

Dr. Bhavani Thuraisingham's Answers to D CEO Magazine's Questions on Innovations in Cyber Security

1. What does innovation mean to you?

Innovation is at the heart of civilization and it means everything to me. To give you a perspective I would like to give some background information about me. I am a Tamil of Sri-Lankan origin. As I was finishing my undergraduate degree in Math and Physics, my marriage was arranged to my husband who was finishing his PhD at the University of Cambridge. Soon after my marriage at 20, I joined my husband in the UK and got my graduate education in Computing. We moved to the USA in 1980 as soon as I finished my PhD and I had a baby son at that time. So, after taking visiting faculty positions for three years first at New Mexico Tech and then at the University of Minnesota, I then worked as a software developer for a few years for Control Data Corporation. I got my lucky career break in 1985 at Honeywell to work in cyber security and data science. Since then I have had a very rewarding career at Honeywell, MITRE, NSF (National Science Foundation), and at the University of Texas at Dallas (UTD). When I was in primary school, I used to travel to school in a man-drawn rickshaw – it was quite primitive. If not for all the innovations made by those before me, I would not have been able to travel by car or train to the capital city of Sri-Lanka and then by airplane to UK and to USA. If not for the breakthrough innovations in computing and information technology, I would not have had all these opportunities in my career. Therefore, I wanted to develop technologies to help humanity ever since I was in graduate school. Throughout my career I have focused not only on research and technology development but also transferring our prototypes to commercial products and operational systems. As a result, we have built a culture of innovation at the Cyber Security Research and Education Institute (CSI) at UTD.

2. What are some of your/your company's greatest innovation achievements of the past year or so?

Together with my team at UTD, we have developed innovative technologies on integrating cyber security and data science over the past few years for the US Air Force, Army, NSF, NIST and NASA. In particular we designed and developed highly effective data science and machine learning technologies and were the first to demonstrate that novel class detection techniques can be effectively utilized for finding brand new or emerging class/patterns in streaming data and applied it to evolving malware analysis, intrusion detection, and insider threat detection. This work has provided the directions for handling zero-day cyber-attacks which is a major breakthrough in cyber-attack detection. Subsequently we were the among the first to develop Adversarial Machine Learning techniques to handle the attacks to the machine techniques. These high impact innovations resulted in several inventions and patents as well as top tier publications (ACM KDD, IEEE ICDM, awards, and books) with numerous citations. In addition, I founded a startup company called Knowledge and Security Analytics, LLC (KSA) to commercialize the technologies.

I have led teams developing secure data management systems, privacy aware data systems, secure real-time systems, secure artificial intelligence systems, and secure cloud and social media systems. In particular, we developed technologies to exchange data securely between organizations in the US, UK and Italy for the US Air Force. Our technologies have been transferred to commercial products and operational systems for the government and several of my patents have been licensed. Innovation is key for us and the first question we ask before we develop a technology is how can it be used by the society? Our goal is to build systems based on sound principles, and that are secure and usable. I have been rewarded for my innovations in cyber security and data science by not only receiving the highly prestigious fellowships and awards (e.g. IEEE Fellow, ACM Fellow), but also the most important award for innovation which is being elected a Fellow of the National Academy of Inventors for which I was congratulated by the Governor of Texas in 2019. More details of my innovations can be found at <https://personal.utdallas.edu/~bxt043000/Bhavani-CV.pdf>

3. What's the biggest lesson you've learned, or what do you wish you had known when first starting out in your career?

I have not experienced a year like 2020 before. It started off so well with so many meetings in Washington DC, London, San Francisco and New York City. Then came COVID-19 and working from home. While nothing is more important than health, it made me realize how critical technology has been during the pandemic. Many of us are able to work and live life because of technology. I will never take things for granted and this pandemic has motivated me even more to develop better technologies for cyber security and data privacy. Because many of us are so preoccupied with COVID-19, we are not paying as much attention to cyber security and this is a great opportunity for hackers. Therefore, we need to focus not only on innovation but also educating the general public to be vigilant. I believe I am at the right place to accomplish this – both innovation and education.

