The E-World as an Enabler to Lean

by

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Abstract

Modern communication and information technologies have proven to be strongly correlated with an increased labor productivity growth in the recent years in the US. New business models utilizing those technologies have emerged so fast that management reviews describing them have rapidly transformed into a very lucrative business. However, the whole electronic business phenomenon is still in its infancy and its real impact remains difficult to evaluate.

This thesis focuses on the impact of contemporary business models on the Lean enterprise. It first examines the Internet phenomenon through the lens of four case studies: Dell Corporation, eBay, Inc., Linux and Enron Corporation. From these case studies, a set of principles is extracted that is further used to scope e-World business trends. The e-World trends are then put side by side with the Lean overarching principles and the interactions between the two sets of principles are analyzed in detail.

As a result of this analysis, a clear overlap between e-World principles and Lean is first established: this thesis not only shows how the e-World facilitates Lean but also how Lean is an enabler to the e-World. Second, this research demonstrates inconsistencies between observed trends from the e-World and the Lean principles. Third, the key Lean concept of value originating from a customer-pull is challenged by recent business trends. This thesis supports a definition of value emerging from a company's core competency to understand and process its customer's information.

Finally, the research examines the technological, institutional, and legal challenges of implementing the observed e-World trends in other industries. It then concentrates on organizational issues and questions the viability of traditional hierarchical structures. Lastly it explores people implications and the role of human resource management.

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Long hours and days of work were dedicated to the timely completion of this thesis. More than the actual research work however, I believe the whole writing and editing effort to have been the greatest challenge of my education at MIT. Periods of intellectual elation followed times of total despair in infinite waltzes during which I often doubted my ability to conclude such an endeavor. For their support during these particular moments that I would like to thank my research advisor, Professor Deborah Nightingale and some of my closest friends.

Life never lets people deal with one problem at a time and my dearest gratitude goes to Debbie who supported me for three semesters and managed to stimulate my work throughout all this time with the same enthusiasm. Coming from a country where students rarely interact with their professors, the research work with Debbie was a completely new experience that I found exceptionally enriching.

I must also thank some of my close friends who assisted me during my graduate studies and especially during the writing of my thesis. For personal reasons I prefer not to mention their names. The courageous few who will decide to read this thesis will recognize themselves easily. A special thank goes to a very special friend who called me regularly in the middle of some long nights to make sure I was not falling asleep on my desk.

Finally I would like to thank MIT and especially the Lean Aerospace Initiative (LAI), which funded this research and enabled me to write this thesis. To more than the industry consortium however, my sincerest gratefulness goes to the people (student, staff and faculty) who daily contributed to creating an enjoyable work environment in the LAI offices and made my graduate studies an unforgettable experience.

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CHAPTER 1: INTRODUCTION

"A consensus is emerging that something fundamental has changed [in the economic system]"

Jorgenson and Stiroh, the American Economic Review, 2000a)

According to many academics and politicians (including for instance Alan Greenspan and Bill Clinton), we are living through one of the select eras in history where advancing technologies and changing organizations are transforming economics, society and life.

As a matter of fact, the performance of the U.S. economy over the last decade has astonished economists. Several studies[1] show that labor productivity growth is rising, which could explain why the economy did not overheat (yet), by way of higher inflation. Equally impressive annual growth figures have only occurred for short periods of American economic history (typically after recessions).

Most scholars within Jorgenson and Stiroh's "consensus" see the progress of information and communication technologies as the critical cause for changes in the economy, particularly for a potential rise in productivity across sectors.

"So, the Internet revolution is not a myth then? Probably not. This thesis is a humble attempt to understand why.

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[1] E.g. OECD, Economics Department (*A post-mortem on economic outlook projections*, December 2000) and other recent studies (Jorgenson and Stiroh, *Raising the speed limit: US economic growth in the information age*, The American Economic Review, October 2000)

1   The Internet Phenomenon

1.1   Foreword

The following words will be very frequently used. Even though some of them have already become common usage words, most of them still lack a precise definition. For that matter and for the context of this thesis, they are defined below.

Internet: Internet is used as shorthand to include the whole cluster of technologies that depend upon and enhance it such as Internet, Intranet, WWW, Email, Electronic Fund transfer, Electronic Forms but also Technical Data Interchange (CAD/CAM/CAE) or Electronic Data Interchange (Request For Quotes, Production Controls, etc.).

B2B: Business-to-business (B2B) is a term that refers to commerce between companies conducted over the Internet.

B2C: Business-to-consumer (B2C) is a term that relates to commerce between companies and their end-customers and conducted over the Internet[2].

1.2   The Internet craze

In 1991, the Internet had less than 3 million users around the world and its application to e-commerce was non-existent. Today, the number of Internet users is approximately 407.1 million[3] and GartnerGroup forecasts close to $1 trillion for US online trade in 2001[4]. As illustrated in the next section, Internet statistics exhibit staggering figures.

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[2]C2B (customer to business) and C2C (customer to customer) are also in use. eBay would be an example of C2C service whereas Priceline.com's enormous success has shown that C2B represents a viable market opportunity. We hardly mention the huge B2C market in this thesis but it was the most rapidly adopted business model. Examples of B2C include Amazon.com, Barnesandnoble.com, eToys, CDnow.

[3]As of November 2000 according to Nua Research http://www.nua.ie/surveys/how_many_online/index.html, quoted by http://www.esa.doc.gov/de2k2.htm - The given figure is different from the DOC's because it was updated.

[4]Another interesting figure is the number of webpages: according to Inktomi and the NEC Research Institute, the amount of information available online has increased ten-fold from early 1997 to early 2000,

The goal of this thesis is to improve our understanding of this pervasive phenomenon. Of course, it would be unrealistic to try and describe the Internet as a whole. Our interest is placed on how the Internet impacts the industry and the way business is conducted with a special emphasis on the Lean enterprise.

In a presentation to Wall Street analysts in June 1999, Lou Gerstner, Chairman and CEO of IBM, described the new "dot-com" companies as "fireflies before the storm – all stirred up, throwing off sparks". But he continued: "The storm that is arriving – the real disturbance in the force – is when the thousands and thousands of institutions that exist today seize the power of this global computing and communication infrastructure and use it to transform themselves. That's the real revolution."[5]

This thesis is an attempt to describe the "real revolution" Mr. Gerstner talks about.

1.3 A statistics maze on the Internet craze

One of the first questions that people usually seek to answer when researching about a new phenomenon is: how big is it? Not surprisingly most research groups, investment banks and consulting groups have attempted to size the tangible (i.e. monetary) Internet, namely B2B and B2C commerce.

Exploring the past is a difficult exercise. Missing, imprecise or even contradictory information make it very challenging, not to mention the endless variety of interpretations for one single piece of information. Exploring the present can be an even more demanding assignment and is indeed very tricky when it comes to estimating the size of a constantly evolving target like Internet commerce.

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to more than a billion discrete pages. Foster City, Calif., January 18, 2000
http://www.inktomi.com/new/press/2000/billion.html
[5] The Economist, *Business and the Internet* survey, June 26 1999, 34

In November 1999, a report from Goldman Sachs estimated that the B2B market in the United States would grow to approximately $1.5 trillion by 2004[6]. In February 2000, Forrester Research forecasted that B2B transactions would reach $2.7 trillion in 2004 while B2C transactions would total up to $184 billion in the same year. In April 2000, Forrester Research[7] revised its forecast and announced $7 trillion for electronic commerce revenues by 2004. In September 2000, a report from the Boston Consulting Group[8] stated that B2B commerce in the US is set to become a $4.8 trillion market by 2004, up from $1.2 trillion in 2000. In October 2000, Jupiter Communication announced that B2B commerce would experience astounding growth over the next five years, rising to $6.3 trillion in 2005 from $336 billion in 2000[9] (see Figure 1)

Time Evolution of Online Trade Projections

November 1999 Goldman Sachs: 1.5	February 2000 Forrester Research: 2.7	April 2000 Forrester Research: 7	September 2000 Boston Consulting Group: 4.8	March 2001 GartnerGroup: 8.5

Y-axis: $ trillion (0 to 9)
X-axis: Source
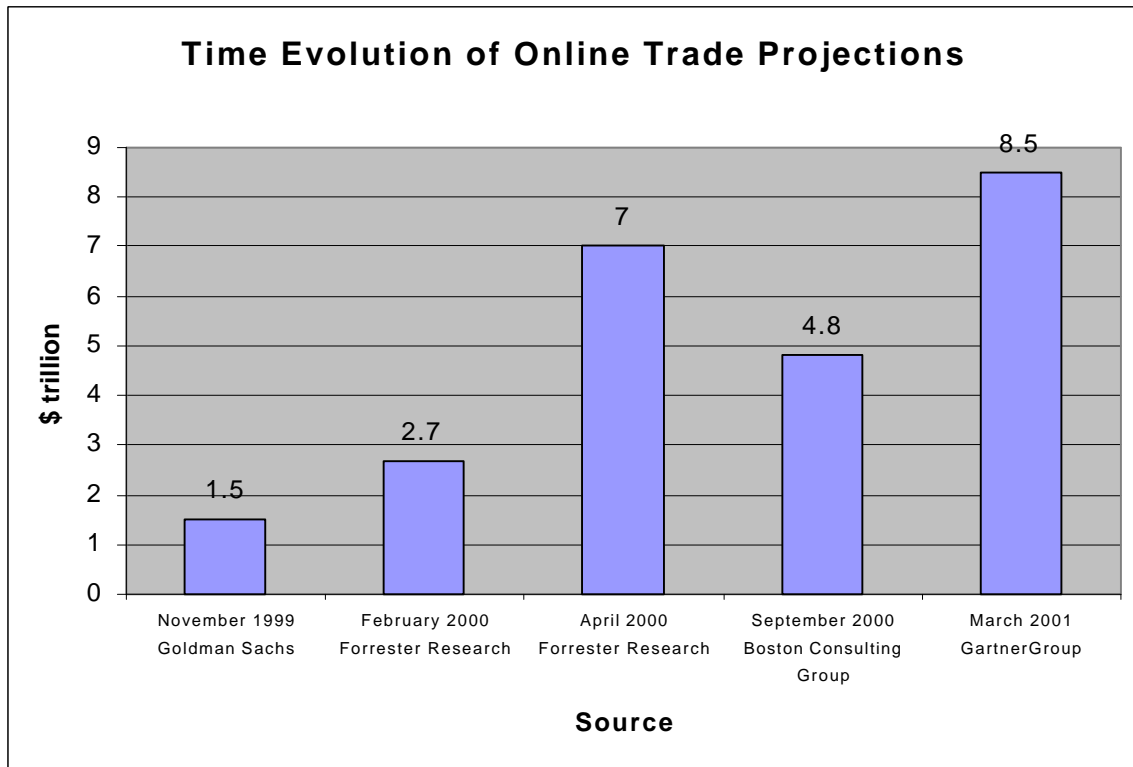
Figure 1: Evolution of Online Trade Projections

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[6] Goldman Sachs Investment Research, *B2B: 2B or Not 2B?,* November 12, 1999, 2
[7] Forrester Research, April 19, 2000 http://www.forrester.com/ER/Press/Release/0,1769,277,FF.html
[8] Boston Consulting Group September, 8 2000
http://www.bcg.com/media_center/media_press_release_subpage22.asp
[9] Jupiter Communication, New York, October 2 2000,
http://jup.com/company/pressrelease.jsp?doc=pr001002

The latest report available on this highly debated question of sizing B2B commerce was published by GartnerGroup in March 2001[10]. Although the economic downturn will negatively affect the growth of B2B, Gartner predicts that the global B2B market will still be worth $8.5 trillion in 2005, up from $433 billion in 2000. Year 2001's total is expected to reach $919 billion, increasing to $1.9 trillion in 2002. The total for 2003 is projected to reach $3.6 trillion, followed by further growth to $6 trillion in 2004 (see Table 1).

	1998	1999	2000	2001	2002	2003	2004	2005
Millions of US dollars	49,877	150,050	433,300	919,000	1,929,000	3,632,000	5,950,000	8,530,000
% growth Year to Year		201%	189%	112%	110%	88%	64%	43%

Table 1: B2B Online Trade Projections - Source: Gartner Group, March 15, 2001

2 The Lean phenomenon

2.1 Definition of Lean

"Becoming lean implies a journey. We will reach our destination when we apply the philosophies underlying lean to develop our own lean systems. There's no reason not to start trying. There are no experts, just people with more experience. The longer we wait, the more experience our competitors will have when we start."

JOHN Y. SHOOK, Director, Japan Technology Management Program,

University of Michigan

Giving a more precise definition of what "Lean" exactly is could be the subject of a whole thesis. Different schools of thoughts exist and support their own interpretation of

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[10]GartnerGroup, March 15 2001, http://www4.gartner.com/5_about/press_room/pr20010313a.html

the concept. For the purposes of this thesis, a brief introduction of where the term Lean comes from and how it led the Lean Aerospace Initiative (LAI) at MIT to develop the Lean Enterprise Model and its 12 overarching principles will be more than sufficient.

2.2   Brief history of Lean

Ironically the Lean manufacturing system really started with Henry Ford. That is a bit simplistic but in fact the moving assembly line was the ideal model on which Toyota based their production system back in the 1940s. A moving assembly line is continuously flowing, like a river, and the ideal for the Toyota Production System (TPS) is to keep all material continuously flowing. Anything that prevents the flow of material is waste or muda in Japanese. Unfortunately Ford Motor Company moved away from the original vision of Henry Ford. The focus on flow through the River Rouge complex became a focus on getting out masses of Model Ts and keeping all equipment busy, whether the next process was ready for more product or not. Inventory built up as "process villages" built at their own tempo regardless of what other processes needed.

> *"*Ford made a dramatic wrong turn at his new Rouge complex. He maintained the assembly track but rearranged his fabrication machinery into process villages. He proceeded to run a push schedule in which growing fluctuations in end-customer demand and persistent hiccups in upstream production were buffered by a vast bank of finished units forced on the dealer network and equally vast buffers of parts at every stage of production upstream from assembly. Thus "flow" production (as Ford termed it in 1914) became "mass production".
>
> James P. Womack[11]

In the meantime the Toyota Production System was developing as the first lean manufacturing system. It started on the shopfloor as a solution to a very real and pressing problem. After World War II when Japanese industry was decimated, the Toyoda family

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[11]Foreword to: *Becoming Lean*, edited by Jeffrey Liker (Portland, Oregon: Productivity press) 1997.

decided to extend Toyota Automatic Loom Company to start an automotive company. They had some cash but did not have the infrastructure. They certainly could not compete directly with the established companies like Ford. So their sole demand was in Japan which meant supplying small quantities, with high variety while Ford was selling any color Model T you wanted as long as it was black. Toyota also had to rely on outside supplier partners to make the capital investment needed to get in business.

Under these conditions, Taiichi Ohno (father of the Toyota Production System) was given the assignment of catching up with American companies in productivity at a time when they were behind by a factor of ten. Ohno drew upon a number of ideas imported from the West and a lot of experimentation to ultimately develop TPS. At the time, Toyota Automatic Loom had invented a loom that stopped when there was a quality problem (e.g., a thread breaking). This was the basis for the TPS concept of jidoka, roughly translated as built-in quality. Ford's moving assembly line was the model of continuously flowing material and Toyota managers all diligently read Henry Ford's books. For example, in the book *Today and Tomorrow*[12], all the basic concepts of lean manufacturing are laid out. Ohno learned of the American supermarket system and how a version was being implemented at Lockheed. The supermarket concept was to place out a small quantity of all the products your customer might want and replenish those items as they are used: a pull system. (http://www.acq-ref.navy.mil/wcp/tps_ono.pdf, http://www.optiprise.com).

The Toyota Production System (TPS) was developed between 1945 and 1970 and it is still evolving today. The 1973 oil crisis hit Japan at least as hard as it hit America and Europe. By 1974, Japan's economy had collapsed to a state of zero growth. At Toyota Motor Company, although profits suffered, greater earnings were sustained in 1975, 1976 and 1977 than at other Japanese companies. The widening gap between Toyota and other Japanese companies opened the eyes of others in Japan to this phenomenon called the Toyota Production System and it began spreading rapidly in Japan.

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[12] Autobiography from Henry Ford

In the U.S., the auto industry awoke when *The Machine that Changed the World*[13] was published highlighting the great accomplishments of Toyota and the huge gap between Japanese quality and productivity and auto companies in the West. Many differences were factors of ten, like the original gap between Toyota and Ford but reversed. That book coined the term "lean manufacturing" because Toyota was doing more with less of everything: less space, less people, less capital and less inventory.

2.3 "Lean Thinking"

Two of the authors of *The Machine that Changed the World*, Womack and Jones worked as consultants to numerous U.S. and European companies that had begun to implement Lean principles and practices during the late 1980s and through the mid-1990s. These experiences were documented in their book *Lean Thinking*[14]. After working with many companies, the authors/consultants began to see a generic framework for successfully implementing Lean in Western companies. This amounted to a restatement of the Lean framework as practiced by Toyota, designed to be more compatible with Western practices and management approaches. Womack and Jones[15] perceived that there are five general principles of Lean thinking.

Value — The starting point for Lean thinking is "value" as defined by the end customer. Value is defined in terms of specific products and services having specific capabilities offered at specific prices to specific customers.

Value Stream — A "value stream" is the set of all specific end-to-end, linked actions, processes, and functions necessary to transform raw materials into a finished product in the hands of the customer. Service after the sale is included in the value stream. Mapping the value stream for each product provides a basis for performing an in-depth analysis of each of the individual actions in the value stream. Each action is classified

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[13] by Womack, Jones and Roos, 1990, from a research conducted through the International Motor Vehicle Program (IMVP) at the Massachusetts Institute of Technology
[14] Womack and Jones 1996
[15] *Lean Thinking,* 1996, 16-26

into one of the following categories: (1) it unambiguously creates value, (2) it creates no value but is unavoidable given the current capabilities within the company (type one muda[16]), and (3) it creates no value and can be eliminated immediately (type two muda[16]). Actions in categories (1) and (2) are analyzed further through the use of value engineering, in an effort to improve the action as much as possible, eliminating unnecessary expenditures of resources.

Flow — Once the wasteful actions along the value stream have been eliminated to the maximum extent possible, the next step according to Lean principles is to make the remaining, value-creating steps "flow." The primary challenge is to discard the batch-and-queue mentality prevalent in mass production and install small-lot production. The ultimate goal is to implement batch sizes of a single unit. Flow is best achieved by discarding traditional functional organizations, replacing them with integrated product teams organized along the value stream.

Pull — Conceptually, the customer "pulls" the product from the enterprise rather than the enterprise pushing the product onto the customer. This "pulling" action cascades up the value stream, stage by stage, all the way to the supply chain. A production system organized in this manner is said to be a "just-in-time" (JIT) system. Establishing a JIT system involves the use of "kanbans[17]" and a system of total quality that roots out all defective work. JIT is supported by production smoothing, standardization of operations, reduction in setup times, single piece flow and rearrangement of production operations into work cells.

Perfection — Companies that have implemented the principles and practices of Lean find that there is no end to the process of reducing waste of all kinds and continually improving the product and service delivered to the customer. Consequently, there are on-

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[16] Muda is a Japanese term meaning waste. Refer to *Lean Thinking,* 1996, Preface, 9. Womack and Jones define type one and type two muda[15]

[17] Kanban is a Japanese term that means "card, sticker" and usually refers to cards that visually signal the upstream stage to produce another unit

going reductions in response cycle times, production time, required production space, costs, and errors.

It is important to note that those five principles have been especially applied to the production level of the enterprise. This thesis however adopts LAI's broader definition of Lean.[18] LAI views "Lean" not merely as a set of practices for the factory floor but rather as a "fundamental change in how the people within an organization think and what they value, thus transforming how they behave."[19] In this view, the true potential of Lean is at the Enterprise level, where every element of the organization, extending forward to the customer and reaching back into its supply chain, applies the Lean concepts.

Recent information technology developments are having a dramatic impact on the manner in which companies may interact with customers, suppliers, partners and other potential stakeholders. Electronic commerce is changing the manner in which enterprises deal with suppliers. The cycle time for ordering, shipping, receiving and paying for supplies has been reduced from weeks to days (or in some cases as we will see in the case studies, even to hours). Equally dramatic change is unfolding in B2B interactions, both in terms of their nature and speed. Strategic partnerships can be formed very rapidly in response to business opportunities that may be available only briefly. To play in this fast-paced game, enterprises must become much more "forward-focused", ever ready to move swiftly and deftly into the fray.

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[18] The Lean Aerospace Initiative (LAI) is a research group at MIT. More will be said about LAI in CHAPTER 4.

[19] *Transitioning to a Lean Enterprise: a Guide for Leaders*, Volume I: Executive Overview, Lean Aerospace Initiative, MIT, September 2000.

3   Research outline

3.1   Motivation

The Internet acts as a disruptive technology that changes the way we work, live, learn and play. What is more, it is doing so at a far greater speed than the other technology revolutions of the 20th Century, such as electricity, the telephone and the car. The first order impact of the Internet on the way we work in terms of online buying and selling, or e-commerce, is obvious. Less understood are the profound changes in the processes and culture of an enterprise.

This research seeks to explore the impacts of the Internet on the whole enterprise. Emphasis is placed on the Lean attributes of the enterprise, comparing them to contemporary business models and showing in what measure they can be both enhanced and modified by the Internet.

3.2   Key questions

"Where do cash flows come from?" is probably one of the first questions one would ask when inquiring about new business models. For electronic commerce, the past two years have shown clear answers to that question. Companies exhibit varying business models, depending on the key products and services they offer and the core sources of e-commerce revenue in these models include transaction fees, auction-driven commissions, advertising, content subscriptions, and software licensing. Each one of these revenue sources could be the subject of a thesis. Our purpose however is to describe the interactions between contemporary, Internet enabled, business models and the Lean enterprise. Key questions include: What are the emerging businesses that we can use as models to describe today's e-World trends? How Lean are those businesses (according to the Lean principles of the LEM)? Are the Lean principles a prerequisite for companies to embrace an Internet strategy? Can Aerospace companies follow the same e-World trends? What lessons can Aerospace companies learn from these trends?

3.3   Methodology

Unlike traditional research, this thesis does not rely on a central data-analysis out of which all results should follow. On the contrary, it is an attempt to shed light on a broad subject about which thousands of articles and publications have already been written. Indeed, the amount of literature that discusses online commerce is enormous. In January 2001, a search on the Lexis-Nexis database for the word "business-to-business" returned an average of almost 450 articles per week over the 10 preceding weeks (see Table 2).

From	To	Number of matching publications
1/29/01	2/4/01	477
1/22/01	1/28/01	521
1/15/01	1/21/01	480
1/8/01	1/14/01	602
1/1/01	1/7/01	392
12/25/00	12/31/00	122
12/18/00	12/24/00	515
12/11/00	12/17/00	455
12/4/00	12/10/00	438
11/27/00	12/3/00	441
Total 10 weeks		**4443**

Table 2: Lexis-Nexis database search for "business-to-business" within the Business and Finance publication section

All 450 weekly articles are obviously not relevant to this thesis. Nonetheless the astounding figures add to the craze of the phenomenon and help understand why Internet commerce is still so poorly understood.

The first milestone for this research consisted in a de facto limited literature review (see Reference chapter for a detailed bibliography). Out of this first step, four major Internet cases were identified and examined in more detail. Putting the four cases side by side with the Lean enterprise principles was the second milestone of this research. The third major step was the analysis and thesis development.

4   Chapter outline

CHAPTER 2 introduces the e-World trends with four case studies: Dell Computer Corporation, eBay, Inc., Linux and Enron. CHAPTER 3 follows with the Internet commerce trends in the Aerospace industry and provides with a framework to structure the comparison between the e-World trends and the Lean Enterprise. CHAPTER 4 defines the Lean principles and the e-World principles and is devoted to a detailed comparison of the two sets of principles. CHAPTER 5 draws on CHAPTER 3 and CHAPTER 4 to analyze policy issues and make recommendations to industry leaders. Finally CHAPTER 6 reviews the research documented in this thesis. It first provides a brief discussion of the research objectives, key questions and research design. It then summarizes the major findings and discusses possible directions for future research.

CHAPTER 2: E-WORLD TRENDS

1 Introduction

1.1 Methodology

At the heart of the logic of this thesis is Professor Charles Fine's concept of fast clockspeed industries serving as model examples for slow clockspeed industries[20]. Fast clockspeed industries include for example the Personal Computer industry (product technology clockspeed under 6 months) or computer-aided software engineering (product technology of about 6 months). Slow clockspeed industries include the steel industry (product technology of 20 to 40 years), the commercial aircraft industry (product technology between 10 and 20 years) or the military aircraft industry (product technology between 20 and 30 years)[21]. For that reason, our analysis begins with four case studies describing contemporary business trends and methods.

