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Big History, Global Corporations, Virtual Capitalism

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Big History, Global Corporations, Virtual Capitalism[1]

Richard L. Nolan[2]

Homo sapiens has mastered its environment so thoroughly that, for the first time in history, a small minority of the population is capable of creating enough food and fuels to support not only itself, but a growing majority of the 6 billion people now living on earth. This unparalleled abundance is allowing our species to develop, distribute, and profit from innovation in nearly every corner of civilization. Now key elements of the modern world such as the speed and connectedness of digital communication, the dynamic movement of capital, and changing nature of political boundaries are propelling capitalism into a new form that can be characterized as "virtual capitalism." And global corporations in their size and global influence are leading the embodiment of virtual capitalism into the modern world.

In the late 1880s, amid the evolution from early capitalism to managerial capitalism,[3] the U.S. railroads birthed the first modern corporations. They were the first to acquire large numbers of salaried professional managers, the first to have large ranks of middle managers operating the functional activities of the business, and the first to

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[1] Do not quote or reproduce without permission from the author.

[2] Harvard Business School, William Barclay Harding Professor of Business Administration (Emeritus). In 2003, I received two almost back-to-back calls while in my Harvard Business School office, which offered me the opportunity to follow and research the evolution toward virtual capitalism. The first call was the Dean of the University of Washington Business School, offering me the newly endowed Boeing Philip M. Condit chaired professorship in the Foster School of Business, which included faculty chair and oversight of the University of Washington Boeing Executive Program. As the first occupant of the University of Washington Philip M. Condit endowed chair, I served for five years as the faculty chair of the UW/AIMS Boeing 3-week, residential executive education program. During this program, I had the opportunity to talk with a diverse group of Boeing managers in the business units that were directly involved in executing the 2016 strategy.

The second call was from Philip Condit, CEO and Chairman of Boeing, who encouraged me to accept the position. I did, and thus I became Professor Emeritus at the Harvard Business School. Also, my first job after completing the PhD program was at Boeing where I had worked in Boeing's Aerospace Division (as a Soft Engineer) and Boeing 737 Branch (as a Financial Systems Manager). I maintained my position at University of Washington from 2003 until 2009 upon my retirement, when I became a University of Washington Professor Emeritus.

[3] Chandler coined the term "managerial capitalism." See Alfred D. Chandler, Jr., *The Visible Hand* (Cambridge, MA: The Belknap Press of Harvard University Press, 1977), p. 120. Chandler coined the term "managerial capitalism."

create large organizational structures with clearly defined lines of responsibility, authority, and communication among departments.[4]

The century preceding the rise of the railroads and the modern corporation had already seen more technological innovation and change than in the last 10,000 years. Now the people in global corporations were positioned to dominate many, if not most, of the innovative contributions to come. By the last half of the twentieth century, in fact, the modern global corporation had expanded its reach beyond national governments and beyond the geographic boundaries of formerly distant continents. With factory farms stretched across many thousands of acres, and with unrivaled technologies for extracting and distributing fossil and nuclear fuels, the modern global corporation yielded seemingly infinite sources of energy to power our homes, our communities, our lives.

The modern corporation's starring role has persisted in the twenty-first century, but the stage where those corporations perform is changing. New network information technologies are extending the reach of corporations into nearly every corner of the global economy, letting them tap the world's seemingly infinite and diverse talent pool and create complex new products, such as jet airliners that transport people and goods around the world in just a few of hours, mobile phones (e.g., the iPhone) that connect people instantly and even provide instant translations from one language to another, and CAD/CAM[5] technologies that allow design of products in one country and manufacture in another country. Modern global corporations operate in an infrastructure characterized

[4] Chandler, *The Visible Hand*. Chandler traced the development of capitalism from the end of the nineteenth century to the birth and refinement of "managerial capitalism." Chandler's conception debunked the notion of an "invisible hand" working in markets to create and distribute the explosion of the goods and services created in the Industrial Revolution. Instead, he argued that the rise of the modern corporation and its ranks of middle managers had made it possible to speed up not only the mass production of goods and services, but also their mass distribution.

[5] CAD/CAM – computer technologies for specifying product designs in software that can be transmitted directly to distributed computers in another physical place, which automatically manufacture physical products.

by an integrated global network of people, working at great distances from one another but engaged in collective learning and sustained innovation. This new era has already moved modern civilization beyond anything we previously imagined, and there's no end in sight.

By 2014, the majority of the world's 100 largest government and corporate organizations were operating globally-- corporations often at a scale surpassing the size of world's national governments.[6] An essential capability of these corporations has been learning how to coordinate worldwide production and distribution of goods and services and create corporate cultures that span national boundaries.

While world governments struggle to come together and deal effectively with global issues such as terrorism, global climate control, and the accelerating extinction of species (including our own), global corporations such as Apple, Boeing, British Petroleum, General Electric, Google, KPMG, and Volkswagen are advancing civilization by designing, building, and distributing a dizzying area of increasingly advanced products and services.

And now the world teeters on a slippery slope. Our peoples are dependent on powerful global corporations for nearly everything. While nations' control and influence over these global corporations becomes weaker and fragmented. For example,

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6 "THE 100 LARGEST GOVERNMENTS AND CORPORATIONS BY REVENUE" AUGUST 27, 2015 *Nicholas Freudenberg.* Source for annual revenues for governments, *The CIA World Fact Book* and for corporations, The *Global Fortune 500 List.* Both provided data for 2014. The 100 governments and corporations with the highest annual revenues in 2014, 63 are corporations and 37 are governments. The detailed results for the top 15 (In billions of dollars), were 1. United States $3029B, China $2.85B 3, Germany 1.680B, 4. Japan $1.512B, 5. France $1.507B, 6. Italy $991B, 7. United Kingdom $$936B, 8. Brazil $$861B, 9. Canada $675B, 10. Spain $530B, 11. Australia $493B, 12. Wal-Mart $486B, 13. Sinopec $428B, 14. Royal Dutch Shell $420B, 15. Russia $417B. Google search "The largest governments and corporations by revenue," by author, March 20, 2016.

corporations seemingly move their bases of operations and headquarters around the world at will.[7]

Big History, Civilization, and Global Corporations

Within the last 50 to 100 years, scientists and historians have come together to combine their research to tell the story of our Earth, and life on Earth, in a coherent body of knowledge loosely described as "Big History."[8] Big History provides context that informs an improved understanding how capitalism has come about. It incorporates many of the key ideas through time in driving how we worked and lived in creating economic value and, in turn, enjoyed increased well-being from our advanced civilizations. Some of these big ideas include the evolution of life on earth, symbiosis, and changing social structures: from kin-ordered to tribute-taking, to early capitalism,

Big History endeavors to contain concepts that would otherwise be too vast for us to understand, let alone cope with and act upon. Consider time. Relative to the history of our universe, which is in billions of years, all of human history would last about six seconds. A human life—our perspective on the world in which we live—would be shorter than a blink of an eye. Yet, collectively, humans have used their "few seconds" on earth to change it beyond recognition from its pre-human state, so much so that we've

[7] A number of large and important corporations founded and headquartered in the United States have engaged in a practice referred to as "inversions": shifting their headquarters out of the United States to countries such as Ireland. See Michael J. de la Merced, David Gelles, and Leslie Picker, "Pfizer Chief Defends Merger with Allergan as Good for U.S.," *New York Times*, November 23, 2015.

[8] See David Christian, *Maps of Time* (Los Angeles, CA: University of California Press, 2004) and Smithsonian lectures series, "Big History." *Maps of Time* is a well referenced work explaining the history of study of the origins of the universe and evolution of life, and is especially well referenced on important breakthroughs beginning in 1960 that enabled a more grounded research description of the origin of the universe, stars, and life on Earth.

wiped out hundreds of species and we have the nuclear capability to erase the rest of it—all of us—in less than a few hours.[9]

Another difficult concept to fathom, understand, and act on is the innovation of science and its process for discovering a better "truth" about the universe, the earth, the environment in which we live, and the future after our death. Humans have always sought to understand why their world works as it does. Over human history many have risen to the question by telling their stories, and some stories have gained followers in the millions. Today the greatest risk of a devastating, life-ending war is between human factions who believe in and practice tribute with regard to their chosen story, including the stories of religions and of science.

These are profound concepts and they are playing out all around us. The focus of this white paper, however, is on one of humanity's most recent innovations: capitalism and its manifestation in our social/economic structure, the global corporation. The innovation of the corporation has enabled unprecedented world population growth now estimated to exceed 10 billion in the next 35 years.[10] It is the dominant economic engine of our civilizations, and with that strength it could also become the primary source of our destruction. Nevertheless, viewed in the grand perspective of "Big History," modern human civilization, and the modern corporation, remain a delicate experiment.

Life on Earth. The story of global corporations begins in a broad context of a much bigger picture: our universe. A preponderance of relatively new scientific research

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[9] As I write this white paper, the threat that human civilizations will cause an apocalypse is most palpable in the rise of the so-called Islamic State (ISIS) and its fundamentalist religious beliefs. See Graeme Wood, "What ISIS Really Wants," *Atlantic Monthly*, March 2015, http://www.theatlantic.com/magazine/archive/2015/03/what-isis-really-wants/384980/, accessed March 2016.

[10] Paul Kennedy, *Preparing for the Twenty-first Century* (London: Fontana, 1994).

dates the beginning of the universe to about 13.7 billion years ago, when latent energy accumulated to the point that an infinitesimal atom combining hydrogen and nitrogen triggered a cosmic explosion that created our ever-expanding universe[11]. This "Big Bang" set-off the long evolutionary march to life on Earth.

Scientists believe that about 2 billion years after the Big Bang, hydrogen and nitrogen clouds accumulated to the point that another cosmic explosion was triggered, this time creating billions of stars and planets grouped into solar systems. One of these was our sun's solar system, including planet Earth.[12] The birth of the stars and planets is believed to have created all 118 of the elements that today we include in our periodic table.[13] Life, including human life, had suddenly become possible.[14]

Figure 1 graphically illustrates the time required for the formation of life on Earth. First was the relatively gradual genetic evolution of life, the appearance of *Homo sapiens*, and then the acceleration of evolution facilitated by humanity's unique ability for collective learning.

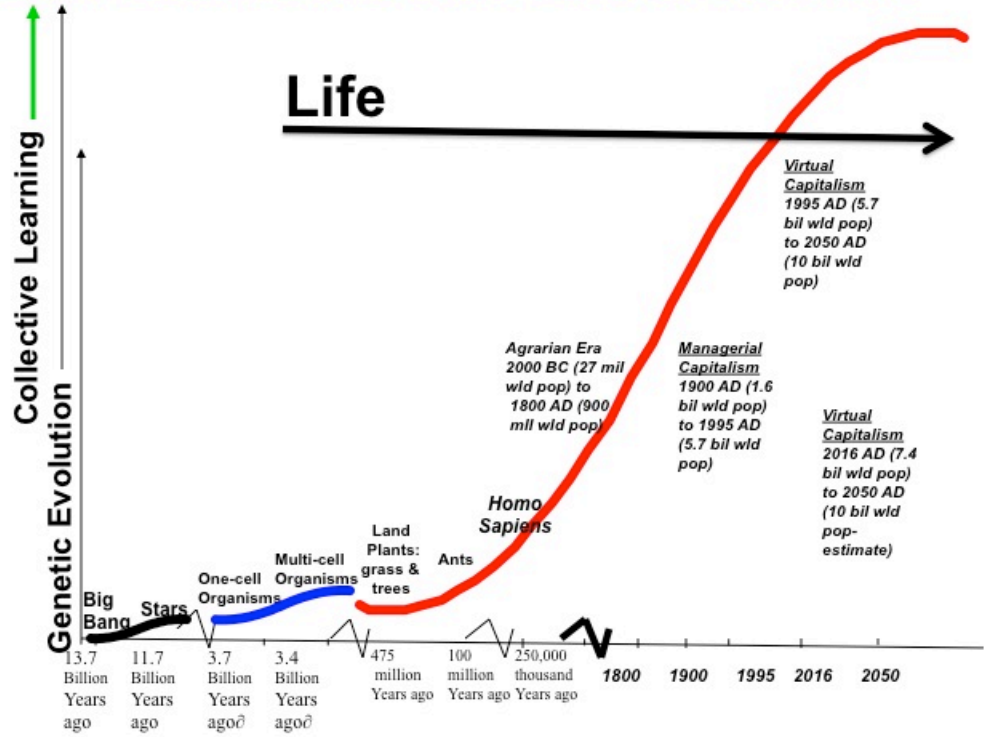
[11] Christian, *Maps of Time.* pp. 28-35.

[12] Christian, *Maps of Time,* pp. 42-43.

[13] The last 4 elements (Uut, Uup, Uns, and Uno) were recognized as elements on January 4, 2016. See "Periodic table's seventh row finally filled as four new elements are added," *The Guardian*, January 4, 2016.

[14] To provide perspective on the vastness of our solar system, consider that the Sun contains an estimated 99.9 percent of all the matter in our solar system.

Figure 1
Evolution of Earth and Life on Earth: 3.7 billion years ago to 2050AD



As our Earth cooled after the Big Bang, its gravity held gases to create our atmosphere. As the water in that atmospheric condensed, our oceans were created. Early life in our oceans is estimated to have occurred about 3.7 billion years ago with one-celled organisms (i.e., prokaryotes). About 3.4 billion years ago, the earth's atmosphere had begun to increase in oxygen. Then, about 0 .7 billion years ago, the first multi-celled organisms evolved—that is, multicellular organisms.

The most widely held theory on the evolution of life on Earth is Charles Darwin's epic work, *On the Origin of Species,* first published in 1859. [15] A main tenet of Darwin's theory is "survival of the fittest of species." That is, the members of a species that are the most fit for life, relative to the environment, tend to survive longer than less fit members

[15] Charles Darwin, *On the Origins of Species* (London, John Murray, Alebemarle Street, 1859).

of the species, and thus they have more chance to pass along genes to their offspring. These offspring, in turn, have a higher probability of adapting and surviving in the earth's continually changing environment. In this way, genetic adaptation in generation after generation allowed a wide variety of species to evolve.[16]

The evolution of plants first appeared in the ocean, beginning with early strains of bacteria that absorbed near-infrared light rather than visible light, and produced sulfur rather than oxygen—the predecessors to chlorophyll. Red and brown algae appeared about 1.2 billion years ago after evolving more complex cellular structures, and the familiar, every-day green algae of today appeared about 0.75 billion years ago. Then, about 475 million years ago, the planet welcomed land plants such as ferns, grasses, and trees, all of which were able to capture more of the sun's light, the ultimate source of all energy, and convert that sunlight into energy through photosynthesis. Photosynthesis marked a fundamental turning point in the saga of life on Earth, in that it enabled living organisms to turn the Sun's hydrogen fusion into a usable form of energy. In turn, plants were consumed by other living organisms, allowing the captured energy to be diffused through the biosphere, creating a "food chain."

In a very early world, virus-like organisms used bacteria to facilitate their metabolism, and eventually many single organisms merged into one organism through the process of s*ymbiosis*, in which organisms cooperate with other organisms. Over time, increasingly complex organisms evolved, with larger and larger numbers of cells organizing themselves to communicate and cooperate for survival. Ultimately this process allowed the creation of our own species, *Homo sapiens*, about 250,000 years ago.

[16] The web site of *Science Daily* estimates there are about 8.7 million species on earth: 6.5 million species on land and 2.2 million in oceans, www.sciencedaily.com/, accessed December 2015.

Today's humans are an example of complex, multicellular organisms made possible by symbiosis. *Homo sapiens* have trillions of cells communicating and cooperating as an ecosystem called the microbiome. Inside our body, as few as one-tenth of the trillions of cells are humans cells; the rest are microbes.[17] These microbes continue to operate within the microbiome, serving important functions such as facilitating the digestion of our food for energy and fighting threatening diseases from invading bacteria. Sometime, of course, a body loses this fight, leading to death.

One particularly important type of symbiosis is *parasitism*, where one species benefits at the expense of another. In early agricultural society, humans domesticated various types of plants such as maize (corn) and rice. In effect, these early humans altered evolution by selectively cultivating their crops to "weed-out" competing plants. The most hardy of these early crops was the maize plant, which was eventually evolved so far from wild maize that it could no longer survive and propagate itself without its human partners. In turn, humans became mutually dependent on the altered maize, so much so that a failed maize harvest could bring death to entire communities.

A critical next level of cell cooperation arose from the formation of societies, or colonies, made up of the same species. Consider the genetic evolution of ants into cooperative societies. Scientists date the earliest known ant species as living upwards of 100 million years ago. Ants have evolved into 5,000 to 10,000 species, and are found on all continents. All ant species are "social" and live in colonies with a few hundred to more than 20 million members.[18]

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[17] This spectacular hidden world of the human microbiome is explored in a new exhibit, "The Secret World Inside You," that opened on November 7, 2015 at the American Museum of Natural History (AMNH) in New York City.

[18] See Brian Thomas, "120-Million-Year-Old Ants Alive and Well?" *Resources Life Sciences Resources›Genetics*, accessed February 2016.

While ants as a species are as different from *Homo sapiens* species as any two organisms might be, their evolved culture and social organization is actually quite similar to our own. Lewis Thomas, in his study of ants and their colonies, discovered that ants farm fungi, raise aphids as livestock, launch armies for wars, use chemical sprays to alarm and confuse their enemies, and capture slaves. They also freely communicate and exchange information among the ants in the colony.[19] Comparing human society with ant societies, Thomas went on to facetiously remark that the ants "do almost everything we do, but watch television."[20]

However, the human species has something different from ants and all other species: a unique brain that has the capacity to move faster than the slow process of genetic evolution. With their advanced brain, *Homo sapiens* have innovated *symbols* to convey complex concepts, *language* to provide broad inter-human communication of concepts and ideas, and *writing* to communicate concepts and ideas that enable *collective learning* and the passing of knowledge from one generation to the next. Broadly speaking, human cultures cumulatively evolved over time, building on diverse innovations that were eventually shared among the populations of the world, leading to advanced civilizations as we know them today.

Civilization. Nomadic kin-ordered families forging, gathering, and killing wild animals for survival provided the earliest *Homo sapiens* a social structure, or civilization.

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[19] As described in Christian's *Maps of Time*, p. 252. Christian's reference is Lewis Thomas, *Societies as Organisms* (London: Viking, 1974).

[20] C. Tickell, "The Human Species: A Suicidal Success?" in the *Human Impact Reader: Readings and Case Studies*, ed. Andrew Goudie (Oxford: Blackwell 1997), p. 450.

Later, agriculture made it possible to produce a surplus of food and thereby support larger populations .[21] But producing food to support more than the primary producers required a social structure that was more complex than the nomadic, kin-directed/family social structure. Redistributing agricultural surpluses demanded additional coordination among the primary producers, a means of procuring those surpluses, adjudication of disputes, and a focus on continued innovations in human work and activities. Also, freeing some from the burden of producing food stocks for their subsistence enabled a focus on innovations in agriculture as well as other pursuits to improve the well being of the overall community.

Accordingly, social organization in early agricultural societies embraced the concept of hierarchy among primary producers and non-primary producers, such as rulers and the administrative staffs who used writing and accounting to keep lists of the food surpluses and things managed.

But there was a side effect; the advent of a hierarchical social structure weakened what had previously been a general equality among humans, resulting in a growing inequality between rulers and their peasant primary producers.[22] According to the anthropologist Eric Wolf, surplus food resources in family or kin-ordered societies had been acquired and distributed with the consent of the people who produced them. In contrast, collecting surplus food for redistribution in hierarchical social structures

[21] Agriculture through parasitic domestication of plants and animals allowed 50 to 100 times more food to be produced than foraging and hunting, allowing a significant increase in the world's human populations.

[22] An extension of this relative inequality between corporate CEOs and lower-level workers exists in the twenty-first century, whereby disparities in compensation are as great or greater than 100 to 1.

required the introduction and institutionalization of taxes and tax collecting. Wolf therefore refers to these hierarchical societies as "tribute-taking" societies.[23]

It's possible that the advent of hierarchical societies was the beginning of what became a continuous state of diverging equality among humans. In the collection of tributes, for example, coercion was widely used to extract the food surplus from the primary producers and provide it to non-producers. Slavery was another method for ensuring that unwilling human laborers would undertake the tasks of building irrigation systems, walled villages for mutual protection from raiders, and church-like monuments to please the "gods." Even where slavery was not widely used, expanding a society's primary producing capacity—and thereby growing an empire—required large investments in land and workers to carry out the long process of domesticating plants. Another, seemingly more expedient alternative emerged: *war*.

