
EXECUTIVE INNOVATION

Gordon W. Arbogast
Arpita Jadav

Jacksonville University

garboga@ju.edu; ajadav@ju.edu

Abstract: One recent quote for the role of CEOs and other C-Suite executives on the innovation of a firm is: “Innovation executives are not expected to be the innovators, but the great ones can facilitate ideation processes effectively to generate great ideas” (Soloman, 2005). This paper explores the role of CEO/Top Executive participation in innovation in modern business. At the turn of the 20th century, there were many great inventors who also became successful businessmen. They founded and played key management roles in firms that created the backbone in the infrastructure and business growth of the country. Thomas Edison (GE), Alexander Graham Bell (AT&T) and the Wright Brothers (Aircraft) are just a few that come to mind. However, as the 20th century wore on, America’s big business organizations became more bureaucratic with CEOs and executives leaving entrepreneurship and innovation primarily to their R&D divisions (e.g., Bell Labs and RCA Labs) and to outside organizations that could be acquired if necessary. However, recent trends indicate that this may be changing. This paper looks at today’s state of innovation and examines the current role of innovation as it pertains to CEO and Top Executives.

This subject of CEO/Executive innovation is approached with a view of: (1) examining if the spirit of innovation is alive at the CEO level; and (2) if it is, determining if today’s CEOs/Executives are contributing to innovation in U.S. major firms. A literature review addresses some of the authors and academicians who have contributed current major ideas concerning innovation. Joel Barker is a futurist who has spent his career focusing on paradigm shifts and innovation. A famous MIT professor, Clayton Christensen, was another who developed and documented key ideas in innovation that are now mainstream e.g., the theory of disruptive innovation. Lastly, most graduate books on Business Strategy address innovation in a separate chapter and describe the latest ways that a firm can embrace innovation to be successful.

Much insight into this topic was gained by examining a recent Forbes list of Executive Innovators (Forbes 2019). At the top of the Forbes list are found some common names of U.S. CEOs and Executives. Quite a few have recently displayed a healthy penchant toward reaping the benefits of innovation. Included in the list were: Sundar Pichai at Alphabet (Google); Jeff Bezos at Amazon; and Elon Musk at Tesla. Three major recent CEOs who epitomized the best in the successful harnessing of innovation over the past 30 years are also discussed in some detail: Steve Jobs (computers and other related fields), Edward Whitacre (Telecommunications) and E. Hunter Harrison (Railroads). While examining these leading CEO/Executives, deregulation in the United States economy was identified to be a potential important construct that may well have influenced positively the changing role of modern CEOs and top Executives in innovation.

It is concluded that all innovation does not necessarily have to be driven by intrapreneurs within a firm or acquired from outside a firm. In fact, CEOs are more active today in driving innovation than at any time since the earliest 20th century. It appears that innovation at the CEO/Executive level has been revived and is far from being defunct!! Future CEO and Top Executive position hires should be examined with innovation in mind. At a minimum criterion for selecting a new CEO or Top Executive needs to include how well they have delivered innovation in their past executive assignments, as well as what ideas they have for generating innovation in their new job.

Recommendations are also made as how to further research this topic to provide definitive factors that are driving innovation at the CEO and Executive levels today. Such research on innovation should not be limited to just technological innovations, but needs to be expanded to include innovations in such functional areas of business as marketing, operations, procurement, R&D etc. Lastly, future research could also be undertaken in innovation using techniques such as data analytics. A data-centric technique could be employed which would focus on using machine learning algorithms to identify themes that are driving the recent upsurge in CEO and Executive innovation.

Keywords: *Innovation; Disruptive versus Incremental Innovation; Precision Scheduling Railroad; Data Analytics*

