structure & Rivalry” for Taiwan is deserving of a treatise in itself. However, I would venture to say that it has a great deal to do with the island’s history in terms of the Japanese Colonial Era, its dependence on America for trade and defense, the swath of European settlers (Dutch, French, Portuguese, Spanish), the historic attitude of Peking towards territories that do not share geographic contiguity with China, Confucian values and a sort of live and let live attitude of the island’s people that seem characteristic of those inhabiting the tropics.

Porter’s Diamond, as modified, still demonstrates the systemic nature of the concept itself. The pieces link together in a self-reinforcing manner. The creation of a technology factor through a strong education system made possible the agglomeration effect of the Hsinchu Science Park. The Science Park then generated the capital required to sustain the necessary headcount that would maintain its role in delivering the word its semiconductors and finished IT goods. This concentration of related and supporting industry surfaced within a homogenous definition of structure, strategy and rivalry. The normative rules for which are based upon a series of historic and geographic conditions that have made the people of the island amenable to global trade.

However the support, regeneration and competition theme as presented by Porter’s Diamond is only a framework to explain the state of a system. Maintaining comparative advantage and competitive advantage require the adoption of new “DNA” in terms of

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57 I owe a debt of gratitude to my classmate Mitsuhiro Kameda (Toshiba Corp.). He was gracious and hospitable enough to host me during a critical period in the writing of this thesis.
progress, because as the words comparative and competitive suggest, there is an ephemeral temperament to any advantage.\textsuperscript{58} This is the worry that the Taiwan executive expressed when he exposed the scale of businesses migrating to China from Taiwan. What implication does this hold for the rest of us? Bear in mind that Taiwan, in the roughly 15 years since its electronics industry appeared on the radar screens of most executives and politicians, leveraged its comparative advantage into competitive advantage, only to meet the same double-edged challenge that we are wrestling with. We will address the implications beginning with the next section by commencing our dialogue on the big picture dynamics behind outsourcing.

\textsuperscript{58} Interview Participant 6, interview by author, Cambridge, MA, April 16, 2004.
1.4 It Isn't Anything New

This chapter ends with the observation that what is happening with outsourcing is nothing new. The same sorts of jobs that American workers gave up in the 70's and 80's to the South East Asian Tigers are now being lost by these Tigers to a giant that no longer has clay feet. This is the irony to the whole issue of outsourcing and globalization. Whereas a few short years ago, Quanta Computers, the world’s largest for hire manufacturer of notebook PCs with a commanding 27% market share was producing all its hardware in Taiwan, today Quanta has shifted 60% of its production to China.\textsuperscript{59}

As Cowan appropriately remarked during his discussion with the Management of Technology students at the Sloan School of Business, “none of this is new.”\textsuperscript{60} So to answer my point made at the outset of the paper, I agree that Mankiw was wrong. Specifically, Cowan reminds us that in the late 19th century England’s textile industry was wiped out by New England’s textile operations, many of which were located a short drive away from MIT in Lowell, Massachusetts. Similar opinions follow from equally prominent members of the community. Ms. Linder, also reminded me in the course of my interview for this paper; “[W]hen the function and skills are no longer worth it then ultimately there will be an outflow… It happened before … in the 80s with manufacturing and it’s happened even within our own country when manufacturing shifted to the South…”\textsuperscript{61} Similarly, John Scully (former CEO of Apple Computers) had a comparable observation. As recounted by a ranking member of a prior White House administration, this interview participant and leading citizen recalled that during the course of a dinner

\textsuperscript{59} Interview Participant 6, interview by author, Cambridge, MA, April 16, 2004.
\textsuperscript{60} Ibid, refer to FN 19.
with Mr. Scully, the CEO reminded his guest that before the Second World War, China was a part of the global community and provided 30% of the world’s manufacturing.  

Whether Mr. Scully is accurate is not the point (it was noted by my interviewee that the figure seemed a bit high). What is important is that what we can all sense and understand as easily as we can understand birth and death is that industries are subject to the same natural laws.

What these notions have in common is the conviction that the industrial era is giving way to something else and no matter what we label it, “the knowledge economy,” the “information society” the “service economy” or the “life science age” the argument is that the declines we see today in certain sectors reflect an inevitable historical process. Because each story of business and competition emerges from a particular moment and specific place in business history, as part of a flow in the chain of developments, our next chapter initiates our discussion of this flow and where we are potentially headed. This is our Trajectory Theme. We shall start with game theory and globalization and its interplay with system dynamics and Clockspeed before introducing the Evolution Matrix.

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CHAPTER TWO
SYSTEMIC GLOBALIZATION – THE PATH TO AN OUTSOURCED WORLD

2.1 Game Theory & Globalization

The philosopher and theologian Pierre Teilhard de Chardin once said that he saw human history advancing toward what he called Point Omega. What “Point Omega” is and where it is are not as significant as the meaning the statement tries to inspire. I think we can all sense what he means though we may all come to slightly different handles on it. So I wrote the author and academic Robert Wright asking him for advice on courses that might integrate and broaden my perspective on culture, history, sociology and technology; he warned me that many academics do not accept big picture dynamics. That was somewhat of a surprise because it seems relatively obvious that innovation, technology or progress, however you wish to call it, waits for no one, and that it has a profound relation to culture and society. Only three decades ago, when I left my native island for my new home (in this country) trans-oceanic air travel was still a big deal; even crossing the Atlantic on the Cunard Line’s Queen Elizabeth II in 1978 was considered a special trip. Today, the cast behind the Magic Kingdom staff vessels operated by the Walt Disney Company to feed vacationers to its numerous parks and resorts.

So I, like Robert Wright, do not disagree with the suggestion that we can capture history’s “basic trajectory by reference to a core pattern.” Wright argues that new technologies arise that encourages richer forms of social interaction. Social structures take advantage of this potential for greater exchange to generate positive sums out of potentially non-zero-sum situations; however it would be naïve to say that the outcomes between exchanges are always positive. Yet, on balance, over the long run, these exchanges seem
to generate more positive sums. After all, we have yet to destroy ourselves with our technology or should I be asking whether it has yet to destroy us? Whatever the case, people continue to actively engage each other in creating ever richer networks, which over time seems to weave our interests ever closer together. I experienced this effect first-hand when in 1997, as an associate in the Hong Kong office of an investment bank. The sudden collapse of the Thai baht triggered a financial crisis that (overnight) would alarm the world into response, as once thriving economies such as Korea’s were sent into a deep funk while the Indonesian and Malaysian economies were brought to a commanding halt. Even the bright lights of Hong Kong seemed to glow with a bit less pride.

What principle drove technological and social evolution to the point of such complex economic structure? Certainly the misery that ensued invited a lot of analysis and speculation however what follows is not another analysis of the flame that detonated the crisis. What I would like to discuss is neatly laid out in the argument presented by Robert Wright, and developed in his book Nonzero, that zero-sum and non-zero-sum dynamics can illuminate the direction of human history, or as applied to our case the trajectory to globalization and ever complicated networks, including production networks. This chapter introduces the concept of non-zero sum dynamics. It is the engine for the bigger picture that we are developing and an integral part of our overall “Trajectory Theme.”

_A Simple Example – Network Scaling_

Allow me a simple example to illustrate the potential size of a network as measured by the number of different combinations which for this purpose we assume to be telephone connections that can be made between one person and another, each link is counted once. With four people in your family, each in different cities, you create six different paths by
which information can flow from one person to another. The simplest illustration would be four dots with lines drawn to form a square and "x" in the center. With 100,000 in your town there are nearly five billion different paths. With the nearly one billion existing lines in the world nosey neighbor "a" has nearly five quadrillion paths from which gossip can be relayed to nosey friend "b". What if you wanted to halt just one rumor from flowing among these five quadrillion different paths? Your best bet would be to catch it with the originator because once that idea flows to a second person and then a third and so on the number of potential paths begins its upward avalanche from one billion to two billion to three billion varied routes, and it will continue onwards toward what for you is an effective trajectory of infinity.

<table>
<thead>
<tr>
<th>No. of Persons with a Phone Line</th>
<th>Number of Different Combinations (to route calls)</th>
<th>&quot;r&quot; Persons with Information</th>
<th>Potential Paths for Information to Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>45</td>
<td>1</td>
<td>999,999,999</td>
</tr>
<tr>
<td>100</td>
<td>4,950</td>
<td>2</td>
<td>1,999,999,997</td>
</tr>
<tr>
<td>1,000</td>
<td>499,500</td>
<td>3</td>
<td>2,999,999,994</td>
</tr>
<tr>
<td>10,000</td>
<td>49,995,000</td>
<td>4</td>
<td>3,999,999,990</td>
</tr>
<tr>
<td>100,000</td>
<td>4,999,950,000</td>
<td>5</td>
<td>4,999,999,985</td>
</tr>
<tr>
<td>1,000,000</td>
<td>499,999,950,000</td>
<td>6</td>
<td>5,999,999,979</td>
</tr>
<tr>
<td>10,000,000</td>
<td>4,999,999,950,000</td>
<td>7</td>
<td>6,999,999,972</td>
</tr>
<tr>
<td>100,000,000</td>
<td>4,999,999,950,000</td>
<td>8</td>
<td>7,999,999,964</td>
</tr>
<tr>
<td>1,000,000,000</td>
<td>499,999,999,950,000</td>
<td>9</td>
<td>8,999,999,955</td>
</tr>
</tbody>
</table>

Table 2-2. 63

<table>
<thead>
<tr>
<th>World Telecommunications - 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figures are per 1,000</td>
</tr>
<tr>
<td>Daily Newspapers</td>
</tr>
<tr>
<td>International Telecom, Outgoing Traffic (minutes per subscriber)</td>
</tr>
<tr>
<td>Mobile Phones</td>
</tr>
<tr>
<td>Radios</td>
</tr>
<tr>
<td>Telephone Average Cost of Local Call (US$ per 3 minutes)</td>
</tr>
<tr>
<td>Telephone Main Lines</td>
</tr>
<tr>
<td>Telephone Main Line Installation Wait Time in Years</td>
</tr>
<tr>
<td>Television Sets</td>
</tr>
<tr>
<td>Population in Billions</td>
</tr>
</tbody>
</table>

No doubt these paths add to the potential for complexity in human interaction and the variety for that interaction but what they really allow for is the full exploitation of “non-zero” sum games. To clarify, a game is zero-sum when you have a loser and a winner but a game is non-zero sum when one player’s gain does not necessarily mean a loss for the other. The goal of course is for ever more positive sums but sometimes people will enter into non-zero sum games just to avoid a loss. The young Shiite militia members slipping into the town of Falluja to fight alongside their historic enemies, the Sunnis, would be an example of two groups playing the game just to avoid the perceived loss of sovereignty for everyone, including Shiites.\textsuperscript{64} Perhaps this is a gory example but it is an example of a prime mover that drives us to play these games – survival. On another extreme another prime mover for increased interconnectedness would be the focus people have for “gain,” call it wealth, social status, whatever you like. Our capitalist economy is played by people who see an enlightened self-interest in participating in exchanges. One hand washes the other, and both are better off than if alone. We evolved not as solitary creatures but amidst groups, and people in groups, as we have experienced, have a desire for honor, power or property that drives us to seek status among our fellows, whom we cannot bear yet cannot bear to leave.\textsuperscript{65} The playing of and accumulation of ever more, ever larger and ever more elaborate non-zero sum games adds to the growth of the connected world, which as we can probably all sense is moving along a trajectory of increasing interconnectedness. Just last month I purchased a voice over IP telephony service called Vonage; it cut my phone bill by a factor of three with no apparent degradation in voice


\textsuperscript{65} Robert Wright, Non Zero, The Logic of Human Destiny (New York: Vintage Books, 2000), p.27. This is actually a paraphrase of Immanuel Kant.
quality. Has my wife or I spent more time then on the phone? Yes, I would say we have spent more time calling our friends and family in Europe and Asia and maybe less time speaking with those in the States.

So, as we discussed earlier, if a consequence of the networked world means that production (as expressed in outsourcing) no longer needs to be bound to one place because technology is a “moveable” factor, we should then at least have a more systematic appreciation for the “game theory” perspective, if that is what is pushing us onward.

_Those Crafty Nootkas_

Again, people have been at this game for millennia. To borrow an example from Robert Wright, take the Northwest Coast Indians who were apparently blessed with bounty. Their rivers and coast were filled with cod, halibut, herring, salmon, shellfish, sea otters, seals, whales, giant calamari and so on. Anyone who has seen the diversity in biologic mosaics in the natural areas surrounding the cities of Portland (Oregon) or Seattle (Washington) can easily imagine the natural abundance that the Northwest Coast Indians must have enjoyed. Well, diverse game calls for diverse technology. Salmon just don’t come looking to leap onto your fork.

Anyway, the Nootka Indians of the Northwest had almost as many fishhooks as types of fish, from heat treated spruce hooks for halibut to a bone hook for cod. They also crafted vessels that ranged in size from one man canoes to whalers that manned nigh a dozen to sixty foot transport vessels that I can only imagine how to maneuver. They were also ingenious enough to rope inflated seal skin to harpoons as used on whales to tire the beasts and they even built homes and curing houses with footprints as large as 4,000 square feet in size. There were even watertight cedar boxes for keeping berries and traps
of all sorts for wildlife – bear, deer or elk – and, as well, salmon traps for a few to catch to however much a group of Nootka could catch in something the size of a house.\textsuperscript{66}

So what did these inventive Nootka do with their bounty? They traded it, of course, to Indians of other tribes for luxury goods that were an exercise in economic independence. Yarn spun from mountain goat wool and colored with copper based dyes and twine made from imported bark made their way to Nootka territories in the form of finished products in exchange for foodstuffs.\textsuperscript{67} Apparently the key ingredients for many of the goods, including the copper and goat wool originated from territories that were even farther away than any Nootka would venture in his lifetime.\textsuperscript{68}

What these Native Americans were doing was to play the non-zero sum game. And this game, mind you, even without a currency or equity market, required plenty of capital investment to even initiate. After all, even if they were not paid with pecuniary reward the builders of the transport canoes had to be fed and this means resources had to be saved in order to be dedicated to such an activity.

I am not saying that gains from non-zero sum interaction elevate social complexity. What I agree with is that each successful playing of a non-zero sum game adds up to a growth in social complexity. People have always been coordinating and dividing labor as the Northwest Coast Indians did to deliver the necessities and innovations that each generation has come to expect and grow accustomed to. The invention of technologies like

\textsuperscript{66} Carleton S. Coon, \textit{The Hunting Peoples}, (Boston: Little Brown, 1971), p.35-37, 66-67, 126-129, 134-135, 143-146, 271. Professor Coon is one of those truly interesting persons, for a taste read, “Why There Has to be a Sasquatch” by none other than Professor Coon.

\textsuperscript{67} Apparently the true blue coloring that was so rare was made possible by the use of urine as a catalyst. How the inventive Indians would have known to use urine is a mystery that seems for me at least to be worthy of a paper on how ancient cultures learned what they learned and what we can learn from trying to understand their process for coming to grips with their needs, whether it be basic life sustaining needs or needs grounded in the vanity of man. How, for example, did the Chinese map all the nerve endings needed for acupuncture? Perhaps this is where the phrase “death from a thousand pin pricks” has its origins.