With respect to my career, I got the opportunity of my lifetime back in 1985 to work in cyber security and data science (they were called Computer Security and Data Management). Honeywell had written a proposal to the Air Force for a secure database system project and they were looking for a qualified person with US citizenship. I had just applied for my US citizenship and then in Fall 1985 it all came together and I got the job. That's when I started my work in computer security and data management. Since then I have had a very productive career at Honeywell, MITRE, NSF and then at UTD. During the early years of my career I did not know much about mentorship. I thought if you did great work you would be rewarded and get those promotions. However, I learned in the early to mid-1990s that mentorship is crucial for career advancement, especially in industry. Therefore, I became proactive in finding mentors and since then I have thrived in my career. Over the years I have become a strong mentor especially to women and underrepresented minority communities and co-direct the Women in Cyber Security and Women in Data Science Centers at UTD. I give keynote talks at outreach events and recently I focus on Diversity, Equity and Inclusion at all levels.

4. How would you rate North Texas as an environment that supports and cultivates innovation and growth?

North Texas is among the top locations in the US for innovation and technology development since we are surrounded by numerous Fortune 500 Corporations including Texas Instruments, Lockheed Martin, Raytheon, Toyota, Trend Micro, Samsung, State Farm, JP Morgan, American Airlines, AT&T, IBM and more. We also have top teaching hospitals and universities. As a result, information technology jobs are booming in North Texas in several sectors from healthcare to finance to insurance to automotive industries. This has given numerous opportunities for the universities in North Texas to develop talent in Computer Science and Information Technology. I am very pleased with the public/private partnerships being formed. I moved to Dallas in October 2004 and during the past 16 years I have seen a growth in technology startups. However, our startup culture is not publicized as much as they do in Silicon Valley or even in Boston and New York. I would like to see more technology events between large companies, academia, government and startups in North Texas so that we can compete with Silicon Valley, attract investors and retain the strong talent we are building in North Texas to advance innovation in Texas.

5. What has you most excited about the future?

I am excited about so many innovative technologies for developing vaccines for pandemics like COVID-19. But perhaps I am most excited about is the integration of Quantum Computing, Cyber Security and Artificial Intelligence (AI)/Data Science – that is the future. Massive amounts of data are being collected and analyzed, possibly trillions of exabytes. Current digital computers would need millions of years to process the data. Quantum Computing is the solution to the problem of massive computations in AI. However, I am also anxious about Quantum Computing because it can possibly break a 2048-bit encryption in seconds while it would take trillions of years for current digital

computers to break it. This would be devastating for Cyber Security. However, Quantum Cryptography, a crypto system based on physics, could provide a solution to this problem. But there is a concern that Quantum Computing could break the code even for Quantum Cryptography. I am hopeful that the next generation of technologists will develop solutions to safely combine Quantum Computing, Cyber Security and Artificial Intelligence/Data Science. My recent lecture to our students was about such a future. As for me, I always say to myself from “Rickshaw to Quantum”.

6. Here is some additional information I added

In order to innovate in cyber security, it is important to focus on multiple areas. That is, while Data Science/AI, Cyber Security and Quantum Computing are popular areas at present, we need to innovate in other areas as well and that includes developments in networking (e.g., 5G and beyond), distributed systems, software engineering especially as it relates to designing and developing large scale secure systems as well as Theory of Computation and Formal Methods to examine the foundations. That is, we need innovations both in theory as well as in practice. Areas like binary code analysis are critical for cyber security. Furthermore, developments in cyber physical systems such as Internet of Transportation Systems and the Power Grids must be secure. Therefore, we need to innovate in such emerging novel areas. We also need to carry out interdisciplinary research and that means integrate computer science into every aspect of our lives such as healthcare, medicine, finance and retail and at the same time examine the security and privacy concerns that arise due to the developments in technology.