



Elon Musk

Tesla, SpaceX, and the Quest for a Fantastic Future

By Ashlee Vance

Will the human race colonize Mars? Will we drive high-performance electric cars that cost nothing to get recharged? Will we cross the ocean in autos that double as submarines? Will we hurtle through tubes in 800 mph train pods?

You might think this is crazy talk. But Elon Musk doesn't. In fact, he'd probably claim he's on the way to achieving some of these dreams. True or not, in the first 45 years of his life he's created one of the most remarkable, visionary and entrepreneurial stories of all time.

Every step of the way, he's courted controversy, staring bankruptcy and other disasters in the face, claiming credit for successes that others have said belongs to them, and antagonizing many of the people he has depended on, including colleagues, employees, family and financiers.

Yet his achievements to date have been little short of breathtaking. He's become one of the richest men on earth, yet he says he's prepared to risk every cent of his wealth in pursuit of his dreams.

And, as a measure of interest in him, Ashlee Vance's book is already at least the fifth Musk biography. What makes Vance's book different from its predecessors is that, for the first time, it's written with Musk's cooperation, despite the author's refusal to allow Musk to review and edit it before publication.

Employing painstaking research that included detailed interviews with scores of Musk's allies and detractors Vance, a *Businessweek* and *Bloomberg* journalist, has produced a riveting warts-and-all account of the ever-changing Musk story.

Like Musk, Vance is also from South Africa, which is where the story begins...

Out Of Africa

Musk comes from pioneering Canadian and South African stock. His mother's parents were the Canadians, a family of adventurers who left North America in search of excitement and new experiences on the southern cape.

Musk often expresses affinity with them, though he actually lived much of his youth with his father after his parents divorced. His father, Errol Musk, was a tough and demanding parent who had very high expectations of Elon and his brother Kimbal.

Dark and difficult times are hinted at in the book, without being fully revealed. Coupled with years of bullying at school, Musk's early notion that the world was a cruel place was constantly reinforced, says Vance.

"It would certainly be accurate to say that I did not have a good childhood," Musk admitted.

He had an insatiable appetite for learning, which fed a photographic memory. He was an obsessive reader and earned a reputation for grasping ideas much faster than his peers.

He also had a unique characteristic that has remained to this day - the ability to escape into a trance in which he can cut himself off from his surroundings and focus intensely.

"Part of this ability stemmed from the very visual way in which Musk's mind worked," says Vance. "He could see images in his mind's eye with a clarity and detail that we might associate today with an engineering drawing produced by computer software."

At 17, he ran away to Canada, spending the next year bed-surfing with distant family members and working odd jobs, before enrolling in Queen's University in Ontario to study commerce. He was joined there by Kimbal.

There, some of his big ideas and characteristic traits began to emerge. He told a girlfriend he spent a lot of time thinking about electric cars and he wished there was a way he didn't have to waste time eating.

And his striving for perfection, which dominates his management style today, had already surfaced when he protested a 98% score his tutor had awarded him for a college paper. He backed up his case with evidence and the hapless tutor upped his score to 100%.

But he was restless in Canada, and decided to fulfill an ambition to live and work in the United States by transferring to the University of Pennsylvania to study physics. It was there that he wrote a paper entitled "The Importance of Being Solar" showing his early interest in renewable energy.

Zippering Along

But solar energy was actually a long way off on the Musk agenda. His first project was a forerunner of an online business directory that he called the Global Link Information Network, which he set up with Kimbal.

Musk had taught himself to write computer code as a youngster and honed his skills as an intern at Rocket Science Games in Silicon Valley, where he had now settled.

So he wrote most of the software himself for his new service, which he renamed Zip2.

This was back in 1995, when the Internet was in its early days and computers weren't yet the central feature they are to everyday life today. But the business was a success, attracting the support of venture capitalists who were impressed by Musk's diligence and determination.