\textsuperscript{68} Ibid, refer to FN 65.
the fish traps encouraged non-zero sum interaction that we can now better bill as the conversion of non-zero sums to positive sums. Technology like the fish trap creates new opportunities for positive sums. And as people maneuver to seize these sums, social structure changes as a result – this would include, of course, the current alarm about the potential for permanent dislocation of former white collar workers to the underclass as production/service networks extend ever further afar. I doubt my friend in the German tire company would have been able to spend hours on the phone with me had he not been using IP telephony – his caller ID registered a 213 area code for Southern California and my call to him registered as 44 for the United Kingdom.

**Positive Sums**

But if there are people being displaced how could there be a positive sum? Well, the very coordination the Apollo 13 astronauts exhibited was an exercise in the ultimate non-zero sum game. You either win and live (cooperate fully) or lose and die (do not cooperate or do not contribute fully). This is the game the astronauts were playing when 320,000 kilometers from earth, an oxygen tank explodes, severely damaging their Service Module and leaving the Command Module without power or air. What if only two made it or one or none made it? If none made it the answer is obvious. If only one made it or two made it then on balance it was a game worth playing because at least one (and we assume they would not have known which one) survived.

This sounds unusually cruel but only so because it is the extreme example of a non-zero sum game. Most sensible business people I think would avoid such dire win lose games unless survival options had been reduced to such a minimal choice. My intentions are to demonstrate that non-zero sum game playing is a powerful force and that it goes a
long way in explaining the trajectory we are on and why it is not something that can be easily stopped, even if we wanted to. As a matter of fact if we look to system dynamics we can even develop a reason explaining why the trajectory cannot be stopped.
2.2 The Dynamics to the System

We began this chapter by looking at how game theory can explain why we are progressing toward systemic globalization. Now we examine the dynamics to the system for a look at the internal mechanics of what is going on within the system. To do this we will construct a conceptual model of our progress to this point using system dynamics principles. We will elucidate what these principles are and apply them using a story that takes us back to the creation of one of the world’s most respected companies and then reveal the model that ensues.

To begin, we should have understood by now that accelerating changes in technology, economic activity, and the rate of interaction among people is transforming our world from the prosaic – the effect of information technology on the common phone (the Vonage example) – to the profound – the trespass of “foreign” labor against white-collar American jobs. The challenge we face is in moving from generalizations on the trajectory argument to tools and processes that help us understand complexity, to design better policies. System dynamics is a method – tool – to enhance learning in complex systems. It is grounded in the theory of nonlinear dynamics and feedback control developed in mathematics, physics and engineering. It also draws upon the social sciences (human cognitive and social psychology as well as economics and others) because we apply these tools to the behavior of human as well as technical systems. To simplify, much of the art in system dynamics is in discovering and representing feedback processes because most complex behaviors usually arise from the interactions of the feedback and not from the complexity of the feedback’s components. We look at all dynamics as arising from just two types of feedback (which we can envisage as loops). Thankfully, there are
just two types of loops, the positive self-reinforcing loop and the negative self-correcting loop.

Positive loops tend to reinforce or amplify whatever is happening in the system. For example, arms races, price wars, the dominance of certain product architectures are all the result of self-reinforcing loop dynamics. Intel and Microsoft dominate the computing world because the larger their installed user base the more attractive it is for software developers. The more software developers code for the “Wintel” architecture the more people are apt to select the “Wintel” solution because of the greater variety in software titles. The more nuclear weapons that America produces the more nuclear weapons that Russia or China produces, which in turn might prompt the Americans to make more and so on around the circle.\(^{69}\)

On the other hand, negative loops oppose change. The more profitable a business is the more entrants there are; the more entrants there are the lower the prices, the lower the prices the less attractive the business; the less attractive the business the less entrants there are. Negative loops are self-limiting, they seek balance.

Now that we have that settled, what kind of loop is outsourcing mixed up with? The positive one, of course.

As we have been saying all along, the trajectory is only accelerating. In the prior section we examined how game theory plays a role in driving ever greater complexity in interaction, which, phrased another way, means the spread of knowledge. But the interactions are never always smooth. It is just that over time the ups and downs tend to

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cancel each other out, when things get out of hand very bad things happen that tend to reset the game.

History is littered with examples; unfortunately, the most readily understood examples seem to do with violence. Whether you are a winner or a loser in an epic conflagration, the side that you are on is engaged in a fierce non-zero sum dynamic – cooperation. Because if you do not cooperate the chances are your enemy will walk all over you. But even if violence inserts a zero-sum dynamic into the equation, within the groups things are different. Thus if there is something that we should have picked up by now it is that this theme of non-zero sum games and the exchange that goes with it is inextricably intertwined with our history, and if we have anything to learn from history, it is to be humble.

Whether in fact we digest the lesson is another matter and because it seems that we are slow learners it is probably a significant cause for the continuing attenuation we experience as business cycles. But despite the implied assertion that globalization is not new, it bears repeating that there have been numerous waves of new technologies, each of which has contributed to industrial evolution.

Rajneesh Narula writes that Schumpeter first highlighted the role of technological paradigms in determining the long-term cyclical trends in economic development, as first suggested by Kondratieff. And though many are suspicious of Kondratieff cycles because of the ease by which we can draw seemingly esoteric and almost occult like conclusions it is undeniable that technology has caused discontinuities across virtually every industry and sector of the economy.

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In the modern economy employees are often required to sign employment contracts that contain covenants not to compete. So apart from any proprietary trade secrets these employees may learn they remain free to ply their trade and practice their skills, including the know-how gained from working on a particular technology during their tenure. More than a half century ago we could live comfortably without this modern habit. We had just emerged as the victors in the most violent exercise in human ingenuity to date and the economy was in full throttle. It was in this world that several young Japanese engineers, de-commissioned from the Emperor’s armed service, came together to form the Tokyo Telecommunications Engineering Company and acquired the knowledge for a piece of technology that would alter Japan’s corporate landscape.

The small company began by making an electric rice cooker and vacuum tube voltmeter, which incidentally had more buyers than the rice cooker. As it was, one of the original members of this group was Masaru Ibuka who in 1953 visited the United States and heard about the transistor and impending availability of its patent through licensing. Mr. Ibuka new very little about transistors but was interested enough to decide that it may provide what he needed for his company to expand its consumer products business. Luckily for Mr. Ibuka no other major Japanese corporation paid attention to his interest. After acquiring the license the next year for US$25,000 (about ¥9,000,000 at the time) Mr. Ibuka sent technicians to the U.S. to gather available technical publications on the transistor and to consult with scientists and engineers on various aspects of the transistor’s production.\(^\text{71}\) Essentially the technicians were to assimilate every bit of written, oral and visual information relating to the as still nascent semiconductor technology and then

diffuse that knowledge to the manufacture of their own transistors for a pocket sized radio receiver sold as the TR-55 by SONY, the new name for the Tokyo Telecommunications Engineering Company.\textsuperscript{72} Personally I believe SONY stands for Semiconductor Origin New York since so much of what played out in securing the license as well as first news of it came from Mr. Ibuka’s friends in New York but this is conjecture; the rest of the story is history.

Japan in the 1950s was, to quote George Basalla, “an unlikely place for the commercial development of an invention that was the result of the concentrated efforts of some of the best minds of Western science.”\textsuperscript{73} Japan was remote, geographically and intellectually, from the latest developments in solid-state physics. Yet, Mr. Ibuka and the people at SONY saw an opportunity that others did not even though to realize the prospect they had to understand the transistor first. In sum, knowledge and people both had to flow. Neither of these things would have been possible had it not been for a web of other technologies like air travel (even if it did take Mr. Ibuka more than 48 hours to reach the continental United States) and cable communications and an existing market for radio broadcasts that was based on an inferior prior art, the vacuum tube.

This case is interesting because it shows that development and commercialization of a product derived from advanced technologies can be executed successfully by a society with a scientific base that is less developed, as Japan’s was after being “reset” by the Second World War. For Japan the slate was wiped clean.

Japanese companies like Sony would pick up new technologies to re-connect with the playing of non-zero sum games. The more they played the more experience (capability) they gained – including additional players on an individual level; like more people studying engineering or trade and leaving for work with the manufacturers or shosha's, giant trading companies that exported the produced goods. And the more they gathered capabilities the more valuable the positive sums would become. With greater accumulation of wealth as a measure of positive sums the Japanese could re-initiate the cycle with more know-how or better technologies, for more complicated non-zero sum games. So though the physical primer for the revolution in consumer electronics at SONY was from an exogenous source, the semiconductor revolution and consumer electronics boom that makes possible our wired world was initiated by a component-part that would have a systemic impact and increase the overall rate for playing non-zero sum games.
This ultimately leads us back to the course of the paper so far. That is, technology is a moveable factor that provides the avenue by which ever greater volumes of non-zero sum games are played. When companies try to leverage comparative advantage they are playing their competitive advantages, no matter which side of the fence you sit, because the more non-zero sum games you play with those who can play them the faster the ensuing speed at which capabilities are transferred, which many interpret as outsourcing.

<table>
<thead>
<tr>
<th>Company</th>
<th>Leading Customers</th>
<th>Facility</th>
<th>Manufacturing Square Footage</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flextronics</td>
<td>Dell (desktop PC, enclosure, plastics, system assembly), IBM (laptop enclosures), Kyocera (handsets), Microsoft (Xbox), Motorola (handsets), Palm (PDAs)</td>
<td>Doumen, China</td>
<td>3 million (end 2004)</td>
<td>13,500</td>
</tr>
<tr>
<td>Jabil Circuit</td>
<td>3com (PCBA for routers), Alcatel (cordless DEC phones), Canon, Dell, GE, HP (laser printer boards), Raytek, Whirlpool, Yamaha</td>
<td>Huangpu, China</td>
<td>475,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Hon Hai Precision</td>
<td>HP (PCs), Cisco, Motorola, Dell, Sony, Apple Shenzhen, China</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Industry Sanmina</td>
<td>Verifone, IBM (PCs), Ericsson (base stations), Nokia (base stations and set-top box), Kodak (digital camera boards), NEC (base stations), Hitachi (hard disk drives), Mitec (base stations), Efore (power converters), Draeger (medical products), Schneider (power modules), Lucent (optical switches)</td>
<td>Kunshan, China</td>
<td>368,000</td>
<td>1,700</td>
</tr>
<tr>
<td>Solectron</td>
<td>Alcatel (handsets), Ericsson, IBM (notebook motherboards), Motorola (base stations and handsets), NEC (handsets), Nokia (base stations), Nortel (base stations)</td>
<td>Jiangsu, China</td>
<td>583,000</td>
<td>5,600</td>
</tr>
</tbody>
</table>

The scale at which the world’s major electronics companies are playing the game is evident above. Note that the facilities are all located in China and are being shared by companies from North America, Japan and Europe. As China plays the game, it too will begin to accumulate greater positive sums. If foreign reserves are any measure of success, China’s US$400bn plus makes it the strongest new player.\(^\text{75}\)


What relevant lessons can we draw from understanding this cycle? The lesson for the manager is to understand the dynamics behind the trend so one can spot where new non-zero sum games are starting and more importantly to assess where one might want to steer operations. Outsourcing might be a trend but you won’t want to get bucked by the wave. On this point, Lester Thurow cautioned, “You think about what could be outsourced versus what should be outsourced... For many it’s just an issue of how fast to zero profit in the economic sense. With a place like China you ride the wave. You just can’t outsource [machine tool production] to a place like China because it’s cheaper... You introduce a new machine tool and a few months later they have a knock-off.”

The object of the game is to catch another wave as it picks up, looking around your immediate surroundings won’t help you spot that wave. However, understanding the dynamics that generate them will because that is akin to reading the waves, and to do this you have to look afar.

The next section will introduce the Clockspeed concept. This will serve as our point of entry for the next chapter, which is dedicated to the Evolution Matrix as a tool to link the various pieces of our discussion thus far.

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2.3 Clockspeed

Clockspeed has three components: Organization Clockspeed, Product Clockspeed and Process Clockspeed. Respectively, these refer to: (1) how often a firm reengines itself in response to changes in the overall (internal and external) business environment (2) the impact of market wide changes in product development and the company’s response, and (3) the effect of changes in process development on a company’s reply in product terms. How each component fits into the Evolution Matrix will be covered in the following chapter. For this section, we will pay a bit more heed to Product Clockspeed before proceeding. This is because the argument so far is that the move to outsourcing is inevitable on account of the globalization trajectory and that this trajectory, owing to the examples selected, can be viewed in production terms.

So for our purposes, we will mostly take clockspeed to mean the rate of product improvement or variety in introduction. That is, in the literal sense, the rate at which a company brings a product to market; arguably speaking, we are talking of improvements in a series or a perceived difference along a series. For example, clockspeed for the clothing industry would be fantastic because every three months new designs are being introduced so each season a line within a brand has something different, regardless of whether the functionality of a cardigan has been improved upon. The microprocessor would be an example of an improvement; Moore’s Law observes that the density of transistors within a microprocessor doubles roughly every 18 months. If speed is any measure of utility, the microprocessor improves each 18 months.

Figure 2-2 is an excellent visualization of the trajectory that industry clockspeed can force a company into. You either stay along the path or fall off it, like Cyrix (a defunct
producer of PC microprocessors) or you are marginal like Motorola or IBM in supplying PC microprocessors for a niche company like Apple Computers, Inc.

*Figure 2-2. Moore’s Law & Product Clockspeed*

So clockspeed also has a trajectory aspect that is based on the accumulation of capabilities required to deliver change. And whether such change be simple in nature like variety or a marked improvement in performance the context for change rests against a backdrop that is painted by corporate and industrial evolution. For example, the IT industry is replete with fast clockspeed companies. These would be the equivalent of the business world’s “fruit flies” in the sense that for most any observer, one can readily notice that some industries and their companies undergo astonishingly rapid change (usually those that are technology based). Others, however, seem to lumber along, such as petroleum companies. As these industries change, they undergo fundamental mutations, whether purposeful and thus endogenous or environmental and thus exogenous. These

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transformations appear most visibly as changes in product development and, to a behind the scenes extent, process creation and organizational renewal.

The interesting thing about clockspeed and many other models that try to explain change is that they inherently recognize that evolution is a dynamic process. And because it is dynamic one can assume the expected duration for any competitive advantage to be short lived. The message for business leaders then is that their skills must also include an appreciation for the interdependencies that affect the evolutionary processes in their industry and business. This is the essence of the foregoing material (hence the lengthy discussion of Evolutionary Trajectories) and, I assume, why the subtitle to the book *Clockspeed*, is “winning industry control in the age of temporary advantage.”

To conclude, and we fall back to the trajectory concept, as visualized in Figure 2-2, even if the manager believes that “the future is in the windshield and not the rearview mirror,” the past is still an excellent point of reference. You can get an accurate sense for where your clockspeed trajectory is taking you by looking over your shoulders. An analogy would be like riding a train and getting the seat that faces backwards. While looking out the window you won’t know what is ahead of you. But from the bend of the track that you can see unfurling behind you and the momentum against your body, you can safely assume that you will continue to head in a given trajectory and the sharper that bend is the more likely it is you are in a fast clockspeed industry.

So for our purposes, we will take the clockspeed principle as having more to do with products and the trajectory this puts a company on. This would fit our earlier

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development of the trajectory theme per comparative advantage, Porter’s Diamond, game theory and system dynamics and the discussion to follow on production networks.
CHAPTER THREE
THE EVOLUTION MATRIX

3.1 The Evolution Matrix – Measures & S-curves

In this chapter we will take the Clockspeed concept and merge it with the Evolution Trajectory perspective developed earlier to arrive at a new framework for examining the environment for outsourcing – we call this tool, the Evolution Matrix. The purpose of this chapter is to pull together our story by providing a point of reference using the Matrix as a structure for discussions regarding the strategic value of and ramification to outsourcing. We will begin with a quick explanation of the Matrix, introduce architecture and s-curves as components that help explain, respectively, movement within the Matrix grid and evolution, then delve deeper into Matrix particulars.