Rulers of tribute-taking societies accordingly expanded their coercive capabilities for tax collecting by using armies to protect their lands and peasants, but also to wage war to conquer additional lands and peasant farmers, thereby extending their empire. The exercise of excessive coercive power and greed for seeming expediency in expanding one's resources has continued throughout human history and continues to this day in many variations and forms.[24]

Creating and enforcing stratifications among social groups was a significant milestone in human social organization, and it founded an enduring dichotomy between those with power (rulers) and those with less power (peasant primary producers). Those

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[23] See Eric R. Wolf, *Europe and the People Without History* (Berkeley: University of California Press, 1982). Wolf coined the term "tribute-taking" and expanded on its workings.

[24] A modern example is arguably firms in the private equity industry, which carry out a form of "war" by taking over a corporation with the intent of quickly re-selling it for short-term financial gains.

who refused to accept inequality had to separate from the emerging city-states in order to live more independently and freely. This typically meant leaving behind the fertile lowlands where city-states flourished to build a life in the "hills"—higher, less accessible places that the armies of the city-state had trouble reaching.

Seminal research on the phenomenon and history of this hierarchical dichotomy has been reported by James C. Scott in his book *The Art of Not Being Governed*.[25] Scott describes the city-state inhabitants as "…lowland people and the upland separatists as hill people."[26] He also concludes that much of written history reflects the biases of lowland people, who distinguish themselves from the self-governed hill people with dichotomous descriptions such as "… the raw and the cooked, the wild and the tamed, the hill/forest people and the valley/cleared-land people, the upstream and downstream, and the barbarian and the civilized.[27]

Scott argues that hill peoples are best understood as runaways, fugitives, and maroon communities who have, over the course of two millennia, been fleeing the oppression of state-making projects in the valleys: slavery, conscription, taxes, corvee labor,[28] health epidemics, and warfare.[29] He coined the name Zamia to signify all of the lands at altitudes more than three hundred meters, from the Central Highlands of Vietnam to northeastern India and traversing five southeastern nations (Vietnam, Cambodia, Laos, Thailand, and Burma) and four provinces of China (Yunnan, Guizhon, Guangxi, and

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[25] James C. Scott, *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia* (New Haven and London: Yale University Press, 2009).

[26] Scott, *The Art of Not Being Governed*, p. 3.

[27] *Ibid.*

[28] Corvée is a form of unpaid, unfree labor, which is intermittent in nature and for limited periods of time.

[29] Scott, *The Art of Not Being Governed*, p. xi. Also see William McNeill, The Great Frontier: Freedom & Hierarchy in Modern Times:http://www.amazon.com/The-Great-Frontier-Hierarchy-Historical/dp/0691046581
Accessed by the author, March 20, 2016.

parts of Sichuan), a region consisting of 2.5 million square kilometers and 100 million people. Today, Scott says, Zamia is the largest remaining region of the world where people have not yet been fully incorporated into nation-states.[30]

While history often paints hill people as anti-social, or even as outlaws, Scott points out that "valley people have always existed in symbiosis with hill people."[31] He cautions that writing an account of valley people without including hill people would be like "writing a history of colonial New England and the Mid-Atlantic States without considering the American Frontier."[32]

Over 4,000 years, the development and spread of agrarian civilization increased in population scale, diversity, and the complexity of exchange networks. In turn, the processes of increased collective learning fueled technological, political, and cultural dynamism.

The sociologist Immanuel Wallerstein originated the concept of "world systems" as networks of power and commerce.[33] He went on to argue that the European States as a network of exchange was the first truly "world system."[34] The sociologist Michael Mann similarly identified four networks of power and influence: ideological, economic, military, and political.[35] Building on Mann's work, sociologists Christopher Chase-Dunn and Thomas Hall suggested that there are several distinct types of networks of exchange:

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[30] Scott also expresses pessimism about Zamia's future as an ungoverned district: "Its days are numbered."

[31] Scott, *The Art of Not Being Governed*, p.26. Scott's Chapter 1, footnote 55, references I. W. Mabbett, "Kingship at Angkor," *Journal of the Siam Society* 66 (1978: 1958) and Q. W. Woleters, *History, Culture and Region in Southeast Asian Perspectives* (New York: Southeast Asia Program Publications, 1999).

[32] Scott, *The Art of Not Being Governed*, p. 27.

[33] See Immanuel Wallerstein, *The Modern World System* (New York: Academic Press, 1974), p. 89.

[34] Wallerstein, *The Modern World System.* Although the European States did not represent the entire world at this point, they were clearly the dominant economic force at the time.

[35] See Michael Mann, *The Sources of Social Power, Vol. 2: A History of Power from the Beginning to AD 2700* (Cambridge: Cambridge University Press, 1997).

bulk goods networks, prestige-goods networks, political/military networks, and information networks.[36] Each network was associated with speed and influence in the nature of, and impact of, collective learning throughout the world resulting in the evolution of social structures from dominant tribute-taking.

Early Capitalism

German philosopher Karl Marx (1818–1883) was an early and critical commentator on the emerging social structure of the Modern era.[37] Marx contended that capital generated by exchange networks would replace the Agrarian Era social structure with a new social structure—which he called Capitalism.[38]

Wallerstein, Mann, Chase-Dunn, and Hall were among the first to identify the importance of capitalism as a distinct type of exchange network with a distinct set of players and markets: (1) a dominant class of entrepreneurs (i.e., capitalist, who own/control productive resources); (2) a class of laborers who would be wage earners and dependent on networks of exchange for their subsistence (unlike the food-growing peasants of the 18th and 19th century); and (3) competitive markets of exchange to link the two classes through market forces.[39]

The two most important developments in the 4,000 years during which the Agrarian Era evolved into the Modern Era were the extensive formation of cities and states and the expansion of exchange information networks. The cities and states contained a high level of diversity, facilitating increased innovation. The expansion of

[36] Christopher Chase-Dunn and Thomas D. Hall, *Rise and Demise: Comparing World Systems* (Boulder, Colorado: Westview Press, 1997).

[37] The Modern Era is generally seen as beginning after the Middle Ages, around 1500, with the Renaissance and continuing through the Industrial Revolution into 1800s and beyond.

[38] Karl Marx, *Das Kapital* (Germany: Veriag von Otto Meisner, 1867).

[39] As cited and described in Christian, *Maps of Time*, p. 358.

exchange networks among the cities and states induced high levels of information flow, which accelerated collective learning and further propelled the geographical impact of any innovation.

Along the exchange trade routes, horseback-riding armies emerged with innovations such as metallurgy weaponry and saddle stirrups that allowed them to wage large-scale wars. In the thirteenth century, the extensive conquests of Genghis Kahn (AD 1155 – AD 1227) created the Mongol Empire, which was even more spectacular than the empire created by Alexander the Great (356 BC – 323 BC).

Also associated with exchange networks were early explorations with ocean-going ships. Gathering the investments required to build these ships and finance trans-oceanic voyages helped sow the seeds of early capitalism and corporate-like structures. China is believed to be the first society to have constructed ocean-going ships and engage in naval exploration.

Under the command of Zheng He, from 1405 to 1433, China engaged in trans-ocean explorations in fleets of up to 60 ships and 40,000 soldiers. Their ships reached Ceylon, Mecca, East Africa, and most likely northern Australia. However, China's objective was to identify territories for possible Chinese conquest rather than find opportunities for trade. The Chinese government terminated their expensive naval program in 1433.

Although the Chinese ships were five times the length of Christopher Columbus's ship, the *Santa Maria*, and employed navigation techniques with relatively accurate maps, the *Santa Maria* was more maneuverable and better suited to the

exploration of unfamiliar seas.[40] Between 1492 and 1503, Columbus completed four round-trip voyages between Spain and the Americas under the sponsorship of the Crown of Castile of Spain. These voyages marked the beginning of the European exploration and colonization of the American continents. Following Columbus's successful voyage to the Americas, other European states built fleets of ocean-going ships to travel the world.

In contrast to the Agrarian Era, when land was a means for cultivation and subsistence by peasants, land in the Modern Era was seen as being subject to capitalistic forces for purposes of greater productivity. Now classes of entrepreneurs and wage earners—peasants who had lost access to their land and, therefore, their source of food—embraced and pursued competition and innovation for greater land productivity and, ultimately, their own survival.

The concept of private property, nation-state laws, and enforcement to protect private property become an integral part of the workings of the capitalistic system. The emerging nation-states became larger, and required more powerful military forces to enforce the laws for exchange. Also, the primacy of exchange enabled the rise of a new merchant class whose power steadily eroded the primacy of the ruler or nobility class that had dominated the Agrarian Era. While this transformation varied widely in time and cultural details around the world, its rapid progress in England offers an illustrative example of the overall process of capitalism.

In England, the tribute-taking aristocracy became increasingly involved in commerce, including becoming entrepreneurial landowners. The government encouraged commercialization of the land by buying up peasants' ancient land rights and eliminating

[40] Christian, *Maps of Time,* Chapter 12.

fenced-in land enclosures, creating large, consolidated tracts. Further land consolidations and commercialization were facilitated by taxation, indebtedness, crop failures, and expropriating peasant-tenants' claims.

From about 1500 to 1800, peasants engaged in cultivating land for their own subsistence were forced out by aristocratic land owners who wanted to increase production by consolidating the land and embracing new innovations for cultivation, fertilization, and domestication. Consolidated tracts could also be more aggressively devoted to producing raw materials for the emerging industrial processes. For example, the size of sheep herds was expanded to provide wool for innovations like spinning machines and the mass-production of wool fabrics for clothes.

By the beginning of the eighteenth century, English landlords controlled approximately 70 percent of all cultivable land in England, and 40 percent of the English population were no longer involved in subsistence agriculture. Instead, they had become wage earners, forced to earn wages to purchase their food and other life necessities in emerging markets.[41]

Managerial Capitalism

While capitalism continued to evolve and supplant the social and economic structures of the Agrarian Era economy, the rise of the managerial class was a relatively slow process in the world in general. Even in the United States, agricultural plantations and mining operations had hundreds or thousand of workers who were managed by the owners, with the help of very few overseers or supervisors.

[41] N. F. R. Crafts, *British Economic Growth during the Industrial Revolution* (Oxford: Clarendon, 1985), pp.13-14. Also see Christian, *Maps of Time*, Chapter 12.

Then, with almost perfect timing, the United States railroads arrived to redefine capitalism with innovations such as the steam engine, telegraph and the emerging telephone. At the time, the United States consisted of vast lands bounded by two oceans, with rich fisheries, a middle-west with so productive soils it came to be known as the "bread basket of the nation and world," and a fledging European immigration movement to build a diverse, growing, and productive population.

The railroads in the United States became the first modern corporations. Their pioneering managers launched the era of "managerial capitalism" by creating ranks of professional middle managers and the discipline of management theory and its practices that followed.[42] The railroads exploited transformational innovations and knitted together into an integrated network of railroad tracks a speedy flow of the land's bounty and the nation's workforce's steady stream of products and services. In a blazingly short time, the railroads had exploited the innovations of the 1850s and 1860s to create standard corporate management practices during the 1870s and 1880s.[43]

The railroad managers organized peer group meetings to discuss and debate railroad management techniques such as scheduling, operations, and the integration of new technologies and innovations. By the 1870s, organization and accounting were topics being published in periodicals and books.[44] Management became a widely

[42] Chandler, *The visible Hand.*

[43] By 1906 there were 31 railroad corporations in the United States with capitalizations ranging from $120 million to $1.2 billion and total track mileage of 178,328 miles. This network connected the nation's population from coast to coast and from north to south.

[44] Chandler, *The visible Hand*, p. 121. Periodicals included *Railroad Gazette* and *Railroad Journal*. Books included Marshall Kirkman, *Railroad Revenue: A Treatise on the Organization of Railroads and the Collection of Railroad Receipts* (New York, 1879). Daniel C. McCallum, general superintendent of the Erie Railroad, published "The six basic principles of general administration" (Chandler, *The visible Hand*., pp.101-102). Also in this period the railroads created formal organization charts (Chandler, *The visible Hand*.p.108) and early accounting charts (Chandler, *The visible Hand.*, pp. 113-115).

teachable discipline, further accelerating its adoption by the surging number of corporations.

These innovations[45] included financial accounting: using detailed chart of accounts (assets, liabilities, and equity) to determine capital requirements; annual depreciation for the use of assets and long-term asset replacement for the business; and profit and loss accounting for determining revenue and expenses and residual operating profit for the year. These new methods of accounting allowed the performance of a business to be calculated and reported annually to management and stockholders in the now-familiar form of the annual report. Further accounting and management innovations included cash flow analysis for determining short-term loan requirements and cost accounting for determining product profitability and pricing strategies. These innovations were quickly formalized and refined, and they have stood the test of time. Today they are being taught as integral parts of MBA programs across the world and have been almost universally adopted by the millions of corporations in existence.[46] The robust "accounting model" became the first widely accepted abstract model of business for the modern corporation.[47]

As the railroad corporations grew in size and complexity through vertical and horizontal integration, railroad managers pioneered organizational structural innovations, including functional divisions of labor (line/staff specializations) and decentralized

[45] As a Harvard Business School professor during the late twentieth and early twenty-first centuries, I was surprised to learn the extent to which accounting and management techniques had been developed and rapidly refined by the explosive growth of middle management at the early railroads.

[46] Entering the twenty-first century, there were about 50,000 corporations listed on public exchanges and more than an estimated 100 million operating companies in the world.

[47] The General Electric Corporation adopted and refined the model for planning and controlling their conglomerate portfolio of businesses. Its confidence in the power of the accounting model by managers is encapsulated in the oft-heard phrase in business schools: "A good manager can manage anything."

operating divisions, as the corporations integrated freight sourcing and forwarding, telegraph operations, and subsequently, telephone operations.

The governance of the large railroad corporations was also thrashed out during their early development. Most significant was the evolution of boards of directors. Early boards consisted of two groups: the entrepreneur or financier who had invested capital in the corporation, and the salaried top managers: president, treasurer, and heads of transportation and traffic management. These two groups often had divergent interests. The financiers gave priority to maintaining dividends to assure a rate of return on their investments. The career managers often retained little or no stock shares, and so they gave priority to maintaining the corporation's competitiveness, and thus its long-term viability. Accordingly, their interest was to reduce dividends to retain growth.

As the railroads began to build inter-territorial and coast-to-coast systems, the investment significantly increased, drawing in specialized investment bankers such as J. P. Morgan, the Cornelius Vanderbilt family, and the like. These specialized banking firms had ties with British and European sources of capital to help supply the massive amounts of capital required by the growing railroads in the United States.

The large amounts of capital, plus the integration of operations of the railroad to include construction and freight express companies, along with assignment of mineral rights along the line of the railroads, drew in a third group of railroad board members: speculators. Speculators were focused more on relatively risky short-term returns.[48]

As the railroad corporations continued to grow and became more complex, and as the railroad tracks crossed and re-crossed the United States, the railroads carried out a

[48] Chandler, *The visible Hand*, pp. 146-147.

surprisingly high level of cooperation, including the difficult coordination necessary for running trains back and forth on a single track. But then the inevitable happened: On October 5, 1841, the Western Railroad suffered a head-on-collision between two passenger trains, killing a conductor and a passenger and injuring 17 others.[49] The resulting public outcry led the Massachusetts Legislature to investigate the Western Railroad. The investigation culminated in a report ("Report on Avoiding Collisions and Governing the Employees"[50]) and a demand to fix "definite responsibilities for each phase of the company's business, drawing solid lines of authority and communication for the railroad's administration, maintenance, and operation."

Very little federal or state regulation of corporations followed, until the election of President Delano Roosevelt in 1932. At the time, corporations in general were impacting the lives of almost everyone in the United States in one way or another, and firms had accumulated substantial power over the political and economic well being of countries and their citizens. Roosevelt established the Securities and Exchange Commission (SEC) as a means to more actively regulate corporations' activities.

Soon after, a book published in 1932 by Adolf Berle and Gardiner Means[51] alerted the public to the risks of separating ownership from control in the structure of the modern corporation. In the eyes of the common law, Berle and Means pointed out a public corporation would be treated as an "artificial person," with rights similar to those of humans. Legally, corporations could potentially sue people for alleged persecution of

[49] See Chandler, *The visible Hand*, p. 96.

[50] As referenced in Chandler, *The visible Hand.*, Chapter 3, footnote 24, pp. 186-187. The railroad corporations continued to coordinate their operations largely by the activities of functional middle managers.

[51] Adolph A. Berle and Gardiner Means, *The Modern Corporation and Private Property* (New York: Macmillan, 1932).

their individual rights guaranteed by the U.S. Constitution. Further, giving a public corporation the right to religious beliefs would allow it to deny benefits to workers of certain persuasions. The right of free speech would also allow corporations to spend large sums of money to influence the political process.

In their book, Berle and Means went on to point out that the separation of ownership from management could destroy the owner's traditional interests and motivations regarding property rights. Shareholders would be stripped of motivational power, and as a result might become disinterested. Treating the corporation as an "artificial person" allowed the corporation to be sued for illegal activity, but limited the shareholders' risk to the value of their initial share investments—far less than the potential losses faced by someone who owned an entire company. In this system, "agents" (professional managers or stewards) would make decisions that had traditionally been the purview of owners, and would wield the power of the corporation to implement them.[52] Nearly a century later, there are many signs that these implications have come to pass, from run-away CEO compensation to the buffering of corporate leadership from direct accountability for the decisions a corporation makes.

The U.S. railroad corporations developed management practices and organization structures that sped the flow of agricultural and natural resources throughout the nation, and to a growing extent throughout the world. The next stage of development was a further development of the modern corporation: to harness mass production and thereby speed the conversion of agrarian and natural resources into industrial and consumer

[52] Especially in the financial services industry, it had been widely reported that some executives were responsible for decisions leading to massive corporate loses, but were made immune by the common law and therefore were not held directly accountable for their decisions, even in situations where the corporation had to pay substantial fines levied by federal and state regulatory bodies for illegal acts.

products; and to enable mass distribution with similarly accelerated speeds.[53] While this stage began with agricultural products, such as the conversion of wheat into packaged flour (e.g., Pillsbury Company, from 1872) and the conversion of domesticated animals into packaged meat (Armour & Company, from 1857), it quickly extended to metalworking, machine tools and complex industrial products such as automobiles (e.g., Ford Motor Company, from 1903) and commercial airplanes (e.g., Boeing Company, from 1916).

Another important development occurred at the turn of the century to further accelerate the growth of corporations: the formal study of management in colleges and universities. In 1900, William Jewett Tucker, the president of Dartmouth, contacted his previous college roommate, an international financier and railroad investor named Edward Tuck (1842–1938), for assistance in establishing the first graduate business program of study in 1901: The Tuck School of Business. The second graduate program of business, Harvard Business School, was established by Harvard University in 1908. The Harvard Business School (HBS) faculty went on to adopt and extend the case method for the academic study of management. In 2011, HBS Publishing is estimated to have sold 8.5 million HBS cases, which accounted for approximately 80 percent of the business case studies used in academic programs,[54] further contributing to the world-wide academic study and practice of business management.[55]

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[53] A subsequent and later stage would follow in the mass production and distribution of services, such as processing product returns, travel services, and hospital care.

[54] See Melissa Korn, " The Business of Cases," *Wall Street Journal*, March 1, 2012.

[55] Soon after I joined the HBS faculty in 1969, a study was done on MBA degrees awarded. In 1972, an estimated 7,200 MBA degrees were awarded per year, and HBS awarded about 800 per year. In 2014, John Bryne reported that there are hundreds of thousands of MBA students a year earning degrees at thousands of universities making the MBA the most popular postgraduate degree. John Bryne, "Why the MBA has become the most popular master's degree in the U.S.", *Fortune*, May 31, 2014. Google access by author, March 21, 2016.