1.2 Classification matrix

1.2.1 Traditional frameworks

Considering the multitude of companies that currently use the Internet (which, for short, we will refer to as Internet companies) for business purposes, it is not obvious to limit a research sample to four cases. Several frameworks exist to help classify Internet

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[20] Charles H. Fine, *Clockspeed – Winning Control in the Age of Temporary Advantage,* Perseus Books, 1998.
[21] Charles H. Fine, *Clockspeed – Winning Control in the Age of Temporary Advantage,* Perseus Books, 1998, 239

companies. The most common looks at the identity of the seller and the buyer and gives the four traditional categories B2B (Covisint), B2C (Amazon), C2B (Priceline), C2C (eBay). Steven Kaplan and Mohanbir Sawhney developed another framework, the B2B matrix, based on "How" and "What" Internet companies buy[22]. "What" companies buy is either operating inputs or manufacturing inputs and "How" they buy those inputs is either by systematic sourcing or spot sourcing, which leads to four categories: MRO hubs (e.g. Ariba), Catalog hubs (e.g. Chemdex), Yield Managers (Employease) and Exchanges (e-Steel). Both frameworks are useful. The first one however is too broad to really understand the business model type under the designation. The second one, even though it provides a more understandable description of each category, is too specific for our purposes since it concentrates on B2B commerce. Consequently Don Tapscott's framework[23] was chosen because it combines the quality of the two previously mentioned frameworks: comprehensiveness and comprehension.

1.2.2   *Tapscott's control/value integration matrix[23]*

Tapscott's classification matrix differentiates Internet companies along two primary dimensions: control (self-organizing or hierarchical) and value integration (low or high).

Control is about economics. Some Internet companies are hierarchical; they have a leader who controls the content of the value proposition, the pricing, and the flow of transactions. General Motors designs and leads the integrated supply networks to produce preconceived products. Retailers like Amazon.com function hierarchically, taking responsibility for product selection, pricing, and customer satisfaction. Other Internet companies self-organize. The market and its dynamics define the value and price of goods and services. Open-source software follows no management-imposed blueprint, because the product evolves through an organic development process open to all programmers. In stock exchanges and other types of auctions, the participants, not a

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[22] Steven Kaplan and Mohanbir Sawhney, *E-Hubs: The New B2B Marketplaces,* Harvard Business Review, May-June 2000, 99.
[23] Don Tapscott, David Ticoll, Alex Lowi, *Digital Capital – Harnessing the power of business webs,* Harvard Business School Press, 2000, 28.

single leader, drive content and price. Anyone can sell anything on an eBay auction. Trading activity in the stock market continually responds to internal and external forces, whether a crisis of confidence in Asia, a speech by Alan Greenspan or a stampeding herd of institutional investors.

Some Internet companies focus on high value integration, that is, facilitating the production of specific product or service offerings (like cars, computers, consulting services) by integrating value contributions from multiple sources. Tapscott defines value as the benefit that a user gains from a good or service. Dell achieves high value integration by taking contributions from many suppliers and turning them into a computer. Other Internet companies focus on selection (low value integration), that is, providing a basket of choices rather than a single integrated solution. Ingram Micro, a leading wholesaler of computer hardware and software, does not alter the product offering. It focuses on distributing high-tech products, not making them. It currently offers products from more than 1,500 manufacturers. In between high and low value integration lie services like Instill, a restaurant industry supplier, which aggregates online catalogs from food producers, but also manages part of the restaurant supply chain, reducing inventory and minimizing stockouts.

These two parameters (economic control and value integration) define the characteristics of the e-World trends we will examine in the next section. As illustrated in Figure 2, Tapscott uses fives designation to classify Internet ventures: Agoras (e.g. eBay), Aggregation (Amazon.com), Value Chain (Dell Computer), Alliance (Linux) and Distributive Network (Enron). In an effort to cover most aspects of the e-World, we will focus our attention on four cases: Dell Computer Corporation, eBay, Inc., the Linux phenomenon and Enron.
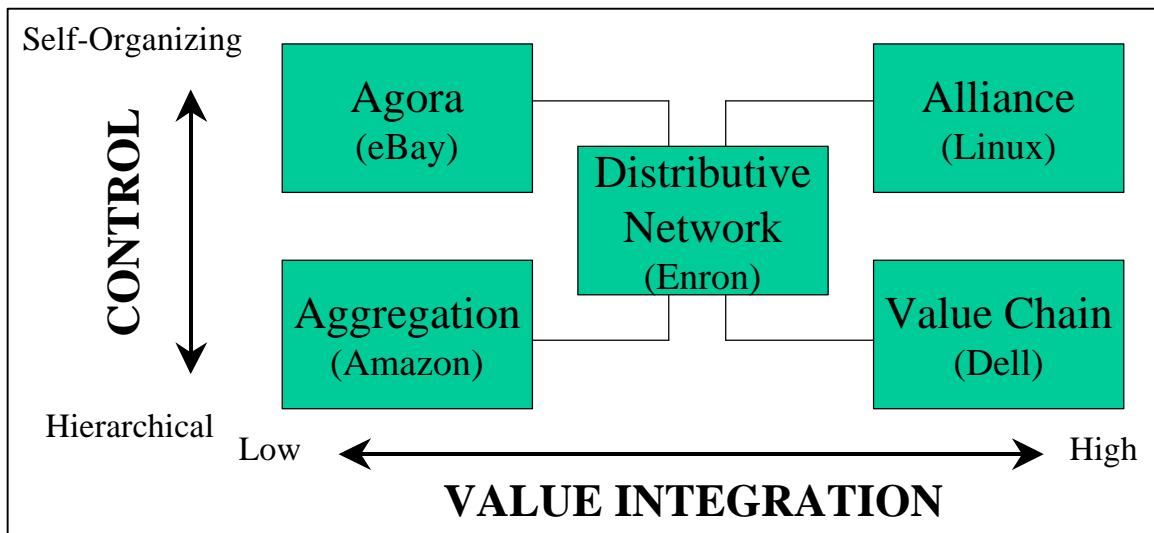
Figure 2: Tapscott's control/value integration matrix

2   Case Study #1: Dell Computer Corporation

"I believe we have the right business model for the Internet age."

-Michael Dell, CEO, Dell Computer Corporation[24].

2.1   Overview of The Dell Computer Corporation

Michael Dell founded Dell Computer Corporation in 1984 with $1,000 and an unprecedented idea in the personal computer industry: bypass the middleman who adds little value to the products, and sell custom-built PCs directly to end-users.

By using this innovative direct-marketing approach and by pioneering the industry's first service and support programs, Dell Computer Corporation has established itself as one of the top vendors of personal computers worldwide and is a premier provider of products and services required for customers to build their Internet infrastructures. Today Dell is

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[24] "Dells paves the Way for a New Level of Direct Economics and Customer Benefits" 14 April, 1997

the world's number one direct seller of computers. In 16 years, the company's sales have grown from $6 million to $32 billion for the past four quarters.

Since its first international subsidiary opened in the United Kingdom in 1987, Dell has opened sales offices in 34 countries around the world, and its approximately 40,000 employees serve customers worldwide[25].

The latest global innovation to come from Dell is its leadership on the Web. Dell on-line was launched in 1997 and in the first quarter of 1997 Dell reported online sales of US$1million. August 1999 daily online sales had reached $30 million[26]. Today Dell's website features about 80 country-specific pages draws $40 million in computer sales daily and processes up to half of the company transactions[27].

With an average annual sales increase of almost 60% for the past decade[27], Dell is acknowledged to be the largest online commercial seller of computer systems.

The purpose of this case study is to understand the unpreceded success of Dell.

2.2   The Personal computer market in the 1980s

In 1980, the majority of computer sold were mainframe computers (about 75% of industry volume), the rest were minicomputers. Within a decade this picture had changed. By 1990, the industry was dominated by personal computers, which accounted for 40% of the volume.

Over the course of a decade, personal computers had zoomed from birth to a $40 billion industry in the States. This growth was fueled by dramatic breakthroughs in processing and storage technologies. The cost of processing a million intructions per second (MIPS)

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[25] From Michael Dell biography, URL:
http://www.dell.com/us/en/gen/corporate/biography/biography_generic_michael_dell.htm
[26] Center for Asian Business Cases, School of Business, the University of Hong-Kong, "Dell: Selling Directly, Globally"
[27] Hoover's Inc., Dow-Jones Interactive, Dell Computer Corporation – Company background information (February 2001)

fell from \$75,000 in 1980 to \$10,000 by 1985 and further down to \$2,000 by 1991[28]. Along with this breakneck growth also came a tremendous churning of the personal computer industry. Literally, hundreds of manufacturers and distributors entered this industry with high hopes for success only to leave as paupers a couple years later. Even those who successfully bore up against this disaster found their margins severely decreased by 1991.

> "Computers have become commodities… Once an icon of technological wizardry, personal computers have become a commodity… The price of a complete computer system is being dragged down to the sum of its parts…And customers are less willing to pay for service and hand-holding."

> *-The Economist*, November 2, 1991

Dell Computer Corporation is one of the rare exceptions that weathered the storm successfully.

2.3   The Story of Dell

The founding companies of the industry (IBM, Compaq, HP) had no other choice but to create their computers from scratch. They needed to manufacture each single component themselves: disk drives, memory chips, and application software. For this reason, all the various pieces of the industry had to be vertically integrated within one firm. Digital Equipment, for example, had to become expert in a wide array of components. These activities did not create any value but were unavoidable given the current capabilities within the company, which we refered to as type one muda in the Lean introduction of CHAPTER 1.

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[28] "Dell Computer Corporation" Harvard Business School, September 25, 1996

The tremendous expansion of the industry caused more and more companies to specialize in specific manufacturing components. The competition soon became very intensive and for a small start up at the time, the key question was: how do we enter that market?

Dell's original strategy was to sell directly to their customers by combining manufacturing and distribution channel operations. The Dell model, as it is today, relies on three main principles: selling directly, focusing on customers, and integrating the whole value chain. These three strengths are the core competencies of Dell that we will analyze more in detail in the following sections.

2.4   The Direct Business Model

Dell's now famous Direct Business Model was radically different from the traditional engineering-centric view of the rest of the industry.

Dell, a small startup in the mid 1980s, could not afford to create every piece of the value chain as IBM and HP were doing. Michael Dell had started as a university freshman to assemble computers for midsize companies and did not see the interest in/the benefits of entering the same highly competitive market as everybody else was doing. As he himself explains: "in graphic chips, there were about 20 players 10 years ago. In those circumstances, do you want to be the 21st player or evaluate the field and pick the best?[29]"

Thus initial strategy was to leverage the investments others had made to deliver solutions and systems to customers. A key element of this strategy was to bypass the middleman reseller. For this purpose, sales were primarily generated through advertising in computer trade magazines and, eventually in catalogs.

The resulting build-to-order model enabled Dell to start the production cycle that began after the company received a customer's order, and created an efficient customer-pull: one of Womack's 5 Lean principles (see "Lean Thinking" in CHAPTER 1).

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[29] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p74

The benefits of this model were exceptional: by the mid 1990s, Dell's work-in-process (WIP) and finished goods inventory as a percent of total inventory ranged from 10% to 20%[30]. This contrasted sharply with the industry leaders, such as Compaq, Apple and IBM, whose WIP and finished goods inventory typically ranged from 50% to 70% of total inventory, not including inventory held by their resellers[31].

As a consequence of the initial Direct Business Model strategy, Dell reached a period of hyper growth. The reasons of its extraordinary growth were also its superior flexibility of labor and capital assets. Of course Dell had almost no physical assets but that also meant they did not need to move and constantly adapt a 50,000 people organization. In a fast moving industry, it was thus much easier to get more capacity from the cutting edge suppliers. Growth at 57% a year would certainly have been impossible if Dell had had to build its own factories – "I would spend 500% of my time interviewing prospective vice presidents because the company would not have 15,000 employees but 80,000."[32]

Dell's Direct Business Model created an efficient customer-pull system and allowed Dell to reach an unpreceded rate of growth in the industry. The two other main strengths of Dell are its customer focus and its ability to integrate the value chain.

2.5   Customer focus

Customer focus at Dell is threefold and relies on the following principles: understanding customer needs, keeping close customer contact and managing tight customer segmentation. As a consequence, Dell masters customer value creation.

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[30] I am thankful to Khusrow Uzair for clarifying this point. Total inventory also includes office supply inventory and raw material inventory. Since the rate of obsolescence of WIP and especially of finished goods is very high in the PC industry, low WIP and finished goods as a percentage of total inventory is an indicator of Dell's efficiency.

[31] From HBR August 2000, "Dell's working capital", p1

[32] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p75

2.5.1 *Understanding customer needs*

Understanding customer needs for Dell Corporation means being able to anticipate what customers want in order to create the best customer service. Dell was the first in the industry to provide toll free telephone and on-site technical support in an effort to differentiate itself in customer service[33].

The Direct Model enabled Dell to have a direct contact to their customers and therefore avoid noise in the information they received from them. Michael Dell explains that the feedback system in traditional value chain for automobile distribution can actually lead to misinformation[34]: "If you have three yellow Mustangs sitting on a dealer's lot and a customer wants a red one, the salesman is really good at figuring out how to sell the yellow Mustang. So the yellow Mustang gets sold, and a signal gets sent back to the factory that, hey, people want yellow Mustangs."

Dell's extreme ability to understand its customer is a consequence of its efforts to keep customer contact as close as possible.

2.5.2 *Close customer contact*

Close customer contact at Dell is done primarily through its Premier Pages and its Platinum Councils.

The Premier Pages are customized intranet sites for over 200 of Dell's largest global customers. They are located securely within the customers' firewalls, and they give them direct access to purchasing and technical information about the specific configurations they buy from Dell. One of Dell's customers allows its 50,000 employees to view and select products on-line. They use the Premier Page as an interactive catalog of all the configurations the company authorizes; employees can then price and order the PC they want. As a result, Dell's salespeople are freed to play a more consultative role.

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[33] From HBR August 2000, "Dell's working capital", p1

[34] "The dot.com within Ford", *US News & World Report,* 7 February 2000, 34

The Platinum Councils are regional meetings – in Asia-Pacific, Japan, the United States, and Europe – of Dell's largest customers. They meet every six to nine months; in the larger regions, there is one for the information executives – the CIO types – and then there is one for the technical types. In these meetings, Dell's senior technologists share their views on where the technology is heading and lay out road maps of product plans over the next two years. There are also break out sessions and working groups in which Dell's engineering teams focus on specific product areas and talk about how to solve problems that may not necessarily have anything to do with the commercial relationship with Dell. For example, "Is leasing better than buying?" or "How do you manage the transition to Windows NT?" or "How do you manage a field force of notebook computers?" Another advantage for the customers is the possibility to learn from each other since even very different businesses may have very similar problems when it comes to PCs.

As a concrete benefit of this strategy, Michael Dell mentions[35]: instead of having desktop engineers who operate on the theory that customers want performance, Dell concentrated on intergenerational product consistency over many years since customers had expressed the need for more stability rather than more performance. "Yeah, performance is okay. But what I really want is a stable product that doesn't change. Because if I'm trying to run a bank or an airline, I don't care if it's 2% faster or 3% slower. What really matters is stability".

Close customer contact is a key element that enables Dell to pursue a powerful customer segmentation strategy.

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[35] Michael Dell reporting customers' feedback during a Platinum Council. From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell"

2.5.3   *Customer segmentation*

"Computer giant Dell focuses on the process of rapid reorganization (or patching) around focused customer segments. A key How-to rule for this process is that a business must be split when its revenue hits $1 billion[36]."

One key aspect of customer segmentation is to recognize that each segment has its own issues. For example, in education, a teacher does not necessarily have a phone in her classroom, which makes her difficult to reach. Dell managers become more and more specialized to be able to understand and address each customer's needs. Customer segmentation enables to forecast capacity and customer's needs.

Capacity forecasting is crucial for the direct model. Getting inventories to turn 30 times in year[37] would certainly be impossible for any company without sharp forecasts of customer needs and expectations. Sales account managers lead customers through a discussion of their future PC purchase. Dell walks each customer through every department of his company, asking him to designate which needs are certain and which are contingent. In case they are contingent on some event, the salesperson will know what that event is so he can follow up. This is done with Dell's large accounts, which make up the bulk of their business. For smaller customers, salespeople gather real-time information about what customers are buying directly on the phone. Moreover, Dell's salespeople can steer customers in real time, on the phone, towards configurations that are available, which is another way Dell can fine-tune the balance between supply and demand[38].

As we mentioned earlier, Dell organized councils yearly with their large account customers.   These councils, with direct customer feedback, enable Dell to better

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[36] Kathleen M. Eisenhardt and Donald N. Sull, "Strategy as Simple Rules", HBR
[37] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell"
[38] and in that case, a customer won't necessarily obtain the exact computer she had in mind, but will still pay for the Dell service premium…

understand its customers. For example they made possible the early adoption of Pentium-based systems – "Dell beat the competition to the market place with Pentium-based products and was the first in the industry to achieve volume production of systems with the 120mhz Pentium processor"[39]. Also in July 1995, Dell became the first manufacturer to convert its entire major product line to the Pentium technology[40].

> "We sometimes know more about a customer's operations than they do themselves[41]"

Ironically, Dell's original strategy was to make no customer differentiation at all and treat all customers equally. This evolved towards a very elaborated customer segmentation strategy (Figure 3).
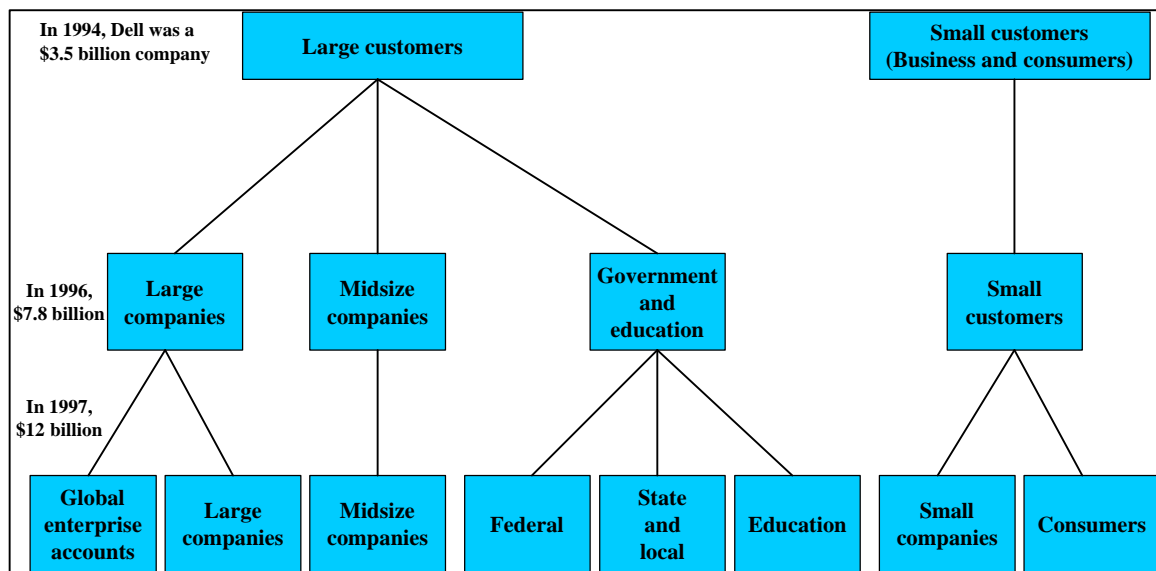
Figure 3: Dell's Fast-cycle Segmentation[42]

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[39] Anon, "Dell First to Ship Systems with the New Pentium Processor", *PR Newswire*, April 19, 1995
[40] Anon, "Dell Taking Orders for Factory-Installed Windows'95 on Dell Dimension Desktop PCs", *PR Newswire*, August 2, 1995.
[41] Michael Dell explaining how direct sells enables Dell to keep track of a customer's total PC purchases, country by country, From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p79
[42] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p78

In 1998, 90% of Dell's sales went to institutions (business or government) and 70% to very large customers that bought at least $1 million in PCs per year[43].

An interesting consequence of Dell's customer focus is its ability to deliver value to its customers.

2.5.4 *Four examples of customer value creation*

The following four examples illustrate Dell's customer value creation.

1st example: Eastman Chemical has its own unique mix of software, some of it licensed from Microsoft, some of it they have written themselves, some of it having to do with the way their network works. Normally they would get their PCs, take them out of the box, and then somebody carrying a walkie-talkie and diskettes and CD-ROMs would come to each employee's desk to set up the system and load the appropriate software. Typically, this would require one to two hours and cost $200 to $300. Dell's solution was to create a massive network in their factory with high-speed, 100-megabit Ethernet. They load Eastman Chemical's software onto a huge Dell server. Then when a machine comes down the assembly line and says: "I'm an Eastman Chemical analyst workstation, configuration number 14", all of a sudden a few hundred megabytes of data come rushing through the network and onto the workstation's hard disk, just as part of the progressive build through Dell's factory. If the customer wants, Dell can put an asset tag with the company's logo on the machine, and they can keep an electronic register of the customer's assets.   This solution is much simpler for the customer than sending somebody around on a thankless mission, placing asset tags on computer when he finds them.

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[43] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p77

What happens to the money Dell's customer is saving? Dell could charge them $250, arguing that its customer still saves $50. But instead they charge $15 or $20, and make their product and service much more valuable.

> "It also means we're not going to be just your PC vendor anymore. We're going to be your IT department[44]."

2nd example: Boeing has 100,000 Dell PCs, and Dell has 30 people that live at Boeing. Boeing account at Dell Corporation is large enough to justify a dedicated on-site team from Dell.

> "If you look at the things we are doing for them or for other customers, we don't look like a supplier, we look more like Boeing's PC department. We become intimately involved in planning their PC needs and the configuration of their network[44]."

At the Boeing Corporation, Dell almost plays the role of its own customer.

3rd example: Dell, for many of its customers, is the most efficient way to buy Intel of Microsoft technologies. But beyond that Dell is evolving into a technology selector, or navigator by helping customers to choose relevant technologies. "Intel and Microsoft tend to launch into a massive variety of things, some of which are speculative and aimed at exploring new technologies. We think it is our job to help our customers sort out the technology relevant to today's needs from the bleeding edge[45]."

4th example: the R&D department at Dell (1,500 people in 1998) works on 2 main domains: a) improving the whole user experience, that is selecting appropriate technology, delivering the latest relevant technology, making it easy to use and keeping costs down and b) focusing on process and quality improvements in manufacturing[45].

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[44]From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell" p79
[45] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell" p82

In conclusion, what Dell is really doing is an intensive use of technology to free people up to solve more complicated problems.

> "Remember, a lot of companies have far more complex problems to deal with than PC purchasing and servicing. They can't wait to get somebody else to take care of that so they can worry about more strategic issues[46]."

The third main strength of the Dell model is its value chain integration process.

2.6 Value chain integration – "virtual integration"

> "We are not experts in the technology we buy; we are experts in the technology of integration."

> Dick Hunter, Director, Dell Corporation's supply-chain management

What exactly does value chain integration mean? We could define it as: A process of collaboration between all the stakeholders of an enterprise that optimizes both internal and external activities involved in delivering value to the end customer[47]. Value chain integration at Dell Corporation is the combination of two principles: disdain of inventory and supplier partnerships.

"With vertical integration, you can be an efficient producer as long as the world isn't changing very much. But virtual integration (see

Figure 4) lets you be efficient and responsive to change at the same time – at least that is what we are trying to do.[48]"

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[46] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell" p80

[47] Adapted from John Dobbs of Cambridge Technology Partners, a leading systems integrator, quoted in the Economist's June 1999 survey on "Business and the Internet".

[48] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p83

The **dominant model in the personal computer industry** – a value chain with arms-length transactions from one layer to the next:

| Distribution channels | Distribution channels | Distribution channels | Distribution channels |

Dell's direct model eliminates the time and cost of third party distribution:

| Distribution channels | Distribution channels | Distribution channels |

Virtual integration work even faster by blurring the traditional boundaries and roles in the value chain:

| Distribution channels | Distribution channels | Distribution channels |

Figure 4: The evolution of a Faster Business Model[49]

2.6.1   *Disdain inventory*

"[Inventory is]… the physical embodiment of bad information."