Matrix Levers – the Four Measures

The Evolution Matrix is a rubric comprising four levers: Clockspeed, Evolution Trajectory, Capability and Complementors. Each of the first two has a clear temporal aspect while each of the other two has a production facet. Combined, these four measures form a matrix without solid or static internal walls, such that shifting positions within the Matrix is possible if product architecture shifts.

The Clockspeed and Evolution Measures & S-Curves

Within the framework, Clockspeed is, as previously described, measured in terms of product variety and improvement versus shifts in architecture. For example, sporting equipment like tennis or soccer gear will most likely not undergo an architectural shift
between seasons; there are simply not that many ways to shape a racquet nor are there many ways to reinvent the ball. Granted, materials may change but the architecture of a racquet or ski boot remains fairly stable. However, the iterations of color and style can be overwhelming since no design seems to carry into the next season. In this situation we would say that Clockspeed is fast. On the other hand, writing instruments like the ballpoint pen undergo little if any change in design variety and improvement, relative to basketball shoes. In this circumstance we would say that Clockspeed is slow.

The idea of Evolution Trajectory as driven by game dynamics and technological progress is captured in the Evolution axis. It is measured by (1) capital intensity and (2) potential for architecture shift because they are closely linked. Architecture is defined as improvements that change the way in which the components of a product are linked together, while leaving the core design concepts (and thus the basic knowledge underlying the components) untouched.\footnote{Rebecca Henderson and Kim B. Clark. "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms." \textit{Administrative Science Quarterly} (March 1990), p.10.} A shift in architecture supposes a shift to a better technology and hence something better evolved. It also assumes that any leap from one architecture to another that is marked by improved technology stems from money spent on research and development.

There appears to be a fine line between Evolution and Clockspeed because both levers involve change. However, there is a difference between the two and it can be seen in their s-curves. The s-curve is typically used to explain how an emerging technology supplants an established one. The point to watch is where the slope of the curve for the established technology begins to change. If the curve has passed its point of inflection so that its “second derivative is negative, the technology is improving at a decreasing rate;” it
is at this point that companies stand at greatest risk of new technologies supplanting the established one.\textsuperscript{80}

In our case (Figure 3-1) we denote Clockspeed with the series of small s-curves running along the spine of the large s-curve, which we interpret as product architecture. As an example, consider traditional photography and the onslaught of digital cameras on the domain of celluloid media. The progress of film based photography can be characterized by a series of improvements in resolution, color and film speed (as measured by International Standard Organization ratings of 25, 64, 100, 200, 400, 800… for light sensitivity and resolution) as well as advances in camera technology (e.g. single-lens reflex, point-and-shoot, disposable) and film packaging (e.g. Advanced Photo System film cartridges). The sum of these incremental advances in performance and utility would be represented by the small s-curves whereas, in total, traditional photography as a medium and the technologies that go with it would be represented by the large s-curve.

\textit{Figure 3-1. S-Curves for Clockspeed and Architecture Shift}

However, digital photography has upset these trajectories. The move to digital photography represents a *shift* in architecture. The convenience and cost savings of doing away with film and processing in the pursuit of instant gratification spells the eventual demise of film-based photography.

*Figure 3-2. Digital Photography: Rise of New Architecture & Firms*\(^81\)

The rapid rate of technology advance and surge in entrants at the near outset of the digital photography boom in the mid 1990s is illustrated in the series of graphs that comprise Figure 3-2. The industry has advanced to the state where digital camera consumption has crossed over that for traditional cameras. In 2000 more than 45 million digital cameras were shipped in comparison to the roughly 30 million traditional cameras.

delivered. By 2005, industry analysts forecast that more than 55 million digital cameras will be distributed whereas film camera shipments will fall to less than 20 million units.

To clarify, the small s-curves mark changes in architecture whereas the large s-curves represent a shift in architecture, with very significant industry wide consequences. And the argument for capital intensity is that faster evolution means greater engineering effort (e.g. patents), which requires greater capital expenditure for research and development (e.g., start-up companies) and possibly a re-engineering of the entire business platform from company through to industry if a shift in architecture and jump in s-curve is involved.

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Figure 3-3. The Evolution Matrix

Matrix Attributes:
- Outsourcing becomes riskier as you move up the Center Arrow; the potential for discontinuity rises.
- Movement between Quadrants often one-way & involves jumping to another S-curve with architecture change.
- Proprietary Column merits extra caution & is highly linked with capital intensity.
- Capacity is in relative terms to Product Variety and Improvement Cycle.

- **Fast Clockspeed** (Product Variety & Improvement)
  - Low Evolution
    - e.g. Racquets
  - High Evolution
    - e.g. CAT Imaging (Specialized Tools)

- **Proprietary Capability** (Closed)
  - Low Discontinuity
    - e.g. Digital Cameras
  - High Discontinuity
    - e.g. Basketball Shoes

- **Transient Capability** (Open)
  - Low Discontinuity
    - e.g. Racquets
  - High Discontinuity
    - e.g. Basketball Shoes

- **Outsourcing**
  - Low Danger
  - High Danger

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83 Ibid.
The Capability and Capacity Measures

Capability and Capacity are fairly straightforward in concept. Like the Evolution lever, Capability and Capacity also encompass a monetary quality. Capability is defined as the intangible property (know-how) necessary to produce a given product. This knowledge typically provides a competitive edge. It could be patented intellectual property ("IP"), a trade secret or process method; in short, it is the knowledge that provides a barrier against entry. My argument is that, like the Evolution lever, the more complex and valuable your capabilities are the more costly they are or were to develop.

On a similar note, Capacity is the volume in production that the market demands of your product. Earlier we mentioned sporting goods and ballpoint pens. One might argue that the Matrix falls apart under these examples, however, as with all models our Evolution Matrix is not meant to mirror our world. Rather it is a simplification for analytical purposes. So if we try to fit the ballpoint pen or soccer ball or even squash racquet into the Matrix, we may run up against a dichotomy. For example, ballpoint pens and even light bulbs are intense Capacity but low Clockspeed. But they also have commodity characteristics; so cost is everything, making outsourcing a virtual given.

There is also another aspect to the Capacity lever that is fairly unique. Specialized instruments like medical equipment seem captive to this lever. These items require a great deal of study and investment but because they are specialized volume production is fairly low. However, due to the intensity of investigation in the health sciences, Evolution s-curve shifts are often quite dramatic. As an example, one might think of the CAT (Computed Axial Tomography) scan and its improvement over the x-ray.
CAT scanning was invented in 1972 by British engineer Godfrey Hounsfield of EMI Laboratories, England. The first clinical CAT scanners were installed between 1974 and 1976; these systems were dedicated to head imaging only, but "whole body" systems with larger patient openings became available in 1976. CAT scanning became widely available by about 1980. Today there are roughly 6,000 CAT scanners installed in the U.S. and about 30,000 installed worldwide.84

The first CAT scanner developed by Hounsfield in his lab at EMI took several hours to acquire the raw data for a single scan or "slice" and took days to reconstruct a single image from this raw data. The latest multi-slice CAT systems can collect up to 4 slices of data in about 350 ms and reconstruct a 512 x 512-matrix image from millions of data points in less than a second. An entire chest (forty 8 mm slices) can be scanned in five to ten seconds using the most advanced multi-slice CAT system.85

Examined alongside Capability, Capacity suggests that outsourcing something that is Capability intensive and Capacity rich will result in the immediate diffusion and loss of your competitive edge due to the rapid and dynamic non-zero sum game playing and network scaling effect.

Thus whereas Evolution and Clockspeed embody a time element that is marked by shifts in architecture and product iteration, the Capability and Capacity levers have qualities linked with knowledge and its diffusion. Together these levers form the Evolution Matrix.

Moving Within the Matrix & the Discontinuity Path

85 Ibid. The summary paragraphs in FN 84 and 85 are taken directly from the Imaginis Corporation website.
The interior walls of the Matrix are not solid because movement within the Matrix is possible. As we shall see technology may throw an industry from mechanical to digital, overnight. This is what happened to printing when it went from block type to Adobe TrueType. In a sense then, movement within the Matrix is one way though the photographic film industry may be sliding towards hobbyist or scientific relevance (the lower left portion of the grid) as it loses ground to digital imaging.

Thus, merely as a guide, the Discontinuity Path (the dotted diagonal line) indicates the disruptive potential of outsourcing for your company. If your business sits on the top right portion of the grid, along the Discontinuity Path, versus the lower left portion then you may want to seriously consider not using outsourcing. The reason is the Trajectory Theme for your company is cycling at a tremendous rate: product iterations, investment into technology, capability acquisition and value as well as production volumes are great. What this means is that there is no time to adjust for mistakes. Game theory dynamics and network effects will scatter your competitive advantage to the wind if your firm is not cautious. Having said that and introduced the Evolution Matrix, there are a few caveats that must be made clear.

_Evolution Matrix Caveats_

Again, as far as models go, the Matrix is not meant for the world to fit nicely within its borders, despite the subjective qualities inherent in each of the levers. The levers are also not scientifically precise and have not been illustrated with quantifiable data. And as we have seen with ballpoint pens and certain athletic equipment there are contradictions, though these contradictions tend to be for industries that are _not_ so dependent on technology. Thus, the levers seem to have more application for companies that _are_
dependent on technology though I surmise it will be of use to firms that are niche specialists in their field. Finally, the use of capital intensity in the measure of Evolution presumes the garage inventor is a thing of the past and disruptive change won’t issue from the nooks and crannies of the inventors world.

That being said we can begin to liven the Matrix with more examples.

**Applying the Matrix – Clockspeed Redux**

We have encountered Clockspeed and its industry effect conceptually, and given Clockspeed a definition for the purpose of this thesis. Now allow me to reiterate that in the big-picture sense Clockspeed reflects the sequence of product introduction or improvement generated by the nature of product cycles, in your industry. Over the long-term, the character of these successions, how repetitive or severe they are for the industry, depends on the Evolutionary Trajectory that we have been discussing.

We revisit Clockspeed as it relates to evolution because it has to do with the *context and core* of any outsourcing assessment. Your context can be someone else’s core. Whatever the case, one does not want to outsource a core activity because this directly relates to the long-term viability of your project or company. For example, Motorola thought it could outsource assembly to the Chinese (for mobile phones sold in China) since they did not possess the know-how for handset components. Motorola was going to produce for the local market using local labor but as one interview participant observed; “Selling in China is a locals’ game. Even if you could buy the talent there are too many entrepreneurial Chinese [meaning size is no defense against shrewd competition].”

Motorola made two mistakes. One, Motorola overlooked the ready availability of

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components on the open market – at competitive prices given the large volumes in China. Two, Motorola did not understand the Trajectory Theme and acceleration potential of the non-zero sum game and technology mix. In today’s world of product platforms and modular design one only needs to understand assembly to join the fray. Join the fray the Chinese did. It was not the components that were essential; it was the assembly capability that the Chinese lacked and which Motorola handed over – recall the Taiwan case example. What was context for Motorola was core for the Chinese and what was core for the Chinese is now public context for the industry. As Credit Suisse First Boston writes in their annual Asia Pacific wireless telecommunications sector review:

“It is clear now that China’s domestic handset vendors have effectively captured the growth opportunity in the booming handset market... In 2002, local brands accounted for over 30% of sales to end users in China... This came as a major surprise to most industry observers. When domestic vendors began to appear in the handset market three years ago, they were not expected to achieve a significant market share soon. Clearly, international vendors had competitive advantages in areas such as R&D and technical capacity, economies of scale, management efficiency and industrial experience, etc. Unlike other manufacturing industries in China, the domestic handset industry could not leverage off the low production costs in China yet, due to their lack of core technology and economies of scale... Often, when they need to rush new models to the market, they have to just buy the whole phones from ODM suppliers and simply put on their

own labels. However, local vendors quickly found their competitive edge: distribution, product design and marketing. With the revised strategies, domestic vendors quickly began to gain market share.”

Motorola failed to judge the market properly. It failed to examine strategy from a holistic perspective that includes more than one’s traditional competitors. What unseen outsourcing dangers did it encounter and what could it have done to avoid them? For unruly places like China where Clockspeed can be accelerated by the evolution theme in technology, a unified framework is required to identify just how much leverage you have. This chapter will attempt to do so with the Evolution Matrix.

89 Equity Research, “Asia Pacific/China Wireless Telecommunications Equipment,” Credit Suisse First Boston, October 3, 2003, p.05.
3.2 The Evolution Matrix & Clockspeed – Layer One

The interplay between the Clockspeed and Evolution levers form the first layer of two layers in the Evolution Matrix. This section will lay out the first layer of the Matrix but concentrate on Clockspeed since evolution and its many facets has been discussed at length in Chapters One and Two. So the following will be dedicated to Clockspeed, which in a deeper sense has three components: organization, product and process. We will talk about these components in turn. By the end we should have a model that can take us to the next level of discussion involving how capabilities might be transferred and how likely you are to become dependent on another organization, once you hand over the keys.

![Figure 3-4. Evolution Matrix – Layer One](image)

The first layer of the model measures Clockspeed and evolution in terms of slow and fast. In general terms any industry that falls into (Block 1) the slow Clockspeed & low Evolution portion of the grid is relatively stable. The likelihood of disruption from a shift in s-curve and architecture would be minimal compared to other Blocks because business
has no major trends and neither is technology or production improving at a noticeable pace. This section is relatively grounded in continuity. Take printing as an example. Up until the time digital publishing appeared and the village clock evolved the way of the wristwatch, not much has really changed since the Guttenberg Bible, both in terms of technology and how business was conducted. Once printing went digital however, the structure of the industry moved up to one defined by mass-market publishing in the literal sense. So it is possible to shift between sectors.

If you fall into (Block 2) the low Evolution & fast Clockspeed part of the grid, your industry experiences constant short-term upheaval, perhaps on a seasonal basis yet the capability that goes into your business evolves at a fairly archaic pace. The clothing industry is an excellent example. Here it seems as if evolution is inextricably bound to the number of appendages we have and the genetic stock of plant and animal life we still possess but variety and trends rip through showrooms with the seasons.

If your business is in (Block 3) the slow Clockspeed & high Evolution sector then your industry experiences less in terms of volatility or perhaps the volatility is more stretched out than Block 4. But over the long haul the change in technology can have quite a dramatic impact on the nature of business. The aircraft industry is a great example. The general principles behind the airplane remain unchanged since the Chinese started flying kites. In addition jetliners are such capital-intensive goods that their numbers are relatively few when compared to all the other mechanical artifacts in existence. Sure the industry experiences cycles (what we earlier described as “wobbles”) but development in engine technology as well as material science means that in little less than three generations flight
has gone from propellers to ramjets and even ion drives for space faring exploration vessels.\textsuperscript{90}

Finally, if you are in (Block 4) the fast Clockspeed & high Evolution part of the grid, the goods (products or services) that define your industry are subject to discontinuity at any time. Replacement may come not only through newer versions but also entirely different architectures that may change your mode for conducting business. For example, it is not without the realm of possibility that silicon chips be replaced with an organic substitute because though in its infancy the field of organic computing has gained enough credibility to be an area of research in major universities.\textsuperscript{91}

With the Evolution Matrix's definition complete, the next section will bring together the Clockspeed elements, each in turn, and integrate them into our grid.