1. BACKGROUND

It has been observed that innovation is the life blood of a nation. Over the past 200 years innovation by United States inventors has been a major reason that America has been successful in establishing a vibrant and powerful national economy. Fulton's steamboat, Eli Whitney's Cotton Gin, Cyrus McCormick's Reaper, Otis's Elevator, Samuel Colt's revolvers, Goodyear's Vulcanization of rubber, Samuel Morse's telegraph were just a few of the major inventions by Americans in the early-to-mid 1800s. In the late 1800s and early 1900s a major industrial nation arose on the heels of the inventions of Alexander Graham Bell, Thomas Edison, Nikola Tesla, the Wright Brothers, and a host of other entrepreneurial innovators. What was unique about many of these late 19th Century innovators was that they did not only invent new and useful things, but they then made major contributions to society by commercializing their inventions as Executives of firms they helped to create. By going into business, they laid the groundwork for major industries that would make their company's products available to millions of people world-wide. Alexander Graham Bell invented the telephone and then was the President of Bell Telephone Company (1877) and later in 1884 the new AT&T (Alexander Graham Bell, Wikipedia). In 1878 Thomas Edison invented the light bulb and then the Edison Electric Light Company. He had many other patents involving electricity and played a major role in the formation of General Electric in the early 1900s (Thomas Edison, Wikipedia). In 1880 George Eastman invented the first commercially available camera and founded Eastman Camera Company (later Eastman Kodak) (Ball, 2013). Ford developed the large-scale assembly line in the early 1900s to mass produce his Model T cars at a price that could be sold to the middle class (Webb, 2021). The Wright Brother invented the airplane and established the Wright Company in 1909 (Wright Brothers, Wikipedia). Although not inventors per se, numerous other American entrepreneurs capitalized on the boom in technology and innovation in the late 1800s to build the modern infrastructure of the nation i.e. Vanderbilt (Railroads), Carnegie (Steel), Rockefeller (Oil), Westinghouse (electrification of America with Alternating Current), and lastly J.P. Morgan, the great banker who financed many of the great infrastructure projects in the early 1900s (History Channel, 2019).

In the 20th century the United States had many new products and innovations. However, most of the inventions from this century were made by entrepreneurs who have not served as Presidents (or the more modern term Chief Executive Officer or CEO) of firms that have acquired such inventions. The Radio Corporation of America (RCA) is a good example. David Sarnoff was the major executive of RCA from 1920-1969, but was not an inventor. He was a Russian immigrant who made his reputation by operating a Marconi radio that took the distress call from the Titanic in 1912 and directed the RMS Carpathia to pick up survivors. Later as President of RCA, he adopted the inventions of Lee de Forest (the Father of Radio), Philo Farnsworth (first real commercial Black & White TV), and John Baird (Color TV) to make RCA the premier communications company in the world starting around 1940 (Dreher, 1977). As illustrated by Sarnoff, a shift occurred by the mid-20th Century with most new inventions being made by scientists and engineers employed in an organic R&D organization of the parent firm (e.g., RCA Sarnoff labs and AT&T's Bell Lab) or outside the big firms by enterprising entrepreneurs. The time when inventors were establishing new businesses and transforming them into major Fortune 500 firms had seeming receded into the distant past. However, events over the past 30 years may lead one to question that premise. The major thesis of this paper is that CEOs and top executives today may well be playing key roles in innovation.

2. LITERATURE REVIEW

The important role of innovation in success has been echoed by many who have studied it. In the Journal of Strategic Leadership, Gary Oster was only one researcher who acknowledged this sentiment. In 2009 he stated: "In perilous economic times, fresh ideas and innovation are the lifeblood of every corporation" and by extension every nation (Oster, 2009).

Another recent quote on innovation is: "Executives are not expected to be the innovators, but the

great ones can facilitate ideation processes effectively to generate great ideas” (Soloman, 2005). This section reviews some of the recent major authors and academicians who have contributed current important ideas on innovation. Joel Barker is a futurist who has spent his career focusing on paradigm shifts. Clayton Christensen, an MIT professor, is another who has developed and documented key ideas in innovation that are now mainstream e.g., the theory of disruptive innovation. Lastly, most graduate books on Business Strategy address innovation in a chapter and describe the latest ways a firm can embrace innovation to be successful.

Joel Barker was the first person to popularize the concept of paradigm shifts as it pertains to innovation in the modern corporate world. He began his work in 1975 and he observed that discovering new paradigms is at the heart of innovation. He stated that paradigm shifts were the most profound changes that occur in the world (Barker, 1992). He defines a paradigm shift as a new approach to a process or system that does two things: (1) defines the boundaries; and (2) helps in solving problems. Paradigms can be in very common areas (like washing dishes) to complex ones (changes in governments). These can occur in a multitude of major areas e.g., technological, social, environmental, economic, political etc. (Ibid).

Some major paradigm shifts that have occurred in the past 40 years include: the shift from vacuum tubes to solid-state electronics and then to integrated circuits; mechanical (Swiss) watches to Quartz Crystal (Japanese) Watches, Birth of the Internet, and the advent of both cell phones and the Iphone; Rachel Carson was cited by him, as well as the Fall of the Soviet Union (Barker, 1992). Carson’s book *Silent Spring* created a paradigm shift and triggered the environmental movement (Carson, 1962). In the quest for new innovation, Barker advanced his famous “Impossibility Question” to be asked to all employees in a firm that are involved with a process or new product i.e. “What is impossible to do today, but if it could be done would result in a fundamentally change your organization for the better?” (Barker, 1993).