Boeing Company Case Study: Evolution of the Corporation and Its Executive Leadership and Oversight

In the era of managerial capitalism, modern corporations evolved their leadership and governance to extend into the mass production and distribution of an increasingly complex array of industrial and consumer products. Building on the entrepreneurial leadership of their founders, these corporations quickly acquired and built ranks of professional managerial leadership, including the top position of Chief Executive Officer (CEO), and evolved their boards of directors to provide oversight on the CEO's leadership of the performance of the overall corporation. The Boeing Company case study offers an example of mastering managerial capitalism, and extending into mastering virtual capitalism in successful mass production for one of the most complex industrial products of its age: the commercial airplane.

Boeing 1916 - 1934

Boeing's story began in the early dawn of the twentieth century, a time when all factors were favorable for change. In the far reaches of the Pacific Northwest, Bill Boeing, a first-generation German immigrant, Yale dropout,[56] lumberman, and boat builder, had already made his fortune in the lumber business by establishing the Greenwood Timber Company. He was the epitome of the persistent, risk-taking, prescient visionary, acting on clues that few others could see.[57]

[56] It is plausible that Bill Boeing dropped out of Yale a year short of graduation for reasons similar to those that would drive Bill Gates to drop out of Harvard University in 1975. Both men seemed to feel the urgency to seize nascent entrepreneurial opportunities: Boeing in the vibrant economy of the Pacific Northwest, Gates in embryonic industry for microcomputers.

[57] Bill Boeing's father, Wilhelm Boeing, had no money when he immigrated to Detroit from his hometown close to Dusseldorf, Germany. Wilhelm made a small fortune applying his skills in iron ore mining in the Mesabi Range. Bill Boeing made his first fortune in Northwest timberlands. He leveraged his father's influence by acquiring the mining rights on the land that he leased or purchased for lumbering. An important part of Bill's fortune was due to the subsequent mining of taconite from his Northwest purchased/leased timberlands. Taconite, a lower grade iron ore, was mined as the richer ore from the Mesabi Range in Minnesota became depleted.

Inspiration reportedly struck Boeing on July 4, 1915, on the shores of Seattle's Lake Washington. There he met Terah Maroney, a "barnstormer" pilot selling rides to thrill seekers and the curious. Maroney's bi-wing, wooden and fabric airplane was only slightly more advanced than the 1903 Wright brothers' first airplane flown at Kitty Hawk a dozen years earlier. Boeing and his friend, Navy Lieutenant G. Conrad Westervelt, decided to accept Maroney's offer. After that flight and a few more, Boeing and Westervelt made it their mission to build a better airplane.[58]

Bill Boeing underwent pilot training while Westervelt sought advice from academic and practical airplane experts. They contacted Herb Munter, the local Seattle exhibition flyer, who was also building his own primitive airplane. Munter joined the team as test pilot. After taking measurements from Maroney's airplane, reviewing the Wright Brothers' patents, and consulting Jerome Hunsaker, who had established a wind tunnel at MIT,[59] the team began building their first airplane. A little less than a year later, they had designed and built the B&W (short for Boeing and Westervelt) airplane.

Bill Boeing piloted the B&W on its maiden flight on June 15, 1916. The airplane weighed 2,600 pounds and had a wingspan of 52 feet, a cruising speed of 67 mph, and a range of 320 miles.[60] On July 15, 1916**,** Bill Boeing incorporated Pacific Aero Products Co. for $100,000. Boeing bought 998 of the 1,000 stocks issued and moved the operation to a shipyard he had bought in 1910.[61]

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[58] Boeing's first flight with Maroney is described in "The Boeing Logbook: 1881–1919," http://www.boeing.com/history/chronology/chron01.html.

[59] Massachusetts Institute of Technology.

[60] Boeing History, "Heritage of Innovation," http://www.boeing.com/history/.

[61] Many years later, this "Red Barn" building was moved to Seattle's Museum of Flight.

Boeing hired the company's first aeronautical engineer out of MIT's pioneering Aeronautical Engineering Department. Tsu Wong, a Chinese national,[62] applied his knowledge from MIT to design and build Boeing's next-generation Type C airplanes. The Boeing Company took form developing core capabilities applied to aeronautical engineering, practical pilot experience, and financing. Shortly after the Type C Boeing airplanes designed and manufactured, Tsu Wong left Boeing to return to China, where he became chief secretary of that country's first airline, the China National Aviation Corporation.

Boeing tried to hire more aeronautical engineers from the East. When that failed, he convinced the dean of engineering at the University of Washington (UW) to create one of the country's earliest aeronautical engineering programs.[63] Boeing contributed to the new program's launch by building a wind tunnel, similar to one at MIT, on the UW campus, making it possible to research and test the aerodynamic efficiency of various airplane designs. The program's launch initiated a partnership between Boeing Company and the university that would endure and grow over time.[64] Many important patents in

[62] Eve Dumovich, "The 1st and the Best," *Boeing Frontiers*, http//www.boeing.com/news/frontiers/archive/2006/December/ts_sf12.pdf, accessed December 2010). Wong Tsu (1893–1965) was born in Beijing, China. At the age of 12, he was selected as a naval cadet, and at 16 he was sent first to England to study naval engineering, and then to the United States to study aeronautical engineering at MIT. Graduating in 1916, he learned to fly at the Curtiss Flying Boat School in Buffalo, New York. He was then hired by the fledgling Boeing aircraft company and designed its first product, the Boeing Model C, more than 50 of which were acquired by the U.S. Navy. The Model C's first flight was Nov. 15, 1916. The plane had a 100 horsepower engine, a wingspan of 43'10", and a weight of 2,395 pounds. Its top speed was 65 mph, with a range of 200 miles and a ceiling of 6,500 feet.

[63] Boeing company web site, http://www.boeing.com/, accessed February 2016. On June 4, 1917**,** Boeing Airplane Co. hired Clairmont (Claire) L. Egtvedt and Philip G. Johnson, both recent engineering graduates of the University of Washington. Both went on to be company presidents.

[64] Boeing company web site, http://www.boeing.com/, accessed February 2016. On February 15, 1919**,** the company appointed George Pocock as foreman of experimental construction in the pontoon department. Pocock later became famous for building racing shells for the University of Washington. The sciences of ship design and airplane design have much in common because there are significant similarities between the flows of water and air.

aerospace and high tech are held jointly between Boeing, Puget Sound companies, and the University of Washington and its faculty.

Although Bill Boeing was indisputably an entrepreneur, his management style was more like that of a contemporary hands-on venture capitalist. As leader of his emerging airplane manufacturing company, he built a strong management team and then stepped back from the day-to-day running of operations. On the advice of Professor C. Moore, dean of the University of Washington engineering program, Bill Boeing met with and hired his first UW engineering graduates: Philip Johnson and Clairmont Egtvedt. Egtvedt became a talented Boeing aerospace design engineer. Johnson emerged as a brilliant factory manager, enabling Boeing to lower the cost of producing its airplanes. This in turn allowed the company to win more early airplane manufacturing contracts and become a profitable enterprise.

The company was shaping up to have a unique technology/engineering culture. The impact of Bill Boeing's early leadership is reflected in one of his quotes that today is displayed at the entrance to Boeing's famous Seattle Phantom Works Developmental Center. Engraved in stone above the entrance, it reads: "*Let no airplane technology pass us by*."

The culture evolved with an essential practical side, too. Bill Boeing imprinted a "build to perfection" culture in not only what he said, but in what he did. According to a near-mythical story repeated in various forms throughout the years, Bill Boeing was once walking through the Boeing Lake Union plant when he saw a band-saw worker cutting out struts for the wings of a Boeing airplane. Boeing happened to see that one of the struts in the finished pile had a knothole. He picked up the strut with the knothole, took

the worker's place in front of the band saw, cut the flawed strut in half, and pointedly threw it into the trash barrel. He then lectured the worker, saying that if the Boeing Company could not build perfect parts, he would shut down the company. This take-charge, practical approach to management was reinforced another day when Boeing's test pilot, Herb Munter, did not show up on time to take the B&W on its maiden flight: Bill Boeing climbed into the cockpit and piloted the plane himself.

With the end of the First World War the Boeing Company experienced the reality of another characteristic of the airplane manufacturing industry (which remains true today): "boom and bust." After World War I, the market for new airplanes collapsed, forcing the company to lay off all but 30 of its employees and to stem its losses by manufacturing furniture products. The company eventually worked its way back by aggressively bidding on an Army contract for the manufacture of 100 Thomas-Morse-designed pursuit airplanes. Bill Boeing became alarmed and almost withdrew the company's bid because it was by far the lowest. But successfully building at such a low cost was possible due to the extraordinary factory efficiency managed by Philip Johnson, an emerging talent who would play a critical future role in building the Boeing organization and factory infrastructure. Boeing won the bid.

While still producing the highly successful pursuit fighters, Boeing embarked on a bold initiative to build an even faster, high-tech plane: the PB-1. In February 1926, Bill Boeing made Philip Johnson president of the company at the young age of 31. By 1928, the Boeing Company had rebounded, and in Bill Boeing's own words:

> *It is a matter of great pride and satisfaction to me to realize that within the short space of 12 years, an infant company with a personnel of less than a dozen men,*

has grown to be the largest plant in America, devoted solely to the manufacture of aircraft, and at the present time employing approximately 1,000 men.[65]

Acting as his own investment banker, Boeing began assembling a vertically integrated conglomerate, then called a "trust." Boeing's original vision for airplanes was expansive in that it reached beyond designing and manufacturing airplanes to include passenger air travel and air-freight, which was incorporated into Boeing's corporate charter.

Creating and sustaining a corporate charter is important in communicating future strategic directions to corporate stakeholders such as employees, banks and customers. Herein in enters another major player in the Boeing Company's original cast of characters: Bill Allen.

Bill Allen was a Harvard Law School graduate and a member of a prominent Seattle Law firm who became involved with Boeing early in the company's history as its outside legal counsel. Later, Bill Boeing invited Allen to participate in the Boeing executive committee senior management and engineering team meetings. Allen went on to become influential in the company and in the evolution of Boeing's board of directors. Eventually, Allen would become one of Boeing's most important presidents.

In October 1920, Boeing test pilot Eddie Hubbard left the company and, with his Boeing B1 airplane,[66] won a contract to deliver airmail between Seattle and Victoria. By January 1923, Hubbard had flown 50 tons of mail, but Alaska Airlines outbid him for the Seattle–Victoria route and Hubbard rejoined the Boeing Company. He convinced Bill Boeing and Clairmont Egtvedt, then Boeing's chief engineer, to bid for the federal San

[65] Quotewise.com, William Boeing quotes. Accessed by author, January 16, 2016.

[66] The B-1 airplane was Boeing's first commercial airplane, and is on display at Seattle's Museum of History and Industry (MOAH).

Francisco–Chicago airmail route. Their key argument for Boeing's low bid was that Boeing would build its own mail-carrier airplane. At the time, airplanes carried airmail in planes with heavy water-cooled engines, which limited the planes' speed and their ability to fly high enough to cross the Rocky Mountains. Egtvedt proposed switching the Pratt &Whitney water-cooled engines on the Boeing Model 80 to the more modern, lighter Pratt &Whitney air-cooled engines. Egtvedt figured that the Boeing 40A could carry 1,200 pounds of mail at $1.50 per pound for the first thousand miles, plus 15 cents a pound for every additional 100 miles, and still make money.[67]

After winning the contract, Boeing established Boeing Air Transport (BAT) with Hubbard as manager and vice president. BAT bought 24 40As from its parent company and was profitable at the outset.

The Boeing 40As incorporated another feature that helped to realize Bill Boeing's vision: seats to fly passengers. The first 40As had two seats for flying passengers on their mail routes, but as the public's enthusiasm for flying increased, Boeing increased the number of passenger seats to four and then more. This Boeing upstart eventually became United Airlines.

In 1928, Bill Boeing merged the company with Pratt & Whitney[68] and then went on to make several more acquisitions: Chance Vought (naval aircraft), Stearman Aircraft in Wichita, Northrup Aircraft, and Sirkosky. In addition, he established the Boeing School of Aeronautics to ensure a supply of trained pilots and mechanics. On February 1,

[67] Robert J. Serling, *Legend and Legacy* (New York: St. Martin's Press, 1992), p. 10.

[68] Serling, *Legend and Legacy*, p. 16.

1929, Bill Boeing became Chairman and Fred Rentschler (from Pratt &Whitney) became president of the new entity: the United Aircraft & Transport Corporation (UATC).

Egtvedt had his own vision for the company, which he called "big Boeings." He saw big airplanes as the future and continued to push the company in that direction. Egtvedt hired well in execution of his vision. One of his early hires was Edward C. Wells, a Stanford graduate who became an important member of Boeing's 247 design team. The Boeing 247 had a speed and reliability that became a "game changer" in the airline industry. Its extraordinary structural integrity was in part due to being one of the first airplanes to undergo static testing, whereby structural components like the wings were stressed to the breaking point during the overall design process.

Boeing decided it would restrict sales of the 247 to United Airlines until that company's demand was met, and only then open sales to other airlines. This decision led United competitors TWA and American Airlines to turn to Boeing's competitor, Donald Douglas, to design and manufacture an airplane to compete with the 247, giving the much smaller competitor, Douglas Aircraft, the wherewithal and time to launch its Douglas DC series.

Although the 247 set the standard for structural integrity for future Boeing airplanes, the management decision to sell to United Airlines only caused the premature obsolescence of Boeing's game-changing airplane. After the successful Douglas Company DC 1, 2, and 3 airplane series, Boeing sold only 15 247s on top of its original 60-airplane order from United Airlines.[69]

[69] Two of the 247s were sold to Germany's Lufthansa Airlines, appropriated by the German Military and were obviously dismantled and studied. The 247's structural components were copied and incorporated in to German aircraft as discovered by Boeing engineers after capturing and analyzing them.

In an attempt to rationalize the fragmented U.S. air transportation system, then consisting of 44 airlines carrying U.S. mail, Postmaster General Walter Folger Brown invited the airlines to a conference—but only those that were solidly financed, with big airplanes, operating routes exceeding 250 miles, and with the capability to fly at night.[70] These conditions were only met by the larger airlines including United Airlines, American Airways, and TWA. Brown's strategy worked in establishing a more efficient U.S. airmail system operated by the large airlines, including United Airlines.

With great fanfare, Clairmont Egtvedt announced on January 28, 1927, that Boeing had been awarded the U.S. Airmail route between Chicago and San Francisco (1,900 miles over mountains), and that the route would include passenger service.[71]

Then, on October 24, 1929, the stock market crashed. Franklin Roosevelt was elected president and large business trusts like Boeing's United Aircraft and Transport Corporation were subjected to scrutiny by the U.S. Congress. During the congressional review, it was disclosed that Bill Boeing had personally received $12 million from the Federal mail transaction, and that Johnson, Egtvedt, and a few other Boeing executives had become millionaires.

No wrongdoing was established, but congressional leaders seemed to think these rewards were egregious uses of stockholders' money. In response, Congress passed a law that no federal contract could be awarded to an airline associated with a company that sold aircraft or aircraft equipment—legislation that dealt a devastating blow to Bill

[70] This meeting was later referred to in distain as the "Spoils Conference." The meetings were dubbed the Spoils Conference because Brown gave them little publicity and directly invited only a handful of people from the larger airlines.

[71] *Seattle Times*, January 27, 1927. Source: Phillip G. Johnson scrapbook and other material, Museum of History & Industry, Seattle, accessed by the author.

Boeing and United Aircraft and Transport Corporation. In the summation of the federal antitrust legal proceedings against Boeing United Aircraft and Transport Corporation, Bill Boeing addressed the court:

> *Mr. Chairman, you must remember that this aircraft thing is a life work with me, it has gone over the whole of my life. I went through all the hazards, periods when everyone thought I was a fool…. I risked a good, big part of my personal fortune at that time and I stayed with it. This may be a reward for my life work—I don't know.*[72]

A dejected Bill Boeing felt vilified, as did Philip Johnson, who negotiated the Federal U.S. mail air-delivery contract. Bill Boeing was ordered by the U.S. government to break up UA&TC, and on September 24, 1934, he sold the airline, which formally became United Airlines, and separated the rest into two companies: Pratt &Whitney and the Boeing Airplane Company. Before the breakup, in 1928, the United Aircraft and Transport Corporation employed 5,000 people and produced revenue of $34 million. After the breakup, in 1934, the Boeing Aircraft Company had revenue of $1.1 million with a share price of $9.50 and a market value of $5 million.

Phil Johnson was forced to leave the company. He became president of the then-troubled Kenworth Truck Manufacturing Company, which he quickly turned around into a successful, profitable company. Bill Boeing resigned, sold all his stock, and left the company.

Government intervention had broken up the vertically integrated company and split-up the dream team. In the end, only one of the key management team survived: Clairmont Egtvedt as newly appointed president, and active board member, Bill Allen.[73]

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[72] Quotewise.com, William Boeing quotes, accessed January 2016.

[73] In 1934, the Board of Directors of the Boeing Company included Bill Allen of Messrs. Todd, Holman & Sprague; Harold Bowman, Secretary and Treasurer of Boeing Aircraft Company; Gardner Carr, VP Manufacturing; Clairmont

Further growth at the Boeing Company, without its founder, was to prove to be a rocky road.

Boeing 1934 - 1944

Egtvedt continued to execute his vision of taking the company toward "Big Boeings" rather than continuing to build smaller military and commercial airplanes. With the wartime economy heating up during the early 1930s, the Army looked to Boeing for bombers. The Army funded Boeing's experimental XB-15 bomber and asked Boeing to produce a multi-engine bomber that could fly 200 mph for 2,000 miles carrying 2,000 pounds of bombs.

Egtvedt, Wells, and the Boeing design team took liberty with the specification of "multi-engine" and went beyond the assumed two-engine bomber by designing and building a four-engine bomber—the Boeing 299. Boeing's board voted to approve $275,000 for development funds at a time when the company was losing money ($266,000 for its year ending 1934).[74] The Boeing 299 became the B-17, but it was better known as the "Flying Fortress," a name coined by a Seattle newspaper man who was present when the gleaming airplane rolled out on the tarmac for the first time in July of 1935."[75]

The order for B-17s led to the need to build a new plant. Boeing Plant Two was a gigantic structure for its time—466,000 square feet—and was constructed across the

Egtvedt, President; Harry Kirk of Chicago, Illinois; Charles Monteith, VP Engineering; Erik Nelson, VP Sales; and Dietrich Schmitz, President, Washington Mutual Savings Bank.

[74] Serling, *Legend and Legacy*, p. 30.

[75] Serling, *Legend and Legacy*, p. 32.

street from Boeing Field.[76] In line with the "Big Boeings" strategy, and borrowing much from the XB-15 and the B-17, two additional Boeing commercial airplanes followed. On December 31, 1938, the Boeing 307, the commercial version of the B-17, took off on its maiden flight. Between 1938 and 1941, Boeing also built its Boeing 314 Clipper flying boat.

It is important to appreciate the brilliance of Egtvedt and the team that he recruited, including Ed Wells and Wellwood Beal, who were perhaps the most talented aeronautical engineers of their time. Although only12 Boeing 314 Flying Boats were built, these airplanes made trans-oceanic travel a reality in the 1930s. The Boeing 314s incorporated important innovations such as fully feathering propellers, large wings that allowed airplane engine maintenance and trouble-shooting in flight, carrying 74 passengers in relatively luxury, and making more than 5,000 trans-oceanic crossings. The Boeing 314 was the Boeing 747 of its time, and its comparable size can be seen in this photograph.

[76] Boeing Plant 2 was built between 1936 and 1941, and was demolished in July 2010. Nearly 7000 B-17's were built in Plant 2, and the plant was still active in building Boeing 737s when I went to work for Boeing as a 737 Financial Systems Manager in 1966.

*Figure 2: The Clipper first flew passengers across the Atlantic on June 28, 1939. Source: Boeing Corporation Archives.

During Egtvedt's presidency, Boeing bled cash and incurred sustained multi-million dollar loses. The company's Board of Directors became increasingly concerned, agreed on a corrective course of action, and asked board member Bill Allen to confront Egtvedt with their decision: Egvedt was being asked to step down to make way for the return of Phil Johnson, who thanks to a request from Boeing's board to the government, was no longer banned.

On September 9, 1939, Johnson returned as president of the Boeing Company and a reluctant Egtvedt stepped down, appointed as chairman of the board, and returned to fully focus on the duties of chief aeronautical engineer.[77]

[77] Clairmont Egtvedt was hired into Boeing in 1917 and served in a number of important Boeing Corporation positions until 1966, when he retired. These positions included chief engineer, president, CEO, chairman of the board, and board member.