3.2.1 Layer One & Organization Clockspeed

Organizational Clockspeed relates to how frequently a firm reorganizes itself in response to changes in either the external environment or internal corporate environment. How a firm responds may lead to it moving between the blocks. The Comcast Corporation’s recent bid to acquire the Walt Disney Company and remake itself into a content generating organization rather than just a content supplying one is being driven, in part, by perceived changes in the interplay between technology and content.\(^2\) Whereas Comcast was once providing a service, it is now bidding to upgrade into the capital intensive fast Clockspeed & high Evolution entertainment industry.\(^3\) As Charlie Fine writes on the information-entertainment industry, “Its products – motion pictures, for example – can have half-lives measured in hours, if not days... In December of 1997 ... the major U.S. movie studios and many of the most luminous American directors collectively launched almost $400 million worth of movies on a single Friday evening, with ‘their fates [to be] a settled issue by Saturday night.”\(^4\)

The following excerpt from an interview with Brian Roberts (CEO of the Comcast Corporation) illustrates his vision of how organizational Clockspeed must change to suit shifting exogenous conditions, and whether he realizes or not the shift between sectors of the Evolution Matrix.

\(^3\) Few would argue that the entertainment industry is not fast in clockspeed. However, I also argue that the entertainment industry has, as well, high Evolution traits because of the heavy use of digital imaging and digital animation. “Star Wars: Clone Wars” was shot entirely in digital media and most of its special effects were digitally rendered. This opens up the possibility for fiber optics and Internet 2 to change the face of entertainment again; perhaps, by allowing live participation on popular shows.
"You would be able to take our technology and our distribution, our reach in 22 million American homes, in the best cities, 22 of the top 25 cities in the country, and accelerate the change that we fundamentally believe is happening to television in this country. [We want to be] at the beginning of the next generation. Those [Turner, HBO, Discovery] were the winners in wealth creation. None of the existing broadcasters started CNN, or ESPN, or BET, or Discovery Channel, or HBO, or Show Time... I think that it's our view that we can help take the content, and the libraries, and the portfolio of The Walt Disney Company and help to accelerate its growth rate."95

Whether Comcast can tackle a much larger Disney and digest a very different culture without the corporate equivalent of gas remains to be seen. But if the future can be foreshadowed, one might also pay special attention to endogenous factors like shareholder efforts to remove Michael Eisner (CEO & former Chairman of Disney) from the board. As the Wall Street Journal wrote of the prevailing zeitgeist, "Those holders say they are unhappy with a range of issues including Mr. Eisner's leadership, the company's corporate governance practices, and its lagging financial performance and stock price over most of the past seven years."96 These may well prove to be prescient words if shareholder activism in response to poor corporate governance and the failings of an indefatigable but

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legendary CEO to guide the organization are driving the demand for a shift in organizational Clockspeed.97

Yet the appearance that technology is forcing Comcast to consider a bold move and the prevailing shareholder sentiment against Mr. Eisner and his stewardship are but the superficial recasting of a deeper question. If one looks behind the news, the better question to ask is whether your company is organized to anticipate the capabilities that are worth investing in, to make the jump between sectors. A failure to consider your organization's Clockspeed and the trajectory over which applicable technology is evolving may mean your shareholders could make the decision for you.

The next section will introduce the second layer of the Matrix and the role of Product and Process Clockspeed in it.

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3.3 The Evolution Matrix & Clockspeed – Layer Two

Layer two introduces the capability and capacity relationship. Capability can either be proprietary or open. Proprietary-Capability embodies the range of know-how that is ensconced in intellectual property, trade secrets, or other intangible skills that are difficult for others to duplicate. Proprietary-Capabilities tend to be more capital intensive. Open-Capability embraces the body of knowledge or skills required for your product or service that can be duplicated with a minimum of effort and expense. Capacity can be intense or moderate and is defined as the capacity your firm requires to reasonably meet industry demand. It sits opposite Clockspeed because, as mentioned, product variety and improvement for fast Clockspeed industries is often synonymous with demand.

3.3.1 Layer Two & Product Clockspeed

Product Clockspeed, for our purposes, relates to the impact of market wide changes in product development and the effect of this on the market environment. For the sake of example let us pick two industries that could not be any more diametrically opposed – fashion and aircraft engines – to illustrate the relevant sections of the complete Matrix.

Say you are a designer of haute couture and cater to the whims of glamorous people. Would, in an evolutionary sense, volatility in terms of sheer change be slower or faster in the fashion industry than say in the industry for strike fighters? As the Austrian physicist and philosopher Ernst Mach surmised, motion is relative. If in addition we consider that outsourcing places the company within the grid of two dependencies, capability and capacity, and overlay this matrix against that for Clockspeed and evolution we have the Evolution Matrix. This framework offers another measure of comfort from
which to judge the relative strategic value that outsourcing can bring to the firm. The Evolution Matrix is important because as we shall see in the chapter to follow it provides a good segway into our discussion of international production networks and their relation to outsourcing.

![Figure 3-5. Evolution Matrix – Complete Capability](image)

Matrix Attributes:
- Outsourcing becomes riskier as you move up the Center Arrow, the potential for discontinuity rises.
- Movement between Quadrants often one-way & involves jumping to another S-curve with architecture change.
- Proprietary Column merits extra caution & is highly linked with capital intensity.
- Capacity is in relative terms to Product Variety and Improvement Cycle.

From the vantage of our *limited life-span* the fashion industry would fall into Block 2. Clothing technology trundles along at a turtle’s pace but market volatility is fearsome because of seasonal change and shifting trends. We see this with each visit to the shopping mall or each time we come across an ad for a Nike Air something or the other or each time we lift the pages of *Vogue* magazine or *GQ*. Each season, each year, the fashion houses
deliver an endless repertoire of style that, despite our having only two arms and two legs, seem to always persuade our pockets otherwise.  

In stark contrast is Block 3, where low capacity is paired against proprietary capability and slow Clockspeed is contrasted with fast Evolution. A fitting example would be airplane engines, which in comparison to clothing, fails miserably in attracting the same attention from the glitterati. There simply does not seem to be much by way of variation when paired against the rhythm of supermodel hips and the creations of Gianfranco Ferre.

The dominant design for an aircraft’s engine is captured in the principle of igniting fuel mixed with compressed air from a rapidly spinning series of blades. What the engine and the airplane will look like in 50 more years is anyone’s guess. Consider it took Mr. Ibuka more than two days to arrive in the United States on a propeller driven Northwest DC-6 airliner; today NASA is testing a ramjet engine capable of making the Tokyo to New York flight a 3 hour trip at mach 10. 99 In all likelihood Mr. Ferre will have fashionable Milanese swaggering about in the latest fall fashions far before we have the opportunity to experience the gravity force of a ramjet powered commercial airliner.

The contrast in scenarios is strange to think about because our context in history could not be any more different than that of our parents, or at least my parents. Their memory for Mitsubishi A-6 Zero’s and Grumman Hellcats dueling over the skies of then Japanese Taiwan is quite acute; perhaps because they can both recall Lockheed P-36 Lightning tactical fighter bombers strafing and bombing the airfields near their towns.

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Sixty years later I am sitting in Cambridge (Massachusetts) watching Tom Brokaw in the evening broadcast report on another war where the enemies often do not even see each other. Indeed, the inertia of anything in the universe does seem to be determined by its relation to everything else in the universe.

An equally remarkable and disparate contrast exists between Block 1 and Block 4. In the low capacity and open capability sector (Block 1) that is also distinguished by slow Clockspeed and low Evolution we might consider the tools used to bind this paper. This would be in stark contrast to the proprietary capability and capacity intensive nature of the rapidly evolving and high Clockspeed semiconductor industry, Block 4. However, these businesses highlight the polar ends to the differences between an open capability and moderate capacity industry, such as that for paper binding, and a capability demanding and volume intensive field like that for dynamic random access memory ("DRAM"). One would believe that there is more to lose with the latter than the former, hence the Discontinuity Path that reflects risk in outsourcing the further up the arrow one travels. But this does not mean that the Matrix is not dynamic. Though one might guess the potential for discontinuity would be greater the farther up the arrow one goes, the potential for severe disruption is also present in the most hum-drums portion of the grid. Consider the following example.

Paper binding began with the needle, which is an artifact known to be older than the pyramids.\textsuperscript{100} Needles and thread not only kept our ancestors clothed but were used to gather printed leaves of parchment and paper. The classic shape of a book’s spine derives

\textsuperscript{100} Petroski, Henry. \textit{The Evolution of Useful Things}. (New York, NY: Vintage Books, 1994) p.87-91. The example of book and thread and needle was borrowed from, Henry Petroski, an engineer, curious mind, and student of history and his lovely book called the “Evolution of Useful Things.” Within this book he relates an intriguing story as to how not only the staple came to be but also the fork, paper click and the bottle cap.
from the thickening folds of paper formed from passing thread through them. The spine was fanned out and left in the curved state so that the threads did not sit on top of each other and cause the thickening bind to lend the book an odd isosceles like shape. This was and remains the classic form of bookbinding and dates back a thousand years. By the late 19th century not much had changed except that reading habits now included magazines being bound by sewing their leaves together using a needle that was its own thread, hence the term “saddle stitch.” This however was not very economical for smaller jobs as the machinery used would have to be adjusted to accommodate varying thickness. So in 1896 Thomas Briggs started a company called the Boston Wire Stitcher Company to make and sell his machine which could be adjusted by turning a screw but which still fed wire perpendicular to the seam, before cutting off a piece and turning it twice, back into the work. This was still a cumbersome and expensive solution, machines were still free-standing and foot operated. It would not be until 1923 that the first hand-fed individual preformed wire stapling contraptions were introduced at the height of post war efficiency movements in design – as best characterized by the Bauhaus movement from which sprang of all things the inspiration for the Volkswagen Beetle. In between this final design and the time Briggs started his company the stapling concept continued to evolve and include individual hand-fed pieces, pieces loaded individually into a chamber, pieces wrapped in paper around a tin core, and to what we understand today of staples being glued together in a row.

Where stapling technology will proceed probably does not worry many. Most would probably think of this problem in terms of Walter Mitty. But for the Boston Wire Stitcher Company, which we know today as Bostitch, this problem is real. Science-fiction
movies like *Red Planet* depicting Mars stranded explorers using viewing screens that flex like paper are soon to arrive.\(^{101}\) Conversations with executives from large electronics companies reveal that this dream is something that is already in the initial phases of commercialization with organic light emitting diode ("OLED") technology.\(^ {102}\) So perhaps the stapler and Bostitch are headed the way of the dinosaur because the greatest thing to fear for businesses in Block 1 of our Matrix is irrelevance.\(^ {103}\) Technology’s evolution and the potential for discontinuity simply cannot be underestimated.

Consider next the proprietary nature of and intensive capacity requirements for Block 4. This is paired with fast Clockspeed and high Evolution, as characteristic of high technology businesses that demand intensive capital investment. A business that fits this block well would be that for volatile memory, DRAM – the standard for temporary data

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\(^{103}\) Chang-Gyu Hwang (CEO of Samsung Electronics). Presentation to MIT Students, Cambridge, MA, April 15, 2004. Mr. Hwang put the audience on alert that flexible OLEDs that can act as substitutes for paper are within immediate reach.
storage in PCs. In the 30 years since its initial market introduction in the 1970s, the capacity for DRAM to store data onto a single chip has increased on a near exponential scale (Figure 3-6). In the coming decade, the capacity for volatile memory to store data will exceed that of the human mind. On a similar although not as dramatic positive slope is the cost of each factory ("fab").

Figure 3-7. Semiconductor Fab Cost Trend

Perhaps, the scion of a major Asian conglomerate engaged in the DRAM business captured the environment best when she responded to the issue of escalating costs, per generation of chip fabrication technology by commenting, “The rate at which technology for this business [DRAM] is changing is so fast that on hindsight our money would probably have been better spent elsewhere.”\(^{104}\)

What lessons can we derive from this and the preceding sections? First, technology has a dynamic effect on the Matrix, which itself is not static. It is possible to move within the Matrix, doing so is normally the result of some advent in technology. And you should

not be returning to the sector from whence you came because the entire nature of business for your industry should have changed. Second, what is core to your operation may be context for another and what you treat as context may be another's core. The further up the central arrow you move, the more you experience of the core-context debate. Moving further up the central arrow means you risk, through outsourcing, compromising your proprietary capabilities as you seek to avoid capacity demands, assuming this is why you are considering outsourcing. Third, if you can understand the relation between Clockspeed and evolution in your industry you can map that against capability and capacity within the Evolution Matrix to avoid the type of error Motorola made.

The next section describes Process Clockspeed and its role within the Evolution Matrix. When we conclude with the following section we will move on to production networks and learn why caution must be exercised even with what you believe to be context.
3.3.2 Layer Two & Process Clockspeed

Process Clockspeed has to do with the "how" of fabricating the product. For obvious reasons, it is closely related to Product Clockspeed. However, often, product and Process Clockspeed are not in synch, and they do not have to be. It is possible to have Product Clockspeed change very quickly while Process Clockspeed seems motionless. The effect of this in relation to capability and capacity is not all that different from that found in Product Clockspeed.

We return to Block 2 as a good starting point and revisit the world of clothing, but this time of fashion for the definite elite. Clothes fit for the most exclusive showings in Paris and which carry too much brand cache for the fashion runway, if such a thing is possible, are still hand assembled by expert seamstresses. The artisan work required would be no different than that level of attention necessary to adorn Queen Elizabeth's regalia in the 16th century, as depicted in her portrait (Figure 3-8) by Nicholas Hilliard from 1585.

Figure 3-8. Beaded Regalia

Figure 3-9. Sequins c.1961

Source: Hatfield House, UK

Source: Metropolitan Museum of Art New York

Indeed, clients who purchase from any of the grand design houses in Europe would receive a perfection of fit only achieved by painstaking methods of cutting and fitting to the client's body. As a matter of fact, the sewing required can casually consume more than 1,000 man hours at best and cost in excess of £20,000 pounds for the 21\textsuperscript{st} century equivalent of an embellished, beaded, status symbol. Each bead would be hand sewn, probably by an expert from the famous Parisian embroidery and beading firm of Lesage.\textsuperscript{106} And after one season and one presentation the perceived fashion utility of the dress would be consumed, at which point the dress would lose its purpose.

Fashion has a fast Clockspeed but low evolutionary trend. Perhaps it is because styles are timed to match the seasons. Whatever the case I think the point is clear when I write 18\textsuperscript{th} century men's fashion involved knit wool leggings and skirts and so does John Paul Gaultier's late 20\textsuperscript{th} century redefinition of high-fashion for men.

Contrast this with the Process Clockspeed for aircraft engines, an item with a clear purpose but one in which its progress does not draw much attention. However, tracing the development of turbine power technology from the early 18\textsuperscript{th} century to the early 20\textsuperscript{th} century reveals a dynamic evolving architecture, the flow of which is elegant enough to seem obvious and almost uninspiring, even if the Clockspeed is too slow to notice.

Despite the seemingly revolutionary character of the jet engine, it is a machine that is not without its antecedents, as the map in Figure 3-10 clearly illustrates. At the level of the artifact, the family or things that precede modern turbines express two centuries of continuity. The jet engine belongs to a tradition of turbine development that includes everything from water wheels to the internal combustion gas turbine. In this example, the

artifact and not science is central to technology and its trajectory. For though science and technology involve cognitive processes, their end products are not the same – one delivers a theoretical position or experimental finding and the other delivers an addition to the world of the manufactured, but both build on each other.