For an innovation to take place, two protagonists are needed – the paradigm shifter and the paradigm pioneer. In paradigm parlance the shifter is the inventor of the new device or processes. A good example of this was Wernher Von Braun. He was instrumental in Germany’s V-2 rocket success in World War II. After the war he was recruited by the United States and moved to Redstone Arsenal in Huntsville, Alabama (Neufeld, 2007). He was then appointed the Director of Development Operations in the newly created Army Ballistic Missile Agency (ABMA). In that role he was instrumental in developing the innovations in technology that would be used in the US Space Program that became prominent in the 1960s. He and his ABMA team were transferred to NASA in the new NASA Marshall Space Center in Huntsville in 1958. As Director, he pioneered the development of the SATURN V rockets to carry heavy payloads into space. These were used along with other of his ground-breaking innovations (e.g., the lunar orbit rendezvous concept) to enable six teams of astronauts to reach the surface of the moon later in the decade (Ward, 2005)).

Barker’s paradigm pioneer is the person that sees that the paradigm is shifting and puts all their resources and personal attention into commercializing the shift. A good example of the latter is Bill Gates. When the computer world was shifting from mainframes (the old paradigm) to smaller computer servers, Gates was able to recognize the fundamental shift and devote all his attention and resources to help bring the new computer world into being with DOS and Windows (Barker, 1993). Other recent paradigm pioneers include Elon Musk (in Electric Vehicles) and a person we will discuss in some detail later in this paper- Edward Whitacre.

The late Clayton Christensen was the Kim B. Clark Professor at Harvard Business School, the author of seven books, a five-time recipient of the McKinsey Award for Harvard Business Review's best article, and the cofounder of four companies, including the innovation consulting firm Innosight (Google Book Review, 2011). Also, in 2011 he published the now classic book on Innovation entitled *The Innovator’s Dilemma* (Christensen, 2011). In 2011 he was named the world's most influential business thinker in a bi-annual ranking conducted by Thinkers50- the Oscars of Management Thought (Thinkers50, 2021). Professor Christensen introduced the now famous “Theory of Disruptive Innovation” in 2015. (MIT Sloan Management Review, Spring 2015). Focusing on “disruptive

technology,” Christensen showed why most companies miss out on new waves of innovation. Whether in electronics or retailing, a successful company with established products will get pushed aside unless managers know when to abandon traditional business practices. Using the lessons of successes and failures from leading companies, *The Innovator’s Dilemma* presents a set of rules for capitalizing on the phenomenon of disruptive innovation. In this revolutionary bestseller, innovation expert Clayton M. Christensen says outstanding companies can do everything right and still lose their market leadership—or worse, disappear altogether. And not only does he prove what he says, but he tells others how to avoid a similar fate (Ibid). Numerous examples of disruptive technologies have been identified by Christensen and other researchers. These include the transition from vacuum tubes to solid state electronics in the 1960s, Toyota’s entry into the North American car market in the 1980s, and later Kodak’s loss of the camera market, and Amazon creating a Kindle to spur the sale of books by moving to electronic delivery from paper copy. It should be noted that there is a close relationship between the terms of disruptive technology and paradigm shifts. In reality a disruptive technology normally enables a paradigm shift to create a new product. As previously mentioned, paradigm shifts are a more general term that also embraces changes in process, systems and/or broader issues.

Modern textbooks used in MBA programs normally have an entire chapter on innovation. In that chapter they discuss several key concepts that have become central to the study of innovation. First, they draw a distinction between inventions and innovation. Specifically, inventions are the creation of new products while innovation is the inventions and then commercialization of these new products i.e., inventions by themselves are valuable, but unless they can be made useful by society they do not qualify as innovations. Secondly, entrepreneurs are individuals who create new innovations outside of established firms, while intrapreneurs create innovations within firms. Entrepreneurs normally do so by raising money from friends and family and using that capital to invent something new, often a new prototype. However, to be able to scale up to make more improved products and to market their invention, they need capital. This is normally obtained from Venture Capitalists (the VCs) who are looking to invest their money into a promising venture. It is at this point that it becomes an innovation if it becomes commercially viable. In the case of a successful product, the original investors then often employ an Investment Bank to do an Initial Public Offering (IPO) that results in a new business that allows the Inventor, VCs and/or other investors to recover their investment by cashing out of the venture (Hitt, Ireland, and Hoskisson, 2019).