Upon his return, Johnson found a very different company than the one he had left. The airplanes had exponentially increased in complexity, with multiple kinds of engineering required: mechanical, structural, hydraulic, electrical, aerodynamic, electronics, acoustical, and sanitary.[78] The financial situation was a backorder of $28 million, with insufficient working capital to fulfill the orders. Bank credit had been completely used up. Losses were running at more than $2 million per year. Boeing had over-extended itself by building small lots of expensive airplanes, failing to reach quantity production on either the B-307 Stratoliner or the B-314 Clipper.

Johnson worked with Bill Allen to refinance the company through a combination of issuing new stock and securing loans. He led the Boeing Company to build factories that achieved the highest mass-production of large airplanes that Boeing had ever realized, or for that matter, the highest large-airplane production rates that the world has ever seen.[79]

Below is a 1942 photograph showing mass production of B-17s in Boeing's Plant 2.[80]

[78] Harold Mansfield, *Vision: A Saga of the Sky* (New York: Duell, Sloan and Pearce, 1956), p. 167.

[79] The term "large" is used here to differentiate large military and commercial airplanes from smaller passenger airplanes that carried less than 20 passengers.

[80] Boeing photograph: Fuselage section during production of B-17F (Flying Fortress) bombers, at the Boeing aircraft plant, Seattle, December 1942.

Figure 3: Mass Production of the B-17 at Boeing Plant 2.

At its peak, Seattle Plant 2 was producing 16 B-17s every 24 hours. Total Boeing production of B-17s amounted to 6,981. With collaboration from Boeing, the Lockheed and Douglas factories produced another 5,745 B-17s.[81]

In achieving the scale, quality, reliability and incorporating the latest technology in mass producing airplanes in geographically dispersed plants, Boeing mastered three important management processes: "build to print," supply chain, and "engineer change orders."[82]

[81] Boeing History, "B-17 Flying Fortress," http://www.boeing.com/history/boeing/b17.html, accessed February 2016.

[82] Boeing's manufacturing innovations continued throughout the twentieth century and included the first moving line for building a commercial airplane. See Harvard Business School case study: Robert D. Austin, Richard L. Nolan, and Shannon O'Donnell. "The Boeing Company: Moonshine Shop." Harvard Business School Case 607-130, April 2007.

1. **"Build to Print"**: A modern airplane will consist of 3 million to 6 million parts. The design of a new airplane begins as a collaborative effort among a relatively small team. Multiple conceptual designs are developed until one is settled upon. Once the conceptual design is decided, the process is begun to develop the work breakdown structure showing how all the parts come together to make up the completed airplane. Next the "detailed engineering drawing" process begins to specify the dimensions, materials, and functionality of each of the millions of parts. Then manufacturing engineering is undertaken for tooling necessary to produce each of the parts. At this point, the relatively small new-airplane conceptual-design team explodes in size to hundreds, if not thousands, of aeronautical engineers.

2. **Supply Chain**: Once the work breakdown structure is established and the detailed engineering drawings completed, a manufacturing schedule is decided upon. Next the millions of detailed engineering drawing are fanned out to the "supply chain"—a mix of Boeing-owned suppliers and third-party suppliers.[83]

Early on, Boeing maintained control of the inevitable problems of coordination of its large number of suppliers by having internal Boeing "swat teams" ready to "parachute" in at early signs of supplier problems to assist them in getting back on track to meet either schedule or quality problems.

Also increasing the complexity of the coordination problem, the sophistication of the airplane product itself necessitated off-loading deep subject matter expertise to independent specialists called "Tier 1" suppliers (such as airplane engines). The Tier 1

[83] With the future trend from vertical integration of suppliers to increased numbers of virtually integrated, independent, global, outsourced suppliers, the management challenge of coordination would become increasingly difficult.

suppliers worked off the conceptual design of the airplane (as well as collaborating with the main Boeing team during conceptual design), developed the detailed parts designs and drawings, and carried out manufacturing engineering. The Tier 1 suppliers, in turn, coordinated their Tier 2 and Tier3 suppliers, and the Tier 2 suppliers coordinated their Tier 3 suppliers.

This process was forced upon Boeing early on with the 1934 anti-trust divesture of its Pratt & Whitney engine business unit. At that time, Boeing began working in close coordination with what was now an independent designer and manufacturer of its airplane engines—one of the most important systems in a modern commercial airplane. Over time, Tier 1 suppliers have expanded from piston engines to jet engines, airplane landing gears, avionics, and, most recently, wings.[84]

3. "Engineering Change Orders": The Engineering Change Order (ECO) process is one of the most important, and often most contentious, processes in building an airplane. It is the process that incorporates the latest learnings and innovations into the airplane, balanced against the risk and cost implications to the ultimate profitability (or loss) of the program. The ECO process is continuous from the time that the first detailed drawings are developed, all the way through manufacturing, flight test, and then through the life of the program.

The magnitude and the detail of the process is staggering. A perpetual inventory of all the millions of parts on in-service commercial airplanes is maintained during the life of the airplane. If an essential part on one airplane is found to be defective, the

[84] Boeing historically maintained its proprietary expertise in designing commercial airplane wings through patents as well as placing a high priority on their expertise. For example, Phil Condit (Boeing CEO 1996–2003) early in his career had developed proprietary wing designs for the Boeing 747, and retained patents jointly with Boeing on the 747 wing design.

airplane inventories are checked to determine on what other airplanes that part is installed, and then all of the defective parts are replaced. And, of course, careful maintenance records are kept for each airplane to ensure that the inventory of parts on the airplane is kept current.

As experience was obtained in flying the B-17 bomber runs in combat operations, a myriad of improvements, such as additional defensive gunnery, redundant systems, and performance enhancements, resulted in successive improvements that were continuously incorporated into the manufacturing process.[85] In a short time, the major improvements were incorporated through the alphabet to a much improved and more successful B-17G.

During my own stint at Boeing in the late 1960s, in the commercial Boeing 737 program, the ECO was viewed as the "enemy" of airplane program profitability. Each ECO required re-engineering of drawings, manufacturing engineering to figure out how to integrate the ECO into the manufacturing process, including any new tooling, quality control procedure changes, and retrofits for airplanes that were further down the assembly line or out in operation. All of this amounted to more expense (and less profit) for the program.

Balanced against this negative was the positive impact of imbuing Boeing's company culture with a commitment to building the most technologically advanced and reliable commercial airplanes in the industry. The balance between ECOs and program profitability remains an important tension—and somewhat of an "art form" for effective airplane programs even today.

[85] The intensity and creativity that went into redesign improvements of the B-17 is legendary. One especially interesting insight was the decision not to concentrate on where the bullet holes were in the returning B-17s, and instead concentrate on where they were *not*.

Right before World War II ended, on September 13, 1944, Philip Johnson died prematurely when he suffered a massive stroke while visiting the Boeing Wichita Plant.[86] Clairmont Egtvedt was elected as interim president and served for one year, and then Bill Allen was named president on September 13, 1945.

Boeing 1945 -1996

From the mid-1930s through the 1950s the board's schedule evolved to include four or five all-day meetings sequenced throughout the calendar year. Formal board charters emerged and, along with them, a set of formal subcommittees including an audit committee, compensation committee, and governance committee. More board members were recruited to serve as independent outside directors and chairmen of the subcommittees. Within the same time period, corporate boards of directors in general followed similar patterns in developing their structures and memberships.

Bill Allen began his presidency with the most daunting and immediate challenge: "Develop a postwar future for Boeing." Almost over night, Boeing's military plane orders went from 155 per month to 20 per month and its workforce was reduced from 45,000 to 30,000.

But with a little self-made luck, occasionally "a bluebird flies in." On the morning Germany surrendered to General Eisenhower, a group of several scientists, including Boeing engineer George Schairer, were on a mission to gather technical data from abandoned German research sites.[87] The team was at Germany's Reichsmarshal Goeing's Aeronautical Research Institute. Although Schairer did not speak German, he began going through the files. He recognized the names of the distinguished German scientists

[86] Johnson's legacy equipped Boeing to be the low-cost producer of commercial airplanes into the twenty-first century.
[87] George S. Schairer was an MIT graduate who came to work for Boeing in 1939 as chief of aerodynamics.

authoring the papers, and came across a drawing of a jet-propelled, swept-wing airplane. The papers included fragments of formulas similar to the ones that he had been working on researching the feasibility of swept-wing jet airplanes. It was an "ah-ha" moment.

Schairer communicated his discoveries back to Ed Wells at Boeing, who immediately began wind tunnel tests of the swept-wing model. The wind tunnel tests were a revelation. The Boeing engineering team had begun work on the new generation XB-47 bomber, with the conservative turbo-prop propulsion engines. But Ed Wells' swept-wing, jet-engine wind tests showed extremely favorable results. Bill Allen told Ed Wells: "If that's what you're for, let's go for it."

The Boeing engineering group made a convincing pitch to the Air Force at Wright Field and obtained a contract to build two swept-wing, jet-propelled XB-47s. The combined German wind tunnel data, along with Boeing's continued improvements using Boeing's own wind tunnel, proved to be exceedingly important performance designs: the wings were swept 35 degrees (further than the 29-degree maximum reported in the German data), the jet engines were changed from in-the-wing engines to engines hanging from pods underneath the wings. The two experimental prototype bombers proved the feasibility and improved performance of a new generation of military bombers.[88]

Boeing had mastered the mass production of military airplanes, and had transformed the military bomber into swept-wing jet bombers. However, the military bombers were not promising candidates for sustained mass production, and the slowing of orders for military bombers required Boeing to lay off 7,000 workers in 1949 and another 1,400 in 1950.

[88] Serling, *Legend and Legacy*, p. 87.

In the meantime, Ed Wells had returned from a September 1949 visit to England. He reported that de Havilland Company had their Comet jet transport flying with an order for 10 of the new jet airplanes to be delivered to the government-owned airline; Boeing would have to start soon on their own commercial prototype or be left behind. The estimate for the Boeing prototype was around $15 million and the possibility of government funding was dim. The argument was compelling for Boeing to build a commercial jet airliner, and it was in line with their strategy. Boeing was still the only airplane manufacturer with its own wind tunnel, and 10,000 hours of wind tunnel data, along with 5,000,000 engineering man-hours, were spent on perfecting big jet airplanes.[89] Boeing built two new-generation jet bombers. On April 15, 1952, test pilot Tex Johnson piloted the XB-52 on its successful maiden flight. Bill Allen was convinced that the jet age had been launched. Six days later, he convened his board of directors to present and approve plans to design and build the Dash-80—the 707 prototype: a bold "bet your company" decision.

On May 13, 1954, the Dash-80 was rolled out onto the Boeing Renton Air Field tarmac. Bill Boeing, at 72 years of age, attended the christening ceremony. His wife, Bertha, did the honors: "I christen thee, the airplane of tomorrow, the Boeing Jet Stratoliner and Stratotanker."[90]

On July 15, 1954, Tex Johnson piloted the Dash-80 on its maiden fight. Successful military sales were made for the KC-135 tanker version. The commercial sales, however, were disappointingly slow to arrive. The airlines were cautious. The flying public had become more skeptical of commercial jet airplanes due to the highly

[89] Mansfield, *Vision: A Saga of the Sky*, p. 321.
[90] Mansfield, *Vision: A Saga of the Sky*, p. 343.

publicized Comet commercial jet crashes in the United Kingdom. Several of the Comets had exploded in flight at high altitudes, killing all of their passengers and crew.

Through their own wind tunnel testing, Boeing's aeronautical engineering team was learning a lot from the Comet. The team became especially aware of the risk of explosive decompression at high altitudes.

The Comet had a conventional fuselage for airplanes of the time, including square windows. In contrast, the Dash-80 incorporated rounded windows with triple reinforcement, and barrel-like staves circling the fuselage along with reinforcing straps along the length of the fuselage acting as "stoppers" for any fuselage failure. So no matter where a fuselage failure occurred, the failure would be contained and the fuselage would stay intact rather than explosively ripping apart. This change would buy the airplane time to drop to a lower altitude and reduce the compression pressure, and let passengers breath less thin air. [91]

While safety had been deeply engineered into the Dash-80 and could be shown in scientific papers, a Boeing test pilot decided to demonstrate to the public himself that the Dash-80 was a safe airplane. This took place on a summer day in 1955 over Lake Washington.[92]

At the 1955 Gold Cup races, I was a young boy standing on the shores of Lake Washington with 300,000 or so other spectators, along with the hordes of spectators on their pleasure boats tied up onto the race course log boom. On one of the yachts, Bill

[91] Through wind tunnel tests, it was discovered that the corners of square windows were particularly vulnerable to fuselage failure. Boeing developed a video to show airlines a high-altitude decompression on a conventional fuselage and on the Dash-80 fuselage.

[92] On June 26, 1950, with Stan Sayres driving and hydroplane designer Ted Jones riding alongside as mechanic, SLO-MO-SHUN IV set a new speed record over water of 160.323 mile per hour. Later that year at the Gold Cup race on the Detroit River, SLO-MO-SHUN IV won the Gold Cup and brought the race to Seattle, starting another tradition of technology excellence in the Puget Sound region.

Allen was hosting Boeing airline industry guests. During an intermission between heats, we all saw something that few of use would forget, especially Bill Allen.

A few minutes earlier, Boeing test pilot Tex Johnson had lifted off the Dash-80 from Boeing Field. Flying 450 mph and 300 feet above the lake, Johnson approached the Gold Cup race course. As we all heard the screaming jet engines getting closer (jet engines were very loud then), we looked up to see Tex Johnson pull up and barrel-roll the Dash-80 over the race course.[93] Johnson reversed course, and performed a second barrel roll of the monstrous jet.

On Monday morning, Bill Allen asked Tex Johnson: "What were you doing?"

Johnson replied: "Selling airplanes."

A few months after the barrel-roll spectacle, Pan Am placed the first order for 20 707s. Douglas, then the leading commercial airplane manufacturer, had responded with the jet-propelled DC-8 airplane, but it was significantly behind deliveries of Boeing's 707. The 707 sales continued to pick up momentum, and the 707 became the fastest selling commercial airliner at the time.

It is hard to overestimate the importance of the role that Bill Allen played in influencing and crafting the leadership and development of the Boeing Company from its early formation to achieving its world leadership into the jet age of commercial airplanes. One of the most important contributions was the evolution of the board of directors in its role in providing effective and timely oversight on corporate strategy, risk-taking, and executive leadership. Allen led the process of replacing Clairmont Egtvedt as Boeing president, as well as retaining Egtvedt's aeronautical engineering talent in the Boeing

[93] On this video Johnson describes his Monday morning meeting with Bill Allen: Google search: "Pilot Tex Johnston Performs Roll In Dash-80 Prototype Aircraft In 1955," accessed January 2016.

Company. Allen also influenced the evolution of the Boeing board of directors from an insider executive committee to a fully operating board of directors providing critical oversight and corrections during the overall evolution of the Boeing Company during its growth as a major bomber manufacturer during World War II, and the corporation's post-war return to commercial airplane design and manufacturing.

By 1960, the Boeing board had reached substantial maturity in its operation and corporate oversight role. The 1960 board numbered thirteen members, with a balanced number of six outside directors and seven inside directors.[94] The inside directors were steeped in functional subject-matter expertise in aeronautical engineering, accounting, marketing, and management. The outside directors were CEOs and chairmen of other manufacturing and financial services corporations.

Interest on the part of United Airlines and Western Airlines in a smaller, lighter 707 led Boeing to develop two 707 derivatives: the 720A and 720B. These derivatives launched Boeing into further development of its "family" of commercial jets, including the 727 three-engine jet with the engines mounted on the tail, the 737 two-engine jet with the engines mounted on pods hanging from the wings, and the "jumbo" 747 4-engine jet.

When in 1965 Boeing lost a contract to Lockheed to build a jumbo military transport (C-5A Galaxy),[95] Bill Allen met with the president of Pan Am, turning his attention to selling and building a jumbo commercial jet that would carry more than 400

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[94] By 1960, the Boeing board of directors numbered 13, with 6 outside directors (Darram Corbet, Chairman, Smith Cannery Machines, Seattle; D. A. Forward, Retired Vice Chairman, First National City Bank of New York; Arthur Gates, Consultant, New York City; Paul Pigott, President, Pacific Car and Foundry, Renton; William Reed, Chairman, Simpson Timber Company, Seattle; and Dietreich Schmitz, Chairman, Washington Mutual Savings Bank, Seattle), and 7 inside directors (Bill Allen, President; Wellwood E. Beall, Senior Vice President; Clairmont Egtvedt, Chairman of the Board; Fred Laudan, Vice President of Manufacturing; J. E. Schaffer, Vice Chairman; Ed Wells, Vice President Engineering; and J. O. Yeasting, Vice President and General Manager, Transport Division).

[95] Lockheed was selected the winner in September 1965, then awarded the C5A Galazy contract in December 1965.

passengers: the Boeing 747. The Pan Am president confirmed his serious interest. Bill Allen then selected Mal Stamper as developmental project executive to lead the 50,000 Boeing 747 project team, and Boeing legendary engineer Joe Sutter[96] to serve as 747 chief engineer.

In early 1966, the new 747 airplane program, together with the proposal to build a new factory that would be the largest factory in the world, was presented to the Board of Directors.[97] The program was every bit as bold as Boeing's earlier 707 program had been. The board unanimously approved Allen's recommendation to go ahead with the 747 new airplane program.

In addition to requiring the largest factory in the world, the new 747 program demanded a new organization, in this case consisting of subcontractors from 48 of the 50 states. The change forced Boeing to develop a hedge to the pressure and the associated risk that the program was placing on its sub-contractors. In response to its earlier success, Boeing further extended its crack Auburn parts fabrication factory, would not only built many of the 747 parts, but strengthened the team that could "parachute in" to assist subcontractors that were having problems in developing parts to meet Boeing's quality or schedule needs.

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[96] On April 16, 2008, I interviewed Joe Sutter about his perspectives on Boeing and the 787 program at his Boeing office in Renton. We also specifically discussed the Boeing 747 program and his book, *747: Creating the World's First Jumbo Jet and Other Adventures from a Life in Aviation* (New York: Smithsonian, 2006).

[97] By 1966, Bill Allen had built Boeing's board of directors to twelve directors, six inside directors (Bill Allen as chairman; Clairmont Egtvedt, engineer and past president; Ed Wells, engineer; John Yeasting, the Industrial Relations executive; and the Administrative executive), and six outside directors (three CEO's: W. L. Campbell, President General America Corp., Seattle; Crawford Greenewalt, CEO of DuPont; George Weyerhaeuser; and three advisors: a banker and two consultants). The 1966 board had evolved to include an equal number of inside and outside directors. Nevertheless, the 1966 board remained highly influenced by the inside management team, and Bill Allen had great sway. The board's style of operation is in evidence in Boeing's 1966 Annual Report, where all 40 "directors and officers" are listed on the same page.

However, this unique capability also created a "double-edge sword." One edge effectively coped with the risk of having many 747 subcontractors and the resulting complex supply chain. The other edge, however, lulled Boeing senior management into thinking that they had found a solution to the problem of complexity. They hadn't, in that some Boeing suppliers began to be overly reliant on Boeing's helping hand in troubled situations. This supplier overreliance would come to haunt the twenty-first century Boeing management team in a subsequent new airplane program.[98]

Thornton "T." Arnold Wilson (1921–1999) came to Boeing as an aeronautical engineer in 1943 and was elected CEO in 1968 when he was 47 years old, succeeding Bill Allen. Taking over a company of $3.2 billion in revenues, Wilson had worked his way up to project engineer for the B-52 program, and then became the highly successful head of the Minuteman intercontinental ballistic missile program. He marched Boeing into the changing times of the 1960s and into the 1970s to be the undisputed aerospace industry leader and largest U.S. exporter. He became the epitome of the very "soul" of the Boeing Company.

Upon becoming CEO, Wilson did not move into Bill Allen's corner office. He did not move his family to the exclusive Highlands into a larger house. He did not buy a newer and fancier car. When leaving an event at Seattle's prestigious Rainier Club, a member called over to Wilson, and asked why he was driving that old Japanese Datsun.