*Figure 3-10. The Turbine Engine’s Scientific & Technical Ancestry*  

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This is why understanding process and its relation to product evolution should also be a central theme in your analysis of outsourcing because once you outsource a part of your map you must deal with the potential ripples that emanate from that decision. And the size of those ripples and when they occur has as much to do with the knowledge that flows out of your control as the immediate disconnect that might occur by not having material capacity when you need it. As such the Discontinuity Path bisecting the Matrix along the diagonal. Recall, the further out you are on this path the more you should be concerned about outsourcing. Which forms a wave from a ripple would depend upon what is more valuable to you, capability or capacity? I would think in almost all cases

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107 Ibid, refer to FN 73, p.29.
knowledge outweighs capacity, so long as you can hang on to the capability. As a matter of fact some industries have largely done away with capacity due to the strain of fast Clockspeed and high Evolution.

The following chapter will discuss the rise of international production networks in the electronics industry as an outcome of the systemic globalization that we have covered. The purpose is to show how our Trajectory Theme has affected an entire industry as an illustration of the potential for change and caution that must be exercised as one evolves up the Discontinuity Path. The wish is for the reader to understand that outsourcing creates dependencies and that knowledge must be managed up and down the value chain; essentially, outsourcing fosters the illusion that risk can be eliminated while reward can be retained – which I suppose could be another way to frame the purpose for this essay.
CHAPTER FOUR
GLOBAL PRODUCTION NETWORKS & THE ELECTRONICS INDUSTRY

4.1 The International Production Network, Avoiding Bull Whips

Our narrative in business literature, as with any other account, emerges from a particular moment and a specific place in industrial history as part of a string of developments. In our particular case, the narrative’s preface would not only include the unfolding of globalization but also the story of a paradigm shift that signals the rise of merchant production capacity. These two commingled trends form the focal point for this chapter wherein we will explore, under the shadow of the Evolution Matrix, the nature of the global “for hire” (or turnkey) electronics production network and the caution that must be exercised when tapping such an arrangement.

The argument is that this type of production network though successful, for the electronics industry, presents a potential trap. The unwary manager may walk his company down the core competency (Prahalad and Hamel, 1990) trend out of a misguided interpretation and misplaced faith in the idea of leveraging production networks. The assumption is that the company finds itself outsourcing to low cost regions of the world where intellectual property protection is weak. The consequence is that essential fundamental capabilities are lost. As Dan Whitney a mechanical engineering professor teaching product design and development at the Sloan School (MIT) notes, “outsourcing relates to knowledge and learning, dependency and power.” 108 This is what the Evolution Matrix tries to capture and what we will address in a bit more detail.

This chapter then specifically tries to (1) put a face to the electronics production network and (2) questions when outsourcing as a tactical advantage creates strategic weakness, especially with regard to places that do not have the intellectual property protections we are accustomed to.\textsuperscript{109} We will also, immediately below, offer an alternative explanation to cost and core competency as a reason for why managers find this network appealing and why it persists.

\textit{Avoiding Bull Whips}

I began my studies at Sloan by playing of all things “the Beer Game,” which contrary to what the name suggests has nearly as much to do with beer as the QWERTY keyboard. The Beer Game is a logistics game developed at MIT to show the influence of how each of our “standard” perceptual frameworks for viewing our world can influence how we react to perceived shifts in the environment without first questioning the change. The game entails four people assuming the role of companies in the supply chain, each is the other’s customer or supplier. The objective is to minimize the total cost for everyone in the supply chain by keeping the least inventory yet managing to meet the supply for all orders. The game is a game of cooperation, and becomes especially so when competing against other teams, like any game involving non-zero sums. The results are almost always contrary to expectations because the way people react to orders from customers creates tremendous and unnecessary amplitude in the supply chain’s volatility, despite customer order levels that would suggest otherwise. This, of course, means lost dollars

\textsuperscript{109}For an in-depth look at the rise of international production network examine materials by Dieter Ernst of BRIE; John Zysman (also of BRIE) has an interesting paper on the whether production is relevant in the digital era.
from extra inventory and unnecessary capital expenditure on production capacity. So what
does this waste look like?

![Figure 4-1. Beer Game: Bull Whip](image)

Say, for example, that General Motors invites buyers for a new vehicle that appeals
to the “bling-bling” generation with incentives that are too hard for them to refuse. A
perturbation in the supply chain has occurred. Information begins to move up the line and
filters through to managers. The time it takes for them to realize and respond to changes
will mean delivery lags are being generated. If we add interpretations from each
management layer, the varied perceptions will almost invariably contain miscalculations as
to the magnitude of the triggering event; the result is either an over shooting in supply or
under shooting in supply. What then follows is usually an engagement in some form of
iterative loop to probe for “the’ sweat spot.”

The result of this game plays out in the real world. Using an example from the
book *Clockspeed*, Cincinnati Milacron, a machine tool supplier to the automotive industry,
reported that while U.S. GDP oscillated within a 2 to 3 percent range from 1961 to 1991,
the percent change in automobile production reacted with swings of plus or minus 20
percent while the machine tool industry responded with percent changes in net new orders
of minus 60 percent to plus 80 percent.\(^{110}\) Clearly as the Beer Game suggests, changes in
one end of the supply chain can result in wild volatility on the other end. To paraphrase a

manager from a major outsourcing company to the PC industry, this volatility effect “happens all the time and is one of the reasons why outsourcing to EMS companies like ours exists.”

Why this happens is a subject of much debate. A senior executive at a major contractor for Boeing explained how preposterous and potentially unqualified the management of such oscillations could be, much to his chagrin. To borrow his example, he explained how each Boeing jetliner has the number of given parts strictly defined. If each wing requires 10 hydraulic actuators for the ailerons that number is fixed. “You know how many you need and you know how many [planes] are in the pipeline and you know when you need them... The whole thing fits together in a tightly defined process.” Yet, this manager will receive orders that go above what one can actually install into a wing. Why this may remain the case for some functional areas of Boeing is beyond anyone’s guess; one possible reason is that Boeing’s supply chain software is dysfunctional because it “doesn’t take into account production capacity limits.” The more likely reason is as the beer game demonstrates that a perturbation in the supply chain caused a hiccup that snowballed as individuals lent their own interpretations to the change.

And it’s not just in production oriented industries that we see this effect. If we go back to the Dot.com mania of the mid to late 90s we can see the same wild volatility as initiated by financiers. At that time, venture capital money showered start-ups with pennies from heaven making possible a boom and bust cycle. The Internet hardware and Dot.com start-ups provided the excuse for major telecoms to access capital markets for new fiber optic networks, which in turn allowed for many more new start-ups such as those

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113 Ibid.
that clustered in Richardson (Texas) to supply the components and equipment for which the optical cable would connect to.\textsuperscript{114}

Figure 4-2. Dot.com Mania, The Bubble’s Excess

One of the consequences of this boom and bust is that since the late 1980’s over 283 million miles of optical cable have been laid, enough to circle the world more than 11,000 times. Much of this was constructed as a reaction to the Dot.com mania.\textsuperscript{115} One of the more ridiculous outcomes of the mania is that cities like Portland (Oregon) and Richardson (Texas) are not even sure how much optical cable lies beneath their geographies.\textsuperscript{116} Then of course there is the issue of what to do with all the potential


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capacity if one cable can carry more than 140 million calls and dense wavelength division multiplexing can multiply the utility of one cable strand by factors of ten. As one manager from the telecommunications industry said, "The future didn’t come as fast as they thought." This however credits the manager with a great deal of foresight and places the blame on everyone else for not being up to speed. So I might say the future arrived when it was supposed to; it was the manager that did not know what to do with it.

That being said, one can imagine why management will be so eager to outsource. By doing so, you essentially pass the proverbial hot potato to someone else. But can management really do away with oscillations in the supply chain by outsourcing? The next section studies why this may not be the case. In fact, we consider the possibility that a penny saved today may be several pennies lost tomorrow.
4.1.1 The Evolution Matrix & the Electronics Industry

When we talk about the American electronics industry and its global production network what is invariably included in the conversation is: (1) Asia and (2) the information technology ("IT") industry, as defined by computing – the Personal Computer ("PC") and all the attendant industries spun from the production and sale of peripherals like ink jet printers and monitors. As a strategist in TSMC remarked, "For the IT industry the PC is the fundamental backbone, in terms of units, for the entire industry."

For the purposes of our discussion we will adopt this observation and define the electronics industry (or IT industry) as one that is circumscribed by the personal computer ("PC"). And for the sake of variety and pliability with language we will treat references to the electronics industry and IT industry as being the same.

Admittedly the business is a dull one; it is probably the equivalent of lab mice for management study. But we learn a lot from lab mice so we examine this industry because of its universal reach and context. Where it lies within the Evolution Matrix is fairly straightforward. Even for those not interested in industrial history the thorough presence of IT, as expressed by computing, is such that we do not need to parse the grid too intensely. This leaves us more room for the critical issues that Dan Whitney framed.

If we mapped the electronics industry using the Evolution Matrix where would it lie and where would it be along the Discontinuity Path? It would be somewhere on the top far right corner shooting into the next galaxy. As Michael Riordan writes in Crystal Fire, "Whereas our parents learned about the world by reading newspapers and magazines or by listening to the baritone voice of Edward R. Murrow on their radios, we can now access far

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more information at the click of a mouse – and from a far greater variety of sources.”

This forms the precept behind our selection of the PC industry. It is an industry that is being carried along by the Trajectory Theme at full throttle. If we visualize the Evolution Matrix effect in revenue terms we can see this. A good measure would be to examine the combined revenue growth for the world’s top 5 electronics hardware contract manufacturers (which are all American) and their Taiwan counterparts. The U.S. companies posted compounded annual revenue growth in excess of 36.0% for the seven years since 1996, while their Taiwan peer group registered a CAGR in excess of 40.0%. Over that same period (1996 to 2003) the Nasdaq Composite Index grew by a CAGR of only 9.6%, principally due to the sharp decline in the Index from a high of 5,132 in 2000 to a close of 1,335 on December 31, 2002.

![Figure 4-3. Revenue Growth for Top 5 U.S. EMS Companies](image)

121 The top five U.S. contract manufacturers in terms of revenues are Celestica, Flextronics, Jabil, Sanmina & Solectron. The top four Taiwan contract manufacturers in terms of customer penetration are Asustek, Inventec, Hon Hai and Quanta.
Just what sort of businesses can manage such strong revenues after a disruptive shift in value for the entire industry and its client base? What kind of Matrix effect allows a business to undergo a drop in market valuation of more than 230% (as Solectron Inc., the largest electronics contract manufacturer suffered from 2000 to 2002) and still continue along its revenue growth trajectory?

Figure 4-4. Solectron Share Price 1991 – 2003 Q1[^122]

To begin our analysis, we start with the left y-axis – Clockspeed, which for the electronics industry cycles at a dizzying pace. Think the PC is boring? Think again and consider what the PC is morphing into and how the industry Clockspeed is cycling to adjust. Strong content and device relationships are pushing content and application DNA to combine.

The dynamics begin with the digital media value chain (Figure 4-5). Consumers are demanding greater freedom in media consumption. We take digital photos from our cameras or phones and share them with friends through the Internet and 3G networks. We download music and video from the Internet into our PCs and then transfer them to our MP3 music players. Apple Computers and the way its iPOD music player is co-dependent

with its PC desktops and notebooks for the online iTunes music download service is an excellent example of the converging media centric PC theme.\textsuperscript{123}  

\textit{Figure 4-5. Digital Media Value Chain – Industry Perspective} \textsuperscript{124}

- Music  
- TV  
- Movies  

- Cable  
- Broadband  
- Cellular  
- Terrestrial  
- Packaged Media  

- Mobile Devices  
- (PDA, PC, MP3)  
- PC media center  
- Game Consoles  
- AV recorder  
- (HDD, recordable DVD)  
- Set Top Box  
- Home Networks

- Transactions & Downloads  
- Subscriptions & Streaming

Meanwhile, broadband households are embracing digital entertainment applications, thereby strengthening the PCs position as a digital media network hub. Consider the behavior exhibited by the broadband enabled household in terms of media use for the home PC (Figure 4-6).

\textit{Figure 4-6. Media Use in Broadband Homes} \textsuperscript{125}

\textsuperscript{125} Ibid.
The consequence of the intermarriage between the PC and digital media is that PC vendors are turning media entertainment enabling hardware into commodities. As PC prices continue to fall the penetration of PC media hardware continues to accelerate (Figure 4-7).

![Figure 4-7. Media Hardware Household Penetration](image)

Second, applying the Trajectory Theme (the Evolution axis) that we used earlier to this mix of application and content DNA shows just how amazing evolution is for this industry. The industry has moved from Howard Aiken’s “automatic sequence controlled calculator,” which marks zero-hour for the modern computer era to the 2 kilogram notebook PC that I am now using to compose this essay. Aiken’s machine contained more than 750,000 components, was 50 feet long, 8 feet tall and weighed nearly 5 tons; I might add that it was described as sounding like a “roomful of ladies knitting.”

Third, in terms of Capability lever the rivalry between Intel and AMD, both manufacturers of microprocessors, is second to none in exposing how fiercely critical

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126 Ibid.
intellectual property and business methodology is to these companies.\footnote{128} When AMD sued Intel for abuse of one or more undertakings of a dominant position within the common market AMD was not merely pressing litigation for alleged antitrust practices. Reading the case history and the court’s decision leaves one speculating what the possible strategic considerations may have been for such a suit. Was AMD purposely trolling for non-public business structure, market relationship, and financial data on product series for a detailed map on Intel strategy? Intel may have revealed this material in its defense for another case.\footnote{129} As the same former White House attorney from the outset of this paper said during our meeting, “[I]t’s all in the intellectual property...”\footnote{130} We’ll get back to this third segment later because it will play a very important role in this chapter.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figures/figure_4-8.pdf}
\caption{Evolution Matrix & the PC Industry\textsuperscript{\footnote{131}}}
\end{figure}

\begin{itemize}
\item \textit{Closed} - Prices: competition in the digital media value chain, content + distribution + hardware & services
\item \textit{Open} - Prices: Fast: convergence in the digital media value chain, content + distribution + hardware & services
\item \textit{Evolution} - Prices: Fast: microprocessor, transistors on chip scaling at Moore’s Law
\item \textit{Capability} - Prices: Proprietary: Intellectual Property for content like music/video, software, processors, flash memory ...
\item \textit{Capacity} - Prices: Intense: household PC penetration in excess of 50% by 1999
\end{itemize}

\footnote{130} Former White House Counsel, interview by author, Washington DC, March 5, 2004.
\footnote{131} Tom Diederich. “Home PC Penetration Hits 50%,” \textit{CNN.com}, <http://www.cnn.com/TECH/computing/9902/11/50pc.idg/>., accessed April 30, 2004. Though impressive, the 50% penetration rate of PCs into US households (by 1999) carries more significance if one considers the potential that can be unleashed by the home PC acting as the media entertainment hub.
Finally, most interesting are the sociologic interpretations that industry \textit{Capacity} has been subject to. What this industry commands and demands is so enveloping that it has become the amorphous and insidious enabler of fearsome machines in Hollywood science fiction. This is largely because the search for a populated place not dependent in one way or another on computing seems a futile challenge; such is the state of our world in \textbf{the Matrix}\textsuperscript{132} – a movie which depicts a vast computing grid writing reality for the bodies and minds of billions upon billions of humans who are farmed like produce, tapped as energy sources in a post Armageddon machine world.