In the case of innovations that are created within the firm, that process is called Internal Corporate Venturing. There are two major ways that this can occur- in a strategic context or in a structural context. In the first case, the firm resorts to autonomous strategic behavior. This occurs in firms that encourage their employees to innovate on their own, but do not directly support a specific innovation that is occurring in their firm or are even aware of the activity going on to create it (Ibid). An example was in INTEL in the early 80s. At the time the lead author of this paper was in the Pentagon on the Army Staff when INTEL was lobbying DOD for support in their chip manufacturing. Japanese firms were then receiving generous governmental support in their chip manufacture process, creating a less than level playing field. They were then able to cut prices and dump RAM, DRAM and ROM chips in the United States. INTEL purported to the Pentagon that if this continued, they would soon be forced out of the chip making business. They claimed the upshot would be that the United States would then become totally dependent on off-shore chips for its many weapons, communications, and other Defense mission essential systems. The Reagan Administration did not support INTEL’s views and they were left on their own to figure out a way to survive. Fortunately, they had in their firm some intrapreneurial scientists in their organic R&D organization who had just invented processor chips. The timing was perfect for INTEL to make a strategic shift from memory chips to processor chips. Thus, their chips found a home in the first personal computers (PCs) - the famous X286 chip. As PCs in the early 1980s were in their embryonic stage, it did not produce much revenue at first. However, when PCs exploded on the scene, these chips (along with follow-on X386, X486, Pentiums etc.) became the major revenue source for INTEL and a boon to the Defense Department and the country.

The second way firms can stimulate innovation is by a structural context called induced strategic

behavior. In this way a firm plays an active role by providing funds to a specific R&D sub-organization within the firm. This is often called a “Skunk Works” (Rich and Janos, 1994). The scientists and engineers then are fully employed in using these funds to wisely create a new product. Two good examples of this were the creation of the Stealth Fighter (SR-71) and the Arpanet. In 1975, engineers at Lockheed Skunk Works found that an aircraft made with faceted surfaces could have a very low radar signature because the surfaces would radiate almost all of the radar energy away from the receiver (Ibid). In the case of the ARPANET, it was the forerunner of the modern-day INTERNET (Abbate, 2000). The ARPANET was effectively a “Skunk Works” in the Department of Defense’s (DOD) Defense Advanced Research Projects Agency (DARPA). DARPA was established by President Eisenhower in 1958 in response to the Soviet launching of Sputnik 1 in 1957. By collaborating with academia, industry, and government partners, DARPA was tasked to formulate and execute research and development projects to expand the frontiers of technology and science, often beyond immediate U.S. military requirements (Eisenhower, 2008). The ARPANET was conceived by DARPA in the 1960s when packet-switching first became available. In 1990, the ARPANET was decommissioned and its technology went mainstream into the commercial world (DARPA, Wikipedia). Tim Berners-Lee and his colleagues at CERN developed hypertext markup language (HTML) and the uniform resource locator (URL), giving birth to the first incarnation of the World Wide Web (Berners-Lee, 2010).

The research cited above illustrate examples of where much of the innovation was coming from in the United States in the post-World War II period (1945- 1983). The lead author of this paper spent over 30 years in the telecommunications industry (as an engineer, principal scientist, and with his last two assignments as the Chief Engineer of the Defense Communications Agency and later as Vice President of Systems Technology at Pacific Bell. In his many roles he had first-hand knowledge of the major innovations (and also failures of innovation) in the telecommunications industry. He was intimately aware of the following: AT&T had Bell Labs; RCA had the RCA Sarnoff Labs; IBM had IBM Labs; Xerox had Xerox Palo Alto Research Center (PARC); and INTEL had the scientific intrapreneurs in their organic R&D arm. In the same post-World War II timeframe most of the major firms mentioned were being run by CEOs and Executives who were primarily strategic managers and not closely involved with innovation. As a result, innovation was often overlooked and stagnated. Two classic examples of this lack of foresight and resulting failure to support innovation were:

- a. AT&T- Bell Labs led the world each year in the number of filed patents throughout much of the 1960s and 1970s. However, the AT&T CEOs and top management allowed very few of these to go into production. As AT&T had a “natural monopoly” at the time and were making good profits, they did not have the incentive to see much change in telecommunications. At the time we all found humorous that there were consumer outcries to replace the black phone on the wall in our homes in the 1960s. Finally, AT&T gave in and gave us what- a white phone!!! Years later when deregulation broke up the stranglehold that AT&T had on telecom, there were a variety of new phones e.g., different colors, Princess Phones etc. Such a lack of innovation led to huge consequences with AT&T’s subsequent demise. Congress intervened by deregulating telecommunications in the “Great Divestiture of 1984”. This was a seismic event in the telecommunications industry. As a giant U.S., corporation, AT&T was at the top of the Fortune 500 list of U.S. corporations before the breakup. After the divestiture, AT&T was carved up into primarily seven Baby Bells and AT&T Long-Lines (with the R&D arm “Bellcore” replacing Bell Labs). All eight of these firms were still ranked in the top 50 of the Forbes Fortune 500 largest US corporations (Coll, 1986), a testament to the impact of this huge economic event (Coll, 1986).
- b. Xerox- Another well-known example of retarded innovation occurred in the 1970s at Xerox. Xerox PARC had developed many of the innovations that would one day fire the Internet Revolution e.g., the mouse, the first Graphical User Interface, the Laser Printer and Ethernet to name just a few. When these were presented to the Xerox top management and Board of Directors, inventions such as the mouse were rejected for production. When the outsider Steve