[98] In Boeing's 787 new airplane program, a large number of Boeing subcontractor did not have an aeronautical engineering capability in-house. They had come to rely on Boeing "parachuting-in" that capability if problems arose. In the interim, Boeing made a strategic/financial decision not to maintain control over contractors with respect to Boeing retaining engineering drawings for outsourcing subsystems and parts. Thus, when Boeing's 787 subcontractors ran into problems, Boeing could not "parachute in their swat team" with "build-to-print" blueprints in hand.

Wilson answered back, "Because the car is well engineered, and the Japanese are the only ones that have bought our airplanes during the last 17 months."[99]

In the Boeing culture, Wilson was considered a "squirrel." Boeing "squirrels" were independent thinkers who freely spoke their mind. Squirrels were also people who had deeply internalized the vision of the Boeing Company and made it their own, earning respect and a voice in the company. Squirrels' views were heard and taken seriously no matter what their formal organizational position. They often were found in the engineering ranks, strengthening the engineering influence in Boeing's company culture. But Boeing squirrels came from other backgrounds too—up-and-down the organization and throughout the functions.

Upon the selection of Wilson as Boeing president, Allen retained the CEO position for one year before turning it over to Wilson, and retained his position as Chairman of the Board until 1973, at which time Wilson succeeded him as Chairman. Bill Allen remained available to Wilson for 5 years as Wilson took on the job of Boeing CEO and Chairman.[100]

T. Wilson inherited a company that was over-extended, with five major commercial airplane programs in progress (707, 727, 737, 747 and the SST), and in a dire financial situation, with a bloated workforce of more than 100,000. Things got even worse when the 737 and 747 new airplane programs incurred problems simultaneously, severely draining the company's cash. One of the problems with the 747 program had to

[99] Serling, *Legend and Legacy*, p. 327.

[100] Retaining the previous CEO on the board after turning the reins over to a successor was another characteristic of Boeing, and one rarely followed by other corporations. The prevailing rationale for the alternative was concern that retaining the previous CEO on the board may overly constrain a newly elected CEO from making changes in organization and strategy. The rationale for Boeing's approach was to maintain the strong Boeing corporate culture and to provide mentoring to the new CEO.

do with the general sense in the industry that the SST program would lead to the rapid obsolesce of sub-sonic commercial airliners similar to the 707. Thus, Pan Am, among the other airlines, swayed Boeing to build the 747 to also be a cargo airplane. This direction resulted in engineering changes to allow the cockpit of the 747 to swing up to load cargo containers, and to bulk up the airplane with additional structural weight. These design changes plunged Boeing into an expensive conflict with its engine manufacturers when the originally designed jet engines proved to be problematic with the bulked up weight of the 747. In 1971 Congress cancelled the SST program.

Then the U.S. economy plunged into its 1973-1975 recession, slowing commercial airplane orders and military contracts. A number of airlines cancelled airplane orders as well. Negative factors came together reminiscent of a "perfect storm." The situation became potentially cataclysmic, threatening Boeing with bankruptcy.

This crisis had a different dimension, and one that would be repeated in the now common multi-product, multi-billion-dollar revenue companies. Boeing had dealt with the problems of "bigness," and simultaneously operating multiple new airplane programs, by increasing manpower. Payroll costs rose to high levels, yet the problems persisted. The factories were becoming increasingly less efficient as the ranks of inexperienced workers grew.

The company's debt swelled to more than a billion dollars. As cash continued to dwindle, Wilson had to make severe cuts in the payroll; the number of Boeing employees fell from more than 100,000 to 38,000. No department escaped the deep cuts. Engineering was reduced from 15,000 to 8,000. Twelve vice presidents were eliminated.

Remaining officers took pay cuts; Wilson cut his own salary by $25,000—a fourth of his total salary.[101]

The grim impact of Boeing's layoffs on Seattle and the Puget Sound region was captured in billboard that popped up along a major highway leading out of Seattle: "Will the last person leaving SEATTLE—turn off the lights."[102] It was a low point for the Puget Sound region, the Boeing Company, and, especially, for T. Wilson.

Wilson and his senior management team stepped up to the challenge, and reduced its workforce out of necessity and expediency. They were deeply shaken. Administrative centralizations were undertaken challenging the strong trend during the 1960s and 1970s towards extensive decentralization of business units that had their own support functions.

In a manner similar to Bill Boeing's earlier initiatives to seek other sources of revenues during hard times, Wilson's senior management team explored revenue opportunities from other businesses such as computer services (Boeing Computer Services), Hydrofoil boats, mass transit systems, and wind power systems. In all, 33 new ventures were undertaken, but with little success. A sanguine future CEO, Phil Condit, was to later comment on these ventures: "We were 33 to 0. We went into 33 ventures, with a zero success rate."[103]

The turnaround from flirting with bankruptcy came slowly for Boeing. Military contracts were the start. The first was winning the SRAM (Short Range Attack Missile) contract. This was followed by three more government contracts: the NASA contract to

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[101] Serling, *Legend and Legacy*, p. 334.

[102] During April 1971, two Seattle real estate agents, Bob McDonald and Jim Youngren, constructed this billboard along Pacific Highway South leaving Seattle. The sign became a familiar gesture of future downturns across the country.

[103] Philip Condit, personal interview with the author via Skype, 2010.

build the Mariner 10 space-probe craft, the contract for designing and manufacturing the B-1 bomber offensive avionics, and a contract to build four 747 airborne command post airplanes.

The real trigger of Boeing' comeback, however, originated with one of Boeing's squirrels: aeronautical engineer Jack Steiner. In a skunkwork[104] project that even today is not fully understood,[105] Jack Steiner and his team persisted in their efforts to bring out the 727-200 derivative, which was thought to be an obsolete airplane because of the new wide-body planes from Boeing's competitors: the Douglas DC-10 and Lockheed's 1011.

Steiner and his skunkwork group got it right. The DC-10 and L-1011 were too big and operationally too expensive for the medium-haul routes—thus leaving a market niche unfulfilled. The Advanced 727 was perfect. Not only did Steiner and his team build the right airplane for this niche, but they sensed the airline customer's unfulfilled need: a modern interior with appealing sidewall lighting from the 747 and large enclosed storage bins. It gave the 727 interiors a wide-body look without being a wide-body. The Advanced 727-200 was introduced in 1970 and more than half of all the 727s sold were Advanced 727-200s. Wilson later remarked:

"Steiner, I don't know whether you designed the 727 or not, but I do know that you helped pay off our billion dollar debt."[106]

In 1970, the 747 entered airline service first with Pan Am and TWA, and later with the first foreign operator, Lufthansa. Immediately there were customer support

[104] A skunkworks (also known as skunk works) is a small group of people who work on a project in an unconventional way. The group's purpose is to develop something quickly with minimal management constraints.

[105] During the author's employment in the 737 program, a friend and colleague reported that he went on to have accounting responsibilities for Steiner's group and was asked by Steiner to approve some of the skunk group expenses, which he did. Since the expenses originated from Steiner's group, the documentation was not up to Boeing standards, but under the current conditions, he approved the expenses. And it turned out to be a good thing.

[106] Serling, *Legend and Legacy*, p. 343.

problems with the Pratt &Whitney engines. When these problems came to T. Wilson's attention, it became obvious the sources of the problems were multi-airplane programs, as well as cuts to the customer service program during Boeing's workforce cut-backs.

Wilson realized that being viewed as a company with unreliable airplanes violated a hard-earned reputation. He took quick action to form a new, independent unit consolidating all customer support functions, consisting of its own engineers, pilots, mechanics, and spare personnel. The new unit responded to "AOG" (Airplane On the Ground) situations, immediately deploying SWAT teams to get the Boeing airplane back in the air. In other words, Boeing took total responsibility to fix the problem without regard to what or whose system or part caused the problem.

Every AOG was exhaustively analyzed and its cause tracked down. The cause was remedied and fixed on all Boeing planes in service. In its analysis, Boeing viewed the pilot as one of Boeing's many systems—and a system for which Boeing took responsibility. Pilot error would not be the first factor[107] examined in causing a crash, but if detected, the company said, it was Boeing's responsibility to fix it.

For pioneering these responses, T. Wilson ranks with Bill Boeing and Bill Allen as being one of the most brilliant and influential CEOs and leaders of the Boeing Company. It can be debated (and will be) who contributed more. But this is not a very productive debate, because of the nature of the leadership provided by each in his time. And each of the leaders built upon the foundation and architecture of the Boeing Company left by his predecessor.

[107] As commercial airlines and jet travel became increasingly global, pilot training varied, and Boeing concluded that it was important to integrate the concept of the pilot as one of the many important systems of a Boeing commercial airplane.

Bill Allen initiated collaborative corporate leadership at Boeing. He also institutionalized the form when he turned over the presidency to T. Wilson in 1968, and remained CEO for another year before turning that position over to Wilson. Allen then remained chairman of the board until 1972, when he turned that position over to Wilson, too. The form continued at Boeing with chairman, CEO, president, and CEO overlapping and operating like a top-leader collaborative in addressing major company decisions.

Wilson suffered a second heart attack and announced in 1972 that Malcolm Stamper would become Boeing's new president. Nevertheless, upon announcing Stamper's position as president, Wilson emphasized "…if anyone wants to know who's boss, I am."[108] Wilson remained Chairman and CEO until 1988.

Wilson's comment about remaining the boss demonstrated his sense that Boeing needed decisiveness in its senior management ranks, yet Wilson's distinct leadership style of Boeing was "collaborative corporate leadership." The corporate leadership structure was in place: an active board with strong independent and inside directors to whom he listened, a strong senior management team, and arguably the best aeronautical engineering team in the world. The unique and talented engineering team included the active counsel of George Schairer and Ed Wells; the experience and maturity of Jack Steiner, Ken Holtby, and Joe Sutter; and rising-star engineers like Phil Condit. The Boeing board of directors during the 1960s and 70s played an important strategic oversight role in carrying Boeing forward in achieving industry leadership during the fast-changing jet age of the commercial airplane industry.

[108] Serling, *Legend and Legacy*, p. 349.

As Boeing approached the mid-1970s, the troubled airplane programs were all getting on track and the company was once again becoming financially healthy. Wilson and his engineering team turned their attention to a new airplane program and a successor airplane program for the 727. Jack Steiner was advocating that the 727's successor be a derivative 727-300 airplane, and the new airplane program started out looking like the three-engine DC-10 and Lockheed 1011: two engines under the wings and one in the tail.

After extensive wind tunnel tests,[109] however, Ed Wells disagreed with having a third engine in the tail of the new airplane. Wells prevailed over Jack Steiner, and the 767 two-engine design using pods under the wings became the preferred approach. The two airplanes would be totally new designs (the 757 and the 767) and would be undertaken simultaneously—a first for Boeing.

The engineers worked as a collaborative team. Phil Condit was chief engineer of the 757 program and recalled a meeting with George Shairer (now a Boeing Distinguished Engineer[110]), who had a penchant for dropping in to Phil's office unannounced "to talk." On one of these visits, Condit listened to Schairer talk about the importance of extra range. The discussion included range limitations of the Airbus 300, which was a European commercial airplane with a biased design for the shorter distances in flying around Europe. Condit followed up on Schairer's advice and the resulting design of the 757 had a range to fly non-stop from Miami to Seattle. The range of the 757 turned out to be a major feature of the airplane that enabled it to be used in a wide

[109] By this time, the early investment in a wind tunnel along with Boeing's strong relationship with the University of Washington's Aerospace Engineers had become an important core strength and source of competitive advantage for Boeing.

[110] The Boeing Distinguished Engineer was similar to achieving tenure in a major university. The Boeing Distinguished Engineer was given the opportunity to move about the Boeing Corporation at will, talk to most anyone, and decide what he/she wanted to work on in the Corporation.

number of flying environments[111] and remain a viable jet airliner into the twenty-first century.[112]

The engineering team developed a larger wing for the 767, which would eventually enable the two-engine 767 to fly intercontinental flights. There was initially a concern that a long range 767 would cut into the 747 market. Wilson did not see it that way, however. He thought there was an unfilled market niche for flying trans-ocean flights with smaller load factors more appropriate for a 767 than a 747—and he would be proved right.

The Boeing team began working with the FAA to certify an ER (Extended Range) 767 for long-range, trans-ocean flights, and it succeeded. The 767 was the first two-engine jet certified for two-engine transatlantic flights—the two-engine jet liner had considerable fuel and other savings versus the 4-engine jet airliners.

Boeing pioneered the certification of the 767ER and trans-Atlantic flights of 767ERs, which began in 1984 by TWA, El Al, and Air Canada airlines. Formal certification by the FAA quickly followed. By 1991, Boeing had orders for 598 767s and 405 delivered; orders for the 757 totaled 770, with 412 delivered.

In 1988, Wilson retired as chairman and Frank Shrontz was elected chairman and CEO. Shrontz became Boeing's second CEO without formal aerospace training and the first holding an MBA degree.[113]

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[111] One of the challenging flying environments that the Boeing 757 was used included the high altitude Tibet airports. The first landing of a commercial aircraft af the Nyinchi Mainling Airport (at 4,000 meters) was made by an Air China Boeing 757 without passengers on July 12, 2006. Six weeks later the first commercial flight with passengers was made to the airport.

[112] Phil Condit, personal interview via Skype, 2010.

[113] Frank Shrontz joined Boeing in 1958 with a law degree from the University of Idaho and an MBA from the Harvard Business School. Bill Allen was the first Boeing CEO without formal aerospace training. IN 2005, Jim McNerney would be the second Boeing CEO holding a Harvard Business School MBA.

By the 1970s a strong trend toward more outside directors of public corporations' boards had significantly changed the make-up of boards in the United States. The 1970 Boeing Board of Directors changed from the 1960 balanced board of six outside directors and seven inside directors to a board of three inside directors—T. Wilson, CEO and chairman; M. T. Stamper, Boeing's president, and CFO H. W. Haynes—and eight outside directors. In 1980 the board consisted of the same three inside directors and nine outside directors.

It had taken Boeing Corporation 38 years from its founding to achieve $1 billion in annual revenue—making Boeing the twenty-third largest corporation in the world in 1954. Then Boeing grew its 1954 annual revenues 27 times to reach annual revenues of $27 billion in 1990. Similar growth in other global corporations had made corporations among the largest organizations in the world. Simultaneously, the challenge of managing and leading these orders-of-magnitude more complex corporations almost totally fell to the newly burgeoning ranks of middle and upper management flooding into corporations. The task of providing oversight for business strategy and operating performance in increasingly complex corporations fell to the changing boards of directors.

Boeing's 1990 board consisted of 11 directors.[114] Nine were outside directors; only two were inside directors: Frank Shrontz, chairman and CEO, and T. Wilson, retired chairman and CEO. The 1990 board also possessed another significant difference from

[114] The 1990 board consisted of 11 directors. Nine were outside directors (Robert Beck, chairman emeritus, Prudential Insurance; John Ferry, chairman and CEO of Boise Cascade; Lee Morgan, retired chairman and CEO of Caterpillar; George Schulz, professor at Stanford University and retired Secretary of State; Harold Haynes, retired chairman and CEO of Chevron; Stanley Hiller, Jr., partner, Hiller Investment Company; George Keller, retired chairman and CEO of Chevron; Charles Pigott, chairman and CEO of PACCAR; and George Weyerhaeuser, chairman and CEO of Weyerhaeuser). There were only two inside directors: Frank Shrontz, chairman and CEO, and T. Wilson, retired chairman and CEO.

Boeing's earlier boards: it had become characterized as an "interlocking" board; that is, the Boeing board had directors that were also on the boards of Boeing's outside directors.

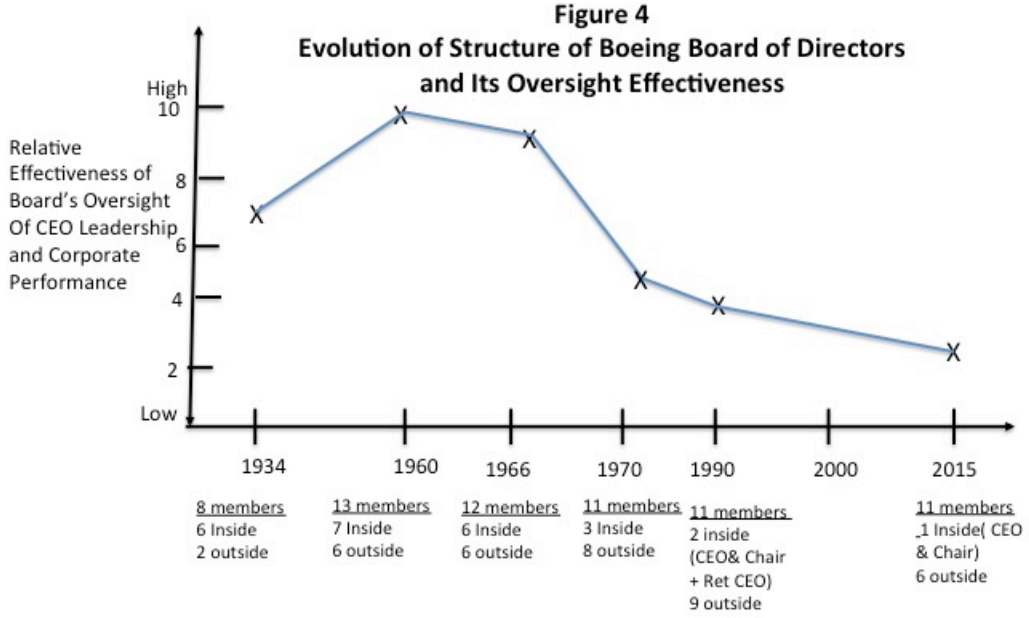
The eleven members of the 1990 Boeing board served on an average of 4.6 boards, including Boeing's. But, the Boeing board members served on many of the same boards. Frank Shrontz served on John Ferry's Boise Cascade board. T. Wilson served on George Weyerhaeuser's board, as did Harold Haynes and Charles Pigott. Harold Haynes and George Keller, both retired chairmen and CEOs of Chevron, had George Shultz and Charles Pigott on the Chevron board. Charles Pigott had Harold Haynes, George Weyerhaeuser, and T. Wilson serve on the PACCAR board.

By the 1990s it was clear that there had been a sea change in the size, power, and influence of corporations. Yet, most boards of directors had not kept pace with respect to oversight. The large global corporations' boards of directors faced serious issues and potential conflicts, with high risks of encumbering the board's duties of corporate oversight. These issues and potential conflicts included objectivity, conflicts of interest, appropriate time devoted to corporate oversight, and ensuring the subject matter expertise and experience required for corporate performance oversight.

Figure 4 is a conceptual graph illustrating the relative decline in the effectiveness of Boeing board of directors oversight of CEO leadership and corporate performance over time reflecting structural changes in the corporate board structure. While increasing complexity of the size and global scope of the Boeing Company increased, the board initially added outside directors with banking and legal expertise, achieved a balance between outside and inside board members by the 1960's, and evolved a formal committee structure for financial oversight, compensation oversight, and governance.

By1970, the balance was tipped to a majority of outside directors, weakening the availability to the overall board of direct peer-level contact with operational management of the corporation.

Figure 4
Evolution of Structure of Boeing Board of Directors and Its Oversight Effectiveness



Combining the CEO and chairman positions rapidly evolved in the United States into having the CEO also serve as chairman of the board.[115] The chairman of the board has influence on the nomination and selection of board members, setting the agenda for board meetings, deciding who from the management team will report to the board on various strategic issues the corporation is facing, and what will and will not be reported to the board. The interlocking structure of Boeing's 1990 board created the potential for

[115] This practice of combining the CEO and Chairman of the Board positions was highly prevalent in the United States, and less prevalent in Europe, and it remains more prevalent in the United States.

moral hazard: that is, that outside board member "CEO A" might expect that his approval/disapproval of the Boeing's CEO remuneration would have some influence when, later, the Boeing CEO voted as an outside member on a board that decided CEO A's remuneration .[116]

During this period, corporations were also experiencing increased global competition. During Shrontz's 10-year rein as CEO (1988–1998), Boeing was experiencing competition from the McDonnell Douglas's MD-11, a modernization of the DC-10, which was going after a niche in the marketplace smaller than the 747 and larger than the 767-300, DC-10, and L-1011. The MD-11 was a 323-passenger, fuel-efficient airplane. Airbus entered the competition with its A-340 and A-330.

