

Innovation Lessons: Implications of Nikola Tesla's Life for Today's Engineers, Scientists, and Technology Designers

Maximus Schmorrow¹ and Dylan Schmorrow²(✉)

¹ Cunningham Park Elementary School, Vienna, VA, USA
maxschmorrow@gmail.com

² Soar Technology Inc., Ann Arbor, MI, USA
dylan.schmorrow@soartech.com

Abstract. Nikola Tesla was one of the greatest inventors of all time. His life was full of interesting twists and turns. He is most famous for inventing the Alternating Current motor, Tesla Coil, and the Bladeless Turbine, to name a few. Other inventors inspired him, such as, Thomas Edison and George Westinghouse. His trust in the people that inspired him eventually impacted him negatively. Nikola Tesla made mind-blowing discoveries and inventions that are still used today. His first break-through was creating a rotating magnetic field to make an Alternating Current without having to use a commutator. He also invented the Tesla Coil, which was able to produce a high voltage of electricity for transporting the electricity farther distances. These coils can be seen at the tops of electrical poles that hold electrical wires and cables sometimes for miles. Tesla's final invention was the bladeless turbine, able to produce energy using fluids, gases and centripetal force. His most popular invention was the Alternating Current motor, which did not use a dynamo or a commutator, but the rotating magnetic field. This would prove to be one of Tesla's greatest contributions. This paper examines the life of Nikola Tesla and document the ups and downs he faced while becoming one of the greatest inventors of all times. Although there have been many attempts to extract ubiquitous lessons learned from his life, this paper is unique in it's international focus (i.e., impact on North American innovation from European thought leadership) and serves as a mechanism for discussing the implications for HCI (i.e., process, design and social interactions). It also provides specific innovation lessons from his life and provides a summary of the implications of these lessons for 21st century engineers, scientists and technology designers.

Keywords: Innovation · Engineers · Scientists · Tesla · Invention · Discovery · Inventors · Lessons learned · HCI · Systems design · Technology · Designers · Implications

1 Introduction

Nikola Tesla was one of the greatest inventors of all time [1]. His life was full of interesting twists and turns. He is most famous for inventing the Alternating Current motor, Tesla Coil, and the Bladeless Turbine, to name a few [2–5]. Other inventors

inspired him, such as, Thomas Edison and George Westinghouse. His trust in the people that inspired him eventually impacted him negatively [6].

Nikola Tesla was born on July 10, 1856 in a small town called Smiljan where Croatia is located today. His father, Milutin, was a minister and his mother, Djouka, stayed on the farm selling products they made and grew. When Tesla was a young boy, he caught Cholera and spent his time reading his father's Mark Twain novels. Nikola had four siblings: Dane (Dah-nay), Angelina, Milka, and Marica. Dane was their parent's pride and joy, until he was thrown off their horse and passed because of the injuries. Nikola couldn't make or build anything without his parents mourning over Dane's passing. This made him want to become an inventor so his parents would be proud [7].

In 1875, Nikola Tesla enrolled in the Polytechnic Institute located in Graz, Austria. He was planning on to be a mathematics professor, so he studied arithmetic, geometry, calculus, theoretical and experimental physics, analytical chemistry, mineralogy, machinery construction, botany, wave theory, optics, French, and English. Nikola studied more than twenty hours a day and changed his major to engineering. After he returned from school, his father urged him not to go a second year because of his unhealthy study habits. He went back for a second year, and a Gramme dynamo, patented by a Belgian engineer, was sent to his physics class. Tesla suspected that the dynamo could work without a commutator, but his physics teacher proved him wrong and for the rest of the class explained how impossible that is. This triggered a spark that made Tesla determined to prove his professor wrong [8].

For four years Tesla tried to create alternating current without a dynamo or a commutator. During that time, his friend Anthony Szigeti was hired as Tesla's assistant. Anthony was a former classmate and good friend of Nikola. They would go on walks, thinking of ways to design the alternating current motor. On one walk Nikola froze with the answer to the question. As Szigeti helped him down to a bench, Tesla explained how the motor worked with a rotating magnetic field. Since constantly rotating, it was able to alternate without a commutator. While Tesla had all the information, he needed to get the money to do it [1].