Would it be safe to say now that the electronics industry and the PC have more going on and about it than most would pause to give it credit for? I would assume yes. However, the luster behind the industry also has a dark sheen beneath the activity. As I said earlier, businesses considering outsourcing must be careful of the kind of industry mechanism technology evolution begets because the network that makes outsourcing palatable also makes it risky.

4.1.2 Network Characteristics – Standards & Complementors

Michael Borras, former co-director of the Berkeley Roundtable on the International Economy ("BRIE"), observes that the production network we are speaking of helped account for the resurgence of U.S. technical leadership in the electronics industry, despite its near death encounter with Japan’s electronics giants.\textsuperscript{133} The revival was made possible because of the network’s distinct qualities. According to the researchers at BRIE our production network for the electronics industry has two such distinct qualities: (1) the network supports the trend to standards, components, subsystems and architectures and (2) the rise of companies within the network that shifted the base for assembly and production facilities to Asia.

Beginning with point one, the trend to standards is by default a fairly open one since the power of controlling a standard like Microsoft’s operating system is that everyone else has access to your intellectual property. This may sound incongruous but it really is not. The objective here is one of securing as many complementors as possible, far more than anyone else if achievable. Should you manage to do so you will achieve a state of \textit{system lock-in}, which keeps your customers inextricably bound to your solution. Complementors are, as Arnoldo C. Hax (MIT business strategy professor) describes, any person or firm producing products and/or services that enhance your own product and service portfolio; in other words their product complements yours.\textsuperscript{134} There is a system dynamics feedback concept inherent in Hax’s model. The feedback structure resembles

\textsuperscript{133} John Zysman, “Production in A Digital Era: Commodity or Strategic Weapon?” \textit{BRIE Working Paper} 147, \texttt{<http://brie.berkeley.edu/~briewww/research/workingpapers.htm>}, accessed February 28, 2004. Much of the material that falls under the heading “What Characteristics Define the Network?” was made available through the kindness of the staff at BRIE.

\textsuperscript{134} Arnoldo C. Hax, and Dean L. Wilde III. “The Delta Project” (New York, NY: Palgrave, 2001).
the one we used in discussing game theory. The more complementors there are the more non-zero sum games can be played, utilizing your product. And the more non-zero sum games are played the more the players learn how to extract positive sums, which leads them to create more tools for more sophisticated game playing and greater accumulation of positive sums. The power of this dynamic (in having as many complementors as possible) is readily observable at any PC hardware and software vendor. Walk into any such store and you will notice a definite dominance of Windows based software titles over those for its nearest rival, the Macintosh operating system. The standards thus have a dual nature; they are restricted in the sense that they are owned but they are open to the degree that low prices make the standard open enough for most anyone to access and propagate. This is how system lock-in and standards are linked, like the two strands in DNA.

The significance of dictating any standard is that it effectively attenuates the link between market power and ownership of production assets. At the extremes are much talked about and studied companies like Cisco Systems Inc. or Dell Inc., which are decoupled from ownership of manufacturing assets.\textsuperscript{135} For these companies and Microsoft, the control of standards imposes taller barriers against entry than any amount of scale or vertical control over production and technology. This is because intellectual property is more expensive and harder to duplicate. It is also considerably easier to utilize intellectual property rights and licensing strategies to define a defensive or offensive position than it is to scale production capacity. To put it crudely, person per person lawyers can wreak more havoc than a mob of construction workers. On the other hand IP is also easier to abscond.

\textsuperscript{135} John Zysman. "Production in A Digital Era: Commodity or Strategic Weapon?" \textit{BRIE Working Paper} 147, \textless http://brie.berkeley.edu/~briewww/research/workingpapers.htm\textgreater, accessed February 28, 2004, p. 25. Though DELL does not "own" any industry technical standard in the IP sense what it has in terms of leverage and control is the industry leading capability to sell directly from the factories that others own to DELL's consumers. In many ways it has taken the art of the middleman to an entirely distinct plateau.
So if the first quality has to do with standards, the second point has to do with maximizing the potential for the first because it touches upon the rise of Asia’s electronic goods manufacturers. It is not that companies like Cisco and Dell simply decided to outsource so they can focus on their core competency. As Zysman and Borrus write, of the sheer technological complexity of modern industry, “No one, no matter their scale and sophistication, could do all the things that mattered.” Because of this, work was farmed out. And it was more than simply labor costs that acted as a motivator. Owners of IP went across national borders to create complementary production arrangements that individual companies and nations would be incapable of maintaining independently. Yes, cost was a factor but so was the requisite base of know-how; that is what we talked about earlier with places like the Hsinchu Science Park. So a firm like Dell might have in its products, as assembled by Quanta Computer Inc. of Taiwan, lithium-ion battery cells made by Samsung SDI Co., Ltd. of Korea, passive components by Murata Manufacturing Co., Ltd. of Japan, and disk drives from a Seagate Technology Inc. facility in Malaysia.

What I am suggesting is that the role of the electronics production network, and outsourcing, is in disaggregating an entire industry and enabling the playing of a new sort of game in which competition is about the definition of standards (IP) and accumulation of complementors.

More on Point (2) – So What Kind of Network Is It?

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137 Ibid, refer to FN 135, p.25.
What are the significant pieces of this network and how do they work together? For one thing, what the network offers is turnkey manufacturing capacity resting within a production structure that consists of specialized and highly capable merchant suppliers. These merchant suppliers can be grouped into two general categories for the purpose of this paper: (1) electronic manufacturing services (“EMS”) and (2) original design manufacturers (“ODM”). Also the term contract manufacturer, as used above, is frequently used to refer to the EMS or ODM as both are contracting out their capabilities in assembly and production. The distinction between an EMS and ODM can be quite blurry in the acronym banter that engineers and trade experts are apt to use; we will draw the line by examining the two from their business models.

Whereas an EMS is capable of producing the same item as an ODM it often does not have the design capability to create products that may compete against its customer. And even if it could, its business model calls for the EMS not to. An ODM has both a production and design capability but its business model is not one that focuses on scaling production to manufacture products designed by others. Rather, ODMs are capable of providing complete solutions and the manufacturing capacity to go with their answer, in essence leaving the buyer to apply its name on the product and to follow up with after-sales support. The ODM’s business model does not call for it to resist competing against a customer. You might liken both these types of companies as mercenary manufacturers, except the ODM may shoot back at you.

As the general manager (Asia Pacific Region) for one of the world’s largest EMS companies describes, “Dell and HP, their business models no longer require them to build or touch their products... that is why those Dell and HP people are very selective, in
selecting the outsourcing partner, to determine whether they will be able to compete as a brand name... If you look at outsourcing models, the outsourcing models apply to those with brand names. If you have no brand name you don't outsource. You focus your resources on the brand name you create... so the electronic manufacturing service companies all lean toward a non-competing value proposition. I build it for you, I'm the supply chain guy, but I don't create a brand [to compete]."¹³⁸ The very mention of small and medium sized may not be cause for worry but as Dan Whitney warns:

"First Tier suppliers, this is happening very much in the car industry and also in the personal computer industry, your getting a power structure at the first tier, one below in other words the final manufacturer. Power and knowledge are accumulating at the first tier. And in fact they have begun to call themselves Tier 0.5...

Somebody like Lear and Johnson controls advertises themselves as a subsystem integrator. Lear started out just making seats... And then they went on to make the ... headliner ... backboard ... and now they are at the point where they will deliver you an entire interior for a car. So they are moving up... Their ability to create coherent systems is giving them power.

The interesting thing about these coherent systems is that they reach right through to the end customer. The end customer experiences the interior of the car... This is an attribute of the whole car. And so they get to know things about the customer. The more they know about customers the more they can do their job...

What the OEMs think they are doing is focusing on customer needs and telling these people down below what to do as though they were just manufacturers. But that is an incomplete explanation for what they are doing. And this is sort of a growing gradual trend and to some extent the companies at the top are trying to block it but it’s not clear they are going to be completely successful. It’s not clear that it is reversible… Once you let this type of knowledge go it’s hard to get it back.\textsuperscript{139}

To distill and condense Whitney’s message, the warning for the party assigning the outsourcing task is to take notice of two particularly subtle but stark yellow flags. They are subtle because despite the allure of cost savings and/or the potential to better focus on core competencies, rewards from outsourcing are not easily retained. Thus, the \textit{first} of the yellow flags is to be wary of the danger in losing capabilities that are costly to regain. The \textit{second} caution is that once you pass on the skill or knowledge to your supplier, do not be surprised if you are empowering them to horizontally integrate and deepen technically. What I might add in addition to Whitney’s observations is that his lessons can come to bitter fruition within a few short years. Take Taiwan’s ODMs as an example, since the best and largest have evolved in Taiwan, and take the migration of Taiwan businesses to China as a further example.

We started with EMS companies so what are ODMs? The ODM, unlike the EMS company, is quite capable of building brands. Taiwan’s Acer Incorporated is an excellent example of an ODM that grew large enough to try flexing its muscle by spinning off a sizeable portion of its own operations to create a branded company called BenQ Corporation (formerly, Acer Communications & Multimedia, Inc.). It is the potential for

\textsuperscript{139} Ibid, refer to FN 108.
such spin-off that concerns us, and that should concern any manager because Acer Communications & Multimedia, Inc. was started in 1984. BenQ was established in 2001. Today it is rated by BusinessWeek as a top 100 IT company, is also the second largest manufacturer of branded liquid crystal display monitors and controls approximately 4.0% of the world market for cellular phones. As a high level executive in BenQ said of the effects its own outsourcing was having on the creation of competition, “[S]ome of the medium sized and small sized manufacturers, when we outsource with them, we teach them to improve their capability for design. They then turn away and build up smaller brands…” Does this seem like déjà vu? BenQ was unheard of in 2001 and so was Acer in 1984, as far as consumers and industry was concerned. Now one-third of BenQ’s US$4 billion in revenues are derived from Europe and 47.0% from Asia (including China).

BenQ, however, remains relatively unknown in the United States, for now. Its marketing strategy calls for a go-slow approach when tackling the most difficult market on earth. However, the same type of trajectory when in full effect can be seen in other companies, like the Samsung Electronics Co., Ltd. (founded in 1969) or, as we have seen, SONY. Today Samsung is, among other achievements, ranked 67th in the Financial Times survey of the world’s 500 largest companies, is the third largest cellular phone vendor and first to produce 70 nanometer 1 gigabit flash memory.

The contrast between the two forms of business model (EMS and ODM) is in the option. One chooses not to compete (Solelectron) and the other decided to join the branding
game (Acer/BenQ). But neither would be where they are today if the electronics industry
did not embrace the rules of "Wintelism,"145 which is the geek-speak for the architecture
governing today's dominant PC standard, as defined by Microsoft's Windows operating
system and Intel's microprocessor.

As we have discussed, in this new game in which production is disaggregated the
leading industry players like Dell or Microsoft focus on the engineering and design of key
products for the highly specialized market segments that they seek to dominate. The
objective is to command their industry product standards through: (1) defining new
product markets by developing and integrating breakthrough technologies and rapidly
commercializing them, and (2) creating control and economies of scale in their respective
market segments.146 What this means is that branded firms are asserting tighter control
over market creating capabilities – product definition, design and marketing – and
outsourcing market supplying capacity per our Evolution Matrix, or are they? This is the
question we started the paper with. So is there an advantage to this strategy and for how
long can a business keep it up?

Bear in mind that in this game the very logic of the status quo to internal structures
in the corporation is being put to task by growing external economies, like that made
possible in the Hsinchu Science Park, which itself is a link in the network chain. The
totality of the external linkages whether it is with EMS companies or ODMs located in
stand-alone factories or agglomeration venues like the science park is our global

145 Michael Borrus and J. Zysman, "Globalization with Borders: the Rise of Wintelism as the Future of
146 Bou Lutjje. "Electronics Contract Manufacturing: Global Production and the International Division of
production network. The next section will address the questions we just raised – what is the advantage and for how long?
4.2 What Advantage & How Long For

The issue of “what” advantage is there to outsourcing is almost always immediately answered by a cost related response but as we have seen in the discussion of Ricardian economic thought the caveats associated with cost make it a complicated and poor choice. A close second in popularity to cost is core competency, but as we shall see in this section core competency may be as much of a knee jerk and ill thought out basis for outsourcing as cost. This section will therefore concentrate on core competency, as it is a central theme in many outsourcing decisions and remains to be discussed.

What exactly is core competence? C.K. Prahalad and Gary Hamel, the authors that wrote the Harvard Business Review article that made core competence a part of management lexicon, identify core competence as: (1) something that provides potential access to a wide variety of markets – e.g., competence in display devices allowed Casio to also make handheld TV’s, (2) making a significant contribution to the perceived customer benefits of the end product – e.g., engine expertise makes Porsche cars exciting, and (3) being difficult for competitors to imitate.\textsuperscript{147}

Prahalad and Hamel also qualify their measures. A core competence is difficult to imitate if it is a “complex harmonization of individual technology and production skills.”\textsuperscript{148} In addition they warn that if fundamental technologies change or if a supplier decides to enter the market and become a competitor then your products, along with all of its associated investments in marketing and distribution, could be vulnerable. Thus, outsourcing can provide a shortcut to a more competitive product, but it “typically

\textsuperscript{148} Ibid.
contributes *little* [emphasis added] to building the people embodied skills that are needed to sustain product leadership."\(^{149}\) Finally, Prahalad and Hamel write of Asian companies as practicing a certain strategy that calls for focusing on a competence (usually technical) and embedding it in core products; “Asian competitors have built up advantages in components markets first and have then leveraged off their superior products to move downstream to build brand share.”\(^{150}\)

I do not believe that Prahalad and Hamel have muddied their own definition because they never really defined core competency; rather, they give three tools by which to *identify* it. Ill informed managers operating from mental models that examine core competency through conventional wisdom might define core competency as, “what a company is good at” or something that “creates competitive advantage” or something that “drives innovation.” However, this is rather tautological. It is quite possible that core competency is something that cannot be defined but is known when encountered; this would be along the lines of thinking employed by Justice Potter Stewart in his famous comment on obscenity – “I know it when I see it.”\(^{151}\) I say this because what Prahalad and Hamel write about core competency suggests that core competency is a *bundle* of corporate skills that can be put to use producing different consumables. Note that I use consumables instead of products because Prahalad and Hamel warn against thinking that businesses simply produce products. Businesses create processes, alliances, cultures, so a business is more than just products. Thus, the thrust of their core competency article is to

\(^{149}\) Ibid, p. 84.

\(^{150}\) Ibid, p. 85.

\(^{151}\) This is a paraphrase of U.S. Supreme Court Justice Potter Stewart’s famous comment on obscenity, “I know it when I see it.” Jacobellis v. Ohio, 378 US 184 (1964).
prompt business managers to search for those elements of their operations that when taken together can be used as a platform to continually deliver successful consumables.

So, we come to another prominent and related question, whether production can be divorced from the rest of your business by outsourcing it? I would say no, in so far as the very reasons that Prahalad and Hamel gave and which I repeated above. There are two reasons for this.