Boeing had not brought out a new commercial airplane for almost a decade. While Boeing had been initially thinking about responding to the competition with a 767 derivative airplane, Phil Condit was convinced that a 767 derivative was not the way to go, and he advocated for building a new airplane.[117] By the time that Boeing decided to launch a new airplane program, the 777, McDonnell-Douglas had secured 173 MD-11 advanced orders and Airbus has secured 217 advanced orders.[118] Once again, Boeing would not be the first with a new airplane program.

While starting from behind the competition might not have been a conscious strategy for Boeing, it was a position that was partially due to the extensive wind tunnel

[116] The conflict can be further exacerbated when general collegiality and board dynamics discourage questions or challenges that might offend other board members. In such circumstances, some refer to board meetings as "social loafing." The atmosphere can gravitate to excessive compromise and mediocre outcomes when the board votes on important issues such as new airplane programs and manufacturing strategies.

[117] Philip Condit, personal interview via Skype, 2010.

[118] Serling, *Legend and Legacy*, p. 452.

testing that Boeing did, as well as the massive engineering effort that it undertook in both the conceptual design phase and the detailed engineering phase.

In the conceptual design of the 777, Phil Condit extended Shrontz's broader communications program to include airline customers. He broke with tradition and invited eight airlines into the process of designing the 777. What became known as the "Gang of Eight" led to a wider fuselage than either the McDonnell Douglas or Airbus airplanes and an innovative overhead bin which moved down and out. This bin provided more passenger headroom and made the cabin look larger. Boeing was quick to build a mock-up of the fuselages for all three new airplanes, which they paraded potential airline customers through to experience first-hand the effects of the broader fuselage.[119]

Alan Mulally, the vice president of engineering for the 777, also made notable contributions to increased communications and collaboration. Mulally created a team of project engineers, including project engineers for configuration development and design, performance, and liaison with airline customers.

The 777 program was subjected to close profitability analysis. A 1988 study showed that the previous year Boeing had $15.5 billion in revenue but realized only $480 million in net income—3 percent of revenue. The study further concluded that at least $2.5 billion of expenses were related to non-value-added costs. Boeing's "economic value-added" program was launched to reduce non-value-added costs and increase profitability.

[119] This tactic had become an effective Boeing selling ploy, having proved successful for the 707 versus the Comet decompression demo, the 737 versus the DC-9 and BAC-111 cabins, and now the 777 versus the MD-11 and Airbus 340/330 cabins.

Also, during this time, information technology began an increasingly important factor. Boeing aggressively employed IT in targeting "perfect" manufacturing through the elimination of physical prototypes and complete reliance on computer design and engineering drawings for the 777—another first for Boeing and for commercial airplane manufacturing. The entire 777 was digitized using three-dimensional models for the parts and sub-assemblies of the airplane. The whole airplane was put together virtually on the computer. It was also the first Boeing airplane to incorporate "fly-by-wire," which was introduced earlier on Airbus commercial airplanes.

The 777 new airplane program unleashed a lot of innovative and bold ideas. Some on the engineering team advocated making the airplane an all-composite structural and skin airplane. Boeing had been experimenting with composite airplane structures and built and flew the experimental all-composite robot-piloted Condor airplane. In 1988, the Condor set an altitude record for a piston airplane by flying at 67,000 feet. But the all-composite commercial airplane was rejected and would only emerge later.

The actual manufactured 777 measured only a fraction-of-an-inch differently from the virtually designed 777. Not only was the all-computer-designed 777 significantly more efficient, eliminating the need for physical prototypes for taking complicated measurements, it heralded a process in which the total airplane would be "digitized," enabling potentially efficient global outsourcing.

United Airlines was the first advanced-sales customer for the 777, in 1990. The 777's maiden flight was June 12, 1994, and it entered airline service with United Airlines in 1995. More than 1,000 777s in various configurations were sold, making it among the most successful of Boeing's commercial airplanes.

During Shrontz's 10-year tenure as CEO, Boeing's revenues increased from $13.6 to $22.7 billion, and its share priced more than doubled from $52 to $106.50—a record high. Phil Condit's leadership on the 777 new airplane program contributed to making him the leading candidate to succeed Frank Shrontz.

Condit was a pilot by 18, an Eagle Scout, a master's graduate of Princeton's aerospace engineering program. He came to work at Boeing in 1965 as an aerospace engineer in Boeing's Supersonic Transport program, went on to become lead performance engineer for the Boeing 747 airplane program, where he patented his "sail wing" innovation, going on to earn the rarified status of Boeing legendary aeronautical engineer.

On the fast track for Boeing executive leadership, he earned a Master's Degree from the MIT Sloan Industrial Management master's program in 1974 and returned to hold diverse Boeing executive management positions, culminating in his leadership of the successful Boeing 777 new airplane in 1983, as executive vice president and general manger.

New Boeing CEO Spearheads Boeing into the Virtual Capitalism era

On August 31, 1992, Boeing named Phil Condit president and a member of the board.[120] He was 51. At the time, the economy was in recession with reduced commercial airplane orders. Although Boeing held 55 percent market share for commercial airplanes, Airbus was making critical inroads. It had even broken Boeing's historic hold on a major

[120] In 67 years of CEO leadership at Boeing, 47 years were guided by CEOs with strong aeronautical engineering backgrounds and 29 years were guided by CEOs with backgrounds in law (Bill Allen) and business studies (MBA) (Frank Shrontz).

customer, United Airlines. United had just placed an order for 100 Airbus medium-range airplanes.

As Boeing's newly appointed president, Condit was asked by Shrontz to lead a multi-discipline, executive-level project team to develop a vision and strategy for guiding Boeing into the twenty-first century and retaining its position as industry leader. Condit started the team's deliberations using a "clean sheet of paper."[121]

Condit described one of the early conclusions of the team as coming relatively easily: "Boeing is an aerospace company. Boeing needs to stick to its knitting. And, there is a lot of opportunity in the aerospace business."[122]

Condit further characterized the team discussion: "what business are we in" continued to sources of future growth. Boeing had grown organically and now it was experiencing a maturing in the commercial airplane manufacturing industry, whereby industry growth had fallen to the low single digits. The team concluded that the company should seek out large aerospace acquisitions, which, together with organic growth, would allow it to achieve its strategic growth objectives—that is specifically, a more balanced aerospace company in Defense and Space relative to Commercial Airliners.

The project team analyzed and debated important concepts that the strategy should be built around: globalization and strategic outsourcing; organic versus growth by acquisitions; innovation and intellectual property (IP); and an organizational structure that would be integrated more virtually than vertically.

[121] From author's 2010 Skype interviews with Phil Condit.
[122] Paul C. Proctor, "Boeing Ascendant," *Frontiers* 1 (May 2002).

The ensuing discussions and deliberations led the group to identify three strategic core competencies of the Boeing Company: (1) large-systems integration, (2) detailed customer knowledge and focus, and (3) lean manufacturing.

The core competency of large-systems integration was unique, and it ran deep in Boeing's company culture. This core competency began with the approach to designing new commercial airplanes that went beyond conventional thinking, as illustrated by the Sonic Cruiser then on the drawing board. From the really "out there" advanced concept, Boeing worked backward to the conventional (i.e., do-able) in reconciling to their "detailed customer knowledge and focus," allowing the company to bring out the most advanced commercial airplanes that the airlines would buy.

The core competency of detailed customer knowledge and focus was uniquely enabled by Boeing's daily contact with its airline customers around the world during the operations and service of Boeing airplanes. All of this information was carefully recorded and analyzed in computer databases. Any known part defect found on one airplane would be identified on all other Boeing airplanes that had that part installed, and all of the parts would be replaced in either routine or emergency maintenance.

The core competency of "lean manufacturing" was based on the logic that, if Boeing was going to be involved in manufacturing, it had to be solidly grounded. Lean manufacturing involved thinking about and managing the manufacturing process differently from traditional methods. It was based on sustained innovation of the

manufacturing process and the concept that "everything is viewed as flows," typified by Boeing's continuously moving 737 final assembly line.[123]

Condit and the team also concluded that a company should have only two or three core competencies, or in rare cases four, because having more would undermine the company's capacity to differentiate in terms of resources and focus.[124] In 1996, the resulting strategy was presented and accepted by the Board of Directors.

Early in the twenty-first century, information technologies had deeply penetrated modern corporations and organizations in general.[125] In 1995, with the commercialization of Netscape's Navigator browser, corporations began seeing the Internet's potential in a new light. Venture capital flowed into new Internet-based start-ups, creating the stock market dot-com bubble. The NASDAQ index increased from 1,000 in 1995 to over 5,000 by 2000.

After giving the Internet short-shrift in the 1990s, the two dominant IT-industry corporations, IBM[126] and Microsoft[127], dramatically altered their strategies to incorporate network technologies. While the dot-com bubble burst soon after 2000, some of the Internet-based corporations created in that period— Amazon, Google, and Facebook among them—would go on to spearhead a new era of Virtual Capitalism. The phenomenon also would have a transformational impact on the modern corporation.

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[123] Condit had initiated Boeing tours of Japanese factories to study Japanese management and lean manufacturing. He was so involved with the Japanese processes that he studied and received a doctorate in engineering from Science University of Tokyo in 1997.

[124] Phil Condit, personal interview via Skype, March 1, 2010.

[125] I was involved in a book project at Harvard Business School, with a team of authors led by Alfred Chandler and James Cortada, on the impact of information on transforming nations. See Alfred D. Chandler, Jr., and James W. Cortada, *A Nation Transformed by Information* (New York: Oxford University Press, 2000). The book explores the evolution of information technologies and their transformational impact on the U.S. economy.

[126] At the 1998 "Second International Conference on Internet & Society," IBM CEO Louis V. Gestner gave an address on IBM's Internet strategy.

[127] On May 28, 1995, Bill Gates, co-founder and CEO of Microsoft Corporation, sent an email to all Microsoft employees titled "The Internet Tidal Wave,' which can be accessed on the Internet with a search of the email title.

In April 1996, Condit succeeded Shrontz as CEO and unveiled the new strategy to Boeing managers in the company's Spring Managers Meeting in Seattle. His speech espoused a set of ideals that became the twenty-year 2016 Strategy:

> *That Boeing must become a knowledge and resource-sharing company that excels in the design, manufacture, and support of commercial aircraft, defense, and space systems. That it would continue its global leadership in core competencies such as the integration of large, complex*[128] *systems, with detailed customer knowledge and focus and operating lean and efficient systems.*[129]

The overarching theme of Condit's team vision and strategy was to transform the Boeing Company from predominately a commercial airplane manufacturer to a balanced leader in the aerospace industry. The 2016 strategic direction of staying focused on "aerospace" businesses was deemed critically important to Boeing's twenty-first century success. Boeing's core competencies also had important synergies with the nation's space programs, whereby Boeing conducted leading-edge space research on advanced materials like composites and propulsion systems.

Boeing's military airplane business offered synergies for designing and building advanced airplanes with leading-edge innovations that could then be put to use in commercial airliners.

When Condit became CEO, commercial airplanes were producing 80 percent of Boeing's revenue. Condit and his team concluded that they could not effectively transition into a more balanced aerospace company using Boeing's traditional approach of organic growth. Thus, they included an acquisition component in the 2016 Strategy. In addition, Condit's team concluded that their traditional vertical organization (which had

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[128] Subsequently, the term "complex" was eliminated. As explain to the author by Phil Condit, while the systems were complex, there was no inherent objective to make them complex. In fact, the emphasis was more on simplification.

[129] Mansfield, *Vision: A Saga of the Sky*, p. 167.

been evolving to include more global outsourcers) had to be transformed from its vertically integrated structure to a virtually, integrated structure, including a major shift to outsourcing to global partners. In summary, the team set off on a course to transform Boeing from a "wrench-turning, stick manufacturer"[130] of commercial airplanes to a "systems integrator through global virtual integration" in the aerospace industry.

Boeing 1997 - 2016

Herein is a historical event in Boeing's corporate evolution in its effort to bring out its third industry, game-changing commercial airline: the Boeing 787. The Boeing 787 "Dreamliner" program was intended to be transformational for Boeing not only because it would create a new standard for customer experience in a commercial airliner, but because it would exploit network IT to design and manufacture that airliner in a virtually integrated global network.

Triggered by a major acquisition and the pressure toward the globalization of markets, modern corporations similar to Boeing were faced with the challenge of extending their corporate structures to embrace virtual global integration.[131] The essence of this challenge was to exploit the power of IT-enabled networks to expand from corporate vertical integration to corporate global virtual integration. By embracing this challenge for the 787 project, Boeing intended to tap into innovative and creative talent beyond the limits of the Boeing Corporation. Second, it intended to manage the high risks

[130] The concept of a "wrench-turning, stick manufacturer" of airplanes was used to describe the Boeing airplane assembly lines, where parts were installed to complete the airplane as it moved through the assembly line. This concept was contrasted with being a "systems integrator," whereby Boeing integrated the system components of an airplane or aerospace system into a finished product.

[131] Richard L. Nolan, "Ubiquitous IT: The Case of the Boeing 787 and the Implications for Strategic IT Research," *Journal of Strategic Information Systems* 21 (2012), pp. 96-98.

involved in bringing all the essential resources together by leveraging global real-time IT network infrastructure technologies and advanced CAD/CAM technologies to coordinate a set of global partners, all working consistently and coordinated towards a common objective. Finally, it would tackle the challenge of how to distribute the rewards of achieving the objective in a manner that would maintain motivation of all the diverse people resources necessary.[132]

Up until this time, the Boeing Company had achieved its growth organically—that is, it had grown through the work of evolving its own organization structure, leveraging its home-built culture, and hiring and training its own employees. Now Condit and his management team got off to an aggressive start in a new direction. The first objective was to become a more balanced aerospace corporation through a series of acquisitions—that is, acquisitions in the space industry and defense industry to become more balanced with respect to Boeing's commercial airplane business. The second phase would be to undertake a major corporate organizational restructuring to facilitate global virtual integration. The goal of both phases would be transforming previously separate organisms into one unified whole.

Phase 1: Acquisitions. In 1996, Condit and his executive team acquired two of Rockwell Aerospace's businesses for $3.1 billion: a space-related business and a defense-related business. Then, in 1997, Boeing took on its largest acquisition ever, spending $13 billion to purchase McDonnell Douglas, a company with $17 billion in revenues and a viable defense business, but a troubled commercial airplane business. The McDonnell Douglas acquisition increased Boeing's revenue to $52 billion, making it a significant

[132] See Richard L. Nolan, *Executive Team Leadership in the Global Economic and Competitive Environment* (Routledge, New York and London, 2015).

step toward making Boeing a more balanced aerospace company as well as the world's largest manufacturer of commercial and military airplanes.

Fortune magazine called Boeing's acquisition of McDonnell Douglas the "Sale of the Century."[133] That year Condit imitated the corporate structure of General Electric by establishing three Boeing divisions—commercial, defense, and space. The leader of each division was given the title CEO with the hope that each would function more as an independent company.

Condit remained Boeing Corporate CEO and chairman, while the previous CEO of McDonnell Douglas, Harry Stonecipher, became Boeing Corporate President and Chief Operating Officer (COO). These moves were to decentralize the company after Boeing's long run of recentralizing many of its functional departments during earlier difficult times.

McDonnell Douglas company culture was markedly different than Boeing's. Both the McDonnell Company and the Douglas Company had been impacted by troubled commercial airplane programs resulting in near bankruptcy. Accordingly, turnaround executives had been recruited in both corporations, who emphasized cost cutting and streamlining intended to enhance shareholder value. As a result, McDonnell acquired troubled Douglas Corporation. And, then again the combined corporations were again streamlined, to make the newly formed McDonnell-Douglas Corporation attractive for being acquired. Along comes Boeing, and the McDonnell-Douglas is acquired and seemingly fits well into Boeing's newly created 2016 Strategy. At the time of

[133] David Whitford, "Sale of the Century," *Fortune*, February 17, 1996.

acquisition, the McDonnell-Douglas corporate culture could not have been more different than the Boeing Corporate culture.

The Boeing culture, shaped by the leadership of Bill Boeing, Bill Allen, T. Wilson, and Frank Shrontz, was built around the company's engineering excellence, technology prowess, drive for innovation, and manufacturing to perfection. It did not take long for the Boeing and McDonnell Douglas factions to become polarized. Boeing's values were to be subjugated to financial engineering for enhanced shareholder value. A survey of employee morale that was 69 percent positive in 1998 plummeted to 31 percent positive a year later.[134]

In the restructuring, Condit stepped back from running the company. First, he moved Boeing corporate headquarters from Seattle to Chicago. Previously, the Boeing executive management style involved frequent plant visits, including crossing the street to walk around Plant 2, interacting with the factory managers and line workers.

Second, Boeing executive leadership and board oversight had been altered by the assimilation of McDonnell Douglas executives and board members. Harry Stonecipher, previously the McDonnell Douglas CEO, and John McDonnell, a board member and son of the McDonnell Douglas co-founder, were awarded Boeing stock—1.3 million for Stonecipher and 15 million for John McDonnell—and elected to the Boeing board of directors. Stonecipher was also made Boeing president and chief operating officer. Phil Condit, meanwhile, held about a half of a million shares of Boeing stock.[135] In other

[134] For an extensive research report and analysis of the changing Boeing employees and their perceptions about the Boeing Company, see the book by Edward S. Greenberg, Leon Grunberg, Sarah Moore, and Patricia B. Sikora, *Turbulence: Boeing and the State of the American Workers and Managers* (New Haven and London: Yale University Press, 2010).

[135] Scott Hamilton, "The Real Boeing Story: Mortgaging the Future," *The Seattle Times*, March 25, 2001.

words, for every dollar increase in Boeing's stock price, John McDonnell would make $15 million, Harry Stonecipher would make $1.3 million, and Phil Condit would make $550,000.

Senior management bonuses were based on a newly installed "performance share" grant program, which converted to common stock triggered by increases in share price. Financial engineering programs were mounted to shed assets and employ greater use of outsourcing.

Assets of the commercial airplane group declined to $9.8 billion in 2000 compared to $11 billion in 1998. Other programs focused on increasing profits through cutting expenses. R&D expenses for commercial airplanes were cut from $1 billion in 1998 to $574 million in 2000; capital expenditures for the group during the same period were reduced to $237 million from $754 million. Moving Boeing's corporate headquarters from Seattle to Chicago reduced the headquarters by half—from 1,000 employees in Seattle to 500 employees in Chicago.

Condit initiated the program to address factory efficiency by using his personal leadership to encourage his senior management team to study Japanese manufacturing techniques and practices. Airbus had closed the gap between it and Boeing in manufacturing "very good" commercial airplanes, aggressively priced. Bill Allen's strategy of "build the best airplane, and the airlines will buy it" had run its course. Boeing factories had lost their cost advantage, and Airbus had started outselling Boeing.

Condit and his senior management team responded by dropping the price of their airplanes to be competitive with Airbus. Boeing's order book rebounded. But in October 1997, the increased production rate was too much for the traditional factories, leading to a

loss of control and supply chain problems that shut down two major assembly lines. The shutdown caused one factory manager to be replaced and cost Boeing $2.6 billion to recover. For 1997, the year Condit was also elected as chairman, Boeing reported its first lost in 50 years: $178 million. Wall Street analysts turned from praising Condit to becoming highly critical of him, and Boeing's share priced toppled from $106 to $49.[136]

Dejected and frustrated with the pace of improvements to factory efficiency, Condit broke with tradition and fired 80 of his senior executives. Nothing like this had happened to the senior management team in Boeing since the late 1960s, when T. Wilson had been forced to reduce the Boeing workforce from more than 100,000 to 38,000.

Bill Allen had inculcated a high level of loyalty among the senior management team. The typical Boeing process for dealing with senior management performance problems was to remove the manager from his/her position and put them into what was referred to as the "penalty box." In the penalty box, the manager would have only token responsibility, but would have the opportunity to work his/her way out of the penalty box back over time and return to a position of significant responsibility.[137]

Phil Condit's vision of converting the Boeing factories from "pulse assembly lines" to "moving assembly lines" eventually happened—first with the 737 lines, and

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[136] The fallout of Boeing's shift in emphasis to financial engineering and maximizing shareholder value were many. First to come was a shareholder suit claiming Boeing used "accounting tricks" to cover up the assembly line shutdown. Boeing paid $92.5 million to settle the shareholder suit. Second, Airbus ate away steadily at Boeing's 70 percent share of the commercial airplane manufacturing market, and in 2003 became the market-share leader. Further fall out from the loss of control was in evidence when a former McDonnell Douglas executive, now Boeing's CFO, was shown to have broken the law by hiring an Air Force procurement officer, who then gave Boeing a copy of Airbus's bid for a large refueling tanker contract. Condit fired both the CFO and the procurement officer, who was then a Boeing executive. A similar breach of ethics occurred when Boeing failed to return proprietary documents to Lockheed. The government then took $1 billion of rocket contracts away from Boeing and gave them to Lockheed.