He told one of them: "My mentality is that of a samurai. I would rather commit seppuku (ritual suicide) than fail."

But like a samurai, he crossed swords with those around him, including his funders, who, after their initial enthusiasm, demoted him into a supporting IT role and appointed a new CEO.

This was a painful experience for Musk and he determined not to let control slip from his grasp so easily next time around.

By 1999, Zip2 was enough of a success for Compaq Computer to buy it for \$307 million, with Musk netting \$22 million, which would become the seed capital for his future enterprises.

The PayPal Era

During his early time in Canada, Musk had interned at the Bank of Nova Scotia, a summer job that gave him an insight into the world of finance.

This provided the germ of an idea he had to create an Internet bank, a full service financial institution that he called X.com, into which he plowed most of his Zip2 cash.

"That's what separates Elon from mere mortals," X.com co-founder Ed Ho told the author. "He's willing to take an insane amount of personal risk."

Vance adds: "Musk also began to hone his trademark style of entering an ultracomplex business and not letting the fact that he knew very little about the industry's nuances bother him in the slightest."

"(His) ego and confidence had started heading toward the levels that would inspire some and leave others thinking of him as pompous and unscrupulous."

So, it was hardly a surprise when personalities began to clash at the top of X.com.

Fellow Canadian Harris Fricker accused him of overhyping its products and after just five months, Fricker attempted a coup.

Musk fought back, prompting Fricker to quit. Fricker left to start up his own venture in a different field, but he took most of X.com's employees with him - a sign of the friction Musk was capable of generating with those working for him at all levels.

Nevertheless, Musk simply recruited more staff and successfully relaunched the venture.

However, there were new challenges ahead in the shape of a competitor, Cofinity, whose main online financial service was called PayPal.

After months of bloody fighting, the two companies agreed to merge, with Musk in the driver's seat. But yet again bickering ensued, including a tussle over whether to use the PayPal or X.com brand name for the financial service. Obviously, this was one battle that Musk lost.

Then there was another coup attempt, this time successful, while Musk was away on vacation. It was, says Vance "one of the nastiest coups in Silicon Valley's long history of nasty coups."

Yet, despite being ousted from the helm of the business, Musk remained PayPal's biggest shareholder. He even increased his stake. Subsequently, eBay paid \$1.5 billion for the company in 2002 and Musk walked away with \$250 million in his pocket.

However, the whole experience left a sour taste in many mouths, with observers and participants challenging Musk's subsequent claims to be a co-founder of PayPal.

The debate continued for many years but as Vance points out, Musk's role in steering the company to continued success was critical. Under Musk's leadership, PayPal survived the bursting of the dot-com bubble in 2000 and had the first blockbuster IPO after 9/11.

Journey Into Space

Now married to his first wife, Justine, Musk and his family moved from Silicon Valley to Los Angeles, where he encountered the metropolis's burgeoning aerospace industry.

Typically thinking bigger and bolder than those he interacted with, he began to talk about setting up a human colony on Mars. And, again typically, he joined and then quit the like-minded Mars Society, to launch his own Life to Mars Foundation.

He and his cohorts tore through several ideas, realizing that the journey into space would have to start with more earthly aims - firing rockets inside our own orbit. With this in mind, Space Exploration Inc, now just SpaceX, was born in 2002.

An early experience set in motion a revolution in the aerospace industry that has become the hallmark of Musk's enterprises.

After failing to buy a rocket from the Russians, Musk came up with the idea that his company would build the entire thing themselves - from the ground up - on American soil.

Actually, he didn't just come up with the idea. Among his many intellectual strengths, Musk is a mathematical genius, so, on the flight back from Russia, he worked his way through complex spreadsheets to discover if it could be done.

Not only did he prove it could be done, but Musk also found that SpaceX could build rockets for far less than the Russians or any other competitor, by doing everything themselves.

There were plenty of naysayers, but Musk assembled a team of some of the best engineering brains in the world and set about building his Falcon series of rockets.