First, the core competency concept is most easily applied in the context of IP intensive economic activity; this is why it can be misleading. It is also why the Prahalad and Hamel article is littered with examples from the tech world. But what if you feel IP is not as powerful a dynamic in your line of work? What if you are dealing with standards and systems of assembly for products as common as the PC? Is it likely then that the fear of losing technological competence is not so great, or is it? Consider that IBM developed and lost the PC standard long ago, when IBM gave it to the world by hiring as “sub-contractors” Microsoft and Intel. The standards game does not mean you may worry less, you must be equally paranoid because in not exercising strong control over IP an American company is a shave and a haircut away from their Taiwanese competitors who have mastered and refined the art of production. So I brought up Dell when writing of standards because though Dell owns no “technical” standards in the Intel sense and owns no production facilities it does own proprietary capabilities in supply chain design that, at least, make it unique among the world of PC vendors.152

Dell sets the standards for logistics and direct to consumer selling that everyone tries to emulate. Thus I might add that if I were Michael Dell I would be watching, out of

the corner of my eye, a company like BenQ. I would be concerned that BenQ emulates my model of direct consumer sales since it can truly sell from factory to consumer, whereas Dell, arguably speaking, has taken the art of the middleman to new heights. Further BenQ is not established in the U.S. Like Dell, when it started, BenQ won’t have the baggage of established retail and wholesaler relationships that hindered Compaq in its effort to challenge Dell’s direct sales model. Where BenQ goes is anyone’s guess, but if it manages to “Dellify” itself then the non-zero sum game is going to be even more interesting to watch.

Second, even if you identify what you feel to be your core competency the effort won’t tell you what should be outsourced. Say your firm produces a product that goes through three stages of production (design, make and sell) and assume your firm is better than others at doing all of this, regardless of stage. Now assume that you find out you are best at the first and final stages compared to the middle stage. Should you outsource the second stage? If you outsource the second stage should you outsource the first stage also or will you be tossing the baby out with the bath water? Your design engineers are sure to require fairly complicated and expensive interaction with the contract manufacturers; why not just let the ODM take care of everything? The core competency argument would say that you keep all stages within your company even if it can be demonstrated that opting out of the first and second stages will make your company more profitable. Yet companies, like Dell or IBM, still outsource the first and second stages to Taiwan’s’ ODMs and U.S. EMS companies.
They do this because of the relative efficiency – specialization – debate we covered when discussing comparative advantage.\footnote{From speaking with an executive at Conexant Systems Inc., I know Conexant uses net present value calculation to justify core competency arguments. As a matter of fact, I generalize but I do so with a relative degree of confidence when I say, I believe most American companies use a mix of this and other bottom line oriented financial tools like enterprise value added or free cash flow projections in their core competency deliberations. However, I would tend to doubt that managers account for assumptions like the potential loss of knowledge and the costs to regain it when making such models.} But that discussion essentially said comparative advantage is fleeting and technology makes it even more so. As a matter of fact I even suggested technology makes outsourcing even easier and that it enhances non-zero sum game playing. Look at it this way, if technology enhances outsourcing and non-zero sum game playing and we are dealing with mercenary for hire production capacity, which means the system is open to all, then any competitive advantage to outsourcing must be \textit{short-lived}. As the same GM (general manager) for the largest EMS said, his biggest challenge from globalization is in managing all the disparate business models wherein some call for the simultaneous launch of a product world wide and some call for just a few units to be made each year.\footnote{Interview Participant 8, interview by author, Cambridge, MA, April 11, 2004.}

So as I hinted at the outset, factor price equalization takes place when others reach your levels not only in wages earned but also in the sophistication required to generate those wages. When I visited Delta Electronics Inc., in Taiwan with MIT’s Management of Technology Program in January of this year we were shown various products and devices installed within a special showroom designed like a home theater. The point our hosts was making was that Delta is moving beyond PCs to home electronics, which is exactly what its customer Dell is doing, because it has the capability to move up the value chain also.\footnote{Richard Shim, and John G. Spooner, “Dell Opens Its Doors to Home Electronics,” \textit{Cnet.com}, September 27, 2003, <http://news.com.com/2100-1001-5082284.html>, accessed May 7, 2004.} Delta happens to be the largest ODM power supply manufacturer in the world and supplies
its products to brands like Compaq, Dell, HP and Toshiba. As a matter of fact, Delta claims to control 45% of the world market for server power supplies, 42% for notebook PCs, 16% for desktop PCs and 70% for home game products like the SONY Playstation.\textsuperscript{156} And though our hosts may have been talking about the PC centric home, I was looking at their flat panel televisions and projection TVs and wondering when the growth trajectory for this company would collide with those of its customers. When I returned and examined their annual report I was surprised to find that the company was already grappling with that issue, and I was even more surprised at how they were going about with a proposed solution, tapping American’s finest technology institutes. I quote from the Chairman’s Statement from Delta’s 2002 annual report:

“\text{One important debate came up recently was whether Delta should be an ODM (original design manufacturer) or EMS (electronics manufacturing services) company. After careful studies, we have decided to build on our current strength of cutting-edge and market-oriented product development and continue with the ODM strategy. We have many years maintained research collaborations with leading universities such as Virginia Tech and MIT to keep ourselves abreast of technological and future trends. A good example is our Spoken Language Systems research team is working closely with MIT’s Laboratory for Computer Science under an Affiliate Program for research in human-computer interaction via natural spoken language. We also started our Business Headquarters and Corporate R&D Center in Taipei last year in light of Delta’s future sustainable growth.}”

The R&D center is currently engaged in projects relating to spoken language systems, MEMS, and opto-electronics. These projects will thrive in a corporate environment where the company's commitment for longer-term success comes before quarter-to-quarter results [emphasis added].

ODM versus EMS debate, Virginia Tech and MIT, commitment for long term growth over short term results? It seems as if the recipients of outsourcing are now purposely paving the way to engage the established brands in a test of patience and endurance. Recall what I quoted from Prahalad and Hamel about Asian competitors building competence with components to move downstream and build brand share. Delta has a history that is not any longer than that of BenQ. So if it takes less than one generation of managers to create world-class competition from outsourcing then how much longer will it take before more Samsung's or SONY's are created from Taiwan? I would fathom to guess that under the Evolution Matrix framework that period will arrive in a much compressed timeframe. So to close the question we started this chapter with, outsourcing, as Prahalad and Hamel warn, contributes little to building the skills needed to sustain a company. For sustainability, one must look at the complex harmonization of individual technology and production skills; but if you outsource production then half the formula is gone so what would you be left harmonizing? The advantage in my opinion is as Prahalad and Hamel warn, short lived.

Remember, this paper is about corporate longevity (hence the Evolution Matrix) and examining some of the fundamental issues associated with outsourcing; it is not a how to exercise. So the next significant issue I wish to examine before we close the paper has

to do with intellectual property. My intent is to explain why I believe any intellectual property released to developing nations like China will be appropriated without payment in exchange. From this final detail I hope to end our chapter on the International Production Network and why outsourcing helps the Evolution Matrix cycle at faster rates.
4.3 Intellectual Property & Ricardian Economics, Coming Full Circle

We began the paper by examining comparative advantage and its caveats. We will close the paper with another look, but from the perspective of intellectual property. The premise for this section is simple. Like factor price equalization there is an intellectual property equalization dynamic whereby those with less catch up to those with more, usually by appropriating knowledge, doing so without payment. This is because of enormous disparities between those rich in IP resources and those trying to accumulate IP resources. Efforts by the IP rich to harmonize laws for and enforcement of IP rights will be a bitter exercise in frustration until those catching up feel they have accumulated an ample stock of IP positive sums to seek their protection. Like the IP rich nations it is an attempt at preserving advantages for engaging in the creation of more complicated games. Otherwise, until then a state like China won’t be playing by the “proper” rules.

As Lester Thurow writes in *Fortune Favors the Bold*, “Property rights are what give businesses an incentive to invest in productive facilities to make more goods and services... The only remaining source of true competitive advantage are technologies that others do not have, copyrights they cannot infringe, or brand names that set one apart.”\(^{158}\) As I have been arguing all along, to engage in the creation of more positive sums means you must accumulate the capabilities to do so. To do this, you either acquire it from elsewhere or you create your own that others will find useful.

However, IP regulatory regimes have one purpose, to create an artificial scarcity of a particular bit of knowledge and turn it into a private good. It makes acquisition costly and creation that much more difficult. This is a problem common to all developing

nations. We have covered why technology should be considered in comparative advantage and will now consider how a place like China can arbitrage technology for its benefit. This is because after having spent as much time as I have with the Chinese, Japanese, Taiwanese and Koreans I am left without any doubt that their respective populations are convinced that the ease and comfort of modern life can be credited to technology, and the fastest way to attain that life is to acquire – fair or foul – technology to fill any gaps in knowledge. As a matter of fact, according to the gentleman interviewed at BenQ, Asians have grown so accustomed to consuming the latest technology that many of the Asian electronics companies are starting to turn their attention to Asia instead of the U.S.\textsuperscript{159}

What I want to convey here is that unlike oil or any other natural resource that is scarce by virtue of geography and God’s will, without political constraints IP has no such restriction. Furthermore, IP is a step above the tacit quality of the type of information that cannot be conveyed effectively without actual hands on experience. IP can be committed to any physical form; it can be digitized, photographed, replicated and so forth.

Also, I argue that neither a universal body to enforce nor a universally enforceable regime for strong IPR protection exists; “there is no global system for enforcing intellectual property rights.”\textsuperscript{160} Thus, the U.S., under pressure from IP industries, in particular the entertainment industry, passed the Digital Millennium Copyright Act\textsuperscript{161} in an effort to stay the online piracy of media content. And Europe created its equivalent to the U.S. law in the European Union's Intellectual Property Rights Enforcement

\textsuperscript{159} Interview Participant 7, interview by author, Cambridge, MA, April 9, 2004.
\textsuperscript{160} Ibid, refer to FN 158, p. 173.
Directive. Though both are designed to treat piracy neither are enforceable in the others geography. And although archaic concepts of reciprocity exist, these are grounded more on what I feel to be rules of “gentlemanly” conduct than any inked treaty ceding a modicum of sovereignty over a states citizens – thus, the prevailing difficulty in harmonization of laws and enforcement.

Without getting into too philosophical a debate on what defines a pioneering nation, I tend to agree with what Simon Kuznets has to say in Modern Economic Growth: Rate, Structure and Spread:

“[T]he increase in the stock of useful knowledge and the extension of its application are the essence of modern economic growth. ... No matter where these technological and social innovations emerge ... the economic growth of any given nation depends on their adaption [emphasis added]. In that sense, whatever the national affiliation of the resources used, any single nation’s economic growth has its base somewhere outside its boundaries, with the single exception of the pioneering nations.”

In other words, the cheap transfer of intellectual property from a developed nation to a developing nation accelerates the latter’s rate of growth, speeding it along the Evolution Matrix. This fact is not lost on China as its own Foreign Language Press (a state media body) wrote:

“The grasp and assimilation of foreign scientific and technological achievements is regarded as an important way to develop China’s own

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162 PE-CONS 3636/04 (Brussels, April 19, 2004)
science and technology. For the development of China's science and technology, it is an easier, short-cut way to study actively, digest and assimilate other countries' advanced scientific and technological achievements suitable to China's conditions while maintaining her own independence, initiative and self-reliance. This will save much money and time and, in the meantime, promote the growth of China's own scientific and technological force. To learn conscientiously from others is a necessity.\footnote{164}

The interpretation of "actively digest" and "assimilate" at others potential expense seems a fact that many Western companies are willing to overlook or just do not see. Business in China is run on "ifs" and China is one big "if." A close friend and college classmate recounts as his favorite tale of utter guffaw and brazen thick skin how his family lost more than US$3.0 million to their business partner in China, after the partner emptied their joint venture and warehouse of all its assets. Perhaps Western companies are not subject to such outright appropriation by locals, out of fear for involving a state level security apparatus, but just outside the U.S. embassy in Peking, on "Silk Alley," there are plenty of vendors selling pirate software and DVDs and plenty of buyers (Westerners included).\footnote{165} The Business Software Alliance ranks China as one of the worst IP rights violators with more than 90% of software in China pirated.\footnote{166}

\footnote{164} Ibid.
\footnote{165} It was and remains often said in Chinese communities that non-Chinese receive favored treatment in most any type of appeal to legal organs because the Chinese central government does not wish to affect the flow of business flowing into China. However, I tend to believe that although this may have been the case in the recent past, the Chinese are now at the point in development where they feel more confident and willing to enforce IP rights that, at least, they share an interest in protecting.
Even Lester Thurow advises that China (and Israel) rank among the worse violators of intellectual property rights. And even these “violators” operate against each other. In a fairly amusing twist, the professor described during our interview session how a group of Chinese academics/engineers visiting the Technion Institute of Management in Israel were caught disassembling, for reverse engineering, an agriculture irrigation device at three in the morning. The sum of my cautioning is that China can be a very difficult place to conduct business; as the Red Herring magazine writes, China ranks as one of the top eight corrupt nations. So for the manager conducting outsourcing, he must be attuned to the adversarial business style the Chinese practice, which should be familiar. Again, as Lester Thurow told me (and which I concur) the Chinese business style is closer to that found in the United States – expect no mercy despite the polite manners and expect joint ventures to last only so long as they are useful, or as Lester Thurow might say, “joint ventures don’t work [in China].”

To be fair to the Chinese, the language herein is not an expression of conservative American paranoia. The gist of this section is that the manager must be aware that outsourcing to places with relatively weak IP rights protection means the quickening of Evolution Matrix and Game Dynamic effects, especially if your business is looking to outsourcing for a quick fix. “… Chinese law is relative, depending on whether you get caught and, more importantly, who you are (and who you know)... authorities on the local level will often seek to protect pirate factories that are beneficial to the area’s

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170 Ibid, refer to FN 168.
So to quote an old Chinese proverb, “If everyone is doing wrong, no one will be punished.”

Take the case of AM Communications (“AM”). AM was a small publicly owned American company that developed and owned software used by cable-TV operators to monitor their systems. When AM met tough times in 1998, it turned to a “visionary” Indian-born American CEO, Javad Hassan. At least that was how AM’s founder Alvin Hoffman described Hassan. Hassan had a vision for a new kind of company, “a virtual company, that would own technology or customer base and outsource everything else... Right from the beginning [Hassan outsourced] taking everything to India,” driving operating costs “way down.” Yet this did not fix AM’s fundamental cash flow problems – it needed more customers, more sales. Taking operating costs down was not going to improve growth prospects. When AM lost a major customer in fiscal year 2003, the bottom fell out. Soon thereafter it filed for creditor protection. Later, after some of AM’s employees banded together in an attempt to acquire AM, their investor backed out at the last minute because there was a sense that “not only were the manufacturing and development services based in India, but that the company’s most important knowledge – software and engineering savvy, not to mention its development expertise – had also departed the U.S... All the knowledge about how to do things had moved over to India.”

173 Ibid.
174 Ibid.
175 Ibid.
The lesson of this story is not that the catcher-uppers are sinister sportsmen; rather we must understand that when we send jobs to foreign businesses, we also send critical capabilities (processes, procedures, development knowledge, as well as IP). This makes outsourcing no light matter. The earliest parts of this paper were replete with cues from experts that the U.S., at one point, in its industrial development was just as hazardous a place for business. But the message there was that none of this is new. And though this may be true, Evolution Matrix effects have compressed the timeframe in which a business has time to react against potential errors and new competitors.

Actually, U.S. business people have more to blame for the fallout and critique from outsourcing than the Indians or Chinese. After all, we initiated the current round of outsourcing and there is some truth to the argument that "the ... concept of U.S. technological superiority [runs counter to] the prevailing doctrine of free trade."\(^{176}\) This is in the sense that it runs against the harmonizing effects of the natural course of economic evolution, which we have seen in factor price equalization and in the trajectory of the game-theory Evolution Matrix. Technological superiority sounds good but maintaining it will only become increasingly difficult as technology makes the world a smaller place. Trying to have our cake and eat it too is a messy affair.