Jobs contacted Xerox top management and asked permission to experiment with several of these innovations, Xerox management foolishly acceded to his requests. The PARC scientists and engineers were totally flummoxed. The result gave Jobs at Apple a running head-start as he copied much of Xerox's innovative work in his first computers and systems. (Pirates of Silicon Valley, wikipedia.org).

3. INNOVATION AND DEREGULATION

The Great Divestiture of AT&T in the 1980s had further, major world-wide impact. Most foreign industrialized countries had over the years copied the United States' approach to telecommunication. Each of these countries had one major telecommunications firm that provided telephone and other communications service for internal communications e.g., British Telecom in England, French Telecom in France, Nippon in Japan, Deutsche Bundespost in Germany etc. Virtually all deplored the break-up of the sacred AT&T and expressed grave reservations about the eventual consequences of the chaos that would be wrought. Most were later amazed when the deregulation of AT&T worked. For starters many of the scientists and engineers who had been stymied in operationalizing their patents were motivated to shortly depart their previously parent organizations and start their own major firms e.g., Larry Ellison left Ampex and started ORACLE; five previous IBM engineers founded SAP; Jack Shemer from Xerox helped found TERADATA etc.

In the 1980s and 1990s deregulation occurred in virtually most of the major industries in the United States. This included deregulation in such major industries as telecommunications, finance, banking, the airlines, railroads, natural gas and trucking. When major innovations began to appear in all these industries, the major industrialized countries that had been critical of deregulation soon followed suit. (Wilson, 1998). The rapid acceleration of innovation, especially in the industries dependent on technology, appear to have benefited from deregulation. In support of the major thesis of this paper, innovation appears to have been assisted greatly and may have been a virtual byproduct of deregulation. Many highly qualified and motivated engineers and scientists were released into the marketplace where they founded numerous start-ups and new firms. Heretofore, such innovation brainpower had not been present in the US economy. Working with major technological universities such as MIT and the California Institute of Technology, these newly released scientists and engineers inspired an entire new crop of entrepreneurs to join in and participate in the innovation revolution.

An excellent snapshot of innovation today in the United States today was created by Forbes Magazine. It was a listing of the top fifty innovators listed with their industry. Updated in 2019 (Forbes, 2019) the list provides the following information:

- a. The top ten CEOs and Executives who have been recently active in innovation in their firms is quite insightful. In order they are: Jeff Bezos at #1 (Amazon); Elon Musk (Tesla); Mark Zuckerberg (Facebook); Reed Hastings (Netflix); Sataya Nadella (Microsoft); Shantanu Naragen (Adobe); Tim Cook (Apple); Larry Page and Sergey Brin (Alphabet/Google). Note that most firms here are technological in nature.
- b. Well over 25 of the top 50 CEOs were from firms that also made their mark in technology and are very active in innovation. A partial listing of these firms is Intuit, Boston Scientific, BioMarin Pharmaceutical, Abbott Laboratories, NVIDIA, Medtronic, Texas Instruments, Electronic Arts, Stryker, Electronic Arts, Activision Blizzard, AbbVie Inc., Lab Corp, Education Lifesciences, and Henry Schein (Ibid).

4. MODERN DAY INNOVATORS

This section discusses the careers of several recent innovative CEOs who made major contributions to their industries with their innovations. These three major CEOs epitomize some of the best in the successful harnessing of innovation and are discussed in some detail: The are in order: Steve Jobs (computers and other related fields), Edward Whitacre (Telecommunications) and E. Hunter Harrison

(Railroads).

Steve Jobs- Steve Jobs is probably the best known of the three modern day executive innovators. He co-founded Apple Computer in 1976 with his partner Steve Wozniak. As new start-up entrepreneurs, they succeeded in building a successful firm with innovations such as the Apple 1, Apple 2, and Macintosh computers (Isaacson, 2011). He resigned in 1985 and next founded a second successful computer company- NeXT Computer. NeXT computers were used by several computer innovators such as Tim Berners Lee. Berners Lee used a NEXt operating system to invent Web Sites in 1994. Web Sites was one of the most important innovations that triggered the Internet Revolution in the late 1990s (Berners Lee, 2010).