Paul Bell, Director, Dell Computer Corporation[50]

Dell's metrics for inventory is what they call *inventory velocity*. It basically changes the focus from "how much inventory there is" to "how fast is the inventory moving". A concrete result is that Dell has 11 days of inventory against 80 for its competitors[51]. Thus when Intel comes out with a new processor, Dell is 69 days in advance on the market. Once again, Dell provides a clear illustration of customer-pull as it is defined by in the Lean enterprise.

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[49] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p82

[50] In 2000, Paul Bell was running Dell Computer's operations in Europe, the Middle East and Africa

[51] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p76

For example, monitors from Sony do not get out of their boxes before they reach the customer. Dell considers that extra testing would be a loss of time and resources since Sony monitors have under 1000 defects per million[51].

In order to keep a close eye to inventory velocity, inventory levels and replenishment needs are communicated regularly (hourly with some vendors), which is simple since Dell has only three centers worldwide: Austin, Ireland and Malaysia. Besides, demand forecasts are precise because of a large customer mix: no customer represents more than 1-2% of Dell's revenues[51] and their needs are not correlated. A huge benefit of this regular information update is that it avoids the bullwhip effect[52].

Dell's focus on inventory velocity is a way to minimize asset risks. Assets are comprised of inventory and accounts receivable. Since most of Dell's customers are large companies, accounts receivable typically do not bear much risk. Accounts receivable from Goldman Sachs or Microsoft for example are seldom a source of concern. Inventory value however can drop dramatically and very fast. The PC industry has a very short product lifetime, and in turn inventories lose value rapidly. For example, in the mid-1990s, Dell maintained an inventory of components. The cost of components, such as processor chips, comprised about 80% of the costs of a PC[53]. As new technology replaced old, the prices of components fell by an average of 30% a year[54].

Another advantage of keeping low finished-goods inventory is that is made it unnecessary to dismantle PCs to replace the microprocessor when Intel Corporation discovered its Pentium chip was flawed in 1994. Dell was able to quickly manufacture systems with the "updated" Pentium chip while others (i.e. Compaq) were still selling

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[52] The expression "bullwhip effect" illustrates that the longer the time lag between the point of demand and the point of supply, the more variability, the more inventory, the higher costs and the more risks there is in the chain

[53] From HBR August 2000, "Dell's working capital", p2

[54] From The Economist: " Selling PCs like bananas", October 5 1996, p63

flawed systems from inventory[55]. In July 1995, Dell became the first manufacturer to convert its entire major product line to the Pentium Technology[39].

Similarly, Dell was able to begin shipping its Dell Dimension systems equipped with Microsoft Corporation's new Windows 95 operation system on August 25, 1995 – the very day Microsoft launched the product. As a direct marketer, Dell was able to bring new component technology to the market with an average of 35 days – a third of the time it took competitors to move a new product through indirect channels[56].

An impressive result of Dell's focus on inventory velocity is their negative cash conversion cycle[57], which basically means that they get paid by their customers before they pay their suppliers[58].

But Dell's successful value chain integration is not only a consequence of its tight inventory management. Its partnerships with key suppliers are the other key to its success.

2.6.2   Supplier partnerships

> "I'm only half joking when I say that the only thing better than the Internet would be mental telepathy.[59]"

> Michael Dell, Harvard Business Review.

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[55] From HBR August 2000, "Dell's working capital", p4

[56] Judy, Hard, "Runaway Horse: Michael Dell wants to rein in growth; shareholders want whip", *Financial World*, October 24, 1995, p.36.

[57] Cash Conversion Cycle = Days Sales of Inventory (DSI) + Days Sales Outstanding (DSO)– Days Payables Outstanding (DPO)
DSI = Net Inventory / (Quarterly Cost of Goods Sold / 90)
DSO = Net Accounts Receivables / (Quarterly Sales / 90)
DPO = Accounts Payables / (Quarterly Cost of Goods Sold / 90)

[58] Kevin Rollins, vice chairman of Dell Computer Corporation, "Using Information to Speed Execution", HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p81

[59] From HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p83

Modern information technology enables Dell to share design databases and methodologies with supplier-partners. As a consequence, time to market is dramatically diminished and the resulting value is shared between buyers and suppliers. Quality measures are set with service providers to enable real time evaluation and total transparence in the whole supply chain. For example, everybody can see immediately when parts are dispatched, how long it takes to respond to a request for service.

Suppliers'engineers are assigned to Dell's design team and Dell treats them as if they were part of the company. When a new product is launched, suppliers'engineers are stationed right in Dell's plants. If a customer calls with a problem, Dell then stops shipping products while they fix the problem in real time.

Figuring out how many partners are needed is a process of trial and error following the rule that fewer suppliers is better. Having only a few partners enables Dell to inform them precisely about components' defects so they can redesign the components. The whole process eliminates poor quality and therefore friction in the system. "Clearly we could not operate that way if we were dealing with hundreds of suppliers. So for us, working with a handful of partners is one of the keys to improving quality – and therefore speed – in our system[60]."

It is important to note that the whole work of supplier coordination is taken very seriously. At Dell Corporation, the R&D department spends a substantial part of its time on optimizing process coordination.

Dell recognizes that all partnerships are not to be treated equally. The length of supplier relationships highly depends on the stability of the underlying technology. Monitors, for example, are a fairly stable technology. Memory chip technologies, on the contrary, are

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[60] Kevin Rollins, vice chairman of Dell Computer Corporation, "Using Information to Speed Execution", HBR March-April 1998, "The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell", p81

evolving fast, which makes Dell much less willing to commit to a long-term partnership with memory chip manufacturers.

2.7   Conclusion

Modern information technology is clearly a key enabler of Dell's business model. However its direct business model was Dell's initial strategy rather than a consequence of Internet technologies.   In fact, Dell's business model exhibits clear lean characteristics such as customer pull, product flow and muda elimination.   One question remains unanswered: would Dell's direct business model still have succeeded without the IT revolution?

3   Case Study #2: eBay, Inc.

"eBay is in a position to give back to America what Wal-Mart took away – the notion of the Main Street Merchant. Mom and Pop running their little shop, doing business with other people and making a living at it, and feeling good at it."

Bob Kagle, Benchmark Capital

3.1   Today's big picture

Today eBay is the world largest and most popular person-to-person community on the Internet[61]. It has furnished the world with a forum for the sale of nearly 4,500 categories of merchandise. Its some 16 million registered users can buy and sell goods ranging from Beanie Babies to antiques from the comfort of their Web browsers. In a bid to foster a sense of cyber-community, eBay has added features such as chat rooms and bulletin boards to its Web site. It also has launched more than 50 smaller, location specific marketplaces around the US so users can purchase large items more easily. In addition,

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[61]Harvard Business School, September 28, 1999, *eBay, Inc*., p.1

the company launched a business-to-business service, eBay Business Exchange that auctions more than 60,000 goods (personal computers, industrial goods) to small businesses. eBay elevated its prestige factor through the acquisition of old-guard auction house Butterfields. The company generates revenue through listing and selling fees, as well as through advertising on its Web site (in partnership with AOL Time Warner).

3.2   Overview/History[62]

Given eBay's success, it is hard to believe that the company evolved out of a pet project. It all started with a conversation between 31-year-old founder, Pierre Omidyar[63], and his (now) wife about her collection of Pez dispensers. Frustrated that she could not readily find other people with Pez dispensers to trade, she wished that there were a way to connect with others over the Internet. A Web enthusiast in his free time, Omidyar developed a program that would allow his wife and other collectors to trade items over the newly emerging Internet. His Web site, called Auction Web, was launched in September 1995, and held its first auction on Labor Day. Making a name for itself largely through word of mouth, the company incorporated in 1996, the same year it began to charge a fee to auction items online. It also enhanced its service with Feedback Forum (buyer and seller ratings) that year.

The company changed the name to eBay in 1997 and began promoting itself through advertising. By the middle of that year, eBay was boasting nearly 800,000 auctions each day and Benchmark Capital came on board as a significant financial backer.

Margaret Whitman, a former Hasbro executive, replaced Omidyar as CEO in early 1998. eBay made a blockbuster debut as a public company later that year. The company moved closer to household name status in 1998 by launching a national ad campaign and inking alliance deals with America Online (now AOL Time Warner) and WebTV.

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[62] All figures from Hoover's Inc, Dow Jones Interactive

[63] Omidyar was a services development engineer at General Magic, a mobile communication platform company, when he created Auction Web. Source: HBR, September 1999, *eBay, Inc*.

eBay showed its acquisitive streak in 1999 with purchases of Alando (online auctions in Germany) and Billpoint (person-to-person credit card technology). It also made one of its first investments in an outside company with the purchase of 6% of TradeOut.com, an online seller of corporate surplus materials. The company set the jewel in its 1999 acquisition crown when it acquired upscale auction house Butterfield & Butterfield (now just Butterfields). eBay also expanded through a joint venture with Australia-based ecorp (formerly PBL Online). A bit of the bloom came off the rose in 1999 when online service interruptions (one "brownout" in June persisted for 22 hours) revealed a chink in eBay's armor. The company called its top 10,000 users to convey its apologies and pledged to improve its Web site's performance.

In 2000 eBay agreed to develop person-to-person and merchant-to-person auction sites for Disney's GO Network, announced plans to distribute information through wireless products, and joined with banking giant Wells Fargo to offer eBay sellers the option of accepting online checks. Also that year the US Department of Justice began an investigation to determine if eBay has violated antitrust laws in its dealing with competitors. In other legal news, a class-action lawsuit was filed against the company claiming that eBay is an auctioneer and therefore must authenticate the items on its site. (The case was dismissed by a trial court in early 2001; plaintiffs have said they will appeal.)

Also in 2000 the company expanded into Japan through 70%-owned eBay Japan (computer firm NEC owns the rest) and launched Canadian and Austrian sites. In addition, eBay took an equity stake in Online used-car dealer AutoTrader.com and launched a co-branded used-car auction Web site. It also acquired Half.com, an online trading community with 250,000 registered users.

3.3   EBay's business model

Since the online consumer auction market drew from a number of different offline trading formats, including auctions, collectable shows, flea markets, garage sales and classified adds, it is difficult to accurately size eBay's market. Nor is it easier to evaluate

Ebay's share of this market. In an April 1999 report, Salomon Smith Barney estimated eBay would control 75% to 80% of the estimated year 2000 $3.7 billion virtual person-to-person auction market[64].

Unlike many other e-commerce companies, eBay does not rely on advertising to generate revenues. eBay generates revenues in two ways. First, listing and special placement fees, the fees sellers paid for listing their items, account for about 45% of eBay's revenues. Second, final value fees, a percentage of final sale price of item[65], accounts for about 55% of revenues.

The strength of eBay's business model relies on three characteristics: its new value creation proposition (management and regulation of the mechanisms for setting prices and allocating goods), the social aspect of the eBay community, and its trust environment.

3.4   New value creation: creating liquidity

"The transaction is the means to the price rather than the price a means to the transaction[66]."

Charles Smith, author of *Auctions: The Social Construction of Value*

Liquidity is generally defined as the ease of converting assets into cash. eBay achieves liquidity by matching buyers and sellers and facilitating price discovery, whereby buyers and sellers cooperate and compete to arrive at a mutually acceptable deal.

Tapscott, author of *Digital Capital*, compares eBay's business model to ancient Greece Agoras[67]. Agoras, whether classified ads or spot markets, historically served a special

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[64] Richard Zandi and Mark J. Rowen 'Equity Research: United States Electronic Commerce: eBay, Inc." *SalomonSmithBarney* (April 7, 1999): 18.
[65] Harvard Business School, September 28, 1999, *eBay, Inc.*, p.5
[66] Charles Smith, interview by Alan Mayer, Alliance for Converging Technologies, December 1998.
[67] Don Tapscott, *Digital Capital: harnessing the power of business webs*, Harvard Business School Press, 2000, 40

distribution function for goods of uncertain or volatile value: unique, distressed or perishable items and commodities for which supply and demand fluctuate continually. These goods are unsuited to traditional fixed-price model (there is no list price); their value makes it cost effective to sell low-end items that would not be worth a $25 classified newspaper ad. "You are lowering the cost of transactions, so more transactions will happen.[68]"

Besides the liquidity creation, eBay offers other sources of utility for customers among which are: convenience, low distribution and marketing costs, lots of information about all aspects of the deal, and entertainment – the thrill of the chase, "Many eBay participants simply write off their purchases as the cost of an evening's entertainment[69]".

The second strength of eBay and on which depends any agora is the social and community life that thrives on eBay online.

3.5 Social/community aspect

Ebay's community life is THE key element to insure what marketing strategists call stickiness, the intangible incentive that keeps customers coming back again and again to a given company's services. eBay appears to be more that just a finely automated auction service. In addition to providing a venue for selling items, eBay provides buyers and sellers a place to socialize, to discuss topic of common interest, and to provide feedback to one another. All these features were designed to foster a large and growing commerce-oriented online community. In December 1998, eBay ranked second to Yahoo! in total monthly usage hours, according to Media Metrix and its audience reach had increased 200% between April 1998 and February 1999.

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[68] Penelope Patsuris, "One-to-one auctions, "The Forbes Digital Tool (January 16, 1998): http://www.forbes.com/tool/html/98/jan/0116/side1.htm
[69] Don Tapscott, *Digital Capital: harnessing the power of business webs*, Harvard Business School Press, 2000, 42

EBay users are as vital to the company's success as its business model. Referring to themselves as "eBay people", eBay users embrace the site as their own, creating a 24-hour a day collector community online. It is that community that eBay strived to cultivate.

> "From the start, eBay's business has been based on the strength of our community. Over time, interpersonal relationships have developed and those relationships make people loyal to one another. It's similar to the growth of a little town.[70]"

> Jeffrey S. Skoll, VP Strategic Planning and Analysis, eBay Inc.

Community is often merely a new kind of marketing tool, a sticky device to capture customer attention. However, in eBay community is a central functional design element. The participants have implicitly agreed to engage in a self-organizing group process to discover the price and allocation of goods, that is the "social construction of value.[71]"A service like eBay requires voluntary and collective participation, which makes it much more challenging a business to construct than traditional retail.

Mary Meeker, an analyst with Morgan Stanley Sean Witter, believes that high switching costs and community values played an important role in eBay's successful community. After using eBay for just a short time, users become actively involved in e-mail dialogues; their reputations on the systems are built as other users observe their actions and rate their reliability; and users come to know the ins and outs of the system. Because of this, Meeker feels that once someone becomes an eBay user, there are not many reasons to go elsewhere[72].

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[70]John M. Moran, "The bids are in growing numbers of Internet users drawn to online auctions", *The Hartford Courant* (January 22, 1998): F1

[71] Charles Smith, *Auctions: The Social Construction of Value* (Berkeley: University of California press, 1990)

[72] Mary Meeker, "eBay (EBAY): Initiating coverage of EBAY with outperform", *Morgan Stanley Dean Witter Report* (September 24, 1998)

Stories about eBay users helping one another prevail. One of the most famous is certainly that about the disappearance of this woman who provided information about dolls (e.g. where to find a missing shoe, who to speak about a type of doll). Those in the doll community who had come to know and value this woman became quite worried. When they tracked her down they learned that she had gone through a divorce, her husband had the computer, and she did not have the money to buy a new one. Because the doll community missed her and wanted her back online, a group of them pooled together to purchase a computer for her.

3.6   Trust and Safety - Security (antifraud) policies

As Meeker notes, the eBay community is self-policing, and users frequently form "neighborhood watch" groups to help guard against misuse or violations of site etiquette. However self-regulation processes soon became a major concern for eBay's top managers.

> "Depending on what the environment is, different things become important. In December, I would not have been able to tell you that trust and safety was going to be what we did in January, February, and March."

> Meg Whitman, President and CEO, eBay

In the early days of eBay, the mentality was to let the online auction regulate itself. There was therefore no control of exchanged content. However as the company became well known, the press started to challenge them about sensitive and sometimes illegal items on their site (e.g. kidneys, assault weapons, drugs, Nazi memorabilia). At first eBay managers neglected the press. They had never proactively screened the site; if people identified illegal items, they would just take them down, but never did they proactively go out to do it themselves. Then the video game community entered the debate and with the IDSA (Interactive Digital Software Association, one of the most vigilant protectors of human intellectual property rights), they argued they should adopt a more proactive stance and threatened to sue the company. This issue had never been a

number one priority and initially eBay managers were confident that they were protected by the Digital Millenium Copyright Act. True but the issue was elsewhere. eBay managers rapidly understood that rumors were threatening the core value of their business (the character of the company): trust among eBay users. They reacted by being very vigilant and proactive, helping public authorities protect intellectual rights. They told the ISDA they were going to help them screen and developed technology tools to do automatic keyword searches that allowed them to identify auctions before they entered their site[73].

Trust (of other participants) and authentication (getting what you expect) are big issues in any *Agora*. Newspaper classifieds are risky form beginning to end: the publisher takes no responsibility for the authenticity or quality of the goods or the trustworthiness of the parties to the transaction. Meanwhile, high-end auction houses like Christie's and top financial markets like the New York Stock Exchange assure trust and authenticity and vouchsafe the completion of transactions. But even these markets deny accountability for the true value of a good.

eBay's solution to the trust problem is the Feedback Forum. Buyers and sellers can rate each other by writing one-line reviews of one another's performance. Some regulars have accumulated thousands of positive comments. Through this grassroots mechanism, these isolated individual and small businesses have built enduring global brands in cyberspace. Instance of fraud do occur, but eBay provides a small financial warranty, and fee-based escrow service, and authentication services for high-end product categories.

The Feedback Forum, already the largest public repository of customer opinion in the world, is eBay's core human capital asset. If a lack of trust can definitely ruin a company's business, eBay's example shows how to turn trust into a powerful strategic advantage.

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[73] 250,000 new items were posted daily. HBR eBay case, 7

3.7 Conclusion

eBay's business model exhibits three main characteristics. First, it illustrates the potential of utilizing Internet technologies to create new value to customers. Skeptics might object that eBay has simply created a new market based on another channel. We prefer to argue that Pierre Omidyar used his knowledge to create value that automatically found its buyers. Second the eBay model shows the power of community effects. eBay successfully weathered the storms of new entrants in its market thanks to its strong community of users. Finally eBay illustrates the importance of trust on a virtual environment where users converse and often collaborate.

4 Case Study #3: The Linux Phenomenon

"The [open-source] world behaves in many respects like a free market or an ecology, a collection of selfish agents attempting to maximize utility which in the process produces a self-correcting spontaneous order more elaborate and efficient that any amount of central planning could have achieved.

Given a large enough beta-tester and co-developer base, almost every problem will be characterized quickly and the fix obvious to someone."

Eric Raymond, *The Cathedral and the Bazaar*

4.1 History of the Linux phenomenon

Early in 1991, a twenty-two-year-old Finnish university student named Linus Torvalds confronted a dilemma. He wanted but could not afford market versions of Unix, a powerful and flexible operating system costing $5,000 for the software and another $10,000 for a specialized workstation. As a result, he decided to build a Unix clone for a PC and designed a simple kernel (the core of the operating system).

On October 2, 1991, Torvalds posted the first working version – Linux .02 – on Usenet, the Internet's global information-sharing resource at the time. He dared others to try his

program that he later patented under the Free Software Foundation's general public license. The license made Linux free and available to all and required anyone who passed it along to include the source code.

An initial hundred or so programmers seized on the idea, each testing the code, commenting back, and proposing changes. Tovalds incorporated what worked and usage mushroomed. By 2000, Linux, complex to set up and manage but free for the asking, powered an estimated 20million servers around the word. Microsoft acknowledged it as a challenge to Windows. A stable, reliable, highly functional product, Linux powered Web sites, email services, and useful real-world applications. Top technology companies like Dell, Hewlett-Packard, Intel and IBM lined up to endorse it. Stock prices of Linux software companies like Red Hat, Corel, and Cobalt Networks took off. The product had shifted from a hacker's dream to commercially viable technology, with lots of money to be made.

The dream of Linus Torvalds was clearly made possible by the Internet, thanks to which network effects could effectively take off. The purpose of this case study is to illustrate how the Internet can foster environments where contributors work towards a common goal using creative collaboration. First it examines the new design paradigm exhibited by the Linux phenomenon and second it shows how other companies have already started to successfully imitate the same model.

4.2 A new design paradigm: the 3 design principles of the Linux phenomenon

The Linux phenomenon is really intriguing and its mechanisms are highly debated. How does such a loose collection of well-meaning souls manage to achieve coherent results? As Tapscott argues, "designers, whether of physical goods (e.g. cars, toothbrushes), technology (computer software), or abstraction (e.g. business strategy), tend to have a linear view of the design process. Define your needs, do a high-level design, and then do a detailed one. Create a prototype, then the item. Test before deploying on a large scale.

And […] keep the team as small and as focused as you can, because there is a law of diminishing returns in design teams. Software engineers have for nearly thirty years sworn by Brooks's law which states that as the number of program developers increases, the number of bugs increases exponentially. Beyond the minimum number required to get the job done, adding people produces a result that is late, of inferior quality, and over budget."

What was different in the Linux phenomenon then? Eric Raymond gives three design processes principles as an explanation[74]. 1) Treating your users as co-developers is the least-hassled route to rapid code improvement and effective debugging. 2) Release early. Release often. And listen to your customers. 3) Given enough testers and co-designers, almost every problem will be identified quickly; the fix will become obvious to someone.

4.3 Companies building on the bazaar model[75]

4.3.1   *Software development*

For-profit companies have recognized the power of the Net-enabled bazaar model and, in 1998, began to adopt it. Sun opened its Java offering to customer innovation, and Netscape published the source code to its browser.

Similarly, Wintel (Windows/Intel) generates real cash in exchange for tangible value, namely: Windows-Compatible Solution. The participants create collections of modular goods, which match needful users to an integrated outcome. Each participant is an autonomous producer (Cisco/Dell/GM…) and the producers adhere to common standards to ensure compatibility and connectivity.

Arguably, software development is a special case, what Tapscott calls a "gift economy" in which producers improve their tools as they use them. They fix bugs because they

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[74] Eric Raymond, *The Cathedral and the Bazaar",* available on the Web at:
http://www.tuxedo.org/~esr/writings/cathedral-bazaar/
[75] Tapscott, *Digital Capital – Harnessing the Power of Business Webs,* 129-138

need to use the software personally. As will be discussed in CHAPTER 5, the mechanisms of the Linux phenomenon are still very controversial.

4.3.2   Automobile design

General Motors collaborates with its electronic marketplace to design cars using three-dimensional visual prototypes that it distributes via the web. Participants include style-conscious customers, fleet buyers, knowledgeable service technicians, supply-chain partners, dealers, car buffs, and industrial designers. These participants are motivated to provide the "gift" of their advice because they love cars, enjoy interacting with the b-web community, and gain pleasure from influencing the design of a future car. When General Motors adopts an idea, it publicizes the news to the community, enhancing the reputation of the contributor. The manufacturer returns the favor by providing buyers rebates based on the quality and quantity of contributions.

4.3.3   Online help services

Amazon.com uses collaborative filtering to help customers choose books. Its software creates anonymous "recommendation" communities of readers and music fans who share similar interests. It produces a reading list just for you, choosing purchases by other customers who bought the same books as you did

Similarly, Cisco's engineers monitor and contribute to various online technical support forums in which its customers provide one another with tips and advice. This is in addition to the large volume of online documentation that the company provides on its own Web site. Cisco's help desk increases customer engagement and loyalty while reducing its costs: the company estimates that its online support environment enables it to avoid hiring four hundred engineers each year.

4.4   Conclusion

The Linux phenomenon exhibits very singular properties. Its profound mechanisms are unclear but Raymond's three design process principles are very compelling. In addition,

evidence of for-profit companies building on the same model demonstrates the potential of the phenomenon and emphasizes the need for today's managers to learn how to leverage network effects and to know when to sacrifice some control over product evolution for the extra momentum that other contributors can provide.

5 Case Study #4: Enron Corporation

5.1 Overview[76]

Houston-based Enron is doing an end run around its energy rivals, transforming itself from a gas pipeline company into a global energy and telecommunications powerhouse. Enron, the US's largest buyer and seller of natural gas, operates a 32,000-mile gas pipeline system that spans 21 states.

Also the top wholesale power marketer in the US, Enron markets and trades not only electricity and natural gas, but a wide range of commodities: coal, chemicals, paper, fiber-optic bandwidth - even energy emission allowances. The company provides risk management services, energy project financing, energy consulting, and engineering and construction services for energy infrastructure around the world. It also owns interests in merchant power plants and other energy projects in Asia, Africa, the Caribbean, Europe, India, the Middle East, and South America. Enron's generation facilities have a combined capacity of some 14,350 MW.