To close with what we started in this section, outsourcing helps speed intellectual property rights equalization and the harmonization of legal and enforcement interests. It might not be anything new and neither might the consequences but the speed at which you may find yourself atop the totem pole with no where to go but off may be something of a surprise, if you are not careful with your know-how.

The next chapter will conclude our discussion with reflections on what the dynamics we have covered throughout the chapters mean for the American business and American manager.
CHAPTER FIVE
CONCLUSION

5.1 Wrapping Up

We opened with a discussion of current events, which in their own time will become history. How future generations read that history is anyone’s guess but how it closes is largely up to those of us in the present. To say that losing jobs to low-wage foreign competition and/or technology is “as old as the Industrial Revolution” is not enough.\(^{177}\) We already know that happens. History already recorded the Homestead Strike, when steel workers fought against efforts by Andrew Carnegie to automate steel production and history committed to memory the Luddites and their smashing of weaving machines – resisting technology. So as I also added earlier, none of this is new. But then, as I think the historian Daniel Boorstin said, planning for the future without a sense of history is like planting cut flowers. I agree; that is why the issues in this paper cannot be taken in isolation.

Why then, as Thomas Malthus wrote more than two hundred years ago, must “the transfer of wealth and population … be slow, painful and unfavorable to happiness?”\(^ {178}\) We know that globalization (trade) and technology can boost living standards by lowering the prices of goods but what I feel we need to understand are the dynamics to how and why those same forces are destroying skilled jobs that workers and managers thought would “never be threatened.”\(^ {179}\) I might add that it is ignorance to think


\(^{178}\) Ibid.

\(^{179}\) Ibid.
something can never be threatened; it is the *expectation* of never and the collision of this hope with "happened" that has people riled. So my path for this paper was an attempt to unite several concepts, namely, Ricardian comparative advantage, non-zero sum game theory and system dynamics into something useful, the Evolution Matrix. The objective, to prepare the manager (myself included) to navigate the outsourcing issue by showing how these tools might help, and hopefully in the process do less harm. What lessons then can we derive from them? This chapter will try to summarize the heart of the paper and its utility for the American business by raising issues generated from the interplay of the tools.

*First,* as Sun Microsystems's Chief Technology Officer acknowledges, there is the danger that the U.S. lose its technology dominance; the communication revolution in computing and networking is making that possible. However, why we may lose it is not because of technology *per se*. Rather, technology is a moveable factor in comparative advantage. Because it is moveable it has a fluid quality that contributes to the ease in creating links within a global network (production network included). And as I have shown, the more links there are the more complicated the non-zero sum game can become. And the more complicated it becomes the more positive sums are generated and the faster one cycles down the Trajectory Theme.

The problem with Sun and with most American companies is that the preponderance of American managers see their firms as always leading the trajectory. Why do I say this? Because the leaders of those companies tomorrow already think like that today. When Roberto Rigobon, economist and MIT funny man, asked his

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macroeconomics class how many thought the Japanese were innovative compared to the Americans only about one quarter raised their hands.\footnote{181} Whether it is Sun or Microsoft or IBM, innovation, like IP rights, is treated as an American institutional given. But as I have illustrated using the rise of Asian competitors in the electronics industry, what is taken for granted is not certain under the overall concept of the Evolution Matrix and the Discontinuity Path. I myself have given up branded American notebook PCs for branded Taiwan ODM PCs; you simply cannot beat the price versus performance and style. Actually, the Matrix is more meaningful for those who subscribe to Rigobon’s assertion that product innovation (those who can assemble components into something consumers want) is more meaningful for the purchaser than “basic research.” In light of this, it is wholly wrong to think that other countries are not going to drive the “next wave of conceptual thinking” because there is a “huge difference between working on components and working on the vision of how those components fit together to take a technology to the next level.”\footnote{182} So as Rigobon espoused in class, America might be good with fundamental research but leave it to the Japanese (Asians) to innovate with products and production by throwing at you not just the key technology but all the complementary hardware – e.g., the multi-CD turntable and the surround sound package to go with it and your DSP TV, as well as the ultra-slim CD player and SONY Playstation… To think and suggest that vision is an American province is hubris. I would listen to Craig Mundie, Chief Technologist at Microsoft when he says,

“I think our competitors recognize what has led to our success and are attempting to reproduce that… We have a persistent problem in terms

\footnote{182} Ibid.
of a shortage of people going into science and engineering. Even though we still have the world’s best universities, there’s now greater competition in other countries. People have studied here and have gone home to recreate that educational infrastructure... [T]alent is uniformly distributed around the planet according to the gene pool.”

I agree with Mundie because I think almost everyone I know in Taiwan that is in some form of leadership role fits Mr. Mundie’s description. This would include, Dr. James Lee, a close family friend and head of the Hsinchu Science Park (Taiwan) and its associated research institutes and Dr. Lee Yuan-Tse, Nobel Laureate and head of the Academia Sinica.

Second, because we can not stop the rest of the world from wanting to have what we enjoy and catch up to our standard of living we should be careful with outsourcing. I see no present and immediate need to have everyone else reach parity with America’s corporations any faster than they are already proceeding. I do not say this out of spite nor do I say this out of a renewed call for isolation. I say this because of the wobbles generated by constant change due to the Clockspeed effect and shifts in s-curves because of the Evolution Trajectory. Yet, though the Evolution Trajectory (in our limited lifespan) may seem to have too many s-curve shifts, how intense each shift is depends on how quickly we can absorb all the change. The dynamics behind the Evolution Matrix forecasts some form of approximate parity in the not too distant future, which is probably not that bad a thing since if everyone has equally much to lose maybe there will be less violence. But in the meantime, the responsible corporate citizen and caretaker of

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shareholder interests must consider how far up the Discontinuity Path the corporation should go and how much in terms of Clockspeed change and potential s-curve shifts the company and its employees can weather. Keep in mind that as you release knowledge form outsourcing, your context becomes someone else’s core. And that means you may be aiding another in the jump to a higher overall s-curve. Remember, BenQ was made in less than the effective lifetime of one manager. Tomorrow’s BenQ’s and Quanta’s and Samsung’s are only going to surface at a faster rate.

Third, if you have not realized it already, the Evolution Matrix treats technology as something that is standardized and commoditized. Again, we can refer to history for an example by considering how in the 19th century, American manufacturers created standardized designs for wheels, gears, pulleys, shafts and screws. “Once such standardized parts were widely available ... there was an outpouring of invention.”

What followed, apparently, was the sewing machine that made clothes more accessible, farm equipment that made planting and harvesting cheaper and more bountiful, and the train that made transportation more convenient and economical. By the end of the century, the cornerstones had been laid for the automobile and the next wave of innovation involving mass production. It all seems to flow with some type of apparent self will.

As the argument goes, meaningful innovation (for the public) came after the basic building blocks were commoditized. However, Wesley J. Hom (a senior executive at IBM) would caution that there is commoditization and then there is commoditization in the sense that competing with a commoditization strategy is not sustainable. As Hom

185 Ibid.
said, chasing prices is a "death spiral... It is not a strategic move... Outsourcing to China or India, there are nightmares that can be associated with that." The most businesses heading to China or India for? Large markets are one but the most superficial reason is cost, at the unfortunate expense of Americans. This is an open fact; hence the hew and cry against Mankiw. But as I have said, cost is more often associated with an ill thought out reaction and so is its cousin, core competency. Therefore, if we think of outsourcing as an intentional move up along the Discontinuity Curve then managers should proceed with caution because the further up one moves the faster everything cycles.

*Fourth*, white-collar outsourcing and the unrest it causes are not going to go away anytime soon. Interdependencies are increasing and innovation is not the domain of any country or large corporation. Globalization and Matrix effects have permanently dampened the pay of less skilled U.S. factory workers. Now, U.S. companies can find, architects, engineers, programmers and financial analysts anywhere in the world for a fraction of the price it costs at home. Again, this is certain to have a negative effect on wages; after all, employers (being the flawed perfectly rational economic being) are not about to pay more unless there is a compelling reason to do so. Thus, "white-collar offshoring will make the wage outlook worse for high-skilled Americans." The question for Americans then is whether we are more productive than our Chinese or Indian counterparts? If the answer is no or marginally so, the result will be sobering because many of the jobs that are being outsourced have more to do with brainpower than

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188 Ibid.
brawn. This opens up another can of worms. If Americans become displaced because of lower wages then those Americans will put a further dampening effect on wages because the pool of for hire skilled labor has become that much larger. This is a system dynamics effect. So can we put a brake on any of this? No. The Evolution Matrix and all the tools that went into it answered that. The only way to stop the Trajectory Effect is to reset in the unthinkable way. And even then game theory dynamics will take over and people will start accumulating non-zero sums, again.

*Fifth,* what can managers do about any of this? Well, since outsourcing moves companies up the Discontinuity Path then almost by default companies must innovate to stay in the game. As I said earlier this paper was never meant to be a “how to” book. I wanted to explore the reasons behind an issue I find interesting and relevant. However, I do have Jane Linder to thank for her contribution in explaining to me the best response I have heard to date on how a company might react to outsourcing. If I can do her ideas any justice in this section of the paper, they can be summarized as, companies must manage innovation *holistically.* This can be done by assessing three points: (1) what is the organization’s overall innovation strategy, (2) how will inside and outside sources be managed to execute the innovation strategy, and (3) how will the organization manage both internal and external sources of innovation, to ensure that business goals are achieved.\(^{189}\) To do this, three organizing frameworks are used: (1) business model analysis, (2) scenario planning, and (3) product domains.\(^{190}\)

Business model analysis is fairly straightforward; but the best way to vet your plan may be to design it in such a way that venture capitalists would be willing to at least


\(^{190}\) Ibid.
critique it, if not invest in it. This way you not only receive the benefit of a VCs grilling (which can be immensely useful) you might also get an early start on promising ideas.

The use of scenarios is something I interpret as similar to the scenario planning popularized by the Royal Dutch Shell Group in the seventies and eighties. To realize the benefit of scenario planning you have to accept uncertainty, try to understand it, and make it a part of your reasoning. It is not a mechanistic process; it is organic. What you learn is continually advanced into ever more refined scenarios that require you to deal easily and quickly with alternatives. The catch is you have to be darn sure that you know the difference between what is uncertain and what is predetermined – events that have already occurred or that have a high potential of occurring, but whose consequences remain unrealized. Why is this? As Professor Henry Weil once warned me, poor observation of facts is a greater sin than poor reasoning. Incidentally, Professor Weil sounds like a lawyer because he comes from a long line of illustrious attorneys. In short, scenario planning (like the Evolution Matrix and the concepts that it is based on) is less focused on predicting outcomes and more on understanding the forces that compel the outcome, insight.

Product domains deal with managing internal and external sources of innovation to ensure that goals are reached. For example, how are innovative concepts prioritized so that internal efforts and external sourcing can be guided? Does the standardization we talked about earlier make communicating and selecting these priorities any easier? How easily can others determine what your company is looking for in terms of innovation? In sum, what practices do you have or can you develop so that the nature of your company’s innovation agenda can be communicated, understood and managed holistically.
This brings us to two other points essential to transformational outsourcing: (1) innovation channels and (2) organizational processes to sustain the changes. Innovation channels are specific sets of tools used to manage and reach innovation needs. Five have been identified: (1) acquiring innovation on the open market, (2) investing in innovative companies, (3) cosourcing like Toyota and GM's NUMMI joint venture for the sharing of production process and technology, (4) community sourcing, akin to Professor Eric Von Hippel's tapping of lead users as innovators, and (5) resourcing, the contracting for on-demand talent. These five channels have an endogenous aspect to them; the more difficult and less likely to be solved with money is the establishment of organizational processes – the setting up of internal mechanisms and structures necessary to carry out your plans. Geography, the flow of information, company size, etc., all have to do with change but I feel the largest obstacle will be established “mental models.” What are mental models? Well, as Michael Armstrong, Chairman of the Comcast Corporation warned the MOT class, culture is nearly impossible to change.\(^{191}\) Culture and mental models are closely linked because the two have to do with deeply held internal images of how our surroundings function. These images, assumptions, stories, help our mind define the organization within which it exists. These mental models are powerful because they affect what we see. This is why new insights are often not realized because they conflict with established perceptions of how and why things work.

So to leave with a few parting thoughts, analyze what your mental models of the world, your organization and yourself are. Knowing the forces driving the outsourcing trend are powerful does not mean you must careen into the future. Consider outsourcing

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in a holistic manner by thinking about the dynamics that flow into an outsourcing decision. That means one must look further than short-term cost savings when outsourcing and it also means the manager should not be lulled into accepting core competency focus as a strategy, excuse. The reason is competitive advantage from outsourcing is fleeting at best and outsourcing is not something that is sustainable. It breaks the harmony in knowledge that is necessary to develop a strong innovation competency. Finally, outsourcing will only become more disruptive for businesses and employees as newer and more powerful technology diffuses, threading the world together. The strategic planner must be creative in his response and certain in identifying his firm’s place on the Discontinuity Path. Using the Evolution Matrix and the other tools discussed will help navigate the complexities and pitfalls to a decision that will surely affect any company’s Evolution Trajectory.
5.2 Special Thanks

I began the paper with an acknowledgement and I end with another. Like movie credits those that come early in the beginning and those that come early in the end carry the most weight. It is perhaps odd to have this in a thesis but then I have never been one for the conventional. That is not hubris speaking by the way; rather, it is my optimism expressing itself. It has simply been a most wonderful year.

So I begin and close with an expression of gratitude to David Weber, director of the Management of Technology Program. I would not have had the good fortune to be happily working at 5 AM recounting the lessons of Shlomo Maital, Arnoldo Hax, Simchi Levy, Charlie Fine, Jim Utterback, Henry Weil, John Stearman, Crazy Rigobon, Peter Senge and Wanda Orlikowski were it not for David’s “E” ticket email to this magical kingdom known as MIT. My world of friends has only become more special.

My gratitude also reaches out to Professors Henry Weil and Lester Thurow. I never cease to be impressed with how much info they can cram into the listener’s mind in a few short minutes. And my thanks and appreciation for Professor Charlie Fine for being that type of cool dude professor that students reminisce about and for “Sir,” Jim Ziglar Sr., a man of resolute conviction who watched me grow up.

Finally, I am in debt to the Dewey Library Reference Desk Librarians and in particular to Maggie Bartley for her patience and good temper. Maggie and her staff is a remarkable and tremendous asset that the MIT community does not recognize enough. The writing of this paper in the extremely compressed time in which I had would not have happened without their unwavering aid. In every way, they helped enrich my learning experience and appreciation for library science.
If I have failed to give adequate thanks to those who made my life special while at MIT or to those who I interviewed or even to the authors of those works that I used for this paper (heaven forbid) then I have no excuses but only my most sincere apologies. Every experience and particular detail added up to my sharing this year with the best bunch ever.

This sentimental boob is not ending with a sigh. He is already peering around the corner for the next curious thing. Cheers!
BIBLIOGRAPHY

Books


Journals & White Papers


*News Articles, Periodicals, Presentations & Websites*

Note: All articles from newspapers, new groups and periodicals used for this thesis were obtained directly from the publishers’ websites. In an effort to save paper and print I have not repeated the original and very lengthy http addresses. All articles used for this thesis are available through the Factiva database. If not, the http address is given.


### Interview Participants

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