[137] One senior factory manager that had been put into the penalty box during the shutdown of a commercial airplane assembly line routinely came to my Boeing AIMS class and spoke about the penalty box process at Boeing. He had worked his way out of the penalty box and emphasized the Boeing company culture of providing senior executives that had performed a second chance. A particularly poignant description by this manager was how lonely it was to be put into the penalty box. He humorously described that his emails went from hundreds down to very few with receiving the Boeing company internal publication (i.e., house organ) as a real highlight during his first year in the penalty box.

then with the others. Many did not believe that a large, heavy commercial airplane could be built on a continuous moving line. The Boeing continuous moving line allowed Boeing to regain its cost efficiency for manufacturing commercial airplanes. When the 737 moving line was finally installed, the labor hours for building a 737 dropped from 30,000 hours to 6,500 hours.

Condit and his senior management team also launched a program between Boeing and Airbus to work collaboratively on bringing out a new "super jumbo" airplane, an airplane much larger than the jumbo Boeing 747. This plane was also referred to as a "Very Large Airplane" (VLA).

The "super jumbo" airplane was based on the assumption that the new airplane would work in concert with the "hub-and-spoke" airport system. In other words, the large airport hubs like New York's Kennedy Airport, London's Heathrow Airport, and Tokyo's Narita Airport would continue to dominate, with smaller airplanes flying people to and from large airport hubs to consolidate large numbers of people for long-haul flights on jumbo airplanes.

As Condit and his senior management team got further into the super jumbo airplane study, they concluded that the hub-and-spoke system might be reaching its limits. Airplane hubs were getting more and more congested as increasing numbers of people were flying. The team began to consider a "game-changing" alternative to the hub-and-spoke system: "point-to-point."

The concept of "point-to-point" was to fly people long distances to where they wanted to go, when they wanted to go, rather than consolidating large numbers of people at inconvenient hubs. This approach would create a market for a fuel efficient, medium-

sized airplane that could fly to smaller, less congested airports around the world. The Condit team further studied this alternative, which they code-named Dreamliner—what later became the Boeing 787.

Phase 2: Global Virtual Integration. The Dreamliner embodied breakthrough airplane innovations. Its design incorporated a shift from primary metal alloy to carbon structural components (e.g., wings and fuselage), thereby making the airplane lighter and more fuel efficient, and its manufacturing would involve extensive global manufacturing outsourcing with strategic partners to build Tier 1 system components (See Figure 5).

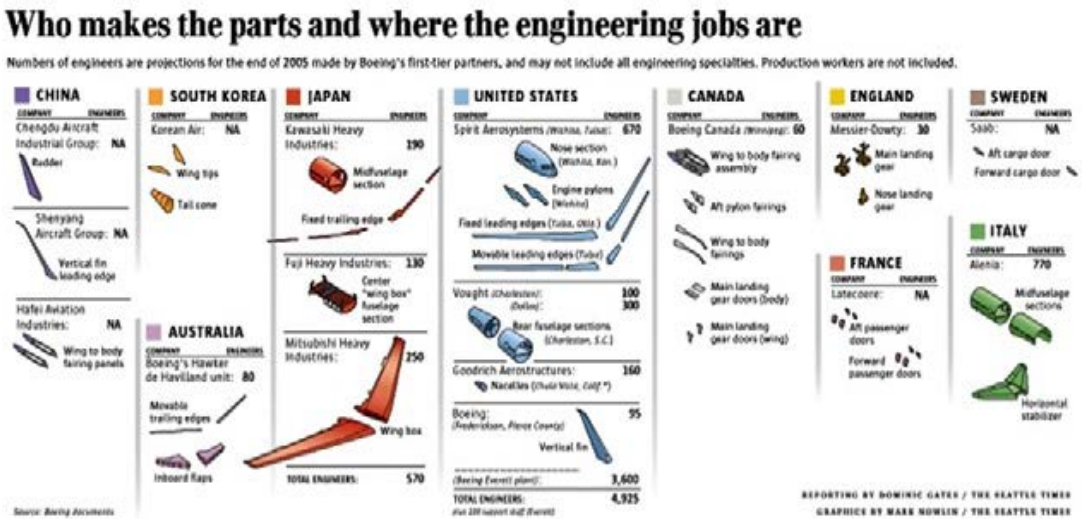

Figure 5: Boeing 787 Global Outsourcing Partners

Sets of Tier 1 systems for each 787 airplane would be serially collected by an air transportation system consisting of three converted 747 (i.e., Dreamlifters) that would fly to each of the strategic partners around the world in a 24-hour period, then return to the Everett final assembly plant for the Tier 1 systems to be clicked together into a finished 787, like Legos, over a three day period.

Boeing would supply approximately 35 percent of the plane's structure, Japan would supply 35 percent, and Italy would supply 26 percent. A team of 15 companies from more than 10 U.S. states and seven countries would be responsible for major structural sections of the plane.

Another innovative feature of the 787 was using interchangeable General Electric and Rolls Royce engines. Boeing's Propulsion Systems Division (PSD), based in Tukwila, Washington, would manage the engine relationships with these 787 engine partners.

For this project, Boeing had asked its 787 structural suppliers to fund their own research and development—a first for a Boeing project. To manage the global integration, by which more than 70 percent of the 787 would be built globally with partners,[138] Boeing implemented one of the largest project life-cycle management systems (PLM) ever created at the time. All of Boeing's partners would be required to use the same PLM digital tools and work off the same database to ensure the project could be completed on schedule and on budget.[139]

Boeing 2016 Strategy execution problems.

There are few events that trouble a modern corporation more than the ones that happen in the early days of assimilating major acquisitions and organizational restructuring. Boeing's structural decentralization into three businesses ultimately caused several lapses in control. First, in Boeing's Rocket Division, lapses of control came to light in 2003 when Lockheed Martin sued Boeing, alleging that Boeing stole proprietary

[138] Boeing estimates that approximately 75 percent of the 787 is U.S. content. With 70 percent of the 787 built by global partners and 75 percent of the 787 consisting of U.S. content, the complex coordination and integration challenges are obvious.

[139] For further description of the Boeing Dreamliner program, see Nolan, Richard L., and Suresh Kotha. "Boeing 787: The Dreamliner." Harvard Business School Compilation 305-101, April 2005. (Revised June 2005.)

documents used in winning a multi-billion-dollar Air Force rocket contract. After its investigation, the Air Force stripped Boeing of $2 billion in rocket contracts and shifted those contracts to Lockheed Martin.

In that same year, in Boeing's Defense Division, it was discovered that a former Pentagon procurement officer had been hired illegally by Boeing and had given then-CFO Michael Sears[140] a copy of rival bids for an $8 billion aerial tanker contract. Both Sears and the procurement officer were convicted of illegal acts and served jail time.

Condit fired Sears. While there was never any evidence unveiled that Condit knew the Air Force procurement officer had been hired, Boeing's board of directors concluded that this lapse of control was severe enough that, on December 3, 2003, the board asked for and received Condit's resignation as CEO and Chairman of the Board.[141]

Upon Condit's resignation, there did not seem to be a clear choice for a Boeing CEO successor. Some thought that Board member Lew Platt, former CEO of Hewlett Packard, was positioning himself for the job. Others thought that insider Alan Mulully, President and CEO of the Commercial Airplane business unit, was the natural choice.

As it turned out, the board elected Lew Platt as Boeing's board non-executive chairman. Then the board elected Harry Stonecipher, called out from retirement as previously Boeing's COO and currently Boeing board member, to become Condit's successor.

Harry Stonecipher thus became the most influential executive with respect to Boeing's first new airplane program, which under Condit's and Mulally's leadership had

[140] Michael Sears was one of the executives from the acquisition of McDonnell-Douglas.
[141] In 2003, Condit was paid a salary of more than $3.8 million, plus other stock and tax benefits. He received a lifetime pension of $1.5 million per year.

shown all signs of being capable of propelling Boeing back to a leadership position in the commercial airplane manufacturing industry. Stonecipher, however, seemed to have a different priority: that is, to stay the course and increase Boeing's share price. Accordingly, Stonecipher became a proponent of extensive strategic outsourcing of manufacturing of the 787 program at the outset of the program, a larger organizational change, with more management challenges, than Boeing had ever undertaken for a commercial airplane program.

With Harry Stonecipher as CEO, the board approved the 787 new airplane program on April 26, 2004—the month after Condit retired from the company. Two days later the company publicly announced the official launch. By this time, Airbus was fully committed to their double-decker Airbus A380 VLA (Very Large Airplane) Program.

Almost immediately, All Nippon Airways (ANA) announced an order for 50 wide-body 787s with a reported list price of $6 Billion—the single largest order ever for a new jet in Boeing's history.[142] Reports indicated the estimates for the development costs for the new plane would be between $8 billion and $10 billion; of that, Boeing would be expected to spend $6 billion, with the rest of the cost borne by strategic partners. (The comparable estimates for Airbus' new super-jumbo A380 plane were between $13 and $15 billion.)

In the following year, in January 2005, Boeing and the People's Republic of China announced that Chinese airlines would purchase 60 787s, a deal valued at approximately $7.2 billion. The new planes were to be delivered to six Chinese carriers in time for the 2008 Beijing Olympics. As of February 2005, Boeing had received 63 firm orders and 129 "less-binding" commitments for the new plane, four-fifths of which were from airlines in

[142] ANA was the second launch customer for the 777. They had ordered 15 airplanes, a $2.6 billion commitment, and had taken options on another 10 airplanes.

Asia. The 787 advanced orders rapidly soared to more than 800 airplanes, making the 787 the fastest selling commercial airplane ever.

The challenge shifted for Boeing from creating its design and selling the 787 to building the 787 for the performance, cost, and schedule that they had promised. The first plane was due for delivery to All Nippon Airways in May 2008. A total of 37 787s would be due that year, ramping up of 10 planes a month in 2010 and a steady production rate of 14 airplanes a month beginning in 2011.

On March 7, 2005, the Boeing board ousted Stonecipher, a mere 15 months into the job, saying that he had shown poor judgment in having an affair with a female Boeing subordinate, a violation of the Boeing code of conduct. It was a double blow to Boeing's previously stellar reputation for executive integrity, as now Boeing's previous CFO was serving a 4-month prison term in connection with the illegal hiring of the former Air Force procurement official, who had admitted showing Boeing favoritism for years. The shaken board appointed James A. Bell, then Boeing's CFO, as interim CEO and launched a search for a new CEO.

On July 1, 2005, Jim McNerney, a Boeing board member who at the time was serving as CEO of 3M Company, was elected chairman and CEO of Boeing.[143] Lew Platt became Boeing's lead director. Alan Mulally subsequently left Boeing to become CEO of Ford Motor Company, where he would later be credited with turning the company around

[143] McNerney was educated at Yale, and went on to the Harvard Business School for his MBA degree. After HBS, he gained diverse business experience as a brand manager for Procter & Gamble, and strategic consulting experience at McKinsey & Company, including working in Germany. Seven years out of HBS, he joined the management team at the General Electric Corporation. McNerney was mentored by GE CEO Jack Welch and rapidly rose in the GE executive ranks, holding positions as president of GE Information Services, EVP of GE Capital, president and CEO of GE Electrical Distribution and Control, president of GE Asia-Pacific, president and CEO of GE Lighting, and president and CEO of GE Aircraft Engines. In 2000, McNerney became CEO and chairman of the 3M Company, where he increased revenue from $16.7 billion in 2000 to $21 billion when he left in 2005.

to profitability with a new line-up of cars and trucks.[144]

McNerney had his work cut out for him. The 787 program had vastly over-extended Boeing's capabilities to get the airplane manufactured within budget and schedule. Boeing workers were severely demoralized. The integration of McDonnell Douglas workforce into Boeing's workforce was in disarray. Communications had broken down between Boeing and its global manufacturing partners, to the point that Boeing management seemed in the dark. Even management seemed to have quit listening to the bad news carried back by their own workers, the Boeing employees who had been deployed to the various strategic partner sites.[145]

Speaking to a reporter about how he sized up Boeing and his approach for leading the company forward, McNerney said Boeing's strategy and financials were in good shape:

> *… so my focus will be on the fundamentals. … it'll be on customers, it will be on deepening my knowledge of the operations, it will be learning the specifics of what's going on, the strengths and weaknesses of some of our people …to take some deep dives into the technology here. [It] is awesome and its deployment is a critical decision. …(my approach) will be less on big structural or financial or strategic fixes, more becoming part of the team.*[146]

[144] "How Alan Mulally rescued Ford," In his book *American Icon*: Alan Mulally and the Fight to Save Ford Motor Company, author Bryce G. Hoffman details the turnarounds of Ford Motor Company by Alan Mulally.

[145] Authors personal impression during teaching in the University of Washington/Boeing AIMS program and visiting Boeing factory sites at the time.

[146] Rich Tuttle, Aerospace Daily & Defense Report, 215 no. 1 (New York: McGraw-Hill, July 1, 2005).

On that same day, being interviewed from his new Boeing Chicago Headquarters office, McNerney told a *Seattle Post Intelligencer* reporter that " the first order of business is to get the 787 done."[147] He continued with a litany of priorities, including: "Winning back the confidence of Congress in the company as a defense contractor…"[148]

Two years passed and McNerney had made few trips to Seattle. At 6:32 p.m. on April 25, 2007, the first Dreamlifter landed at Boeing Everett field and disgorged the major 787 components to be "snapped" together for Plane #1. But it turned out that the various Tier 1 major components were in various states of incompleteness. It wouldn't be days to build the first airplane, nor weeks, nor months; in fact, it was questionable if Plane #1 would ever fly. In the end it did not: the maiden 787 flight would not be flown until Plane #4 flew the maiden flight on December 15, 2009.

The 787 program and strategy had committed the Boeing Corporation into the virtual capitalism era, but its executive leadership was confused as it straddled between its past managerial capitalism and forward momentum into the virtual capitalism era. Figure 6 illustrates the Boeing organization structure shifting from its hierarchical network evolving into its complicated global IT-enabled virtual network structure forced by strategy for designing and manufacturing its Dreamliner/787 program.

[147] Kristen Millares Bolt, "New Boeing Chief Says 787 is No. 1 Priority," *Seattle Post Intelligence*, June 30, 2005.
[148] Bolt, "New Boeing Chief Says 787 is No. 1 Priority."

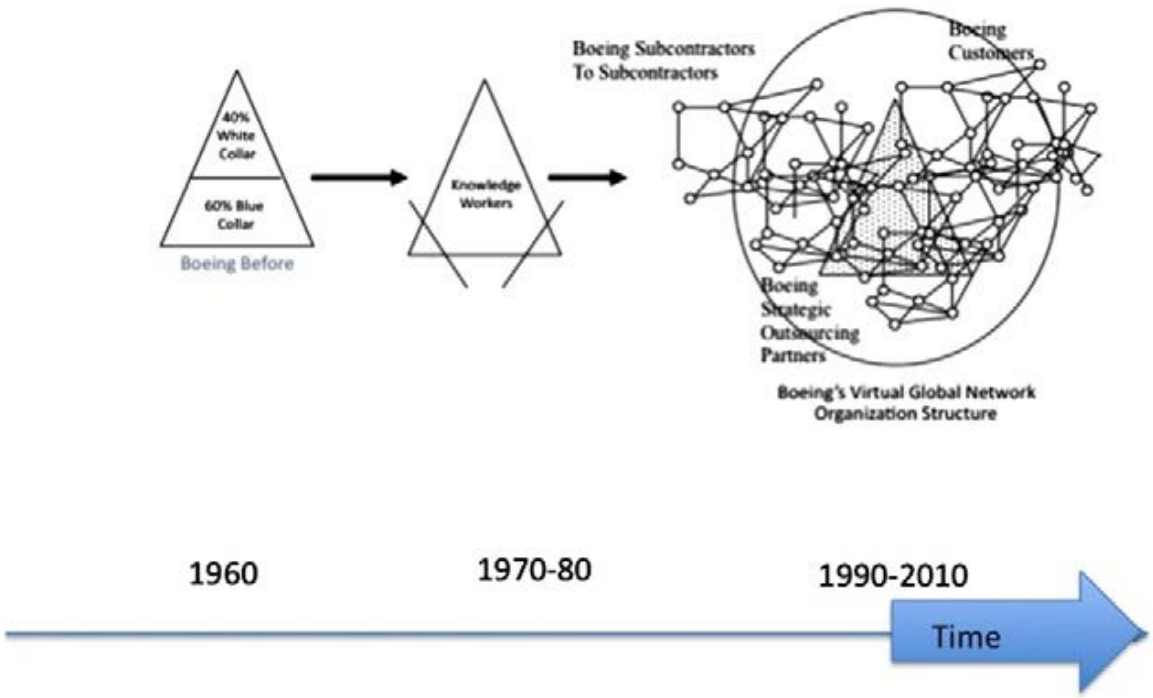

Fig. 6. Vertically integrated organization structure to IT-enabled virtually integrated organization structure.[149]

The early impact of IT during the 70's and into the 80's resulted in the automation of clerical transactions and low-level manual operations such as blueprint design and production. As illustrated in Figure 6 downsizing changed the shape of organization charts to become more diamond shape than triangular. The Boeing 787 organization chart morphed into complex networks inside Boeing (i.e., represented by the circle) and outside the circle with Boeing's 787 strategic partners, and even with greater complexity of outside networks of Tier 1 partners coordinating with their Tier 2 and 3 suppliers for subassemblies and parts.

In the meantime, a charade of "everything is okay" persisted while the Boeing Everett workers scrambled to cobble together the first set of 787 components that they

[149] Adapted from my article, "Ubiquitous IT: The Case of the Boeing 787 and Implications for Strategic IT Research, *Journal of Information Systems*, 21 (2012), pp. 91-102, p. 98.

received to mock up “the first 787” which could be rolled out for Tom Brokaw in a special Today TV show scheduled for the morning of July 8, 2007: 7/8/7 (7/8/2007).

Plane #1 was indeed rolled out on the Today Show, as planned,[150] but unbeknownst to the television audience, it was riddled with custom-fabricated fake parts, made of the same composite materials used for racecar moldings, to look like a finished 787. Even at that late date the official maiden flight of the 787 was said to be in August 2007, with the first deliveries in May 2008 in time for China Airlines to fly spectators on new 787s to the 2008 Peking World Olympics. Neither would happen.

After the Dreamliner Today show, the delivery delays were announced, the severity of the management problems were brought to light, and the firings began. The 787’s maiden flight was moved to late November or December 2007. Then the first delivery delay was formally announced October 10, 2007, with deliveries pushed out 6 months, from May 2008 to November or December 2008. During the announcements, McNerney cited difficulties with “final assembly” of the first 787 and parts shortages in the supply chain.

One severe parts shortage problem was tracked to airplane fasteners. There was no information transparency throughout the “tiered” global supply chain. The shortage of fasteners seemed to be a result of a number of Tier 1, Tier 2, and Tier 3 suppliers hoarding fasteners, which, in turn, resulted in shortages throughout the global 787 supply chain.

[150] “Boeing 787 Dreamliner Rollout,” video, http://www.youtube.com/watch?v=nJ58clgqo9o, July 8, 2008, accessed January 2016.

The second delivery delay, announced on April 9, 2008, was for an additional three months. At this point, the extent of delivery delays would trigger penalty costs for Boeing, at the time estimated to amount to around $1 billion. Boeing had booked more than 800 advanced 787 orders, with a combined value of more than $100 billion.

On April 9, 2008, the third delay was announced. This delay was not months, but one year—to the third quarter of 2009. Under the revised delivery schedule, Boeing would now deliver 25 787 planes by the end of 2008—less than a quarter of what the company had promised to deliver that year. The maiden flight for the 787 was also delayed to the fourth quarter of 2009.