The company has agreed to sell its Portland General Electric (PGE) utility to Sierra Pacific Resources, but the energy crisis in the western US has hurt Sierra Pacific and threatened to kill the deal. Enron plans to compete in deregulated retail electricity markets nationwide through its stake in The New Power Company (TNPC).

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[76]From Hoover's Inc. prodided by Dow Jones Interactive

Outside the energy industry, the company's Enron Broadband Services communications arm is building a national fiber-optic, Internet protocol-based network, and it operates a market for the trading of communications bandwidth. Enron's purchase of the UK's Wessex Water (now part of Azurix) has moved the company into the international water market.

The Enron model exhibits three main characteristics: 1) creating value based on industry standards, 2) building on the stock exchange model and 3) focusing on one's core competency.

5.2 Creating value based on industry standards / network infrastructures

Networked infrastructures (telecommunication networks, roads and trucks, money markets) lie in the heart of the entire economy.

Creating value based networked infrastructures enables companies to benefit from powerful network effects.

> "[…] if the value of a network to a single user is $1 for each other user on the network, then a network of size 10 has a total value of roughly $100. In contrast, a network size of 100 has a total value of roughly $10,000. A tenfold increase in the size of the network leads to a hundred-fold increase in its value.[77]"

For example, as railways spread across the United States in the nineteenth century, touching ever more towns and cities, their value increased exponentially, enabling new "network" business models like the Sears retail catalog.

Likewise, Enron used the network of energy distributors to develop its business: selling power.

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[77] Shapiro and Varian, "Information Rules", 184

5.3   Building on the stock exchange model

There are several reasons to be willing to organize a market as an exchange. Thinking about financial markets can help understand the characteristics of an exchange. First, money has very specific properties (besides the traditional 3: unit of account, store of value and medium of exchange): 1) It is pure information. 2) Unlike information (email messages) it is a pure commodity. 3) It can gain value from itself without diminishing its worth to the depositor. These properties of money explain why financial intermediaries capture extraordinary benefits from their privileged roles. An exchange has the following advantages: 1) Reduced search costs, 2) Reduced transactions costs, 3) Negotiation of short-term and long-term contracts (Spot and Forward markets, hedging and risk management), 4) Efficient aggregation of supply and demand, 5) Efficiency in billing, 6) Stable rating and pricing policies, and 7) Contract enforcement.

All these reasons help us to understand why companies like Enron try and apply this model to their industry (which of course requires a commodity product).

5.4   Focusing on one's core competency

The new environment of deregulation, price volatility and customer dissatisfaction challenges many power companies. Deregulation smashes the assumption behind the asset-based mind-set, disaggregating the businesses of generation, transmission, and marketing, each potentially a distinct business with unique management needs.

Enron Corporation was first to believe that the power industry will be sliced, diced and globalized and therefore chose to concentrate on its core competency: selling energy. Though it builds physical assets, Enron readily sacrifices its power plants, gas wells and pipelines to support its global strategy. In 1999, the company spun out its Enron Oil and Gas (EOG) subsidiary as an independent business, saying that in the deregulated North American market, such fixed assets were no longer strategic. The parent company, with a focus on resale, distribution, and customer service, would get better commodity prices in the open marketplace than from a captive internal subsidiary

Enron's growth engine and 89 percent of its 1998 revenues of $31billion derive from wholesale energy sales, which make it North America's largest supplier of electricity and natural gas.

Enron sells power from anyone to anyone, via a competitor's network or via its own, drawing on the structural capital of the entire industry. Its trading staff uses sophisticated, computer-based risk-management analytics, combined with networked market applications and trading and delivery systems that encompass thousands of suppliers, channels, and end-customers.

In addition, Enron has several new ventures building on the exchange model: a telecom bandwidth exchange, a weather future exchange and a national Internet fiber-optic network for multimedia. All reflect the company's risk management core competency. The fiber-optic network, an initiative of Enron Communications, transmits TV-quality videoconferences. Again, however, Enron is less concerned about owning the end-to-end asset that about delivering the customer service. As Enron Communications CEO Joe Hirko mentions:

> "In the telecommunications industry, companies say they can only give you quality of service because they own the network end-to-end. It's an asset-focused view. We're going to link our networks together at a software layer so that we can deliver the same quality of service end-to-end. But we will do it over multiple networks, invisible to the content provider."

Enron has also started an energy management outsourcing business, positioning itself as a value-added infrastructure services provider. For most businesses – even some manufacturers whose energy costs can be 15percent or more of total expenses – power management is an afterthought. Enron views customer-owned on-site assets like boilers, chillers, lighting, and controls as totally unregulated private utilities. It estimates the value of this market to be $240billion in the US alone. Enron wants to outsource the entire energy management function, including asset capitalization and risk management, on long-term, pay-for-performance contracts.

5.5   FedEx's example

FedEx is another company using an infrastructure network (of roads and trucks) that worked on identifying its core competency. As a matter of fact, not only was FedEx a pioneer with an intelligent software-enabled air-truck network, but then in late 1998, it declared that its physical distribution system of trucks and airplanes was less valuable that its internetworked information resources. FedEx decided to focus on value-added context services like online package tracking and logistics outsourcing, and leave the "driving" to other partners. Essentially, the company started to dump physical capital in favor of customer relationship capital.

5.6   Conclusion

There are three main lessons to be learned from Enron's business model. First it shows the power of becoming an industry standard. As a matter of fact, standards facilitate everybody's daily life, exemplified by each time we pick up a phone or when we call up the plumber to change a pipe in the bathroom. Second it illustrates how to build a business on the exchange model, such as stock exchanges. Third it demonstrates the vital need for companies to identify and focus on their core competency.

6   Summary

CHAPTER 2 examined four case studies to describe current business model trends in the e-World based on Tapscott's classification matrix. Dell's key success factors were identified to be its innovative direct business model, its continuous customer focus and its exemplary value chain integration. Likewise, we extracted three major characteristics from eBay's example: look for opportunities to create new value, leverage community effects and develop a trustful environment. The Linux phenomenon highlighted three other trends: treat customers (users) as co-developers, release early / release often and keep in mind that network effects can overturn Brooks's law (law of diminishing return for software engineers). Finally, Enron's business model was the last of CHAPTER 2's

case studies and proved to rely on three main principles: seek the standard status, build on the exchange model (financial market model), and understand your best strategic role in the whole value chain (=identify and concentrate on your core competency).

CHAPTER 3: AN E-AEROSPACE INDUSTRY?

1   Introduction

This chapter presents the e-World as it is today in the Aerospace industry.   After examining current Aerospace industry companies utilizing the Internet to conduct business, we focus our attention on Lockheed Martin and Exostar. Our ultimate goal is to analyze the impact e-world trends observed in the previous chapter on the Aerospace industry.   The final section of this chapter proposes a framework to structure both the comparative study of Lean and e-World concepts in CHAPTER 4 and the policy analysis in CHAPTER 5.

2   E-Trends in the Aerospace Industry

2.1   One more attempt to size the Internet mania?

CHAPTER 2 was an attempt to make sense out of the Internet mania. Tapscott's value integration/hierarchical control matrix was used in order to classify the various ventures mushrooming on, via, through, over, or with the Internet.   This section focuses on business-to-business (B2B) commerce and especially on business-to-business commerce conducted in the Aerospace industry.

In November 1999, Goldman Sachs evaluated the size of B2B for the Aerospace/Defense electronics industry to total $76.6 billion in 2004, representing an estimated 35% of the

industry's total business transactions[78]. As discussed in CHAPTER 2, online trade projections are constantly increasing, or at least, were constantly increasing until the March 2000 downturn in the Nasdaq. Adjusting Goldman Sachs's November 1999 estimates with GartnerGroup's latest B2B projections (almost $6trillion for 2004[79]) gives an increased evaluation of approximately $300bn for B2B transactions in the Aerospace industry in 2004[80]. Who are the players contributing to online trade in the aerospace industry? This is the question we address now.

2.2   Aerospace B2B players

The aerospace industry, like all other industry, has had a plethora of dot-coms trying to reap the benefit of the Internet rush. As earlier illustrated, trying to size an Internet phenomenon can end up being a pretty frustrating exercise. New players constantly enter the market, change names, merge with other players while a countless number also exit the market bankrupt. Under these circumstances, it is difficult, if not totally impossible, to give a comprehensive list of the current Aerospace B2B players. At best we can mention a few company names that seem to be more successful than others and might remain longer in the arena. The following list was established in November 2000 after a search for the words "aerospace" AND "e-business" OR "ebusiness" on the Lexis-Nexis database section for business and finance publications. It resulted in over 300 articles dating from May 2000 to November 2000 and the companies mentioned in the following table (Table 3) were often[81] cited.

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[78] Goldman Sachs Investment Research, *B2B: 2B or Not 2B?,* November 12, 1999, 38
[79] refer to CHAPTER 1, 1 The Internet Phenomenon
[80] As seen in CHAPTER 1, 1 The Internet Phenomenon, Goldman Sachs total B2B projections for 2004 were approximately $1.5trillion, compared to almost $6trillion for Gartner Groups March 2001's projections. All other proportions kept equal, that leads to an approximate $300bn for B2B in the Aerospace industry ($76.6bn * $6tr/$1.5tr)
[81] "Often" is a rather vague frequency measure. The ideal research would have scanned each single article precisely and counted the number of times each company was quoted. Knowing the high volatility of this sort of information, we decided to let this work to Wall Street analysts focusing on e-aerospace stocks.

	Company	Product / Service Offering	Source
1	**Skyfish**	direct purchases of airlines Incorporate Demand and Supply Chain application into one system Integrate procurement software B2B trading hub	Commuter/Regional Airline News 7/10/2000
2	**AeroV, Inc**	online exchange for Airline parts, supplies and services	Commuter/Regional Airline News 7/10/2000
3	**AviationX (example of a strategy shift in an infant industry**	create web-based software applications for regional airlines	Flight International 5/16/2000
4	**Myboeingfleet.com**	Parts catalog - millions of engineering drawings for all Boeing and McDonnell Douglas airliners and a searchable parts list	Commuter/Regional Airline News 7/03/2000 Flight International 5/16/2000 Airline Business 08/01/2000
5	**My Aircraft**	1) Supply Chain Management customer / supplier collaboration 2) Trading / e-Procurement	eWEEK from ZDWire 8/07/2000 (antitrust problem) Flight International 5/16/2000
6	**AeroXchange**	online exchange for Airline parts, supplies and services	Investment Dealers Digest 11/06/2000
7	**Aerospan.com**	procurement services	Flight International 5/16/2000
8	**Exostar**	procurement services electronic supply chain management online collaboration	Investor's Business Daily November 16, 2000
9	**Partsbase.com**	Parts catalog	Airline Business 8/01/2000
10	**Spec2000.com**	Parts exchange - common data standard for buying and selling spare parts	Airline Business 8/01/2000

Table 3: Aerospace B2B companies

A quick look at this sample of B2B companies shows that most of them do not offer much more than procurement services. As a matter of fact, even though MyAircraft mentions "customer/supplier collaboration", even Exostar[82], which is today the most advanced marketplace in the Aerospace industry, still does not enable online collaboration with all its suppliers and customers[83].

3   Case Study: Lockheed Martin Corporation / Exostar

This section focuses more precisely on the Aerospace industry by looking more closely at Lockheed Martin Corporation and their utilization of Exostar. They are a leading

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[82] See following section for more information on Exostar

[83] An article by Aviation Week & Space Technology of March 5 2001 mentions the newly formed partnership between Exostar and PTC to provide Internet-based manufacturing services.

airframe supplier and integrator as well as a pioneer in implementing Internet technologies in their business activities. The following section on Lockheed Martin and Exostar is based on information from a recent LAI workshop[84].

3.1   Background Information on Lockheed Martin Corporation

3.1.1   Overview[85]

Formed by the merger of defense giants Lockheed and Martin Marietta, Lockheed Martin makes aircraft such as the F-16 fighter and the C-130J transport plane and high-tech flight systems for missiles such as the submarine-launched Trident II and the Theater High Altitude Area Defense (THAAD). It is also involved in many other activities including space launch vehicles and communications satellites, as well as, ship and submarine combat systems, air-control systems and fire-control systems. Our interest is not on any specific program but rather on Lockheed Martin's use of Aerospace exchange Exostar that it co-founded.

3.1.2   Aerospace enterprise roadmap with current B2B ventures

The following figure is a high-level roadmap illustrating the interactions as well as the flows of information and products between the various stakeholders of the Lockheed Martin Enterprise[86].

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[84] Lean Aerospace Initiative Implementation Workshop, *Building Internet-Enabled Integrated Value Networks*, January 30-31, 2001

[85] From Hoover's Inc. on Dow Jones Interactive on April 24, 2001

[86] In fact this roadmap was developed without any particular focus on any specific company. Here it is used to describe Lockheed Martin but it is much more general and could apply to many other companies.
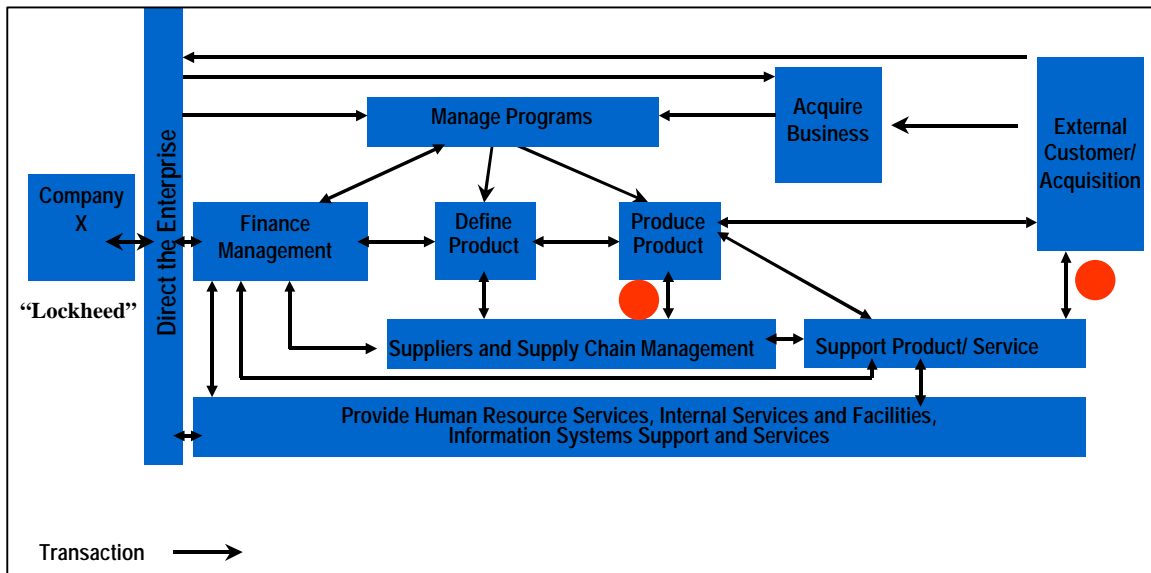
Figure 5: Lockheed (Company X)'s enterprise value stream map

Currently, most B2B players are located between "Produce Product" and "Suppliers and Supply Chain Management", as well as between "Support Product Service' and "External Customer".

3.2   Background Information on Exostar

3.2.1   Overview

Exostar was officially founded in September 2000 by BAE Systems, Boeing, Lockheed Martin and Raytheon with CommerceOne as technology partner. Exostar is aimed at becoming an "open neutral exchange for the Global Aerospace and Defense Industry, open to all participants and all tiers ". Allen Golland, program manager at Lockheed Corporation, defines a B2B exchange as a "mechanism to bring together many trading partners buyers and sellers, customers and suppliers, using common web-based software and new tools and techniques, providing streamlined ordering capability and providing relevant business services."

3.2.2   Exostar's product and service offerings

Exostar's product and service offerings are very ambitious and go well beyond mere electronic procurement.   Among the services it plans to offer, we can find: managed content, automated transaction support, supply chain services, selling services, direct procurement, community services, collaboration, indirect procurement and auction services (see Figure 6).
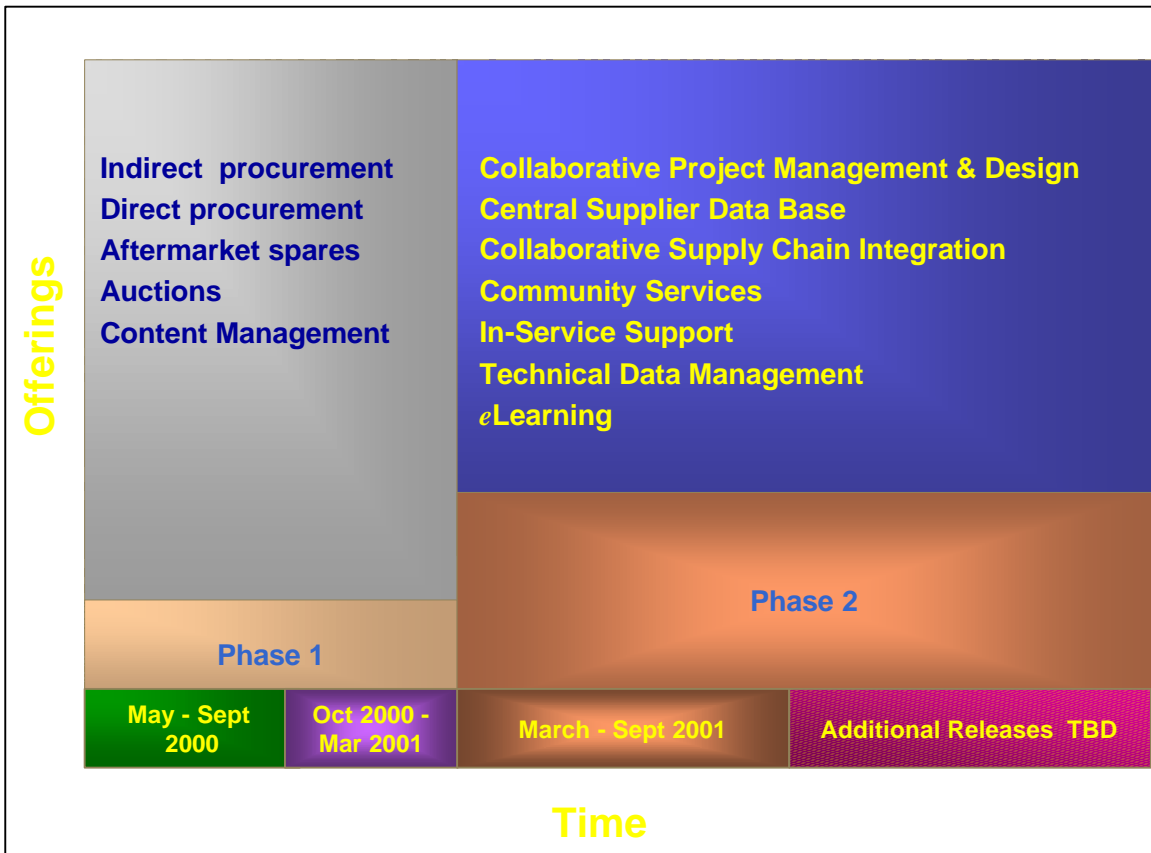
Figure 6: Exostar's product and service offerings

However appealing this variety of product and services might seem, it is important to keep in mind that most B2B marketplaces still simply process procurement transactions via Exostar, using online catalog buying and in some cases reverse auctions. The next steps towards direct procurement and then support for supply chain collaboration still set some challenges. The following two figures illustrate Lockheed Martin's concept of B2B collaborative environment and LMT's ebusiness roadmap (Figure 7 and Figure 8).
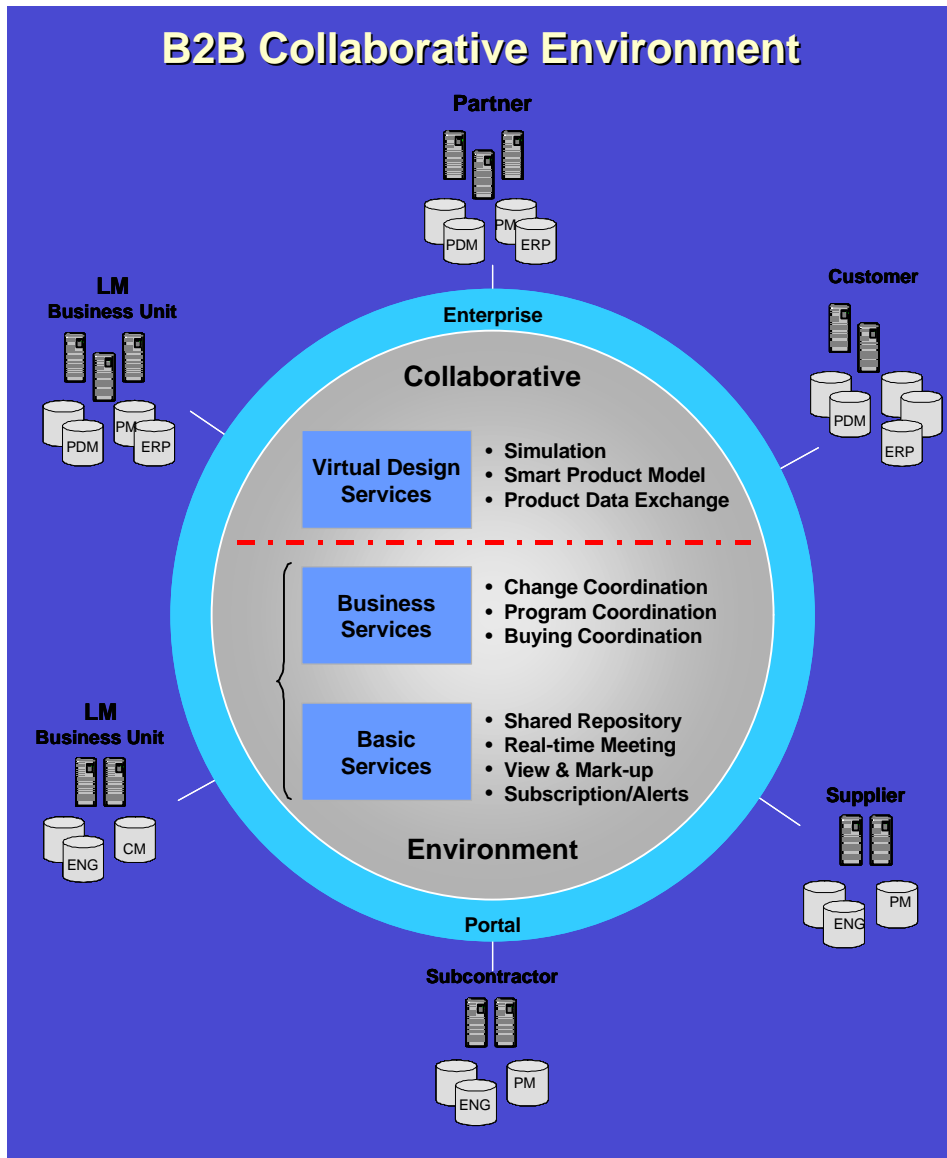
Figure 7: B2B Collaborative Environment
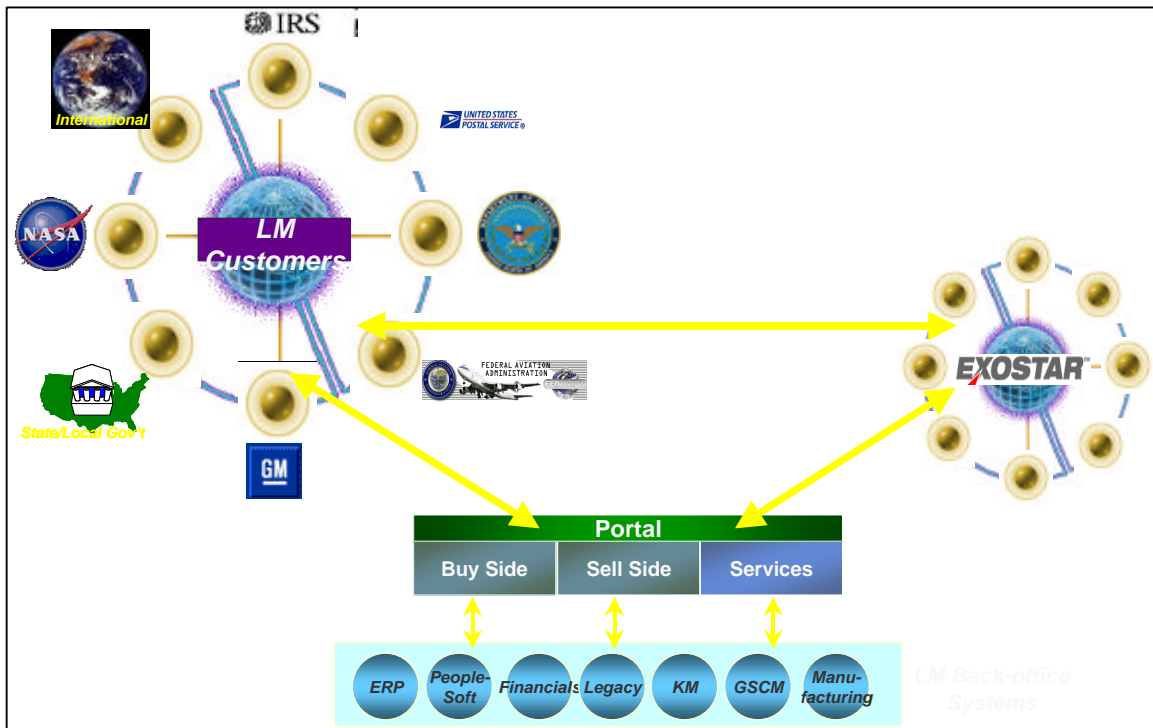
Figure 8: eBusiness Roadmap

In essence Exostar's product and service offerings reflect top managements'strategic move towards what LAI[87] calls the Lean Enterprise. The key Lean ingredients are represented in Figure 7 and Figure 8. Exostar's collaborative environment clearly enables Womack's five Lean principles (see CHAPTER 1 on Lean Thinking): value because customers are included in the collaborative environment; value stream, customer-pull and perfection result from customer/supplier partnerships; finally flow management is optimized in an information technology environment.