Jobs returned to rescue a foundering, near bankrupt Apple in 1997. From 1997 to 2011 he was prolific in making major strides with very significant innovations. Just mentioning a few includes the following: primary inventor or co-inventor of 346 United States patents or patent applications related to a range of technologies; various computers, operating systems, portable devices to user interfaces, speakers, keyboards, power adapters, staircases, clasps, sleeves, lanyards and packages. He also initiated a "Think different" advertising campaign which led to the Apple Store, App Store, iMac, iPad, iPod, iPhone, iTunes, and iTunes Stores. In 2001, the original Mac OS was replaced with a completely new Mac OS X (now known as the MacOS). This was based on NeXT's NeXTSTEP platform, giving the new Operating System a modern Unix-based foundation for the first time. What was significant in virtually all of this innovation is that Jobs used his CEO position to directly involve himself with all aspects of innovation which included product design, production, and creative marketing (Isaacson, 2011).

Edward Whitacre- Ed Whitacre completely revamped U.S. telecommunications with dramatic, innovative initiatives that transformed a deregulated industry into a completely new model. His technological innovations were a major part of this transformation. Whitacre was a seasoned veteran in AT&T when the Telecommunications Reform Act of 1984 was passed. As mentioned, this Act completely ended the century-old monopoly of AT&T, also known as "Ma Bell". In 1988 Whitacre became the CEO of Southwestern Bell (SWB) in Texas. SWB was one of the seven "Baby Bells" that the Telecomm Act had created from the former AT&T. They were given a temporary monopoly for short-range communications in the Southwestern part of the United States e.g., Texas and Oklahoma. The other Baby Bells were Pacific Bell (California and Nevada), NYNEX (Northeastern US), Bell Atlantic (in middle US Eastern States), Bell South, Ameritech (Mid-West) and US West. The remainder of the old AT&T was renamed AT&T Long Lines and had retained the long-distance communications links that tied the entire nation-wide system together. Subsequent to the break-up, the government had advised that a second round of deregulation would be forthcoming that would remove the monopolies from the Baby Bells over short-range communications (Wilson, 1998).

Pacific Bell decided to get ahead of the power curve on this next projected government deregulation action. In 1995 California was the biggest state in the union and economically the seventh largest economy in the world. It is now the 5th largest economy today just behind Germany (<https://en.wikipedia.org>> Economy of California). The strategists at Pacific Bell decided to take a series of actions in the early 1990s to ensure that they could compete with other telecommunications firms that might be attempting to take market share from them in California. As the technological environment was shifting rapidly from analog to digital, PacBell decided to commit over \$3 billion to: (a) digitize their telecom infrastructure i.e., replacing the copper wires in the ground with fiber optics; and (b) digitize their old analog switches and other central office equipment with digital technology. Unfortunately, the large expenditures hit Pac Bell's capital financial structure much harder than they had anticipated. It was an existential moment for PacBell and it was deemed essential to downsize the firm from some 160,000 workers to approximately 55,000 employees. This was done in three successive downsizing waves in the 1992-1994 timeframe and seriously impaired PacBell's operations. It was at this point that Ed Whitacre came calling. Enjoying a huge capital war chest at SWB, he proposed a merger between PacBell with his SWB firm. Having the had the upper hand with ample capital, Whitacre adroitly had succeeded in transforming this merger into a successful acquisition. When the

smoke cleared in 1997 there was only one CEO (Whitacre) left, all three PacBell Executive VPs had been removed and twenty-two of the previously twenty-four PacBell Vice Presidents were gone (the lead author of this paper included). In addition, Whitacre retained some of the best engineers and information systems engineering personnel in the now defunct PacBell. As an example, Ross Ireland had always been recognized as the top communications Engineer in the country and was one of the VPs who was retained. Whitacre had successfully engineered a successful take-over of PacBell and had California securely under his telecom control (Whitacre, 2013).

Thereafter, Whitacre used this successful innovative formula to enlarge his telecommunications empire. In 1998 he acquired Southern New England Telephone (SNET), followed in 1999 by Baby Bell Ameritech and then Comcast. It took him a few years to digest all of these acquisitions, but he then moved decisively in the mid 2000s with the same formula to acquire both large Bell South and Cingular Wireless. In 2005 he put the cherry on the top by acquiring the remaining piece he needed - AT&T Long Lines. He renamed the new company "AT&T", thereby being able to recapture the goodwill that "Ma Bell" had long enjoyed. His new AT&T was now the largest telecommunications company in the world. It also was the largest provider of mobile telephone services in the U.S. As of 2020, AT&T was back to being ranked 9th on the Fortune 500 rankings of the largest United States corporations (<https://fortune.com/fortune500/2020/>).