Prior to the maiden flight, static testing revealed structural integrity problems with the wing box requiring added weight to correct. The added weight impacted the range estimates for the airplane, which were troublesome to a number of 787 airline customers who planned to put their new 787s into service on long-haul routes. Brake testing also revealed heat problems impacting the overall braking systems that had to be resolved. Boeing had never before experienced new airplane delivery delays to this degree.

Nevertheless, these problems were worked out by Boeing workers to the extent that the 787 maiden flight took place on December 15, 2009, and flight tests began to certify the airplane for commercial airline service.

Nevertheless, the 787 manufacturing problems were far from over. Late delivery penalty costs had increased to a staggering $15 billion to $20 billion dollars. To have any chance of overcoming these expenses and making the program profitable, Boeing would have to overcome tough challenges to bring the composite and all-electrical airplane through the rigorous certification process. This process would inevitably involve

engineering changes, along with the manufacturing process changes that would result as the factory workers came down the learning curve for efficiently manufacturing the airplane. Only this time, the learning curve results had to be fanned back out to the multitude of dispersed strategic partners building the various major components of the airplane. These changes required revised manufacturing processes, new tooling, and additional training for the factory workers. And, indeed, many of the "fixes" had to be developed by engineers at the strategic partner sites rather than by Boeing engineers. The coordination and execution of all this posed an unexpected and daunting challenge to successfully carrying out the 787 program. And Boeing would be forced to address these challenges from the disadvantaged position of a program that was still incurring serious supply chain problems and quality-of-work problems. A successful 787 maiden flight would be critically important for bolstering the flagging confidence in Boeing's ability to build and deliver the new plane.

Unfortunately, but perhaps predictably, a host of additional design and manufacturing problems arose during the certification process and made the global supply chain problems worse. In December 2010, the *Seattle Times* reported on the problem-prone 787 program and published photographs of a growing number of unfinished 787s on the tarmac outside the Everett factory. One year after the successful maiden flight, twenty 787s stood on the tarmac with an estimated 140,000 "travellers"[151]—the work required to complete the 787's.[152] Finally, on August 26, 2011,

[151] "travellers" consisted of work that was not completed during points along the assembly line, whereby the airplane continued to move along the assembly line accumulating lists of in-completed work that would be scheduled further down the assembly line. In the worse case, the "travallers work would have to be completed after the airplane was pushed off the assembly line into the factory. tarmac

[152] Gates, "Dreamliner Woes Pile Up," *Seattle Times*, December 18, 2010.

the U.S. Federal Aviation Administration (FAA) and the European Air Safety Agency certified the 787, at last allowing airline deliveries to take place.[153]

The rather speedy certification of the 787 was not without controversy. [154] On September 25, 2011, the first 787 was delivered to Japan's ANA—three years behind schedule. The following month, the first 787 commercial airline flight carried passengers from Narita to Hong Kong. But the design and manufacturing problems were far from over. On December 5, 2012, the FAA ordered inspections of all 787s in service following reports of fuel leaks. In the same month, McNerney told media outlets that the problems were no greater than those experienced by other new Boeing airplanes, such as the Boeing 777.

Still, the problems persisted. Just a month later, on January 7, 2013, a fire broke out on a parked Japan Airlines 787 at Boston's Logan Airport—not the first smoke and fire experienced by a 787. And on January 16, 2013 the FAA issued an emergency airworthiness directive ordering all U.S.-based airlines to ground their Boeing 787s until modifications were made to the electrical systems to reduce the risk of batteries overheating or catching fire.

By January 17, 2013, all airlines grounded the entire fleet of 50 Dreamliners that had been delivered. A similar grounding had not happened since 1979 when the McDonnell Douglas DC-10s were grounded following an inflight hydraulics failure that caused a widely publicized crash landing of a DC-10 airplane in the Midwest.

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[153] Boeing had become an influential force in Washington D.C. President Barack Obama toured the 787 Everett Plant in 2009, and in March 2010 appointed McNerney to chair the president's export council. Soon after the Boeing 787 was FAA certified.

[154] As reported by Dominic Rushe in the *Guardian* on January 18, 2013, former consultant and airline executive Robert Mann opined that Boeing's clout put pressure on the FAA to expedite approval for the Dreamliner, despite its radical design and manufacturing process."

ANA airlines, which had taken the first delivery and had integrated a total of 17 Dreamliners into its airline fleet, estimated that the cost to ANA of grounding the 787s exceeded $1 million per day. The FAA did not lift the grounding directive until April 19, 2013, some 93 days after it was issued. Counting ANA's daily cost of $1 million for grounding 17 Dreamliners, we arrive at a cost per plane of about $5.4 million for the delay. Multiplying that amount by 50, (the total number of delivered 787s across all airlines) gives a total estimated grounding cost to the airlines of some $270 million.

Until the Logan Airport 787 battery fire, McNerney had kept a low profile regarding the Dreamliner program and its problems. But now it appeared the crisis could erode Boeing's longterm relationships with its airline customers. While the 787s were grounded, McNerney and his executive team had protested the decision to award the tanker contract to Airbus after the 2003 scandal, and the protest was upheld. The Airbus contractual award was cancelled, and the competition was re-opened. On February 24, 2011, at a Pentagon news conference, Deputy Defense Secretary William Lynn announced Boeing as the clear winner of the $35 billion contract to build nearly 200 airborne refueling tankers, with first deliveries beginning in 2017.[155] The Boeing tankers were designated KC-46As and based on the Boeing's 767 airplane. Boeing gained some breathing room.

McNerney had now been CEO and Chairman of Boeing for going on 10 years. He had fundamentally shifted the company's culture away from its historical, if rather parochial, Seattle aeronautical engineering roots established by Bill Boeing and exemplified in his mandate to "Let no airplane technology and build to perfection," and

[155] Staff writer Mike Boyer contributed, as did Bloomberg News and the Associated Press to this posting: http://news.cincinnati.com/apps/pbcs.dll/article?AID=/AB/20110224/BIZ01/302240146/

further institutionalized by Bill Allen's credo, "Build the best airplane, and customers will buy it."

Perhaps ironically, this cultural shift had been triggered first by one of Boeing's most talented aeronautical engineers: Phil Condit. Like so many at the time, Condit was impressed with the General Electric culture of focus on financial metrics and increased share value.

In summary, Condit implemented the corporate structure of General Electric by establishing three Boeing divisions—commercial, defense, and space—and naming their leaders CEOs in the hope that each division would function as an independent company. Second, Condit introduced Boeing's Economic Incentive Program whereby a performance calculation was made based on financial accounting metrics to determine Economic Profit in providing employee cash incentive payments.[156] Third, Condit moved Boeing Headquarters out of Seattle to Chicago and cut headquarter employment from 1,000 to fewer than 500. Fourth, he brought McNerney onto the Boeing board of directors in 2001, adding support to Boeing's shift toward GE-type financial management performance.

At the end of these changes, Seattle was no longer central to Boeing, and the strong Boeing engineering culture became overwhelmed by the emphasis on financial metrics. The frequent factory "walk-arounds" by Boeing executive management and informal interactions with engineers and mechanics virtually disappeared.

With the sudden removal of Condit as CEO and replacement by Jim McNerney, a career executive of GE, the conversion of Boeing engineering culture to a shareholder-

[156] See Juna Kim, "Measuring Profit, Sharing Success," *Frontiers* (July 2003).

value culture, with a heavy emphasis on cost cutting, was complete. The supremacy of cutting costs was reflected in the building of the second major 787 final assembly plant not in Seattle but in South Carolina—a non union "right-to-work" state.

During Boeing cost cutting, the Boeing executives were enjoying increasingly higher levels of compensation, primarily due to their compensation incentives to increase the price of Boeing's shares. This further alienated and distanced the Boeing workforce, whose engagement and morale suffered.[157]

On July 1, 2015, after 10 years as Boeing CEO and chairman, Jim McNerney stepped down as Boeing CEO, and was to retain his position as chairman of the board until February 2016, when he retired from Boeing, which he did.

During McNerney's rein as Boeing CEO and Chairman, Boeing's stock dropped to a low of less than $30 per share as a result of Boeing's 787 problems. Problems with the 787 program also caused more than $30 billion of deferred costs that would have to be absorbed by the 787s manufactured later, at the rate of $10 million per plane. Also under McNerney, no new airplanes had been proposed or designed. Instead, existing product platforms were extended: the Boeing 737 was modernized into the 737 MAX; the Boeing 777 was modernized into the 777X; and the Boeing 767 was converted to the Airforce Tanker. The day McNereny's stepped down as CEO on July 1, 2015, Boeing's stock closed at $140 per share.

Opinions about McNerney's leadership of Boeing have been mixed. Some

[157] The *New York Times* had Equilar, an executive compensation data firm, conduct an independent study of 200 large corporations that showed the average worker in the United States had a 2010 median annual compensation of $41,674, an increase of two percent from the average $40,712 the previous year.[157] The average CEO compensation was $9, 600,000, a 12 percent increase. During McNerney's chairmanship, seven directors were replaced with five new directors.

insiders have applauded the financial discipline he brought together with his executive team.[158] Others are critical, concluding that Boeing's future leadership in the industry has been severely compromised.[159]

Boeing's historical engineering culture and Seattle-centric orientation became more similar to modern global corporations in general: disciplined financial and cash flow management, focus on operational efficiency, and more dispersed, global operations.

Boeing's experience is reminiscent of other situations where a professional CEO had been brought into a technology-oriented corporation headed by a technology-oriented CEO. One is reminded of the Apple Corporation, where Pepsi Corporation CEO John Scully replaced Apple CEO Steve Jobs. Scully implemented professional management techniques, which resulted in, record sales and share price for Apple by leveraging and increasing manufacturing efficiency of existing products, but in the same period there were no forthcoming new products to continue revenue growth. It was not until the Apple board brought back Steve Jobs as CEO that Apple renewed its stream of innovative new products and growth.

On July 1, 2015, the board elected Dennis Muilenburg as McNerney's CEO successor. Muilenburg, 52, started his career at Boeing in Seattle after graduating from the University of Iowa engineering program, and continued to rise in the Boeing Corporation, holding leader positions in both the defense and commercial airplanes

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[158] See Dominic Gates*: dgates@seattletimes.com; on Twitter: @dominicgates.* Seattle Times researcher Gene Balk contributed to this story. Accessed February 2016.

[159] See Richard Aboulafia, "Boeing Will Pay High Price For McNerney's Mistake Of Treating Aviation Like It Was Any Other Industry, *Forbes* (July 14, 2015), and accessed February 2016.

divisions.

At his first public meeting with Boeing engineers and others as CEO, Muilenburg described himself as "an engineer at heart," and showed a Boeing video with the slogan: "Build something better." This was received with some relief by the engineers present, and, for many, was seen to be a sign toward a more balanced, engineering-based culture than had been seen at Boeing for the last 10 years.

The current financial position of Boeing is strong, and the change of CEO leadership may put Boeing on a similar track in resuming a steady stream of new products before the current renewals of existing products runs its course.

From Managerial Capitalism to Virtual Capitalism.

The hundred-year history of the Boeing Company takes us through the phases of the modern corporation, from its entrepreneurial founding to the transition to professional management and managerial capitalism during the first half of the twentieth century, and the subsequent transition to virtual capitalism during the last half of the twentieth century into the twenty-first century.

Virtual capitalism has profoundly changed the modern corporation to become not only the largest organizations in the world, but also the first truly worldwide organizations. Today, corporations are almost totally free to move their headquarters, factories, and markets among and throughout many nations. And, many corporations have and are doing so in seeking more advantageous corporate tax arrangements and other advantages. Such moves subject the corporation to an ever increasingly complex legal environment in operating under the laws of many diverse nations. This also involves expanding the corporate IT networks, which inherently increase the risks of

breach and unauthorized invasion of the corporation's private IT networks.[160]

In the Boeing Company case, we observed the assimilation of technologies and disciplines of managerial capitalism in the first half of the twentieth century along with important extensions into industrial mass production of complex products such as commercial airplanes. Then we observed Boeing's evolution into virtual capitalism with its 2016 Strategy, executed through a major acquisition and the launch of its Dreamliner program. Boeing's acquisition of the McDonnell Douglas Corporation was controversial—and in some cases cynically described as the McDonnell Douglas Corporation taking over Boeing with Boeing's own money. David Christian's Big History story provides us with another lens through which to view corporate acquisitions: the process of parasitic symbiosis.

Until relatively recently, the prevailing social organization structures were highly constrained by geography, physical travel, governments, and cultural differences. Virtual capitalism, enabled by modern IT technologies of real time networks, has allowed today's global organizations to overcome many of these constraints, and particularly, the physical limitations faced in the past.

Although it was a rather fitful process, the global virtual organization Boeing created to build, market, and operate its Boeing 787 jet airliner can be viewed as an extended "complex organism" with both a physical and a virtual social organization structure. Within that new organism, the McDonnell Douglas corporate culture of financial engineering and management by financial metrics overwhelmed the Boeing

[160] One of the most widely publicized IT network breaches occurred in 2014 when the North Koreans invaded the Sony Corporate Network to the extent that Sony was forced to remove one of their movies from being publically shown in theaters. The United States government is clandescently engaged in monitoring other IT networks along with many other nations. Almost no corporation's IT networks are fully immune to such attacks.

corporate culture of engineering and technology. As a result, the blended Boeing organism primarily emphasized finance and subordinated engineering/technology.

The reduced emphasis on engineering and technology in the "new Boeing" led a number of Boeing engineers and workers to leave the company. Viewed through the lens of Big History, coercion by management and Boeing security departments operated to enforce the new emphasis on financial metrics, and caused employees who resisted the changes to leave or be fired. Some of these dissenters went on to become "hill-like" people, so to speak, by deciding to work as consultants or for smaller, more entrepreneurial firms outside Boeing's reach.

Successful symbiosis in a major acquisition, similar to the Boeing acquisition of McDonnell Douglas, has been one of the most difficult challenges facing modern corporations. The process is generally severely disruptive to the corporation, takes a long time, and is plagued with a plethora of both strategic and operational issues. Its disruptive severity has often been described as being a "war" between the two corporate management and worker groups, one that eventually becomes resolved with one prevailing more fully over the other.

This conquest approach to acquisitions or major mergers to expedite the growth of modern corporations spawned an industry of infamous "corporate raiders" in the 1980s, beginning with Carl Ichan's hostile takeover of TWA Airlines in 1985. More recently, it has continued into the twenty-first century with the rise of the private equity industry. Firms similar to Paul Singer's Elliott Associates have recruited young hedge fund managers with backgrounds in investment banking to analyze underperforming corporations, often with weak boards of directors, in a search for potential takeover

targets. This trend continues today, to the point that almost no corporation perceived as lagging behind the competitive growth of its peers is immune to the threat of takeover. The promise to shareholders of the "lagging" corporation to return it to its previous growth and industry leadership has proved to be a motivating force to groups of shareholders to support hostile takeovers.[161]

Similar to events during the historical twenty-first century, at some point the rulers of Agrarian empires thought that it might be more *expedient* to grow their empires by pursuing the conquest of other empires rather than continuing exclusively with the arduous and long process of investments toward organic growth.

This historical approach has similarities to Condit's team approach to shift from hard work/won organic growth to what was seen as a more expedient approach of acquisitions for faster growth. This approach also has other similarities reminiscent of lessons of "Big History": parasitic symbiosis—that is, where one organism joins another organism, and ultimately they become one, but a much more complex organism.

Characteristic of parasitic symbiosis one of the organisms prevails in enjoying more from the joining than the other. But once the two organisms join in a symbiosis relationship with synergistic collective benefits, even through there is an inequality between the two, the two organism tend to stay together because of a number of factors—one factor is that breaking off the relationship once consummated often entails significant costs for each—that is, costs so significant that both organisms might not survive the break-up.

[161] For a case study on the process or "playbook" of a private equity firm attacking a public corporation for control see Richard L. Nolan "Novell (A): When an Activist Hedge Fund Came Calling on The Board," HBS Case 9-916-404, July 23, 2015 and Richard L. Nolan, "Novell (B): Board of Directors Aftermath of Hedge Fund Attack," HBS Case 9-916-405, July 23, 2015.

In the emerging trend toward virtual capitalism, Boeing's 787 program—a global virtual partnerships to design, manufacture, and coordinate global supply chains of an extremely complex products—is a precursor to what may be an even greater symbiosis challenge for modern corporations. Accordingly, it is important for the executive leadership and boards of modern corporations to understand both the nature of the challenges Boeing encountered and the critical role played by its management of IT resources.

Appendix

Alternative Future Scenarios[162]

This working paper focuses on the evolution of the corporation in the context of evolving managerial capitalism into an era of virtual capitalism. The primary research basis was case study of the Boeing Corporation. In his conference paper, Professor Robert Mason[163] presents a broader perspective in viewing the future focused on three contemporary global forces: demographic shifts, continued evolution of information and communication technologies (ICTS), and convergence of ICT's with other technologies (e.g., "Internet of things", 3-D Printing, driverless automobiles). In concluding his referenced academic argument, Mason speculates on the future through four alternative future scenarios.

Scenario 1. Distributed Capitalism: Expansion of the Sharing Economy: Pop-ups and Gigs

Scenario 1 predicts that the existing environment of large corporations and national governmental regulation will persist with continued proliferation and growth in "unicorns"—corporations valued at more than a billion dollars (i.e., Pop-up and Gigs). Creation of and structure of unicorns will draw in the emerging new generation of Net Geners (i.e., those born after 1980) by providing them with more freedom in work than traditional large corporations. Further, the ICTS enabled structure of these corporations

[162] Robert M. Mason, University of Washington, Information School, "*Innovation, Entrepreneurship, and Institutional Reform… or Not,*" rmmason@uw.edu. Conference paper presented at the 6th Latin American and European Meeting on Organization Studies (LAEMOS), Viña del Mar, Chile: April 6-9, 2016. Scenario summaries presented with permission of the author: Robert Mason. Do not copy or quote this appendix or excerpts from it without the permission of Robert M. Mason.

[163] Mason, op. cit., *"Innovation, Entrepreneurship, and Institutional Reform… or Not,"* March 6, 2016, pp. 9-14.

will leverage the integration of intangible assets such as the "The Internet of Things."[164]

Scenario 2. Institutional Persistence/Transformation

Mason's underlying assumption for Scenario 2 is that large corporations will remain viable and persist through processes of transformation engaging in projects similar to Boeing's 787. Mason further offers case evidence such as Google's investment in ventures such as Uber, and General Motor's investment in a joint venture with Lyft in self-driving cars Both have characteristics of transformational spearheading projects with similarities to the original vision articulated by Phil Condit of Boeing's 787 project.

Scenario 3. Oligarchies: Centralized and Non-Governance Power

Mason includes Scenario 3 as a historical evidence scenario based on Robert Michels' "Iron law of oligarchy."[165] "… all organizations, no matter how democratic they begin and how much they intend to remain democratic become oligarchies over time."[166] Mason further supports this scenario on the basis that the "Iron law of oligarchy" has survived and provides a conceptual lens for the understanding the present societal tendencies, and possible future of democracies and democratic republics such and the US and most of the European nations.[167]

Scenario 4. Breakdown: Violent Conflict

The basis for Scenario 4 is that the existing continued disparity of wealth concentrated in a few will be overthrown by violence from the majority culminating in a

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164 The "Internet of Things" is a concept of connecting devices (things) to the Internet (and to each other) including everything from cellphones, coffee makers, washing machines, headphones, lamps, wearable devices, jet engines of an airplane, and the drills of oil rigs, and having the devices communicate and control eachother.

165 See Robert Michels, *Political Parties: A Sociological Study of the Oligarchical Tendencies of Modern Democracy*, 1915, trans. Eden and Cedar Paul (Kitchener, Ontario: Batoche Books, 2001), http://socserv2.socsci.mcmaster.ca/~econ/ugcm/3ll3/michels/polipart.pdf.

166 Michels, *op cit.*, p. 11.

167 Mason, op. cit., p. 11.

new order. The analog for this scenario is the French Revolution of 1789-1799 where French citizens razed and redesigned their country's political landscape, uprooting centuries-old institutions of absolute monarchy and the feudal system. Like the American Revolution before it (1765 – 1783), the French Revolution was influenced by Enlightenment ideals, such as the concepts of popular sovereignty and inalienable rights.