From the concepts present on the previous two figures, it seems that the Aerospace industry has nothing to learn from the e-World fruitflies. Nevertheless, if the general principles are already in place, at least in top managers's minds, nobody is really sure of how the e-World trends that were identified in CHAPTER 2 will translate to other industries such as aerospace. The following section provides a framework to structure

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[87] The Lean Aerospace Initiative is a research group at MIT. More will be said about LAI in CHAPTER 4.

the comparison between the Aerospace industry (represented by Lockheed Martin) and the e-World trends observed in CHAPTER 1.

4   Framework for comparison

From the previous sections, it is tempting to believe that any e-World trends could somehow transfer to a business environment such as Lockheed Martin's. Indeed, one might ask why it is that the Aerospace seems so late at adopting best business practices from the Dell model. Before we actually study in details the impact of the e-World (CHAPTER 4), this section provides a framework to analyze how the e-World trends introduced in CHAPTER 1, and especially the Dell model (i.e. Dell with Dellonline), could translate to the Aerospace industry (i.e. Lockheed Martin with Exostar), and what elements make the two industries differ so much. This analysis focuses on macro considerations, concentrating on Enterprise stakeholder, product and production issues.

4.1   Enterprise stakeholders

4.1.1   Stakeholders

The first key difference between the Dell enterprise and the Lockheed Martin enterprise lies in their respective stakeholders: customers (channels and endusers), suppliers, employees, shareholders, competitors (existing and potential new entrants), the B2B exchange (dellonline for Dell and Exostar for Lockheed), and the public (regulation authorities).

Customers at Dell in general are multinational companies rather than individual users, which is also the case for Lockheed. However Dell does not have any dominant customer which could have a real threatening bargaining power on Dell's operations[88], whereas Lockheed Martin, when working on a military program, clearly has to face the

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[88] As mentioned in Dell's case study, no customer at Dell, represent more than 1-2% of Dell's total revenue. For reference see footnote number 51.

unbeatable bargaining power of the US Department of Defense. Dell's customers's bargaining power (one of the five forces of Michael Porter[89]) is thus clearly lower than Lockheed Martin's customers's.

Other issues to bear in mind concerning customers are their number, mix, bargaining power and whether there is a direct contact between the company and its customers or if there is an intermediary channel. Similarly it is important to understand that suppliers are much different across industries: total number, number of tiers, and bargaining power must be considered. Shareholders are also important stakeholders to take into account: their mix, the presence of a dominant shareholder influence decisions differently in various industries. Employees and considerations about their number, the power of unions and the average staff level of education clearly pressure business managers. Finally, B2B exchanges (Dellonline for Dell and Exostar for Lockheed Martin) obviously face different problems according to their potential market power and regulatory bodies are more concerned about the potential market power of Exostar than of that of Dellonline.

4.1.2   *Industry maturity*

Professor Charles Fine, author of *Clockspeed*, draws an analogy between the molecular structure of DNA and the structure of companies, explaining how indutries continuously evolve between vertical and horizontal structures on an infinite loop. "Business genetics features the industrial equivalent of the double helix – a model based on an infinite double loop that cycles between vertically integrated industries inhabited by corporate behemoths and horizontally disintegrated industries populated by myriad of innovators, each seeking a niche in the wide open space left by the earlier demise of the giants.[90]"

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[89] For a fuller discussion, see M.E. Porter, *Competitive Strategy,* Free Press, 1980
[90] Charles H. Fine, *Clockspeed – Winning Industry Control in the Age of Temporary Advantage*, Perseus Books, 1998, 43

Based on this theory, industry maturity becomes an important component of our framework. Andrew Grove, in his book "*Only the Paranoid Survive*", showed how the computer industry evolved from a vertical industry structure with an integral product architecture and two main players (IBM and DEC) between 1975 and 1985 to a horizontal industry structure and modular product architecture with a multitude of players (Intel, Microsoft, Apple, IBM, Lotus, Seagate, DEC, HP, Compaq, Dell, etc.) between 1985 and 1995[91]. The Aerospace industry, though at a much slower pace, is moving towards a more and more horizontal structure with modular product architecture. Due to product complexity, it is difficult however to discuss the whole Aerospace industry at the same level as the PC industry. In terms of products, one might just be able to compare avionics systems in an airplane to personal computers. As we will see next when analyzing the product difference, some products of the Aerospace industry are necessarily highly technically integrated, with and are produced within a group of tightly integrated set of companies and suppliers.

4.2   Product

4.2.1   *Component clockspeed*

Addressing a list of each single component of a computer would be a tedious task, needless to think about realizing a similar counting with an aerospace vehicle such as produced by Lockheed Martin. A fighter aircraft is obviously a much more complex product than a PC. To simplify our analysis, let us reduce the complexity of an airplane to three components: airframe, hardware electronics, and software. Likewise a computer can be reduced to a mix of hardware and software.

One crucial difference between those various components is their rate of innovation, or what Professor Fine calls their clockspeed. Both hardware and software have very high clockspeeds: Microsoft releases a new operating system about every couple years with

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[91] Andrew S. Grove, *Only the Paranoid Survive,* New York: Currency Doubleday, 1996, 40.

very frequent upgrades of each product and Intel produces faster microprocessors every year. Airframes, on the contrary, have much slower clockspeed of about 10 years or longer: Boeing creates a totally new plane roughly every 20 years.

4.2.2 Product architecture

Components, as we have just mentioned, have different clockspeed. They also "interact" differently with one another, depending on the architecture of the product itself. Professor Fine distinguishes between integral and modular product architectures[92], a distinction that is fundamental to defining process and supply chain management. As Professor Fine notes, integral architecture might feature, for example: components that perform many functions, components that are in close proximity or close spatial relationship, or components that are tightly synchronized. In contrast, a modular architecture features separation among a system's constituent parts whereby: components are interchangeable, components are individually upgradable, component interfaces are interchangeable, and/or system failures can be localized.

PC's, and Dell's PCs especially, are highly modular. As a matter of fact, Dell does not manufacture any components itself but only assembles them according to customers' preferences. On the contrary, control software for a weapon system have very high performance requirements which give them a necessarily highly integrated product architecture.

4.3   Production

4.3.1 Supply chain

Building on the product architecture concept enables development of the construct of supply chain architecture. The supply chain architecture, like the product architecture can be integral or modular. Integral supply chain architecture, as explained by Professor

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[92] Charles H. Fine, *Clockspeed – Winning Industry Control in the Age of Temporary advantage,* Perseus Book, 1998, 134.

Fine, is defined by four categories of proximity: geographic, organizational, cultural, and electronic[93]. Dell's supply chain for example is integral, not because of geographic proximity, but essentially because of electronic proximity. Similarly, CAD/CAM systems allow electronic proximity for Lockheed Martin's engineers.

4.3.2   Process architecture

Like the architectures for the product and supply chain, it can also be useful to locate the process architecture along the line extending from the extremes of vertical-integral and horizontal-modular. Professor Fine, once more, describes both extremes in two dimensions: space and time[94]. That is, process architectures can be integrated in both time and space (highly integral), integrated in either space or time, or dispersed in both space and time (highly modular). Dell's assembly process for example is tightly integrated in time. An entire computer is built in a few hours to be rushed off to its future owner. Dell's assembly process is tightly integrated in space as well: all assembly operations take place in a single work cell in a single factory, operated by a very small team.

5   Summary

This chapter provided an overview of how the Aerospace industry follows the e-World trends with very ambitious ventures such as Exostar. If, as noted by IDC research[95], the forecasted growth for emarketplaces has been greatly anticipated, we saw that Exostar has plans that go far beyond mere indirect procurement services. Nevertheless, the Aerospace industry is still clearly in its infancy in applying e-World business practices

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[93]Charles H. Fine, *Clockspeed – Winning Industry Control in the Age of Temporary advantage,* Perseus Book, 1998, 137

[94] Charles H. Fine, *Clockspeed – Winning Industry Control in the Age of Temporary advantage,* Perseus Book, 1998, 143

[95] Sep 15 2000: IDC's report describes calls for thousands of emarketplaces by 2004 as "overzealous". The report makes a more conservative estimate, and claims that only several hundred emarketplaces will exist by that time (more details at http://www.idc.com/Services/press/PR/SV091300pr.stm)

such as Dell's. Figure 9 illustrates the different scopes to date of the Internet's impact on key process interfaces (represented by dots) on Company X, representative of the Aerospace industry versus Company Y, representing Dell Corporation. Various factors (stakeholders, product and production) provide for differences between the two industries and explain why e-World trends are, to date, at two distinct levels of maturity in their business applications at Dell and at Lockheed. This framework introduced in CHAPTER 3 will provide a structure to compare the emerging e-World trends and conclusions of CHAPTER 2 with the Aerospace lean enterprise trends. This analysis and mapping are discussed in the next chapter.
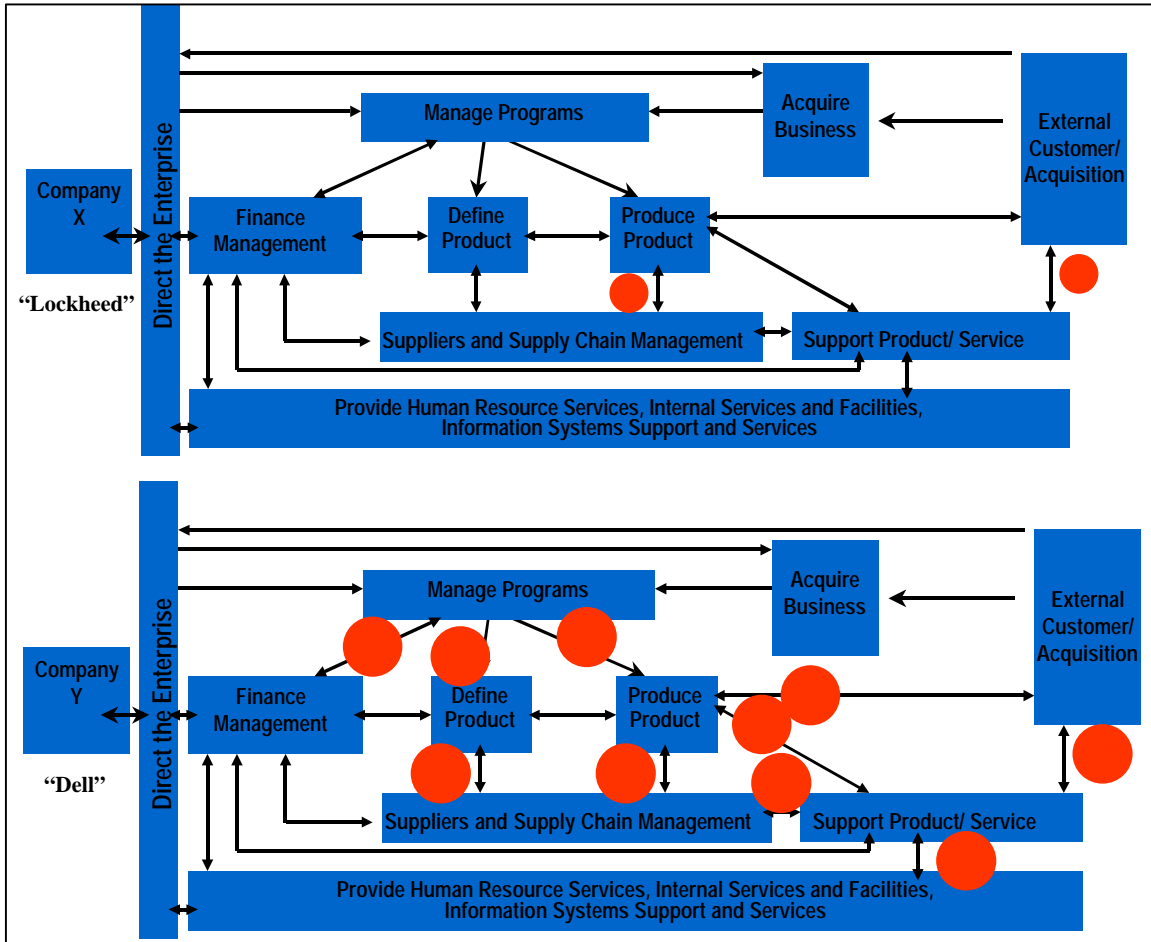

Figure 9: Internet usage in Aerospace industry (top) VS Internet usage at Dell Corporation (bottom)

CHAPTER 4: A MAPPING BETWEEN LEAN AND THE E-WORLD?

1   Introduction

Lean manufacturing has been central to major research efforts in the last decade. Substantial work was undertaken to evolve the conventional scope of Lean (i.e. Lean manufacturing) to other functions of the enterprise such as product design, product development and supply chain management. Many aerospace organizations are activily engaged in extending Lean across their current value chain, both internally and externally to their supplier base.

This chapter examines the Lean Enterprise Model, a taxonomy of Lean principles and practices. Subsequently, a set of e-World principles are extracted from the case studies of CHAPTER 2 and compared to the Lean principles. If some overlap between Lean and the e-World may seem intuitive, other interaction effects require a more detailed analysis to be thoroughly understood. This is the subject of this chapter.

2   The Lean Enterprise Model (LEM)

2.1   Overview

The Lean Enterprise Model (LEM) is a contribution by the Lean Aerospace Initiative (LAI) at the Massachusetts Institute of Technology (MIT).   The LAI is a research partnership among the U.S. government, labor, MIT, and defense aerospace businesses.

Formally launched in 1993, the initial research focused on the aircraft sector but it also expanded its research focus to include the space sector in 1998. Work in the research partnership now involves both aircraft and spacecraft sectors. The LEM not only applies to aerospace businesses, but to other industries as well. The LEM consists of Meta-principles, Enterprise Principles, Enterprise Metrics, Overarching Practices (OAPs), and Enabling Practices that describe the Lean Enterprise. A graphic representation of the LEM structure is shown in Figure 10.
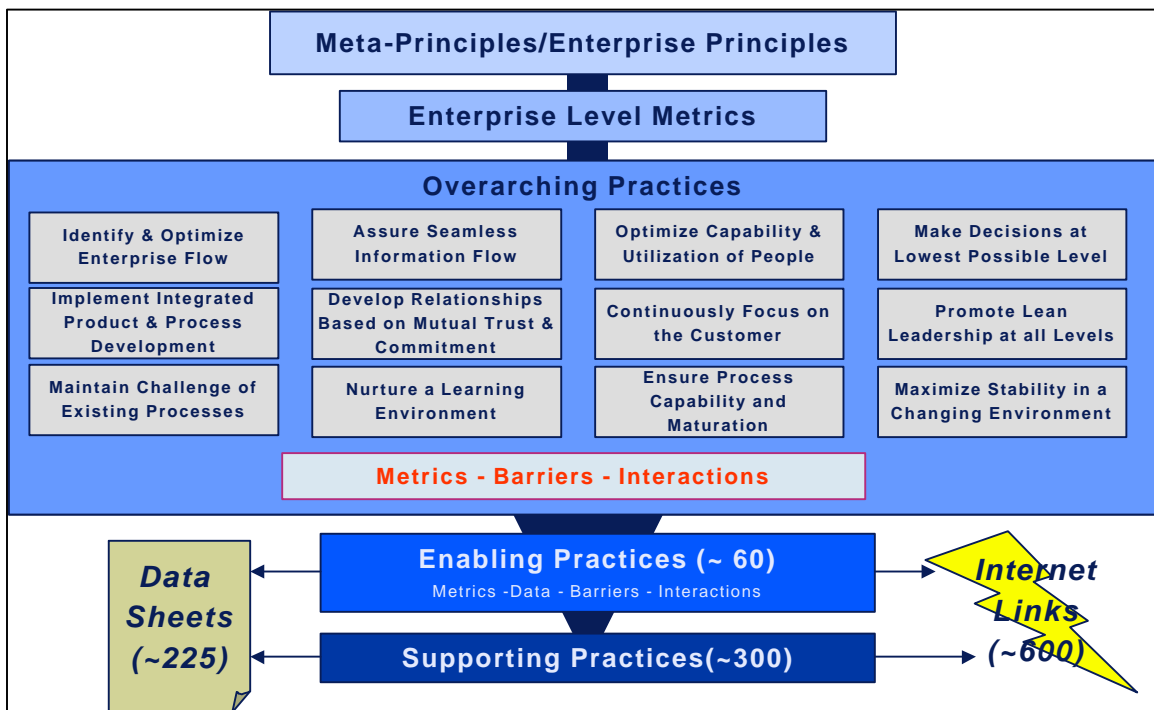
Figure 10: the Lean Enterprise Model (LEM)

2.2   The Lean Principles

The LEM (Figure 10) makes use of a tiered terminology to describe the Lean Enterprise. At the highest level "Responsiveness to Change" and "Waste Elimination" represent the Meta-principles; "Right Thing, Right Place, Right Time, Right Quantity", "Effective Relationships within the Value Stream", "Continuous Improvement" and "Optimal First Delivered Unit Quantity" correspond to the Enterprise principles. The objective of this

chapter is to examine the LEM at a more detailed level and to put the Overarching Practices (also referred to as "Lean Principles") side by side with the e-World trends.

The following table (Table 4) exhibits the description of the 12 Overarching principles (OAPs), numbered OAP1 through OAP12.

Overarching Practice	Title	Description
OAP 1	Identify and optimize enterprise flow	"Optimize the flow of products and services either affecting or within the process, from concept design through point of use."
OAP 2	Assure seamless information flow	"Provide processes for seamless and timely transfer of and access to pertinent information."
OAP 3	Optimize capability and utilization of people	"Assure properly trained people are available when needed."
OAP 4	Make decisions at the lowest possible level	"Design the organizational structure and management systems to accelerate and enhance decision making at the point of knowledge, application, and need."
OAP 5	Implement integrated product and process development	"Create products through an integrated team effort of people and organizations which are knowledgeable of and responsible for all phases of the product's life cycle from concept definition through development, production, deployment, operations and support, and final disposal."
OAP 6	Develop relationships based on mutual trust and commitment	"Establish stable and on-going cooperative relationships within the extended enterprise, encompassing both customers and suppliers."
OAP 7	Continuously focus on the customer	"Proactively understand and respond to the needs of the internal and external customers."
OAP 8	Promote lean leadership at all level	"Align and involve all stakeholders to achieve the enterprise's lean vision."
OAP 9	Maintain challenge of existing processes	"Ensure a culture and systems that use quantitative measurement and analysis to continuously improve processes."
OAP 10	Nurture a learning environment	"Provide for the development and growth of both organizations' and individuals' support of attaining lean enterprise goals."
OAP 11	Ensure process capability and maturation	"Establish and maintain processes capable of consistently designing and producing the key characteristics of the product or service."
OAP 12	Maximize stability in a changing environment	"Establish strategies to maintain program stability in a changing customer driven environment."

Table 4: The Lean Principles - From the Lean Enterprise Model: http://lean.mit.edu

The twelve principles deal with enterprise product and information flow (OAP 1 and 2), stakeholder and organization issues (OAP 3, 4, 6, 7, 8, and 10) as well as process and program management (OAP 5, 9, 11, and 10).

2.3   The Lean principles interaction matrix

The Lean Enterprise Model is a framework to capture lean practices. There are many interactions between the different practices listed. These interactions impact the effectiveness or realization of other practices. Each practice has some impact on the other practices. The following table (Table 5) is taken from the LEM online tool. It shows an estimate of the extent of these interactions. These interactions are not empirically derived nor validated. However, numerous practitioners have found that they afford insight into important relationships inherent in the LEM.

Legend: ● = Prerequisite, ◉ = Strong Impact, ○ = Moderate Impact, □ = Limited Impact (blank)

	Flow (OAP1)	Information (OAP2)	People (OAP3)	Decisions (OAP4)	IPPD (OAP5)	Relationships (OAP6)	Customer (OAP7)	Leadership (OAP8)	Processes (OAP9)	Learning (OAP10)	Capability (OAP11)	Requirement (OAP12)
Flow	**1**	○		○	◉	○	○		○	○	◉	
Information	●	**2**	○	●	●	○	○	○	○	○	○	○
People	◉	○	**3**	◉	◉	○		○	◉	○	○	
Decisions	◉	◉	○	**4**	◉	◉		◉	◉	○	○	
IPPD	○	◉	○	◉	**5**	○	○	○	○	○	◉	○
Relationships	○	◉	◉	●	◉	**6**	◉	○	◉	○	○	◉
Customer	◉	○			◉	◉	**7**	○	○	○	◉	○
Leadership	●	●	●	●	●	●	●	**8**	●	●	●	◉
Processes	◉	○			○	○	○		**9**	○	◉	○
Learning	○		○		○			◉	○	**10**	○	
Capability	●	●			◉		○		○		**11**	○
Requirement	○				○							**12**

LEGEND: ● Prerequisite   ◉ Strong Impact   ○ Moderate Impact   □ Limited Impact

Table 5: OAP interaction matrix

Reading from the rows on the left, the overarching practice impacts the overarching practice in the column as depicted in the intersecting cell (see key for strength of impact). For example, "Seamless Information Flow" (OAP2) is a prerequisite for "Make decisions at the lowest level" (OAP4). In turn, "Make decisions at the lowest possible level" strongly impacts the overarching practice "Develop relationships based on mutual trust and commitment (OAP6)."