The company then began to plow through Musk's fortune, as one test after another misfired.

As usual, Musk set what Vance calls an "insanely ambitious" target for his launches, promising to slash the cost of a standard 550lb payload launch from \$30 million to just \$6.9 million.

And in keeping with his optimistic outlook, he slated a trip to Mars by around the end of the decade - that is, by 2010.

He drove his team relentlessly. He could pull all-nighters and he expected others to do the same. When things went wrong, he didn't want excuses, he wanted a clear plan of what to do next.

It was tough, yet somehow Musk generated a spirit of fierce camaraderie among his troops. One way he did this was to put his engineering team in offices right in the middle of the manufacturing and assembly floor so that everyone felt totally immersed in the rocket-building mission.

His IT chief, Branden Spikes, who had been with him since the Zip2 days, put it this way: "There was always this feeling that we were facing a sort of insurmountable challenge and that we had to band together to fight the good fight."

Spikes was part of a core group of senior employees whose loyalty to Musk was unwavering, despite his demands and angry tirades. Yet, sometimes that sense of unity of mission was imperiled by Musk's ego. For instance, engineers were enraged, says Vance, when they caught Musk in the press "claiming to have designed the Falcon rocket more or less by himself."

In fact, it was years before Falcons flew successfully, and in that time Musk's Internet fortune began to drain away.

More on this later.

Going All Electric

In the meantime, Musk was allowing his focus to be diverted by another project - the development of an electric car.

His interest, which had been there since the days of his youth, was reignited when he linked up with another enthusiast, Martin Eberhard, who wanted to found his own electric car business, funded by Musk. Eberhard came up with the name Tesla Motors.

Applying the same vertical integration logic that led SpaceX to build its own rockets, Tesla opted to build much of its first vehicle, the Roadster, from scratch, albeit with a Lotus Elise chassis.

As the CEO in the early years, Eberhard was frequently irritated by Musk constantly slowing down the project by insisting the car be more comfortable and glitzy.

Again, the inevitable personality clashes began to interfere with progress, a situation that reached critical proportions when experts sent in by the venture capital funders unearthed a mountain of technical problems and shortcomings, and a misjudgment on costs that potentially doubled the target price of the Roadster to an unacceptable \$200,000.

The VCs removed Eberhard and wanted to sell the firm, but as the major shareholder, Musk dug his heels in and refused. Instead, he set about reorganizing the business in his typical way - demanding 110% from everyone and showing no sympathy for those who couldn't meet his demands.

"Some people thought Elon was too tough or hot-tempered or tyrannical," finance director Ryan Popple recalled. "But these were hard times, and those of us close to the operational realities of the company knew it. I appreciated that he didn't sugarcoat things."

One time, Musk sent an e-mail to an employee who had missed an important event so he could witness the birth of his child, saying: "That is no excuse. I am extremely disappointed. You need to figure out where your priorities are. We're changing the world and changing history, and you either commit or you don't."

A Fight For Survival

When you decide to take on complex projects, there's a sense that you almost have to make things up as you go along, solving each unforeseen problem as it emerges.

It's innovation in the raw. And it's costly in terms of time, money and reputation - all issues that, in those early days, began to squeeze like a vise around Musk's twin enterprises.

Through grit and determination, Musk had earned something of legendary status, so much so that actor Robert Downey Jr chose to spend time with him at SpaceX while studying for his role in the movie Iron Man.

"My mind is not easily blown, but this place and this guy were amazing," Downey is quoted as saying.

However, while Musk put on a good show, he'd started to get very worried about his businesses. They were sucking up so much money that he started to sell off some of his valued personal possessions to make ends meet. At a point when even the most diehard entrepreneur would have given up and walked away, Musk sold his prized McLaren sports car for cash to keep the firms going.

An acquaintance recalls him saying, "I will spend my last dollar on these companies." And he almost did.