The first person Tesla went to was Thomas Edison. Tesla and Edison entered a deal that Tesla agreed to fix all Edison's electrical issues he had and perfect the light bulb, for fifty thousand dollars. After a year, Tesla came back with all the electrical issues gone and the light bulb perfected. When he asked Edison for payment as agreed, Edison was shocked, and all he said was, "You don't understand our American humor." Tesla was angry and quit even though Edison offered him a raise to stay [9]. Soon after, Nikola Tesla met Alfred Brown and they created a company called Tesla Electric Company, where Brown provided Tesla with a lab to work in. In this lab, they were able to develop many of the inventions that Tesla is known for to include the Tesla Coil and the Alternating Current Motor [9].

2 Inventions and Challenges

Nikola Tesla made mind-blowing discoveries and inventions that are still used today. His first break-through was creating a rotating magnetic field to make an Alternating Current without having to use a commutator [4]. He also invented the Tesla Coil, which

was able to produce a high voltage of electricity for transporting the electricity farther distances. These coils can be seen at the tops of electrical poles that hold electrical wires and cables sometimes for miles. Tesla's final invention was the bladeless turbine, able to produce energy using fluids, gases and centripetal force. His most popular invention was the Alternating Current motor, which did not use a dynamo or a commutator, but the rotating magnetic field. This would prove to be one of Tesla's greatest contributions [4]. Alternating Current and Direct Current had many differences though. Direct Current is a way of transporting electricity that can only flow one direction and it's voltage can not be changed. Alternating Current is the natural flow of electricity and can change the amount of voltage it is transporting. Alternating Current is more efficient because it can transport electricity for further distances and doesn't need a power plant every mile [1].

Nikola Tesla led a life full of ups and downs. On one hand, he was famous for his inventions and his discoveries and was able to work alongside many other world famous inventors. On the other hand, he did not make wise business decisions. For example, he did not enter into a written contract with Thomas Edison. Edison ended up cheating him out of payment that they had verbally agreed to. Also, George Westinghouse took advantage of Tesla by taking ownership of Tesla's many patents and inventions. Although, Tesla was brilliant and famous due to all the discoveries he made, Nikola died on January 8, 1943 penniless and alone. He deserves more recognition for his scientific contributions to our world [1, 6, 8, 9].

3 Innovation Lessons and Implications for HCI

Although there have been many attempts to extract ubiquitous lessons learned from his life, Barbara Eldredge summarizes these succinctly in five general lessons [10]. Her lessons included: (1) when someone tells you it can't be done, do it anyway; (2) take risks, they always make you stronger; (3) learn from failure, success will follow; (4) don't stop, use past achievement to propel future progress; (5) time can always turn crazy ideas into genius innovations. However, other innovation lessons can be derived from examining Nikola Tesla's life. John Buescher examined innovation and technology in the 19th century [11] and identified two key technological innovations that profoundly altered life in Europe. They were steam and electricity. These technological innovations dramatically expanded the power of humans and animal strength as well as simple tools. Much of the foundational thinking that led to these innovations originated in Europe and subsequently had a profound impact on the rapid growth in North American. In many ways Nikola Tesla's on life story showcases the impact on North American innovation from European thought leadership. In the 21st century many still see the profound impact of European thinking on North American innovation. A current example is the European Commission's 2020 Initiative, Digital Agenda for Europe. In this example policies focused on the socio-economic impact of open innovation is helping promote long-term sustainability as well as creating new products and services [12]. Thought leadership in Europe not only has a direct impact on the European economy and society, but it also impacts North American innovation profoundly in a similar way Nikola Tesla's efforts impacted North America.

4 Conclusion

In this paper, we advocate that Nikola Tesla was one of the greatest inventors of all time. We also suggest that his trust in the people that inspired him eventually impacted him negatively. However, he made mind-blowing discoveries and inventions that are still used today and his innovations transformed North America. There are many lessons to be derived by examining the life of Nikola Tesla. There are lessons for the individual innovator and there are lessons that help foster an understanding of the role of European thought leadership on North American innovation. Understanding the implications of these lessons benefit 21st century engineers, scientists and technology designers. The story of Nikola Tesla's life provides a role model innovator to model oneself on as well as providing an example of how thinking on one continent can impact innovation on another continent.

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