3   The E-World as an enabler to Lean

3.1   e-World principles (trends)

CHAPTER 2 examined four case studies to describe current business model trends in the e-World. Dell's key success factors were identified to be its innovative direct business model, its continuous customer focus and its exemplary value chain integration. Likewise, we extracted three vital characteristics from eBay's example: look for opportunities to create value, leverage community effects and develop a trustful environment. The Linux phenomenon highlighted three other trends: treat customers (users) as co-developers, release early / release often and keep in mind that network effects can overturn Brooks's law (law of diminishing return for software programmers). Enron's business model was the last of our case studies and proved to rely on three main principles: seek the standard status, build on the exchange model (financial market model), understand your best strategic role in the whole value chain (=identify and concentrate on your core competency). Table 6 summarizes the e-World principles.

e-World Principle	Title	Source
e-W 1	Sell directly (bypass the middleman / Direct Business Model)	Dell case study
e-W 2	Focus on end-customer	Dell case study
e-W 3	Integrate the whole supply chain	Dell case study
e-W 4	Look for opportunities to create value (NOT from customer pull)	eBay case study
e-W 5	Leverage community effects	eBay case study
e-W 6	Develop a trustful environment	eBay case study
e-W 7	Treat customers (users) as co-developers	Linux phenomenon case study
e-W 8	Release early / Release often	Linux phenomenon case study
e-W 9	Network effects transform the law of dimishing returns in increasing return!	Linux phenomenon case study
e-W 10	Seek the standard status	Enron case study
e-W 11	Build on the exchange model (financial market model)	Enron case study
e-W 12	Identify and concentrate on your core competency	Enron case study

Table 6: The e-World Principles

3.2   The e-World principles support the Lean principles

Putting the e-World principles side by side with the Lean principles (see Table 7) shows how the two set of principles interact with one another. Let us now examine more in detail how each one of the e-World principles relates to the Lean principles (OAPs).

e-W 1	Sell directly (bypass the middleman / Direct Business Model)	**OAP 1**	Identify and optimize enterprise flow
e-W 2	Focus on end-customer	**OAP 2**	Assure seamless information flow
e-W 3	Integrate the whole supply chain	**OAP 3**	Optimize capability and utilization of people
e-W 4	Look for opportunities to create value (NOT from customer pull)	**OAP 4**	Make decisions at the lowest possible level
e-W 5	Leverage community effects	**OAP 5**	Implement integrated product and process development
e-W 6	Develop a trustful environment	**OAP 6**	Develop relationships based on mutual trust and commitment
e-W 7	Treat customers (users) as co-developers	**OAP 7**	Continuously focus on the customer
e-W 8	Release early / Release often	**OAP 8**	Promote lean leadership at all level
e-W 9	Network effects transform the law of dimishing returns in increasing return!	**OAP 9**	Maintain challenge of existing processes
e-W 10	Seek the standard status	**OAP 10**	Nurture a learning environment
e-W 11	Build on the exchange model (financial market model)	**OAP 11**	Ensure process capability and maturation
e-W 12	Identify and concentrate on your core competency	**OAP 12**	Maximize stability in a changing environment

Table 7: e-World and Lean principles

3.2.1   *Impact on OAP2: Seamless information flow*

Before starting with the systematic approach, it is probably worth noting that one of the most obvious impacts of e-World trends is that they improve seamless information flows (OAP2).   A plethora of publications describe how the Internet speed of information changes the traditional economics of products.   One strategy, described by Evans and Wurster, author of the book "*Blown to Bits"* is to separate the information-rich part of the business from the commodity part, and sell them separately.   In order to support this strategy, they define the traditional tradeoff between richness and reach[96] of information. Reach simply means the number of people, at home or at work, exchanging information. Richness is defined by three aspects of the information itself.   The first is bandwidth, or the amount of information that can be moved from sender to receiver in a given time. The second aspect is the degree to which the information can be customized.   For example, an advertisement on television is far less customized than a personal sales pitch but reaches far more people.   The third aspect is interactivity.   Dialogue is possible for a small group, but to reach millions of people the message must be a monologue.   In general, the communication is rich if information has required proximity and dedicated channels whose costs or physical constraints have limited the size of the audience to which the information could be sent.   Conversely, the communication of information to a large audience has required compromises in bandwidth, customization, and interactivity (see Figure 11).

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[96]Evans and Wurster, *Blown to Bits,* October 1999.

Richness
(Bandwith,
customization,
interactivity)

Internet
Impact

traditional
trade-off

Reach (connectivity)
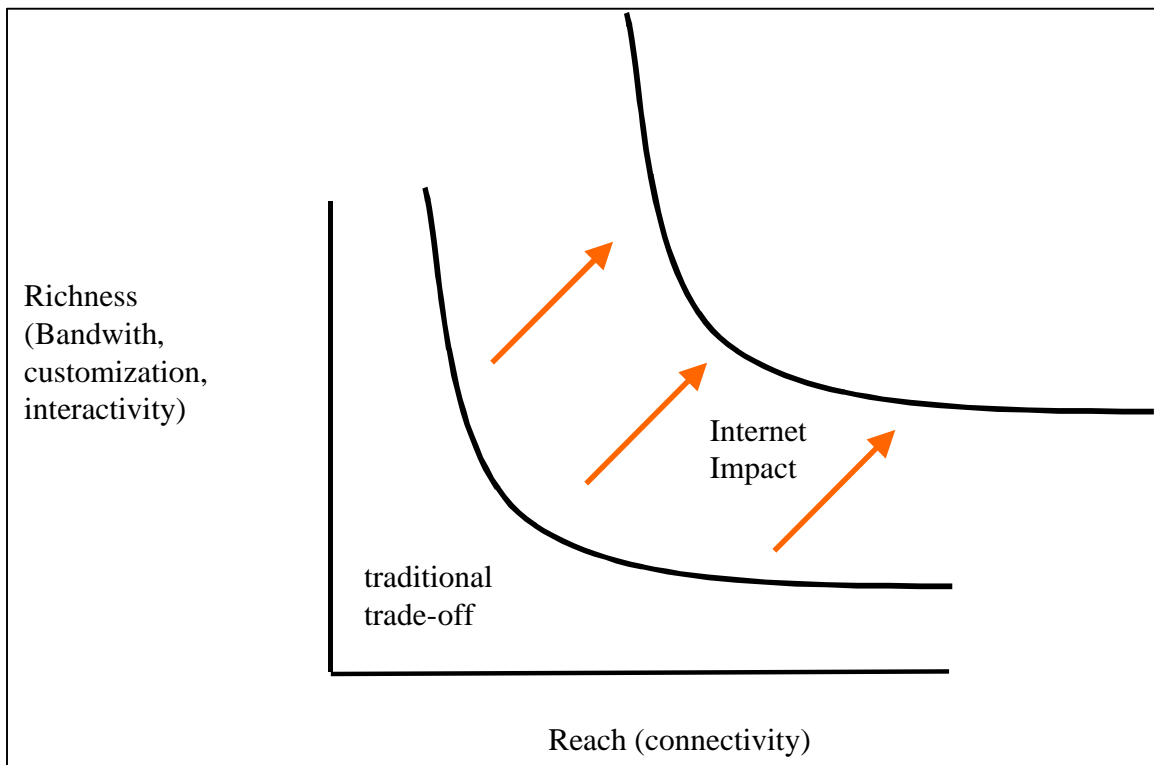
Figure 11: The Impact of the Internet on the Traditional Economics of Information

The Internet shifts the Reach/Richness curve outwards and eliminates the traditional tradeoff. More people have access to richer information that flows seamlessly.

The companies that have gone the furthest in their usage of the Internet claim to save astonishing amounts, especially in transaction costs. GE plans to cut 15% from its cost base of $100 billion in both 2001 and 2002. That is five times the typical annual growth in productivity, even for this fast-moving firm, of 3-4%. In addition, the company hopes to reduce the prices of the materials it buys by making most of its purchases in electronic auctions. That should save a further $2 billion over the next two years[97].

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[97] The Economist, E-Management Survey November 2000

3.2.2   Impact of e-W1, e-W2, e-W3 (Dell)

Undoubtedly, e-W1 (Dell's Sell directly) impacts OAP1 (Flow): As previously described in CHAPTER 2, the Dell-like Internet enabled - enterprise can better optimize the flow of products and services. The inventory level provides a direct measure of the efficiency of an enterprise's flow. By the mid 1990s, Dell's work-in-process (WIP) and finished goods inventory as a percent of total inventory ranged from 10% to 20%. This contrasted sharply with the industry leaders, such as Compaq, Apple and IBM, whose WIP and finished goods inventory typically ranged from 50% to 70% of total inventory, not including inventory held by their resellers[98].

Dell's customer focus principle (e-W2) is very close to the lean customer focus (OAP7). In the e-World, emphasis is placed on the end-customer rather than on the next tier supplier, which really reinforces Womack's (customer) pull principle. Curiously however, the current description of OAP7 specifies that the customer is both the internal and the external customer (see Table 4). Of course both internal and external customers have their importance. It would be foolish for any supplier to neglect its most direct customer and only focus on the end-customer. Dell's example shows how all the suppliers watch the same information to coordinate their value creating efforts, like the musicians of an orchestra observing precisely the conductor to adjust their play. As companies install software applications to take over many of the tasks that employees now do—such as "running errands" to keep information moving—they alter the balance between the internal and external demands on a company, an issue described in a book called "Harmony: Business, Technology & Life After Paperwork" by Arno Penzias, former boss of Bell Labs. "Though to my knowledge no computer has yet managed to replicate the performance of a single office worker," he says, "the right combination of computing and communications can frequently replace whole departments."   The "errands" jobs are not only wasteful; they turn the attention of organizations inwards towards the smooth operation of internal processes, rather than outwards to the customer.

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[98] For further details, refer to case study in CHAPTER 2

Now, though, Internet-based software applications are shifting the balance, shrinking the amount of human time and effort that needs to be spent on internal co-ordination and fostering end-customer focus.

It is also worth noting that e-W2 is very related to e-W7 (users=co-developers). Yet again Dell's definition of customers is closer to Linux's definition of users/co-developers than to Lean's customer pull principle. Dell's Premier Pages are a key element of Dell's close contact to its customers. They are obviously creating a customer pull for the whole Dell enterprise since all suppliers can instantaneously know what the end-customer needs are but also they are an interactive tool where Dell's major customers participate in the conception of the product and service they want. Arguably, Dell is able to anticipate the needs of its customers with such accuracy that it is questionable whether the customer is pulling or Dell is pushing.

e-W3 (Supply Chain Integration) is associated to OAP5 (Implement Integrated Product and Process development) but also has a component of e-W12 (understand your core competency). It also supports OAP1 (Enterprise Flow)

There is one important caveat concerning Dell principle e-W3. As previously demonstrated in the case study, if processes are tightly integrated (Space and Time) as in Dell's example, its product architectures are very modular. In contrast, the LEM was developed primarily for the aerospace community and OAP5 (IPPD) seems to apply especially to highly integrated product architectures. The OAP5 (IPPD) description underlines the importance of a single integrated team effort to be knowledgeable for all phases of the product's life cycle, which is not as critical in a modular product architecture.

Finally, Dell's e-W3 (integrate the whole supply chain) is a key to reinforce and foster trust (OAP6) among all stakeholders.

3.2.3 *Impact of e-W4, e-W5, e-W6 (eBay)*

e-W4 (opportunities to create value), in the case of eBay, can be interpreted as a very good understanding of customer needs and would therefore be very consistent with the Lean definition of value creation - originated by a customer pull.

Ford provides another example of a company trying to define a new market (a new value) for its customer. This new value (e-W4), even if just interpreted as a new distribution channel, combined with e-W1 (Dell's direct sales) is a clear pressure towards bypassing car dealers. However that would need to redefine the whole value chain (e-W3 and e-W12) and to overcome a few transitional problems (in many States car dealers are legal entities with franchises; their business is recognized and supported by law[99]). In any case, should we call it an opportunity to create new value or just an opportunity to benefit from a direct customer pull, the Internet clearly puts pressure on the structure of the automotive value chain (see Figure 12). While the auto manufacturers are locked into a distribution system that puts power in the hands of local dealerships, start-ups are courting online buyers and signing partners to establish new digital value systems. Many of them (e.g. Autobytel and CarPrices.com) are still partnering with existing dealerships. Another contender, CarOrder, however, aims to "disintermediate" auto dealerships by moving the entire distribution model to the Web. Like eCoverage, CarOrder wants to make the traditional industry model a piece of history. In reality, these e-Ventures have recently suffered from the high-tech bubble burst and the Nasdaq downturn, but their long-term prospects matters less than the simple fact that thousands of such companies have been targeting business processes in virtually every industry. Even if eCoverage and CarOrder fail today, it is hard to imagine that the whole concept will disappear forever.

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[99] Over 22,000 car dealers in the United States are protected by franchise agreements and state regulations. Source: Mary J. Cronin, *Unchained Value,* HBS Press 2000, 40.
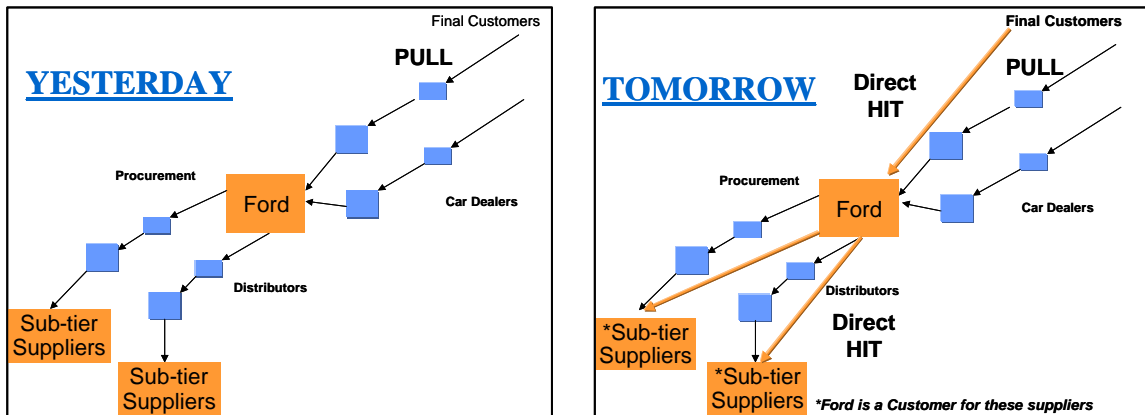
Figure 12: Creating value by enabling an end customer pull[100]

e-W5 (leverage community effects) has a huge impact on Lean principles: reinforcing OAP4 (decisions at the lowest level), OAP5 (IPPD), OAP6 (relationships based on mutual trust), OAP7 (customer) and OAP10 (learning) but seems inconsistent with OAP1 (Flow) and OAP3 (capability and utilization of people). e-W5 originates from an eBay principle. The underlying concept is to rely on a community of users to create value. If this is something natural for a Linux programmer, it is much less so for any traditional manufacturer. One could argue that the eBay communities do not create tangible (thus monetary) value. For eBay, the social and community aspects are its key survival elements. After all, even if eBay benefits from first mover advantage, switching costs should not be high for its users (were it not for the community environment) and its business model really should not be difficult to copy. As a matter of fact, it really proved difficult for Yahoo! and Amazon to enter eBay's market, hence the social component of e-W5. What does that mean for the LEM then? The long-term impact is difficult to guess. Should managers try to define their extended e-enterprise in terms of community benefits for its stakeholders? The complexity of the aerospace community as well as its high-tech products and high skill requirements make "switching" very difficult. In any case, building a community certainly requires abandoning control to seek the benefits of network effects. In that sense, e-W5 makes OAP1 and OAP3 challenging. Since the

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[100] Source: Professor Nightingale's class material

boundaries of a community are not clearly defined, how can one identify and optimize enterprise flows (OAP1) or, even more challenging, optimize capability and utilization of people (OAP3)? This leads to a necessary trade-off between understand/optimize the whole enterprise flow and build on network/community effects.

e-W6 (develop a trustful environment) is a crucial component of e-world ventures and clearly reinforces the Lean concept of trust in OAP6 (Relationships based on mutual trust). In part 1, we illustrated this argument with eBay's trust and safety policies (see case study). eBay managers first neglected the press challenging them but soon understood that its core value built on strong community relationships among its users was seriously threatened. But a trustful environment is also a key element of Dell's model as well as Enron's; and the Linux phenomenon would never have occurred without trust among the Linux community or Enron's partners. As the case studies show, network effects combined with community bonds in eBay and Linux are vital to creating a de facto trustful environment.

3.2.4 Impact of e-W7, e-W8, e-W9 (Linux)

e-W7 (users=co-developers) is a concept highlighted by the Linux phenomenon but also as earlier discussed by Dell's model (Premier Pages). Depending on one's interpretation of OAP4 (Make decision at the lowest possible level), one can argue that e-W7 impacts OAP4. The underlying assumption is that the lowest possible level of OAP4 would include the end customer. This is reflected in the Enabling Practice "delegate or share responsibility for decisions throughout the value chain". In Dell's model, this clearly involves the end-customers. Both the Premier Pages and the Councils are unique collaboration spaces where customers interact to define their needs. They take full responsibility during this process.

e-W7 also clearly impacts OAP5 (IPPD). For both Dell and Linux, customers are integrated in product development (even though not much in process development). The Enabling Practice "Involve all stakeholders early in the requirements definition, design

and development process" also reflects the need to include customers in the product development loop.

e-W8 (release early, release often) and e-W9 (negation of Brooks's law[101]) are two strong disruptive e-world trends for the LEM. e-W8 is a form of real-time collaboration where software programmers work on small pieces of products and let others use their ideas as fast as possible. e-W8 obviously relies on e-W9: because the whole Linux community believes in e-W9, they continue to release early and often. From that perspective, those two e-World trends set a real challenge for OAP5 (integration of process and product development). OAP5 is about relying on close teams to integrate the whole product and process development whereas e-W8 and e-W9 build on the pervasive and elusive power of virtual teams. More research on that topic would require a focus on team building and the efficiency of online collaboration for complex manufacturing goods. As formerly described in the case studies, PalmPilot and Wintel are two successful examples of companies building on the intangible value of users working as co-developers. Both rely on open source principles to let user communities develop their own applications and the implications for physical goods manufacturers are not straightforward. Nevertheless passing over the trend completely might be a risky bet.

3.2.5   *Impact of e-W10, e-W11, e-W12 (Enron)*

As we will later discuss in CHAPTER 5, there are two ways to learn from Enron's case study. On one hand, one can benefit from using Enron's services. On the other hand, one can learn from Enron's business practices. This chapter concentrates on the latter aspect.

The most direct correspondence between Enron's principles and the OAPs is the obvious relationship between e-W12 (Identify and concentrate on your core competency) and OAP1 (Identify and optimize enterprise flow). The first enabling practice of OAP1

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[101] Brooks's law is the law of diminishing returns for software engineers, stating that the number of bugs increases exponentially with the number of engineers working on a given program.

suggests: "Establish models and/or simulations to permit understanding and evaluation of the flow process." This first step was crucial in Enron's strategy and decision to spin off its power generation business, understanding that its core competency resides elsewhere.

More interesting is the model of exchanges on which Enron draws to build its own business (e-W11). What are the advantages of organizing a market on the exchange model? As studied in CHAPTER 2, several factors make the exchange model valuable: reduced search costs, reduced transactions costs (reduces contract negotiation time – but needs uniform contract terms (market driven)), negotiation of short-term and long-term contracts (spot and forward markets, hedging and risk management), efficient aggregation of supply and demand, efficiency in billing, stable rating and pricing policies and contract enforcement. It would obviously be presumptious to think that the exchange model could be applied to any industry or market. Money, as well as energy, has the singular property to be a pure commodity item. This is reflected in e-W10, which advises to seek the status of standard. After all, the Internet itself increases the importance of standards. Indeed, the glue that holds it together is essentially a set of software standards. Their user-friendly simplicity allows people to use the Internet in many different roles - as customers, suppliers, employees, job seekers - without needing to be retrained. Electronic commerce needs standards in order to make it easy to transfer information between companies with different systems: hence the importance of XML. In the Lean enterprise, standards are crucial to optimize processes, platform operations and information transfers. In this extended sense of e-W10 (standards), there is a clear impact of "standards" on OAP2 (Seamless information), OAP5 (IPPD) and OAP11 (Ensure process capability and maturation). In addition, e-W10 arguably impacts OAP1 (Flow) as well: "Standards" in that case is interpreted as standardized business practices or standard processes that enable better enterprise flows. With such a model in the automotive industry combining the effect of e-W10 and e-W11, one could imagine a forward market for certain engine components where one would hedge her portfolio against price volatility. Of course, this scenario presupposes fluctuating prices of engines

components, which might seem impossible to current managers. Let us wait until they all trade in auctions like eBay or priceline.

3.3   Internet impact not directly reflected in e-World principles

This subsection examines how other common Internet trends not represented in the e-World principles also impact the Lean principles.

3.3.1   Online education – Corporate Culture

"The main thing to remember is that online learning is like the microwave oven: it is not a complete replacement for the traditional model, but it does some things better."

John Coné, Dell Computer Corporation's head of learning

OAP10 is entitled "Nurture a learning environment". While the 12 e-World trends do not directly address the issue of learning, the way we learn is clearly impacted by Internet technologies. Very recently (April 2001), MIT announced that it would place all the content of its courses and research on the web[102]. More than any previous technology, the Internet allows companies to ensure that every employee has access to the corporate news, views and vision. Some companies, such as Boeing for instance, use it to teach their employees (as well as suppliers and customers) their ethical code. Boeing offers an online "ethics challenge" where employees can test their moral instincts on such delicate issues as "acceptance of business courtesies" and "the minister drops a hint". Such applications are a way to spread a common approach throughout an organization[103]. Another example of Internet use for online training is found at Dell. There, managers, too, receive some online training, for example on coaching. An optional one-day old-fashioned class is available at the end of the course, but Mr. Coné says that only a small

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[102] But unlike other universities, MIT has not announced any plan to deliver an entirely virtual technology based degree.
[103] The Economist, E-Management Survey, November 2000

minority signs up for it. "The only thing we can't do asynchronously online", he says, "is to have an individual attempt to display a learned behavior, and get immediate feedback based on judgment." Dell now delivers roughly 60% of all formal learning online, and hopes to raise that proportion to 90% within two to three years.

Similarly OAP8 (Promote lean leadership at all levels), or at least promoting leadership and enterprise culture, becomes easier to implement with Internet technologies. As companies become more fragmented and their workers more geographically dispersed, managers need a way to rally the troops. In particular, they need a way to build a corporate culture: that intangible something that binds employees together and teaches them to understand instinctively the defining qualities of the business and the appropriate way to respond to any issue that confronts them. The Internet definitely provides the means to do this. It becomes a way for bosses to tell staff where they want the business to go. For example, at Ford, which claims to have the world's largest intranet, 170,000 staff around the world are e-mailed a weekly "Let's chat" note from Jack Nasser, the chief executive. A newsroom maintains a website upgraded several times a day, and available to Ford's employees around the world (in English only), as well as to those of its new acquisitions, such as Volvo. Not only does the Internet allow managers to talk to their staff; it lets them track whether the staff are at least pretending to listen. William Nuti, president of Europe, the Middle East and Africa for Cisco Systems, a high-tech giant, produces a monthly video to send to his staff, explaining where the business is going. What happens if the staff does not choose to watch? Well, the Internet allows you to track who opens an e-mail and when. "I know everyone who clicks on it, and those who throw it away, and I make phone calls to people, saying it's important you watch this[103]."

Another crucial issue, and arguably part of OAP8 (leadership), is the enforcement of corporate culture. Many companies reckon the importance of getting people used to logging on as a quick way to get their people come to terms with changing business

methods[104]. That is why Ford and some other companies, such as American Airlines, are giving their employees computers to use at home. Two-thirds of Ford's employees are hourly workers, who will not be able to use them to do company work from home. But that is not the point. Ford is hoping to get its entire people used to thinking online, and to have a direct way to reach them all with a consistent global message.

3.3.2   *The e-World highlights key Lean principles*

It is important to note the overlap between e-World principles and Lean principles. The trust issue (e-W6), central to eBay's business model, is nothing more than OAP6 ("Develop relationships based on mutual trust and commitment"). Likewise, "focus on end-customer" (e-W2), "identify and concentrate on your core competency" (e-W12), as well as "treat customers (users) as co-developers" (e-W7) are also common to the Lean principles. e-W2 is similar to OAP7 (customer), e-W12 draws from OAP1 (Flow), and e-W7 is arguably nothing more but an extension of OAP4 (make decisions at the lowest level[105]).

3.3.3   *e-WiOAPj matrix*

The previous paragraphs have demonstrated how the e-World trends impact the Lean principles. The following table (Table 8) summarizes those results. Reading from the left column to the right row, it represents how a given e-World principle e-Wi impacts the Lean principles OAPj. The legend is the same as the legend previously used for the interaction matrix (Table 5). Crosses are used to represent disruptive effects, either of one specific e-W on a specific OAP or on a whole column or row, meaning that a given OAP is disrupted by the whole Internet phenomenon. Some of the interactions were

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[104] As the Economist notes (e-management survey, November 2000): [one way to ensure that people will log on is to make material of direct interest to workers (say, their holiday entitlement) available online. Cisco Systems, keen to attract the attention of its option-owning employees, plonks its share price centre-screen. Other companies post a list of employees with a birthday that week. Scient, an Internet consulting firm in San Francisco, has an area called "Do you want to scream at anyone?", for employees to complain about colleagues who send excessive e-mails. The site shows the daily winner in categories such as "Take a chill pill."]

[105] Understanding the customer to be at the lowest level!

simply deduced from the existing interaction matrix (see Table 5). For example e-W6 (trust) is very similar to OAP6 (relationship) and has a comparable impact on the OAPs as OAP6 has. The "arrows" connecting two e-World or LEM principles indicates a strong correlation between the principles.

Table 8: The e-World as an Enabler to Lean

4 Lean as a prerequisite to the e-World

The purpose of this section is to reverse our vantage point and examine how the Lean principles influence the e-World principles.

4.1 General comments on the LEM

Before starting in greater detail with the systematic analysis of the OAPs, we may want to ponder the concepts displayed in the OAPs of LEM.