Whitacre employed innovation in the way he brilliantly assembled AT&T. He also demonstrated technological innovation by systematically acquiring the best available technological talent in the telecommunications industry and harnessing it effectively throughout his newly created telecom empire. Led by the best engineers and some of the best IT personnel in the country, he was able to gain access to the best technical ideas in the industry. He took a personal interest in many of the technological issues at the time and adroitly worked with and empowered this talent to innovate many new and creative telecom solutions to propel AT&T to the top of his industry (Whitacre, 2013).

Whitacre's actions did not go unnoticed in the industry. When he had started his acquisitions in 1996, the "Baby Bell" Bell Atlantic was watching his every move and began to copy his strategic initiatives and formula. Bell Atlantic acquired NYNEX in the late 1990s, followed up by GTE, TracFone Wireless and some other firms. They renamed their firm Verizon in 2000. Thus, the old AT&T had been restructured in sixteen years into two telecom giants- AT&T and Verizon. Whitacre had to appear before a Congressional committee in 2007, but with two huge firms to compete, as well as a number of smaller firms (e.g., US West which had morphed into Quest), apparently the goals of the government to deregulate telecommunications were satisfied. Along the way Whitacre had outwitted a large number of very smart telecommunications executives to achieve his goal of getting as close to domination in the industry as the country would allow. His actions were reminiscent of Rockefeller (Standard Oil) and the other titans of industry in the late 1890s (Carnegie in Steel; Vanderbilt in Railroads) putting together monopolies, soon to be broken up by Teddy Roosevelt and governmental actions (Ibid)

E. Hunter Harrison- E. Hunter Harrison started work as an oil man and safety inspector in a St. Louis-San Francisco (Frisco) Railway yard. He was later promoted to railroad operator at Frisco, and moved consistently up in the railroad business. He was promoted within Burlington Northern after they purchased Frisco. Harrison was promoted eighteen times in his first decade with Frisco, proving his passion for the job. He learned early in his career that financial performance could be improved in railroads by adding cars to a train, driving trains faster, and eliminating unneeded stops. At one point early on as a laborer, he was stopped by a third-generation railroad worker managing a key terminal. It was operating at full capacity, but the manager wanted more. Harrison, through his unique viewpoints, saw enough capacity, but advised the terminal manager that the cars weren't being loaded rapidly enough. He showed how this could be achieved, opening extra capacity up immediately (Green, 2018).

Harrison had a knack for understanding the intricacies of railroad operations and developing efficient procedures. As current Canadian Pacific CEO and a former colleague of Harrison at Illinois Central, Keith Kreeel pointed out that Harrison's approach was "so simple and so common sense based, they were brilliant. He understood the nuts and bolts of the business well enough to go against the status quo. He was swimming against the stream. Everyone said what he was doing was wrong and

to go forward required a whole lot of risks" (Schleier, 2018}. Kreeel noted that Harrison proved throughout his career that swimming against the stream was the right way to make a railway company run more efficiently and increase financial performance (Ibid).

Harrison didn't spend long in the yards, but joked later in life that he learned more there about railroading in those brief years than he ever did in his 50 years of management. Often crediting rail workers with understanding the operations of a railway company more than anyone else, he often leaned on his early experiences when building his precision scheduled railroading platform. That was where he learned how yards direct lines. Over the years, he built out his precision railroading system concepts based on these insights. Although eventually promoted up to Vice President of Transportation, Harrison left Burlington Northern in 1989 to join Illinois Central (IC). He worked in multiple executive positions until being named CEO in 1993, staying in the position until 1998. When Harrison joined as Chief Transportation Officer at IC, their operating ratio was 98%, or in layman's terms, it cost IC 98 cents to make a dollar. By the time Harrison left IC and it was purchased by Canadian National, Harrison had dropped their operating ratio to 62.3%. Later at Canadian Pacific, he entered with operating ratios at 80%. By the time he left the company in 2016, their operating ratio was at an extraordinary 58.6%. Nobody in the rail industry had such a positive effect on rail companies since the rail systems had been modernized around the turn of the century (Ibid).