Mercifully, the SpaceX Falcon 9 finally had a successful test flight in September 2008. But with Tesla still on its financial knees, Musk faced the agonizing possibility that he'd just be able to back one of the two firms.

By the end of 2008 he was broke and had to lean on friends and senior Tesla employees to write checks to help him make payroll. He even solicited and was offered support from Google.

It was, Vance observes, a near-death experience.

However, his extraordinary determination was enough to convince some venture capitalists to provide a further round of funding for Tesla and, in almost the last breath of the year, NASA backed SpaceX to become a supplier for the International Space Station, paying \$1.6 billion for 12 flights.

To Boldly Go

The rest, as they say, is history.

Notwithstanding a much publicized launch failure that occurred after publication of this book, the Falcon 9 rocket has become SpaceX's workhorse, offering a cheap and generally reliable route into orbit.

Musk's determination to produce American-built rockets from scratch eliminates lengthy and uncertain supply chains and means he can undercut his competitors - Boeing, Lockheed Martin and Orbital Sciences - by what Vance refers to as a ridiculous margin.

In a sense, Musk has changed the economics of the aerospace industry.

"Because of its low costs, SpaceX has once again made the United States a player in the worldwide commercial launch market," Vance adds.

And although Musk doesn't talk so stridently about his plans for colonizing Mars, there's little doubt in observers' minds that, just like everything else he sets out to do, he still has the planet in his sights.

In the same way SpaceX stunned the aerospace industry with its innovation, successes and low-cost base, Tesla also astounded the automotive world with the successor to the Roadster, the Model S sedan.

The vehicle earned accolades from industry observers and auto safety experts, and was declared to be safer, better equipped and more efficient than any vehicle on American roads.

The \$90,000 price tag might put the Model S out of reach for many drivers, but Musk has already announced plans for a \$35,000 vehicle with a 500-mile range.

And should anyone doubt his earnestness or ability to deliver, he shocked the car world again by building a network of strategically located recharging stations where drivers can either recharge their cars for free or have their batteries swapped out in minutes.

In fact, electric power has steadily increased in significance on Musk's agenda, as evidenced in the pioneering work on battery technology at Tesla.

Most recently, he took a lead funding position in SolarCity, a solar panel company launched by two of his cousins.

As with SpaceX and Tesla, the company has steadily moved to a vertical model, eventually manufacturing its own panels, as well as installing them, and slashing costs in the process.

Solar City is now the largest installer of solar panels in the United States, valued at \$7 billion.

In 2014, Musk announced ambitious plans to develop and install commercial and residential battery systems capable of capturing and storing generated electricity. And he plans to build a series of battery-producing "Gigafactories" around the US.

But that's not all. In recent years, Musk has advanced the concept of Hyperloop transportation systems, using the vacuum-tube principle to carry passengers at up to 800 miles an hour between San Francisco and Los Angeles in little more than half an hour.

He may not build them himself but the idea has been picked up by one start-up, and SpaceX recently announced a competition for its design (too late for the publication of this book).

And in the furthest realms of his imagination, Musk has said he likes the idea of amphibious vehicles capable of traveling underwater as well as on conventional roadways - though he admits there may not be great demand for them.

Conclusion

So what are the key ingredients that underpin Musk's success?

The one thing we can say for sure is that his management approach runs counter to many of the inclusive and enlightened principles we see in many successful businesses today.

But Ashlee Vance's profile offers the following clues to the ingredients of Musk's success:

- An unwavering sense of mission and belief in his ability to achieve it.
- Control of the direction of his businesses.
- A high-powered intellect and the ability to rapidly learn and adapt.
- Relentless, restless energy.
- An ability to get the most out of his employees - though more by stick than carrot.
- A risk taker with nerves of steel when the deck is stacked against him.
- A kernel of loyal supporters who believe in him.
- The use of vertical integration to cut costs and increase supply chain reliability.
- A commitment to innovation.
- And perhaps more than a pinch of good luck!