The Lean Enterprise Model is organized in three levels. At the top are the LEM principles, which include the Meta principles and the Enterprise principles (see WebLEM at http://lean.mit.edu/). At the bottom of the LEM, we find the deepest level of information with the Overarching principles and their corresponding Enabling and supporting practices. Between the two layers of information, a set of four enterprise level metrics is used. As the next subsection will show, the graphical presentation of the 12 overarching practices is somehow misguiding because it presents all the OAPs on the same level of importance. However, besides this observation, there seems to be an intrinsic incongruity between OAP12 and the "Responsiveness to Change" Meta-Principle. As a matter of fact, OAP12 (Maximize stability in a changing environment) focuses on maintaining program stability, which seems essentially passive and static, whereas the responsiveness to change Meta principle is fundamentally dynamic. Of course, OAP12 can be justified for the specific context of a military program where the budget constraint is a crucial parameter that one would prefer to keep stable. But isn't Lean also about responding to budget volatility? Industries are all subject to change. Charles Fine, author of "Clockspeed" demonstrates how industry structures constantly evolve from Vertical/Integral to Horizontal/Modular and back on the double helix[106]. Professor Fine also claims the inevitable temporariness of all competitive advantage. His

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[106] Charles Fine, *Clockspeed,* 1998, 49

analysis supports a dynamic approach to the enterprise and questions the need for OAP12 in the LEM.

4.2 All OAPs are equal…some more than others

Even though the LEM presents all OAP at the same level, the LEM interaction matrix (see Table 9) sets implicit priorities among the Lean principles. The LEM interaction matrix, not surprisingly, exhibits the different level of interactions between the OAPs. As explained in the legend of Table 9, the various impacts range from "Prerequisite" to "Limited Impact". Our analysis is based on the study of each dimension of the matrix. Read horizontally, it tells us how a given OAP impacts all the others. For example OAP1 (Flow) has a strong impact on OAP5 (IPPD) since it "provides identification of all steps in the product cycle to establish the stakeholders by function and timing of need to participate in IPTs[107]." To take that factor into account, a horizontal score was calculated for each OAP by adding horizontally its impact on other OAPs. To keep the arithmetic simple, we adopted the following calculation method: "Prerequisite" counts for 3, "Strong Impact" for 2, "Moderate Impact" for 1 and "Limited Impact" for 0. The horizontal score was labeled "Influence factor". For example, OAP10 (Learning) has 5 "Moderate Impacts" and 1 "Strong Impact", which, in the end, results into a horizontal score of 7. The vertical score, by contrast, measures the level of independence of a given OAP. Since OAP2 (Information) is a prerequisite to OAP5 (IPPD), one would rather focus first on OAP2 and then work on OAP5 than the other way around. We are interested in independent OAPs, and to ensure that independent OAPs would score higher than dependent OAPs, we chose the opposite calculation method: 0 for "Prerequisite", 1 for "Strong Impact", 2 for "Moderate Impact", and 3 for "Limited Impact". The horizontal score was labeled "Independence Factor". For example, OAP11 (Capability) has 1 "Limited Impact", 5 "Moderate Impacts", 4 "Strong Impacts" and 1 "Prerequisite", which gives it an independence factor of 17. The sum of the Independence Factor and the Influence Factor gives the Overall Priority Factor.

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[107] From the LEM tool online at lean.mit.edu

This simple calculation leads to the following conclusion: there are clear levels of priority among the OAPs. Not surprisingly, OAP8 (leadership) appears to be the OAP that should be treated as very first priority. It is not new that human capital plays such an important role in the success of an enterprise: OAP8 is exactly about employees getting involved in their work and promoting lean practices. Other OAPs that appear at a high level of priority include: OAP2 (Information), OAP3 (People), OAP4 (Decisions), OAP6 (Trust) and OAP7 (Customer). The notion of priority as we define it among OAPs however should not be confused with the respective level of importance of each OAP. For example, the very low score of OAP1 (Flow) does not mean that identifying and optimizing enterprise flow is less important than OAP8. What the interaction matrix tells us rather, is that OAP2 (seamless information flow) should precede OAP1 (Flow). Extended to the twelve overarching practices, this analysis reinforces the need for a timely approach of the Lean principles.

OAP INTERACTION MATRIX

Legend: ● Prerequisite ◉ Strong Impact ○ Moderate Impact ☐ Limited Impact

	Flow OAP1	Information OAP2	People OAP3	Decisions OAP4	IPPD OAP5	Relationships OAP6	Customer OAP7	Leadership OAP8	Processes OAP9	Learning OAP10	Capability OAP11	Requirement OAP12	HORIZONTAL SCORE:
Flow	1	○		○	◉	○	○		○	○	◉		10
Information	●	2	○	●	◉	○	○	○	○	○	○	○	17
People	◉	○	3	◉	◉	○		○	◉	○	○		13
Decisions	◉	◉	○	4	◉	◉		◉	◉	○	○		15
IPPD	○	◉	○	◉	5	○	○	○	○	○	◉	○	14
Relationships	○	◉	◉	●	◉	6	◉	○	◉	○	○	◉	19
Customer	◉	○			◉	◉	7	○	○	○	◉	○	13
Leadership	●	●	●	●	●	●	●	8	●	●	●	◉	32
Processes	◉	○			○	○	○		9	○	◉		10
Learning	○		○		○			◉	○	10	○		7
Capability	●	●			◉		○		○		11	○	11
Requirement	○				○							12	2

	OAP1	OAP2	OAP3	OAP4	OAP5	OAP6	OAP7	OAP8	OAP9	OAP10	OAP11	OAP12	
VERTICAL SCORE:	12	17	24	19	12	21	23	24	18	22	17	24	← Independence Factor
REPORTED HORIZONTAL SCORE:	10	17	13	15	14	19	13	32	10	7	11	2	← Influence Factor
TOTAL SCORE:	22	34	37	34	26	40	36	56	28	29	28	26	← Overall Priority Factor

NUMBER ONE PRIORITY OAPs

Table 9: All OAPs are not equal

4.3   The Lean "core" principles are principles of the e-World

In this subsection, the OAPs and their impact on the e-World principles are examined in more details. The same systematic OAP by OAP approach as the one we adopted for the e-World trends would be lengthy, tedious, partly redundant with what was already discussed in 3.2 of this chapter, and, last but not least, completely ineffectual. Also, after the two previous subsections, emphasis will be placed on a subset of the OAPs, namely the OAPs which, as we saw in the preceding section, should be prioritized in any implementation of a lean strategy: OAP2 (Information), OAP3 (People), OAP4

(Decision), OAP6 (Relationship), OAP7 (Customer), and, most important, OAP8 (Leadership).

4.3.1   *Lean is a key element of Dell's competitive advantage*

In the fast developing PC industry, component obsolescence is a constant obsession for the supply chain manager. The more inventory in the chain, the higher the obsolescence costs. As Professor Fine explains, "the faster the clockspeed, the higher the obsolescence costs. So whoever has the leanest chains wins – and the faster the clockspeed, the larger the margin of victory. No wonder Michael Dell is printing money[108]." What is lean about Dell that enables them to keep their competitive advantage? Why can't Compaq, IBM and HP just copy Dell's model? After all Dell does not own any proprietary patent on its direct sales model. In fact Dell started Lean from its very first day of operation whereas its competitors are all dependent on their current channel resellers for sales. As Professor Fine explains, "any attempt to eliminate those resellers is likely to cause sales to plummet until the new model is fully worked out. Meanwhile, those lost sales will go to Dell Computer Corporation or another competitor and may not come back. Thus the resellers/channel-dependent producers are forced to adopt a gradual conversion rather than go cold turkey, so to speak. But a gradual conversion in a fast clockspeed industry can seem like a lifetime. As a result, Dell Computer remains in the driver's seat – for now[108]."

As this example clearly shows, lean (here a mix of OAP1 (flow), OAP2 (information), OAP5 (IPPD) and OAP7 (customer)) from the beginning is a key advantage of Dell's model and a reason why competitors cannot just copy the Dell recipe and reap the benefits of the market.

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[108] Charles Fine, *Clockspeed,* 1998, 74.

4.3.2   OAP2 contrasts with e-W5 (community effects)

Isn't the Internet, by definition, about seamless information flows? Section 3 highlighted the overlap between OAP1 (Identify and optimize enterprise flow) and Enron's e-W12 (Identify and concentrate on your core competency). Once this huge part of the job is done, aren't Internet tools going to provide the seamless information flow required throughout the whole enterprise? The answer is "yes and no" and creates the whole complexity of e-World principles.

We have already argued that the e-World principles support OAP4 (decisions at the lowest level) and showed that in fact, the most disruptive e-World trends appeared to be Linux's e-W7 (users=codevelopers) combined with eBay's e-W5 (community effects). Here we just want to reverse our viewpoint and underline that the disruptive effect is indeed symmetrical. OAP2 (information) is described as "Provide processes for seamless and timely transfer of and access to pertinent information." With a goal such as OAP2, it is difficult to imagine trying to leverage community effects in a similar way as what eBay is doing[109], which is why we conclude that OAP2 stands against e-W5.

4.3.3   Leadership is a prerequisite to the e-World

Not directly an overarching principle, leadership (more broadly speaking that just lean leadership) is a crucial firststep to implementing any e-World strategy. As usual a sheer scale of change is impossible without determined leadership. Is it like the electricity revolution? A generational problem? A survey conducted in early 2000 by the National Association of Manufacturers found that more than two-thirds of American manufacturers did not use the Internet for business-to-business commerce. "Whenever I visit software companies," says Andrew McAfee, a professor at Harvard Business School, "I get them to complete the sentence, 'The business-to-business revolution is x%

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[109]eBay's principle is to allow any kind of information exchange to reinforce community bonds between users. This is obviously not the focus of OAP2.

complete.' The biggest number I have heard is 5%. Many say 1%.[110]'' Those comments might seem trivial but implementing an e-business strategy will not succeed without strong leadership. This example is one that adds to the list underlining the staggering importance of OAP8 (leadership).

4.3.4 *OAPie-Wj matrix*

The previous paragraphs have demonstrated how the Lean principles impact the e-World trends. Table 10 summarizes those results. The same legend was used as for the e-WiOAPj matrix. For example, we saw that OAP5 (IPPD) had a strong impact on e-W3 (Supply Chain) and, arguably, it impacts e-W2-4-6 and 10 while it is inconsistent with e-W5 (Community effects). Also we argued about the ambiguity of OAP12 and show how we might want to eliminate it from the LEM principles.

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[110] The Economist, E-Management Survey, November 2000

Table 10: Lean as a prerequisite to the e-World

5   Summary

This chapter first introduced the e-World principles and then studied their interaction with the Lean practices.   Unsurprisingly, the e-World principles have a lot of characteristics in common with the Lean principles. The notion of Trust is in both cases central and primordial to the success of the enterprise. Some very successful Internet companies, such as Dell, have business models integrally tied to Lean principles. Less expected however were some disruptive effects from the e-World.   The notion of

"disintermediation" illustrated by Dell's Direct Business Model was certainly familiar to fans of consulting publications but Linux's challenge to the law of diminishing returns for production functions and eBay's success built on community bonds are much less commonly described in business papers.

CHAPTER 5: RECOMMENDATIONS & POLICY ISSUES

1 A cautionary tale for e-business skeptics: The demise of Encyclopedia Britannica[111]

Skepticism when it does not lead to exaggerated conservatism is often a healthy detachment that enables objectivity. Total skepticism vis-à-vis the mass mediatized "New Economy" revolution is singular but can be a challenging intellectual exercise. Against the totally sceptical the following story is a regularly cited cautionary tale. There are obviously dozens of similar stories but this one is particularly appealing to anyone who was born at a time when books existed.

The notion of an encyclopedia was essentially a product of the Enlightenment. In France, Denis Diderot devoted a lifetime to producing one. But what was to become the most famous encyclopedia in the world started life in 1768, in Edinburgh, Scotland: the Encyclopaedia Britannica. As it went through successive editions, academics and ordinary readers alike came to rely on it; even today, some historians become misty-eyed when they talk of the great 11th edition, published in 1911.

The reputation of Encyclopaedia Britannica survived a change of ownership in 1920 to Sears Roebuck, an upstart mail-order retailer, and a move of its base to Chicago. Two

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[111] as it is for example in Evans and Wurster's Blown to bits. The following case study is based on their book's first chapter.

decades later it became the property of a foundation, the proceeds of which benefited the University of Chicago. Its door-to-door salesmen became legendary for their knack of persuading parents that an encyclopedia was a must if their children were to grow up well educated. By 1989, sales revenues had reached a record $650m, and the firm's sales force had grown to 2,300.

Yet disaster was already waiting in the wings. It began when Microsoft produced a cheap CD-ROM encyclopedia called Encarta in 1993. Britannica's bosses responded with a CD-ROM of their own, but their salesmen rebelled at seeing their hardcover books undercut[112]. The Internet made things infinitely worse. Sales collapsed, along with the sales force. In 1995 the company changed hands again, for a small fraction of its book value. Today it employs fewer than 350 people. In October 1999 the new owner decided to make the contents of Encyclopaedia Britannica available free on the Internet, in the optimistic hope of recouping the cost through advertising on the website. But, as if to question even this new strategy, the site promptly crashed.

2 Introduction

Any subject that is even by far related to Internet technologies carries with it a plethora of policy issues that regulators and industry leaders have to deal with.

The mere notion of private property raises huge questions: "How should policy handle digital property rights, e.g., through contract versus copyright?", "How can we strike the proper balance between privacy, censorship and security (national and commercial) in the electronic economy?". Mention fair access to information and you need to ask: "What rules should govern network access and interoperability?" or "How should issues of equity and universal service be handled?". Add to that an international dimension and the whole pictures blurs into an inextricable gridlock: "What must be decided

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[112] Other versions of the story stipulate that they never believed that a mere CD would ever overtake their noble books share of the market.

internationally to allow national policies to be effective?", "How can one reconcile differences among national regulatory regimes (e.g., in standards-setting processes or privacy laws)?", "What will be the consequences of the contrast between the American preference for markets and the European and Asian desire to use government intervention?".

All these questions are fundamental for decision makers to bear in mind. The ambition of this chapter however is different. First the lessons that can be learned from the four case studies of CHAPTER 2 are discussed. Second this chapter examines the deep changes in organization of industries due to the Internet. Third and most important we turn our attention towards ourselves and examine the impact of the e-World on people, i.e. human resources.

3   Lessons from the "fruitflies[113]"

3.1   Customer focus

[Baseline: Should companies use customer focus to price discriminate? Yes, but there are technological constraints and the customer itself can be difficult to identify and define in a collaborative IT enabled environment]

Dell's case study has demonstrated how customer focus is central to Dell's business model. One obvious way companies could use their customer knowledge is to offer different customers different prices and levels of service. So far, most have hesitated to do so - or at least have hidden their attempts more carefully than did Amazon.com, which was savaged in early 2000 for quoting different prices for the same book[114]. But clearly, the true promise of customer data is to help companies to discriminate, in service quality

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[113] Expression borrowed from Charles Fine's *Clockspeed – Winning Industry Control in the Age of Temporary Advantage,* Perseus Books, 1998.
[114] Smith and Brynjolfsson, *The Great Equalizer, Consumer Choice at Internet Shopbots,* MIT, July 2000

and perhaps in price, and to target their services so that they give priority to their most profitable customers.

There are both technological and cultural limits however to the possibilities of applying customer focus *a la Dell* to any other industry. For telecommunications companies, for example, customer relationship management and customer value management try to create useful knowledge out of enormous databases of customer usage habits and preferences, which rapidly becomes an extremely complex problem. In addition, it becomes less and less obvious to locate one's customers. As companies link their databases together, and try to cross-sell products to a customer who sees a single common front, they run up against a new version of an ancient problem: how to motivate one salesman in a company to hand over a customer to another. Without incentives to share customers, the most elegantly reconciled data in the world will make no difference. As Forrester notes: "In most companies, the tyranny of the distribution channel will make customer-sharing a hard problem". "In large companies," observes George Colony, chief executive of Forrester Research, "tremendous political power has built up around these channels. It takes the CEO to force the breakdown of the walls."

3.2   Value chain integration

[Baseline: 1) The major challenges to value chain integration are technology and trust. 2) Value integrators for aerospace industry (e.g. Exostar) are under scrutiny for anti-collusion]

Value chain integration is another key element of the Dell model that was discussed in CHAPTER 1. At Dell Corporation, the Internet (dellonline) enables suppliers to access information on customer demand in real time and allows a virtual collaboration between Dell and its suppliers-partners. The success of Dell making PCs to order has led executives from traditional manufacturing giants, such General Motors or Maytag, to

make pilgrimages to Austin, Texas to learn the Dell way[115]. For an exchange like Exostar however, integrating 37,000 suppliers faces many challenges.

It is first of all a technological challenge. As mentioned in CHAPTER 3, Lockheed Martin was planning on starting virtual supplier collaboration in March 2001. Today (Spring 2001), Exostar is only able to accommodate the trade of direct material[116] and it is only in February 2001 that Exostar partnered with PTC to deliver global collaborative product design and commerce services[117].

Second, the issue of trust, which appeared so fundamental both in the e-World and Lean principles, constitutes another major challenge for B2B exchanges. Professor Hau Lee from Stanford University has conducted substancial research on the subject. Incentives for partners to second-guess each other are high as some may face the prisoner's dilemma[118].

Third, for the special case of military programs (e.g. defense weapons), the notion of inventory has a definitely different dimension. Even the slightest probability of a war breakout will probably never lead any country's defense department to build its weapons to order without keeping any part in reserve. Related to the military dimension is also the necessarily highly integrated architecture of some products. As discussed in CHAPTER 4, because of high performance requirements and extreme product complexity, it is very difficult, if not completely impossible, to allow the same level of modularity in PCs for commercial or military aircrafts. Nevertheless, one could certainly recommend military

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[115] The Economist, April 14 2001, 63

[116] EC Technology News, January 5 2001

[117] Canada News Wire, February 26 2001, announced that spareparts would be traded on the Exostar exchange in Spring 2001 by incorporating Boeing's Part Analysis and Requirement Tracking (PART) system to Exostar.

[118] The prisoner's dilemma is an often-used concept in game theory. Two prisoners are questioned separately about a crime they committed. Each may give evidence against the other or may say nothing. If both say nothing, they get a minor reprimand and go free because of lack of evidence. If one gives evidence and the other says nothing, the first goes free and the second is severely punished. If both give evidence, both are severely punished. The overall (globally) best strategy is for both to say nothing. However not knowing (or trusting) what the other will do, each prisoner's (locally) best strategy is to give evidence, which is the worst possible outcome.
In general, a situation where local optimization is used leads to the worst possible outcome globally.

industry leaders to catch up as much as possible with modularity in software controls to benefit from hardware innovations.

Finally Exostar, as an enabler to design, development, and production collaboration between until now competing companies, will certainly be much more subject to regulatory offices scrutiny than dellonline will be. In fact, its automobile industry equivalent, Covisint was challenged in its early days by anti-trust authorities both in Europe and the United States. For anti-collusion authorities key questions include: "For what issues is an ad-hoc response appropriate to the regulatory challenges posed by the internet and E-commerce?", "For which issues would it be best to permit commercial practice to be slowly codified as it evolves?", "Under what circumstances do we want to act more proactively?". The list is long.

3.3   eBay's Dynamic Pricing and Enron's exchange model

[Baseline: 1) Dynamic pricing faces challenges to adapt to other industries: product complexity and demand-supply mismatch. 2) Once more: it appears fundamental for a company to identify its core competency]

The eBay and Enron models raise the question of pricing structure on an exchange. Dynamic pricing is a success among eBay and Enron's users but does that mean that the price of any item can be negotiated?

Again, product complexity rises as one of the most obvious hurdles against this e-World trend. As previously discussed, Exostar enables the trade of both indirect (e.g. consumables and piece parts such as nuts and bolts, commodity and commercial, off-the shelf items with part number and catalog reference) and direct products (e.g. black box components with proprietary technology such as radars). It is very questionable whether companies will ever be willing to trade complex built-to-specification subsystems, or even more challenging, jointly designed systems, completely virtually[119]. In addition to

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[119] I am thankful to Dr. Bozdogan for providing me the scale of product complexities

the complexity of the product the allocation problem also arises. Very often buyers ask for a set of items that none of the sellers exactly offers. FreeMarkets, the industry equivalent of eBay, already offers its services to help match a buyer's demand with a seller's supply. Yet again, one can question how such a system could apply to one-time jointly designed and highly integrated products.

As Tapscott notes, dynamic pricing in an auction mode "tends to prevail where the transaction costs of negotiating are lower than the range of uncertainty about the final price[120]." If the value of a good is uncertain, or the purchaser is flexible within a category, or the contract is big enough, then a variable-pricing opportunity certainly exists. Will that lead any business that conducts large-scale selling or buying to eventually use variable pricing? This is an open question to the next generation.

Besides dynamic pricing, one of the main trends highlighted by Enron's case study is the extreme necessity for a company to identify its core competency. This is no new rule for managers, but in the era of Internet speed, the rule has become a number one priority. For skeptical managers, the story of Encyclopedia Britannica is a must-read. Enron proved to be very skilled at identifying and concentrating on its core competency: delivering power. In fact, Enron is *the* company that understood faster than the rest of the industry that power should be traded like financial instruments are traded on the New York Stock Exchange.

3.4 Lessons from the Linux phenomenon

3.4.1 *Getting people to work for free?*

[*Baseline: Getting people to work for free is every manager's dream – a couple recommendation to foster Linux-like innovations*]

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[120] Tapscott, *Digital Capital – Harnessing the Power of Business Webs,* HBS Press, 2000, 40.

Caricaturing the Linux phenomenon to the extreme, it is easy to reject the whole phenomenon. Who would ever work for free in this world?

To add to this pessimism, an empirical study from Von Hippel and Lakhani [121] shows that the need to call upon any of the traditional explanations[122] to clarify the Linux phenomenon exists only for a small portion of information providers. According to their study, most contributors provide others with their help because it increases their own knowledge. Whether one rejects the philanthropy of Linux software programmers or not, companies would certainly benefit from inspiring the sort of altruism that has gone into developing open-source software.

In some ways, corporate innovation increasingly resembles Linux code writing. The teams that work on it are often geographically dispersed. And as discussed earlier, design is increasingly modular rather than sequential: people no longer design the engine and then pass it on to a second group to produce the casing, which discovers problems with the engine design just as the first team has moved on to its next project. Besides, innovation is increasingly delivered not by a single company's research-and-development department, but by a network of companies, each working on a different part of the project.

However, unlike Mr Torvalds[123], it seems that traditional companies still need to rely on their employees' ideas for making their money. IBM has a scheme to make sure that good ideas bring more than a pat on the back. Developing a patent wins a financial reward; so does authorship of a certain number of articles; and consultants get bonuses for creating and sharing good ideas. The company is also working on a way to encourage people to put their ideas into its knowledge database, by rewarding those who create

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[121] *How Open Source software works:"Free" user-to-user assistance*, Karim Lakhani and Eric von Hippel, May, 2000. Note: Lakhani and von Hippel studied the case of Apache

[122]i.e. altruism; incentives to support one's community; reputation-enhancement benefits received by information providers; and expectations of benefits from reciprocal helping behavior by others

[123] Linus Torvalds, a 22 year old Finnish University student in 1991, initiated the Linux phenomenon when he released his Linux code for free on Usenet, the Internet's global information-sharing resource at the time.

material that is frequently used, as well as those who review or grade the stored ideas in particularly helpful ways[124].

3.4.2   *Adapting pricing structure to changing products*

[Baseline: in the e-World, information is free and products can no longer be priced on their sale value. It is recommendable for companies to rethink their pricing structure]

Besides its highly debated altruistic nature, the Linux phenomenon highlights the changing nature of the value of products. As more and more products rely heavily on electronic components and software controls, the whole notion of product value needs to be re-examined.

Since software are pure information products that can be reproduced at zero costs thanks to modern information technology, many have argued that their price will eventually be zero too, with suppliers condemned to undercut each other's prices. Following that reasoning, any information product will also eventually be sold at a zero price and the author's thesis advisor will simply download her new BMW's operating system on a freeware website by pressing a button on the steering wheel. BMW will thus stop producing those products and we will soon drive our grandparent's automobiles again…a plausible scenario isn't it?

Eric Raymond, a strong advocate of the open-source movement, stresses the difference between the sale value and the use value of software products. The sale value is usually defined by the cost of producing the software in terms of programmer's work hours. More and more however, software product innovation speed is increasing so fast, most of the value of software products comes from the customer service (or help desk). Eric Raymond argues that companies should change their pricing structure to take that factor into account. "They just will not afford their current pricing structure[125]."