At every step in his work, he deciphered how inefficient operations could slow trains to a crawl, and then the quickest way to get product to the customer. Harrison ran into opposition from customers, unions (and seemingly everyone in between) as he worked to change how his railways operated. Although his operational model dramatically improved a railways financial performance, it didn't often sit well with customers who were often opposed to the way he operated. Early in Harrison's career, customers controlled the railways because trucking offered them a cheap alternative and customized scheduling. Trains then didn't have scheduling, so customers had no idea when their orders would arrive at the destination. Rail companies kept rates low to compensate and keep their clients. Harrison didn't agree with that model and changed it quickly with every company he took over, even if it meant losing customers in the short-term. While at Illinois Central (IC), he met with a customer worth around \$100 million a year in business, or about 17% of its total revenue. The customer believed prices were high and demanded a steep cut in prices, arguing that rail service was a commodity. Harrison reacted by simply packing up his briefcase and walking out of the meeting. Harrison lost the customer. However, two years later the customer begged to come back after it had tankers sitting on a siding for over three months that their new rail company was unable to move. To describe his leadership to others during these bumps, he said he simply led from the pulpit. He knew what was right for the railways and what would be most efficient and cost effective for the customers in the end. Although often vilified for his harsh leadership tactics and crass treatment of railway employees and customers spanning his four stints as CEO, he was also one of the most celebrated CEOs for the stunning turnarounds he performed. He was named Railroader of the Year, the industry's most prestigious award, in 2002 and 2015 by *Railway Age*, CEO of the year by *Globe and Mail* in 2007, Railroad Innovator of the year in 2009 by *Progressive Railroading*, CEO of the Year by *Morningstar* in 2013, Executive of the Year by *Supply Chain Dive* in 2017, and many others. He was actively recruited by investors before joining his last two railways, as they understood what Harrison's leadership and operational innovation could mean to the companies in which they had a large stake. When his name was merely announced by a CSX investor stating he wanted Harrison to join the company, stock price soared over 20% in a single day. CSX later put together a \$300 million package to bring him onboard (Ibid).

One of the biggest aspects of Harrison's success, as arguably the leading railroad pioneer of the last century, is that he didn't just drive change, he drove foundational innovation that changed the course of large companies. Any effective CEO could have taken the reins of these railroads and cut costs through worker reductions and making train operations more efficient through longer trains and better scheduling. Harrison's model is considered innovative not just because he made such changes, but because he also changed the core way the railways transported goods using his PSR railroading model.

He was shrewd enough in the process to drive the type of change in the firm's culture to support all his efforts. Since the modern railway was first built, companies had employed the traditional hub-and-spoke model to transport goods. Although a solid model for decades, Harrison believed it: (a) caused multi-day delays to shipping goods to the customers; (b) led to over-busy and inefficient large rail yards that companies spent billions to make more efficient and (c) operated on a model that other industries had already proved could be improved. As another innovator (Herb Kelleher) had proved at Southwest Airlines, a point-to-point system could not only work, but it could be extremely profitable. Harrison used this point-to-point model as a basis for the innovation he led across four major railroad companies. The system was so proven that CSX continued its implementation after Harrison's death. Union Pacific Railroad has since followed suit, hoping to recognize the same benefits that Harrison's previous companies did enjoy (Schleier, 2018).

5. CONCLUSIONS

A comprehensive review over the past 125 years reveals that participation by CEOs and Executives in innovation has varied greatly. In the early 1900s executives were very active. However, as the 20th century progressed, executive activity in innovation dwindled significantly. This was evident as the larger firms employed major R&D subordinate organizations such as internal laboratories, Skunk Works and intrapreneurs. However, more recently there are numerous examples of CEOs and other executives that have been much more involved in the innovation process. Steve Jobs, Edward Whitacre, and E. Hunter Harrison were cited in some detail, but the list also includes many familiar names such as Sundar Pichai (Google/Alphabet); Jeff Bezos (Amazon) and Elon Musk (Tesla). In fact, there are many examples today of CEOs that are much more engaged in the innovation process. In short, CEO/Executive innovation today seems to have been resurrected in many different industries.

As innovation is vital to the growth of American industry, it should not be left entirely to intrapreneurs, entrepreneurs, internal R&D organizations, new start-ups and acquisitions. Executives need to play a more decisive role. In the future criteria for selecting CEOs could include how well they delivered innovation in their past industries and executive assignments, as well as how they intend to promote innovation in their new roles.

6. RECOMMENDATIONS

Due to the diversity of industries, CEO/Executive innovation can take different forms. It should not be limited to just technological innovations, but needs to be expanded to include innovations in such functional areas as marketing, operations, procurement, R&D etc. For example, Whitacre's innovations showed how innovation can be accomplished in the area of organizational structuring and design. In any event, future research could also be taken in innovation to specifically determine how CEOs and Executives can best foster innovation in their respective industries.

Also, techniques such as data analytics would be useful in performing future research in innovation. A data analytics study could be set up to employ text mining and use a data-centric (versus a problem centric) methodology. Machine learning algorithms could then be used to convert unstructured data into structured data using natural language processing (NLP). This technique is useful for identifying themes, as well as theory building and modeling. Such a study could identify a variety of themes such as (a) definitive evidence of how much CEO and Executive participation in innovation ebbed and then flowed over the past 125 years; (b) exactly what constructs are driving the recent upsurge in increased CEO and Executive innovation; and (c) how increased innovation by CEOs and Executives could pay dividends in other functional areas of business besides technology.

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