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[124] The Economist, E-Management Survey, November 2000
[125] Eric Raymond, *The Magic Cauldron – 3. The Manufacturing Delusion* (available on his website)

Consequently, traditional manufacturers should examine their pricing structure. As a result of an increased usage of IT in many physical products, more and more companies will define themselves as service, rather than product, providers and their pricing schedule will inevitably need to adapt.

4   Organizational changes

4.1   The end of hierarchy? Political tensions ahead…

4.1.1   Introduction

[Baseline: Until now information access has created hierarchy. With the end of hierarchy, isn't a company's core competency to just organize the supply chain?]

Limited and inequitable information access traditionally creates two types of hierarchies: hierarchy of choice and hierarchy of power[126].

Hierarchy of choice can be illustrated by the decision tree along which customers are compelled to do their shopping in the physical world: they must choose a street, then a shop, then a department, then a shelf, then a product. Hierarchy of power is illustrated by the traditional organization chart, in which senior executives have a wider span of knowledge than their subordinates (Figure 13).

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[126] Evans and Wurster, *Strategy and the New Economics of Information*, Harvard Business Review, September-October 1997, 75
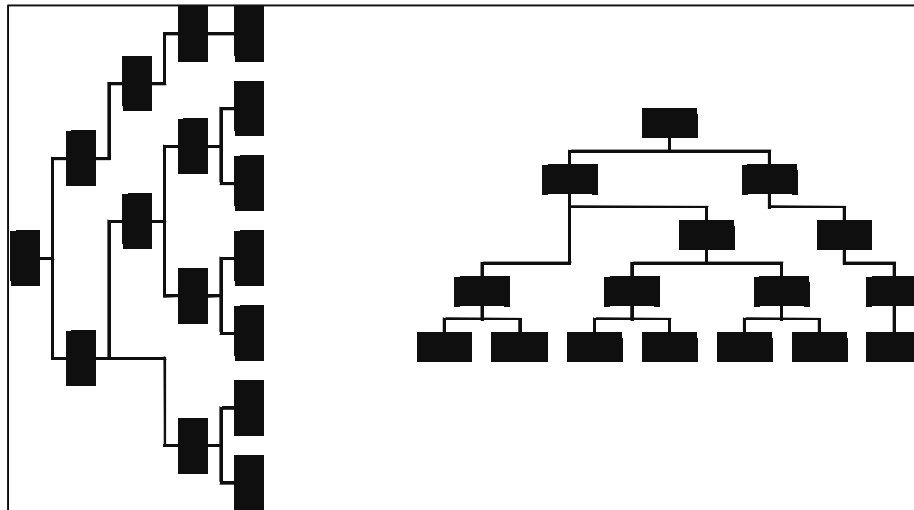
Figure 13: Hierarchical Decision Tree (left) and Hierchical Organization (right)

As Evans and Wurster note, the alternative to hierarchy is markets, which are symmetrical and open to the extent that they are perfect. But traditional markets trade only in less rich information. When the trade-off between richness and reach is eliminated, everyone communicates richly with everyone else on the basis of shared standards. Evans and Wurster name this phenomenon "hyperarchy" after the hyperlinks of the World Wide Web (Figure 14)
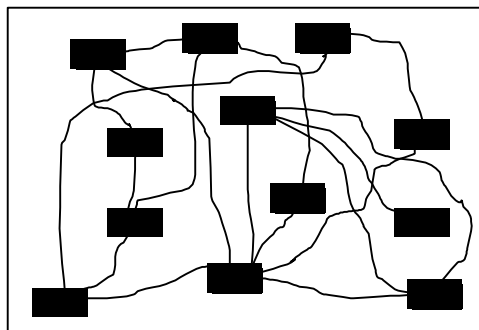
Figure 14: Hyperarchy

If there is a possibility that far richer information can be exchanged than that involved in trading products and certificates of ownership, then hyperarchy may challenge all markets. It may also enable us to answer more fundamental questions of corporate organizations and identity.

Examining visually the fading of the reach/richness tradeoff with a hypothetical four-company enterprise leads to questioning the definition of a company (Figure 15). With a highly modular enterprise architecture built on top of functional teams, it seems that the notion of corporate boundaries disappears. Does that mean that the glue that holds a company together is its ability to organize teams, to assemble and disassemble them (which incidentally is Dell's core competency)[127]?
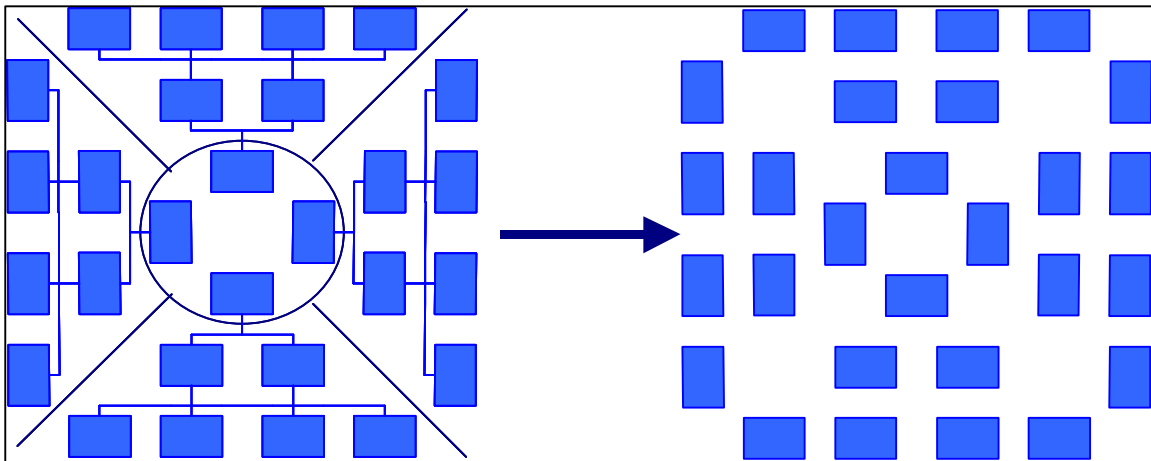
Figure 15: The End of the Hierachical Organization?

4.1.2 Political tensions

[Baseline: the democratizing effect of the Internet faces cultural barriers. Top management seems to be willing to keep its power]

As compelling as this theory of hierarchies's demise might be, the "democratization" effect of the Internet still faces heavy political and cultural barriers.

SAP, a German business-software giant, has a very elaborate communications system that makes it resemble the previous hyperarchy (Figure 14). It allows material to be broadcast on the car radios of workers on the road, for example. The company found that middle managers objected to the chairman e-mailing all employees. Their authority had

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[127] Note that Charles Fine comes to the same conclusion in Clockspeed: companies's ultimate core competency is to organize the supply chain

rested partly on their role as a source of information, and without it they felt exposed. As so often with Internet-driven changes, the implications of what appeared to be a simple, time-saving innovation turned out to be more complex and politically sensitive. That sensitivity becomes more acute as communications become increasingly bottom-up as well as top-down. At Siemens, a large German company, Chittur Ramakrishnan, the chief information officer, has noticed a "very significant number of e-mails to top management. The idea of going through a secretary to get an appointment has changed. People can send e-mails to anyone and expect a response. It is very democratising." Knowing the extreme diplomacy of the CEO of a German company, one can better understand the highly disruptive effect of the Internet on the traditional organization[128].

4.2 The empowerment of the young?

[Baseline: Internet is the youth's first technology revolution. 1) Dramatic changes in training across the whole enterprise are needed. 2) There is also a need to rethink the value added by each rung of the hierarchical chart]

4.2.1   Reversing training programs

Big, traditional companies, from Procter & Gamble to Siemens, have started "reverse mentoring" programs in which middle-aged executives are tutored on the mysteries of the Internet by young newcomers who sometimes slip and call them "dude". General Electric's CEO, Jack Welch, says "e-business knowledge is generally inversely proportional to both age and rank in the organization." GE asked its top 1,000 managers to become "mentee" to 1,000 young employees, many of whom had only recently joined the firm but who nevertheless understood the new technologies better than GE's finest[129].

At the same time, the growth of start-ups and young companies outside the mainstream corporate world is giving young people far more opportunity than ever before. About

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[128] The Economist, E-Management Survey, November 2000
[129] The Economist , The Young Survey, December 2000

15% of American top managers (chief executives, presidents and company owners) are in their 20s or 30s, according to Dun & Bradstreet, a business-information provider. That would have been unthinkable a decade ago[129]. In a world where the World Wide Web becomes the preferred way to communicate, one might recommend strategies to extend all staff development and training programs (as well as recruiting) across the entire extended enterprise.

4.2.2   *The upside-down enterprise*

The Internet craze has seen an increasing number of young people mastering new technologies and landing at the CEO level in the mid 20s or 30s. Does that mean there will be a wholesale takeover by the young? A good place to look for an answer is Microsoft, which has had a quarter-century's experience with the workforce trends that most companies are only just beginning to confront[128].

Microsoft's most important employees are not its managers, but its individual programmers (the lowest rung on the organizational chart), who take the company's only real lasting asset, its knowledge, home with them in their heads each night. They have great autonomy in choosing how to do their job. By and large, the managers' task is not to tell the programmers what to do, but to clear obstacles from the path they choose.

This is the military model turned upside down: the officers serving the enlisted men. The difference is that whereas the best soldiers do not question orders, knowledge workers are valued most for their ability to think for themselves. They are trusted to steer their own path through business problems. Managers hold back, knowing that the more specific their order, the more it is likely to undermine their employees' ability to find creative solutions. So they concentrate on the diplomatic tasks that most of the independent young programmers are not much good at: co-ordinating with other teams, resolving conflicts, motivating people and ensuring that everybody is happy.

Thinking of the programmers as young workers and the managers as older ones looks like a model for the workplace of the future. As it happens, Microsoft's programmers tend to

be in their 20s and early 30s, whereas the managers are about a decade older. Many of the managers are former programmers who reached a point where they no longer wanted to sleep under their desk. The effect of all this is that youth and youth qualities apparently dominate, but the experience and maturity of older employees is put to good use too.

5   People Implications

5.1   Reward structure

[Baseline: Internet age people want to be more involved in their work. How should a company reward them accordingly?]

It has been argued that the Internet modifies the involvement of people in their work. On one hand, the new generation born with the first computers, has been observed by Tapscott in his book "Growing up Digital" and shown to be more entrepreneurial than their parents[130], being brought up with online games fostering their creativity. This point is certainly very debatable, but the increasing number of employees investing in stock is another reason to predict strong desire of people for more performance-based rewards to be involved in the profits of their companies[131].

Pay structures should also be adapted to foster collaborative work, designed to reward team workers rather than lone rangers. As illustrated by the Linux examples, the motives that persuade people to work together are not exclusively financial. In the Linux model, thousands of people around the world who have never met work together, unpaid. The model requires a workable kernel (in this case, the initial 10,000 lines of codes written by Linus Torvalds) to which people can easily add, a modular design, so that different

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[130] Don Tapscott, *Growing up Digital,*
[131] The Economist, The Young Survey and E-Management Survey, November-December 2000

people need to understand only the part they choose to work on, and a small team at the top to set broad guidelines and select the best ideas. Their reward is global recognition.

5.2   Size and definition of companies (boundaries?)– e-Lancers

5.2.1   Decreasing size of firms

[Baseline: Theory and empirical studies demonstrate decreasing size of companies in IT world]

Nobel Laureate Ronald Coase is often cited for his study on the nature of the firm. According to his theory[132], transactions costs should be blamed to explain why each individual worker does not work independently to sell the result of her work to other workers.   Since the Internet's most obvious consequence is its huge reduction of transaction costs, it is tempting to infer that the size of companies should decrease.

As a matter of fact, an empirical study conducted by MIT faculty in 1997[133] finds broad evidence that investment in IT is significantly associated with subsequent decreases in the average size of firms. This same study also finds that the effects of IT on organizations are most pronounced after a lag of two to three years and although the correlations it finds does not necessarily imply causality, they are consistent with the theory that IT makes market-based coordination more attractive relative to internal coordination.

5.2.2   E-lancing

[Baseline: the end of the integrated firm? The rise of e-lancing]

In one extreme view, Thomas Malone and Robert Laubacher argue that a in a couple of decades, we may look back on the integrated firm as a transitional structure that flourished for a brief moment in history.   They suggest in an argumentation similar to

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[132] Ronald Coase, "*The Nature of the Firm*", 1937 (first publication)
[133], Brynjolfsson, Malone, Gurbaxani and Kambil, *An Empirical Analysis of the Relationship Between Information Technology and Firm Size*, MIT, January 1993

Alberthal's global virtual village theory that the fundamental unit of the economy may be reverting from the corporation to the individual. Independent contractors, rather than full-time employees in big companies, will perform most work and "such networked e-lancers will join fluid and temporary webs to design, produce, market, and support goods and services[134]." Indeed, Tapscott mentions that thousands of individual free agents auctioned their services on Talent Market at Monster.com in 1999 and that on eBay, an entire virtual project team put itself up for sale[135].

In yet other signs of change, Prudential, a large insurance company, recently altered its slogan from "Get a piece of the rock" to "Be your own rock". Margaret Reagan, a consultant with Towers Perrin, which studies workforce trends, predicts that barely one-third of the millennials will take steady staff jobs with companies. Instead most will freelance, work under contract, or part-time[136].

5.3 Enterprise culture issue

[Baseline: Home working raises important questions such as how to define enterprise culture, rules and foster innovation]

In a stable, slow-growing and well-established company, a common culture may be easy to maintain. You take each year's new recruits off to boot camp for a fortnight and teach them the company history. But few companies today can afford to be stable or slow growing. Instability and speed make culture-creation harder.

In Silicon Valley, people count as old stagers if they have been with the same employer for much over a year. But rapid turnover is not the only difficulty. In many companies, the sales force or the maintenance folk rarely come into the office. A quarter of IBM's workforce, for instance, is now mobile - they spend at least 80% of their time off-site,

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[134] Thomas Malone and Robert Laubacher, *The Dawn of the E-Lance Economy,* Harvard Business Review 76, no. 5 (1998), 144.
[135] Don Tapscott, *Digital Capital – Harnessing the Power of Business Webs,* HBS Press 2000, 172. Tapscott also precises that the auction was never completed and the team withdrew.
[136] The Economist, The Young Survey, December 2000

usually working from home or on the road. Key people may be based in key markets abroad, a day's air travel away from the main office. Mobility goes right to the top: Douglas Daft, chief executive of Coca-Cola, travels 80% of the time. He boasts: "The headquarters office is where I am[137]."

Arguably, companies do not control their culture anymore. With employees spending part of their days on another firm's website, companies tend to lose their identities. However at the same time, it seems that the extended enterprise needs that intangible something to keep its cohesion. Michael Dell for example spends a substantial amount of time telling the direct sales story as a way to invigorate a culture across the entire extended Dell enterprise in order to strengthen its (virtual) integration.

Several issues arise from increased staff mobility[138] and fading enterprise culture. During his job interviews, the author of this thesis was told by a couple investment banks the importance of keeping their staff together to insure a high rate of product innovation. If this rule holds for other companies, they should definitely ponder the pros and cons of allowing home working. In one extreme view, current enterprise work rules also become totally obsolete if employees work from home. In contexts such as product innovation and enterprise culture management where human interactions are so crucial, it would be interesting to see if the e-World will foster other mechanisms to substitute for geographical proximity. As mentioned in CHAPTER 4, Jack Nasser e-mails a "Let's chat" note to Ford's 170,000 employees weekly and William Nuti, president of Europe, the Middle East and Africa fo Cisco Systems produces a monthly video to send to his staff, explaining where the business is going. Is this tomorrow's substitute for human interactions?

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[137] The Economist, E-Management Survey, November 2000
[138] This point is still controversial. Cutter Consortium (www.cutter.com) recently showed (Apr 06 2001) that workers telecommute on a limited basis. "Most Fortune 1000 companies allow telecommuting but very few employees work from home, and even fewer do so on a full-time basis"

5.4   HR

[Baseline: To capture HR savings, there is a necessity to standardize HR rules throughout the whole enterprise, globally]

The impact of the Internet on HR departments is already clearly visible in many industries.   Typically, HR departments used to spend much of their time answering questions from employees: choice of various permutations of pension, health plan, holidays, pay, etc. Such questions are often more easily answered by a computer than a human being.   This has encouraged companies to put their employees' details on a website, protected by a password, and allow their staff to update their personal information or, in refined versions, to experiment with different combinations of their compensation options.   The results can be dramatic.   Even when staff could use the HR website only to update their records, Ford found that calls to the central help desk fell by 80%[139].

Once they realize how much of HR can be shifted online, some companies might start to think about completely outsourcing their HR department.   BP agreed in December last year to outsource much of its HR work to Exult, a start-up that has recently negotiated a second deal with Unisys, a computer giant.   One effect of handing over this project to Exult has been to reduce unnecessary diversity in compensation schedules, pension and insurance plans.   Once again, the impact of the Internet is to encourage simplicity and centralization.

Should that lead companies to extend their HR (like their training programs) to the extended enterprise?   Aligning compensation schedules across the whole Exostar community might prove complicated.   This point of view is supported by Tapscott however, who defines Interenterprise Human Resource Management[140] as the next step for traditional HR management.   Tapscott also suggests a need to understand human

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[139] Economist, e-management survey, November 2000
[140] Digital capital CHECK DETAILS…

resources as assets rather than liabilities (who would rather be a liability than an asset?). Could the traditional enormous HR department even become a profit center? In the era of immediate communication, one could imagine an "Accenture-like" HR service, providing companies with professional teams when needed. However, this extreme view neglects the fact that HR personnel need to be intimately involved in understanding new business requirements. Outsourcing HR to an independent contractor may severely hamper the ability to recruit the kind of multi skilled knowledge workers required to support a lean enterprise.

6   Summary

Before trying to implement best business practices learned from CHAPTER 2, it is necessary to ponder the implications of such a strategy. CHAPTER 5 started by analyzing the lessons from the fruitflies and then focused on organizational and people issues. Learning from the fruitflies, as CHAPTER 5 demonstrated, is especially tricky because of customer, value chain integration and exchange model related issues. Moreover, an analysis at the organization level is necessary to understand the full impact of e-World trends: traditional hierarchical structure are questionable in view of the new distribution of knowledge within the firm but political tensions seem inevitable with current senior management. Finally, a focus on people issues highlighted the need to adapt reward schedules, enterprise culture and human resources management.

CHAPTER 6: CONCLUSION

This chapter reviews the research documented in this thesis. It first provides a brief discussion of the research objectives, key questions and research design. It then summarizes the major findings and discusses possible directions for future research.

1 Review of research objectives, key questions and research design

The introduction chapter cited Jorgenson and Stiroh's recent research demonstrating a high correlation between labor productivity growth and progress in modern information and communication technologies. Economists may be extremely fastidious but the result is far from obvious when one attempts to understand the nature of this correlation. This thesis concentrated on the interactions between contemporary business models and the Lean enterprise. Following Charles Fine's logic that slower industries (e.g. Aerospace) ultimately follow the same trends as faster ones (e.g. personal computer), CHAPTER 2 focused on four case studies representative of the e-World. CHAPTER 3 was a transition to Aerospace's existing e-World ventures and provided a framework for cross industry comparisons. CHAPTER 4 examined in detail the interactions between the e-World and the Lean enterprise. Lastly, CHAPTER 5 provided a broader perspective for industry leaders to bear in mind when trying to learn from the fast moving e-World trends of CHAPTER 2.

2 Summary of major findings

2.1 E-World principles

CHAPTER 2 described current e-World trends and focused on four case studies. From these case studies, a set of principles was extracted to form the e-World principles. Dell Corporation's business model exhibited three major strengths: e-W1 – Sell Directly, e-W2 – Focus on end-customer, and e-W3 – Integrate the whole supply chain. Likewise, three characteristics were identified from eBay's business model: e-W4 – Look for opportunities to create value, e-W5 – Leverage community effects, and e-W6 – Develop a trustful environment. The third case study analyzed the Linux phenomenon and isolated three vital components: e-W7 – treat customers as co-developers, e-W8 – release early, release often, and e-W9 - Network effects overturn the law of diminishing returns. Finally, the Enron case study provided the last three e-World principles: e-W10 – Seek the standard status, e-W11 – Build on the exchange model, and e-W12 – Identify and concentrate on your core competency.

2.2 Current situation in the Aerospace industry

CHAPTER 3 presented the current trends in the Aerospace industries, illustrated by a number of companies trying to leverage Internet technologies to conduct business. This chapter observed that Aerospace companies are still in infancy compared to much more advanced Dell corporation in the computer industry. However, since it is easy and tempting to draw fast parallels between the Dell model and any other industry, CHAPTER 3 demonstrated the importance to keep stakeholder, product and production issues in mind before trying to apply any recipe from Dell's factories.

2.3 Interactions between e-World and Lean principles

CHAPTER 4 focused more specifically on the interaction between each of the 12 e-World principles with the LEM's 12 overarching principles (OAPs). First to be noted were the similarities and reciprocal reinforcement of e-World and Lean principles. e-W2

and OAP7 both profess the importance of customer focus. Likewise developing a trustful environment is a common characteristic of the e-World and of Lean. Finally, Dell's supply chain integration strength (e-W3) was identified to be a lean mix of flow optimization (OAP1) and integrated product and process development (OAP5). Second to be observed were the inconsistencies between e-World principles and Lean. Most notably conflicting with Lean are eBay's principle of leveraging community effects (e-W5) and Linux's apparent exception to the law of diminishing return (e-W9).

2.4   Policy issues

CHAPTER 5 started by analyzing the lessons from the fruitflies and then focused on organizational and people issues.

The section on fruitfly lessons led to five major conclusions. First, the definition of one's customers is far from trivial in an IT enabled collaborative environment and customer data can be technically difficult to manage. Second, value chain integration faces trust, technological, institutional as well as legal challenges. Third, dynamic pricing and the exchange model may not adapt to product and industry complexities. Fourth, CHAPTER 5 mentioned the need for special reward systems in order to foster Linux-like altruistic work behavior. Fifth, it recommended to rethink pricing structures for software-loaded products.

The organizational analysis of current e-World trends highlighted two major points. First there are some political tensions against the democratizing effect of the Internet that industry leaders should be aware of. Second, companies have to adapt to the new distribution of knowledge within their boundaries. Dramatic changes in training program are needed and the role of each rung in the hierarchical chart needs to be well defined.

Finally the section on people implications underlined three main points. First, the new generation necessitates a different reward structure in which employees are interested in the profits on their company. Second the rise of free agents working on specific projects for limited time-periods should be a point of concern for company leaders when they

define their enterprise culture. Third human resources department need a complete reorganization. Training programs and recruiting in the age of IT enabled collaborative enterprises should be extended to the whole enterprise and not just limited to one given company.

3   Suggestions for further research

The result of learning is always an increased awareness of one's ignorance. Unsurprisingly, this thesis concludes with more questions than were considered in the introductory chapter. What should be the next step of this research then?

Based on the findings of this thesis, the author would recommend several areas for future research.

3.1   Exostar

As Lou Gerstner, CEO and chairman of IBM mentioned, the real Internet revolution is on its way and current plans at Exostar seem to confirm the prediction. It would thus be interesting to not only keep observing the evolution of exchanges such as Exostar and MyAircraft for the Aerospace industry, but also to keep an eye on Chemdex in the petrochemical industry and Covisint in the automobile industry.

3.2   Virtual collaboration

The potential of virtual collaboration is still unclear. One could argue that, like the electricity revolution, professional virtual collaboration needs a new generation to grow up with it before human beings can benefit from it. This thesis identified several hindering factors to the construction of online collaboration. Further research on the topic will certainly require a better understanding of human communication and draw upon psychology and more specific communication research.

Many more areas of research (technology, organization, human behavior etc.) will obviously be solicited for supporting evidence before we can understand the whole Internet phenomenon. How long will that take? Considering that the electricity market is still evolving considerably today after almost a century since managers started to use it to re-organize their factories, wisdom should call for patience.

3.3   Value creation and the definition of value

What are future domains of research for a think-tank like the Lean Aerospace Initiative? This thesis showed the interaction between e-World trends in fast developing industries and the Lean principles. Among the e-World principles, Dell's customer focus principle (e-W2) and eBay's new value creation principle (e-W4) raise interesting questions about the nature of the value creation process. Value, in the traditional Lean view, originates from a customer pull. Arguably, Dell's excellent understanding of its customer's needs is simply a brilliant application of Lean principles. If it means however, that Dell is able to completely anticipate its customer's needs (refer to case study's examples demonstrating how Dell knows what its customers need even before them), the notion of customer-pull become much less trivial. In some extreme cases, Dell has replaced its client's entire IT department. The Internet clearly transforms the economics of information and the concept of value, which is key to Lean, will certainly require further research.

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